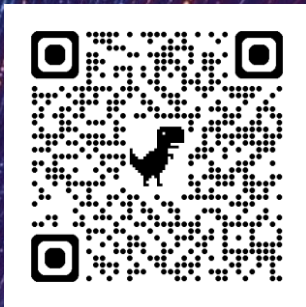


AI UTKARSH SUMMIT 2026

AI UTKARSH CHRONICLES OF NEXT-GEN AI

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CHRONICLES OF NEXT-GEN AI

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Turns 25: Celebrating a Legacy of Excellence

Shaping the Future with AI

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Turns 25: Celebrating a Legacy of Excellence

Shaping the Future with AI

KEY SPEAKERS



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MESSAGES



Sardar Taranjit Singh
Managing Director
JIS Group

The beginning of this landmark year celebrating 25 years of excellence fills me with immense pride as I reflect on the extraordinary journey of Narula Institute of Technology. Over the years, NIT has not merely imparted education; it has nurtured innovators, leaders, and pioneers who are shaping the future.

Narula Institute of Technology, a flagship institution under the aegis of JIS Group, has emerged as a premier centre of technical education in Eastern India. Since its inception, the institute has built a strong legacy of academic excellence, industry relevance, and a culture of continuous innovation, making this silver jubilee year truly significant.

In today's rapidly evolving technological landscape, Artificial Intelligence stands as a transformative force redefining industries and societies. It gives me immense pleasure to witness the successful organization of AI Utkarsh 2026, a landmark initiative that reflects our unwavering commitment to innovation, research, and academic excellence.

JIS Group has consistently stayed ahead through its academic excellence, and with the advent of AI, we are committed to being among the first to adapt, innovate, and lead this transformation.

To our young innovators and participants, I would like to say—while Artificial Intelligence may be the tool, it is your creativity, curiosity, and courage that will shape the future. Let this platform inspire you to think boldly, collaborate meaningfully, and create solutions that make a difference.

This commemorative volume, "AI Utkarsh: Chronicles of Next-Gen AI," captures the spirit of this landmark year—blending our proud 25-year legacy with forward-looking ideas and innovations that will define tomorrow.

I extend my sincere appreciation to all the distinguished speakers, industry experts, faculty members, and students whose contributions have made this initiative a grand success.

I extend my best wishes to Narula Institute of Technology for reaching greater heights and achieving continued success in the years to come.



Sardar Simarpreet Singh

Director
JIS Group

The celebration of 25 years of excellence is not just a milestone—it is a moment to re imagine what the future can look like. These 25 years have built a strong foundation, but what truly defines us is how boldly we shape what comes next.

Narula Institute of Technology has evolved into a space where ideas are encouraged, innovation is nurtured, and students are empowered to think beyond boundaries. Today, it is recognised as one of the most progressive and future-ready institutions in Eastern India. With NAAC 'A' accreditation, NBA-accredited programmes, and recognition as a NIRF-ranked institution, NiT continues to set benchmarks in quality education and institutional excellence. At JIS Group, staying ahead is not just a goal— it is a mindset. As we step into an era driven by Artificial Intelligence, the rules of the game are changing faster than ever, AI Utkarsh 2026 and HACK-O-NiT are not just events—they are platforms where the future is being built in real time. We are not here to follow change; we are here to

create it. Our focus is clear—to integrate AI into learning, research, and innovation in ways that make our students future-ready from day one.

To every student and innovator participating—this is your time, Technology will give you the tools, but it is your mindset, your willingness to experiment, and your courage to challenge the norm that will truly set you apart. Build, break, learn, and build again.

This commemorative volume, "AI Utkarsh: Chronicles of Next-Gen AI," captures not just ideas, but the spirit of a generation ready to lead the AI revolution.

As we celebrate this journey, let us not pause for too long—the real excitement lies ahead.

Wishing Narula Institute of Technology continued momentum, new milestones, and even greater impact in the years to come.



Mr. Bidyut Majumdar
Deputy Director – Business
Development
JIS Group

Artificial Intelligence is no longer an emerging trend—it is the defining force of our times, reshaping industries, economies, and the very way we think and innovate. Platforms like AI Utkarsh 2026 at Narula Institute of Technology are crucial because they move the conversation from theory to real-world application, from awareness to action.

As a panelist, it was truly encouraging to witness the depth of discussions, the diversity of perspectives, and the level of curiosity among students and professionals alike. What stood out most was the collective intent—not just to understand AI, but to meaningfully contribute to its evolution. This is exactly the mindset that will define the next generation of leaders.

At JIS Group, we strongly believe that the future belongs to those who can seamlessly integrate technology with purpose. AI is not just about algorithms or automation; it is about solving complex problems, enhancing human potential, and creating scalable impact. Events like AI Utkarsh and HACK-O-NiT serve

as live ecosystems where innovation is tested, ideas are challenged, and solutions are built in real time.

Narula Institute of Technology has demonstrated a clear vision in embracing this transformation. By creating opportunities for students to engage with cutting-edge technologies, collaborate with industry experts, and participate in hands-on innovation, the institution is actively shaping a future-ready talent pool.

To all participants, I would say—this is your opportunity to experiment fearlessly. The AI landscape is evolving rapidly, and there is no fixed path to success. What matters is your ability to adapt, to question existing norms, and to continuously learn. Do not be afraid to fail—because in AI, every failed attempt is simply data for a better outcome.

The commemorative volume, *“AI Utkarsh: Chronicles of Next-Gen AI,”* reflects this very spirit of exploration and forward-thinking. It is not just a documentation of ideas, but a testament to the transformative potential of young minds when given the right platform.

As we look ahead, the focus must remain on building responsible, ethical, and impactful AI solutions. The journey has just begun, and the possibilities are limitless.



Prof. (Dr.) Subhram Das

Principal

Narula Institute of Technology

Narula Institute of Technology is a well-known private autonomous engineering college located in Kolkata, West Bengal, India. Established in 2001 under the aegis of JIS Group Educational Initiative. It has grown into one of the prominent technical institutions in eastern India, reflecting its academic quality and standards with NIRF ranking and NAAC 'A', NBA accreditations.

Marking 25 glorious years of academic and technological leadership, AI UTKARSH 2026 is a flagship two-day AI Summit hosted by the Narula Institute of Technology. This premier gathering unites industry pioneers, researchers, and startups to explore the frontiers of Artificial Intelligence, balancing cutting-edge innovation with essential ethical discourse. Through high-level keynotes and interactive exhibitions, the

summit serves as a catalyst for future-ready collaborations.

A cornerstone of the event is Hack-O-NiT, a nationwide AI hackathon that challenges young visionaries to engineer practical solutions for today's most pressing issues. From Generative AI, healthcare, smart infrastructure, cybersecurity, and education, participants have the chance to transform raw ideas into impactful prototypes while receiving direct mentorship from top-tier industry experts. Designed to foster innovation and practical problem-solving, the hackathon brings together students, developers, and young innovators to create impactful, real-world AI solutions.

Beyond showcasing groundbreaking ideas, the volume, "AI Utkarsh: Chronicles of Next-Gen AI" embodies the spirit of a new era of thinkers ready to drive the global AI transformation. May this AI Summit be a beacon of innovation and the hackathon be the birthplace of the next great tech solution. Let us continue to strive for excellence, together.

I wish all the stakeholders of Narula Institute of Technology continued brilliance as they strive for excellence. May the coming years bring even greater milestones and a legacy of innovation.



Dr. Nidhi Singh
Registrar
Narula Institute of Technology

Narula Institute of Technology has always believed in transforming limitations into opportunities for meaningful impact. Over the past 25 years, we have worked with a clear purpose—to serve society through quality education, innovation, and responsible practices.

As we move ahead, our vision is to become even more socially focused, where technology, especially Artificial Intelligence, is used not just for advancement, but for solving real-world challenges and creating a positive difference.

AI Utkarsh 2026 reflects this commitment. It is more than just a summit—it is a platform that brings together academicians, industry experts, researchers, startups, policymakers, and students to

exchange ideas and explore how AI can be used responsibly for the greater good.

One of the key highlights of this initiative is Hack-O-NiT, our two-day AI hackathon. It provides young innovators with the opportunity to think creatively, build practical solutions, and engage with experts, turning their ideas into impactful outcomes.

The volume, “AI Utkarsh: Chronicles of Next-Gen AI,” captures the spirit of innovation and the vision of those shaping the future of AI.

As we celebrate 25 years of our journey, we look forward to a future that is more inclusive, responsible, and driven by meaningful innovation.

Wishing the entire Narula Institute of Technology family continued success as we move ahead with purpose and impact.



Prof. (Dr.) Amlan Chakrabarti

Director

A.K. Choudhury School of Information Technology

University of Calcutta

Visiting Professor

IIT Kharagpur

It is a privilege to extend my greetings on the occasion of **AI Utkarsh 2026**, organized by Narula Institute of Technology, Kolkata, as part of its 25-year legacy of academic excellence.

Artificial Intelligence today stands at the forefront of technological transformation, influencing diverse sectors ranging from healthcare and governance to education and industry. In this context, the theme “*Responsible AI – Innovation with Integrity*” is both timely and essential, emphasizing the need to align cutting-edge advancements with ethical responsibility, transparency, and societal impact.

I commend the organizers for envisioning a platform that brings together researchers, academicians, industry experts, and students. Such initiatives not only promote interdisciplinary collaboration but also inspire young minds to engage in meaningful innovation that

addresses real-world challenges.

As educators and researchers, it is our collective responsibility to ensure that AI systems are designed with robustness, fairness, and accountability. Forums like AI Utkarsh play a crucial role in fostering dialogue, sharing knowledge, and strengthening the bridge between academia and industry.

I am confident that this event will serve as a catalyst for innovative ideas, impactful research, and collaborative partnerships, contributing significantly to the advancement of AI in a responsible and sustainable manner.

I extend my best wishes for the success of AI Utkarsh 2026.



Dr. Hena Ray

Associate Director

Scientist F

C-DAC, Kolkata

It is a matter of great pride and pleasure to extend my warm greetings on the occasion of *AI UTKARSH 2026*, organized by Narula Institute of Technology.

Artificial Intelligence is rapidly transforming the way we live, learn, and innovate. Platforms like *AI UTKARSH* play a vital role in bringing together researchers, academicians, and students to exchange ideas, showcase advancements, and explore future directions in this dynamic field.

I commend the organizers for their dedicated efforts in hosting such a meaningful event that encourages knowledge sharing, interdisciplinary collaboration, and technological excellence. I am confident that this initiative will inspire participants to contribute significantly toward the advancement of AI-driven

solutions for societal and industrial challenges.

I extend my best wishes to all participants, contributors, and organizers for the grand success of *AI UTKARSH 2026*. May this event pave the way for impactful research and innovation.



Dr. Nguyen Thi Kim Son

Vice Rector

School of Information and Communication
Technology
Hanoi University of Industry

It is a great honor to extend my warm greetings on the occasion of **AI Utkarsh 2026**, hosted by Narula Institute of Technology, Kolkata.

As the world rapidly advances into an era driven by artificial intelligence, initiatives such as this summit play a vital role in shaping a future that balances innovation with responsibility. The theme, *“Responsible AI – Innovation with Integrity”*, reflects a profound commitment to ensuring that technological progress remains aligned with ethical values, transparency, and societal well-being.

I commend the organizers for creating a multidisciplinary platform that brings together academia, industry, and young researchers. Such collaborations are essential for fostering meaningful dialogue, encouraging knowledge exchange, and developing AI solutions that are inclusive, sustainable, and impactful across global communities.

From an academic perspective, this initiative also highlights the critical role of higher education institutions in nurturing talent, promoting research excellence, and building international partnerships. Events like AI Utkarsh not only inspire innovation but also strengthen global cooperation in advancing AI for the benefit of humanity.

I am confident that this summit will provide valuable insights, stimulate innovative ideas, and open new avenues for collaboration among participants from diverse backgrounds.

I extend my best wishes for the grand success of AI Utkarsh 2026.



Dr Rishi Jain

Program Director

Asian Institute of Technology, Thailand

Managing Editor

International Journal of Deep Tech in

Medical Science and Technology

Executive Member

Federation of Indian Industry, India

AI Utkarsh: Scaling Excellence Through Responsible Innovation

Kolkata has always been a sanctuary for the polymath, the thinker who refuses to see a wall between scientific rigour and humanistic values. As we gather at the Narula Institute of Technology for AI Utkarsh 2026, we find ourselves at a similar crossroads. We aren't just witnessing a technological shift; we are participating in a fundamental evolution of the societal fabric. The theme of this summit—*Responsible AI: Innovation with Integrity* is not just a slogan. It is our roadmap for ensuring that the intelligence we build is as purposeful as it is powerful.

The Shift from Capability to Utility

Artificial Intelligence has long outgrown its identity as a niche academic pursuit. Today, it is the central nervous system of the global industry. We are living through a period of unprecedented creative and analytical

empowerment. From optimising the labyrinthine logistics of global trade to personalising education for the next generation and accelerating drug discovery, AI has become the "Force Multiplier" of the 21st century.

However, for innovation to be truly impactful, it must be sustainable. "Utkarsh," or excellence, is not achieved by simply stacking parameters or building the most complex model possible. True excellence is realised when a system works reliably, fairly, and transparently for the diverse populations it is meant to serve.

The Strategic Rise of SLMs: Efficiency as a Virtue

A pivotal chapter of this evolution is the strategic pivot toward Small Language Models (SLMs). While Large Language Models (LLMs) showcased the "art of the possible," SLMs represent the "art of the practical." These models are leaner, faster, and significantly more resource-efficient.

By prioritising SLMs, we embrace a more democratic and private AI landscape. These models allow for "on-device" processing, keeping sensitive user data local and secure—the literal cornerstone of digital integrity. Furthermore, their lower computational footprint means that high-tier AI is no longer the exclusive province of those with massive server farms. For a nation as vast as India, SLMs offer a pathway to localised, accessible, and environmentally conscious innovation.

Integrity: The Engine of Growth

Too often, "Responsibility" and "Innovation" are framed as opposing forces—the gas pedal versus the brake. In reality, Integrity is the engine. When we build AI systems with integrity, we are building Trust, which remains the primary currency of the digital economy.

A transparent system is easier to scale; a fair model captures a wider market; and an architecture that prioritises privacy gains long-term user confidence. By embedding these values into the development cycle from day one, the innovators here at NIT are creating "Industrial-Grade" solutions that the world can actually rely on.

A Vision for the Architects of Tomorrow

To the students and researchers at this summit: you are the architects of this new digital infrastructure. Your role is to balance the ambition of what *can* be built with the foresight of how it *should* behave.

Our goal at AI Utkarsh is to foster an environment where technical brilliance is matched by ethical clarity. As you dive into the keynote sessions and the Hack-O-NiT challenge, I urge you to build AI that is as "Compassionate" as it is "Calculated." Let us honour Kolkata's intellectual legacy by ensuring that our innovations are defined not just by their code, but by their character.

Let us Innovate with Intent, Lead with Integrity.



Dr. Surajit Ghosh
International Water Management
Institute
Colombo, Sri Lanka

The Imperative: Why AI, Why Now

Water scarcity, floods, droughts, and climate-induced disasters are escalating in frequency and severity across the globe. Recent UN estimates indicate that approximately 2.4 billion people lived in water-stressed countries (as of 2020 data), while direct economic losses from disasters have frequently exceeded USD 300 billion annually, with total costs including cascading and ecosystem impacts reaching far higher figures. Traditional approaches to water governance and disaster preparedness, constrained by fragmented data, reactive decision-making, and institutional silos, are no longer sufficient. Artificial Intelligence offers a transformative paradigm, enabling predictive analytics, real-

time decision support, and intelligent resource allocation that can fundamentally reshape how nations safeguard water security and mitigate the risk of hydrometeorological disasters.

The WMO's Early Warnings for All initiative and UNESCO's intergovernmental hydrological programmes increasingly leverage AI for flood prediction, hydrological forecasting, and transboundary water cooperation. Landmark satellite missions NASA-ISRO's NISAR, ESA's Copernicus, and JAXA's ALOS are generating petabyte-scale Earth Observation datasets that AI is uniquely positioned to translate into actionable intelligence for flood inundation mapping, groundwater assessment, cyclone monitoring, and drought surveillance at continental scales. Hydrological models that integrate upstream satellite observations with downstream gauge data can enhance flood forecasting accuracy across borders and support evidence-based hydro-diplomacy. However, the efficacy of physical models is fundamentally constrained by the availability and quality of ground-truth data. India's sparse hydrological gauge network and irregular reporting lags constitute a critical "data deficit" that must be addressed through expanded in situ monitoring, citizen science, and IoT deployments. Foundation models such as Prithvi-EO-2.0 further overcome data limitations by streamlining the handling of extensive datasets essential for predictive modelling and enhancing the precision of hazard assessments. AI-driven solutions directly accelerate progress on SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities), and SDG 13 (Climate Action), while the Sendai Framework for Disaster Risk Reduction (DRR) recognises data-driven technologies as transformative for strengthening risk understanding, governance, preparedness, and the capacity to "Build Back Better."

India's Digital Water and Disaster Resilience Agenda

India is reported to be one of the world's most water-stressed and disaster-vulnerable nations. A combination of indigenous and advanced technologies powers India's advancement in disaster preparedness. ISRO's Earth Observation ecosystem, featuring RISAT, Cartosat, and the NISAR mission, provides unparalleled SAR and optical data for near-real-time flood inundation mapping, crop water stress assessment, and landslide susceptibility modelling. National-scale initiatives such as the Indian Land Data Assimilation System (ILDAS) integrate

coupled models, while platforms like BrahmaSATARK and GBM-CLIMPACT enable impact-based forecasting for the Ganga–Brahmaputra–Meghna basin. Complementing these efforts, the Gram Panchayat Level Weather Forecasting programme, the high-resolution BharatFS, and emerging tools like MausamGPT are enhancing village-level weather intelligence. SukhaRakshak AI, India’s first anticipatory drought chatbot, delivers hyper-local, multilingual advisories in over 22 Indian languages to farmers and officials. The government’s investments through Digital India, the IndiaAI Mission, and the Prime Minister’s 10-Point Agenda for DRR are building a sovereign technological foundation aligned with the vision of Viksit Bharat 2047.

Yet, grassroots deployment of AI-powered tools must be accompanied by sustained investment in digital literacy and capacity building for frontline workers, including Accredited Social Health Activists (ASHA) workers, Gram Panchayat officials, and local disaster response volunteers. In many rural and tribal areas, limited internet connectivity, low smartphone penetration, and linguistic diversity present formidable barriers, demanding multilingual, low-bandwidth, offline-capable applications designed through participatory approaches that centre community knowledge alongside algorithmic intelligence. Equally critical is the establishment of interoperable data-sharing frameworks across India’s institutional landscape, linking the Central Water Commission (CWC), Indian Meteorological Department (IMD), ISRO, and National Disaster Management Authority (NDMA) through federated data architectures, standardised APIs, and common data schemas to enable seamless multi-source integration for timely early warnings and resource allocation.

A Call to Collective Action

A critical advancement lies in shifting from reactive disaster response to anticipatory action, in which AI-driven early warnings are directly linked to pre-arranged financing, triggers, and rapid-response protocols, aligned with global frameworks. Emerging solutions, such as digital twins of river basins and water systems, further amplify AI’s potential by integrating EO data, in-situ sensors, and predictive modelling for scenario-based planning and real time decision support. However, the communities most vulnerable to water insecurity and disaster impacts are often the least represented in training datasets and the most excluded from technology governance. Gender-responsive AI design is essential, as women and girls in water-stressed and disaster-prone regions bear disproportionate burdens. AI systems must incorporate sex-disaggregated data and gender-differentiated vulnerability indicators, and inclusive engagement encompassing women’s self-help groups, indigenous communities, and persons with disabilities must be embedded at every stage of the AI lifecycle.

Sustaining AI-driven water and disaster management systems beyond initial deployment requires deliberate attention to long-term financial and institutional models. Model retraining, compute infrastructure, software maintenance, and human capacity all entail recurring costs that pilot-phase funding rarely accounts for. Governments, multilateral agencies, and development partners must co-design sustainability frameworks that include dedicated budget

lines, public-private partnerships, and open-source community stewardship to ensure that critical systems do not degrade once project funding concludes.

As AI systems increasingly influence life-critical decisions, flood-evacuation triggers, water-allocation priorities, and disaster-resource deployment, the imperative for responsible AI governance becomes absolute. FAIR data principles (Findable, Accessible, Interoperable, and Reusable) serve as the technical backbone for building robust and trustworthy systems, transforming fragmented data ecosystems into machine-actionable infrastructures that enhance accuracy, scalability, transparency, and reproducibility of AI-driven solutions.

The convergence of AI, EO, and deep domain expertise presents an unprecedented opportunity to build water-secure and disaster-resilient societies. Realising this vision demands sustained, purposeful collaboration across academia, government, industry, and civil society, transcending institutional silos and national borders. AI Utkarsh 2026 is a clarion call to the global community to harness AI not as an end in itself, but as an instrument of equity, sustainability, and human dignity, ensuring that the transformative power of intelligent systems serves those who need it most.



Prof. (Dr.) Debashis De
Department of Computer Science and
Engineering
MAKAUT, WB, India

As I reflect on the journey that has led us to this AI Summit, I am reminded that the most profound technological revolutions are not defined by the complexity of their code, but by the depth of their societal integration. My research group has long been anchored in a singular pursuit: how do we architect artificial intelligence that is not just powerful, but inherently participatory, private, and purposeful? The concepts of Social AI, Federated Learning, and Harmonic AI are not disparate threads; they are the interdependent pillars of what I believe constitutes Next-Gen AI. For years, the dominant paradigm of AI has been centralized—a monolithic model consuming vast datasets in a siloed cloud. While effective, this approach breeds inherent risks: data sovereignty violations, privacy erosion, and a disconnect from the very communities it aims to serve. My work in Federated Learning emerged as a direct response to this limitation. By bringing the model to the data rather than the data to the model, we enable a paradigm where intelligence is distributed. In the context of a nation as diverse as India,

Federated Learning allows us to build robust models for healthcare, agriculture, or education without compromising the privacy of individuals or the strategic autonomy of institutions. It is the technical infrastructure for trust. If Federated Learning is the how, Social AI is the who, it posits that AI systems must be designed to understand the nuances of human interaction, cultural context, and collaborative behaviour. Yet, understanding must be married to balance. This is where the principle of Harmonic AI becomes critical. Harmonic AI deliberate calibration of AI to augment human capability rather than replace it, ensuring that as our machines become smarter, our society becomes more equitable. The convergence of these three pillars—Federated, Social, and Harmonic—finds its ultimate expression in AI for Social Good. We are moving beyond theoretical benchmarks to tangible impact. Whether it is using swarm learning to predict ecological changes in the Sundarbans, deploying privacy-preserving analytics for public health in rural Bengal, or creating adaptive pedagogic tools that respect the linguistic diversity of our classrooms, the goal remains constant: to democratize the benefits of AI. As we chronicle the era of “AI Utkarsh,” we stand at a pivotal moment. The term “Utkarsh” signifies uplift and excellence. But true excellence in AI cannot be measured solely by flops or parameters. It must be measured by inclusion, by the reduction of bias, and by the empowerment of the last mile. My message to the visionaries at this summit is to embrace the complexity of this moment. Let us move away from the allure of “black box” solutions and commit to architectures that are federated by design, social by nature, and harmonic in outcome. The future of AI is not about building machines that think like us; it is about building an ecosystem that learns with us. Let us ensure that the chronicles of Next-Gen AI tell the story of a technology that did not just advance, but uplifted.



Dr. Anasua Sarkar
Chair
IEEE Computer Chapter Kolkata
Section
Associate Professor, CSE
Jadavpur University

It is with great enthusiasm that we welcome you to **AI Utkarsh**, a hackathon dedicated to exploring the limitless possibilities of Artificial Intelligence. This event is not merely a competition—it is a celebration of human ingenuity, collaboration, and the transformative power of technology.

Artificial Intelligence has rapidly evolved from theoretical concepts into practical applications that shape our daily lives. From healthcare diagnostics and sustainable energy solutions to personalized education and advanced robotics, AI is redefining industries and creating opportunities for a better future. The advancement of AI is not just about machines learning—it is about empowering humanity to solve complex challenges with creativity and precision.

Hackathons like AI Utkarsh serve as catalysts for innovation. They provide a unique environment where diverse talents converge to brainstorm, prototype, and build solutions that push the boundaries of what is possible. Here, participants

will not only sharpen their technical skills but also learn the importance of ethical AI, inclusivity, and responsible innovation.

As we embark on this journey together, let us remember that the true advancement of AI lies in its ability to enhance human potential. Every idea nurtured here has the potential to become a breakthrough that impacts society positively. Together, we can ensure that AI remains a force for good, driving progress while upholding values of fairness, transparency, and sustainability. AI Utkarsh is more than an event—it is a movement towards a future where technology and humanity thrive together. Let us embrace this opportunity to innovate, inspire, and lead the way in advancing Artificial Intelligence for the betterment of all.



Dr. Debayan Ganguly

Officer

Special Duty (OSD)

Ex-officio Deputy Director

Directorate of Technical Education,
Government of West Bengal

Artificial Intelligence is undoubtedly one of the most transformative forces of our time, reshaping industries, governance, healthcare, finance, and education. As we gather for AI Utkarsh 2026, the theme “Responsible AI – Innovation with Integrity” reminds us that technological advancement must be guided not only by capability but by conscience.

AI has accelerated innovation at an unprecedented pace. From intelligent decision-making systems to predictive analytics, it is redefining productivity and enabling smarter ecosystems. However, alongside these advancements arise critical concerns like ethical ambiguity, algorithmic bias, data privacy, and transparency. The responsibility, therefore, lies not just in developing AI systems, but in ensuring they are fair, inclusive, and accountable.

At the same time, it is important to reflect on what we truly mean by “innovation.” Innovation does not mean replication. In recent times, we have seen instances where institutions acquire ready-made technologies such as purchasing robotic systems and present them as indigenous developments. Such practices may create an illusion of progress but do not contribute to genuine knowledge creation. Similarly, filing a large number of patents does not necessarily equate to meaningful innovation, especially when acceptance rates remain low. True innovation is not measured by numbers alone, but by originality, impact, and the ability to solve real-world problems.

Real innovation emerges from deep intellectual engagement-what may be called an “inner inquiry.” It requires critical thinking, curiosity, experimentation, and often, failure. This is a dimension where human creativity plays a central role. While AI is a powerful enabler, it does not possess intrinsic curiosity or self-driven exploration. It can assist, augment, and accelerate processes, but it cannot replace the depth of human insight that drives breakthrough ideas.

Therefore, the role of AI should be seen as that of a tool: an extraordinarily powerful one, but still a tool. When used responsibly, it can enhance research, optimize solutions, and open new frontiers of discovery. However, over-reliance on AI without foundational understanding risks creating a generation that consumes technology rather than creates it.

Platforms like AI Utkarsh 2026 are crucial in shaping this perspective. By bringing together academicians, industry leaders, policymakers, and students, the summit fosters meaningful dialogue on both the opportunities and responsibilities associated with AI. It encourages us to move beyond superficial metrics of success and focus on building systems that are ethical, sustainable, and genuinely innovative.

As Narula Institute of Technology celebrates 25 years of academic excellence, this summit stands as a testament to its commitment to responsible education and forward-thinking research. The journey ahead calls for a balanced approach—where innovation is rooted in originality, and technology is guided by integrity.

In conclusion, the future of AI will not be defined solely by how advanced our systems become, but by how thoughtfully we use them. Responsible AI is not a limitation-it is the foundation of meaningful and lasting innovation.



Mr. Debashis Chakrabarti

Director

ELMAX Systems and Solutions

Artificial Intelligence is reshaping industries, education, and research at an unprecedented pace, redefining how we approach innovation and solve complex challenges. As the Director of ELMAX Systems and Solutions, I am proud of our continued commitment to empowering engineers, researchers, and students with advanced MATLAB tools and technologies that accelerate discovery and enable the development of intelligent, real-world solutions using MATLAB & Simulink.

MATLAB offers a powerful set of toolboxes for Engineers that support the complete AI workflow—from data analysis to deployment.

Some important Toolboxes for AI+X Application:

- **Statistics and Machine Learning Toolbox**
Enables data preprocessing, classification, regression, and clustering for building ML models.

- **Deep Learning Toolbox**

Provides tools to design, train, and deploy neural networks such as CNNs and LSTMs.

- **Computer Vision Toolbox**

Supports image and video analysis, object detection, and vision-based AI applications.

- **Fuzzy Logic Toolbox**

Facilitates rule-based intelligent system design.

This AI summit (AI UTKARSH 2026) brings together a vibrant community to exchange ideas, explore state-of-the-art advancements, and collaborate on addressing some of today's most critical challenges. From machine learning and deep learning to control systems and embedded AI, the opportunities ahead are both vast and transformative.

I encourage you to actively engage, share your insights, and take full advantage of this platform to deepen your expertise and build meaningful connections with peers and leaders across academia and industry.

Wishing you a highly productive and inspiring summit.



Mr. Arijit Das
Co-founder and Director
Aeonix Research and Innovations
LLP

Having recently represented our company at the AI India Summit 2026, where we witnessed thousands of visitors engaging deeply with our solutions, one thing became very clear—AI is no longer a distant concept; it is actively shaping industries, businesses, and everyday life. The scale of curiosity, adoption, and real-world application we observed reinforces how critical such platforms are in accelerating innovation.

I would like to sincerely appreciate Narula Institute of Technology for organizing AI Utkarsh 2026 and creating such a meaningful platform within an academic environment. Initiatives like this demonstrate the institute's commitment to bridging the gap between education, innovation, and industry. Events like AI Utkarsh play a uniquely important role, especially when organized within a college. Colleges are not just centers of learning—they are breeding grounds for the next

generation of innovators, founders, and researchers. By bringing together industry leaders, researchers, and students under one roof, this summit creates a powerful bridge between theoretical knowledge and real-world application.

From an industry perspective, one of the biggest challenges today is not just developing AI solutions, but industrializing them—making them scalable, reliable, and responsible. This requires a multidisciplinary approach, combining strong engineering fundamentals, ethical considerations, and a deep understanding of real-world problems. Platforms like this panel discussion are essential to spark these conversations early among students.

For students, exposure to such discussions can be transformative. It helps them understand what lies beyond textbooks—how ideas evolve into products, how startups are built, and how technologies like AI, IoT, and automation converge to solve meaningful problems. More importantly, it inspires them to think beyond conventional career paths and consider building, innovating, and contributing to the ecosystem.

From a broader perspective, India stands at a pivotal moment in the global AI landscape. With a vast talent pool and rapidly growing digital infrastructure, we have the potential to not just adopt AI but lead in creating scalable and responsible solutions for the world. However, this requires strong collaboration between academia, industry, and government—something that events like AI Utkarsh actively promote.

In conclusion, AI Utkarsh 2026 is more than just a summit—it is a catalyst. A catalyst for ideas, for collaboration, and for inspiring the next generation to not just participate in the AI revolution, but to lead it.

Thank you once again for this opportunity. I look forward to being a part of the discussion and contributing to the success of the event.



Dr. Shubhendu Banerjee

Convenor
AI-Utkarsh
Assistant Professor, Dept. of CSE
Narula Institute of Technology

It is a matter of great pride to welcome you all to *AI Utkarsh 2026*, the flagship AI Summit of Narula Institute of Technology. This initiative aims to provide a vibrant platform for academicians, researchers, industry experts, and students to engage in meaningful discussions and explore the evolving landscape of Artificial Intelligence.

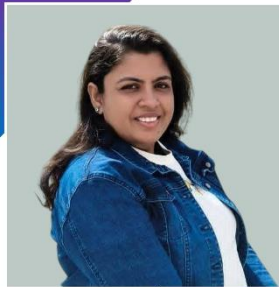
With an emphasis on responsible, ethical, and application-oriented AI, the summit brings together keynote sessions, panel discussions, and the Hack-O-NiT hackathon, encouraging innovation, collaboration, and practical problem-solving. It also seeks to promote interdisciplinary research and strengthen the synergy between academia and industry.

We believe that such gatherings play a crucial role in shaping future-ready professionals who can contribute effectively to technological and societal advancement. I sincerely thank all speakers, participants, sponsors, and organizing members for

their unwavering support and dedication.

I am confident that AI Utkarsh 2026 will serve as a catalyst for new ideas, partnerships, and innovations.

Wishing everyone a highly engaging and enriching experience.



Dr. Bansari Deb Majumder

Convenor
AI-Utkarsh
Head, Dept. of Electrical Engineering
Narula Institute of Technology

It gives me immense pleasure to welcome you to *AI Utkarsh 2026*, a premier AI Summit organized by Narula Institute of Technology. This event has been envisioned as a confluence of knowledge, innovation, and collaboration, bringing together bright minds from academia, industry, and research.

In an era where Artificial Intelligence is transforming every facet of life, AI Utkarsh 2026 focuses on fostering responsible innovation and impactful solutions. Through keynote addresses, interactive panel discussions, and the Hack-O-NiT hackathon, the summit encourages participants to think critically, innovate boldly, and apply AI for real-world challenges.

Beyond technical discussions, this platform aims to inspire young minds, nurture creativity, and build a strong foundation for future collaborations. It reflects our commitment to advancing AI research and developing ethically aware, skilled professionals.

I extend my heartfelt appreciation to all contributors and participants who have made this event possible. I truly believe this summit will ignite new ideas and leave a lasting impression on everyone involved.

Wishing you all an inspiring and rewarding journey at AI Utkarsh 2026.



PROJECT INSIGHTS

RAKSHAMARG: AI-POWERED SAFETY NAVIGATION SYSTEM

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OVERVIEW OF THE PROJECT

RakshaMarg is an AI-powered safety-first navigation system designed to enhance the security and confidence of users, especially women, during travel. Traditional navigation systems primarily focus on identifying the fastest or shortest routes, often ignoring safety concerns such as crime-prone areas, poorly monitored zones, and isolated routes. RakshaMarg addresses this gap by prioritizing safety over speed.

The system evaluates multiple routes between a source and destination and assigns a safety score to each route based on relevant safety indicators. These indicators include crime data, community generated safety reports, and proximity to emergency services such as police stations and hospitals. By leveraging AI-based analysis, RakshaMarg recommends the safest available route to the user.

In addition, the system provides real-time safety awareness through alerts and contextual insights, enabling users to make informed decisions while navigating. The integration of data-driven safety evaluation and intelligent routing makes RakshaMarg a reliable solution for safer urban mobility.

PROBLEM STATEMENT

Most existing navigation applications are optimized for speed and efficiency, neglecting the critical aspect of user safety. This becomes particularly problematic for women traveling during late hours, who often face challenges such as poorly lit streets, isolated areas, and high-crime zones.

Currently, safety decisions during travel are largely based on personal judgment rather than reliable and real-time data. There is no widely adopted system that provides safety-first navigation by integrating crime data, community feedback, and intelligent risk analysis.

OBJECTIVE

The primary objective of RakshaMarg is to develop a navigation system that prioritizes user safety by:

- Recommending safer routes instead of merely the fastest ones
- Utilizing crime data and user-generated safety reports for risk evaluation
- Providing access to nearby emergency services such as police stations and hospitals
- Enhancing situational awareness through AI-based safety analysis

PROPOSED SYSTEM

RakshaMarg operates by generating multiple possible routes between a source and destination using navigation APIs. It then evaluates these routes using a combination of safety indicators, including crime data and real-time user reports.

The system integrates AI-based analysis to interpret these inputs and assign a safety score to each route. Based on this evaluation, the safest route is recommended to the user. Additionally, the system highlights nearby safety resources, ensuring quick access to help in case of emergencies.

METHODOLOGY

The working of RakshaMarg follows a structured pipeline:

1. The user enters the source and destination.
2. The system generates multiple routes using mapping APIs.
3. Safety data is collected from crime records and community reports.
4. Nearby safety resources such as police stations and hospitals are identified.
5. AI-based analysis evaluates the risk associated with each route.
6. A safety score is assigned to each route.
7. The safest route is recommended to the user.

TECHNOLOGY USED

- Google Maps API for map visualization
- Google Directions API for route generation
- Google Places API for identifying nearby services
- Gemini API for AI-based safety analysis
- Firebase for storing and managing user reports

RESULTS AND DISCUSSION

The implementation of RakshaMarg demonstrates that integrating safety-focused data with navigation systems can significantly improve user confidence and decision-making during travel. The system successfully identifies safer routes and provides real-time insights into potential risks.

Although the current model uses basic safety indicators, it establishes a strong foundation for more advanced safety prediction systems. The results highlight the effectiveness of combining AI with real-time data for practical safety applications.

CONCLUSION

RakshaMarg presents a novel approach to navigation by prioritizing safety over speed. By integrating crime data, community insights, and AI-based analysis, the system provides users with safer route recommendations and enhances overall travel security.

This project contributes to the development of intelligent and safety-aware urban navigation systems and has the potential to create a meaningful impact on public safety.

FUTURE SCOPE

- Integration with official government crime databases
- Development of a mobile application for wider accessibility
- Implementation of real-time safety heatmaps
- Enhanced AI models for predictive risk analysis
- Voice-enabled safety assistance for hands-free interaction

AI-POWERED MONITORING SYSTEM FOR SMART INFRASTRUCTURE

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³Department of ECE, Narula Institute of Technology, Kolkata, India

INTRODUCTION

In modern environments such as defence zones, industries, and educational campuses, ensuring safety and security is a major challenge. Traditional monitoring systems like CCTV lack real-time intelligence and predictive capabilities. To address this issue, our project proposes an AI-Powered Monitoring System that integrates Artificial Intelligence and IoT to create a smart, automated, and real-time surveillance solution.

PROBLEM STATEMENT

Critical sectors face issues such as:

- Unauthorized human intrusion
- Hazardous gas leaks
- Abnormal activities
- Delayed emergency response
- Dependence on manual monitoring

These problems can lead to serious risks including accidents, security breaches, and unsafe environments.

OBJECTIVE

The objective of this project is to develop a real-time intelligent monitoring system that:

- Detects intrusion and suspicious activities using AI
- Monitors environmental risks using IoT sensors
- Provides instant alerts based on risk levels
- Integrates all data into a centralized smart dashboard
- Uses predictive analytics to prevent future risks

PROPOSED SOLUTION

The system combines:

- AI-based computer vision for detecting abnormal behavior
- IoT sensors for gas and environmental monitoring
- Real-time alert system (Low, Medium, High priority)
- Centralized dashboard for live monitoring and control
- Predictive analytics for risk prevention

This creates a unified, intelligent, and automated monitoring platform.

APPLICATIONS

- Defence: Detect intruders in restricted areas
- Industry: Prevent accidents and monitor worker safety
- Smart Campuses: Ensure student and staff security

TECHNOLOGY STACK

- AI/ML (Computer Vision, Anomaly Detection)
- IoT Sensors (Gas, Environmental Monitoring)
- Frontend Dashboard
- Backend Server (Real time user)
- Cloud Computing

FEASIBILITY & VIABILITY

The system is:

- Technologically feasible using existing tools
- Scalable across multiple sectors
- Cost-effective due to automation
- Market-ready with high demand for smart surveillance

IMPACT & BENEFITS

- Improved safety and security
- Faster emergency response
- Reduced human error
- Real-time monitoring and insights
- Multi-sector usability

CONCLUSION

The proposed AI-powered monitoring system is a future-ready solution that enhances safety through automation and intelligence. With strong scalability, high demand, and practical implementation, this project has the potential to grow into a successful startup in smart security and surveillance systems.

OZONE: AN ADAPTIVE AI-POWERED ASSESSMENT AND DIAGNOSTIC ENGINE

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INTRODUCTION AND PROBLEM STATEMENT

Traditional mock testing platforms suffer from a critical limitation: they are purely evaluative. When a student completes an exam, they are typically presented with a static score and a basic answer key. These platforms fail to semantically analyse the student & mistakes, leaving the student to manually deduce their own knowledge gaps. Furthermore, educators spend countless hours manually typing and formatting Previous Year Questions (PYQs) or mock tests into digital platforms. To bridge this gap, we developed OZONE, an adaptive, AI-driven educational technology platform. OZONE transforms passive testing into active, personalized learning by leveraging Large Language Models (Google Gemini 2.5 Flash) to automate exam creation for educators and generate hyper-personalized diagnostic reports for students.

CORE ARCHITECTURE AND FEATURES

The OZONE platform is divided into two distinct, seamlessly integrated portals: the Educator Studio and the Student Dashboard.

2.1 The Educator Studio AI Extraction Engine the Educator portal acts as a comprehensive command center for exam generation. Its flagship feature is the AI PDF Extraction Engine. Educators can upload standard PDF documents of past exams. The system processes the document and utilizes AI to automatically extract question text, multiple-choice options, numerical answers (NAT), and corresponding diagrams or images.

- Hybrid Generation: If the AI misses a nuance, educators can utilize the Build from Scratch module to manually inject questions, adjust marking schemes (e.g., +2 / -0.66), and attach official solution diagrams.
- Live Deployment: Once an exam is constructed, it can be deployed to a private Live Room via a unique Room ID, or pushed to a public live feed categorized by exam type (e.g., GATE ECE, JEE Mains).
- 2.2 The Student Assessment Interface The student portal is designed for high-focus exam simulation
- and subsequent deep-dive review. Students can join active mock tests via a Live Public Feed or by entering a secure Room ID. The testing interface supports MCQ, MSQ (Multiple Select), and NAT
- (Numerical Answer Type) formats, accurately simulating competitive engineering and entrance exams.
- 2.3 AI Performance Diagnostics (The Unique Selling Proposition) The true innovation of OZONE
- lies in its post-exam analysis. Upon completing a test, students do not just receive a score; they
- generate an AI Diagnostic Report.

- Semantic Topic Clustering: The platform sends the student performance data—specifically the text of the questions they answered incorrectly or left unattempted—to the Gemini AI model. The AI reads the questions and semantically clusters them into academic subjects (e.g. Analog Electronics) or micro-topics (e.g. MOSFET Biasing).
- Weakness Identification: The AI calculates the exact accuracy percentage for each clustered topic and color-codes the students proficiency (Critical, Average, or Strong). It explicitly lists the exact sub-concepts the student failed to grasp.

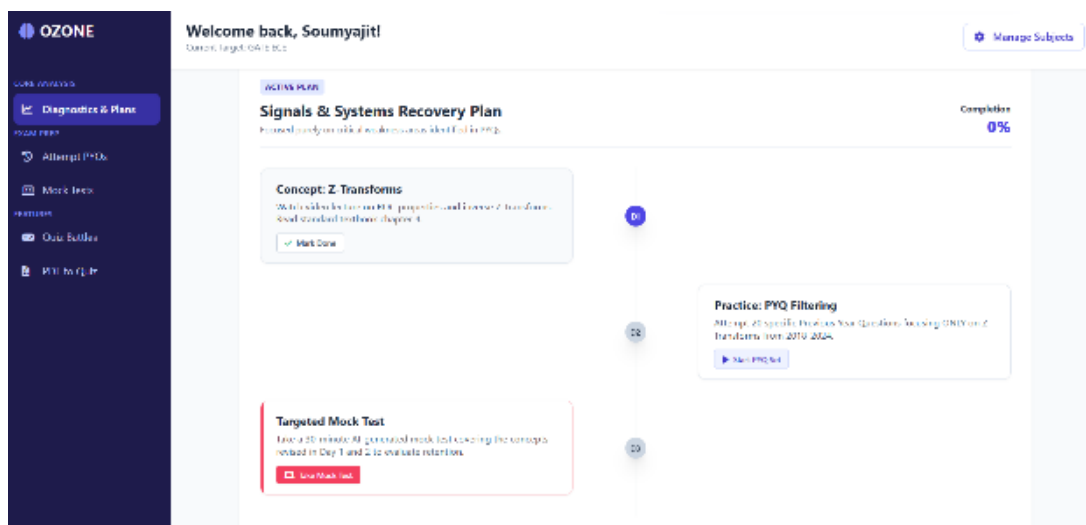


Fig 1 : Diagnostic & plans

- Custom Action Plans: Based on the critical weaknesses identified by the AI, the platform allows students to generate a customized, time-bound study schedule (e.g., a 7-day or 14-day recovery plan) targeting those specific subjects.

TECHNICAL IMPLEMENTATION

OZONE is built on a modern, highly scalable tech stack:

- Frontend: Next.js (App Router) and React provide a lightning-fast, server-rendered user interface. Tailwind CSS is used for highly responsive, accessible, and modern styling.
- Backend & Database: Firebase (Fire store) serves as the NoSQL database for real-time exam state management, student progress tracking, and result storage. Firebase Storage handles the hosting of extracted exam diagrams and solution images.
- Authentication: Clerk handles secure, role-based user authentication (separating Educators and Students).
- AI Integration: The @google/generative-ai SDK connects the platform to the Gemini 2.5 Flash model, which acts as the computational brain for both PDF data extraction and the post-exam diagnostic generation.

CONCLUSION AND FUTURE SCOPE

OZONE successfully demonstrates how generative AI can be utilized to move beyond simple text generation and act as an intelligent, analytical tutor. By automating the heavy lifting of exam creation

for teachers and providing actionable, data-driven recovery plans for students, OZONE represents the next evolution of competitive exam preparation. Future iterations will aim to include real-time Quiz Battles, adaptive difficulty testing, and deeper integrations with interactive visual learning tools.

