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Technology Innovation & Product Support (TIPS)

PCAI – People Centred Artificial Intelligence in Cities

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25 2000 2025 YEARS

Appreciate IARE students who are showing interest in the Artificial Intelligence (AI) Project Program at the Institute of Aeronautical Engineering!

People-Centred Artificial Intelligence (AI) in Cities refers to the design, development, and deployment of AI systems that prioritize human needs, values, ethics, and inclusivity in urban environments. This approach ensures that AI technologies serve citizens equitably, enhance public services, and promote sustainable development, rather than merely optimizing for technical performance or profit. People-centred AI isn't just about making cities "smart" — it's about making them **wise, inclusive, and humane**. For B.Tech students, it offers a meaningful way to apply technical knowledge to socially impactful challenges, preparing them to become responsible innovators and urban changemakers.

Importance of People-Centred AI in Cities

1. **Improves Quality of Life:**
   - AI can optimize traffic management, reduce pollution, enhance waste management, and improve safety, directly impacting urban life.
2. **Promotes Inclusivity & Accessibility:**
   - AI solutions can be tailored to assist the elderly, people with disabilities, and underserved communities.
3. **Supports Smart Governance:**
   - Enables data-driven public policy, participatory governance, and transparency in decision-making.
4. **Boosts Public Trust:**
   - By embedding ethical principles and transparency, people-centred AI helps gain citizen trust in smart city technologies.
5. **Fosters Sustainable Urban Development:**
   - AI can help monitor environmental data, optimize energy consumption, and support smart mobility for greener cities.

These projects help B.Tech students in product development by encourages students to work on practical challenges in cities like traffic congestion, public safety, or waste management. It helps students to integrate knowledge from AI, IoT, ethics, and urban planning—stimulating innovative thinking. Students learn to apply Human-Centered Design (HCD) principles, essential for building successful products. Students gain experience with smart city technologies, a booming domain with high industry demand. The projects help in prototype development and testing by providing live, complex environments for testing AI-based prototypes and collecting real-time feedback.

Goals for Product Development in Artificial Intelligence in cities are:

Inclusivity: Ensure the product is usable by all demographics. Ex: AI assistant for visually impaired in public transport.

Ethical Transparency: Incorporate explainability and fairness in AI models. Ex: Bias-free crime prediction systems.

Data Privacy: Design systems that secure citizen data and ensure informed consent. Ex: Smart health kiosk with privacy-by-design.

Environmental Sustainability: Develop eco-friendly AI solutions. Ex: AI for energy-efficient street lighting.

Real-Time Responsiveness: Build systems that adapt to real-time urban changes. Ex: Dynamic traffic signal control using live data.

Scalability and Integration: Ensure product can integrate with existing infrastructure. Ex: AI-based parking system linked to city applications.

Empowerment through Participation: Allow citizens to provide feedback and contribute. Ex: Crowdsourced urban issue reporting platform using AI.

Accessibility: Make products language-friendly, usable on low-end devices. Ex: Multilingual chatbot for municipal services.

Resilience: Systems should work in crisis situations like floods, pandemics. Ex: AI-powered early disaster alert system.

Lifelong Learning and Adaptability: Continuously improve AI systems based on evolving data and behavior. Ex: Adaptive recommendation engine for public transit routes.

The