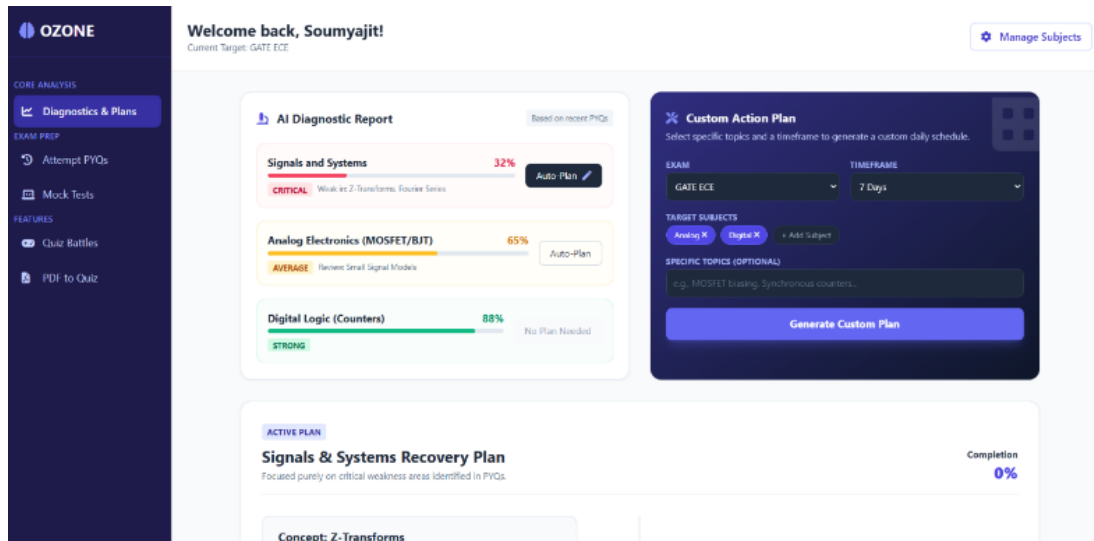


Fig 2: Report Analysis

AI & IOT-POWERED ADVANCED WASTE SEGREGATION AND MONITORING SYSTEM

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INTRODUCTION

Through our experience in hackathons and real-world problem-solving, we identified waste management as a major urban challenge driven by rapid urbanization, population growth, and increasing waste generation, while existing systems remain manual and inefficient. To address this, our project introduces an AI and IoT-based smart waste segregation and monitoring system that integrates AI, IoT, edge computing, cloud computing, and robotics. This solution transforms traditional waste management into an intelligent, automated, and data-driven system that enables real-time monitoring, efficient resource utilization, and scalable operations.

PROBLEM STATEMENT

Despite advancements in technology, waste management systems still suffer from several key limitations:

1. Absence of Proper Segregation at Source Waste is typically disposed of without classification, resulting in mixing of biodegradable, recyclable, and hazardous materials. This significantly reduces recycling efficiency and increases landfill usage.
 2. Inefficient Collection mechanisms Traditional collection system operate on fixed schedules rather than actual need. This leads to overflowing bins in some areas while others are serviced unnecessarily, wasting time and resources.
 3. Environmental and Health Hazards Accumulated waste releases harmful gases such as methane, contributing to air pollution, climate change, and potential fire hazards. Poor waste handling also leads to the spread of diseases.
 4. Dependence on manual labour Sorting and handling waste manually exposes workers to hazardous conditions and is prone to human error.
 5. Lack of real time monitoring and Data Analytical Existing system do not provide continuous monitoring and actionable insights, making decision-making inefficient.
- These challenges highlight the urgent need for a smart, automated, and integrated waste management system.

OBJECTIVES

The primary objectives of this project are:

- To automate waste segregation using AI-based image processing
- To monitor waste bins in real time using IoT sensors
- To detect hazardous environmental conditions such as methane gas levels
- To optimize waste collection routes using GPS and data analytics
- To reduce manual labour through robotic automation

- To provide a user-friendly interface for monitoring and control

PROPOSED SOLUTION

We propose a comprehensive smart waste management system that combines sensing, intelligence, and automation.

The system operates as an interconnected network of smart bins, processing units, cloud services, and user interfaces. It continuously monitors waste conditions, classifies waste types, and triggers appropriate actions.

Key functionalities include:

- Automated waste classification into biodegradable and non-biodegradable categories using AI
- Real-time monitoring of bin fill levels and environmental conditions
- Detection of hazardous gases to ensure safety
- Smart routing and tracking of waste collection vehicles
- Robotic waste handling to minimize manual effort
- Mobile-based control and alerts for efficient management
- This integrated approach ensures efficiency, safety, and sustainability.

SYSTEM ARCHITECTURE

The system is divided into the following major components:

A. Smart Sensor Nodes (Waste Bins)

Each waste bin is equipped with multiple sensors to collect real-time data:

- Ultrasonic Sensor to measure the fill level of the bin
- Gas Sensor (MQ-4) to detect methane gas concentration
- Temperature and Humidity Sensor (DHT11) to monitor environmental conditions
- ESP32-CAM Module to capture images for AI-based classification
- Metal Detector to identify metallic waste
- These sensors continuously monitor conditions and send data to the IoT gateway.

B. IoT Gateway

The IoT gateway acts as the central hub of the system:

- Collects and aggregates data from sensor nodes
- Performs edge processing for real-time analysis
- Uses sensor fusion techniques to combine multiple data inputs
- Communicates with cloud servers via Wi-Fi
- Edge processing reduces latency and minimizes network load.

C. AI-Based Waste Classification

The system uses an AI model based on computer vision:

- Captures images of waste using ESP32-CAM
- Extracts features such as colour, shape, and texture
- Classifies waste into biodegradable and non-biodegradable categories
- Continuously improves through retraining on updated datasets
- This ensures accurate and efficient waste segregation.

D. Cloud Platform

The cloud platform performs:

- Data storage and management
- Real-time monitoring and visualization
- Route optimization for waste collection
- Predictive analytics and alert generation
- It enables centralized control and scalability.

E. Mobile Application

The mobile application provides:

- Real-time updates on bin status and location
- Alerts for full bins or hazardous conditions
- Control over smart vehicles and robotic systems
- Manual override functionality
- This enhances usability and operational efficiency.

ROBOTICS AND AUTOMATION

To further enhance efficiency, the system integrates robotics:

- A GPS-enabled smart vehicle for waste collection
- A 4-DOF robotic arm for automated waste sorting
- Adaptive grippers for handling different types of waste

This reduces human involvement in hazardous environments and increases precision.

WORKING PRINCIPLE

The system operates in three stages:

1. Monitoring

Sensors continuously collect data including fill level, gas concentration, temperature, humidity, and waste images.

2. Processing

Data is processed at the IoT gateway and cloud platform. The AI model classifies waste, and analytics determine required actions.

3. Action and Alerts

- Alerts are generated when bins are full or unsafe conditions are detected
- Waste collection is triggered automatically
- Robotic arm performs sorting
- Routes are optimized using GPS data

This ensures timely and efficient waste management.

KEY FEATURES

1. AI-Based Waste Segregation:

Ensures accurate classification and improved recycling efficiency.

2. Real-Time Monitoring System:

Provides continuous updates on waste and environmental conditions.

3. Safety Monitoring:

Detects methane gas and prevents hazardous situations.

4. Automated Waste Collection:

Smart vehicles reduce manual dependency.

5. Route Optimization:

Minimizes fuel consumption and operational costs.

6. Cloud Integration:

Enables centralized data management and scalability.

7. User-Friendly Interface:

Mobile app allows easy monitoring and control.

INNOVATION AND UNIQUENESS

The uniqueness of our solution lies in:

- Integration of AI, IoT, and robotics in a single system
- Edge AI processing for real-time decision-making
- Multi-sensor data fusion for enhanced accuracy
- Modular and scalable design
- Automated end-to-end waste management

Unlike conventional systems, this solution provides both monitoring and action capabilities.

ADVANTAGES

- Reduces manual labor and human exposure to hazardous waste
- Improves recycling efficiency through accurate segregation
- Minimizes environmental pollution and landfill usage
- Enhances safety by detecting harmful gases
- Optimizes operational costs through smart routing
- Provides scalable and adaptable infrastructure

APPLICATIONS

This system can be implemented in:

1. Smart cities for urban waste management
2. Industrial facilities for handling hazardous waste
3. Hospitals and laboratories for biomedical waste management
4. Educational institutions for campus waste management
5. Rural areas for decentralized waste handling

FEASIBILITY

The project is highly feasible due to:

- Use of cost-effective and easily available hardware components
- Availability of open-source software tools
- Scalable and modular architecture
- Ease of integration with existing systems
- A working prototype can be developed within a short timeframe, making it ideal for hackathons.

FUTURE SCOPE

Future enhancements include:

- Integration of deep learning models for improved accuracy
- Expansion to multi-category waste classification
- Solar-powered smart bins for sustainability

- Predictive analytics for waste generation trends
- Integration with government smart city initiatives

CONCLUSION

This project represents a significant step toward building smarter and more sustainable cities. By integrating AI, IoT, robotics, and cloud computing, it transforms waste management into an intelligent, automated, and efficient process. As a team experienced in hackathons, we believe that impactful solutions must combine innovation with practicality. Our system is not only technologically advanced but also scalable and feasible for real-world deployment. This solution has the potential to revolutionize waste management by improving efficiency, reducing environmental impact, and enhancing public health, ultimately contributing to a cleaner and more sustainable future.

Predictive Healthcare Analytics (with aspects of Telemedicine & Ethical AI)

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INTRODUCTION AND GLOBAL CONTEXT

Globally, over 39 million people live with total blindness, alongside hundreds of millions with severe visual impairments. For decades, the conventional white cane has been their primary navigation tool. Though iconic, this purely mechanical aid has not adapted to the dynamic, complex, and often dangerous nature of modern urban environments.

The traditional cane relies on 100% tactile feedback, requiring users to physically strike an object to detect it. This creates a critical limitation: a zero percent detection rate for upper-body hazards. Consequently, users suffer high rates of injury from low-hanging branches, open vehicle doors, and protruding signs. Furthermore, visually impaired individuals are nearly twice as likely to experience accidental falls, yet conventional mobility aids lack mechanisms to alert caregivers when emergencies occur.

NaviSense bridges the gap between traditional cane use and modern technology. NaviSense is a 4-Tier Assistive Mobility Solution encompassing Reflex Safety, AI Vision, Voice Navigation, and Guardian Net. Utilizing a dual-microcontroller architecture, YOLOv11s vision, and cloud-based telemetry, NaviSense transforms the white cane into an interactive, dynamic guardian.

PROBLEM FORMULATION AND SHORTCOMINGS OF EXISTING SOLUTIONS

NaviSense addresses major shortcomings of traditional and early "intelligent" mobility aids:

Upper-Body Exposure: Traditional canes only detect ground-level obstacles. This leaves the upper body exposed, causing constant navigational anxiety that limits personal freedom.

Mental Overload and Lack of Clarity: Early smart canes relied on basic ultrasonic sensors and vibrating motors or buzzers. These devices provide no context, failing to distinguish harmless boxes from dangerous vehicles, overwhelming users with ambiguous feedback.

The "Lost Tool" Emergency: Dropping or misplacing a cane in a crowded or unfamiliar room instantly deprives the user of their primary navigation tool. Blindly feeling the floor to retrieve it is both dangerous and highly frustrating.

Disconnect in Emergency Situations: In the event of a severe fall or accident, existing canes offer no SOS capabilities, GPS tracking, or remote assessment tools for caregivers to intervene.

REVIEW OF EXISTING LITERATURE AND TECHNOLOGIES

Previous attempts to modernize the white cane fell short. Early smart canes utilized basic infrared sensors, which fail in direct sunlight and cannot detect transparent surfaces like glass.

Recent products integrate ultrasonic sensors and Bluetooth connectivity. Though improved, these aids suffer from high consumer costs and dangerous latency caused by relying on smartphone processors. Academic projects using Raspberry Pi microcomputers for image processing suffer from severe thermal throttling and high power consumption, rendering devices too heavy and battery life too short for practical use.

NaviSense overcomes these barriers through strict hardware segregation. By offloading computational work to a high-performance edge device while hardwiring reflex sensors to a low-power Arduino, NaviSense balances AI capabilities with fail- safe reliability.

PROPOSED SOLUTION

The 4-Tier NaviSense Ecosystem NaviSense proposes a 4-tier technological ecosystem to enhance physical safety and psychological confidence.

Reflex Safety (Edge Hardware): An instantaneous, hardware-based proximity detection system providing immediate, localized auditory feedback for imminent physical obstacles.

AI Vision (The Cloud/Laptop Brain): A Wi-Fi-enabled dual-camera setup feeding visual data to an edge computer for conversational YOLOv11s object detection.

Voice Navigation (Contextual Output): Replaces generic buzzers with human-voice safety alerts and integrates Google Maps for turn-by-turn routing.

Guardian Net (Caregiver Connectivity): A Firebase-linked mobile application enabling live tracking, automated fall-detection SOS alerts, and live video feeds for caregivers.

HARDWARE ARCHITECTURE AND SENSOR ARRAY

To eliminate processing bottlenecks, the hardware uses a segregated dual- microcontroller architecture. Video processing and physical sensor reading are incompatible on one low-power board; therefore, their roles are separated.

The Primary Controller (Arduino Uno): The Arduino Uno serves as the central nervous system for hardware reflex operations, reading sensors offline.

Ultrasonic Radar (HC-SR04): Positioned upward, this sensor continuously monitors the forward path for upper-body obstacles up to 400cm, acting as a reflex shield.

Inertial Measurement Unit (MPU6050): A 6-axis gyroscope and accelerometer monitor spatial orientation. Upon detecting a sudden fall followed by a horizontal resting state, the Arduino triggers the SOS Protocol.

Audio Output: A passive buzzer delivers localized auditory cues for proximity warnings, independent of AI voice features.

The Vision Controller (ESP32-CAM Array)

To provide situational awareness without burdening the Arduino, NaviSense uses dedicated ESP32-CAM modules for visual data. Powered by a 3-cell lithium battery pack and 5V booster, these modules bypass SD card storage. They utilize PSRAM to transmit continuous visual frames over Wi-Fi. This "Memory-Only" protocol guarantees the AI core receives real-time data with zero writing latency and minimal power consumption.

The Wireless Stick Locator (433MHz RF System)

To eliminate the "Lost Tool" crisis, NaviSense incorporates an offline 433MHz Radio Frequency (RF) locator system with a remote control and an integrated RF receiver. Bypassing unreliable Bluetooth connections, the RF system uses the VirtualWire library to transmit a highly secure encrypted signal. When activated, the signal easily penetrates household walls, triggering a distinct triplet alarm on the cane to ensure swift retrieval.

SYSTEM TESTING AND VALIDATION METHODOLOGY

Component-level testing validated the system's reliability during the prototyping phase.

Latency Validation: The dual ESP32-CAM streams were benchmarked across a standard 2.4GHz Wi-Fi network. By writing directly to PSRAM and bypassing SD storage, video latency was reduced to under 150 milliseconds. This ultra-low latency is critical to safely support real-time YOLOv11s pedestrian detection.

Reflex Sensor Calibration: The HC-SR04 ultrasonic sensor underwent extensive angle-of-incidence testing. Results demonstrated that a strict 45-degree upward tilt generated the optimal detection cone for overhead hazards, successfully eliminating false positives caused by rough ground textures.

RF Penetration Testing: The 433MHz locator module underwent simulated environmental testing against up to three standard drywalls. The encrypted radio signal reliably penetrated these barriers, successfully triggering the Arduino's retrieval alarm from a distance of 15 meters, conclusively proving its superiority over standard Bluetooth trackers.

ARTIFICIAL INTELLIGENCE AND SOFTWARE PARADIGM

The true innovation of the NaviSense ecosystem resides in its intelligent software, which transforms raw sensor data into contextual human assistance.

YOLOv11s Conversational AI Vision

Video streams broadcast by the ESP32-CAM array are intercepted via Wi-Fi by a local high-performance edge computer. Utilizing Python and OpenCV libraries, this computer processes the visual data in real-time through a custom-trained YOLOv11s AI model. Unlike standard object detection algorithms that simply draw bounding boxes, the NaviSense AI functions conversationally. It identifies complex obstacles, computes their trajectory and distance, and translates this data into specific spoken warnings. Instead of a confusing rapid beep, the user receives precise audio instructions, such as, "**Stop, stairs going down.**"

Google Maps and Navigation

The central AI processing core is deeply integrated with the Google Maps API. By combining smartphone GPS data with the AI's environmental understanding, the system delivers precise, turn-by-turn voice routing directly to the user's earpiece, enabling confident navigation of complex urban intersections.

The Guardian App and Firebase Cloud Integration

User safety extends beyond their immediate physical environment to include the peace of mind of their caretakers. The Guardian App is a custom-built mobile interface linking caregivers directly to the device. Hardware sensors push constant telemetry to a Firebase Realtime Database, enabling three critical remote functionalities: Live GPS Tracking, Instant SOS Alerts triggered by the MPU6050 fall detection sequence, and Secure Remote Vision Access, allowing caretakers to visually assess the user's surroundings during emergencies.

UNIQUE SELLING PROPOSITIONS (USPS) AND INNOVATION

NaviSense differentiates itself from traditional mobility aids and market competitors through core innovations: **Dual-Microcontroller Segregation:** Forcing the Arduino to handle reflex safety while the ESP-32 handles vision guarantees that a dropped Wi-Fi connection will never disable the physical radar shielding the user.

Conversational Context: Upgrading from ambiguous mechanical buzzers to specific, human-voice environmental context fundamentally shifts the user experience from stressful to empowering.

Wall-Penetrating Retrieval: The analog 433 MHz RF remote eliminates the daily frustration of a misplaced cane, functioning instantly without requiring the user to navigate a smartphone app blindly.

Memory-Optimized Video Streaming: Direct-to-RAM Wi-Fi streaming guarantees the lag-free YOLOv11s AI inference required for rapid pedestrian detection while significantly conserving device battery life.

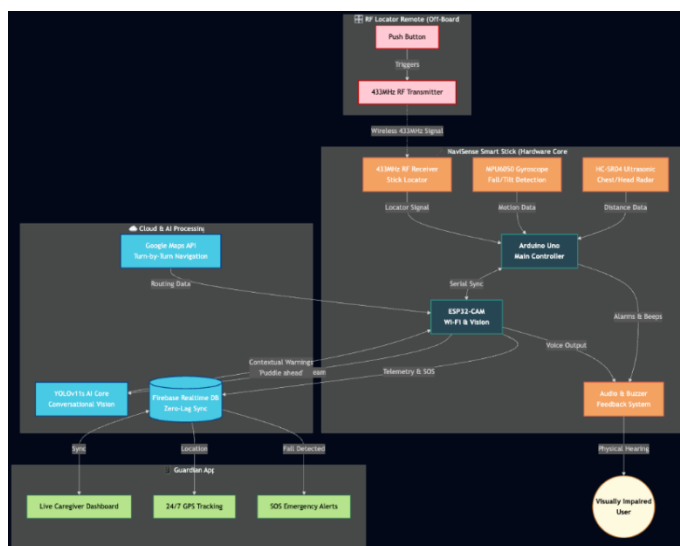


Fig 1: Block Diagram of The Project



Fig 2: Front View Of The Blind Stick

FUTURE SCOPE AND CONCLUSION

While this prototype proves the viability of the 4-Tier ecosystem, there is massive potential for future scalability. Upcoming developments will focus on hardware miniaturization, aiming to condense the architecture onto a single custom-printed PCB featuring an advanced edge computing chip, allowing the YOLO AI to execute entirely onboard the cane. Furthermore, integrating LiDAR sensors could eventually replace ultrasonic modules, enabling millimeter-accurate 3D environmental mapping. In conclusion, the NaviSense project demonstrates that advanced assistive mobility does not require exorbitantly expensive hardware. By intelligently integrating low-cost microcontrollers, cutting-edge conversational AI, and cloud-based telemetry, NaviSense represents a vital paradigm shift in assistive technology. It proves that with the right engineering architecture, a conventional walking stick can evolve into an active, protective companion, granting visually impaired individuals the independence, safety, and confidence to navigate the modern world without barriers.

AI-POWERED LEGAL COURTROOM SIMULATOR FOR INDIAN LAW STUDENTS

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OVERVIEW OF THE PROJECT

Legal education in India has long been rooted in a predominantly theoretical framework. Students pursuing law degrees spend several years reading statutes, memorizing case judgments, and attending lectures, yet many enter the legal profession with remarkably limited exposure to actual courtroom proceedings. This disconnect between academic training and practical advocacy results in graduates who possess substantial knowledge of legal provisions but struggle to apply that knowledge in high-pressure, real-world courtroom environments. The ability to construct compelling arguments, respond to cross-examination, cite relevant provisions under time constraints, and navigate procedural courtroom dynamics are skills that can only be developed through repeated, guided practice. Unfortunately, opportunities for such practice remain scarce, unevenly distributed, and resource-intensive in the current Indian legal education landscape.

To address this critical gap, we present Adjournment.AI, an AI-Powered Legal Courtroom Simulator designed specifically for the Indian legal context. This platform provides law students, moot court participants, and legal professionals with an immersive, intelligent simulation environment where they can engage in realistic courtroom proceedings, argue against an AI-powered opponent, receive structured feedback from an AI judge, and track their performance over time. The system is built on a foundation of modern artificial intelligence techniques, including Large Language Models (LLMs), Retrieval-Augmented Generation (RAG), and a multi-agent architecture, all tailored to the specific requirements of Indian law.

The platform integrates a comprehensive knowledge base of Indian legal documents, including the Indian Penal Code (IPC), the Code of Criminal Procedure (CrPC), the Indian Evidence Act, and relevant Constitutional provisions. These documents are preprocessed, chunked, and indexed into a ChromaDB vector database, enabling semantic search capabilities. When a user presents an argument during a simulation session, the RAG pipeline retrieves the most contextually relevant legal sections and feeds them into the LLM reasoning engine. This ensures that both the AI Judge and the AI Opponent Lawyer ground their responses in verified legal sources rather than hallucinated or inaccurate legal content, a critical requirement for a domain as precise and consequential as law.

The system architecture, illustrated in **Figure 1**, consists of several integrated layers. The Client Layer includes a web-based Game Interface, a Performance Analytics Dashboard, and a Case Dashboard, all accessible through a standard browser. A Voice Interface powered by **Sarvam AI** enables speech-to-text (STT) and text-to-speech (TTS) functionality, along with language translation support for regional Indian languages. Authentication is handled via Google OAuth, ensuring secure and seamless user login. The Backend Services layer is built on FastAPI, which manages session state, routes user arguments to the appropriate AI agents, and coordinates scoring. The AI Services layer houses the core LLM Engine, which runs two role-based agents: the Opponent AI, which dynamically generates legally grounded counter-arguments, and the Judge AI, which evaluates the user's argument quality and provides structured feedback. A dedicated Scoring Engine computes performance metrics based on legal accuracy, argument coherence, evidence citation, and logical structure. The Data Layer consists

of MongoDB collections for storing user profiles and session interactions, as well as a repository of static legal case files used to initialize simulation scenarios.

The simulation workflow begins when a user selects a case from the available repository, which includes criminal, civil, and constitutional scenarios. The system presents the case facts, witness statements, and relevant evidence, after which the user delivers an opening argument. The AI Opponent responds with a counter-argument informed by the **RAG pipeline**, while the AI Judge evaluates the exchange and provides real-time feedback. This cycle continues through subsequent rounds covering legal arguments, evidence submission, and closing statements, closely mirroring real courtroom procedure. At the end of each session, users receive a detailed performance report covering their argument quality, statute citation accuracy, and reasoning consistency across the session.

The scoring framework is deliberately designed to reward sound legal reasoning rather than simply correct final verdicts. Students are evaluated on four weighted dimensions: legal correctness, which checks whether cited statutes and provisions are accurately applied; argument strength, which measures the logical persuasiveness of the argument; structural coherence, which assesses how well the argument follows recognized courtroom conventions; and evidence integration, which evaluates whether the student effectively connected factual evidence to legal provisions. This multi-dimensional approach ensures that students who present well-reasoned, legally accurate arguments are appropriately recognized, even if their conclusions differ from historical case outcomes.

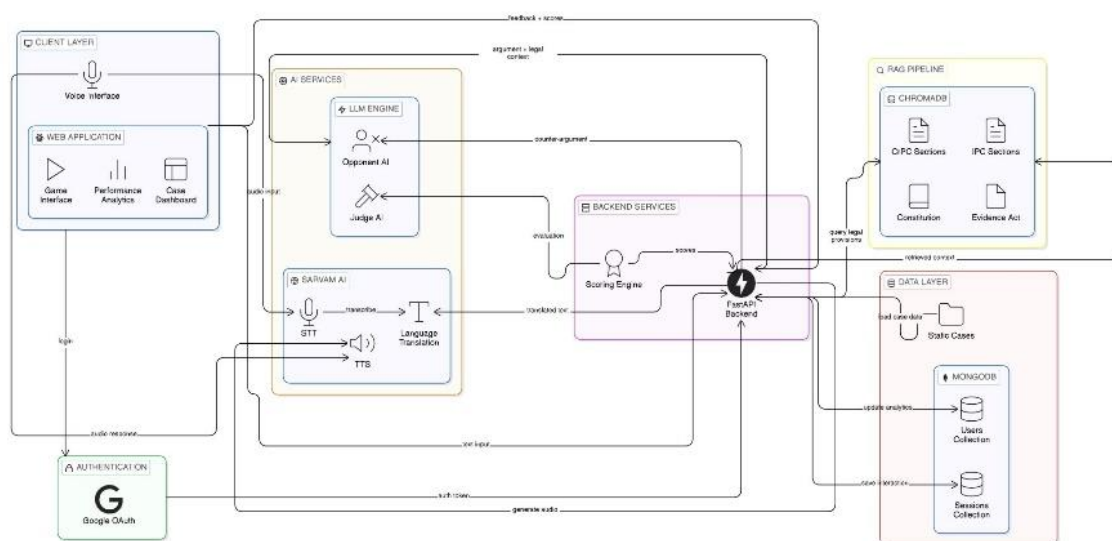


Fig 1: System Architecture Diagram

A key technical challenge in building this system was mitigating AI hallucination, a known risk in LLM-based applications where the model may confidently generate legally inaccurate information. We address this through **strict RAG enforcement**, where all AI-generated legal reasoning is anchored to retrieved document chunks from the verified legal database. Only sections that score above a semantic similarity threshold are included in the LLM context window, reducing the risk of fabricated statute citations or misrepresented case law.

Figure 2 illustrates the user-facing application interface, which presents the simulation in a clean, conversational format. The interface shows the current case context, the user's submitted argument, and the AI Judge's feedback alongside a scoring breakdown. Performance indicators such as Legal Accuracy

and Evidence Usage are displayed as progress bars, providing immediate visual feedback that motivates continued improvement.

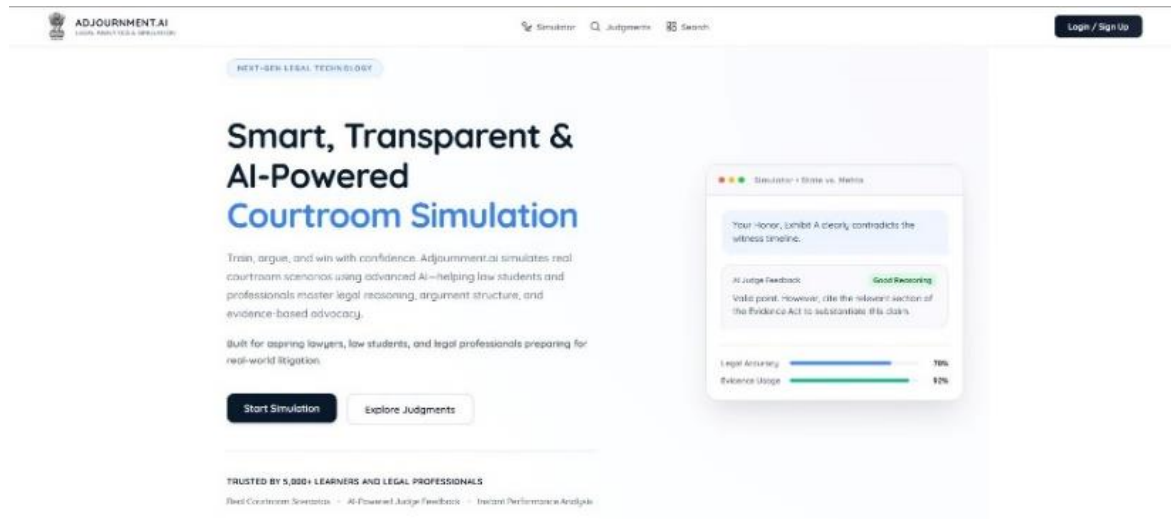


Fig 2: Application UI Screenshot

The platform is intended for a broad audience, including undergraduate and postgraduate law students seeking supplementary practical training, participants preparing for competitive moot court events, legal educators who wish to incorporate simulation-based assessments into their curriculum, and professionals preparing for litigation.

Future development plans include expanding the case repository with real landmark Indian judgments, introducing multiplayer debate modes where two users argue against each other with AI moderation, adding support for additional regional languages beyond Hindi and English, and developing a mobile application for on-the-go practice. Voice-only simulation modes are also planned to prepare students for oral argument scenarios.

In conclusion, Adjournalment.AI represents a meaningful step toward modernizing legal education in India by combining artificial intelligence, legal knowledge engineering, and interactive game-based learning into a single cohesive platform. By simulating the pressures and procedures of real courtroom advocacy, the system equips law students with practical skills that traditional classroom methods cannot adequately provide, ultimately contributing to the development of more competent, confident, and analytically rigorous legal professionals.

AI-POWERED ZERO-TOUCH PERSONAL SAFETY COMPANION

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OVERVIEW OF THE PROJECT

The Personal Safety Companion is a wearable device that helps keep people safe. It can automatically detect when someone is in trouble and send alerts for help. Sometimes people are not able to call for help because they're too scared, hurt or unconscious. Old safety systems that need you to press a button to call for help do not work well in these situations.

This project uses an approach that lets the device recognize when someone is in danger and send for help without anyone needing to do anything. The device has a computer called an ESP32 that helps it work. This computer is good because it does not use a lot of power and can connect to the internet and other devices.

The device also has a sensor that can feel when someone is moving and can tell if they fall down or get hurt. It can even hear if someone is screaming for help. The device uses a kind of computer program that can understand what it is hearing and decide if someone needs help.

One of the things about this project is that it uses information from both the movement sensor and the sound sensor to decide if someone is in trouble. This makes it more accurate. Helps prevent false alarms. For example if someone falls down and screams the device knows that they really need help. The device can work all by itself without needing to connect to the internet. This makes it faster and more reliable. When it detects an emergency it sends a message to a phone app, which then sends the persons location to people who can help.

The Personal Safety Companion is a way to keep people safe. It uses technologies like artificial intelligence and special sensors to help people in trouble. It is better than safety systems because it can detect problems before they get worse and send for help right away.

The device is made up of parts including:

- * A small computer called an ESP32
- * A movement sensor called an MPU6050
- * A sound sensor called a MAX4466
- * A phone app that connects to the device
- * A cloud backend that stores information and sends alerts

All of these parts work together to help keep people safe. The Personal Safety Companion is an example of how technology can be used to make peoples lives better and safer.

In the end the Personal Safety Companion is an useful device that can help people in many situations. It is an idea that can make a big difference, in peoples lives. The Personal Safety Companion is a device that people can wear to stay safe.

AI IN SMART CITIES

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INTRODUCTION AND CORE MISSION

The presentation titled "Bit Heads," developed and presented by the team of Anirudha Sarkar, Ishan Sengupta, and Soham Mondal, explores a critical technological intervention within the broader theme of "CLIMATE & URBAN FUTURE". The core mission of this ambitious initiative is described as "Mapping the invisible threat to build climate-resilient cities". Driven by a proactive and solution-oriented philosophy, the project team emphasizes their unique approach to environmental engineering by stating, "We aren't just mapping heat; we're architecting cool". This statement encapsulates their overarching goal of transitioning from mere climatic observation to the active, structural mitigation of urban heat threats.

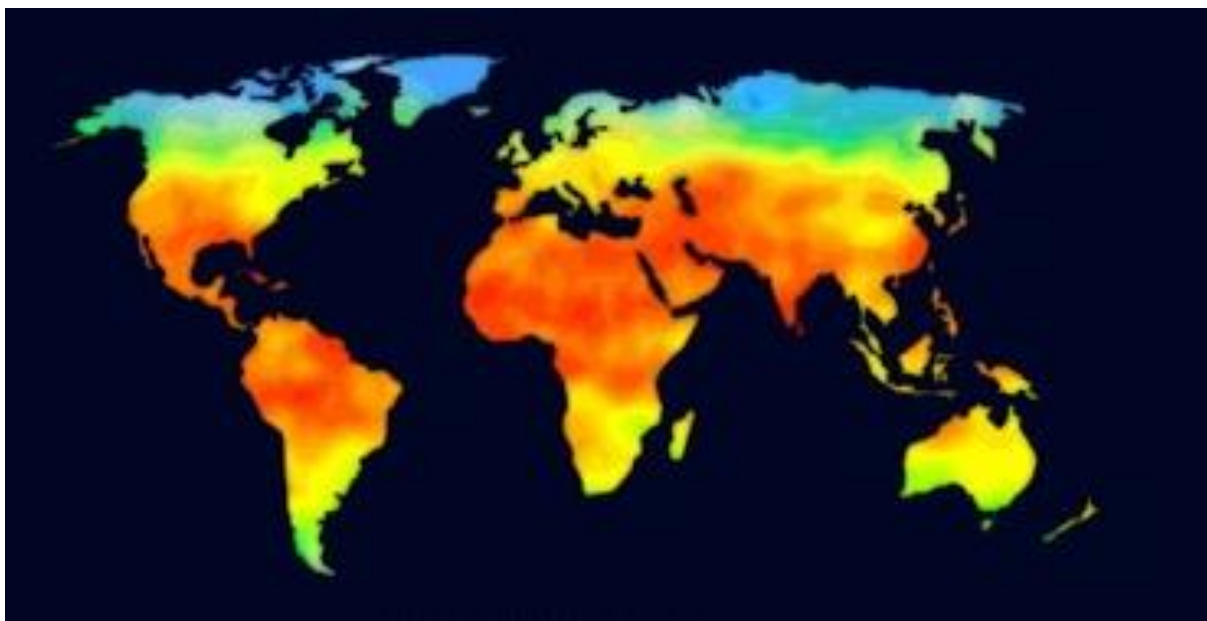


Fig 1: A thermographic world map illustrating global temperature variations and heat distribution

THE URBAN HEAT CRISIS AND ITS COMPOUNDING PILLARS

At the center of the presentation is the "Urban Heat Challenge," which positions the Urban Heat Island (UHI) effect not merely as a matter of localized, everyday discomfort, but rather as a severe and compounding crisis. Due to the UHI phenomenon, modern cities are currently baking at temperatures that are 5 to 10 degrees hotter than their surrounding, non-urbanized areas. The presenters argue that the failure to adequately address this crisis does not stem from a lack of general data, but rather from a fundamental lack of targeted, actionable intelligence.

To fully understand the severity of this compounding threat, the presentation categorizes the crisis into three distinct, interconnecting pillars:

- **The Health Crisis:** This identifies extreme urban heat as a silent killer and a literal life-or-death issue that is drastically increasing the rates of both heatstroke and overall urban mortality.
- **The Energy Trap:** This describes a vicious, self-sustaining cycle where hotter urban environments demand significantly more air conditioning.
- **The Equity Divide:** This highlights the reality that heat does not hit everyone equally. Lower-income neighbourhoods systematically lack adequate tree canopy and green spaces.

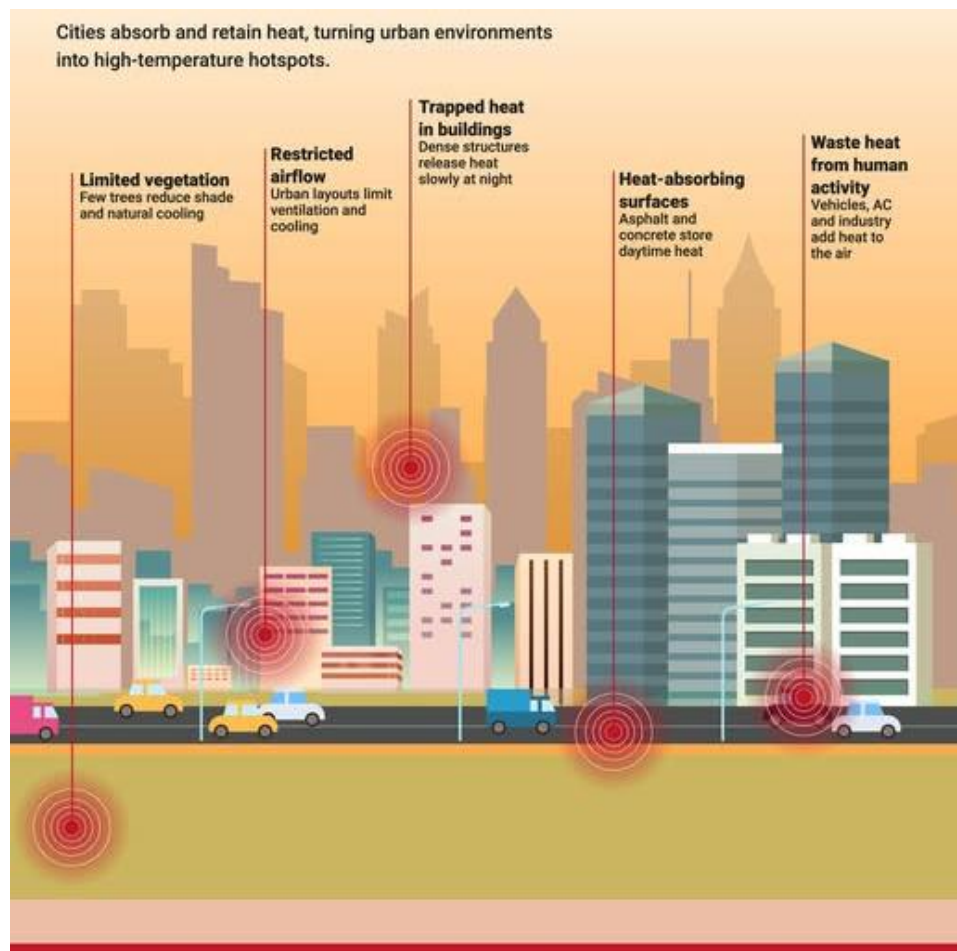


Fig 2: An infographic by the UNDRR explaining the primary drivers of the Urban Heat Island (UHI) effect, including restricted airflow, heat-absorbing surfaces, and waste heat from human activities

IDENTIFYING THE GAP AND PROPOSING A SOLUTION

To pivot towards a viable solution, the team identifies a critical gap in current environmental management strategies. While the scientific community and municipal governments already know that cities are hot, and they possess the broad macro-level data to definitively prove it, this generalized data is entirely insufficient for practical problem-solving. What is currently missing from the urban planning toolkit is the hyper-local intelligence required to take definitive action.

To bridge this critical gap, the Bit Heads team introduces their primary solution: the Autonomous Micro-Climate Rover & Dashboard. This advanced system functions as an overview tool, providing a dual-purpose digital twin designed specifically for the benefit of both urban planners and everyday

citizens. The core value proposition of this technology is the vital shift from passive observation to targeted, physical action. By utilizing this localized data platform, the project successfully shifts the broader climatic narrative from a generic observation like "It's hot today" to highly specific, actionable directives such as, "This specific street needs high-albedo coating, reducing local risk by 15%".



Fig 3: An exterior view of the "AuraHeat" autonomous micro-climate rover prototype, showcasing its sensor suite and computer vision webcam.

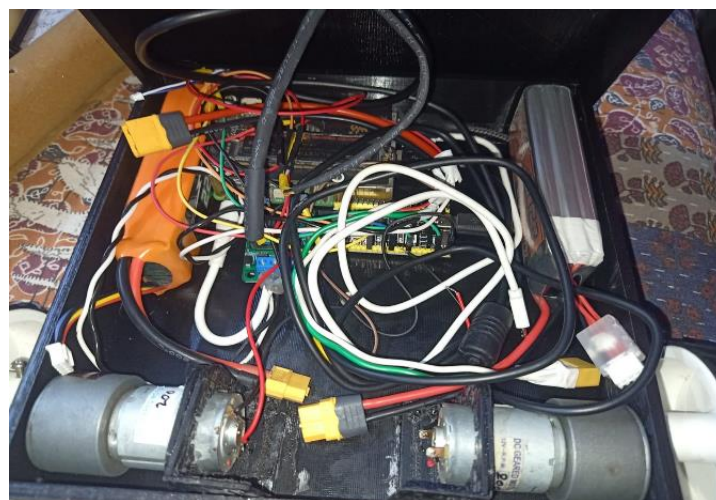


Fig 4: The internal hardware and electronic assembly of the rover, featuring the Raspberry Pi 5, ESP32 co-processor, motor drivers, and power management system.

TECHNICAL ARCHITECTURE AND DATA ECOSYSTEM

The physical hardware and core technology driving this targeted action are highly sophisticated.

- **Physical IoT Framework:** The system relies on physical infrastructure centered around an autonomous Pi 5 and ESP32 rover, which maps the free-space of its environment utilizing computer vision.
- **Data Integration:** The fundamental operation of the system relies on deep data integration, which actively fuses live telemetry gathered from ambient and surface sensors with broader geospatial data, including satellite imagery and land-use mapping.

- **Sensor Telemetry:** To process this telemetry, the rover captures localized surface heat using an MLX90614 IR sensor, while simultaneously gathering ambient air data using a DHT22 sensor and ambient light data using a BH1750 sensor.

Beyond the rover's real-time physical telemetry sent via MQTT, the data ecosystem ingests baseline regional atmospheric trends and forecasts through an Open Weather API. We also use spatial data from Open Street Map to analyze building density and "Urban Canyon" heat trapping effects. The Urban Heat Resilience Planner subsequently utilizes this vast ecosystem to create a high-fidelity digital twin of the environment by seamlessly merging the real-time physical telemetry with these global geospatial datasets.

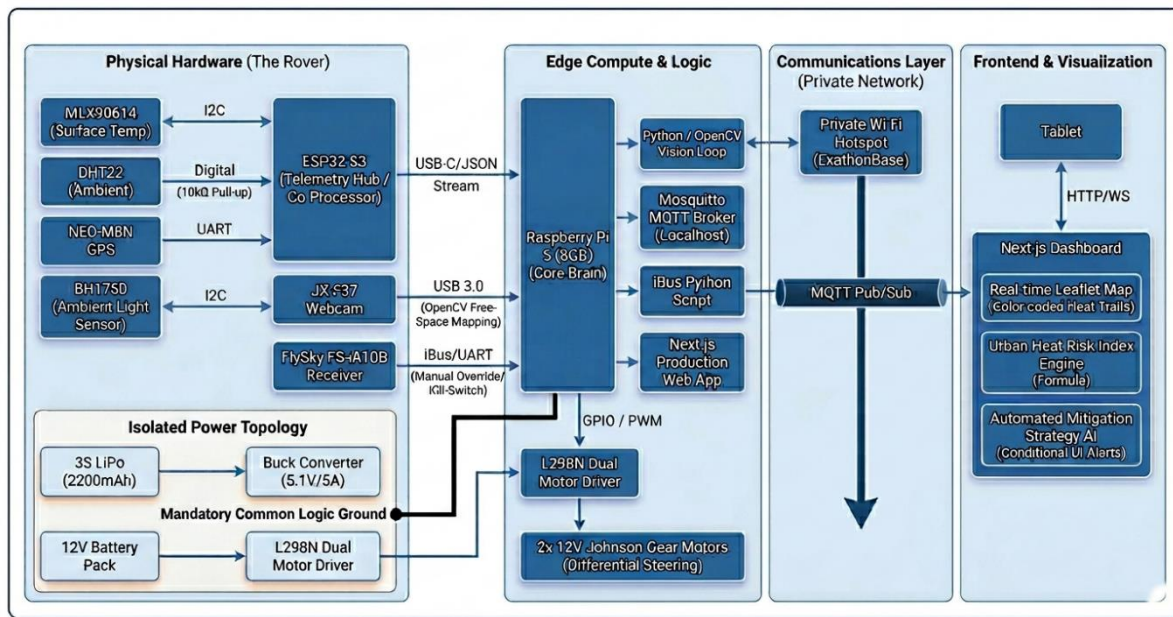


Fig 5: A comprehensive Technical Architecture diagram detailing the data flow from physical sensors to the edge-computing logic and the final frontend dashboard

THE HEAT RISK INDEX (HRI) AND SYSTEM OUTPUTS

The synthesis of this massive data intake culminates in the Real-Time Heat Risk Index (HRI). The HRI Engine relies on a proprietary mathematical model and an automated algorithm designed explicitly to calculate localized vulnerability. The formula used by this automated algorithm merges the aforementioned sensor data into a single, real-time danger score for specific micro-climates, calculated mathematically as: $HRI = (Temp * Humidity) - (Vegetation Density)$.

Once this vulnerability score is calculated, the core system provides two primary, actionable outputs. The first is a 3D Heat Vulnerability Map, delivered via a Next.js-powered Leaflet dashboard that visualizes urban hotspots in real-time. The second output is a Mitigation Recommender AI, which utilizes automated logic to suggest site-specific interventions, such as high-albedo "cool roofs," green corridors, or targeted tree canopy placement based entirely on the newly generated site-specific risk scores.

UI/UX FEATURES FOR USERS AND PLANNERS

The project includes a comprehensive prototype demonstration showcasing tailored views for both end-users and urban planners through its Digital Twin Dashboard's UI/UX. The frontend relies on a Next.js Visual Suite, offering a sleek, high-performance dashboard featuring real-time heatmaps, live camera feeds, and the automated Urban Heat Risk Index. This dashboard provides an instant visualization of surface versus air temperature gradients captured by the rover's onboard sensors.

The platform divides its utility between distinct user and planner features:

- **User Features:** For individual citizens, the platform includes the "Cool Route" Finder. This feature provides heat-aware navigation via an API-driven tool for pedestrians, calculating the safest travel paths by actively prioritizing shaded areas and low-albedo surfaces to minimize personal heatstroke risk.
- **Planner Features:** The platform equips urban planners with advanced "What-If" Simulation features, including a Virtual Urban Greening module. This acts as a drag-and-drop simulator that allows city planners to place virtual parks or high-albedo coatings onto the digital map. Through Impact Prediction capabilities, the system uses current rover data to calculate the projected drop in the Heat Risk Score if those specific mitigation strategies were physically implemented.
- **Community-Driven Data:** The platform integrates community input through "Heat Spot Reporting," which relies on crowdsourced mapping. A "Report a Heat Spot" button allows residents to actively tag localized "thermal pain points," which directly dispatches the autonomous rover to those specific coordinates for precise physical verification of the threat.

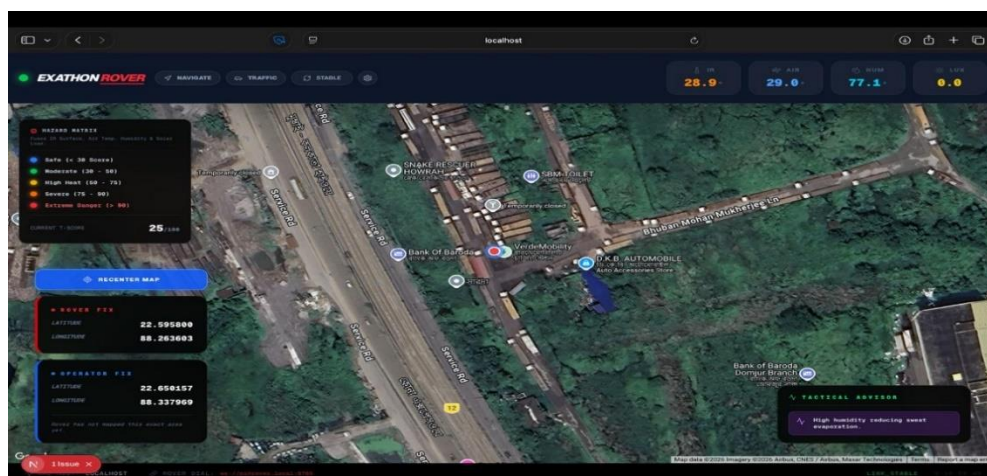


Fig 6: A screenshot of the EXATHON ROVER Digital Twin Dashboard, displaying live satellite mapping, real-time telemetry, and localized heat risk alerts

DEVELOPMENT ROADMAP AND FUTURE SCALABILITY

The strategic development roadmap for this technology is divided into three distinct phases aimed at maximizing impact and ensuring future scalability. Phase 1, the Current Prototyping phase, focuses on autonomous mapping and calculating the real-time Risk Index, and is currently classified as "Demo Ready". Phase 2 represents the Research Phase, focusing heavily on Intelligence, specifically the development of LSTM-based heatwave forecasting capable of 7-day predictions. Finally, Phase 3 represents the Long-term Vision of Deployment, aiming for complete autonomous fleet deployment and city-wide API integration.

It directly supports the global goal of "Sustainable Cities and Communities" by providing the necessary granular data to actively mitigate the Urban Heat Island effect. Furthermore, the system is designed for massive global scalability; its Modular API Architecture allows the Next.js dashboard to easily ingest data from secondary rovers or existing city IoT sensors located anywhere worldwide.

Looking ahead, future enhancements include Predictive AI utilizing Long Short-Term Memory (LSTM) models trained on historical trends and rover telemetry to move beyond real-time data toward accurate 7-day forecasting. The team also plans to introduce a comprehensive Economic Analysis Hub, featuring a financial module to calculate the return on investment (ROI) of Green Infrastructure. This hub will directly compare the upfront costs of tree planting and cool roofs against the projected healthcare savings resulting from reduced heatstroke cases.

CONCLUSION

The team concludes their presentation by asserting that their autonomous rover and edge-computing setup is much more than a simple data collection tool; it is the fundamental foundation for their entire platform. By actively mapping micro-climates and simultaneously pushing automated mitigation strategies directly to their Next.js dashboard, the "Bit Heads" project successfully bridges the massive gap between raw hardware engineering and actionable urban planning. As it states, "We don't just track the heat; we give cities the exact blueprints to turn the temperature down," ultimately transforming raw climate data into life-saving urban infrastructure.



Fig 7: A conceptual 3D visualization of the rover in an urban park, demonstrating its ability to detect high surface temperatures and suggest specific mitigation actions like adding tree canopy

ADVANCED MILITARY SPYING AND BOMB DISPOSAL ROBOT

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INTRODUCTION

In today's world, security threats such as terrorism, hidden explosives, and hazardous environments pose serious risks to human life, especially for defence personnel and bomb disposal squads. Traditional bomb detection and disposal methods often involve manual intervention, which can lead to severe injuries or fatalities. To overcome these challenges, robotics and automation have become essential in modern defence systems. The **Advanced Military Spying and Bomb Disposal Robot** is designed to address these issues by providing a safe, efficient, and intelligent solution for detecting and neutralising explosive threats. This robot is a remotely operated system equipped with multiple sensors, a camera module, and a robotic arm, enabling it to perform surveillance, detection, and disposal tasks without direct human involvement. The system combines mobility, real-time monitoring, and precise handling capabilities, making it highly useful in military operations, public safety scenarios, and disaster management. By integrating different technologies into a single platform, the robot enhances operational efficiency while ensuring maximum safety.

Components Used

The system consists of several hardware and electronic components that work together to achieve detection and disposal:

- **Microcontroller (Arduino/Embedded Board):** Acts as the brain of the system, controlling all operations.
- **Motor Driver Module (L298N or similar):** Controls the movement of the 4-wheel robotic car.
- **DC Motors (4 motors):** Provide motion and mobility to the robot.
- **Robotic Arm with Servo Motors:** Used to pick, hold, and dispose of suspicious objects.
- **Gas Sensor (MQ series):** Detects hazardous or explosive gases in the environment.
- **Metal Detector Sensor:** Identifies metallic components commonly found in explosive devices.
- **IR Sensor:** Helps in obstacle detection and navigation.
- **Camera Module:** Provides real-time video streaming for remote monitoring.
- **Bluetooth Module (HC-05/HC-06):** Enables wireless communication and control.
- **Power Supply (Battery):** Provides energy to the entire system.
- **Chassis and Wheels:** Mechanical structure supporting all components.

WORKING PROCESS

The working of the robot is based on coordinated interaction between sensors, control systems, and mechanical components. Initially, the robot is powered on and connected to a mobile device or controller via the Bluetooth module. The operator sends commands to control the movement of the robot, such as forward, backward, left, and right. The motor driver receives these signals from the microcontroller and drives the motors accordingly. As the robot moves through a suspected area, the sensors continuously monitor the surroundings. The gas sensor detects the presence of harmful or explosive gases, while the metal detector identifies metallic objects that may indicate a hidden bomb. The IR sensor helps avoid obstacles, ensuring smooth navigation. Simultaneously, the camera module streams live video to the operator, allowing real-time observation and decision-making. Once a

suspicious object is detected, the operator carefully navigates the robot closer to the target. The robotic arm is then activated to pick up or interact with the object. Using servo motors, the arm can perform precise movements to safely handle the device. The operator can then move the object to a safer location or simulate disposal actions depending on the design. If any error or unexpected condition occurs, the system can be stopped or adjusted remotely. This ensures full control over the operation without exposing humans to danger.

ADVANTAGES

The proposed system offers several benefits in terms of safety, efficiency, and cost:

- **Enhanced Safety:** Eliminates direct human involvement in bomb detection and disposal, reducing risk to life.
- **Remote Operation:** Allows control from a safe distance using wireless communication.
- **Multi-Sensor Detection:** Combines gas, metal, and IR sensors for improved accuracy.
- **Real-Time Monitoring:** Camera provides live feedback for better decision-making.
- **Cost-Effective:** Much cheaper compared to advanced military robots.
- **Compact and Portable:** Easy to deploy in different environments.
- **Versatile Applications:** Can be used in defence, police operations, airports, and disaster zones.
- **Scalable Design:** Can be upgraded with advanced technologies like AI or GPS.

MARKETING STRATEGY

The marketing strategy for this project focuses on targeting sectors that require high security and safety solutions. Firstly, the primary target audience includes **defence organisations, police departments, bomb squads, and security agencies**. These institutions require reliable and cost-effective solutions for handling explosive threats. Demonstrating the robot's capabilities through live demos, simulations, and field testing can attract attention from these sectors. Secondly, collaboration with **government agencies and defence contractors** can help in scaling the project for real-world deployment. Participating in technology exhibitions, defence expos, and innovation competitions can further increase visibility and credibility. Thirdly, the project can also be marketed to **industrial sectors and disaster management teams**, where hazardous environments require remote handling solutions.

A key selling point of this system is its **low cost and adaptability** compared to existing high-end bomb disposal robots. Highlighting affordability, ease of use, and modular upgrades can make it attractive for wider adoption. Digital marketing strategies such as showcasing videos, prototypes, and technical demonstrations on platforms like LinkedIn, YouTube, and tech forums can also help reach a broader audience.

CONCLUSION

The **Advanced Military Spying and Bomb Disposal Robot** represents an important step toward improving safety and efficiency in handling explosive threats. By integrating robotics, sensors, and wireless communication, the system provides a reliable solution for remote detection, surveillance, and disposal of dangerous objects. This project not only reduces the risk to human life but also enhances operational effectiveness in critical situations. Its cost-effectiveness and scalability make it a promising alternative to expensive existing systems. With further advancements such as artificial intelligence, autonomous navigation, and improved communication technologies, this robot can evolve into a highly sophisticated defence tool. Overall, the project demonstrates how engineering and innovation can be used to solve real-world safety challenges and contribute to a more secure future.

INTELLIGENT IOT-BASED AUTONOMOUS MEDICINE MANAGEMENT AND MONITORING SYSTEM

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OVERVIEW OF THE PROJECT

Healthcare management, especially medication adherence, remains a major challenge for elderly individuals, patients with chronic diseases, and people with busy lifestyles. Missing doses, taking incorrect medication, or ignoring reminders can lead to serious health complications. Existing solutions such as mobile reminders and alarm-based systems are often ineffective as they rely solely on user discipline and can be easily ignored.

To address this critical issue, this project proposes a Smart Autonomous Medicine Management and Monitoring System that integrates IoT, embedded systems, and mobile application technology to ensure timely and accurate medication intake. Unlike traditional reminder systems, this solution introduces a physical enforcement mechanism, making it highly reliable and user-centric.

The system consists of three major components: Hardware Model (Smart Medicine Box) Software System (Mobile Application + Backend) Advanced Mobility & Monitoring Module. The hardware model includes a multi drawer medicine box with seven compartments corresponding to days of the week. A TFT display unit acts as the interface, continuously showing the current date, time, and upcoming medication schedule. Two servo motor-driven robotic arms function as a locking mechanism, ensuring that drawers remain inaccessible until the correct medication time.

The software system includes a mobile application through which users can input personal details such as age, gender, and daily routine, along with medicine-specific details like name, dosage time, food instructions, quantity remaining, and expiry date. This data is securely stored in a cloud-based MongoDB database, hosted via a live backend server. The ESP32 microcontroller, acting as the core processing unit, continuously fetches medication schedules from the backend through APIs. It compares real-time clock data with scheduled medication timings. When the scheduled time matches the current time, the system triggers a series of automated actions: the buzzer activates, the servo motors unlock the drawers, and the TFT screen displays a visual alert, ensuring that the user is notified both audibly and visually.

To further enhance usability, the system provides dual interaction modes. The user can stop the alert either by pressing a physical button on the device or through the mobile application, after which the system resets itself by locking the drawers and returning the display to its normal state. An advanced feature of this project is the integration of a mobile platform system, consisting of motors, ultrasonic sensors, and an ESP32 module. This enables the device to follow the user within a defined radius (2-3 meters), ensuring accessibility and reducing dependency on a fixed location.

Additionally, the system is designed to support future integration of a camera-based emergency detection module, capable of identifying abnormal situations such as falls and triggering an SOS alert to predefined contacts, thereby enhancing patient safety. This project stands out due to its holistic approach, combining automation, physical control, real-time monitoring, and intelligent mobility into a single unified system. It transforms passive reminders into active healthcare assistance, making it especially beneficial for elderly users and patients requiring strict medication adherence.

TECHNICAL APPROACH AND SYSTEM ARCHITECTURE

The proposed system is designed using a layered architecture that integrates hardware, software, and cloud communication to ensure seamless operation. At the core of the system lies the ESP32 microcontroller, which serves as the central processing and communication unit. It connects the physical hardware components with the cloud-based backend and mobile application through Wi-Fi. The hardware layer includes servo motors, a TFT display, buzzer modules, and optional sensors such as ultrasonic sensors and camera modules. The servo motors are programmed to control the locking and unlocking mechanism of the drawers, ensuring controlled access to medicines. The TFT display acts as an interactive interface, continuously providing real-time updates such as current time, medication schedules, and alert notifications. The buzzer module provides strong auditory alerts to capture the user's attention.

The software layer consists of a mobile application developed using modern frameworks, which enables users to input, manage, and monitor their medication schedules. The backend system, built using Node.js and Express, handles data processing and communication between the mobile application and the hardware device. MongoDB is used as the cloud database to store user information and medication details securely. Communication between the ESP32 and backend is achieved through REST APIs, allowing real-time data synchronization. The ESP32 periodically fetches updated schedules and ensures that the system operates even in dynamic scenarios where medication details are modified.



SYSTEM WORKFLOW AND AUTOMATION

The system operates through a continuous monitoring and execution loop. Once the user enters the required details in the mobile application, the data is stored in the cloud database and becomes accessible to the ESP32 module. The ESP32 retrieves the stored data and continuously compares the real-time clock with the scheduled medication timings. When a match occurs, the system triggers a predefined sequence of actions. These actions include activating the buzzer, displaying an alert message on the TFT screen, and unlocking the corresponding drawer using servo motors. The user is then required to interact with the system by taking the medicine and acknowledging the alert. This can be done either through the physical button present on the device or via the mobile application interface. Once acknowledged, the system resets itself by turning off the buzzer, locking the drawers, and restoring the display to its default informational mode. This automated workflow ensures that medication intake is not only reminded but also enforced, significantly reducing the chances of negligence.

FEASIBILITY AND PRACTICAL IMPLEMENTATION

The proposed system is highly feasible due to the use of readily available and cost-effective components. The ESP32 microcontroller, servo motors, and sensors are widely accessible and supported by extensive development communities. The use of open-source software frameworks further reduces development cost and complexity. From an implementation perspective, the system is modular, allowing easy integration and scalability. Each component, whether hardware or software, can be independently upgraded or modified without affecting the overall system functionality. The system is designed to operate efficiently in real-world conditions such as homes, hospitals, and assisted living environments. Its simple user interface and automated processes make it especially suitable for elderly users who may not be technologically advanced.

IMPACT AND CONCLUSION

The Smart Autonomous Medicine Management and Monitoring System presents a transformative approach to healthcare management. By combining automation, physical enforcement, and intelligent monitoring, it addresses one of the most critical issues in healthcare—medication adherence. In conclusion, this project demonstrates how the integration of IoT, embedded systems, and intelligent automation can significantly enhance the quality of life for patients and elderly

individuals. It lays the foundation for future advancements in smart healthcare systems, making it a scalable and impactful innovation.



Automatically analyze soil sensor data and research papers to generate foundation CAD plans

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PROJECT OVERVIEW

Civil Intelligence is an AI-powered system designed to automate the traditionally slow and manual process of foundation design in civil engineering. The platform leverages generative AI to analyze soil sensor data and engineering research, ultimately generating ready-to-use CAD foundation plans.

THE PROBLEM & SOLUTION

The Problem: Civil engineers currently face a bottleneck where analyzing soil data and research papers for foundation design is time-consuming and prone to manual calculation errors.

The Solution: The system uses SONAR (from drones) to collect detailed soil data. This data, along with scrapped research papers and user-defined requirements, is processed by advanced Large Language Models (LLMs) to ensure accurate, data-driven engineering results.

CORE FEATURES

Automated CAD Generation: The system produces Vastu and IS code-compliant foundation plans in standard .dxf format.

AI Assistant: A simplified chatbot interface helps engineers with technical queries, such as pile depth or frequency of piers.

Data Integration: It combines real-world soil sensor data with academic research and regulatory codes.

SOLUTION STACK

Frontend: Built with Flutter for user interaction and data visualization.

Backend & API: Powered by Python and Fast API to connect the frontend with AI logic.

AI Brain: Utilizes Gemini 3.0 Pro for engineering reasoning and validation, and Gemini 1.5 Flash for agentic operations.

Data Tools: Includes Agent QL for scraping research, Pandas for data processing, and ezdxf for generating CAD drawings.

IMPACT & FEASIBILITY

Target Users: Civil engineers, construction firms, infrastructure planners, and engineering students. Key

Benefits: Significant reduction in human error, faster early-stage design cycles, and automated research synthesis.

Feasibility: The project is highly viable as it uses scalable technologies and standard engineering file formats like CSV, JSON, and DXF.

SENTINEL-AI: ENTERPRISE-GRADE CYBER THREAT INTELLIGENCE (CTI) PLATFORM

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EXECUTIVE SUMMARY

SENTINEL-AI is an automated AI-driven pipeline designed to ingest, analyze, and categorize unstructured data from diverse sources—such as intercepted encrypted chats, dark web forums, and network logs. Unlike traditional keyword-based systems, it utilizes Natural Language Processing (NLP) to understand the “Intent” and “Context” of communications to preemptively identify cyber and physical threats.

THE PROBLEM STATEMENT

In modern Security Operations Centres (SOC), analysts are overwhelmed by massive volumes of unstructured data. Manually identifying actionable intelligence (e.g., data breaches, ransomware coordination, or physical violence) is time-consuming and prone to human error. A delay in detection often leads to a successful breach.

THE SENTINEL-AI SOLUTION: Real-time Ingestion: Instantly processes raw text data. Automated Scoring: Calculates a Threat Urgency Score (High/Medium/Low).

ENTITY EXTRACTION: Automatically identifies targets, hacker aliases, malware types, and locations.

ACTIONABLE INTELLIGENCE: Generates STIX 2.1 compliant JSON reports and suggests immediate defensive (SOAR) actions

TECHNICAL ARCHITECTURE

AI & MACHINE LEARNING CORE (THE INTELLIGENCE)

ZERO-SHOT CLASSIFICATION: Powered by BART (facebook/bart-large-mnli) to categorize conversations without specific training on those labels.

NAMED ENTITY RECOGNITION (NER): Utilizes BERT (dslim/bert-base-NER) to extract specific entities like Organizations (ORG), Locations (LOC), and Actors (PER).

HEURISTIC ENGINE: A custom Regex and dictionary-based layer to ensure critical keywords (e.g. onion links, specific weaponry, or ransomware strains) are never missed.

BACKEND API

FASTAPI: A high-performance Python framework used to build the asynchronous analyze REST endpoint.

UVICORN: Serving the application on an ASGI server for low-latency processing.

PYDANTIC: Ensuring strict data validation and structured JSON outputs.

FRONTEND DASHBOARD

REACT.JS: A component-based UI for managing the Threat Meter and Live Intelligence Stream.

DATA VISUALIZATION: Integrated Chart.js for real-time threat level plotting and trend analysis.

DATA VISUALIZATION: Integrated Chart.js for real-time threat level plotting and trend analysis.

KEY FEATURES AND INNOVATIONS

EXPLAINABLE AI (XAI): Provides reasoning behind each threat classification, increasing transparency and analyst trust

SOAR INTEGRATION: Suggests automated response actions such as:

- Isolating affected systems

- Alerting stakeholders

- Initiating containment protocols

Geospatial Enrichment: Detects and maps locations from threat data for situational awareness.

APPLICATIONS: Sentinel-ai can be deployed in:

- Security Operations Centers (SOCs)

- Government intelligence agencies

- Financial institutions

- Critical infrastructure protection systems

FUTURE SCOPE

The platform can be further enhanced by:

- Integration with live dark web scraping systems

- Multi-language NLP support for global intelligence coverage

- Mapping threats to the MITRE ATT&CK framework for deeper analysis.

- Advanced predictive analytics using historical threat patterns

CONCLUSION

SENTINEL-AI represents a next-generation approach to cybersecurity by combining AI, automation, and intelligence-driven analytics. By transforming raw data into actionable insights in real time, it empowers organizations to stay ahead of threats and strengthen their overall security posture.

ELECTROFEET: SMART FOOTSTEP ENERGY HARVESTING SYSTEM

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OVERVIEW OF THE PROJECT

In the modern era, the demand for electrical energy is increasing at an exponential rate due to rapid urbanization, population growth, and the widespread adoption of digital technologies. Cities are becoming more crowded, infrastructure is expanding, and the reliance on electricity is higher than ever before. However, traditional sources of energy such as fossil fuels are not only limited but also harmful to the environment, contributing significantly to pollution and climate change. This has created an urgent need to explore alternative, sustainable, and renewable sources of energy. One such innovative and largely untapped source is the mechanical energy generated by human movement, particularly footsteps in densely populated areas. The ElectroFEET project is designed to harness this overlooked energy and convert it into usable electrical power through an efficient and intelligent system.

ElectroFEET is a hybrid system that integrates both hardware and software components to generate, store, analyse, and visualize electricity produced from human footsteps. The core principle behind this project is the piezoelectric effect, a phenomenon in which certain materials generate an electric charge when subjected to mechanical stress. By embedding piezoelectric sensors beneath specially designed floor tiles, the system captures the pressure exerted by each step and converts it into electrical energy. When a person steps on the tile, the applied force causes deformation in the piezoelectric material, resulting in the generation of a small electrical voltage. This voltage is typically alternating current (AC) and relatively low in magnitude. To make this energy usable, it is passed through a rectifier circuit that converts AC into direct current (DC). The converted energy is then stored in capacitors or rechargeable batteries for later use. Although a single footstep generates only a small amount of energy, the cumulative effect of thousands of footsteps in crowded areas such as railway stations, shopping malls, sidewalks, airports, and educational institutions can lead to a significant amount of power generation over time.

The hardware architecture of ElectroFEET consists of piezoelectric sensors, a microcontroller such as Arduino or ESP32, rectifier circuits, energy storage devices, and supporting electronic components. The microcontroller acts as the central processing unit of the system, collecting signals from the sensors and converting them into meaningful data. It measures parameters such as voltage output, frequency of footsteps, and total step count. This data forms the foundation for monitoring and analysis.

To enhance the intelligence of the system, ElectroFEET incorporates a software-based monitoring platform in the form of a web dashboard. The data collected by the microcontroller is transmitted to a backend server using communication protocols such as Wi-Fi, Bluetooth, or serial communication. The backend is developed using Node.js and Express, which handle data processing, API management, and communication with the database. A database such as MongoDB is used to store both real-time and historical data efficiently and securely.

On the frontend, an interactive dashboard is developed using React, providing a user-friendly interface for data visualization. The dashboard displays key performance indicators such as total number of footsteps, total voltage generated, average energy per step, and energy generation trends over different time intervals including daily, monthly, and yearly analysis. Graphs and charts are used to present data in a clear and visually appealing manner. Additionally, the system identifies peak hours during which maximum energy is generated, offering valuable insights into crowd movement patterns and optimal energy harvesting periods.

One of the most compelling aspects of ElectroFEET is its application in smart cities and modern infrastructure. The system can be installed in high-footfall areas where human movement is constant, enabling continuous energy generation without the need for additional natural resources. The generated energy can be utilized for low-power applications such as street lighting, digital displays, sensor networks, and emergency lighting systems. Furthermore, the integration of this system with smart city frameworks allows for better urban planning, efficient energy management, and improved public infrastructure.

From a feasibility perspective, ElectroFEET is both cost-effective and scalable. Piezoelectric sensors are compact, lightweight, and relatively inexpensive, making them suitable for large-scale deployment. The system can be integrated into existing flooring structures with minimal modifications. Additionally, the use of widely available microcontrollers and open-source software technologies reduces development and maintenance costs. The modular design of the system allows it to be expanded easily based on the size and requirements of the installation area.

Despite its advantages, the project also presents certain challenges. The energy output from each footstep is relatively low, which requires efficient energy storage and management systems to accumulate usable power. The durability and longevity of the sensors must also be ensured, as they are subjected to continuous mechanical stress. Environmental factors such as temperature changes, moisture, and physical wear can affect performance. These challenges can be addressed through improved material selection, protective casing, optimized circuit design, and strategic placement of sensors in high-pressure zones.

The innovation of ElectroFEET lies in its ability to convert everyday human activity into a valuable source of renewable energy while integrating it with modern digital technologies. Unlike conventional renewable energy sources such as solar or wind power, which depend on environmental conditions, ElectroFEET leverages human movement, which is consistent and predictable in urban environments. This makes it a reliable supplementary energy source. The inclusion of real-time monitoring and data analytics further enhances its effectiveness, enabling users to track performance and make informed decisions.

The impact of ElectroFEET extends across environmental, economic, and social dimensions. Environmentally, it promotes clean energy generation and helps reduce carbon emissions. Economically, it provides a low-cost method of generating supplemental electricity in public spaces, potentially lowering operational costs. Socially, it raises awareness about renewable energy and encourages innovative thinking towards sustainability. It also creates opportunities for integrating technology into everyday infrastructure, making cities smarter and more efficient.

Looking ahead, ElectroFEET has strong potential for future enhancements and expansion. The system can be integrated with smart grids, allowing the generated energy to be supplied directly to the power network. Advanced analytics and machine learning techniques can be applied to predict energy generation patterns and optimize system performance. Mobile applications can be developed to provide real-time access to data, making the system more interactive and accessible to users. Additionally, improvements in piezoelectric materials and energy storage technologies can further increase efficiency and output.

In conclusion, ElectroFEET is a forward-thinking and innovative solution that addresses the growing need for sustainable energy in modern urban environments. By harnessing the power of human footsteps and combining it with intelligent monitoring systems, the project demonstrates how small, everyday actions can contribute to meaningful energy generation. It represents a step towards a greener, smarter, and more sustainable future, where technology and human activity work together to create efficient and eco-friendly energy solutions.

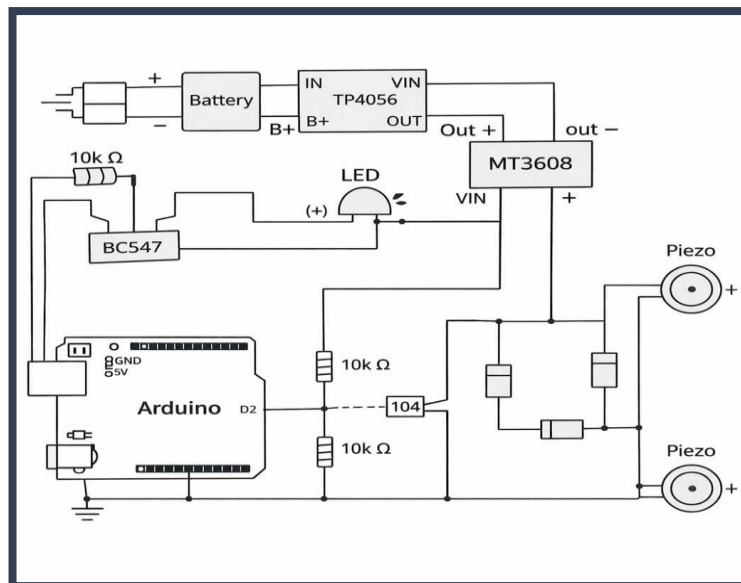


Fig 1: Circuit Diagram

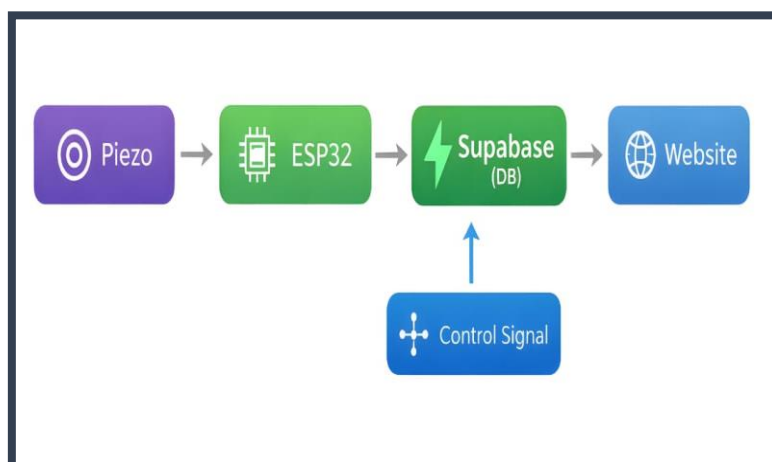


Fig 2: Data Flow

PROMETHIUM MARK-I: AI-DRIVEN MODULAR POWERED COMBAT EXOSUIT

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OVERVIEW OF THE PROJECT

Promethium Mark-I is an AI-driven modular powered combat exosuit developed under an Indian Patent filing, designed to augment infantry soldiers with real-time artificial intelligence, autonomous threat detection, and multi-modal sensor fusion. The system is built around a Raspberry Pi 4B compute core running YOLOv8n object detection at 8-12 FPS, Vosk offline speech recognition, and a dual-LLM AI stack (Claude Haiku API primary, Ollama/Phi-3 Mini offline fallback) branded as ZADIEN. The platform is engineered for DRDO and iDEX procurement pathways as India's first domestically developed AI-native combat exosuit.

The Mark-I prototype demonstrates the full AI-hardware integration stack: 32-channel servo control across dual PCA9685 I2C boards drives deployable shoulder panels with laser emitter assemblies, forearm blaster housings with LED emitters, and DS3225/MG996R articulated elbow joints. The helmet integrates a 5-inch HDMI LCD with R biconvex optics for an immersive heads-up display. AI inference can run offline with zero cloud dependency with ollama fallback, making it operationally viable in denied-communication zones.

PROBLEM STATEMENT

Modern infantry soldiers face extreme physical and cognitive overload in hostile environments — high-altitude Himalayan terrain, desert operations, and NBC-contaminated theatres. Existing exosuit technologies globally are either prohibitively expensive (USD 5-15M per unit), non-AI-integrated, or lack modularity for diverse mission profiles. India has no domestically fielded powered exosuit system. There is a critical gap for an open-architecture, AI-native, cost-optimised platform that can evolve from a prototype to a militarized production system through a structured DRDO/iDEX funding pathway.

PROPOSED SOLUTION

Promethium Mark-I delivers a fully integrated hardware-software solution across three layers:

- **AI Cognitive Layer:** ZADIEN AI runs YOLOv8n NCNN vision, Vosk always-on STT with wake word detection, Claude Haiku LLM for tactical advisory with Phi-3 Mini offline fallback, and a Flask HUD server in Chromium kiosk mode. A keyword-based hardware dispatcher handles servo commands at sub-100ms latency without routing through the LLM.
- **Sensor & Control Layer:** MPU-6050 IMU for orientation and gesture inference, ADS1115 ADC for analog sensor interfacing, WS2812B LED status arrays, SSD1306 OLED forearm display, PAM8403 audio amplifier, and Arduino Nano watchdog ensuring hardware failsafe. AI-based gesture recognition (fist, open palm, point, peace sign, nod, wrist flick) drives all combat actions hands-free.
- **Mechanical & Actuation Layer:** Deployable shoulder panels housing laser emitter assemblies on aiming servos, forearm blaster housings with LED emitters, DS3225 elbow joints, MG996R/MG90S for panel deployment, and split power rails (5V Pi / 6V servo) with modular 3D-printed housing across the full suit.

KEY TECHNICAL SPECIFICATIONS

Component	Specification
Compute Core	Raspberry Pi 4B (4GB RAM)
Vision AI	YOLOv8n NCNN — 8–12 FPS on CPU
Speech Recognition	Vosk offline STT + openwakeword
LLM Stack	Claude Haiku API / Phi-3 Mini (Ollama fallback)
Gesture Control	AI-based via MPU-6050 IMU — 6 combat gestures
Servo Control	2x PCA9685 I2C — 32 channels total
Primary Servos	DS3225 (elbows), MG996R, MG90S/SG90
IMU	MPU-6050 6-axis gyro/accelerometer
Helmet Display	5" HDMI LCD 800x480 + VR biconvex optics
Forearm Display	SSD1306 OLED 128x64
LED System	WS2812B addressable RGB arrays
Audio / TTS	PAM8403 amplifier + pyttsx3/espeak
Watchdog	Arduino Nano failsafe (I2C monitor)
Power Rails	5V (Pi compute) / 6V (servo actuation), split
Deployable Systems	Shoulder laser panels + forearm blaster housings
Patent Status	Indian Patent filed — Principal Inventor: RJ
Funding Target	iDEX DISC / ADITI / DRDO Dare to Dream 4.0

AI-BASED GESTURE CONTROL SYSTEM

The complete gesture control system enables hands-free operation of all suit functions in high-noise, high-stress combat environments. The MPU-6050 IMU feeds a trained gesture classifier running on the Pi CPU. Each gesture maps to a hardware event dispatched at sub-100ms latency bypassing the LLM pipeline entirely: Fist = repulsor/weapon fire; Open Palm = suppression/area denial; Point = target lock and tracking; Peace Sign = faceplate visor toggle; Head Nod = mission confirmation; Head Shake = abort/cancel; Wrist Flick = shoulder/forearm panel deploy. Voice-gesture fusion combos enable compound commands such as simultaneous gesture + voice trigger for weapons hot activation, providing a dual-authentication safety layer for lethal systems.

FUTURE SCOPE: MILITARIZED PRODUCTION UPGRADES

The Mark-I prototype establishes the foundational AI-hardware stack. The following upgrade pathway defines the roadmap toward a fully militarized, production-grade exosuit system across successive development phases:

- **Exoskeleton Structural Upgrade:** Transition from 3D-printed modular housing to a full titanium-alloy and carbon-fibre composite powered exoskeleton frame with motorised load-bearing joints (actuated knee, hip, and ankle). Hydraulic or series elastic actuators (SEA) will replace servo-based elbow joints, enabling genuine force multiplication for load carriage (target: 100 kg payload assist) and high-terrain mobility.
- **JetCat P350 Propulsion Integration:** Installation of real JetCat P350 turbine engines (350N thrust each) replacing the current 3D-printed scale models. Six engines positioned at back (2x), arms (2x), and thighs (2x) with full 2-axis pitch and yaw gimbal assemblies using 608ZZ bearing rings. Thrust vectoring under AI control enables short-burst vertical lift, rapid lateral evasion, and controlled low-altitude flight. Fuel system integration with JP-8/kerosene tank management, throttle-by-wire via servo-controlled ECU, and thermal shielding for pilot and adjacent suit systems.
- **Industry-Grade Ballistic Shielding:** Integration of NIJ Level IV certified composite armour panels using Dyneema HB80 UHMWPE layered with boron carbide ceramic strike face across chest, back, shoulders, and helmet. Reactive armour tile mounts on outer shell for RPG/grenade fragment mitigation. Total armour weight target under 18 kg distributed via the powered exoskeleton frame, eliminating fatigue loading on the operator.
- **Micro Drone Swarm Integration:** Shoulder-mounted deployable micro-drone swarm canisters housing 8-12 autonomous UAVs (approx. 120mm diameter each) for reconnaissance, perimeter surveillance, and area denial. Swarm coordination runs on a dedicated Jetson Orin Nano co-processor with encrypted 2.4/5.8 GHz mesh links. ZADIEN AI acts as swarm commander, delegating mission objectives while individual drones operate autonomously on pre-programmed search and relay behaviours.
- **IR Pulse and Microwave Directed Energy:** Forearm-mounted IR pulse emitters for short-range sensor blinding and drone counter-UAS operations. Integration of a compact Active Denial System (ADS) module using a 95 GHz millimetre-wave emitter for non-lethal crowd suppression and perimeter denial. All directed energy systems are slaved to the gesture control pipeline and require dual-authentication (gesture + voice) to activate, with a hardware-level safety interlock preventing accidental discharge.
- **Integrated Weapon Systems:** Forearm-integrated 9mm PDW or .308 semi-auto weapon mount with AI-assisted target tracking via YOLOv8 bounding box lock, range estimation through stereo depth camera, and ballistic compensation overlay on the HUD. Shoulder hardpoints for 40mm grenade launcher integration. All weapon fire commands require biometric confirmation (palm vein scan + gesture) to prevent misuse. Encrypted ATAK radio integration for fire coordination with ground units.
- **Oxygen and Extreme Environment Life Support:** Integration of a 2-litre composite SCBA oxygen tank (DRDO DEBEL-spec) with demand regulator and positive-pressure sealed helmet visor for operation in high-altitude (above 7,000m), NBC-contaminated, and underwater shallow-dive environments. INMAS-spec biometric health monitoring (SpO2, heart rate, core temperature, hydration index) feeds real-time operator status to the HUD and relays critical alerts to command via encrypted mesh. Suit internal climate regulation via thermoelectric Peltier modules for both Arctic and desert thermal extremes.
- **Adaptive Camouflage and Stealth:** Outer panel ports designed for retro-reflective and electrochromic material integration enabling visual-spectrum adaptive camouflage. IR-

suppression coating on all external surfaces to reduce thermal signature. Low-observable profile in STEALTH HUD mode with automatic WS2812B LED suppression, audio dampening, and reduced RF emission footprint.

FUNDING PATHWAY & SOCIETAL IMPACT

A 36-month phased development roadmap targets iDEX DISC (up to INR 1.5 Cr for Mark-I prototype validation), ADITI (up to INR 25 Cr for powered exoskeleton and propulsion integration), and PRIME (up to INR 50 Cr for full militarized production prototype). DRDO collaboration is targeted with DEBEL (life support), CAIR (autonomous AI), R&DE(E) (structural), ADE (propulsion), and DYSL-CT (directed energy). Beyond combat, the platform is directly applicable to disaster response, HADR operations, space analogue suits, and industrial exoskeleton markets — aligning with India's Aatmanirbhar Bharat defence manufacturing vision.

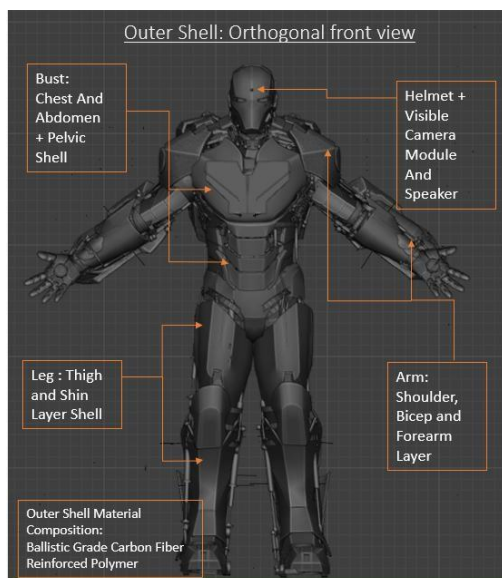


Fig 1.: Promethium Mark-I External View

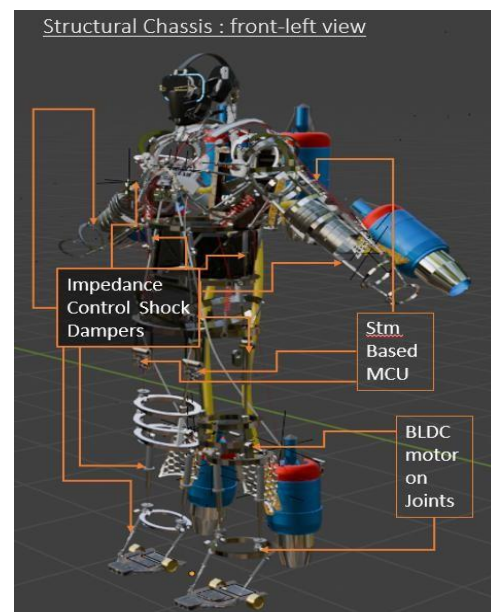


Fig 2.: Internal Proposed Architecture

A VICTIM DETECTION MODEL FOR A TOF SENSOR DRONE USING ARTIFICIAL INTELLIGENCE(AI) IN DISASTER MANAGEMENT

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ABSTRACT

In disaster-hit areas, rapid victim detection is critical, especially in environments where GPS signals are unreliable or unavailable. This work proposes an AI-based victim detection system using a multi-sensor unmanned aerial vehicle (UAV) equipped with Time-of-Flight (ToF) and thermal sensors. The drone operates without GPS navigation, relying instead on onboard sensing and intelligent data processing. The ToF sensor provides depth information for obstacle avoidance and spatial mapping, while thermal sensors help identify heat signatures and human presence even in low-visibility conditions.

The collected sensor data is fused and processed through an AI model designed to detect and classify potential victims. Two key algorithms are employed: a sensor-fusion algorithm to integrate heterogeneous data for improved accuracy, and a machine-learning-based detection algorithm to identify human patterns in thermal signatures. This approach enhances detection reliability while minimising false positives.

The proposed system ensures efficient area coverage, real-time analysis, and autonomous operation, making it well-suited for search-and-rescue missions in complex disaster scenarios, such as collapsed buildings, forest fires, and flood-affected regions.

KEYWORDS

UAV (Unmanned Aerial Vehicle), Disaster Management, Victim Detection, Sensor Fusion, Thermal and Tof Sensing, GPS-Denied Navigation

INTRODUCTION

Disaster scenarios such as earthquakes, floods, and fires create hazardous environments that make victim detection difficult and risky. Traditional search and rescue operations are often slow and unsafe, especially in areas with limited accessibility and damaged communication infrastructure. Unmanned Aerial Vehicles (UAVs) offer a promising solution for rapid and safe assessment of such regions.

However, many UAV systems rely on GPS, which may be unreliable in disaster conditions due to signal blockage or interference. To address this, this work proposes a GPS-denied UAV system integrated with Time-of-Flight (ToF) and thermal sensors for efficient victim detection.

These sensors enable the system to capture depth information and detect heat signatures, allowing identification of human presence even in low-visibility or obstructed environments. By leveraging sensor fusion and AI-based algorithms, the model improves detection accuracy and operational efficiency.

Challenges such as debris, smoke, darkness, and complex terrain often limit conventional vision-based systems. To overcome this, the proposed system combines ToF-based depth awareness for safe navigation with thermal sensing for detecting human body heat, even when victims are partially hidden. The system incorporates a sensor fusion algorithm for comprehensive environmental understanding and an AI-based detection algorithm for accurate victim identification. This integrated approach enables autonomous operation, efficient coverage, and real-time decision-making, ultimately improving rescue effectiveness and reducing response time.

PROPOSED METHODOLOGY

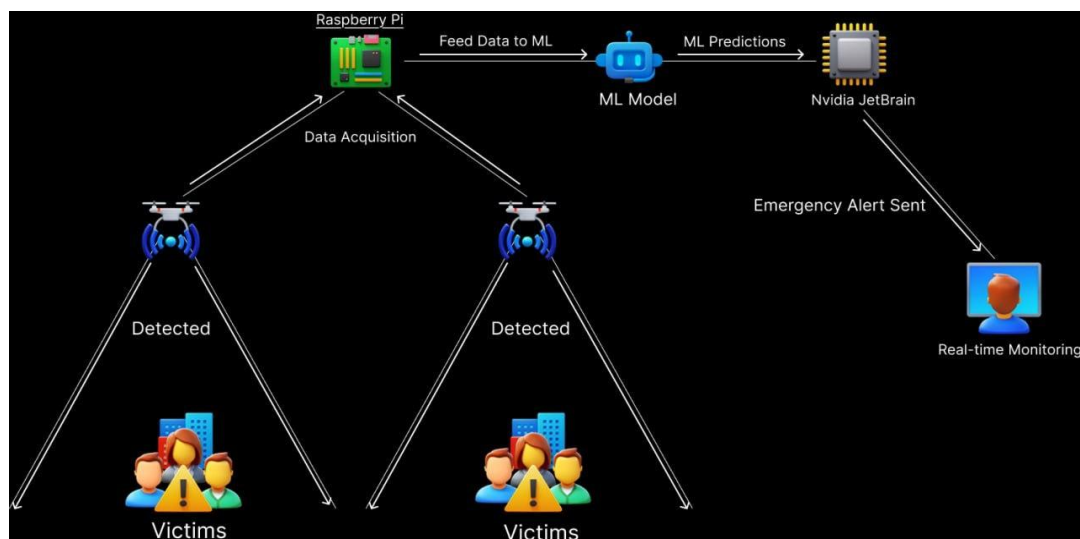


Fig1: System Architecture

1. Input Sensors (Data Acquisition) The UAV is equipped with a multi-sensor payload to facilitate comprehensive data acquisition across varying disaster conditions, including low-visibility and high-obscuration environments:

- **High-Resolution ToF Sensor:** Facilitates the capture of standard visual spectrum data for spatial mapping.
- **Thermal Imaging Camera:** Detects critical heat signatures to identify human presence amidst debris or in GPS-denied, obstructed environments.

2. Drone Onboard Processing Hub (Raspberry Pi) Serving as the central data router, this unit manages the ingestion and pre-processing of heterogeneous sensor information.

- **Sensor Interface (CSI/USB):** Manages the ingestion of raw visual and thermal data streams directly from the hardware payload.
- **Data Pre-processing:** Standardizes, resizes, and normalizes high-volume video frames to ensure compatibility with AI inference models.
- **Communications Manager:** Orchestrates internal data routing to the inference engine and facilitates external transmission to the Ground Control Station.

3. AI Inference Engine (NVIDIA Jetson) Functioning as the system's primary intelligence unit, this module performs real-time analysis and victim classification.

- **Inbound Data Handling:** Receives normalized video frames from the processing hub for immediate computational analysis.
- **Deep Learning Implementation:** Executes the YOLOv8 object detection model to achieve high-accuracy detection reliability.
- **Feature Extraction and Classification:** Analyzes human patterns to distinguish between "Victim" and "Not-Present" classes with minimized false positives.

- **Metadata Feedback:** Transmits classification results, including spatial bounding boxes and confidence scores, back to the central hub.

4. Ground Control Station (GCS) The GCS integrates sensor fusion results with spatial metadata to enable autonomous operation and rapid emergency response.

- **Operator Interface:** Human rescuers monitor the mission via a ruggedized terminal to oversee real-time analysis and decision-making.
- **Real-time Detection Display:** The interface overlays live feeds with bounding boxes and statistical confidence indicators, such as "VICTIM DETECTED (81% Confidence)."
- **Spatial Mapping and Alerts:** Pinpoints exact coordinates on an integrated map, triggering automated logging to alert search-and-rescue teams.

RESULT & DISCUSSION

- The performance of the proposed random forest model was evaluated using precision, recall, and F1-score. The performance of the proposed classification model was evaluated using precision, recall, and F1-score metrics. The model was trained on a large-scale dataset consisting of approximately 20,000 samples, out of which 1,000 samples were reserved for testing, while the remaining data were used for training.
- The model achieved an overall accuracy of 81% on the test dataset. For the Not Present class, the model obtained a precision of 0.82, recall of 0.98, and F1-score of 0.89, indicating strong performance in identifying negative instances.
- In contrast, the performance on the Victim class is significantly lower, with a precision of 0.27, a recall of 0.04, and an F1-score of 0.07. The extremely low recall suggests that the model fails to correctly identify most of the positive instances. Furthermore, the macro-average F1-score of 0.48 highlights the imbalance in class-wise performance, while the weighted F1-score of 0.75 is influenced by the dominance of the majority class. These results indicate that the model is biased toward the majority class and struggles with effective detection of minority class instances.

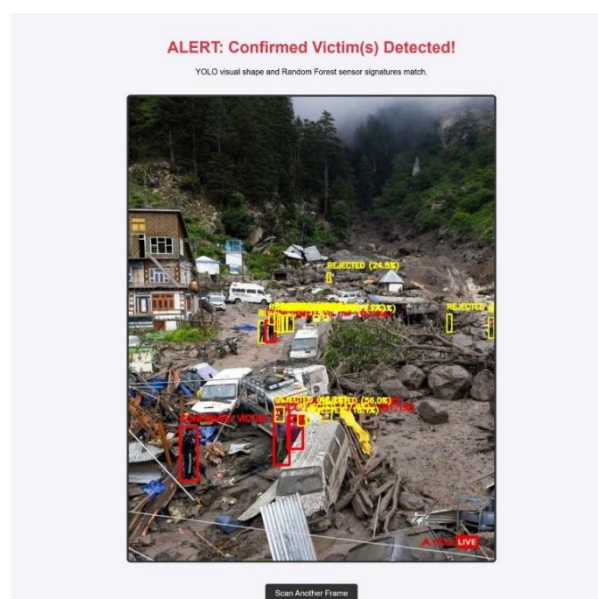


Fig 2: Real-time victim detection results

The result snippet is given below

Class	Precision	Recall	F1-score	Support
Not Present	0.82	0.98	0.89	8219
Victim	0.27	0.04	0.07	1775
Accuracy			0.81	9994
Macro Avg	0.55	0.51	0.48	9994
Weighted Avg	0.73	0.81	0.75	9994

CONCLUSION

In this study, a GPS-independent UAV-based system has been proposed for effective victim detection in disaster-stricken areas. The integration of Time-of-Flight (ToF) and thermal sensors enables the system to operate efficiently in challenging environments where visibility is low and navigation is difficult. By utilizing a sensor fusion algorithm, the system combines data from multiple sources to improve environmental understanding, while the AI-based detection algorithm accurately identifies human presence.

The proposed model enhances search and rescue operations by providing faster detection, reduced human effort, and improved safety for rescue teams. Its ability to function autonomously in GPS-denied environments makes it highly suitable for real-world disaster scenarios. With further advancements and optimization, this system can serve as a reliable and scalable solution for modern disaster management and emergency response applications.

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KrishiGrow AI: An AI-Powered Smart Farming Platform

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OVERVIEW OF THE PROJECT

Agriculture plays a vital role in India's economy, supporting the livelihoods of millions of farmers. However, despite its importance, the sector faces numerous challenges such as unpredictable weather conditions, lack of access to real-time information, inefficient resource utilization, and dependency on traditional farming practices. These issues often lead to reduced crop yield, financial losses, and farmer distress.

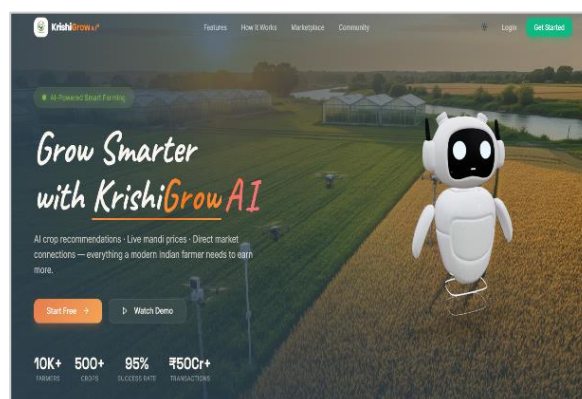


To address these challenges, this project introduces KrishiGrow AI, an AI-powered smart farming platform designed to assist farmers in making informed decisions. The platform uses Artificial Intelligence, data analytics, and cloud technologies to analyze soil conditions, weather data, and market trends.

KrishiGrow AI helps farmers in crop selection by providing data-driven recommendations. It integrates real-time weather forecasting to reduce risks caused by climate uncertainty. The system also provides market price analysis to help farmers sell their Produce at better rates.

Additional features include soil health monitoring, smart irrigation management, disease detection, and yield prediction. The platform also offers a chatbot, a farmer community and expert consultation support to guide farmers.

Overall, KrishiGrow AI aims to improve productivity, reduce losses, and promote sustainable farming practices through technology-driven solutions.



A.R.I.S.E.: Automated Reception Interface for Support and Enquiries

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OVERVIEW OF THE PROJECT

The proposed automated reception interface for support and enquiries, A.R.I.S.E., is designed to operate like a personal assistant for office tasks. This interface can handle tasks like an actual human assistant and be further upgraded with artificial intelligence and physical mobility to a smart robot for efficient human-robot interaction. In this work, we have utilized the automated interface A.R.I.S.E. to provide support at busy offices, viz. college principal's office.

BACKGROUND & MOTIVATION

Students often face crowds, long waiting times, and unclear processes during routine office work, which leads to missing classes and delays. These are common problems due to poor communication and management. These kinds of incidents motivate us to develop an AI-based Receptionist system for real-time updates and assistance. The A.R.I.S.E. makes it easier for students to get help and for the principal to manage the office. In this direction, several works have been developed; for example, a robot named 'ROBOR' uses a Raspberry Pi and a camera to interact and communicate with visitors. This robot can turn what people say into text using Google's technology [1]. There is another robot, 'Heriot-Watt AI Robotarium' Receptionist, which is really good at talking to people. This robot is designed to look and act like a human. It can make faces and move its body to look more real. This makes it easier for people to talk to the robot [2]. The new human-robot interaction system, called A.R.I.S.E., is designed to be simple and easy to use. It does not need a lot of equipment, like the Raspberry Pi 4. The A.R.I.S.E. interface is still able to do all the things a receptionist generally does. It is easier to make and use the A.R.I.S.E. since it focuses on smooth interaction between humans and robots using voice and basic communication [1-2]. The A.R.I.S.E. presented in this work can operate like a personal assistant for office tasks. It is simple and robust in design, uses an ESP32 to send audio and a camera to welcome people [2]. This low-cost system is also easy for students to use (unlike other receptionist robots). Besides, it uses Google technology to turn voices into text and computer programs to understand what people are asking. The A.R.I.S.E. uses technology to recognise the faces of the students and answer their questions [3-4]. It works as a smart gatekeeper and allows authorities to concentrate on important decisions while maintaining efficient visitor management.

TECHNICAL DETAILS & PERFORMANCE OUTCOMES

This section explains the technical details and performance of our system. The A.R.I.S.E. has a smart user interface (Fig. 1) enabling students to interact with the principal's office and access necessary information as per the requirement. The ESP32 (Fig. 2) serves as the main controller for A.R.I.S.E., handling sensor inputs and managing hardware components. It allows for wireless communication via Wi-Fi and Bluetooth, assisting in smooth interaction with external systems. This guarantees the system functions efficiently and intelligently. We have also used the ESP-32 camera module to identify the faces of the students who come in front of the principal's office.

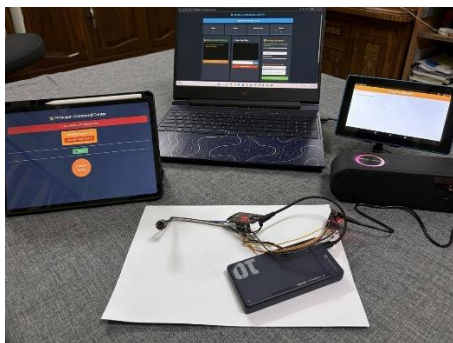


Fig 1. Setup of A. R. I. S. E.



Fig 2. ESP-32 with mic module

The A.R.I.S.E. (office companion / personal assistant) uses a list of student information to do this job. If a student faces a problem that the A.R.I.S.E. cannot solve, it sends a message to the principal. Thus, the principal can examine the issue and take action in a timely manner. The principal can accept, reject or hold a student's request without directly meeting with the student, but by a desk window. The principal can also convey a message to the student via an intercom. We have used the ESP-32 development board, which is used as the microcontroller. The PCM5102A amplifier module is used as a Digital Analog Converter. We have trained our AI model using datasets stored in .txt files to enable accurate understanding and responses.

CONCLUSION & FUTURE WORK

In this work, we introduced the A.R.I.S.E., an automated reception interface designed to function as a personal assistant for handling office tasks. It has a straightforward and durable design, yet offers an effective solution when used to engage with students in the principal's office.

- (i) The future direction of the A.R.I.S.E. includes incorporating 'Multimodal Sentiment Analysis' to identify student urgency based on facial expressions, as well as broadening support for regional languages such as Bengali, Hindi, Tamil, and others.
- (ii) Furthermore, our goal is to integrate artificial intelligence with physical movement to turn the A.R.I.S.E. into a smart robot capable of enabling efficient human-robot interaction.
- (iii) Furthermore, this system can be converted into a predictive administrative centre by utilizing data analytics from MySQL logs to detect and proactively address common student inquiries.

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ReproSense: A Real-Time Multi-Camera Suspect Tracking and Trajectory Prediction System Using Computer Vision and Edge Hardware

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OVERVIEW OF THE PROJECT

ReproSense is a real-time multi-camera intelligence system designed to detect, track, and re-identify suspects or persons of interest across a network of spatially non-overlapping surveillance cameras. Unlike conventional closed-circuit television systems that record passively, ReproSense actively correlates detections across multiple camera feeds, maintains a global identity registry, estimates suspect location during camera blind spots, and predicts future movement — all in real time. The system is built on a combination of edge hardware nodes (ESP32-CAM modules), a deep learning inference pipeline running on a laptop GPU, and an interactive operations dashboard that provides live situational awareness to the operator.

The core problem ReproSense addresses is the surveillance blind spot — the gap that exists between camera coverage zones in any real-world deployment. When a suspect moves out of one camera's field of view, existing systems simply lose them. There is no identity continuity, no spatial reasoning, and no predictive capability. ReproSense closes this gap by treating the camera network as a connected graph, applying cross-camera re-identification through CLIP-based visual embeddings, and computing an expanding uncertainty radius that represents the possible location of the subject in the absence of camera coverage.

PROBLEM STATEMENT

Urban surveillance infrastructure in Indian cities is extensive but analytically shallow. The majority of the estimated 18 million CCTV cameras deployed across India perform detection and recording but lack the intelligence layer required for real-time cross-camera tracking. Existing solutions from vendors such as Hikvision, CP Plus, and domestic AI companies like Staqu and Nayan AI offer single-camera analytics, basic face recognition, and license plate reading — but none implement trajectory prediction with spatial uncertainty modeling across non-overlapping camera networks at the edge-hardware level. When a suspect leaves one camera zone, the operator has no automated assistance in determining where that person will appear next.

PROPOSED SOLUTION AND METHODOLOGY

ReproSense implements a five-stage intelligence pipeline. In the first stage, three ESP32-CAM modules broadcast live MJPEG video streams over a local WiFi hotspot. Each stream is ingested by the central inference laptop using OpenCV in parallel threads, maintaining a two-frame queue per camera to avoid stale frame processing. The second stage applies YOLOv8n object detection on each incoming frame, restricted to the 'person' class for surveillance contexts. Detected bounding boxes are passed to DeepSORT, which maintains independent per-camera track identities using Kalman filtering for motion prediction and Hungarian algorithm assignment.

The third stage is the core innovation of the system. Each confirmed person crop is encoded into a 512-dimensional visual embedding using OpenAI's CLIP model (ViT-B/32). When a new detection appears on any camera, the system queries a global track registry using cosine similarity. A match above a tuned threshold of 0.80 triggers a cross-camera re-identification event, linking the new detection to an existing global track. A feasibility check using Haversine distance and estimated travel time is applied to reject physically impossible matches, improving precision without sacrificing recall.

The fourth stage handles the blind-spot interval. When a tracked subject disappears from all cameras, the system begins computing an expanding uncertainty radius using the formula $r = v \times \Delta t$, where v is the estimated walking speed (1.4 m/s default) and Δt is elapsed time since last detection. This radius is rendered as a live animated pulsing circle on the operations dashboard, providing the operator with a probabilistic search zone. Simultaneously, a NetworkX camera graph — pre-configured with real-world transition times between camera nodes — produces a ranked list of next predicted cameras with associated probability scores.

The fifth stage is physical response. When the uncertainty radius exceeds a configurable threshold, ReproSense optionally triggers a drone dispatch event, animating a drone icon on the dashboard map and signaling the operator to deploy a physical quadcopter unit to the center of the uncertainty zone for visual verification. This bridges the gap between software intelligence and hardware response, which is the defining characteristic of ReproSense compared to purely software-based analytics platforms.

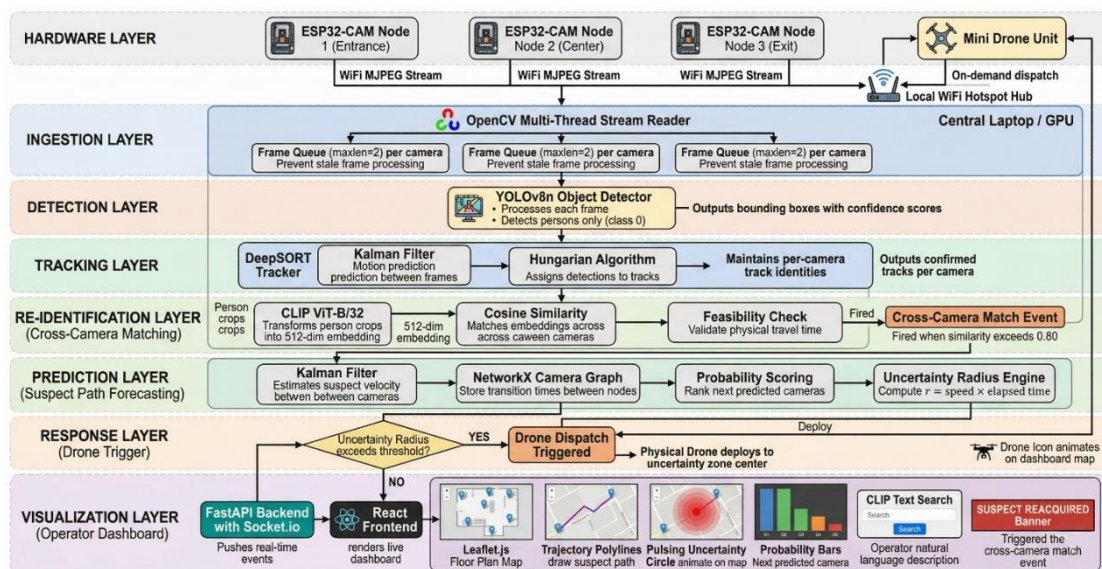


Fig. 1: System Architecture — Hardware to Visualization Pipeline

KEY FEATURES AND INNOVATIONS

ReproSense introduces several features that are not present in existing commercial or academic surveillance systems at this scale and cost:

- Cross-camera re-identification without facial recognition: Identity is matched using full-body visual embeddings from CLIP, making the system operational in low-resolution or partially occluded scenarios where face-based systems fail.
- Text-driven suspect search: Operators can type a natural-language description such as 'man in dark jacket carrying a bag' and the system performs a CLIP text-to-embedding search across all stored person crops, returning the closest matches with similarity scores.
- Expanding uncertainty radius with confidence degradation: The system quantifies what it does not know — a probabilistic search zone that grows over time, paired with a confidence percentage that degrades as the zone expands.
- Hardware integration at low cost: The complete camera network runs on three ESP32-CAM modules totaling approximately Rs. 1,500, making the system deployable in resource-constrained environments without enterprise hardware.
- Drone dispatch integration: Physical response is triggered automatically by the AI pipeline, representing a closed-loop from detection to action.

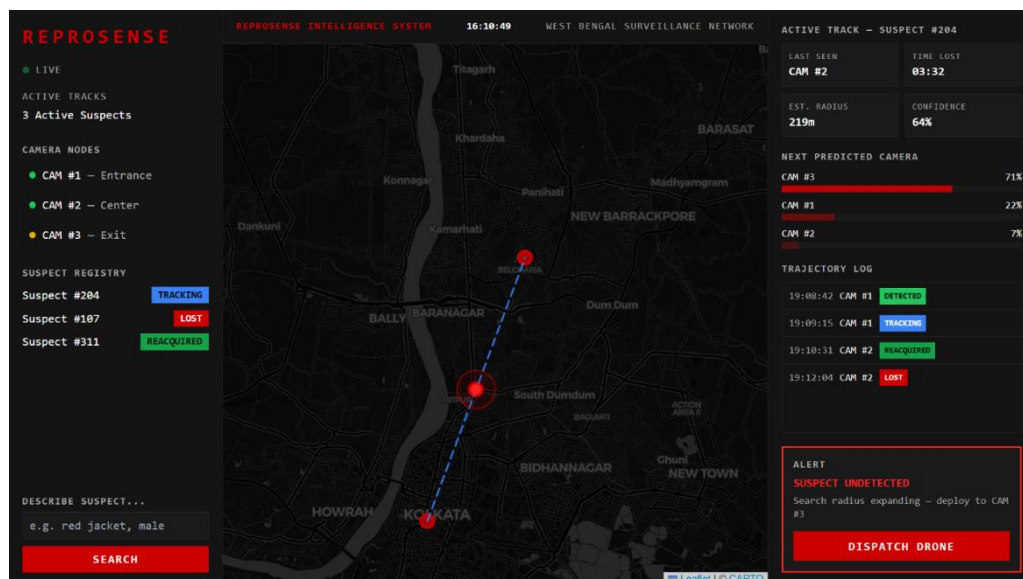


Fig. 2: Live Dashboard — Uncertainty Radius and Trajectory Overlay

TECHNOLOGY STACK

The hardware layer consists of three AI-Thinker ESP32-CAM modules streaming MJPEG video over a local WiFi hotspot network, powered by USB power banks for wireless operation. The inference layer runs on a central laptop and uses Ultralytics YOLOv8n for object detection, the deepsort-realtime library for single-camera tracking, and OpenAI CLIP (ViT-B/32) via PyTorch for visual embeddings and text-based search. Path prediction uses the filterpy Kalman filter implementation and NetworkX for camera graph traversal. The backend is built with FastAPI and Socket.io for real-time event streaming. The frontend dashboard uses React with Tailwind CSS and Leaflet.js for the live SVG floor-plan map with animated trajectory overlays.

EXPECTED OUTCOMES AND APPLICATIONS

ReproSense demonstrates that enterprise-grade multi-camera intelligence — previously available only in large-scale government platforms such as Palantir Gotham or Anduril Lattice — can be replicated at near-zero hardware cost using open-source computer vision tools and commodity edge hardware. The system is designed for deployment in controlled environments such as college campuses, gated communities, commercial complexes, and event venues. With appropriate scaling, the architecture extends to city-block-level surveillance networks, making it a viable foundation for smart city public safety infrastructure.

The project contributes a working prototype that integrates computer vision, distributed video processing, graph-based spatial reasoning, vision-language models, and physical hardware response in a single coherent system — demonstrating both technical depth and practical deployability.

Smart Traffic Management System

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OVERVIEW OF THE PROJECT

Urban traffic congestion is a critical challenge in modern smart cities, leading to increased travel time, fuel consumption, and environmental pollution. Traditional traffic management systems rely on static routing and pre-timed signal controls, which fail to adapt to dynamic traffic conditions and uncertainty. This project proposes a **Hybrid Fusion Controller** that integrates real-time data acquisition, uncertainty-aware routing, congestion forecasting, and adaptive traffic signal control to optimize traffic flow efficiently.

In the proposed system, vehicles (cars) continuously transmit telemetry data such as speed, position, and movement patterns to nearby Road Side Units (RSUs). These RSUs act as intermediate edge devices that aggregate data from multiple vehicles and form batches for efficient processing. The batched data is then transmitted to a flask server implemented using Python, ensuring scalability and low-latency communication.

At the server level, a **Graph Neural Network (GNN)** model is employed to perform **uncertainty-aware routing**. The road network is modelled as a graph where nodes represent intersections and edges represent road segments. The GNN processes real-time traffic data along with uncertainty estimations to predict optimal routes for vehicles. Unlike traditional shortest-path algorithms, this approach incorporates probabilistic uncertainty, enabling more robust and risk-aware routing decisions under fluctuating traffic conditions.

Once the optimal route is determined, the vehicle follows the suggested path within a Simulation of Urban Mobility (SUMO) environment. SUMO is used to simulate realistic traffic scenarios and validate the effectiveness of the proposed routing strategy. This simulation ensures that the system can be tested under controlled yet dynamic conditions before real-world deployment.

Parallel to the routing process, RSUs are responsible for training and updating a **Reinforcement Learning (RL)-based traffic signal control model**. This model dynamically adjusts traffic light timings based on current traffic density and flow patterns. By continuously learning from incoming data, the RL agent optimizes signal phases to reduce congestion, waiting time, and queue lengths at intersections.

Additionally, the system incorporates a **congestion forecasting module** using a Federated Learning (FL) approach. In this setup, RSUs collaboratively train models without sharing raw data, preserving privacy while enabling distributed intelligence. The forecasting model not only predicts future congestion levels but also provides uncertainty estimates, which are crucial for making reliable traffic management decisions.

The integration of these three components—uncertainty-aware routing using GNN, adaptive signal control using RL, and congestion forecasting using FL—forms the **Hybrid Fusion Controller**. This

controller enables a holistic approach to traffic optimization by combining predictive analytics, real-time decision-making, and decentralized learning.

The proposed system offers several advantages over conventional methods. It improves route efficiency by considering uncertainty, enhances traffic signal responsiveness through adaptive learning, and ensures data privacy via federated learning. Moreover, the edge-cloud architecture reduces communication overhead and supports scalability for large urban environments.

In conclusion, this project presents an intelligent, scalable, and robust traffic management framework that leverages advanced AI techniques and modern computing paradigms. By integrating routing, forecasting, and signal control into a unified system, the Hybrid Fusion Controller aims to significantly reduce congestion and improve overall transportation efficiency in smart cities.

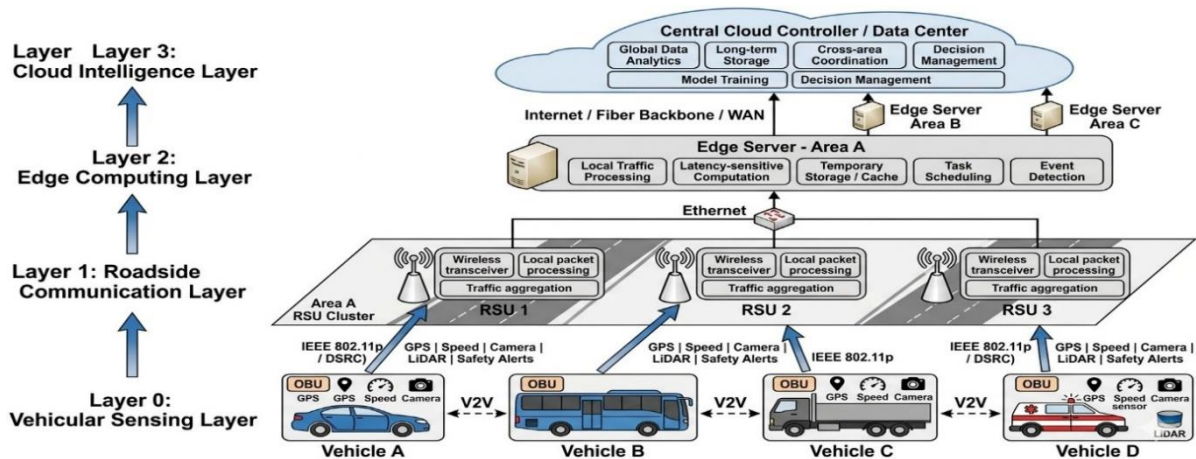


Figure 1: Multi-layer ITS: vehicle sensing, RSU aggregation, edge & cloud intelligence for real-time traffic.

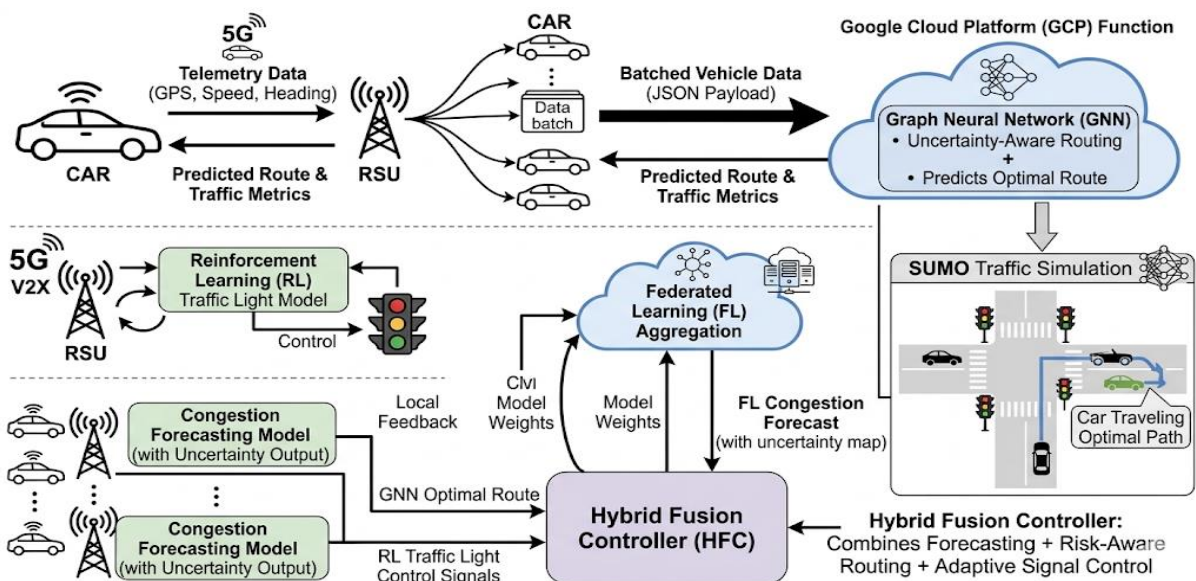


Figure 2: System Architecture of the Hybrid Fusion Controller (HFC)

JeevanDhara AI – When Every Second Matters

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OVERVIEW OF THE PROJECT

In today's fast-paced world, emergency response systems are largely reactive, relying heavily on manual triggering by victims or bystanders. In critical situations such as medical emergencies, accidents, or threats to personal safety especially for women victims are often unable to initiate an SOS request. This delay in response significantly increases the risk of severe consequences, including loss of life. To address this challenge, we propose our solution JeevanDhara AI, an intelligent, Artificial Intelligence-powered real-time emergency detection system designed to proactively identify distress situations without requiring manual user intervention. By leveraging advancements in Artificial Intelligence, Emotional Recognition, and Natural Language Processing (NLP), the system detects signs of panic, fear, or stress from voice inputs and automatically initiates emergency response actions. The primary objective of JeevanDhara AI is to reduce response time during emergencies, enhance public safety, and provide a seamless, automated support system that works even when the victim cannot actively seek help.

PROBLEM STATEMENT

Current emergency systems face several limitations which are reactive rather than proactive, relying on user-initiated actions. Victims in distress may be physically or mentally incapable of triggering SOS alerts. Some delays in emergency response led to increased fatality rates. There can be some lack of real-time detection mechanisms for women safety and sudden health emergencies. These gaps highlight the urgent need for an intelligent system capable of automatic distress detection and rapid response activation.

OBJECTIVES

Our proposed system aims to develop an Artificial Intelligence based real-time distress detection system, which enabling automatic emergency response without user intervention. This reduces response time in some critical situations. Enhancing women safety and medical emergency handling. This can be integrated seamlessly with smart devices and urban infrastructure.

PROPOSED SOLUTION

JeevanDhara AI is an Artificial Intelligence and Emotional Intelligence system that continuously monitors user audio signals to detect distress patterns and trigger automated emergency actions.

Key Features includes:

1. Voice & Emotion Detection.
2. Detects emotions such as fear, panic, and stress using AI models.
3. Automatic Emergency Response.
4. Instantly contacts ambulance services and nearby hospitals.
5. SOS Alert System.
6. Sends alerts to police and trusted contacts along with live location.

7. Women Safety Detection.
8. Identifies distress situations even without explicit SOS triggers.
9. Location Intelligence
10. Identifies unsafe zones using clustering techniques and historical data.

This system ensures that even in situations where the victim cannot act, help is automatically initiated.

TECHNICAL APPROACH

Technologies Used

JeevanDhara AI leverages Artificial Intelligence and Machine Learning integrated with emotion recognition models, speech recognition systems, and Natural Language Processing (NLP) to detect distress situations in real time. The system captures audio continuously or through triggered inputs via smartphones or wearable devices, and processes it using advanced feature extraction techniques such as pitch, tone, frequency, and MFCC. The AI model then classifies emotional states like panic, fear, or stress, while NLP modules simultaneously detect distress-related keywords and phrases. A smart decision engine combines both emotional and linguistic signals to ensure high accuracy and reduce false positives. Once a critical situation is identified, the system automatically triggers emergency actions using APIs and cloud infrastructure (Firebase/AWS), including ambulance booking, police alerts, GPS-based location sharing, and SOS notifications to trusted contacts, ensuring a rapid and intelligent response in life-threatening scenarios.

FEASIBILITY AND VIABILITY

JeevanDhara AI is highly feasible as it leverages existing AI models, speech recognition systems, and readily available APIs, making practical implementation achievable within current technological capabilities. The system can be seamlessly integrated into smartphones, smartwatches, and IoT devices, while cloud platforms like Firebase or AWS enable real-time processing and scalability. However, challenges such as false positives in emotion detection, background noise interference, and privacy concerns must be addressed. To overcome these, the system employs multi-layer verification by combining emotion recognition with keyword detection, along with advanced noise filtering and audio preprocessing techniques to improve accuracy. Additionally, end-to-end encryption ensures secure data handling, while user consent-based activation and privacy controls maintain trust and compliance.

IMPACT AND BENEFITS

JeevanDhara AI creates significant social, economic, and technological impact by transforming emergency response systems into proactive and intelligent solutions. Socially, it enables faster emergency response, helping save lives while enhancing women's safety and overall personal security, thereby increasing public trust in smart safety technologies. Economically, it reduces damages caused by delayed responses and lowers healthcare costs by ensuring timely intervention, while also enabling efficient utilization of emergency resources. Technologically, the system contributes to the advancement of AI-driven safety solutions, lays the foundation for integration into smart city infrastructures, and promotes innovation in emotion-aware computing for real-world applications.

FUTURE SCOPE

The future scope of this project directly depends on properly integration with smart city surveillance systems with a wide expansion into health monitoring systems (like heart rate, fall detection, etc).

Moreover, this solution can also focus on the multilingual emotion detection models for wider accessibility with some proper Artificial Intelligence based predictive safety analytics system.

CONCLUSION

JeevanDhara AI represents a shift from reactive to proactive emergency response systems. By combining Artificial Intelligence, emotional intelligence, and real-time automation, it addresses critical gaps in current safety infrastructure. The system has the potential to save lives, enhance public safety, and contribute significantly to the development of smart and secure environments.

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AI-Driven Flood Management using NISAR Data

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OVERVIEW OF PROJECT

Mozambique, located in southeastern Africa, exhibits a diverse climate characterized by tropical coastal conditions and subtropical environments across its central plateaus. In recent years, the country has experienced a sequence of compounded climate shocks. A prolonged El Niño-induced drought during 2023–2024 significantly weakened household resilience, which was followed by extensive flooding in early 2026. This flood event was driven by intense local rainfall in southern Mozambique, compounded by transboundary river inflows originating from upstream catchments in South Africa, Zambia, and Zimbabwe.

This study presents a comprehensive assessment of the January 2026 flood event, leveraging newly available data from the NASA–ISRO Synthetic Aperture Radar (NISAR) mission, the first spaceborne dual-frequency (L- and S-band) SAR system designed for global Earth observation. The methodological framework integrates GPM IMERG precipitation estimates, in situ hydrological station observations, and NISAR L-band SAR data to characterize flood dynamics across the lower Limpopo Basin.

Flood inundation mapping was conducted using the Otsu thresholding algorithm applied to SAR backscatter data, with validation performed through Receiver Operating Characteristic (ROC) analysis. The model achieved an Area Under the Curve (AUC) of 0.823, indicating strong classification performance. Results demonstrate that NISAR L-band SAR data (approximately 24 cm wavelength) provide significantly enhanced capability for detecting flood signatures beneath vegetated canopies, particularly within the Chókwè irrigation scheme and along riparian corridors.

The analysis reveals that a total of 725.26 km² was inundated in Chókwè District, including 207.34 km² of cropland. This integrated multi-sensor framework offers a robust and replicable approach for flood monitoring in data-sparse, transboundary river basins. Furthermore, it highlights the transformative potential of NISAR in advancing operational disaster risk reduction and supporting global frameworks such as the Sendai Framework for Disaster Risk Reduction and the United Nations Sustainable Development Goals.

AI Powered Surveillance System: Reducing Manual Monitoring Labour

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INTRODUCTION

i. Brief overview of the project idea

In many organizations, manual CCTV monitoring is still the primary method for ensuring safety and security. Human operators are required to watch multiple video feeds simultaneously, which is both labour-intensive and prone to fatigue-related oversight. This can result in delayed detection of incidents such as unauthorized entry, theft, fire, or safety violations.

The proposed AI-powered surveillance system automates video analysis using computer vision and artificial intelligence, enabling real-time detection of suspicious activities, safety breaches, and emergencies.

ii. The need or motivation behind selecting the topic.

Manual monitoring requires a large workforce and is prone to human error. The need to reduce manpower costs and improve the efficiency of security systems motivated the selection of this topic. By using AI, we can ensure continuous, accurate monitoring and faster response times to security breaches.

iii. Relevance of the project in the current scenario.

With increasing urbanization and the expansion of surveillance networks, the amount of data generated has grown exponentially. Manual monitoring is no longer feasible at scale. AI-powered solutions are now being adopted globally, making this project highly relevant to present-day security and safety needs.

PROBLEM STATEMENT

iv. Clear articulation of the problem being addressed.

Traditional surveillance systems depend heavily on human operators to continuously monitor live video streams, leading to inefficiencies and missed incidents.

ANY EXISTING ISSUES OR CHALLENGES IN THE CURRENT SYSTEM.

- Fatigue and attention loss lead to missed events.
- High labour costs for 24/7 monitoring.
- Delayed response time to incidents.
- Difficulty in scaling monitoring operations.

OBJECTIVES OF THE PROJECT

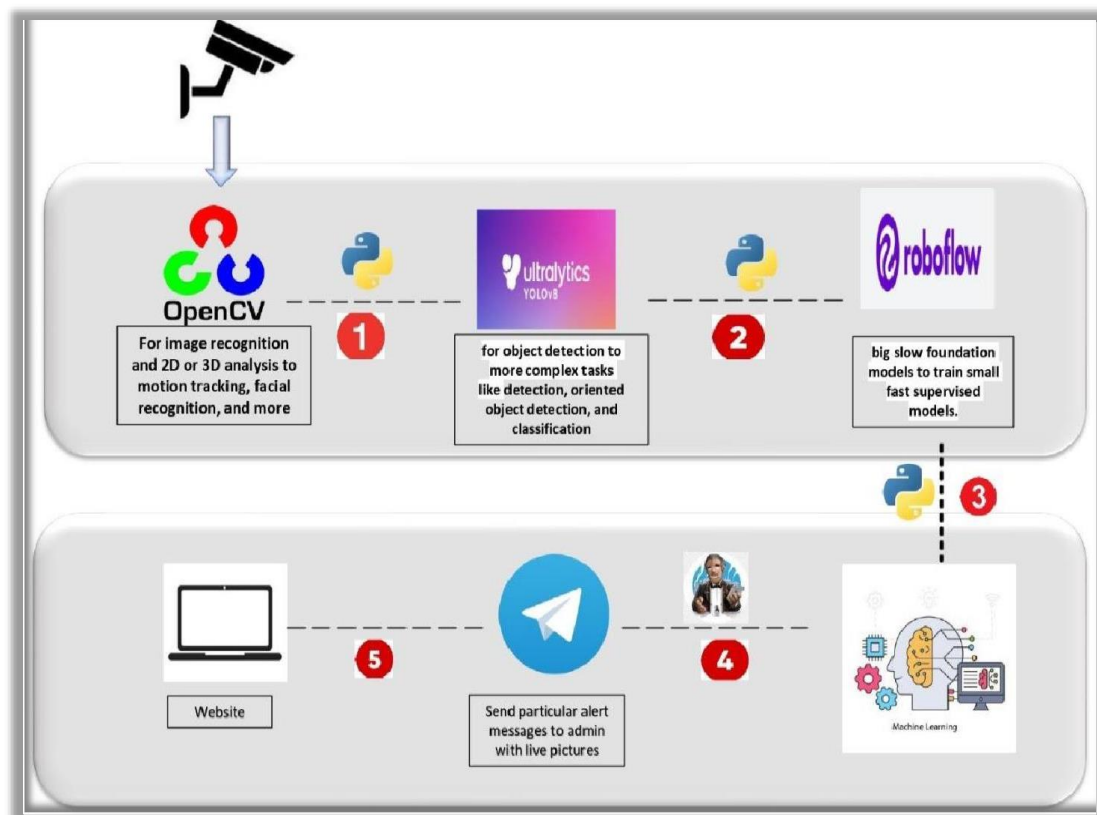
- Develop a real-time AI-based video analysis module capable of detecting suspicious activities and safety violations.
- Integrate multiple video feed processing for large-scale surveillance coverage.
- Implement instant alert mechanisms (email, SMS, or Telegram) to notify security teams.
- Store incident footage and metadata in a secure database for review and audit.
- Create a dashboard for security administrators to manage and analyze alerts.

SOFTWARE AND HARDWARE REQUIREMENTS

- Programming Language(s): Python, JavaScript
- Tools/Frameworks: OpenCV, TensorFlow/PyTorch, Flask/Express.js, React.js
- Operating System: MacOS/ Windows 10
- Database: MongoDB/MySQL
- Hardware: Surveillance Cameras

METHODOLOGY / PROPOSED SYSTEM

1. System architecture or workflow diagram:



2. What your project will deliver.

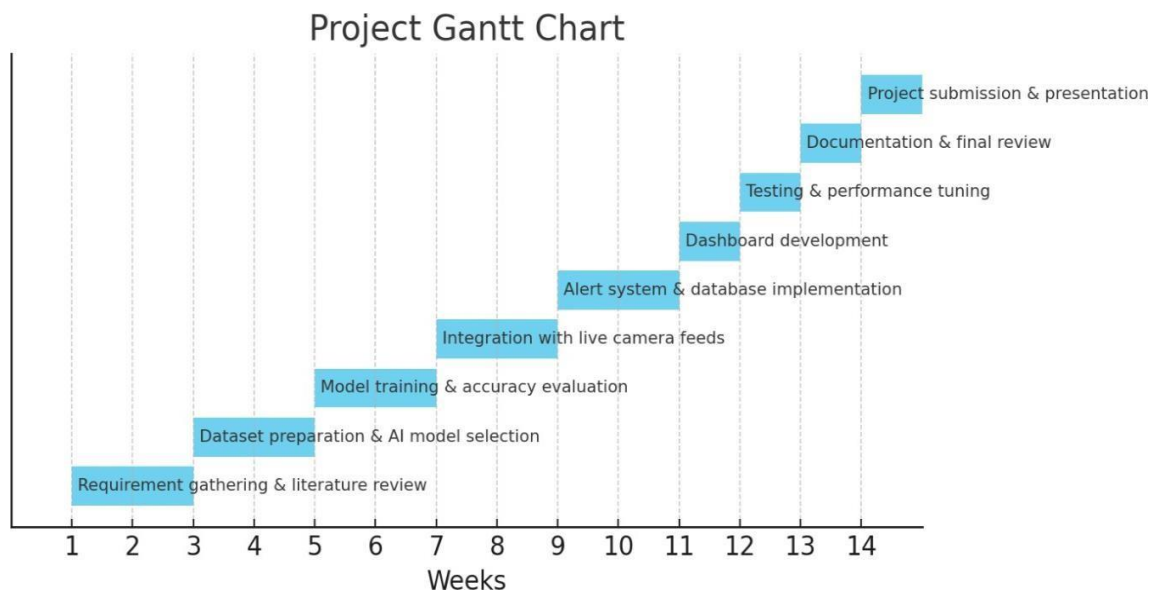
The system will deliver automated detection of suspicious activities, and fire hazards from live surveillance feeds with minimal false positives.

3. Benefits or contributions to users or society.

- Reduction in manual monitoring workload by over 60%.
- Faster response times to incidents.
- Improved workplace safety and security.
- Scalable to multiple cameras and large infrastructure.

WORK PLAN AND TIMELINE

Gantt chart or phase-wise timeline of tasks



Real-Time Deepfake Detection for Secure Online Interviews

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PROBLEM

The rapid evolution of AI-driven deepfake technology has compromised the integrity of remote hiring, enabling highly realistic identity theft and video manipulation. Current video conferencing platforms lack robust, real-time mechanisms to detect these sophisticated injections, leading to a rise in fraudulent candidate evaluations.

SOLUTION

We propose a Multi-Modal AI Integration engine that captures synchronized video and audio streams for millisecond-level analysis. The system utilizes a Spatial-Temporal Convolutional Neural Network (CNN)—specifically EfficientNet—to detect GAN-based swapping and texture anomalies in real-time.

CORE OBJECTIVES

1. Real-Time Detection & Authentication:

- Instant Analysis: Detects deepfake video and audio manipulations within milliseconds during live streams.
- Continuous Monitoring: Provide non-stop background verification throughout the entire interview session.
- Low-Latency Performance: Ensure a smooth user experience using lightweight CNN models and edge processing.

2. Multi-Modal Forensic Security:

- Synchronized Analysis: Capture and analyze both visual and auditory cues simultaneously to identify inconsistencies.
- Advanced Countermeasures: Eliminate sophisticated GAN-based face-swapping and virtual camera injection techniques.
- Explainable AI (XAI): Provide recruiters with clear reasons for flags, such as lip-sync errors or texture anomalies.

3. Institutional Integrity & Scale:

- Fair Evaluation: Protect the hiring process from impersonation and identity theft to ensure candidate fairness.
- Enterprise Integration: Offer a "Zero Friction" solution that embeds directly into existing browser-based conferencing tools.
- Scalable Governance: Utilize a cloud-native backend (FastAPI/Supabase) to handle high-volume recruitment needs.

BENEFITS TO THE COMMUNITY

- **Restores Hiring Integrity:** Ensures fair competition by preventing fraudulent candidates from displacing honest, qualified applicants.
- **Protects Digital Identity:** Reduces the risk of identity theft and impersonation in professional ecosystems.
- **Scalable Trust:** Provides a "zero-friction" security layer that works on standard webcams, making advanced protection accessible to everyone.
- **Educational Transparency:** Uses Explainable AI (XAI) to show users exactly why a deepfake was flagged, increasing community awareness of AI threats.
- **Future-Proof Governance:** Establishes a proactive defense against the 25% of job applications predicted to be fake by 2028.

PROJECT PLAN

Phase 1: Research & Data Refinement (Weeks 1-2)

- **Dataset Expansion:** Integrate high-resolution faces from GenImage and CIFAKE to improve detection of Midjourney and DALL-E 3 artifacts.
- **Preprocessing Pipeline:** Finalize the OpenCV and PyTorch scripts for automated face detection and frame extraction at variable rates.
- **Baseline Benchmarking:** Use the 90/10 data split to establish a reliable baseline for cross-entropy loss before further hyper-parameter tuning.

Phase 2: Core AI Model Development (Weeks 3-5)

- **Spatial-Temporal Training:** Train the EfficientNet video model to recognize temporal inconsistencies (flickering, unnatural blinking) across consecutive frames.
- **Multi-Modal Fusion:** Develop the logic to aggregate scores from both the Image Model and the Audio Analysis engine.
- **Explainable AI (XAI):** Implement a diagnostic layer that identifies specific "Detection Reasons" (e.g., texture anomalies or lip-sync errors) for the final report.

Phase 3: Backend & Integration (Weeks 6-8)

- **API Development:** Build the FastAPI backend to handle real-time inference requests from the web frontend.
- **Infrastructure Setup:** Configure Supabase for secure media storage and real-time logging of interview sessions.
- **Browser Extension:** Finalize the React-based browser extension that captures the webcam stream and provides the real-time overlay indicators.

Phase 4: Testing & Optimization (Weeks 9-10)

- **Latency Stress Test:** Optimize the "Decision Unit" to ensure the end-to-end processing happens within milliseconds for a smooth interview experience.

- Edge Case Validation: Test against "virtual camera" injections (like OBS) and high-quality deepfake streams to verify system robustness.

TECH STACKS

1. Frontend & User Interface:

- React: Used for building the main Website and dashboard for recruiters.
- Browser Extension: A specialized component to capture the Webcam feed and inject real-time detection overlays.

2. Machine Learning Backend (Python-based):

- FastAPI: The high-speed web framework used to handle real-time API requests between the frontend and the AI models.
- EfficientNet: The primary Video Model architecture used for feature extraction and identifying deepfake patterns.
- PyTorch: The deep learning framework used to build and train the neural network pipelines.
- OpenCV: Utilized in the Preprocess stage for real-time Face Detection and Frame Extraction.

3. Backend & Data Management:

- Node.js & Express: Powers the Web Backend, managing user authentication and routing.
- Supabase: Serves as the primary Storage for media files and Logging of detection results.

4. Deployment & Processing:

- Edge Processing: Implemented to ensure Low-Latency results within milliseconds during live interviews.
- Cloud Native Design: Ensures the system is Scale-Ready and can integrate with government or enterprise APIs.

DELIVERABLES

- Real-Time Detection Engine: A trained EfficientNet model optimized to distinguish real faces from GAN-based deepfakes in milliseconds.
- Multi-Modal Analysis Pipeline: A system that processes synchronized video and audio streams to identify spatial-temporal inconsistencies.
- FastAPI Inference Module: A high-performance backend providing real-time "Deepfake Scoring" and immediate alerting.
- Software Interfaces: A React-based dashboard for recruiters and a browser extension for live webcam stream capture and overlay indicators.
- Explainable AI (XAI) Module: A diagnostic tool that provides clear reasons for detection, such as lip-sync errors or texture anomalies.
- Secure Data Infrastructure: A Supabase integrated backend for media logging, session history, and continuous background verification.

- **Verifiable Credentials:** A system to authenticate candidate identity and provide tamper-proof interview integrity data.

ACKNOWLEDGEMENT

We express our sincere gratitude to Dr. B. C. Roy Engineering College, Durgapur, for providing the academic environment and infrastructure necessary to develop this project. We are also thankful to our Mentor for their invaluable guidance in navigating the complexities of AI and Cybersecurity Governance.

Special thanks to the open-source community and platforms like Kaggle, Hugging Face, and GitHub for providing the datasets and research repositories that formed the foundation of our model training. We also acknowledge **AI UTKARSH 2026- AI SUMMIT HACK-O-NIT** for providing this platform to showcase our innovation and contribute to the integrity of digital recruitment systems.

Finally, we appreciate the efforts of Team PseudoNoma for their dedicated collaboration in building a solution to secure the future of online interviews.

EduGraphix AI: AI-Powered Student Analytics Dashboard

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PROBLEM STATEMENT

In modern education systems, a large amount of student data is generated daily, including attendance, exam scores, assignments, and engagement records. Although this data is valuable, it is not used effectively due to lack of proper tools and technical knowledge.

From a teacher's perspective, analyzing this data is difficult. Most systems require knowledge of tools like SQL or complex dashboards. Teachers often rely on manual spreadsheets or technical teams to extract insights. This process is slow, inefficient, and delays important decisions such as identifying weak students or understanding class performance.

From a student's perspective, the problem is different but equally important. Students usually receive marks or grades but do not get detailed feedback. They are often unaware of:

- Which topics they are weak in
- Why their performance is low
- How they can improve

This lack of personalized guidance reduces their ability to improve effectively.

Additionally, students at an early stage often face confusion while selecting their academic streams or subjects. Due to the absence of clear performance insights and skill analysis, they may choose fields that do not align with their strengths and interests. This can affect their future career direction and growth.

Overall, there is a clear gap between data availability and meaningful usage. Both teachers and students need a simple way to understand and use this data for better learning outcomes.

OBJECTIVE

The main objective of **EduGraphix AI** is to make student data analysis simple, accessible, and useful for both teachers and students by using natural language and AI-driven insights.

For Teachers

- Enable teachers to interact with data using natural language (simple English)
- Automatically convert queries into data analysis without requiring coding or SQL
- Generate interactive dashboards instantly for better visualization
- Help identify weak students and provide clear insights and explanations to understand class performance
- Support faster, data-driven decision-making in teaching

For Students

- Help students understand their strengths and weaknesses through personalized insights

- Identify weak topics and specific areas that need improvement
- Provide clear and actionable suggestions to improve performance
- Encourage self-learning and independent progress
- Help students make informed decisions while selecting their academic streams or subjects
- Support students in choosing the right career path based on their performance, skills, and interests

The overall goal is to enable data-driven education without requiring technical expertise, while empowering both teachers and students to make better academic and career decisions.

PROPOSED SOLUTION

EduGraphix AI is an AI-powered platform that acts as an intelligent assistant for analyzing student data. It enables both teachers and students to ask questions in simple English and receive instant dashboards, insights, and personalized recommendations.

For example:

- **Teacher:** “Show weak students in Mathematics.”
- **Student:** “Which topics should I improve?”

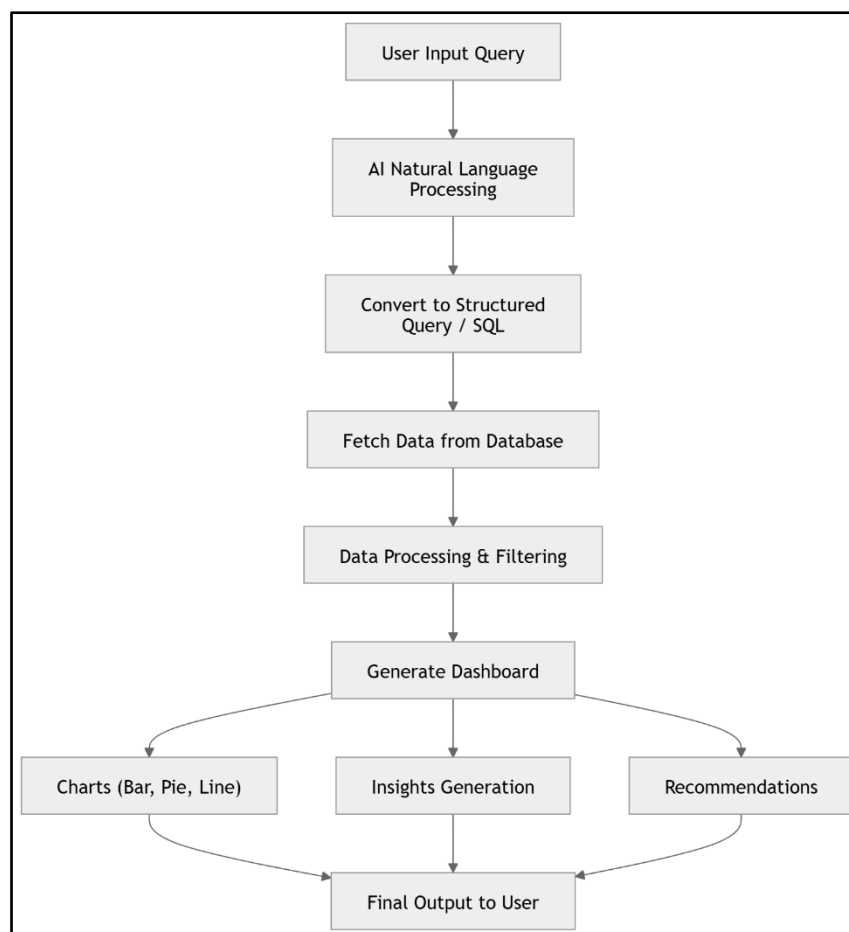


Fig1. Flowchart of the System

The system processes these queries through the following steps:

1. **Natural Language Understanding:** The system uses AI to understand the user's query and identify key details such as subject, conditions, and performance criteria.
2. **Query Conversion:** The query is automatically converted into a structured database query without requiring any coding.
3. **Data Retrieval:** Relevant data is fetched from the database based on the generated query.
4. **Dashboard Generation:** The system creates appropriate visualizations such as:
 - Bar charts (marks comparison)
 - Pie charts (attendance distribution)
 - Line charts (progress trends)
5. **Insight Generation (Smart Insights):** Unlike traditional dashboards, the system not only displays data but also explains it in simple language by:
 - Identifying trends
 - Highlighting patterns
 - Showing relationships (e.g., attendance vs marks)
6. **Skill Gap Detection:** The system breaks subjects into smaller topics (such as Arrays, Trees, Graphs) and identifies exactly where students are struggling, enabling more precise learning support.
7. **Recommendation System:** Based on the analysis, the platform provides actionable and personalized suggestions such as:
 - Topics to revise
 - Practice strategies
 - Focus areas for improvement



Fig2. Format of the Output

TECHNICAL APPROACH

- **Frontend:** React.js for building an interactive user interface
- **Backend:** Flask (Python) for handling APIs and logic
- **Database:** PostgreSQL or JSON for storing student data
- **AI/NLP Layer:** Large Language Models for understanding queries and generating responses
- **Visualization:** Recharts or Chart.js for dashboards

Methodology and Process for Implementation

1. **Data Preparation:** Create a dataset containing student details, marks, attendance, and topics
2. **Backend Development**
 - Build APIs to handle user queries
 - Connect with AI model
3. **AI Integration**
 - Convert natural language queries into structured queries
 - Generate insights and suggestions
4. **Data Processing:** Fetch and filter relevant data
5. **Visualization:** Generate charts dynamically
6. **Frontend Development:** Create input interface and dashboard display
7. **Testing:** Test different queries and outputs

FEASIBILITY AND VIABILITY

Analysis of Feasibility

The project is highly feasible because:

- AI models are easily available via APIs
- Educational data is already structured
- Technologies used are widely supported

The system can be developed quickly as a working prototype.

Potential Challenges and Risks

1. **Query Ambiguity:** Users may ask unclear questions
2. **AI Accuracy:** Incorrect interpretation may give wrong results
3. **Data Privacy:** Student data is sensitive

Strategies for Overcoming Challenges

- Use structured prompts to improve AI accuracy
- Implement clarification for unclear queries
- Apply role-based access control for data security
- Use clean and well-structured datasets

IMPACT AND BENEFITS

EduGraphix AI will significantly improve how both teachers and students interact with academic data by making it simple, fast, and meaningful.

- 1. Time Efficiency:** **EduGraphix AI** reduces the time required for data analysis from hours or even days to just a few seconds. Teachers no longer need to manually analyze spreadsheets or depend on technical teams, allowing them to focus more on teaching.
- 2. Better Learning Outcomes:** By identifying weak students and specific problem areas early, the system enables timely intervention. This helps improve overall student performance and ensures that learning gaps are addressed before they become major issues.
- 3. Accessibility:** The platform is designed for non-technical users. Teachers and students can use simple English queries instead of complex tools, making data analysis accessible to everyone.
- 4. Personalized Learning:** Each student receives customized insights based on their own performance. This allows them to focus on their weak areas and improve at their own pace, leading to more effective learning.
- 5. Data-Driven Decisions:** **EduGraphix AI** promotes smarter decision-making by providing clear insights and explanations. Teachers can adjust their teaching strategies, and students can plan their studies based on actual data rather than assumptions.
- 6. Career & Stream Guidance:** The system helps students understand their strengths and choose the right academic stream or subjects. This ensures better career direction and reduces confusion in important decision-making stages.
- 7. Scalability:** The solution can be easily expanded and used across schools, colleges, and even online learning platforms, making it suitable for large-scale implementation.

CONCLUSION

EduGraphix AI is a powerful and practical solution that bridges the gap between raw data and meaningful decision-making in education. By combining artificial intelligence, interactive dashboards, and natural language processing, it transforms complex data into simple, understandable insights.

The platform not only helps teachers analyze class performance and make faster decisions but also empowers students to take control of their own learning journey. With features like personalized insights, skill gap detection, and career guidance, students can clearly understand where they stand and how to improve.

By supporting both teachers and students, **EduGraphix AI** creates a more efficient, data-driven, and personalized education system. It has the potential to improve learning outcomes, guide students toward the right career paths, and make education smarter and more impactful.

MindfulAI: Real-Time Mental Health Chatbot with Emotion

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OVERVIEW OF THE PROJECT

The rising prevalence of emotional distress, academic burnout, and severe anxiety among youth and students has highlighted a critical gap in accessible mental healthcare. While professional therapy is invaluable, the immediate moments of crisis—such as a pre-exam panic attack or sudden depressive episodes—often occur when professional help is unreachable. To address this, we present 'MindfulAI,' a highly responsive, browser-based artificial intelligence companion engineered to provide immediate, empathetic, and evidence-based mental health interventions. MindfulAI operates not just as a chatbot, but as an active emotional sensor that dynamically reshapes its environment to support the user's current mental state.

At the core of the project is a sophisticated Conversational AI engine powered by a Large Language Model (Llama-3.1 via the Groq API), which is specifically prompt-engineered to emulate a psychologically safe, supportive, and non-judgmental companion named 'Mira.' Unlike standard generative AI, Mira's pipeline is reinforced with a proprietary, client-side 'Emotion Detection Engine.' This engine performs real-time heuristic sentiment analysis on the user's text to categorize their dominant emotional state into specific vectors, such as Stress, Anxiety, Sadness, Burnout, or Anger.

Furthermore, the system introduces a unique 'Typing Stress Detector' which tracks the user's Words-Per-Minute (WPM) cadence. If erratic or hyper-accelerated typing is detected—a common physiological symptom of a panic attack—the interface visually intervenes, gently prompting the user to pause and breathe. To provide holistic stabilization, MindfulAI integrates an automated 'Real-Time Music Therapy' module. Upon detecting a shift in the user's emotional state, the system dynamically curates and embeds specific therapeutic audio playlists continuously fetched via YouTube's iframe API. For instance, if severe stress is detected, the system auto-populates 'Focus Lo-Fi' tracks; for sadness, it queues 'Uplifting Acoustics.'

Recognizing the severe toll of academic pressure, a dedicated 'Student Wellness Hub' is integrated directly into the platform. This module features a localized Burnout Self-Assessment questionnaire algorithmically designed to identify early symptoms of academic exhaustion. Furthermore, to aid in cognitive load management, the hub includes a built-in Pomodoro study timer and interactive study-break intervention guides.

Safety and early crisis intervention are the highest priorities of MindfulAI. The platform features an instantly accessible 'Panic Mode' override. At the click of a button, the standard interface is replaced with an emergency grounding overlay. This includes a pulsing visual ring for guided breathing

AI FIRE INTELLIGENCE DRONE "UNDERSTAND FIRE BEFORE FIGHTING IT"

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PROBLEM STATEMENT

In fire emergencies, firefighters often enter hazardous environments without real-time information about fire origin, spread, gas presence, or trapped victims. This lack of awareness increases risk, delays decisions, and slows critical information detection in unknown environments, leading to loss of lives. Toxic gases such as carbon monoxide (CO) and carbon dioxide (CO₂) are undetectable to human senses, making the environment even more dangerous. Additionally, locating trapped individuals becomes extremely difficult, resulting in delayed rescue operations.

PROPOSED SOLUTION

We propose an AI-powered autonomous **Fire Intelligence Drone** designed to provide complete real-time information before firefighters enter the danger zone. The drone is capable of detecting fire origin, analyzing spread patterns, identifying harmful gases, and locating trapped humans or animals. It also supports early-stage fire suppression by automatically deploying fire-suppressant chemical balls directly at the fire source, helping control the situation in minimum time.

OBJECTIVES

- Enhance firefighter safety through real-time intelligence
- Reduce response time during fire emergencies
- Accurately detect fire origin and spread
- Identify toxic gases before human entry
- Locate trapped victims efficiently
- Assist in early fire suppression

METHODOLOGY / WORKING

The system operates autonomously and performs the following steps:

- The drone is deployed into the affected area

- It scans the surroundings using thermal and RGB cameras
- Gas sensors detect CO, CO₂, smoke, and temperature levels
- AI algorithms process the data in real-time using edge computing
- Fire origin and spread direction are identified
- Trapped humans and animals are detected via thermal imaging
- Live data is transmitted to the command center
- Fire-suppressant chemical balls are automatically deployed at the detected fire source for immediate suppression.

TECH STACK

- Artificial Intelligence & Machine Learning
- Computer Vision
- Edge AI Processing
- Embedded Systems (STM32 / Raspberry Pi)
- Thermal + RGB Camera System
- Gas Sensors (CO, CO₂, Smoke, Temperature)

EXPECTED OUTCOME

- Increased safety for firefighters
- Faster and more efficient rescue operations
- Reduction in casualties and damage
- Real-time decision-making support
- Improved fire management system

INNOVATION / UNIQUENESS

This system goes beyond traditional firefighting methods by providing complete real-time fire intelligence before human intervention. The integration of AI, thermal imaging, gas detection, and autonomous suppression into a single drone makes it a highly innovative and life-saving solution.

FUTURE SCOPE

- Integration with smart city emergency systems
- Deployment of multiple drones for large-scale incidents
- AI-based fire prediction and risk analysis
- Advanced automation in disaster management

AI-POWERED THREAT INTELLIGENCE DASHBOARD WITH CONTENT SHIELD BROWSER

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PROBLEM STATEMENT AND OBJECTIVES

Due to the proliferation of unsafe websites detrimental to children, as well as phishing and malware attacks that continue to increase, the modern digital environment is running wild with sophisticated threats. Instead of having a clue about whether or not to worry about a URL or an incoming message, most users have no real time awareness of threats as they move around the internet. In addition, parents too often lack effective tools to monitor or control browsing activity, resulting in a wide vacuum in digital oversight and child safety. The main aim of this project is to close that gap by developing an AI-based Cyber Threat Detection Dashboard along with a "Content Shield" Browser. The method implements the threat detection and classification mechanism as a binary classification: first classifying an URL as either Threatening or Non-threatening, and subsequently categorizing Threatening URLs as one of the following three classes: Safe, Suspicious or Malicious. Through a detailed Risk Score and a rationale for each detection, the project intends to suggest actions that will allow the users to take their own informed decisions on security.

PROPOSED SOLUTION AND INNOVATION

The proposed solution is twofold: a native content shield browser, and an AI-based threat detection dashboard. Features include full URL and IP scanning, live risk scores, and AI-powered content filtering to keep things safe for all ages. To improve parental controls, the platform adds "Trust Zones" and a usage analytics dashboard that gives a look at browsing behavior. What distinguishes this project from other solutions is that it is a browser with a separate AI security dashboard (that is still in the design phase) focused on child-centric cybersecurity – a very underserved niche at this point in time. Also, use of "Explainable AI" (XAI) means users are not just told a site is harmful, but are informed technically why it was detected, such as domain age or suspicious certificate patterns. This is augmented by time-based parental controls, to moderate digital intake and safeguard against screen addiction.

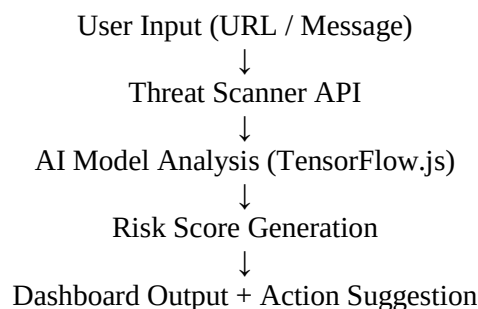


Fig.1: System Architecture

TECHNICAL APPROACH

Our technology architecture is based on a state-of-the-art scalable stack to deliver high performance and data consistency. React.js and Tailwind CSS are used in the frontend for a responsive user interface, and Node.js with Express.js is used in the backend to manage API requests and user handling. The core intelligence TensorFlow.js is used to run AI and ML models directly in the browser, with a database infrastructure using Firebase for real-time updates or MongoDB for storing structured data. Security measures such as the application of Google's Safe Browsing API and the encrypting of sensitive information using the industry standard AES Encryption.

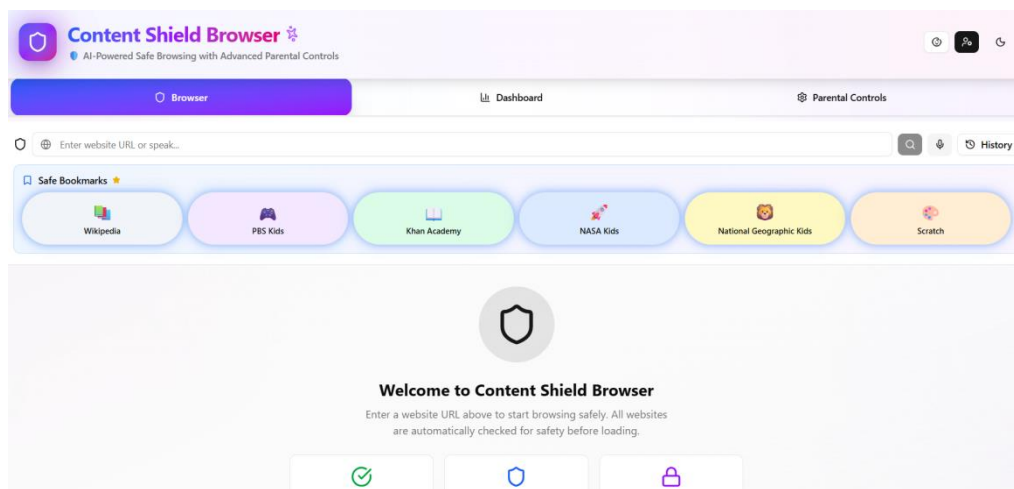


Fig.2: Dashboard Interface

FEASIBILITY, CHALLENGES, AND IMPACT

The project's viability is based on already existing technologies and lightweight AI models which enable the deployment on the browser, without the need for massive resources on the server side. Although challenges, including false positive threat detections and performance overheads in real-time, exist, they are alleviated through continuous tuning of the models and optimized API calls. Data security is a major concern and all user data are protected by strong AES encryption to prevent access. This project has a multi-fold impact: Social Impact: Creates awareness about digital safety among young users and reassuring parents.

- * Economic impact: Contributes to the protection of consumers' money from cyber crime and fraudulent use of identities.
- * Educational impact: Gives students a safe and controlled environment in which to surf the web.
- * Technical impact: Decreases cumulative phishing and malware exposure risk for users.

RESEARCH FOUNDATIONS AND REFERENCES

The investigation is based on OWASP Web Security Guidelines, Google Safe Browsing documentation, and official TensorFlow.js documentation. In addition, this work is inspired from the scientific papers relating to AI phishing detection, threat analysis in real time, and the psychological effect of digital safety in children. With these references, the "Error 405 Found" knows it is working with cutting-edge technology in the world of cyber security.

CONCLUSION

To sum up, the AI-Powered Threat Intelligence Dashboard together with the Content Shield Browser is an evolutionary step forward in individualized cybersecurity. Bringing real-time AI analysis to a simple interface in the browser, the "Error 405 Found" developers have created a solution that meets the strong demand for protecting children with proactive safety and threat knowledge. The project strikes a nice balance between enterprise-grade security such as AES encryption and TensorFlow.js modelling with user-friendly parental controls and "Trust Zones". In the end, this approach doesn't simply shield users from harm; it educates them with explainable AI, helping breed a more resilient and knowledgeable generation of digital users. With the continuous changes in the Internet, the tools that will provide light detection at a time and behavioral-oriented analysis will be critically needed to create an enjoyable, safe, and secure Internet environment for students, parents, and teachers.

OutreachX: An Agentic AI-Based Multi-Channel Campaign Automation Platform

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OVERVIEW OF THE PROJECT

OutreachX — Intelligent Campaign Automation, Reimagined

Businesses today operate across a fragmented communication landscape. Emails go out from one tool, WhatsApp messages from another, phone calls from a third — each platform siloed, each requiring its own setup and manual effort. The result is outreach that's slow, inconsistent, and rarely personalized at scale. Marketing teams spend more time managing tools than actually connecting with customers.

OutreachX was built to change that.

OutreachX is an agentic AI-driven campaign automation platform that brings every channel — messaging, voice, and email — into a single intelligent system. It doesn't just centralize communication; it makes that communication smarter, faster, and genuinely adaptive. By combining structured campaign workflows with advanced AI, real-time conversation handling, and deep analytics, OutreachX transforms outreach from a manual grind into an automated, continuously improving engine.

The Problem

The core challenge isn't that businesses lack tools — it's that they have too many, and none of them talk to each other. Personalization is manual and inconsistent. Most automation tools follow rigid scripts that break the moment a customer says something unexpected. Traditional chatbots fail at nuance. IVR phone systems frustrate users. And analytics rarely reveal what customers actually said or felt — just whether a message was delivered.

What's missing is a unified platform with real intelligence at its core.

How OutreachX Works

At its foundation, OutreachX is built around a guided six-step campaign builder. Teams define campaign parameters, select channels, configure messaging assets, and launch — all from one interface. No juggling between platforms, no disconnected dashboards.

But the workflow is just the surface. The real power lies underneath.

AI-Generated Content Every campaign is backed by AI that writes and refines messages based on tone, audience, and goals — not static templates. Whether targeting cold prospects or returning customers, the AI adapts the copy accordingly. This extends to voice as well: OutreachX uses text-to-speech generation to produce natural, branded audio messages without a recording studio or voice actor.

RAG-Powered Knowledge Integration Businesses can upload documents — FAQs, product manuals, pricing sheets, pitch decks — and OutreachX indexes that content into a live knowledge base using Retrieval-Augmented Generation (RAG). Every AI response, across every channel, can draw from this knowledge base to deliver accurate, context-aware answers grounded in your actual content — not hallucinated approximations.

Agentic Phone Calls OutreachX can initiate and conduct real AI-powered phone calls. Unlike automated systems that play recordings or navigate users through numbered menus, the platform deploys an AI agent capable of genuine multi-turn conversation. It listens, interprets intent, retrieves relevant information, and responds naturally — adapting to wherever the conversation goes. For lead qualification, customer surveys, appointment reminders, or feedback collection, this replaces hours of manual calling with intelligent, scalable automation that still feels human.

Live WhatsApp Handling When customers reply via WhatsApp, OutreachX doesn't just log the message — it responds. Drawing on conversation history, campaign context, and the knowledge base, the system generates intelligent replies in real time. The moment a customer engages, the platform engages back — closing the gap that most automation tools leave wide open.

Analytics That Go Deeper

Most platforms stop at open rates and delivery counts. OutreachX goes further. The analytics dashboard provides real-time tracking across all channels — delivery status, engagement rates, call outcomes — but also surfaces direct visibility into actual customer conversations.

This creates a genuine feedback loop. Teams can read through exchanges, spot recurring objections, identify what's resonating, and use those insights to refine content, adjust targeting, or update the knowledge base. The system doesn't just report on what happened — it gives you the raw material to understand it and improve.

Why It Matters

The efficiency gains are significant: smaller teams can manage larger campaigns, AI handles content and responses automatically, and iteration cycles shrink from months to days. But the deeper value is in what better outreach enables.

Faster, more personalized communication improves customer experience. People receive messages relevant to them, get questions answered immediately, and interact with a system that treats them as individuals. For startups validating a product or enterprises running large-scale campaigns, OutreachX

offers something especially valuable: a way to reach real users, gather real feedback, and rapidly refine an offering based on what the market actually says.

Built to Scale

OutreachX runs on production-grade infrastructure — cloud databases, communication APIs, and advanced AI models — designed to scale horizontally as campaign volume grows. Data privacy and security are built into the architecture, not bolted on. API cost optimization and efficient resource management ensure the platform remains viable at scale.

OutreachX isn't just automation — it's agentic AI applied to one of the most critical functions in any business. A unified platform that initiates contact, holds real conversations, learns from every interaction, and makes every campaign smarter than the last



Fig. 1: Landing Page

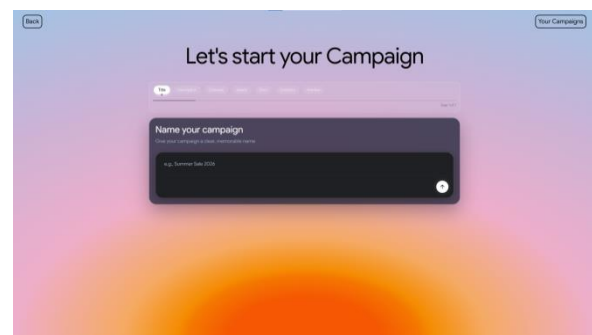


Fig. 2: Campaign creation page

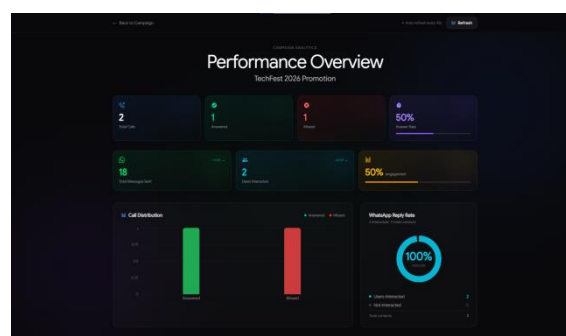


Fig. 3: Realtime Analytics Dashboard

RecallCast - AI Object Memory Glasses

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ABSTRACT

Existing smart glasses for memory augmentation suffer from high costs, severe battery drain, and thermal throttling caused by continuous on-board video processing. To address this, we propose RecallCast, a low-power, cost-effective wearable memory assistant that utilizes a "thin client" architecture to bypass traditional hardware constraints. An ESP32-CAM mounted on the glasses silently captures periodic images and immediately relays them wirelessly to a tethered host device, performing zero on-board processing.

The host device receives the images. Frames are then analyzed using the Gemma-3-27B vision model, which is guided by strict prompts to perform Optical Character Recognition (OCR), identify objects, and generate concise contextual summaries strictly in JSON format. These summaries are chronologically logged in a MongoDB database and converted into dense vector embeddings stored in a Pinecone vector database. Finally, users interact with their visual history through a conversational interface. This enables users to effortlessly query their memory log in natural language to retrieve the exact timestamp and location of forgotten items or past events.

Introduction

The evolution of augmented reality (AR) has reached a critical strategic inflection point, transitioning from a staple of speculative fiction into a tangible "cognitive prosthetic." Historically, the human brain has been tethered to biological limitations like forgetting names, misplacing objects, or losing the context of past events. The emergence of "context-aware" smart glasses serves as a bridge, enabling a "second brain" architecture that supplements human recall with digital precision. By superimposing semantic layers directly onto the user's field of vision, these devices transform the physical environment into a living, searchable database, effectively offloading the mental burden of data retention to high-performance wearable hardware.

Developing a wearable that "sees" requires managing a fundamental tension: the high-resolution requirements of recognition tasks versus the rigid thermal envelope and battery constraints of mobile hardware. Constant video streaming leads to rapid thermal throttling, making persistent assistance impractical. Therefore, the strategic architecture of these devices relies on an "Asymmetric Resolution Requirement." While scene understanding and recognizing a room's layout or general objects, tolerates coarse, low-resolution features (3MP), Optical Character Recognition (OCR) is highly sensitive to detail. Accuracy benchmarks show a precipitous drop from 89% at 12MP to under 20% at 3MP, necessitating a hybrid capture strategy.

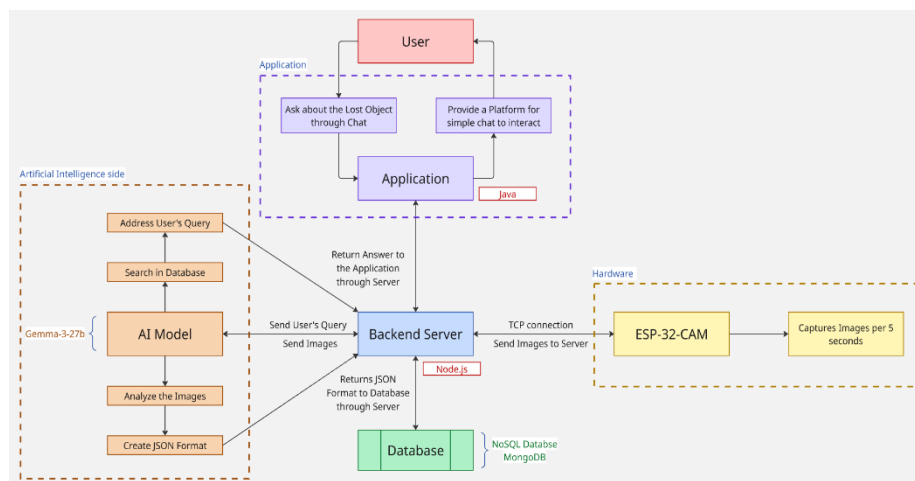
Technology Stack

The AI-based smart glasses system includes an ESP32-CAM module for image acquisition, an image processing server for extraction and retrieval, and an AI assistant for interaction. The system is designed using a microservice architecture, where embedding, retrieval, and recognition tasks are independently assigned into proxies.

1. **ESP32-CAM:** This is the lightweight hardware device mounted on the smart glasses. Acting strictly as a "thin client," it **captures images at set intervals** and immediately transmits them wirelessly via Wi-Fi or Bluetooth. To conserve battery life and prevent thermal throttling, it performs zero heavy on-board processing.
2. **The Server:** Hosted on the backend central hub, this serves as the central system built using **Node.js and Express**. It receives the incoming image streams via HTTP POST requests.

Gemma-3-27B: Serving as the primary artificial intelligence engine, this model processes frames. Using strict system

3. prompts, it performs **Optical Character Recognition (OCR)**, identifies objects, and generates a contextual one-sentence summary of the scene. It is forced to output this analysis **strictly in JSON format**. Using Gemma-3-27B ensures to process a continuous, high volume of images without hitting the restrictive rate limits of cloud-based APIs.
4. **Database:** A NoSQL storage solution like **MongoDB** acts as the system's long-term memory. It continuously stores the AI-generated JSON summaries alongside their respective timestamps and GPS coordinates, creating a **chronological and searchable "memory log"**.



Features & Innovation

1. Features:

- **100% Passive Context Capture:** Users never have to press a button, take a note, or say "record." The wearable autonomously captures their visual surroundings at regular intervals, acting as a seamless background assistant that does not interrupt their workflow.
- **Natural Language Memory Retrieval (RAG):** Instead of manually scrolling through a gallery of thousands of photos, users query their own life using conversational language. By passing the chronological JSON logs into the LLM as context, the system can answer highly specific queries like, *"Where did I put my reading glasses around 10:00 AM?"*
- **Cross-Contextual Summarization:** Because the AI analyzes images in batches, it doesn't just identify static objects but understands *actions* over time. It can summarize a 15-minute block of time as *"The user was reading a book and drinking coffee,"* rather than just logging *"book, cup, desk."*

2. Innovations:

- **Asynchronous Visual Batch Processing:** To overcome the severe power constraints of the ESP32-CAM and prevent API rate-limiting, the system employs an intelligent queuing mechanism. Instead of analyzing every frame individually, it buffers images on the backend and processes them in chronological batches. This drastically reduces cloud compute costs and latency.
- **"Thin Client" Hardware Architecture:** By offloading 100% of the processing to a local hub, your system avoids the severe battery drain and thermal throttling that typically plague edge-vision wearables. This extreme cost-efficiency allows you to build the hardware for a fraction of the cost of commercial AR glasses.

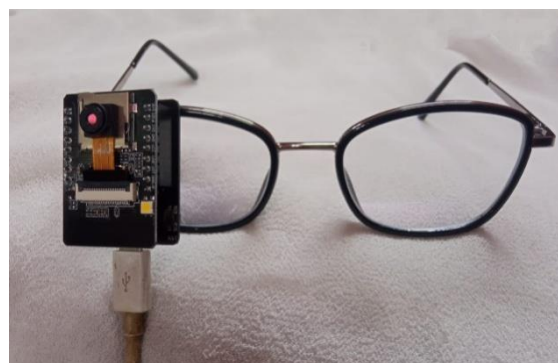


Fig 2: Wearable Hardware Prototype of the Recall Cast System

APPLICATIONS

RecallCast is fundamentally designed as a non-invasive, assistive cognitive wearable. By acting as an infallible, secondary working memory, the system addresses critical challenges in outpatient care, geriatric support, and neurodivergent accessibility.

1. **Support for Early-Stage Dementia & Alzheimer's:** For patients experiencing early cognitive decline, maintaining independence is the primary goal of care. RecallCast allows patients to navigate their daily lives with reduced anxiety. Instead of relying on flawed organic memory or complex smartphone interfaces, a patient can simply ask about lost objects. The AI retrieves the exact chronological context, preventing missed doses and reducing confusion.
2. **Accessibility for Neurodivergent Individuals (ADHD/Executive Dysfunction):** Individuals with ADHD frequently struggle with working memory deficits and object permanence. RecallCast offloads this cognitive burden. By passively logging the environment, it acts as a searchable index for the physical world, drastically reducing daily friction and cognitive fatigue.
3. **Objective Data for Clinical Decision Support:** Currently, neurologists and therapists rely on "patient self-reporting" to gauge how well someone is managing at home, data that is inherently unreliable when the patient has a memory disorder. With the patient's consent, RecallCast's chronological JSON logs can provide doctors with an objective, text-based timeline of daily living activities, dietary habits, and medication adherence to better inform treatment plans.

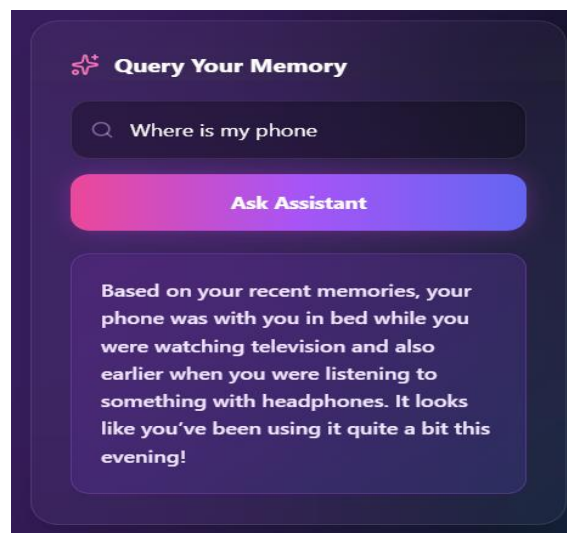


Fig 3: Preview of AI-Assisted Object Localization via Chat Interface, demonstrating RAG pipeline.

Future Scope

- **Edge AI & On-Device Processing (NPU Integration):** Currently, the system relies on a local network server or cloud API to process the vision models. The next immediate iteration will leverage modern smartphone Neural Processing Units (NPUs) via a mobile companion app. By running quantized vision models directly on the user's smartphone hardware, we can achieve 100% offline, zero-latency memory processing without needing a dedicated Node.js server.
- **Custom PCB & Frame Integration:** The ESP32-CAM development board, while excellent for prototyping, will be replaced with a custom-designed Printed Circuit Board (PCB). This will allow us to move away from external power banks and integrate a micro-LiPo battery management system directly into the arms of the glasses, utilizing flex-cables to maintain a standard, lightweight eyewear form factor.

- **Proactive Contextual Alerts:** Rather than acting purely as a reactive search engine, the AI pipeline will be upgraded to recognize critical anomalies in real-time. For example, if a patient with memory deficits leaves the house but the camera recognizes the stove is still on, the system can proactively push an alert to their phone or audio feed before a crisis occurs.

Limitations

While RecallCast successfully demonstrates a novel chronological memory agent, the current hardware prototype operates with specific physical and network constraints. The reliance on the ESP32-CAM module necessitates an external Wi-Fi connection tethering the device to a secondary network for continuous data transmission. Furthermore, the high current draw required during periodic image uploads necessitates an external power bank, preventing a truly wireless, self-contained eyewear form factor in this iteration. Finally, because the heavy multimodal processing is offloaded to a Node.js server and external Large Language Models, the system requires an uninterrupted internet connection, temporarily limiting its utility in network dead zones or entirely offline environments.

Conclusion

RecallCast represents a vital step forward in ethical, wearable assistive technology. By replacing invasive spatial tracking with a secure, time-based visual memory pipeline, the system successfully bridges the gap between extreme hardware constraints and state-of-the-art multimodal AI. Ultimately, this project proves that continuous, passive cognitive support can be achieved efficiently and affordably. By offering users a reliable, privacy-first extension of their own working memory, RecallCast empowers individuals to navigate their daily lives with greater confidence, autonomy, and peace of mind.

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TokiFy: A Web3-powered platform for instant, low-cost, and borderless global payments

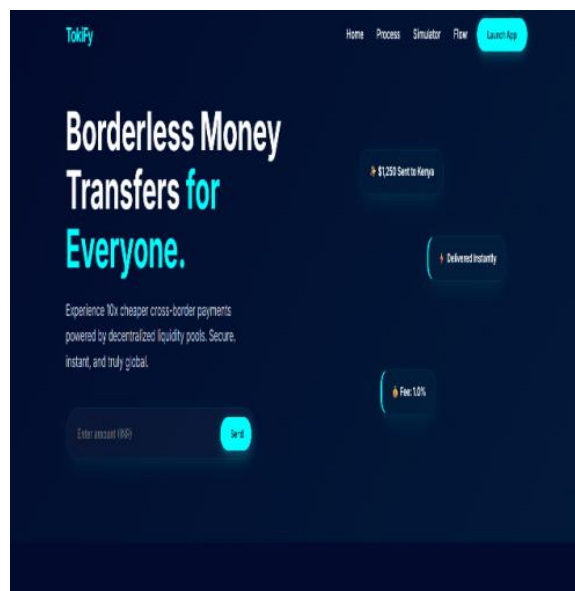
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Project Synopsis: Tokify Financial Ecosystem

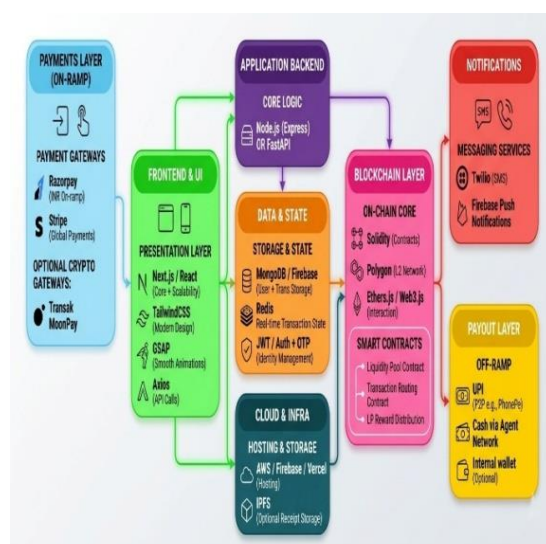
Traditional cross-border remittances are currently hindered by aging infrastructure, resulting in high transaction fees averaging 8%, significant settlement delays, and a lack of transparency. Tokify is a



Web3-powered financial platform designed to disrupt this model by leveraging decentralized ledger technology and stablecoins to facilitate instant, low-cost, and borderless payments. By removing intermediary banks, Tokify ensures that more capital reaches its destination securely. The platform addresses the "unbanked" population's needs by replacing opaque processes with a transparent, blockchain-based protocol that provides verifiable real-time transactions.

The proposed solution utilizes a decentralized liquidity pool model on the Polygon network to bridge digital assets and physical cash. Users convert local fiat into stablecoins, which are routed through optimized pools for local payouts via a verified agent network. The primary objective is to slash total transaction fees to approximately 1% while ensuring near-instant settlement. The technical stack features

a Next.js and React frontend for premium UI, a Node.js backend for robust logic, and Solidity smart contracts for on-chain execution. This architecture ensures high performance, minimal gas fees, and a seamless "just send money" user experience.



Technically, Tokify is feasible as it builds upon proven DeFi primitives like stablecoin swaps and automated routing. To manage real-world constraints during the development phase, a simulation layer is used to demonstrate KYC and AML compliance-ready workflows. Risk mitigation strategies include a hybrid fiat-crypto model to satisfy regulators, the use of pegged stablecoins to eliminate volatility, and agent staking to prevent fraud. By requiring agents to provide collateral and using OTP-verified QR codes for withdrawals, the system maintains a high level of security and trust for both the senders and the receivers.

Socially and economically, Tokify offers a transformative revenue model where fees are shared

between the platform, liquidity providers, and local agents. Beyond individual transfers, the system scales through B2B API licensing for global payroll and FX spreads. By reducing the cost of sending money from 8% to 1%, Tokify directly increases the disposable income of migrant communities and fosters financial inclusion. This synergy of modern web architecture and smart contract logic positions Tokify as a viable, next-generation solution for global finance, promising significant economic equity in international remittance corridors.

Brief AI: AI-Powered CEO Morning Briefing Platform

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ABSTRACT

In today's fast-paced business environment, Indian business leaders face significant challenges due to fragmented and overwhelming information from multiple sources such as financial news platforms and global updates. This often results in reactive decision-making and inefficient use of time. Brief AI addresses this problem by providing an AI-powered CEO morning briefing platform that aggregates, analyzes, and summarizes critical business information into concise, actionable insights. Leveraging advanced language models via Grow API, the system processes large datasets and delivers personalized 5-line summaries, sentiment indicators, and risk assessments by 8:00 AM IST daily. The platform integrates automated data ingestion, AI-driven analysis, and an intuitive dashboard to ensure accessibility and usability. By reducing information overload and enhancing decision-making efficiency, Brief AI aims to democratize business intelligence for Indian entrepreneurs and investors.

KEYWORDS: Generative AI, Business Intelligence, Market Sentiment Analysis, Financial Data Aggregation, Decision Support System, LLM

INTRODUCTION

In the modern Indian business ecosystem, access to timely and relevant information is critical for effective decision-making. However, business leaders often spend considerable time navigating multiple platforms such as financial news websites and social media, leading to information overload and inefficiency. Existing solutions either lack actionable insights or are expensive and inaccessible.

Brief AI is proposed as an AI-powered business intelligence assistant that delivers concise, personalized, and actionable insights. By transforming raw financial data and global events into structured summaries and sentiment-driven outputs, the system enables users to shift from reactive to proactive decision-making.

Unlike traditional platforms such as Bloomberg Terminal, which are expensive and complex, or conventional financial newsletters that lack real-time personalization, Brief AI provides an affordable, AI-driven, and highly personalized solution tailored for quick and actionable decision-making.

PROPOSED METHODOLOGY

The proposed system follows a structured four-stage pipeline to efficiently process data and deliver actionable business insights to users.

Data Ingestion:

Data ingestion is carried out using automated Vercelcron jobs scheduled at 2:30 AM UTC. The system collects real-time financial data, including NIFTY and SENSEX indices, global news updates, and oil prices through APIs such as Yahoo Finance and GNews. This ensures continuous and reliable aggregation of relevant information from multiple sources.

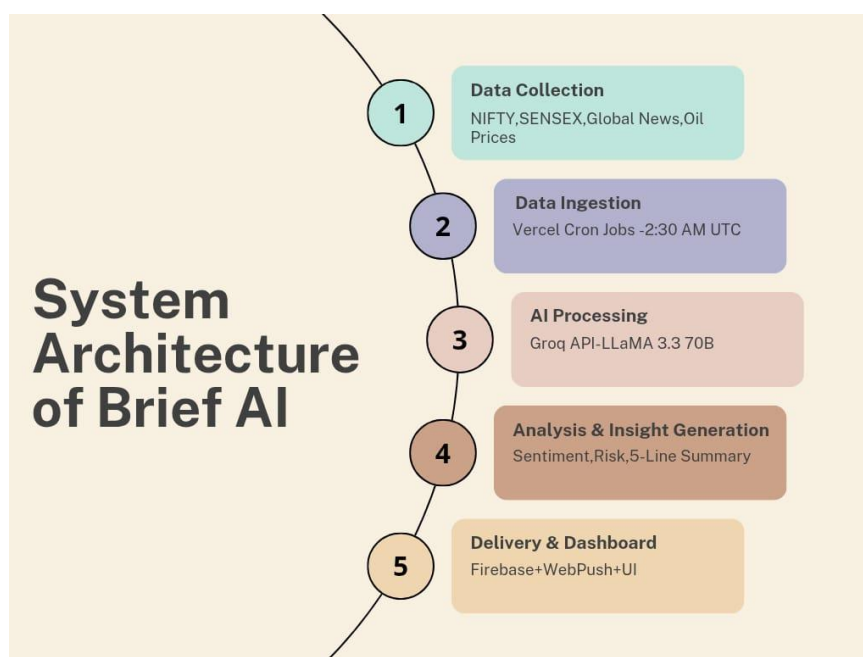
AI Processing Engine:

The collected data is processed using the LLaMA 3.3 70B model via the Groq API. This enables high-speed inference (under 10 seconds) and efficient handling of large datasets with a high context window. The AI model filters irrelevant data, performs contextual understanding, and structures the information for further analysis.

Synthesis and Analysis:

In this stage, the processed data is transformed into meaningful insights. The system performs financial sentiment analysis (Bullish, Bearish, Neutral), risk assessment (Low, Medium, High), and trend correlation analysis. It generates personalized 5-line summaries that are concise, relevant, and tailored to the user's needs.

The final insights are stored in Firebase (Firestore/Realtime Database) and delivered to users via Web Push Notifications at 8:00 AM IST. The frontend interface is developed using Next.js 14, ensuring a fast, responsive, and scalable user experience. Firebase is also utilized for real-time data synchronization and backend support, enabling seamless integration between data processing and user interaction. The dashboard presents insights in a clean, intuitive, and user-friendly format.



RESULT & DISCUSSION

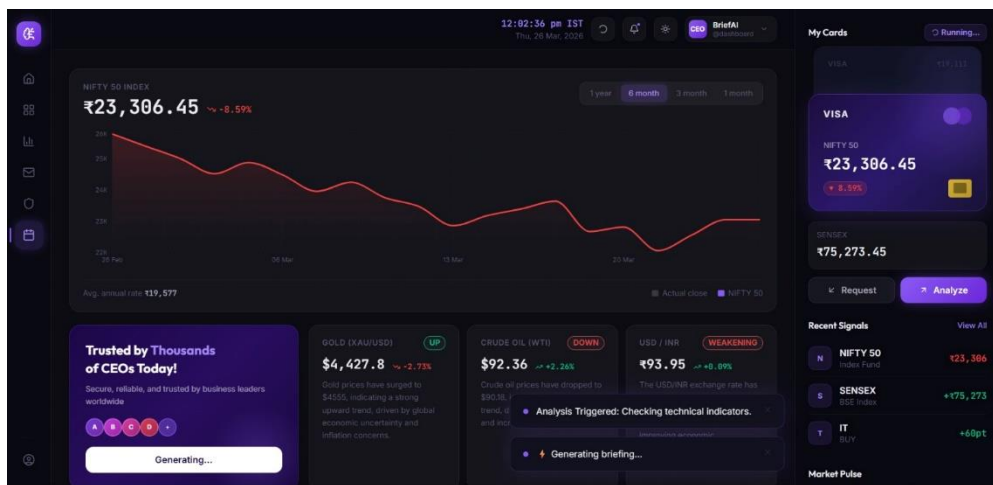
The proposed system effectively reduces information overload by consolidating multiple data sources into a single platform. It significantly decreases the time required for information gathering while improving the quality of decision-making.

The use of Groq's LLaMA 3.3 model ensures low latency and cost efficiency, while cloud deployment guarantees scalability and reliability. Unlike traditional platforms, Brief AI provides clear, actionable outputs such as BUY, HOLD, or AVOID signals based on sentiment analysis.

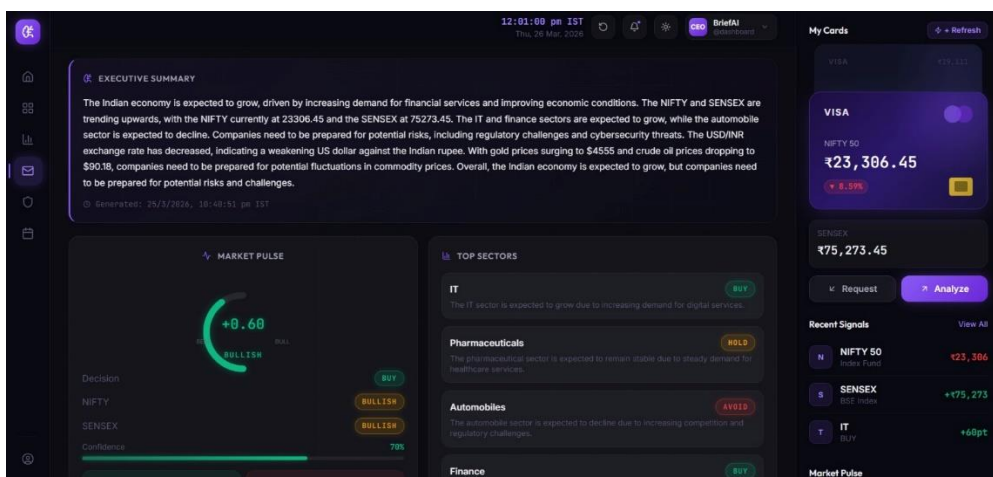
The platform's minimalist interface and personalized summaries enhance usability and user engagement.

The following figures represent the user interface of the proposed system:

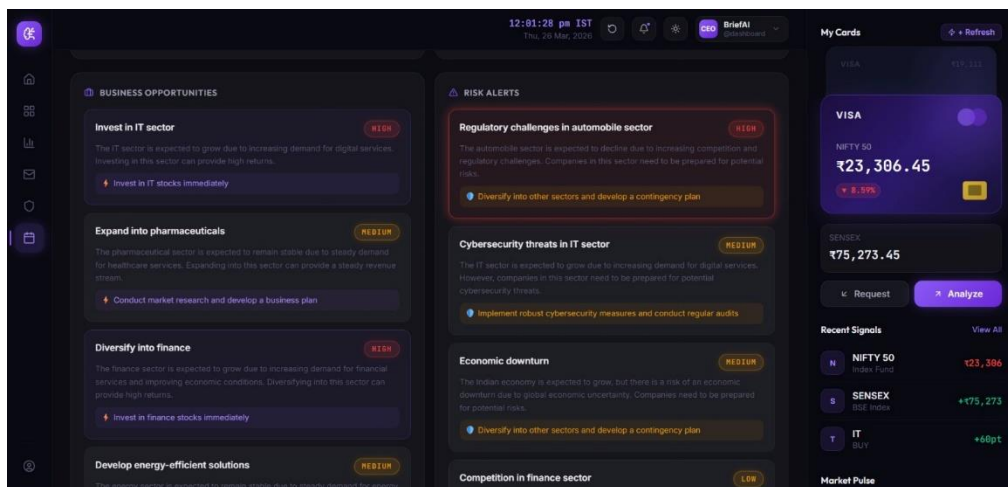
Executive summary interface showing NIFTY index trend along with AI-driven financial analysis



Dashboard Interface of Brief AI showing executive summary, market sentiment analysis, and sector-wise insights:



Output interface showcasing AI-driven business opportunities and risk assessment insights:



CONCLUSION

Brief AI successfully transforms complex financial data into concise, actionable insights, enabling faster and more informed decision-making. By leveraging AI and automation, the platform reduces time consumption and enhances efficiency for business leaders.

The system has strong potential for scalability and real-world adoption. Future enhancements may include deeper sector analysis and predictive capabilities.

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AI in Education and Skill Development

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OVERVIEW OF THE PROJECT

The “AI in Education and Skill Development” project is an innovative solution developed within a hackathon-driven environment that emphasizes creativity, collaboration, and real-world problem-solving. The platform is designed under the Smart Education theme, aiming to transform traditional learning systems into intelligent, adaptive, and skill-oriented ecosystems. Unlike conventional education models that follow a one-size-fits-all approach, this project introduces a personalized and scalable learning experience powered by modern Artificial Intelligence technologies and cloud-based infrastructure.

At its core, the project focuses on addressing one of the most critical challenges in education: the lack of personalization. In traditional systems, all students are exposed to the same teaching methodology regardless of their individual learning pace, cognitive abilities, or interests. This often leads to disengagement, poor understanding, and unequal learning outcomes. To overcome this limitation, the proposed system leverages AI to create a dynamic and adaptive learning environment where each user receives customized content tailored to their unique needs.

The architecture of the application is built using a modern, scalable, and modular technology stack. The frontend is developed using React.js, enhanced with Ant Design for structured UI components and Framer Motion for smooth animations and an engaging user experience. This ensures that users interact with a responsive, visually appealing, and intuitive interface. On the backend, the system utilizes Supabase, a powerful serverless platform that provides PostgreSQL database management, authentication services, and edge functions. This replaces traditional backend systems like Node.js and MongoDB, resulting in a more efficient, scalable, and cloud-native infrastructure.

The integration of advanced AI services plays a crucial role in the functionality of the platform. APIs such as Google Gemini and Groq are used to power the intelligent chatbot and recommendation systems. These integrations allow the platform to deliver real-time assistance, generate explanations, and provide context-aware responses to users. Additionally, payment integration is handled using Razorpay, enabling a subscription-based model where premium features can be unlocked seamlessly.

The workflow of the application is designed to ensure a smooth and personalized user journey. The process begins with secure onboarding through authentication systems provided by Supabase and Google OAuth. Once logged in, users are directed to a personalized dashboard that displays their learning progress, recommendations, and activity insights. This dashboard acts as a central hub where users can access all features of the platform.

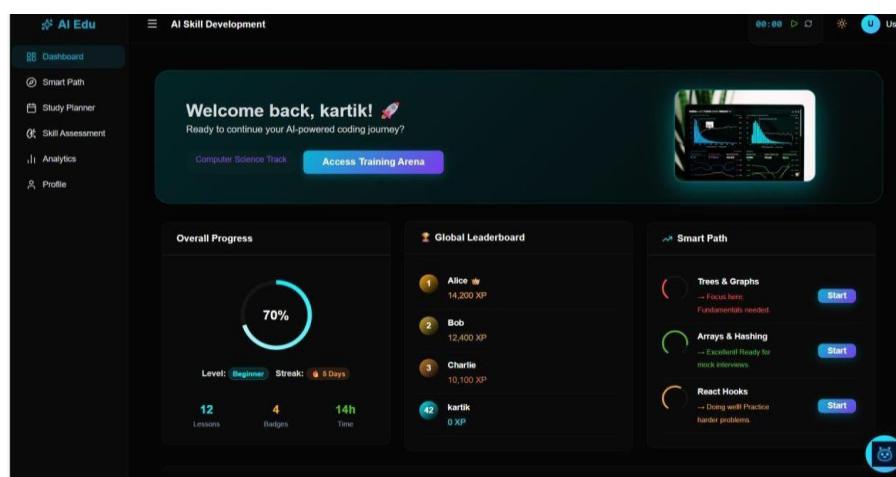
The learning engine is one of the most significant components of the system. It uses Machine Learning algorithms to analyze user data such as quiz performance, time spent on different topics, and interaction patterns. Based on this analysis, the system generates a tailored learning path for each user. For example, if a student is weak in a particular topic, the platform automatically suggests additional practice questions, simplified explanations, or alternative resources. This adaptive mechanism ensures that learning becomes more efficient and targeted.

To further enhance the learning experience, the platform includes an interactive coding and problem-solving environment inspired by platforms like LeetCode. This feature is particularly useful for students preparing for technical interviews or aiming to improve their programming skills. Users can solve Data Structures and Algorithms problems directly within the platform, receive instant feedback, and track their performance over time. This hands-on approach bridges the gap between theoretical knowledge and practical application.

Another key feature of the system is the AI-powered chatbot, which acts as a virtual tutor. Using Natural Language Processing techniques, the chatbot can understand user queries, provide explanations, and guide learners through complex concepts. It is available 24/7, making learning flexible and accessible at any time. This reduces dependency on traditional classroom support and encourages self-paced learning. The chatbot also assists users during problem-solving sessions by offering hints and explanations, thereby enhancing the overall learning process.

Progress tracking and data management are handled efficiently through the Supabase database. Every user interaction, including completed lessons, quiz scores, and activity logs, is stored and updated in real time. This data is then used to generate detailed analytics dashboards that provide insights into user performance and engagement. Students can monitor their progress, identify areas of improvement, and set learning goals, while educators or administrators can analyze overall trends and optimize content delivery.

The project also incorporates a monetization model to ensure financial sustainability. A Software-as-a-Service (SaaS) approach is adopted, where users can access basic features for free and unlock advanced functionalities through a subscription plan. The pricing model is designed to be affordable while ensuring recurring revenue, making the platform viable for long-term deployment and scalability.



From a feasibility perspective, the project demonstrates strong technical, market, and financial viability. Technically, it leverages proven technologies such as AI/ML frameworks, cloud computing, and serverless architecture, ensuring reliability and scalability. The use of Supabase simplifies backend management while maintaining high performance. The modular design allows easy updates and feature additions, making the system future-proof.

In terms of market readiness, there is a growing demand for digital learning solutions across schools, colleges, and professional training institutions. The shift towards online education and the increasing

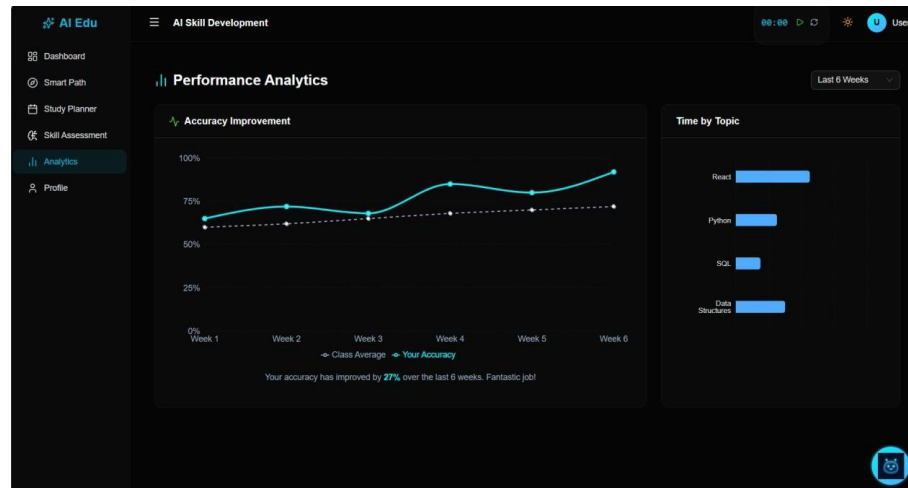
importance of skill-based learning make this platform highly relevant. By combining personalized learning with skill development, the project addresses both academic and industry requirements, making it attractive to a wide range of users.

Financially, the SaaS model ensures a steady revenue stream. By offering premium features such as advanced analytics, personalized mentoring, and exclusive content, the platform can generate consistent income while maintaining a large user base. This balance between accessibility and monetization contributes to the overall sustainability of the project.

Despite its advantages, the project also faces certain challenges and risks. One of the primary concerns is data privacy and security. Since the platform collects and processes sensitive user data, it must comply with strict data protection regulations. To address this, the system implements secure authentication, encryption, and access control mechanisms, ensuring that user information is protected at all times.

Another challenge is user adoption, particularly among educators who may be resistant to new technologies. To overcome this, the platform is designed with a user-friendly interface that requires minimal training. Comprehensive onboarding and support systems are also included to help users adapt quickly.

Content quality is another critical factor that affects the effectiveness of the platform. AI-generated recommendations are only as good as the underlying content. To ensure high-quality learning materials, the platform can collaborate with educators and subject matter experts who validate and curate the content. This combination of AI and expert input ensures accuracy and reliability.



To successfully implement and scale the project, a phased rollout strategy is proposed. In the initial phase, the platform will be tested in a limited number of institutions to gather feedback and identify areas for improvement. In the second phase, the system will be expanded to a larger audience, incorporating diverse user groups and refining its features based on real-world usage. Finally, in the third phase, the platform will be deployed on a national or global scale, establishing partnerships with educational institutions and organizations.

In addition to its core features, the platform also focuses on enhancing user engagement through modern design and interaction techniques. Animations, interactive elements, and intuitive navigation create an

enjoyable learning experience. The use of gamification elements such as progress tracking and achievement indicators further motivates users to stay consistent in their learning journey.

Accessibility is another important aspect of the project. The platform is designed to be inclusive, supporting users from different backgrounds and regions. Features such as multilingual support and compatibility with various devices ensure that education is accessible to a broader audience. This contributes to reducing educational inequality and promoting equal opportunities for learning.

In conclusion, the “AI in Education and Skill Development” project represents a comprehensive and forward-thinking approach to modern education. By integrating Artificial Intelligence, cloud computing, and user-centric design, it creates a personalized, scalable, and efficient learning platform. The project not only addresses the limitations of traditional education systems but also prepares learners for real-world challenges by focusing on skill development and practical application.

With its robust architecture, innovative features, and clear implementation strategy, the platform has the potential to significantly impact the education sector. It bridges the gap between academic learning and industry requirements, empowers learners with personalized guidance, and provides a flexible and engaging learning experience. As education continues to evolve in the digital age, this project stands as a strong example of how technology can be used to create meaningful and lasting improvements in learning systems.

RespiCore: Smartphone Acoustic Respiratory Triage

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OVERVIEW OF THE PROJECT

The Acoustic Cough & Respiratory Triage App is a cross-disciplinary engineering solution designed to bridge the gap between smartphone hardware, advanced signal processing, and deep learning. By converting raw audio waves from smartphone microphones into visual Mel-spectrograms, the application leverages Convolutional Neural Networks (CNNs) to analyse acoustic patterns of respiratory anomalies, such as wheezing, heavy breathing, or wet coughs. The core innovation lies in its highly optimized on-device inference architecture, ensuring that sophisticated medical triage processing occurs entirely offline without transmitting sensitive health data to cloud servers.

PROBLEM STATEMENT

Early detection and triage of respiratory conditions—ranging from asthma to chronic obstructive pulmonary disease (COPD) and infectious diseases—are often delayed due to the inaccessibility of clinical diagnostics. While telehealth has rapidly expanded, remote respiratory assessment remains largely subjective. Furthermore, existing AI audio analysis tools frequently rely on cloud-based processing. This introduces severe privacy risks regarding patient audio data and requires a stable internet connection, heavily limiting accessibility in rural, underserved, or bandwidth-constrained areas. There is a critical need for an objective, private, and accessible triage tool that operates seamlessly in real-world environments.

PROPOSED SOLUTION AND METHODOLOGY

We propose a mobile application that acts as an accessible, rapid triage tool by mathematically treating "audio as an image." The methodology is structured across a three-step pipeline:

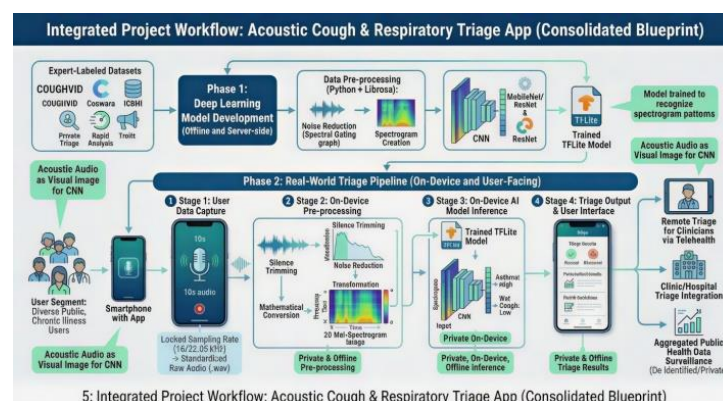
1. **Standardized Data Acquisition:** The app records a 10-second audio clip, locking the microphone sampling rate to 16 kHz or 22.05 kHz to ensure data uniformity across varying smartphone hardware.
2. **Signal Processing:** The raw 1D audio waveform is processed to trim silence and filter out ambient noise. Utilizing mathematical transformations, the audio is converted into a 2D Mel-spectrogram—a visual heatmap where the X-axis is time, the Y-axis is frequency, and colors represent amplitude.
3. **Model Inference:** The spectrogram image is fed into a lightweight CNN trained on clinically validated datasets (e.g., COUGHVID, Coswara, ICBHI). The model identifies visual patterns corresponding to specific lung sounds (e.g., asthma wheezes appearing as horizontal high-frequency lines) and outputs a triage probability score.

KEY FEATURES AND INNOVATIONS

- **Acoustic-to-Visual Transformation:** Innovatively bypasses traditional audio processing by converting sound into high-fidelity Mel-spectrogram images, allowing the application of powerful computer vision algorithms to acoustic data.
- **100% On-Device Inference:** Utilizes optimized machine learning models to run directly on the smartphone. This zero-cloud architecture guarantees patient privacy (HIPAA compliance readiness) and enables offline functionality.
- **Robust Environmental Noise Reduction:** Incorporates spectral gating and preprocessing to filter out real-world background noise—such as traffic or AC hums—prior to spectrogram generation, ensuring high diagnostic accuracy outside of clinical settings.
- **Hardware Standardization:** Employs strict frontend controls to standardize sampling rates across diverse mobile devices, preventing hardware-induced biases in the AI model's predictions

TECHNOLOGY STACK

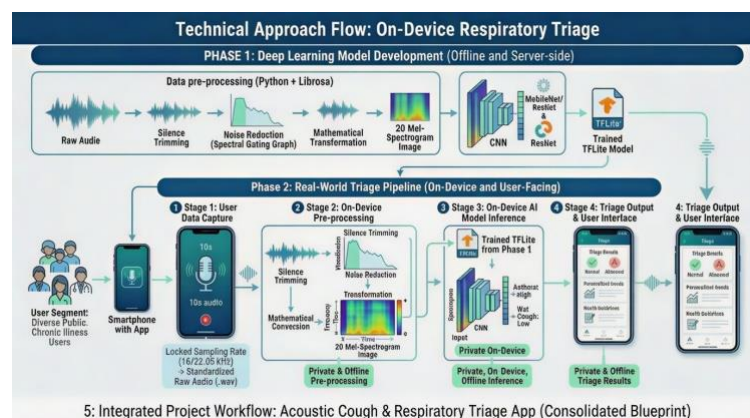
- **Frontend Mobile Development:** Flutter (or Kotlin/Swift) for building a responsive, cross-platform user interface capable of hardware-level microphone control.
- **Signal Processing Engine:** Python utilizing the Librosa library for audio manipulation, silence trimming, noise reduction, and Mel-spectrogram generation.
- **Machine Learning Pipeline:** PyTorch for training lightweight Convolutional Neural Networks (e.g., MobileNet or a scaled-down ResNet) using open-source, expert-labeled datasets.
- **Edge Deployment:** TensorFlow Lite (TFLite) for exporting the trained PyTorch models into a highly compressed, mobile-optimized format for on-device inference.



EXPECTED OUTCOMES AND APPLICATIONS

The project will deliver a fully functional, privacy-first mobile prototype capable of real-time respiratory triage. Key applications include:

- **Rapid Patient Self-Assessment:** Empowering individuals to proactively monitor chronic conditions like asthma or COPD from home.
- **Telehealth Enhancement:** Providing physicians with objective, AI-backed acoustic data during virtual consultations to improve remote diagnostic accuracy.
- **Accessible Global Healthcare:** Delivering clinical-grade triage capabilities to remote or underdeveloped regions without requiring expensive medical hardware or reliable internet connectivity.
- **Public Health Surveillance:** Offering a scalable foundation for tracking and managing epidemiological outbreaks of respiratory diseases.



Project- OwnLocal- Infrastructure for Hyper-Local Fractional Equity

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OVERVIEW OF THE PROJECT

The "Amazon-ification" of modern commerce has decoupled consumer spending from community wealth, leading to significant capital flight from local ecosystems to global e-commerce giants. While Gen-Z consumers possess high spending power, they lack frictionless entry points into equity markets. Simultaneously, local Small and Medium Enterprises (SMEs) lack sophisticated tools to compete with the retention mechanics of large-scale platforms.

OwnLocal serves as a Hyper-Local Micro-Equity Ledger (HMEL), a disruptive fintech infrastructure designed to bridge this gap. By moving away from traditional "Reward Points"—which act as liabilities on merchant books—OwnLocal introduces Equity Tokens as a tangible asset for the consumer. This project aims to build a decentralized autonomous loyalty layer where consumer spending is programmatically converted into fractional revenue-share tokens using the India Stack and the Account Aggregator (AA) Framework.

TECHNICAL ARCHITECTURE AND METHODOLOGY

The proposed solution utilizes a multi-layered technical stack to ensure security, compliance, and scalability:

1. Data Acquisition Layer: Integration with SETU/Sahamati (Account Aggregator) to fetch encrypted, consent-linked Financial Information Provider (FIP) data. This ensures adherence to DEPA (Data Empowerment and Protection Architecture).
2. AI Processing Engine: A Node.js microservice architecture performs Natural Language Processing (NLP) and pattern matching on transaction strings to identify specific local merchants (e.g., Gariahat Complex) from bank statements.
3. Ledger Layer: A private EVM-compatible sidechain (such as Polygon Edge) or a high-performance NoSQL distributed ledger is used for minting non-inflationary Revenue Share Tokens (RSTs).
4. Frontend Interface: Developed using React Native with a "Nightmare Pink" aesthetic layer via Tailwind CSS to reduce the complexity barrier often associated with fintech applications.

FEASIBILITY, SCALABILITY, AND IMPACT

The project is designed to operate within the RBI's Regulatory Sandbox, utilizing fractional ownership models similar to global Real-World Asset (RWA) tokenization trends. To manage scalability, the system employs Pincode-based sharding, allowing the infrastructure to scale city-by-city without cross-loading regional data.

The impact of this infrastructure is three-fold:

- For the Economy: It recirculates wealth within a 2km radius of a specific pincode, preventing capital flight.

- For the Consumer: It provides financial inclusion; a student purchasing coffee effectively builds a diversified local equity portfolio.
- For the Merchant: It transforms a traditional cost-center (marketing) into a community-capital-raising tool, fostering a base of “brand evangelists.”

CONCLUSION AND ROADMAP

OwnLocal is positioned not merely as an application, but as the financial operating system for the modern neighborhood. The roadmap includes a Phase 1 Beta launch in Kolkata (specifically Pincodes 700019 and 700032), followed by Phase 2 integration with ONDC (Open Network for Digital Commerce) to enable direct-to-app ordering. By applying the "Endowment Effect" from behavioral economics, the project ensures that users value local commerce more deeply through ownership stake.

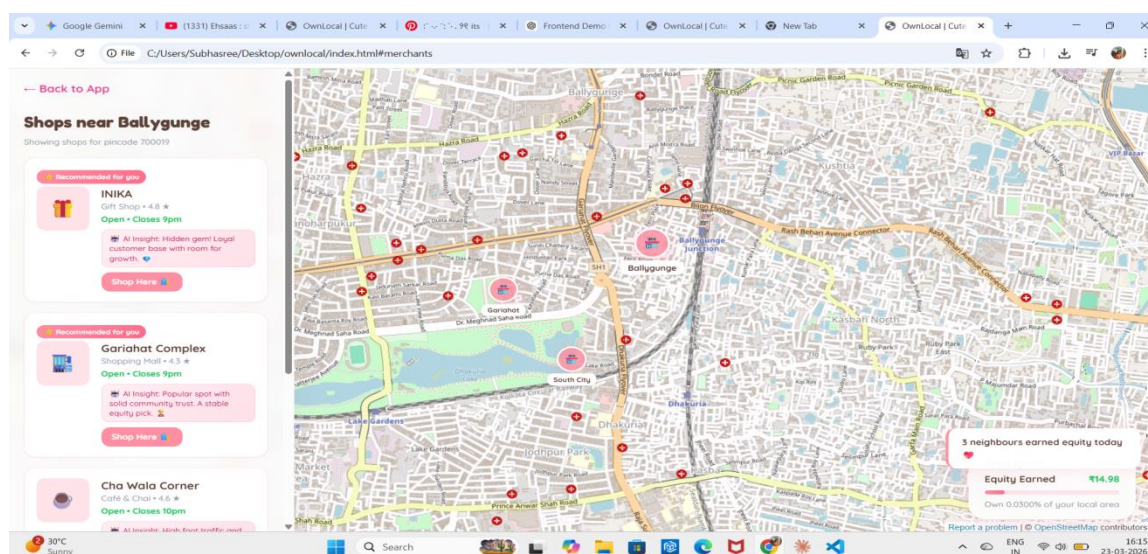


Fig 1 - A high-fidelity dashboard interface for **OwnLocal**, a hyper-local fintech platform, featuring a detailed interactive map of **South Kolkata** (Ballygunge, Gariahat, and Dhakuria areas). The UI displays local merchant listings like "Corner Kirana" and "Local Sweets Co." with AI-driven insights, alongside a "Your Equity Portfolio" widget that tracks real-time consumer spending and fractional equity earned within the 700032 pincode.

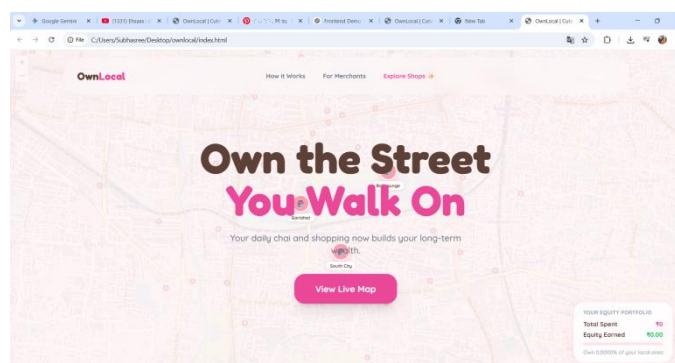


Fig 2 : Landing page

AI-Powered Career Preparation System

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OVERVIEW OF THE PROJECT

USER AUTHENTICATION

The process begins with user login or registration using secure token-based authentication implemented through JWT. Token blacklisting is used to ensure secure logout and prevent unauthorized access.

RESUME UPLOAD

After successful authentication, the user uploads their resume in PDF format through the frontend interface developed using React.js. The resume is sent to the backend server for processing.

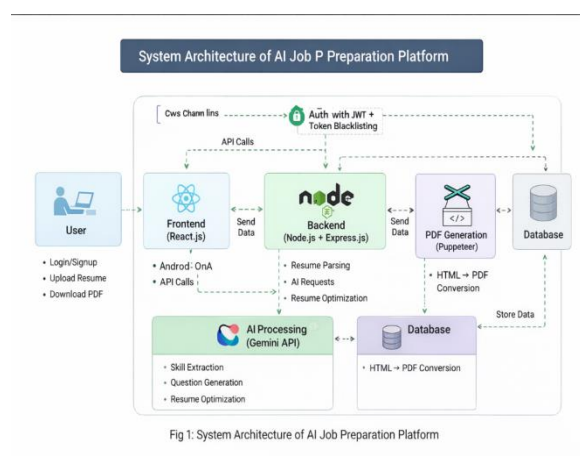
BACKEND PROCESSING

The backend, built using Node.js and Express.js, extracts and preprocesses the resume content. It prepares the data along with the job description for further AI-based analysis.

AI-BASED ANALYSIS

The processed data is sent to the Google Gemini API, which performs multiple tasks such skill extraction, identification of skill gaps, and generation of technical as well as behavioural interview questions. It also produces an optimized resume tailored to the job description.

RESULT DISPLAY AND PDF GENERATION



The generated results, including skills, gaps, questions, and the optimized resume, are displayed to the user on the frontend. Finally, the resume is converted into a downloadable PDF using Puppeteer, ensuring a clean and ATS-friendly format.



Sentinel: An AI Governance Proxy for Multi-Agent Systems

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INTRODUCTION

The rapid advancements of autonomous AI agents in enterprise environments have created a critical and largely unsolved problem, i.e. organisations have no central mechanism to govern, monitor, or audit what these agents actually do. Agents communicate directly with large language model (LLM) APIs such as OpenAI and Gemini, often carrying sensitive corporate data and executing high-stakes actions. This uncontrolled landscape, commonly termed Shadow AI, exposes enterprises to data leaks, prompt injection attacks, policy violations, and runaway token costs. Project Sentinel addresses this problem by introducing a governance proxy, a NestJS-based control plane that intercepts every agent-to-LLM request, applies a layered security pipeline, enforces company-defined policies, and produces a real-time audit trail for compliance teams.

PROBLEM STATEMENT

Enterprise AI deployments face four compounding risks when agents operate without governance:

- **Data Privacy Breaches:** Agents routinely embed personally identifiable information (PII) and protected health information (PHI) such as names, emails, SSNs, and medical identifiers in prompts sent to external LLM APIs.
- **Prompt Injection Attacks:** Malicious or misconfigured agents can attempt to override system instructions and exfiltrate sensitive internal data.
- **Policy Violations:** Agents may perform actions explicitly forbidden by corporate policy, for example disclosing salary data or accessing unauthorised databases.
- **Cost and Compliance Blindspots:** Without token tracking and audit logs, organisations cannot identify runaway agents or demonstrate regulatory compliance.

PROPOSED SOLUTION

Project Sentinel is a governance proxy built on NestJS and TypeScript. Every agent request is routed through the proxy before reaching any LLM API. The proxy applies three sequential guard phases:

- **Inbound Guard:** Presidio scans the prompt for PII and PHI and redacts detected entities. A zero-shot transformer classifier, running locally via `@xenova/transformers`, simultaneously checks for prompt injection patterns. Requests that fail either check are immediately blocked with a 403 response and an audit event is written to MongoDB.
- **Policy Engine:** A LangChain.js chain loads company-defined rules from MongoDB and classifies the intent of the request (for example, `salary_leak`, or `jailbreak`). Requests that violate any rule are blocked and logged with full metadata.
- **Outbound Validator:** After the LLM responds, Presidio re-scans the output for sensitive data leaks. Low-confidence or anomalous responses are flagged and optionally suppressed before being returned to the agent. Session state, including rate limits, token counters, and per-agent security scores, is maintained in Redis for low-latency enforcement. All security events are persisted as flexible JSON documents in MongoDB, enabling rich querying without schema migrations when new threat types are added.

SYSTEM ARCHITECTURE

The system consists of four layers working together:

- Proxy Layer: A NestJS custom interceptor chains all guard services and short-circuits on any block, ensuring no request can bypass governance.
- State Layer: Redis manages ephemeral counters and security scores; MongoDB persists the agent registry, policy rules, and the full audit trail.
- Observability Layer: A NestJS WebSocket gateway pushes real-time security events to the frontend. A React and React Flow dashboard renders a live Shadow AI Discovery Map, displaying authorised and rogue agents as nodes with colour-coded edges (green for clean requests, red for blocked ones).
- Compliance Layer: A dedicated REST endpoint to generate a PDF compliance report via Pdf make and a structured JSON dump of all security interventions, ready for enterprise stakeholders and regulatory review.

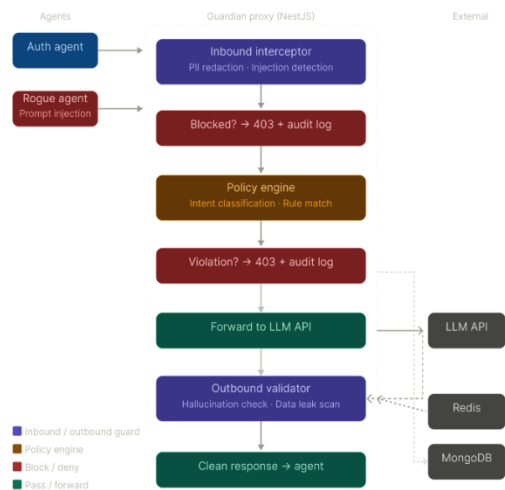


Fig 1: Project Sentinel system architecture overview showing the proxy, state, observability, and

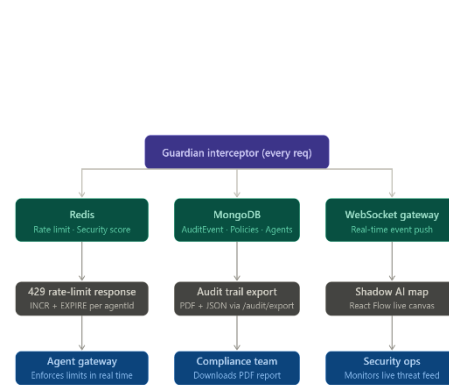


Fig 2: The Observability Layer breakdown showing the actions that would be

TECHNICAL STACK

Backend: NestJS with TypeScript, using interceptors, WebSocket gateway, and REST API.
 Security: Microsoft Presidio for PII and PHI entity recognition; @xenova/transformers for offline intent classification; LangChain.js for composable policy chains.
 Data: Redis with ioredis for session state; MongoDB with Mongoose for audit persistence.
 Frontend: React with React Flow for the live agent graph.
 Export: pdfmake for server-side PDF generation.

KEY FEATURES AND INNOVATION

- Offline-safe Threat Detection: Intent classification runs entirely within the Node.js process using a quantized transformer model, eliminating external API dependency.
- Schema-flexible Audit Trail: MongoDB stores heterogeneous threat metadata with different fields per threat type, without requiring schema migrations.

- **Data-driven Policy Rules:** Policies are stored as documents in MongoDB, so new rules can be added without code changes or redeployment.
- **Live Shadow AI Discovery Map:** The React Flow canvas updates in real time via WebSocket, making blocked agent events immediately visible to security operators.
- **One-click Compliance Export:** A single API call produces a PDF audit report and a JSON dump suitable for regulatory review.

CONCLUSION

Project Sentinel provides enterprises with the control plane they urgently need as autonomous AI agents become ubiquitous. By intercepting, classifying, and auditing every agent-LLM interaction in real time, the system reduces the risk of data breaches, enforces corporate governance policies, and provides audit evidence required for regulatory compliance, all without modifying the agents themselves. The architecture is extensible, offline-capable, and designed to scale from a hackathon MVP to a production-grade enterprise service.

TrapForge — AI-Powered Adaptive Honeypot for Real-Time Cyber Threat Intelligence

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OVERVIEW OF THE PROJECT

TrapForge is an AI-powered adaptive honeypot system designed to capture, classify, and respond to cyber threats in real time. It deploys five fake network services — SSH, FTP, HTTP, MySQL, and SMTP — to lure attackers and record their behaviour. Every connection is passed through a Machine Learning pipeline (Random Forest with TF-IDF character n-grams) that classifies the attack intent into one of ten categories with 94.3% accuracy in under 80 ms. The classified event is then forwarded to a Grok xAI LLM, which generates a context-aware deceptive reply — serving fake success to APT actors and fake “404 Not Found” responses to malware scanners. All events are tagged with the corresponding MITRE ATT&CK Technique ID, making findings instantly audit-ready, and pushed over a WebSocket to a React 18 dashboard featuring a live attack feed, an intent-distribution chart, and a real-time SVG world map.

PROBLEM STATEMENT

Contemporary enterprise networks lack a proactive deception layer. Static perimeter defences such as firewalls and intrusion-detection systems generate alerts only after a breach has begun. Studies indicate that 93% of breaches go undetected for weeks, causing significant damage before discovery. Traditional honeypots merely log attacker sessions; they do not classify intent, generate deceptive responses, or produce actionable intelligence. No existing open-source or commercial tool combines a real-time Machine Learning classifier with a Large Language Model for adaptive deception within a single, lightweight deployment.

PROPOSED SOLUTION

TrapForge addresses each identified gap with a purpose-built dual-AI pipeline. Five honeypot services are launched concurrently on a single Linux VPS; the first attack is captured within 15 minutes of deployment. The ML classifier — a 100-tree. Random Forest trained on TF-IDF character n-gram features — labels each session as one of ten attack types (APT, Brute Force, Recon, SQL Injection, XSS, DoS, MITM, Malware, Zero-Day, Path Traversal) in under 80 ms. The Grok xAI module then constructs a context-aware fake reply: an APT actor receives a simulated success response while a malware scanner receives a convincing “404 Not Found”. Every event is simultaneously mapped to a MITRE ATT&CK Technique ID (e.g., T1595 Active Scanning, T1110 Brute Force, T1190 Exploit Public-Facing Application) and pushed over a WebSocket to a React 18 dashboard. The backend is built on FastAPI with asyncio and uses an in-memory deque with a thread-safe lock for O(1) read/write —eliminating database latency. The complete stack can be deployed on Oracle Cloud Free Tier or AWS Free Tier at zero cost.

SYSTEM ARCHITECTURE & TECHNOLOGY STACK

The system is organised into four layers. The Honeypot Layer uses Python's socket and threading.Thread modules to simultaneously emulate SSH, FTP, HTTP, MySQL, and SMTP services, serving realistic banners to any connecting client. The ML Pipeline layer employs scikit-learn with TF-IDF character n-gram tokenisation fed into a Random Forest of 100 decision trees; this design captures obfuscated, hex-encoded, and novel attack variants that word-level tokenisers miss. The AI Deception Layer calls the Grok xAI API (grok-3-fast model, OpenAI-compatible SDK) to synthesise a service-specific, intent-aware fake reply for each classified session. The Backend API layer is implemented in FastAPI with uvicorn, broadcast over WebSocket using asyncio, and stores all events in an in-memory collections.deque protected by a threading.Lock. The Frontend is a React 18 application bundled with Vite, visualising data through Recharts bar and doughnut charts and a custom SVG world map rendered without a third-party mapping library.

PERFORMANCE METRICS

Live testing on a single-core VPS yielded 187 attacks captured within a 30-minute observation window across all five honeypot services (SSH 38%, HTTP 28%, FTP 16%, MySQL 12%, SMTP 6%). The ML classifier sustained 94.3% accuracy across the 10-class distribution with an average intent classification latency of 79 ms. WebSocket push latency from event creation to dashboard update remained below 50 ms throughout the test. The complete system — from attacker connection to a labelled, MITRE-tagged event visible on the dashboard — completed the full pipeline in under 80 ms end-to-end.

INNOVATION & UNIQUENESS

TrapForge is the only known open-source tool that combines a real-time ML classifier with an LLM-based adaptive deception engine in a single sub-80 ms pipeline. Existing honeypots such as Cowrie and Dionaea capture session logs but offer no intent classification, deception logic, or AI-generated narrative. Enterprise SIEM platforms such as Splunk and QRadar analyse events after the fact and cannot generate fake service responses. No publicly available tool integrates both ML and LLM in a real-time honeypot loop. Moreover, enterprise deception platforms typically cost \$50,000 or more per year; TrapForge runs entirely on a zero-cost Oracle Cloud Free Tier VPS, making enterprise-grade deception accessible to startups, small businesses, hospitals, and academic institutions.

TARGET USERS & CASES

TrapForge serves five primary user segments. Startups and small businesses require no SIEM and can run the full stack on a free-tier cloud server. Banks and financial institutions benefit from early detection of brute-force and SQL injection attacks; MITRE ATT&CK tagging satisfies RBI and internal compliance audit requirements. Hospitals and healthcare providers can deploy fake SMTP and HTTP services to trap phishing infrastructure and protect patient data. Cybersecurity researchers gain access to live, labelled attack datasets suitable for ML model training and CERT-In TTP sharing. Cloud providers and ISPs can monitor exposed ports at scale and feed the Threat Intelligence API into existing SOC platforms.

FUTURE SCOPE

Planned enhancements include a Ransomware Simulator lure for early detection of encryption-based attacks, a Graph RAG module for semantic queries across captured sessions, Docker one-command deployment, a SaaS B2B subscription model targeting SOC teams and regulated industries, a B2G collaboration channel with CERT-In and NCIIPC, a live Threat Intelligence API data feed for security vendors, and a cloud marketplace listing for one-click deployment on AWS, Azure, and GCP.

TubeInsight AI: AI-Powered YouTube Audience Intelligence Platform

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OVERVIEW OF THE PROJECT

TubeInsight AI is a comprehensive creator intelligence platform designed to transform raw YouTube audience feedback data into structured, actionable insights. Leveraging multi-agent AI orchestration via LangGraph, sentiment analysis, and RAG-powered natural language processing, the platform enables content creators to deeply understand their audience dynamics, identify emerging trends, and optimize content strategy based on real viewer feedback. The platform integrates multiple specialized AI agents: a data ingestion agent that fetches YouTube comments via the YouTube API v3, a sentiment analysis agent that scores viewer emotion and engagement, a topic clustering agent that surfaces recurring themes, a RAG chatbot that answers natural questions about audience insights, and a report generation agent that synthesizes findings into compelling narratives. The entire orchestration is powered by LangGraph's StateGraph, with embeddings handled by sentence-transformers and vector storage managed through ChromaDB. Our project solves what even top AI chat models can't, that is, a full-fledged Creator Interaction using raw comment responses with Audience Dashboard.

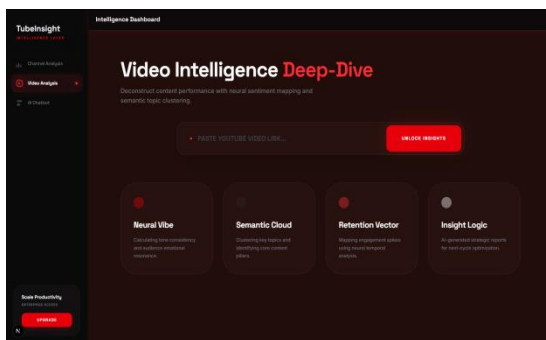


Fig: 1

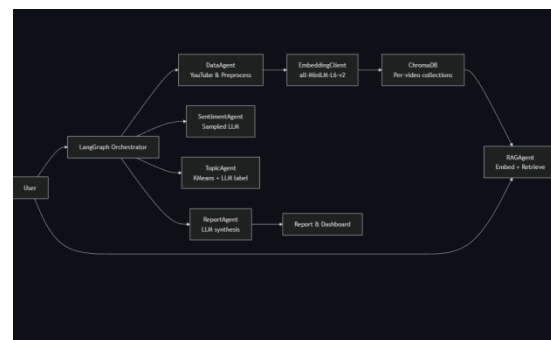


Fig: 2

Fig 1. :LangGraph Agent Orchestration Pipeline showing DataAgent → SentimentAgent → TopicAgent → RAGAgent → ReportAgent workflow.

Fig 2.:Sentiment & Topic Distribution Dashboard showing viewer engagement metrics and recurring comment themes across videos

Smart Fire Detection & Neutralization Automotive Robot

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Kolkata, India

OVERVIEW OF THE PROJECT

Industrial disasters highlight the critical need for autonomous machines capable of operating in hazardous environments. Human intervention in fire emergencies is frequently delayed by extreme heat, toxic smoke, and the inherent dangers of entering chemical or confined “no-go” zones. Statement 1 is correct that traditional ceiling sprinkler systems possess static limitations and cannot actively target an isolated, moving fire source. To address these life- threatening delays, this project proposes the design and development of an autonomous fire- neutralizing robotic vehicle. The primary objective is to engineer a proactive, highly agile mechatronic system capable of independently patrolling, detecting, and extinguishing localized thermal threats before they escalate into uncontrollable disasters. The developed prototype is built upon a lightweight, 500-gram 2WD chassis, prioritizing maneuverability in tight indoor spaces. The core intelligence of the system is governed by an Arduino Uno R3 (ATmega328P) microcontroller, which processes real-time environmental data. To achieve a 180-degree proactive detection field, the vehicle integrates a triple array of infrared (IR) flame sensors tuned to detect radiation wavelengths between 760nm and 1100nm. The actuation and locomotion layer is managed by an L293D Motor Driver Shield, powered by dual high-density 18650 Li-ion batteries providing a stable 7.4V output. The “Detect-Target-Neutralize” algorithm is programmed using Embedded C. Upon detecting a flame signature, the logic forces the vehicle to halt entirely to maintain structural stability. Subsequently, an SG90 micro servo sweeps a mounted nozzle across a 60-degree to 120- degree arc while a submersible DC pump forcefully ejects water to suffocate the fire at its exact source. Experimental testing demonstrates the high efficiency and viability of the prototype. The robot successfully and reliably detects matchstick sized flames from a distance of up to 30 centimeters, neutralizing the fire threat autonomously in under three seconds without any human input. Furthermore, the overall development cost of the prototype was strictly maintained at ₹1,502 INR, establishing it as a highly cost-effective and economically scalable solution for warehouses and residential complexes. Future iterations of this project will aim to integrate an ESP32-CAM module for live Wi-Fi video streaming and a GSM module for instant emergency dispatch alerts. In conclusion, the integration of mechanical engineering with automated electronics in this prototype proves that low-cost, autonomous safety technology can effectively handle high-risk tasks, prevent property damage, and ultimately save human lives.

Weather Adaptive Vision Stick: A Smart Assistive Device for Visually Impaired Navigation.

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OVERVIEW OF THE PROJECT

The Weather Adaptive Vision Stick is an advanced IoT-based assistive device designed to provide safe and independent navigation for the visually impaired. Unlike standard white canes, this system utilizes a multi-sensor fusion approach combined with AI-driven object detection to identify obstacles, environmental hazards, and weather-related risks in real-time.

SYSTEM ARCHITECTURE & COMPONENTS

The heart of the system is the **ESP32-S3 CAM**, which handles image processing tasks for object recognition. It is supplemented by:

Component	Description	Role
ESP32-S3 CAM	AI-enabled MCU	Central processing & Vision
VL53L0X	ToF Laser Sensor	Precise distance measurement
HC-SR04	Ultrasonic Sensor	Wide-angle obstacle detection
BME280	Environmental Sensor	Weather data (Temp/Hum/Press)
Water Sensor	Moisture Probe	Puddle & Wet surface detection
Buzzer/Haptic	Output Interface	User alerts & feedback

WORKING METHODOLOGY

A. Sensor Fusion: The system combines Ultrasonic waves and Laser (ToF) data to eliminate blind spots. While ultrasonic sensors detect large objects, the ToF sensor provides millimetres-level accuracy for small or transparent obstacles.

B. Weather Adaptability: The BME280 sensor monitors ambient conditions. In high humidity or fog, the system automatically boosts the gain of the ultrasonic sensors to compensate for signal attenuation, ensuring consistent safety.

C. User Feedback: A 'Smart-Pulse' buzzer system is implemented. Obstacle distance is mapped to frequency: the closer the object, the higher the beep frequency, providing an intuitive sense of distance.

FUTURE SCOPE

- Future iterations will include GPS + GSM for emergency location sharing
- Bluetooth app for customization and voice feedback
- Haptic motors for multi-modal alerts
- TinyML on-device object recognition
- Cloud integration for usage analytics (with privacy focus) Add GPS + GSM for emergency location sharing
- Bluetooth app for customization and voice feedback
- Haptic motors for multi-modal alerts
- TinyML on-device object recognition (person, vehicle, stairs)
- Cloud integration for usage analytics (with privacy focus)

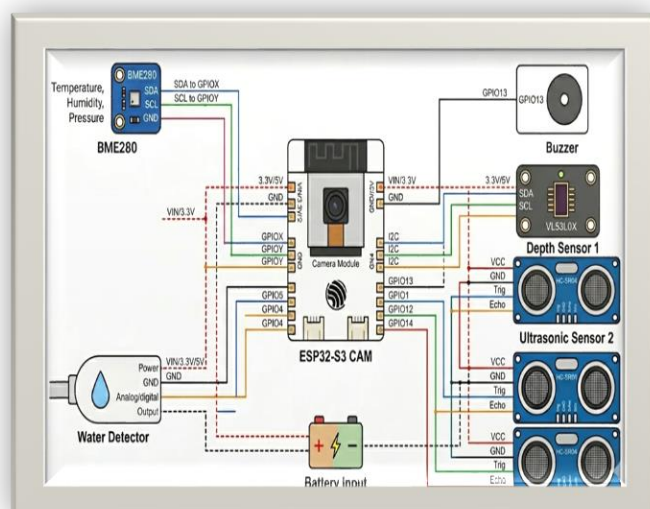


CONCLUSION

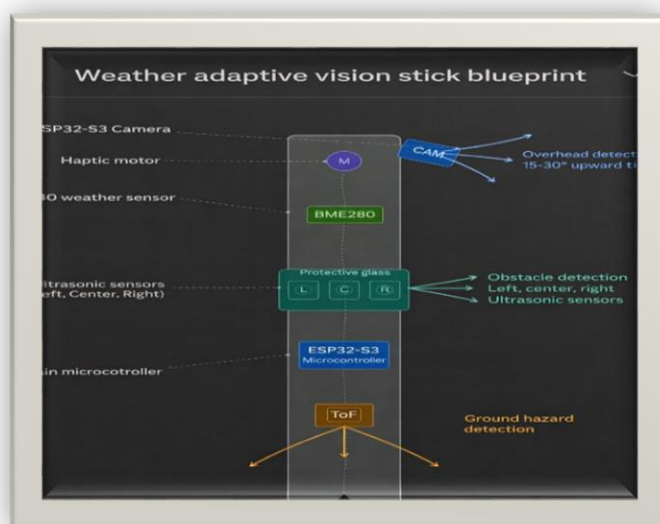
The Weather Adaptive Vision Stick proves that thoughtful integration of IoT, sensors, and adaptive intelligence can create meaningful impact in assistive technology. Built within hackathon constraints, it showcases a practical, affordable, and innovative solution that can be further developed into a real product. We believe this device has the potential to improve daily lives of millions of visually impaired people worldwide.

REFERENCES

Inspiration from various open-source smart cane projects and Sensor datasheets (ESP32-S3, VL53L0X, BME280, etc.)



Feature	Others	Vision X Edge
Price	₹20k-₹50k	₹4k-₹8k
Internet	Yes	Offline
Weight	400g+	~400g
Weather Adaptation	—	Our Algorithm
Battery Life	4-6 hr	12+ hr



AI-Powered Drone Technology for Crowd Management and Disaster Response

Aditya Poddar, Sania Nazar, Souvik Dhar, Raj Mishra Kingshuk Das
Sanghamitra Layek, and Bikas Mondal

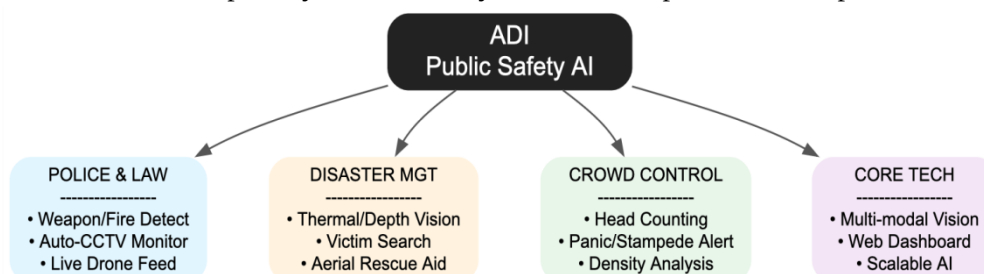
Department of Electronics and Computer Science, Narula Institute of Technology, Agarpara–
700109, India

The **ADI (Autonomous Disaster Intelligence) Drone** is an advanced aerial system built to fix the major gaps in real-time monitoring, crowd control, and disaster response. Right now, the standard ways we handle surveillance are usually slow, expensive, and rely way too much on having a stable internet connection. This is a huge issue because during a real crisis, these systems stop working effectively just when fast decisions are needed most. When response times lag and there's no clear situational awareness, the risks to people in crowded spots or disaster zones just keep going up. The ADI drone solves these current limitations by packing several sensors and offline processing into a single compact, low-cost system. Rather than relying on cloud servers, all data processing happens directly on the hardware. This architecture allows the drone to remain fully operational in environments with zero internet access. It's a design built for the real world—specifically for remote areas or disaster sites where communication networks are often completely down or non-existent. By using a mix of RGB and infrared cameras, the system can track human presence regardless of the lighting or environment. During the day, the RGB feed handles the heavy lifting for visual data, making it easy to spot people and map out movement in tight crowds. If things get dark or visibility drops due to smoke or fog—which is pretty much a given in a fire or earthquake—the infrared sensor takes over. This dual-camera setup means the monitoring doesn't just stop when conditions get tough; it stays effective 24/7.

To analyze the captured data, the system uses models such as YOLOv8 along with posture estimation and tracking techniques. These are used to study crowd density, identify unusual movements, and detect individuals who may be in distress or facing difficulty. By observing patterns in movement and posture, the system can recognize situations like panic, abnormal crowd behaviour, or individuals needing immediate help. This helps in early detection of risks before they turn into serious incidents. The drone doesn't just use its eyes; it has built-in audio sensors to pick up on things like sirens, screaming, or someone calling for help. This is huge for disasters because you can't always see people through rubble or smoke, but you can definitely hear them. By adding sound to the mix, the system becomes way better at finding trapped people who might be hidden from the camera. Combining both sight and sound makes this much more reliable than any standard camera drone. One of the important features of the ADI drone is its ability to create real-time heatmaps and generate useful insights based on the collected data. These heatmaps help in identifying heavily-dense areas, congestion points, and regions where uneven activity is taking place. By analyzing the information, authorities and organizations can take quick decisions and do faster response to critical situations. This reduces the chances of accidents such as stampedes and helps in improving overall crowd management.

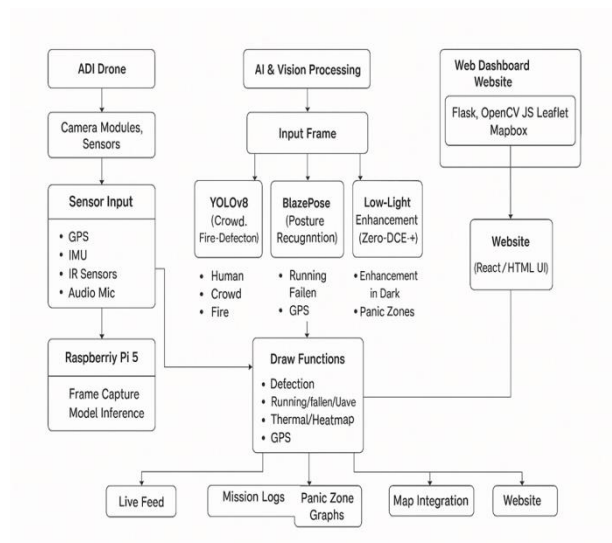
To handle the flying part, we put in GPS and an IMU so the drone basically takes care of itself. It stays stable and moves on its own without needing someone to baby the controls every single second. It can track a path and stay balanced even when the environment gets rough, which is a life-saver in actual disaster zones. In those spots, trying to fly a drone by hand is a nightmare because of all the debris and obstacles—having it navigate autonomously is the only way it actually works. The drone also has speakers built right into it so we can talk to people on the ground. This is huge when things go wrong because the drone can give out directions, lead people to safety, or warn them about something dangerous nearby. It's basically a direct way to shout out instructions and keep everyone

safe when things get messy and chaotic. A major advantage of the ADI drone is that the entire system operates without requiring internet connectivity. Unlike many commercial drones that rely on cloud-based processing, this system performs all computations onboard. This ensures that it continues to function properly even in remote areas or disaster-affected regions where network connectivity is not available. This offline capability makes the system more dependable and practical for real-world



applications. The cost of the ADI drone is another significant factor that makes it stand out. With an estimated cost of around ₹35,000 to ₹60,000, it is much more affordable compared to most commercial drones available in the market, which can cost several lakhs. Despite the lower cost, the system still provides multiple advanced features such as real-time analysis, offline processing, and multi-sensor integration. This makes it a cost-effective solution for organizations and authorities that require reliable monitoring systems but have budget limitations.

The design of the drone is modular and compact, which allows easy upgrades and future expansion. New features and improvements can be added without redesigning the entire system. This flexibility makes the project scalable and adaptable to future requirements. As technology continues to improve, the system can be enhanced with better sensors, improved processing techniques, and additional functionalities. From a feasibility point of view, the system is practical and achievable. The technologies used, such as YOLOv8, posture estimation, and GPS-based navigation, have already been tested individually. Their integration into a single system is realistic and can be implemented using platforms like Raspberry Pi. The drone can also be deployed quickly and used by authorities such as police, disaster response teams, and emergency services after basic training. Of course, there are some real-world hurdles we have to deal with. Running several AI models at once can really push the drone's hardware to its limit. Bad weather like heavy rain, high winds, or even just dust can mess with how stable it flies, and tall buildings in cities sometimes make the GPS act up. Battery life is another big one—it limits how long the drone can stay up in the air. On top of all that, we have to navigate all the legal rules and flight permissions before we can even get it off the ground. To overcome these challenges, certain strategies can be applied. Model optimization techniques can be used to improve performance. The ADI drone can really make a difference in a few big ways. Most importantly, it saves lives by spotting emergencies early so help can get there faster. It can even stop things like stampedes before they happen by watching how a crowd is moving. It's also much cheaper than those high-end commercial drones, so you don't need a huge budget or a ton of people to run it. Plus, since it's energy-efficient and catches hazards like fires early, it helps keep environmental damage to a minimum during a disaster. The system can be used by various target groups, including disaster response teams, police departments, and event organizers. It is especially useful in large gatherings such as festivals, concerts, and public events where crowd control is



important. It can also be used in rural and remote areas where traditional surveillance systems are not available.

Right now, most drones are either way too expensive or just can't do enough to be useful. Most of them are stuck needing an internet connection to work and they completely lack things like offline processing, sound detection, or live heatmaps. Because of these gaps, emergency teams are still stuck watching screens manually. We built the ADI drone to fix all of that by making a high-tech system that actually works where it's needed, without breaking the bank. Looking ahead, we could plug this system right into a smart city's existing network to handle monitoring on a massive scale. There's a lot of room to keep upgrading the AI and adding new features as we go. Because it's so easy to scale up and doesn't cost a fortune, it could really be used in all sorts of different industries, not just for disasters. It's basically built to grow along with whatever tech comes next. At the end of the day, the ADI drone is just a smarter, more practical way to keep people safe when things go wrong. By putting all that sensing tech and offline processing into one unit that flies itself, it gives rescue teams a much clearer picture of what's happening on the ground—and it does it fast. This project proves you don't need a massive budget to use high-end tech for fixing real-world problems; you just need a system that's built to actually work when the stakes are high.

AI-BASED LPG GAS LEAKAGE DETECTION SYSTEM

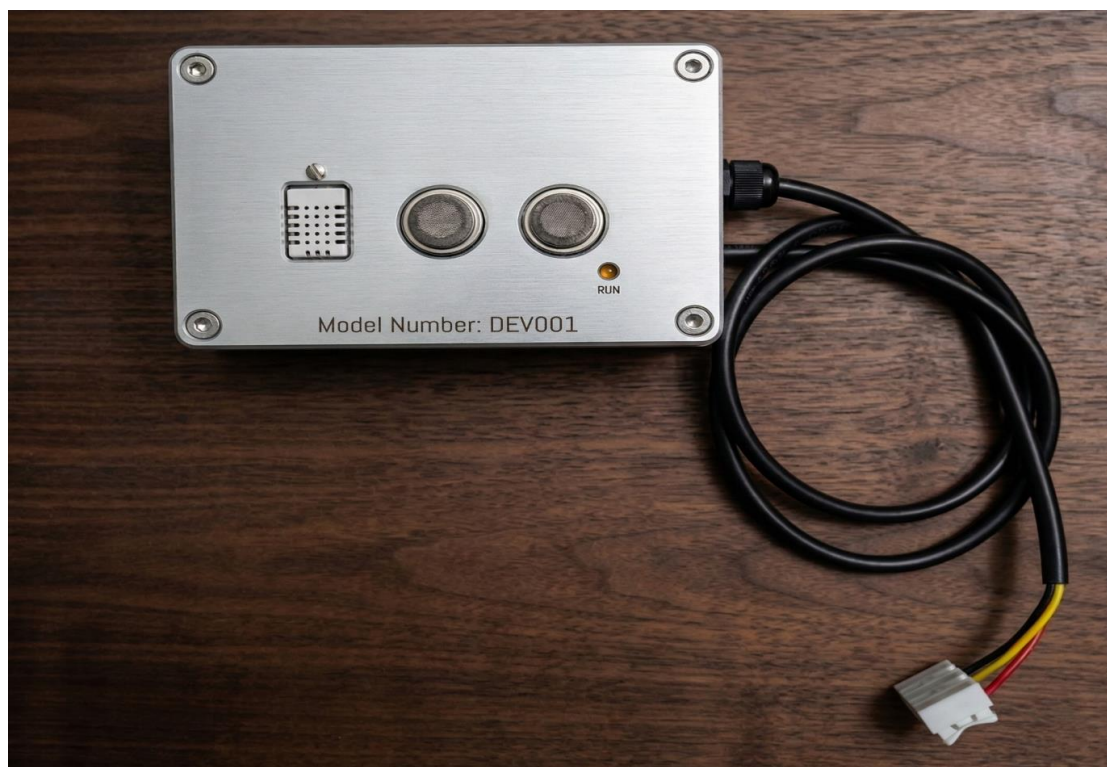
Aniket Das, Harshvardhan Mehta, Soumyadipta Seal, Anushka Paul, Dishari Ghosh, and Pushpita Roy

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PROJECT OVERVIEW

This project introduces an **AI-driven LPG Gas Leakage Detection System** that seamlessly integrates **IoT Technology with a robust Web-based Platform called LPG IoT**. This system is designed to significantly enhance safety in both domestic and commercial environments by enabling Real-Time Detection of LPG Gas Leakage and initiating immediate preventive actions.

The proposed solution ensures early-stage LPG Gas Leak identification, instant alert notifications, automated safety mechanisms, and continuous remote monitoring. By combining intelligent Hardware with a scalable Software architecture, the system delivers a smart, reliable and efficient safety infrastructure aimed at minimizing risks and preventing potential hazards associated with LPG Gas Leakage.



AI-based LPG Gas Leakage Detection Device

HARDWARE IMPLEMENTATION

The Hardware System serves as a core operational unit responsible for detecting LPG Gas Leakage and initiating immediate safety responses. It is designed using an integrated combination of MQ6 and MQ5 Gas Sensors, DHT22 Temperature and Humidity Sensor, ESP32 Microcontroller, and Control Modules, enabling efficient Real-Time Monitoring and Action.

The System primarily utilizes MQ6 and MQ5 Gas Sensors, which are highly sensitive to LPG Gas components such as Propane and Butane. These sensors continuously monitor the surrounding air and detect abnormal rise in Gas Concentration. In addition, a DHT22 sensor is incorporated to measure Temperature and Humidity, as these environmental factors can significantly influence Gas Dispersion Patterns.

All the sensors are interfaced with ESP32 Microcontroller, which acts as Central Processing Unit of the System. It processes the incoming sensor data in real time and determines whether the environment is safe or potentially hazardous.

A Relay Module is integrated to control Electrical Appliances. When the LPG Gas Leakage is detected, the System automatically cuts off the Room's Power Supply, reducing the risks of Sparks and Fire Hazards. At the same time, a Buzzer is activated to immediately alert occupants. Further, a System-generated Call is triggered to the User.

To further enhance safety, a Ventilation Mechanism is included through controlled fan activation. This helps dispersing the leaked gas, thereby lowering the risk of Fire and Explosion. All components work in coordination to ensure that detection is immediately followed by preventive action.

Overall process of Hardware System:

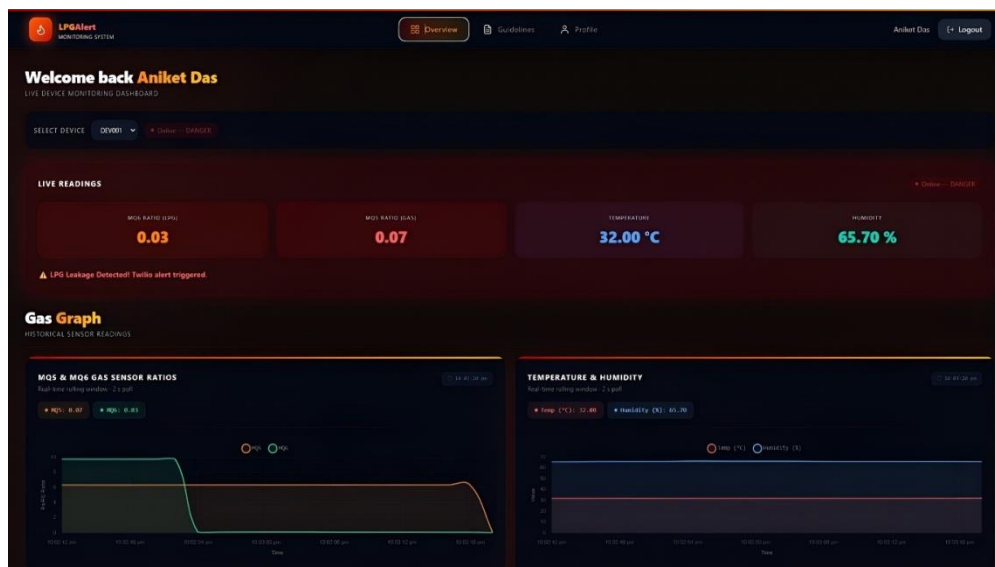
- Sensors continuously monitor gas levels and environmental conditions.
- Microcontroller processes sensor data in Real-Time.
- If gas level exceeds pre-defined thresholds, leakage is detected.
- Safety actions (Buzzer Alert, Relay-based Power cut-off, and Ventilation Fan) are triggered. Also, a System-generated Call is triggered to the User.
- Data is transmitted to the Server for further processing and monitoring.

This Hardware setup ensures Real-Time Detection, rapid response, and automated safety control, making it a highly reliable solution for LPG Gas Leakage prevention in both domestic and commercial environments.

SOFTWARE IMPLEMENTATION

The Software System is designed to provide seamless User Interaction, Real-Time Monitoring, and Efficient Data Management through a Web-based Platform called LPG IoT. The Platform features a User-friendly Interface, ensuring easy accessibility and smooth navigation for users across different environment.

User Dashboard Interface



The Platform includes multiple functional modules such as Device Booking, Contact Support, User Feedback, and ChatBot Assistance, making it a comprehensive and User-Centric Solution. Through the Booking System, users can purchase the LPG Leakage Device via a secure Online Payment process. Upon Successful Booking, the System generates a unique Device ID, which is used to link the User with their respective LPG Gas Leakage Device.

During Registration, Users provide essential details including their Device ID, Name, Email Address, Password, Home Address, Primary Mobile Number, and Secondary Mobile Number. In cases, where a Secondary Mobile Number is not provided, then a nearby Fire Station Contact Number is automatically assigned as Secondary Contact. All User Information is securely stored in a MongoDB Database, ensuring reliable, scalable and secure Data Management.

The Platform includes several Support and Interaction Features:

- A Contact Page for handling User Queries and Support Requests.
- A Feedback Page for collecting User Experiences and Suggestions.
- An Integrated ChatBot System that provides Quick Guidance and Assistance, enhancing User Experience.

A key component of the Platform is the Real-Time Monitoring Dashboard, which displays live data received from the respective LPG Gas Detection Device. Users can monitor critical parameters such as:

- Current Gas Levels
- Room Temperature & Humidity
- LPG Gas Leakage Detection Status (Detected/Not Detected)

The Platform also provides Historical Data and Analytics, enabling Users to analyze Gas-usage Patterns and identify potential risks over time.

Additionally, a dedicated Safety Guideline section is included to educate users about the preventive measures, emergency response procedures, and best safety practices.

A critical feature of the System is its Multi-Level Automation Alert and Notification Mechanism, designed to ensure rapid response during LPG Gas Leakage incidents.

In the event of LPG Gas Leak, the System retrieves the User's Registered Contact Details from the Database and immediately initiates a System-generated Phone Call to User's Primary Contact Number. If the Call is declined or unanswered, the System escalates the Response by sending an SMS Alert to the Primary Number. Simultaneously, the System triggers a System-generated Phone Call to User's Secondary Contact Number. If this Call is also declined or unanswered, an additional SMS Alert is sent to the Secondary Number, ensuring Alert at least reaches the User. This Sequential Escalation Mechanism guarantees that multiple communication channels are utilized, significantly increasing the chances of timely awareness and intervention.

Overall, the Software System acts as a bridge between the User and the LPG Gas Leakage Device Hardware, delivering Real-Time Insights, Emergency Assistance, and a Centralized Platform for monitoring and controlling effectively Safety Management.

INTEGRATION OF HARDWARE AND SOFTWARE

The effectiveness of this Project lies in the seamless integration of Hardware and Software Systems, enabling a unified and intelligent Safety Solution. The LPG Gas Leakage Device continuously collects environmental and gas concentration data and transmits it to the Web Server via Internet. This Real-Time Data Exchange ensures smooth coordination between the Physical Device and the Web-based Platform, allowing for instant processing and response.

This integration establishes a Complete Smart Safety Ecosystem, where Detection (Hardware), Data Processing (Microcontroller & Server), Alerting (Notification System), and Monitoring (Web Platform) operate simultaneously and efficiently.

The result is a highly responsive, automated, and reliable system that enhances safety by minimizing Human Intervention and ensuring timely preventive action.

AUTOMATED SAFETY FEATURES

The system is designed to execute immediate automated safety actions upon detecting LPG Gas Leakage, ensuring rapid response and minimizing potential hazards. These actions are triggered in Real-Time without requiring any Manual Intervention.

The key Automated Safety Measures include:

1. Automatic Power cut-off is achieved using a Relay Module, which instantly disconnect Room's Electric Power Supply, reducing the risk of Sparks and fire Hazards.
2. A **Ventilation Fan is automatically activated** to disperse the accumulated LPG Gas within the room, lowering the LPG Gas Concentration and reducing the risk of explosion.
3. A **Buzzer Alarm** is triggered to provide immediate On-Site Alerts, warning occupants about the LPG Gas Leakage.

4. A Multi-Level Automated Alert Mechanism retrieves the User's Registered Contact Details from the MongoDB Database and immediately initiates a System-generated Phone Call to User's Primary Contact Number. If the Call is declined or unanswered, the System escalates the Response by sending an SMS Alert to the Primary Number. Simultaneously, the System triggers a System-generated Phone Call to User's Secondary Contact Number. If this Call is also declined or unanswered, an additional SMS Alert is sent to the Secondary Number, ensuring Alert at least reaches the User.

This Sequential Escalation Mechanism guarantees that multiple communication channels are utilized, significantly increasing the chances of timely awareness and response.

CONCLUSION

This project presents a Smart Infrastructure Solution that effectively combines AI, IoT, and Web Technologies to address a Critical Safety Concern associated with LPG Gas Leakage. By integrating Real-Time LPG Gas Detection, Automated Response Mechanisms and a User-Friendly Monitoring Platform, the System ensures a high level of Safety, Reliability and Operational Efficiency.

The System's coordinated, automated Safety Actions further contribute to reduced Response Time, Minimal Human Dependency, and Enhanced Overall Safety, making it highly effective in preventing LPG-related Accidents.

The LPG IoT System is Scalable, Cost-Effective, and Adaptable, making it suitable for widespread deployment, particularly in regions with high LPG Gas Usage. It represents a meaningful step towards building Safer, Smarter, and more Connected Environments, leveraging Modern Technology for proactive Risk Management and improved Public Safety.

AI-Powered Smart Traffic Management System

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INTRODUCTION

: In cities today, traffic jams are a big problem because the number of vehicles is growing very fast. Old traffic signals work on fixed timers, meaning they change after a set time whether there is traffic or not. This system does not work well and causes long waits, wasted fuel, and more pollution. This project offers a better solution by using artificial intelligence to manage traffic based on real-time conditions.

OBJECTIVES

The goal of this project is to detect vehicles using AI, count how many vehicles are on the road, change signal timings automatically based on traffic density, and reduce congestion so that traffic moves more smoothly.

METHODOLOGY

The system uses a camera and a smart computer program to see and understand traffic. A camera is placed at an intersection to record live video. This video is then analyzed using a technology called YOLO, which can identify different types of vehicles like cars, bikes, buses, and trucks. The system counts these vehicles and determines whether the road is crowded or empty. Based on this information, it decides how long the traffic light should stay green. A road with more vehicles gets a longer green light, while an empty road gets a shorter one. Tools and Technologies: To build this system, the project uses Python as the programming language, OpenCV to process images from the camera, and YOLO as the AI model that detects vehicles.

EXPECTED OUTCOME

: Once completed, the system will be able to detect vehicles accurately in real-time, estimate traffic density correctly, and make smart decisions about signal timings. This will help reduce traffic jams and make waiting times shorter for drivers.

APPLICATIONS AND ADVANTAGES

This system can be used for smart traffic signals, city traffic management, and highway monitoring. It works in real-time, is affordable because it uses existing cameras, and can be expanded to cover many intersections. It also helps save fuel and reduce pollution by cutting down the time vehicles spend idling at red lights. Scope: In the future, this system can be improved to detect emergency vehicles like ambulances and fire trucks and give them priority at signals. It can also be connected to multiple

lanes and multiple signals for better coordination, and it can be linked to the cloud for city wide traffic monitoring as part of a smart city project.

CONCLUSION

: This project shows that artificial intelligence can help solve everyday traffic problems. By using live data and smart technology, traffic signals can become more intelligent, leading to better traffic flow, less waiting, and a cleaner environment.

MeetMind — AI-Powered Meeting Intelligence Platform: A Smart System for Automated Transcription, Analysis, and Q&A

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OVERVIEW OF THE PROJECT

MeetMind is an AI-powered meeting intelligence platform designed to automate transcription, summarization, and extraction of actionable insights from meeting recordings. It leverages advanced speech recognition and natural language processing techniques to convert raw meeting data into structured and useful information.

INTRODUCTION

Meetings are an essential part of communication in organizations, but they generate large amounts of unstructured data. Manual note-taking is inefficient and often leads to missing critical information. MeetMind solves this problem using AI technologies such as speech recognition and large language models.

PROBLEM STATEMENT

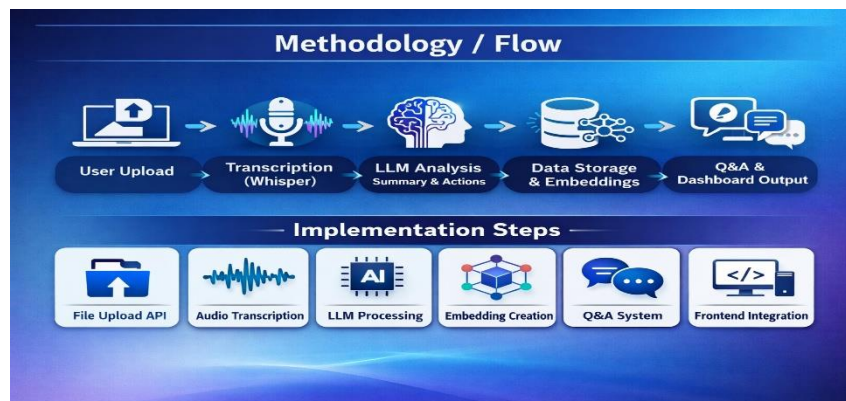
Meetings produce unstructured data
Important decisions are missed
Manual note-taking is inefficient
No intelligent search system

OBJECTIVES

Automate transcription
Extract key insights
Enable intelligent Q&A
Improve productivity

METHODOLOGY

User Upload → Transcription (Whisper) → LLM Analysis → Embeddings → Q&A



IMPLEMENTATION

FastAPI backend
Whisper integration
LLM processing
RAG-based Q&A system
React frontend

RESULTS

The system successfully generates accurate transcriptions, summaries, and answers contextual queries based on meeting data.

CONCLUSION

MeetMind improves productivity by automating meeting workflows using AI and provides an efficient solution for managing and analyzing meetings.

PhishGuard 360: AI-Powered Email Threat Detection

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PhishGuard 360 is an advanced cybersecurity solution designed to combat the rapidly growing threat of phishing attacks by leveraging the power of artificial intelligence, machine learning, and natural language processing to detect and prevent malicious emails in real time. In the modern digital landscape, email remains one of the most widely used communication tools for individuals, businesses, and government organizations, but it is also a primary target for cybercriminals who exploit human trust through deceptive messages that appear legitimate. Traditional email filtering systems, which rely on rule-based approaches such as keyword matching, blacklists, and basic spam detection, are no longer sufficient to counter increasingly sophisticated phishing attacks, especially those generated using AI that can mimic human writing styles, personalize content, and bypass conventional security measures. PhishGuard 360 addresses these limitations by implementing a multi-layered intelligent detection system that analyzes email content, metadata, URLs, attachments, and user behaviour to identify hidden patterns and anomalies associated with phishing attempts. The system begins with a data collection phase, where it gathers both legitimate and phishing email datasets, followed by a preprocessing stage that cleans and structures the data through techniques such as tokenization, normalization, and stop word removal. It then performs feature engineering to extract meaningful attributes, including sender authenticity, domain reputation, suspicious links, linguistic cues such as urgency or fear-based language, and behavioural indicators such as unusual communication patterns. At the core of the system lies the AI detection engine, which utilizes a combination of machine learning algorithms like Naïve Bayes, Support Vector Machines, and Random Forest, along with deep learning models such as Long Short-Term Memory (LSTM) networks and transformer-based architectures, to classify emails with high accuracy. By using ensemble learning techniques, PhishGuard 360 enhances prediction reliability and reduces false positives and false negatives, ensuring that legitimate emails are not incorrectly flagged while malicious ones are effectively blocked. The system operates in real time, scanning incoming emails, assigning risk scores, and categorizing them into safe, suspicious, or phishing, while also providing users with clear explanations through explainable AI (XAI) techniques to build trust and awareness. Additionally, PhishGuard 360 incorporates continuous learning mechanisms, allowing the model to adapt to new and evolving phishing strategies by updating itself with fresh data, making it a future-ready solution in the ever-changing cybersecurity landscape. The project is implemented using technologies such as Python, machine learning libraries like Scikit-learn and TensorFlow, and web frameworks like Django or Flask, with a user-friendly interface that displays alerts, analytics, and threat insights. Its applications span across multiple sectors, including corporate environments, banking systems, educational institutions, government agencies, and individual users, where it plays a critical role in safeguarding sensitive information and preventing financial and data losses. Despite its advantages, the system also faces challenges such as handling adversarial attacks, ensuring data privacy, and maintaining scalability, which can be addressed through future enhancements like cloud integration, multi-language support, blockchain-based email authentication, and federated learning. Overall, PhishGuard 360 represents a powerful and intelligent approach to email security, combining advanced AI technologies with practical usability to create a robust defense mechanism against phishing threats, ultimately contributing to safer digital communication and increased cybersecurity resilience in today's interconnected world.



Fig:1

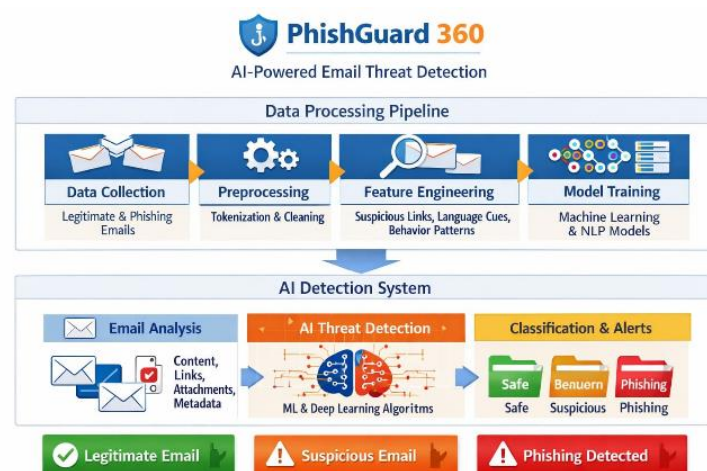


Fig:2

DEEFAKE DETECTION USING MACHINE LEARNING AND DEEP LEARNING TECHNIQUES

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ABSTRACT

The rapid advancement of artificial intelligence and deep learning has enabled the creation of highly realistic synthetic media, commonly known as deepfakes. While such technologies have beneficial applications in entertainment and content creation, their misuse poses significant threats in the form of misinformation, identity theft, and digital manipulation. Detecting deepfake content has therefore become a critical challenge in ensuring digital authenticity and security. This project presents a robust deepfake detection system that integrates computer vision and deep learning techniques to identify manipulated videos. The proposed solution combines OpenCV for preprocessing, YOLO (You Only Look Once) for face detection, and a hybrid deep learning architecture consisting of Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks for classification. The system is trained on the FaceForensics dataset using Google Colab with GPU acceleration to ensure efficient learning. A user-friendly web application is developed using Streamlit, enabling users to upload videos and receive real-time predictions regarding their authenticity. The combination of spatial and temporal feature analysis allows the system to detect subtle inconsistencies in facial features and motion patterns. Experimental results demonstrate that the hybrid CNN-LSTM model significantly improves detection accuracy compared to standalone models. This work contributes toward building reliable tools for combating deepfake threats and enhancing trust in digital media.

INTRODUCTION

In recent years, deepfake technology has emerged as a powerful application of deep learning, capable of generating highly realistic fake videos by manipulating facial features and expressions. These videos are often indistinguishable from real ones, making them a serious concern in domains such as social media, journalism, and cybersecurity. Deepfakes are typically generated using generative adversarial networks (GANs) or autoencoder-based architectures, which learn to replicate human facial expressions and movements. While these techniques have legitimate uses in film production and virtual reality, they have also been exploited for malicious purposes such as spreading fake news, impersonation, and fraud. The increasing accessibility of deepfake tools has made it possible for individuals with minimal technical expertise to create convincing fake content. This highlights the urgent need for automated systems capable of detecting such manipulations. Traditional detection methods often rely on handcrafted features and fail to generalize across different types of deepfakes. Therefore, deep learning-based approaches that can learn complex patterns directly from data are more effective. This project focuses on designing and implementing a deepfake detection system that leverages both spatial and temporal analysis to improve detection accuracy. By combining CNN and LSTM architectures, the system captures both frame-level and sequence-level inconsistencies, providing a comprehensive solution.

OBJECTIVES

The primary objectives of this project are:

- ☐ To develop an efficient system for detecting deepfake videos
- ☐ To utilize hybrid deep learning techniques for improved accuracy
- ☐ To analyse both spatial (frame-based) and temporal (sequence-based) features
- ☐ To build a real-time, user-friendly web application using Streamlit
- ☐ To train and validate the model using a reliable dataset (FaceForensics)
- ☐ To create a scalable solution suitable for real-world applications

LITERATURE OVERVIEW

Recent research in deepfake detection has explored various approaches, including frequency-based analysis, biological signal detection, and deep learning models. Convolutional Neural Networks (CNNs) have been widely used for detecting visual artifacts such as blurring, colour mismatches, and unnatural textures in manipulated images. However, deepfake videos also exhibit temporal inconsistencies that cannot be captured by CNNs alone. Recurrent neural networks, particularly Long Short-Term Memory (LSTM) networks, have been introduced to analyse sequential data and detect irregular motion patterns across frames. Hybrid models combining CNN and LSTM have shown promising results, as they leverage both spatial and temporal features. Additionally, object detection algorithms like YOLO have been used to improve preprocessing efficiency by accurately localizing faces in video frames. This project builds upon these advancements by integrating multiple techniques into a unified system for improved performance.

METHODOLOGY

The proposed system follows a structured pipeline consisting of multiple stages:

Data Collection

The FaceForensics dataset is used for training and evaluation. It contains a large collection of real and manipulated videos generated using different deepfake techniques, ensuring diversity and robustness.

Video Preprocessing

OpenCV is used to process input videos. Each video is decomposed into frames, which are then resized and normalized. Redundant frames are removed to reduce computational overhead.

Face Detection using YOLO

YOLO is employed to detect faces in each frame. It is a real-time object detection algorithm known for its speed and accuracy. The detected facial regions are cropped and used as inputs for further processing.

Spatial Feature Extraction using CNN

A Convolutional Neural Network is used to extract spatial features from the detected faces. CNN layers identify patterns such as edges, textures, and facial structures that may indicate manipulation.

Temporal Feature Learning using LSTM

To capture temporal dependencies, the sequence of extracted features is passed to an LSTM network. This helps identify inconsistencies in motion, blinking patterns, and facial expressions over time.

Model Training

The combined CNN-LSTM architecture is trained using Google Colab with GPU acceleration. The dataset is split into training and validation sets. Optimization techniques such as Adam optimizer and appropriate loss functions are used to enhance performance.

Prediction and Classification

The trained model outputs a binary classification: real or fake. A confidence score is also generated to indicate prediction reliability.

IMPLEMENTATION

The system is implemented using the following technologies:

- ☐ OpenCV: Frame extraction and preprocessing
- ☐ YOLO: Real-time face detection
- ☐ CNN: Spatial feature extraction
- ☐ LSTM: Temporal sequence modeling
- ☐ Google Colab: Model training with GPU support
- ☐ Streamlit: Web application development

Workflow:

1. User uploads a video via the Streamlit interface
2. Video is processed frame-by-frame using OpenCV
3. Faces are detected using YOLO
4. Extracted faces are passed through the CNN-LSTM model
5. Model predicts whether the video is real or fake
6. Result is displayed along with confidence score

The Streamlit interface ensures ease of use, allowing even non-technical users to interact with the system efficiently.

RESULTS AND DISCUSSION

The proposed system demonstrates strong performance in detecting deepfake videos. The hybrid CNN-LSTM model outperforms standalone CNN models due to its ability to analyse temporal information.

Key Findings:

- ☐ Improved accuracy with hybrid architecture
- ☐ Effective detection of subtle motion inconsistencies
- ☐ Fast preprocessing due to YOLO
- ☐ Real-time usability via Streamlit

Limitations:

- ☐ Performance may decrease for highly sophisticated deepfakes
- ☐ Requires significant computational resources during training
- ☐ Sensitive to low-quality or heavily compressed videos

APPLICATIONS

The system has wide-ranging applications, including:

- ☐ Social Media Monitoring: Detecting fake videos before they spread
- ☐ Journalism: Verifying authenticity of media content
- ☐ Cybersecurity: Preventing identity fraud and impersonation
- ☐ Digital Forensics: Assisting investigations
- ☐ Legal Systems: Providing evidence verification tools

FUTURE SCOPE

Future improvements can include:

- ❑ Expanding the dataset for better generalization
- ❑ Implementing real-time video stream detection
- ❑ Integrating audio-based deepfake detection
- ❑ Deploying the system on cloud platforms
- ❑ Using advanced architectures such as Vision Transformers

CONCLUSION

Deepfake technology presents a growing challenge in maintaining the authenticity of digital media. This project proposes a comprehensive deepfake detection system that combines computer vision and deep learning techniques to effectively identify manipulated videos. By leveraging CNN for spatial analysis and LSTM for temporal modeling, the system achieves improved accuracy and robustness. The integration of the model into a Streamlit-based web application makes it accessible and practical for real-world use.



Fig 1: UI of the WebApp

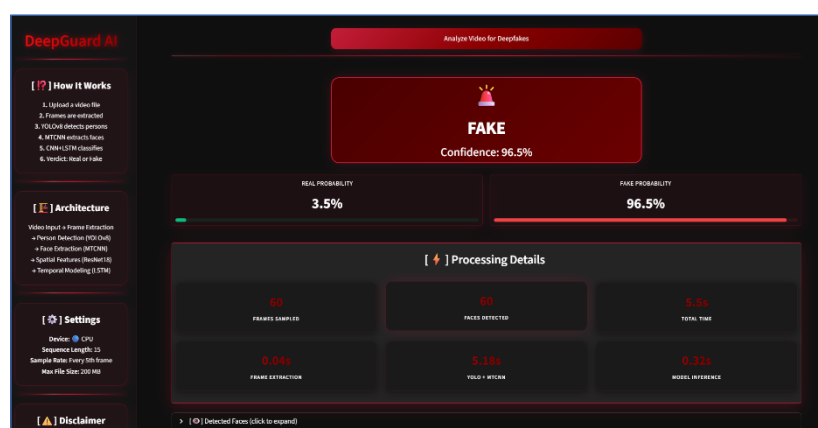


Fig 2: Final Verdict after analyzing the video

RotoGuard : Continuous Machine Health Monitoring via Acoustic Analysis

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THE VISION: WHAT WE ARE MAKING

We are developing an AI-driven early warning system that predicts industrial machinery failures **before they happen**. Think of it as a continuous "fitness tracker" for heavy factory equipment. Just as a smartwatch monitors a person's heart rate to gauge their health, our system uses physical sensors to track a machine's vital signs—such as subtle shifts in **sound frequencies**, unusual **vibrations**, or sudden **temperature** spikes. By continuously analyzing this data with our **own AI**, the system acts as an advanced diagnostic tool, capable of predicting a mechanical malfunction **5 to 7 days** before the hardware actually breaks down. All of this live telemetry is fed into a **website centralized dashboard**, giving factory managers a single, clear website to monitor equipment health, analyze historical performance trends, and receive the instant alerts necessary to prevent costly downtime.

THE PROBLEM: THE HIDDEN COST OF FACTORY OPERATIONS

In large-scale manufacturing, machines are the lifeblood of the operation. However, factories currently face a massive problem: unexpected equipment failure.

Right now, most factories rely on two types of maintenance. The first is "reactive"—waiting for a machine to break down and then rushing to fix it. The second is "scheduled"—replacing parts every few months whether they need it or not, just to be safe. Both approaches are incredibly **expensive**.

When a machine fails unexpectedly, the entire production line stops. Workers stand idle, deadlines are missed, and a minor issue (like a worn-out gear) can suddenly destroy an entire engine. The problem is that a machine rarely just stops working out of nowhere. It whispers before it screams. But on a loud, busy factory floor, human operators cannot catch those **microscopic changes in sound or temperature**. By the time a machine is visibly smoking or shaking violently, the catastrophic damage is already done.

THE SOLUTION: WHAT OUR PRODUCT DOES

Our product sits directly on or near the factory machinery and constantly listens to and feels the equipment. It focuses on three specific vital signs:

- **Sound:** Every machine has a baseline "hum." Long before a part snaps or grinds to a halt, it changes its tune. It might be a subtle whine, a tiny click, or an irregular scrape. Our device captures these microscopic audio changes that human ears miss.

- **Heat:** Friction creates heat. If a bearing is wearing down or a belt is slipping, that specific area will start to get unusually warm. We monitor these temperature changes continuously.
- **Vibration:** A balanced machine runs perfectly smooth. If a gear is misaligned or a high-torque motor is taking too much strain in a heavy-duty mechanical build, it starts to shudder. We measure these physical vibrations.

By themselves, these signs might just look like random data. But our product feeds the sound, heat, and vibration information into our own AI system which we trained for this specific purpose. The AI learns the "perfect pitch" of how that specific machine is supposed to run. It instantly spots when the machine goes out of tune, connecting the dots between a slight temperature rise and a new humming noise to understand exactly what is happening inside the metal casing.

THE IMPACT: HOW IT HELPS THE FACTORY

Implementing this system transforms a factory's operations in several high-impact ways:

1. **Eliminating Surprise Downtime:** The biggest financial drain on a factory is a halted production line. By predicting a failure weeks in advance, the factory can plan to swap out the failing part during a scheduled shift change or a weekend, ensuring production never stops unexpectedly.
2. **Drastically Reducing Repair Costs:** Fixing a single, slightly worn bearing might cost fifty dollars. Replacing a massive motor because that ignored bearing eventually shattered and destroyed the engine costs thousands. By catching problems at their absolute earliest stage, factories save massive amounts of money on replacement parts.
3. **Increasing Workplace Safety:** Heavy machinery failures can be dangerous. A snapping belt or an overheating engine puts the factory floor workers at immediate risk. Predicting these hazards keeps the environment safe for everyone.
4. **Extending Machine Lifespan:** Factory equipment is pushed to its absolute limits. By ensuring every machine is running without hidden friction or vibration, our system ensures these multi-million dollar assets last years longer than they normally would.

In short, we are giving a **voice to the machines**, allowing them to tell operators exactly what they need and when they need it, turning chaotic, reactive factories into smooth, predictable, and highly efficient operations.

ROTOGUARD: PROJECT DATA FLOW

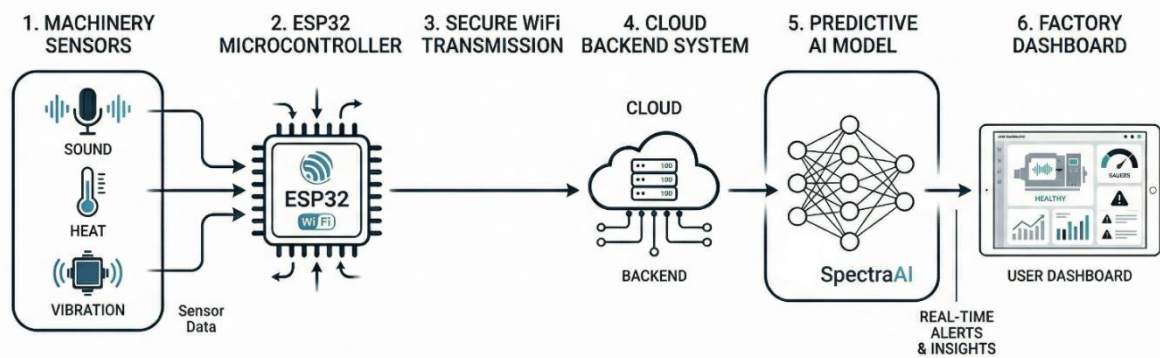


Fig 1: Data Flow-Chart of the whole system.

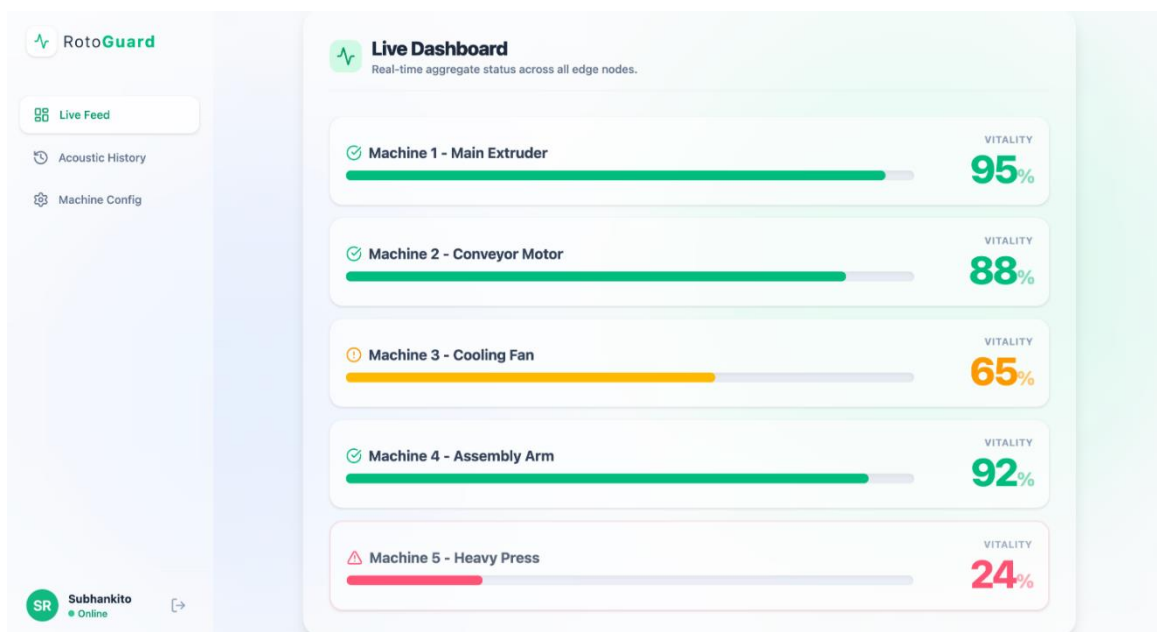


Fig 2: Live dashboard of the whole factory (actual footage, ready to use)

JobTracker with Smart AI Career Assistant

Sonia Ghosh, Madhavi Kumari, Md Zeeshan Khan, and Kaushik Sarkar

Department of ECE, Narula Institute of Technology, Kolkata, India

OVERVIEW OF THE PROJECT

JobTracker with Smart AI Career Assistant is a full-stack web application designed to help students and job seekers manage their job and internship applications efficiently. The platform integrates intelligent AI capabilities directly into the job search workflow, offering resume analysis, job match scoring, interview preparation, and predictive analytics — all within a single, streamlined interface.

HOW THE WEBSITE WORKS

The platform is organized into four primary sections accessible via the navigation bar: Overview, Applications, AI Analyzer, and Success Predictor. Upon login, users are greeted by name and can immediately begin tracking applications or analyzing their profile.

WEBSITE SCREENSHOTS

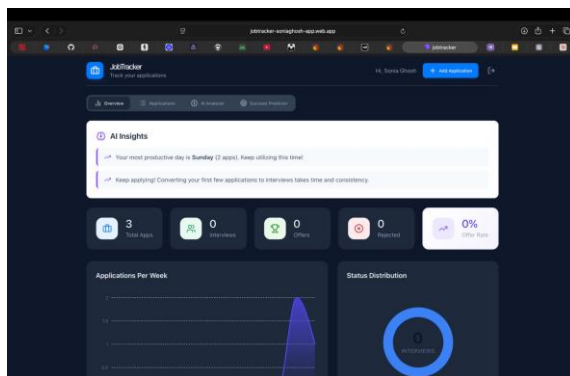


Fig 1: Overview Dashboard

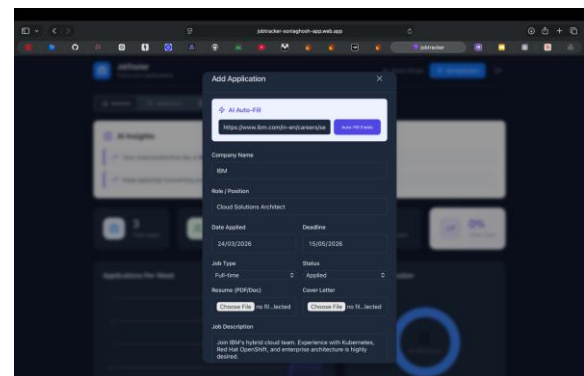


Fig 2: Add Application (AI Auto-Fill)

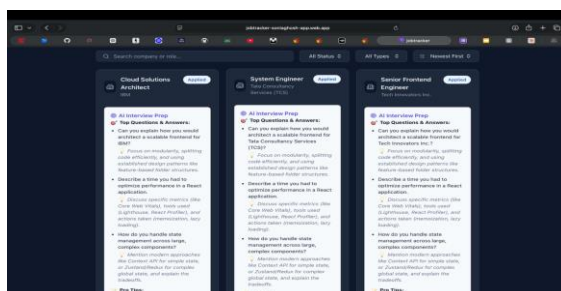


Fig 3: AI Interview Prep

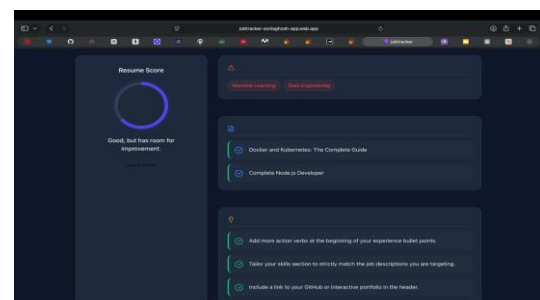


Fig 4: AI Resume Analyzer Results

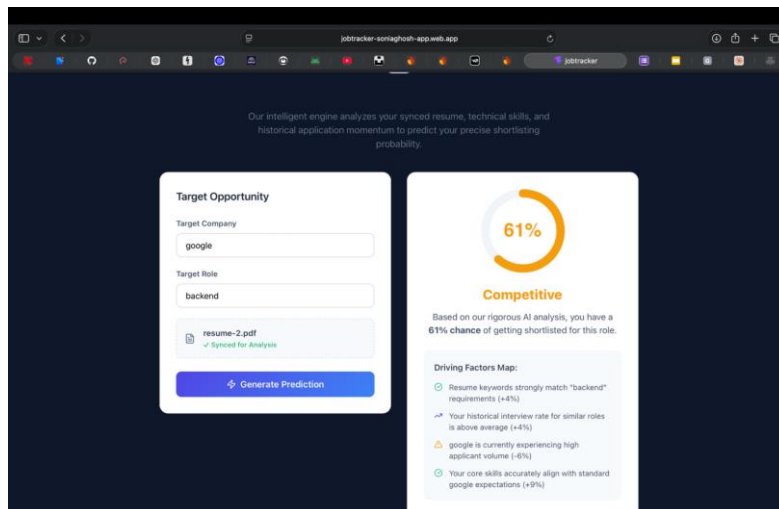


Fig 5: Success Predictor — Job Shortlisting Score

CORE FEATURES

The **Overview Dashboard** (Fig 1) displays AI-generated insights, key metrics (Total Apps, Interviews, Offers, Rejected, Offer Rate), an Applications Per Week line chart, and a Status Distribution donut chart — giving users an instant snapshot of their job search health.

Add Application with AI Auto-Fill (Fig 2): Users paste a job URL and the AI automatically extracts the company name, role, required skills, job description, and deadline. Additional fields for resume, cover letter, job type, and status can be filled manually or auto-populated.

AI Interview Prep Generator (Fig 3): For each tracked application, the AI generates role-specific interview questions with detailed model answers and pro tips, covering technical and behavioral aspects tailored to the target company and position.

SPECIAL AI-POWERED FEATURES

AI Resume Analyzer (Fig 4): After uploading a resume, the AI returns a quality score with a visual gauge, highlights missing skills such as Machine Learning and Data Engineering, recommends relevant courses (e.g., Docker and Kubernetes, Node.js), and provides specific resume improvement tips like adding action verbs and linking a GitHub portfolio.

Success Predictor (Fig 5): Users enter a target company and role; the AI analyses the synced resume, technical skills, and historical application momentum to generate a shortlisting probability score. A Driving Factors Map breaks down contributing elements — for example, a 61% Competitive score for a Google Backend role with factors such as keyword match (+4%), interview rate (+4%), and applicant volume (-6%).

Smart Reminder System: Context-aware reminders go beyond basic deadline alerts, sending nudges such as "You haven't applied in 5 days" or "Follow up on your TCS application" to maintain a consistent and strategic job search pace.

CONCLUSION

JobTracker with Smart AI Career Assistant transforms the job search experience by combining application management with AI-driven insights and personalized guidance. It is designed to be the ultimate companion for students and early career professionals seeking to navigate the competitive job market with clarity, strategy, and confidence.

ABOUT ELMAX

A Journey of Innovation and Success

- Software Developer
- Helps in Skill Development
- Academic Engagement
- Research Activities
- Make in India Initiatives

OVERVIEW

ELMAX Systems & Solutions has been a pioneer in the market segment of Engineering Design & Simulation catering to the needs of different sectors encompassing Academia and Industry. ELMAX understands the rising demand and diversifying application trends and hence has come up with its own set of solutions in certain application areas in the eco-space of Robotics, Electric vehicles etc.

We do have experience in the Supply, Installation, and Training of MATLAB along with toolboxes across the Polytechnics & Engineering Institutes in the State of Odisha and Bihar. We do provide a different set of short-term and long-term training programs for faculties and students in different areas of emerging technologies like AI, IoT, ROBOTICS, EV, etc. Our strong Application Team on its own does the physical and mathematical modeling of a system, various Engineering Design, Simulates and Validates the scientific result on Software Environment.

OBJECTIVES

- Skilling up students with Industry ready skills like Manufacturing, Robotics, EV, AI etc.
- System design, development and testing on appropriate software platforms.
- Integration of MATLAB and SOLIDWORKS for industrial case studies.
- Project based learning with different programmable hardware.
- FDPs, Internship Programs, Workshops on engineering domains driven by us.
- Guidance to students to sit for global certification exams at different level.
- Domain specific ONRAMP workshops for additional certification.



OUR DESIGN SOLUTIONS

We have also moved into 3D Design to manufacturing and Simulation with SOLIDWORKS as one of our product lines. We are partners of SOLIDWORKS (Dassault Systemes), a world leader in the 3D Designing & Simulation Software. Herein we have a complete set of Software tools for 3D CAD / CAM to work on a wide range of product lines like Sheet Metal to Plastics, Simulation including FEA and CFD tools, for Robotic Design or maybe sustainability analysis.

Our synergy activity in 3D Printing has been welcomed by the Industry, so we tied up with Make3D to foray into additive manufacturing. Our journey finally now embarks into the arena of Design and Consultancy for third party products.

OUR CONTRIBUTION TOWARDS ENGINEERING EDUCATION

We adequately prepare students for success in the career growth. Thus, the skill development program is necessary to acquire advanced knowledge in the industry relevant area and skills for industrial development. The students in this program should be able to work in prestigious companies, institutions, R&D labs or create a start-up of its own. Our Core strength is Academia as we have closely worked with Engineering education in entire East and North- East India for last more than twenty five (as ELMAX Group). Today most of the Engineering Institutions including I.I.Ts, N.I.Ts, State universities, Private Universities and colleges are our customers.



Your Solutions Partner

www.elmaxsystemsandsolutions.in

OUR LATEST PROJECT OVERVIEW :

MATLAB & SOLIDWORKS SOFTWARE TRAINING PROGRAM CONDUCTED BY ELMAX SYSTEMS AND SOLUTIONS



TOT TRAINING PROGRAM IN BIHAR

The training on SOLIDWORKS Education for **38 Government Engineering Colleges** and **46 Government Polytechnic institutes**.

In Polytechnic and Graduate Engineering Education, we are probably the most competent people as we have completed Supply, Installation and Training of MATLAB Software for upskilling the students in

- **All 28 Govt. Polytechnic Institutes in Odisha**

Project: Supply, installation and training of MATLAB to Polytechnics under DTET, Odisha

Duration: 2018-19 and 2019-20 FY , Status: Successfully completed.

- **All 44 Govt. Polytechnic Institutes under DSTTE Bihar**

- **30 Govt. Engineering Institutes under DSTTE Bihar**

Enhancing skills in SolidWorks through Supply, Installation, and Training in Bihar in

- **38 Government Engineering Colleges**

- **46 Government Polytechnic Colleges**

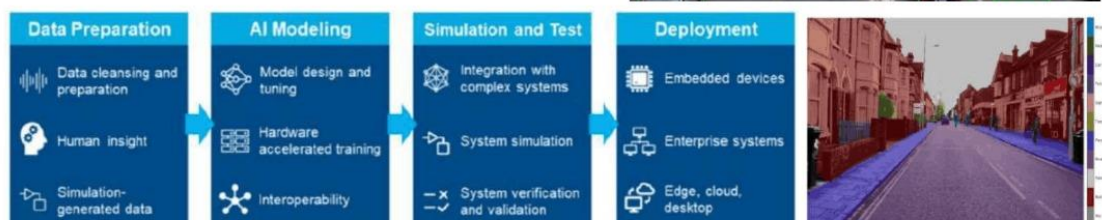
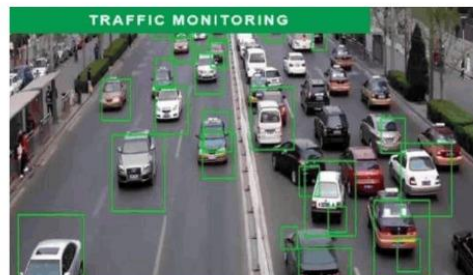


Empowering AI Skills with MATLAB Software for Industry & Academia

MATLAB is a popularly used software platform having relevant tools of AI which provides an easy way of developing smart systems both programmatically as well as interactive apps. Machine Learning and Deep Learning algorithms can be designed using inbuilt flexible tools.

Proficiency in AI +X using MATLAB

The platform also provides model-based design facility where an AI-driven smart system can be developed. A simple and well-defined workflow can be formulated for performing an AI+ X applications in Electrical Machine, Power System, Control System, Signal and Image Processing, Communications, Test and Measurement, Power Electronics, Robotics, Electric Vehicle, Drone, IoT, Science etc.



1. FLEXIBILITY WITH OUR PRODUCTS for AI +X Application



MATLAB and Simulink provide a flexible environment (1. MATLAB Online 2. MATLAB Drive 3. MATLAB Mobile) that enables you to accelerate your research, reduce analysis and development time, and deploy advanced applications. This rich set of proven tools for analyzing and visualizing systems and data enables you to experiment with new approaches and gain insight into the behavior of complex systems.

2. MATLAB & PYTHON INTEROPERABILITY

MATLAB can also be integrated with Python today. The system has in-built tools for calling Python directly. In-built tools provides the platform for easy interface with Python functions.

Run the speech-to-text detector (Python module)

```
[3]: detectedText = mySpeechRecognizer.speechToText()
print(detectedText)

I went to my favorite restaurant and had a delicious meal
```

Run the sentiment analysis (MATLAB function)

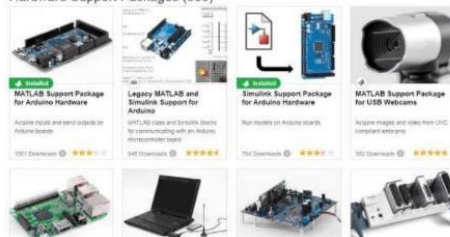
```
[4]: [sentiment,scores] = eng.sentimentAnalysisVADER(detectedText,narg
print(sentiment)
print(scores)

Positive
[[0.0,0.510948896408081,0.48905110359191895]]
```

Quit the MATLAB Engine

Latest version of MATLAB has different suitable low-cost hardware integration facility using which students, researchers can build their prototype. The availability of hardware support package provides a good platform to download and use for hardware project building. Hardware support is available for different applications like AI, Robotics & so on.

Hardware Support Packages (308)



AI Projects using MATLAB

Hands-On: Classify Flower Species

Classification (Step 2: Train a Model using Classification Learner App)

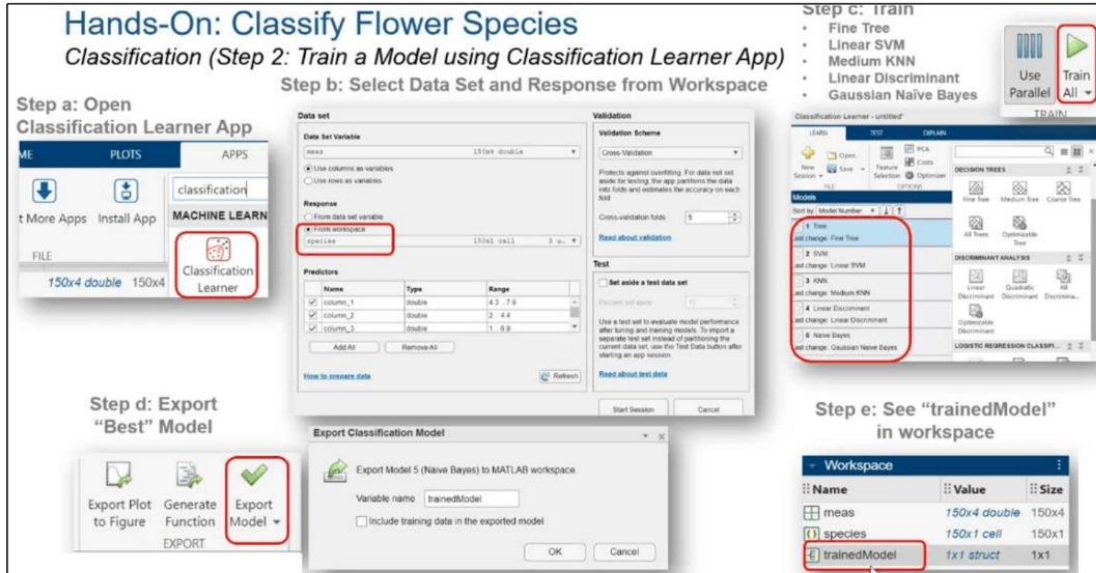
Step a: Open Classification Learner App

Step b: Select Data Set and Response from Workspace

Step c: Train

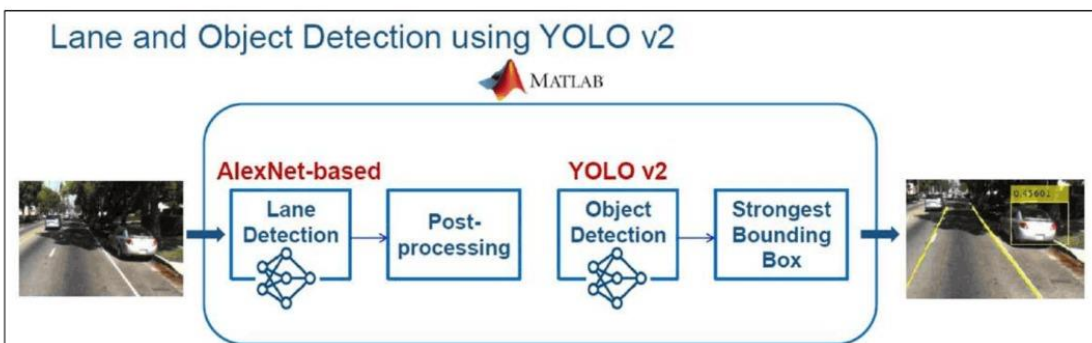
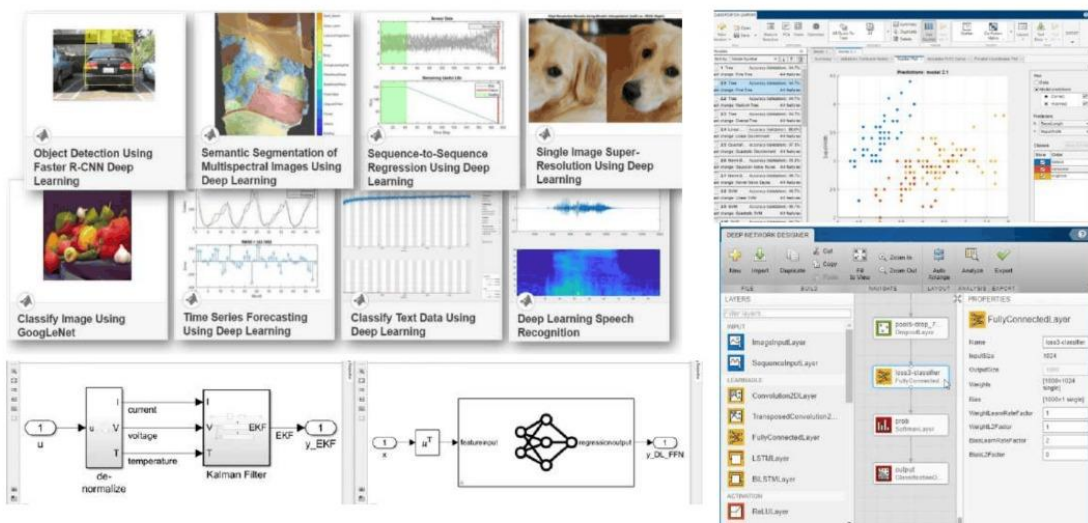
Step d: Export "Best" Model

Step e: See "trainedModel" in workspace



Workspace:

Name	Value	Size
meas	150x4 double	150x4
species	150x1 cell	150x1
trainedModel	1x1 struct	1x1

Object Detection Using Faster R-CNN Deep Learning

Semantic Segmentation of Multispectral Images Using Deep Learning

Sequence-to-Sequence Regression Using Deep Learning

Single Image Super-Resolution Using Deep Learning

Classify Image Using GoogLeNet

Time Series Forecasting Using Deep Learning

Classify Text Data Using Deep Learning

Deep Learning Speech Recognition

Neural Network Diagram:

```

graph LR
    Input[Input] --> Normalizer[de-normalize]
    Normalizer --> Kalman[Kalman Filter]
    Kalman --> EKF[EKF]
    EKF --> Output[Output]
  
```

Deep Learning Designer Interface:

Layers:

- InputLayer
- SequenceInputLayer
- Convolution2dLayer
- TransposedConvolution2dLayer
- FullyConnectedLayer
- LSTMLayer
- BLSTMLayer
- ReLULayer

Properties:

- name: FullyConnectedLayer
- size: 1024
- weights: 1024x1024
- bias: 1024x1
- activation: ReLU



ISO 9901 : 2015 CERTIFIED

CONSTELL CONSULTANTS PRIVATE LIMITED

"WE SURVEY AND EXPLORE YOUR DREAM PROJECTS"



ABOUT US :

- Established in 1964, we have been in the field of Geotechnical Engineering & Consultancy since inception.
- We have grown to be involved in planning, surveys, design, and construction consultancy.
- We conduct boring and drilling all across India and beyond for Subsurface Investigations of soil and rock.
- We also have expertise in pavement and Structural Engineering.
- We do field tests: CRR, Plate Load Test, Falling Weight Deflectometer Test (FWD), Static Cone Penetration Test (SCPT), Dynamic Cone Penetration Test (DCPT), and Pressure Meter Test.

OUR SERVICES :

- Geotechnical Investigation
- Chemical Testing of Soil and Water
- DPR and DBR
- Topographical Survey
- Geophysical Investigation
- Retrofitting Consultancy
- Hydrographic Survey
- Traffic & Axle Load Survey
- Falling Weight Deflectometer
- Dilatometer Test



PROJECTS :

- Soil Investigation Test, Bowbazar Area in Kolkata
- Area in r Fast West Man Metray Project, (ITTD)
- Geotechnical Investigt Technology, Mizoran Bakroy, Mizoran, (IRCON)
- Geotechnical Investsnigation for National Institute of Technology LtW Technology, Mizoran, (IRCON)
- Geotechnical Investetigation for development of deomant for drail imfroement int Mamdrirk. Rail Link Doubling Rail Rail and Biogrora kilry Project for dhally irrastructure (RITES)



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- Bridge & Roof Co., Indial Ltd.
- Engineers India Ltd.
- Haldia Dock Complex
- Hindustan Steel Works Construction Company Ltd.
- Indian Oil Corporation Limited
- JACOBS' CES
- National Hydroelectric Power Corporation limited
- Horth Frontier Railway
- Simplex Infrastructures Ltd.
- South Eastern Railway
- Tata Consulting Engineers (TCE)



Aeonix

Research and Innovations

(LLPIN-: AAU-7135)

Aeonix is a leading software, IoT, and robotics company providing innovative, customized solutions for various industries. We specialize in tailored robotics, IoT integrations, and advanced software, delivering future-ready results. From concept to deployment, we ensure seamless execution with cutting-edge technology to turn your vision into reality.

Our Services

-  Industrial Automation, IOT and Robotics
-  Data Science and AI
-  Software/Web/Apps
-  3D Designing and Printing



Why Choose Aeonix ?

○ Tailored Solutions:

We provide customized robotics, IoT, and software solutions to meet your unique business needs.

○ Proven Expertise:

Trusted by industry leaders like Tata Motors and ITC, our solutions have been featured in top publications.

○ End-to-End Support:

From concept to deployment, we ensure seamless integration and exceptional quality at every stage.

○ Made in India, for the World:

We deliver high-quality, cost-effective solutions while supporting India's self-reliance.

○ Future-Ready Innovations:

Our scalable, eco-friendly technologies help you stay ahead in an evolving market.

Our Top Clients



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- Workshop :** Boral Main Road, Ramchandrapur, Boral, Bonhooghly, Kolkata 154

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The first day of *AI Utkarsh 2026* at Narula Institute of Technology began on a positive note with a lavish inaugural ceremony that brought together notable academics, business executives, dignitaries, and innovators.



Distinguished Guests Grace the Inauguration

The event was honored by the presence of eminent personalities, including:

- **Sardar Taranjit Singh**, Managing Director, JIS Group
- **Dr. Dipan Sahu**, Assistant Innovation Director, Ministry of Education, Innovation Cell – AICTE
- **Mr. Manojit Sengupta**, Delivery Center Head – Eastern Region, Tata Consultancy Services
- **Prof. Swagatam Das**, Indian Statistical Institute, Kolkata
- **Mr. P. K. Das**, Director, MSME, DFO Kolkata
- **Dr. Tapas Kumar Bandyopadhyay**, IIT Kharagpur
- **Prof. (Dr.) Subhram Das**, Principal, Narula Institute of Technology (NiT)
- **Dr. Nidhi Singh, Registrar**, Narula Institute of Technology (NiT)

The dignitaries emphasised the value of creativity, interdisciplinary cooperation, and solid industry-academia ties while offering insightful commentary on the revolutionary potential of AI. Their motivating speeches set the tone for the summit and encouraged attendees to use AI to solve practical problems.

The first session effectively laid a solid and forward-thinking basis for AI Utkarsh 2026, marking a promising start to the event.





KEYNOTE SESSION

The Future of AI in Modern Engineering

SESSION OVERVIEW

Dr. Tapas Kumar Bandyopadhyay • Dr. Rishi Jain • Mr. Dhrubajyoti Das • Prof. Amlan Chakraborti • Prof. Nguyen Thi Kim Son
— eminent visionaries at the confluence of artificial intelligence, engineering education, and global innovation.

DISTINGUISHED SPEAKERS



Dr. Tapas Kumar Bandyopadhyay
PROFESSOR INCHARGE OF IPR AND IR



Dr. Rishi Jain
Faculty of Advanced Science and Technology, AIT



Mr. Dhrubajyoti Das
CBG Retail UK EMEA
India- TCS



Prof. Amlan Chakraborti
UNIVERSITY OF CALCUTTA



Prof. Nguyen Thi Kim Son
Vice Rector at Hanoi University of Industry (HaUI), Vietnam.



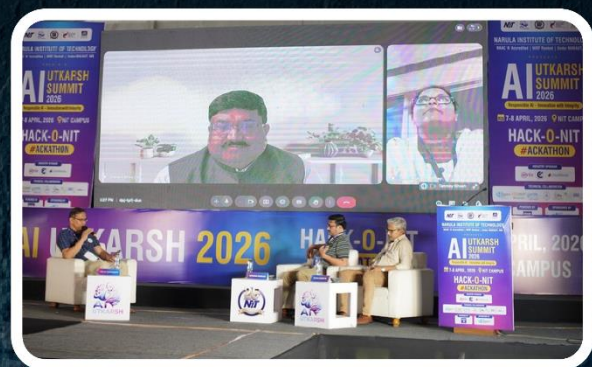
Dr. Swagatam Das
Prof-In-Charge- ISI -Kolkata

SESSION OVERVIEW

Dr. Tapas Kumar Bandyopadhyay, Dr. Rishi Jain, Mr. Dhrubajyoti Das, Prof. Amlan Chakraborti, and Prof. Nguyen Thi Kim Son were among the eminent experts who shared profound perspectives on the future of AI, industry transformation, education, and global innovation during the keynote address at AI Utkarsh 2026.

These discussions, a potent confluence of knowledge and concepts, genuinely captured the spirit of creativity and cooperation propelling AI's future — forging a lasting vision for the engineers and leaders of tomorrow.





The panel discussions brought together an exceptional lineup of thought leaders and practitioners. Panel Discussion I, moderated by **Dr. Tanushyam Chattopadhyay**, included **Dr. Debayan Ganguly**, **Dr. Debashis De**, **Mr. Rohit Sarkar**, **Dr. Tuhin Banik**, and **Mr. Arijit Das**, focusing on scaling AI from research to responsible deployment. Panel Discussion II, moderated by **Mr. Bidyut Majumdar**, featured **Pickon Majumdar**, **Dr. Rishi Jain**, **Ms. Sarika Agarwal**, **Prof. Surajit Ghosh**, and **Dr. Raja Hussain**, exploring the future of work and evolving skill landscapes. Panel Discussion III, moderated by **Prof. Amlan Chakraborti**, brought together **Dr. Indranil Mitra**, **Dr. Hena Roy**, **Prof. Ansuman Banerjee**, and **Mr. Partha Sengupta** to discuss building responsible and reliable AI systems.





HACK-O-NIT

OUR FLAGSHIP HACKATHON

Hack-O-NiT ignited rather than merely happening



THE VISIONARIES

"Every team gave it their all during rigorous build sessions and breakthrough moments, pushing the envelope and redefining what Responsible AI actually entails: innovation with integrity and purpose"



TEAM ATHRV'S



HACK SQUAD



When imagination, coding, and creation came together at **Narula Institute of Technology** for the **AI Utkarsh Summit 2026**, the excitement reached an entirely new level. **Hack-O-NiT** was more than just a hackathon; it was an intense demonstration of concepts being transformed into practical, significant solutions.

CONGRATULATIONS TO OUR WINNERS WHO CHANGED THE GAME !



MOU

MEMORANDUM OF UNDERSTANDING
FUTURE OF POSSIBILITIES



AI UTKARSH 2026

AT NARULA INSTITUTE OF TECHNOLOGY



AI Utkarsh 2026 at Narula Institute of Technology wasn't just about talking future—it was about **signing it into reality**.



In a defining moment of impact and intent, **10 strategic MOUs** were formalized at the summit—each one a bold step toward strengthening the synergy between academia, industry, and innovation.



At Narula Institute of Technology, where transformation is actively sought through **10 partnerships** aimed at generating **unlimited outcomes**, the atmosphere was heated as leaders and innovators came together to progress AI and redefine possibilities.





APPLE AI INNOVATION CELL



During **AI Utkarsh 2026**, the **Apple AI Innovation Cell** opened at NiT. The Apple AI Innovation Cell was formally launched at Narula Institute of Technology during AI Utkarsh 2026, marking a major step towards future-ready innovation.

Distinguished guests attended the inauguration, including **Sardar Simarpreet Singh**, Director of JIS Group, **Dr. Tapas Kumar Bandyopadhyay**, Professor in charge of IPR and IR at **IIT Kharagpur**, and **Dr. Dipan Sahu**, Assistant Innovation Director, Ministry of Education, Innovation Cell-AICTE.

NiT's dedication to supporting cutting-edge research, innovation, and industry-aligned AI learning environments is strengthened by this project. The Apple AI Innovation Cell will provide students with practical experience, cutting-edge tools, and a platform to develop significant, forward-thinking solutions.



THE DRONE WORKSHOP



AI-Utkarsh



AI Utkarsh 2026's Drone
Workshop Takes Off!!

7TH MARCH, 2026

INSPIRING YOUNG AVIATORS

At AI Utkarsh 2026, Narula Institute of Technology hosted an interactive drone workshop for schoolchildren. Through expert instruction, live demonstrations, and hands-on flying experience, students explored flight principles and sparked their curiosity for cutting-edge technology!



টিকনোজিগলিগ 'এআই উকর্ক' ২০১৬
কদ্যাপিত হয়েছ। দুপিরের এ
কর্মস্টি শুরু হয়েছিল বৃহৎস্টিবার
নাঙ্গল ইনস্টিটিউট অব টেকনোলজিগলিগ
ছিল 'দায়িত্বশীল ক্রিয়ম মোধা (এআই-
অন্তরতার সঙ্গে প্রয়োগ)' এই কর্মস্টি
প্রযোজনী অনুষ্ঠানে বক্তব্য রাখেন শিক্ষ
কর্তাদের সহকারী অধিকর্তা ড. দীপ
নাথ, টাটা কনসালট্যান্সি সার্ভিসেস
বিশ্বকীয় প্রধান মনোজিগত সেবাগু
এআইএস গ্রুপের ম্যানেজিং ডাইরেক্টর
দের তরনজিগ বি, জেআইএস
গ্রুপের ডাইরেক্টর সর্দার সীমাত্রীতি সি
হ বিশিষ্ট ব্যক্তিরা। এই আলোচনা
গুপতিত ছিলেন সিঙ্গাপুর, থাইল্যান্ড
ভিয়েতনাম, শ্রীলঙ্কা সব বিভিন্ন দেশের
সংস্করণ। জেআইএস গ্রুপের
ম্যানেজিং ডাইরেক্টর সর্দার তরনজিগ
সি বলেছেন, 'এআই উকর্ক' ২০১৬
নকস্টি আলোচনা শিক্ষার ক্ষেত্রে
আর্থিকভাবে এর আলোচনা করা



Kolkata Codes Its AI Moment

Narula Institute's AI Utkarsh 2026 turns a campus summit into a statement of intent

On April 7 and 8, 2026, Narula Institute of Technology transformed into a vibrant intersection of policy dialogue, technological innovation, academic ambition and industry collaboration. AI Utkarsh 2026, positioned as an international-level summit, became far more than a conventional academic event. It emerged as a strong statement that India's innovation map is steadily expanding beyond traditional technology hubs and that cities like Kolkata are actively shaping the country's AI-driven future.

The summit brought together academicians, researchers, industry leaders, start-up founders, policymakers and students under one platform to discuss the growing impact of AI across sectors.





Beyond the Buzzword

AI Utkarsh 2026 acknowledged global transformation while firmly positioning Kolkata within the national innovation conversation. The summit was aligned with larger national frameworks including the Viksit Bharat @ 2047 vision and India's AI Mission. Yet, the deeper significance of the event

was local and strategic: can institutions outside Bengaluru, Hyderabad or Pune become meaningful contributors to India's AI ecosystem? The summit confidently answered that question in the affirmative.

Several keynote sessions highlighted how regional institutions can play a

critical role in democratizing technological access and nurturing talent at the grassroots level. Speakers also stressed the importance of creating AI ecosystems that are inclusive, ethical and accessible to students from diverse academic and economic backgrounds.



Inauguration of the Apple AI Innovation Cell

One of the landmark moments of the summit was the official inauguration of the Apple AI Innovation Cell at the Narula Institute of Technology. The facility is designed to provide students with hands-on exposure to advanced tools in Artificial Intelligence and iOS development while bridging the gap between classroom learning and industry-aligned innovation.

The initiative aims to equip students with practical experience in building future-ready solutions and working within real-world technology environments. The inauguration

was attended by dignitaries from the Ministry of Education, Innovation Cell-AICTE and IIT Kharagpur, reinforcing the importance of industry-academia collaboration in shaping next-generation talent.

The lab is also expected to encourage interdisciplinary learning, collaborative research and start-up oriented innovation among students and faculty members. By integrating industry-grade resources into academic infrastructure, the institution is positioning itself as a future-focused technology hub.



Industry-academia MoUs

AI Utkarsh 2026 also witnessed the signing of 10 industry-academia Memorandums of Understanding (MoUs), aimed at strengthening collaboration between educational institutions and the corporate ecosystem. If implemented effectively, these partnerships could create robust pathways for applied research, internships, live industry projects, start-up incubation and placement opportunities.

Energy on the Ground

A 24-hour hackathon - Hack-O-Nit - became one of the most dynamic segments of the summit, running on caffeine, creativity and urgency. Students worked through the night to develop prototypes and technology-driven solutions focused on solving practical challenges across sectors such as healthcare, education, sustainability and mobility.

Alongside the hackathon, a drone workshop attracted enthusiastic participation from school students, offering them early exposure to emerging technologies that are increasingly becoming mainstream. The workshop reflected the summit's larger objective of encouraging innovation from an early stage and building confidence among young learners.

A start-up expo further added to the momentum, bringing together student innovators, entrepreneurs and early-stage ventures.





Why us?



National Ranking



Rankings by MHRD, Govt.of India
since last six years (2017 to 2026)
in Engineering Category



International Rating



Narula Institute of Technology has become
the 1st Institution in Eastern India
to earn the prestigious
'Five Star in Teaching' by
QS International Rating



NAAC Accredited



Grade
A
Institutional CGPA
3.22 out of 4



JIS SAMMAN 2026



Team, NiT receiving
the prestigious best
college award from
MD, JIS Group



Placement Status

89%

Placement Offers 2023
Highest Package Offered:
47.8 LPA
200+ Multiple Job Offered



Activities @ Abroad



International Internship and Study Tour
at AIT Bangkok | Russia | Malaysia

AI UTKARSH: CHRONICLES OF NEXT-GEN AI

Step into the evolving world of Artificial Intelligence with *AI UTKARSH: Chronicles of Next-Gen AI* — a compelling collection that captures the ideas, innovations, and insights shaping the future of intelligent systems.

This volume brings together contributions from researchers, academicians, industry experts, and young innovators, offering a diverse perspective on cutting-edge advancements in AI. From theoretical breakthroughs to real-world applications, the book explores how AI is transforming industries, redefining human potential, and addressing global challenges.

Spanning topics such as machine learning, ethical AI, smart systems, and emerging technologies, this book serves as both a knowledge resource and an inspiration for the next generation of thinkers and creators.

More than just a compilation, *AI UTKARSH* is a reflection of a growing movement—where curiosity meets innovation, and ideas turn into impactful solutions.

Discover. Innovate. Transform.

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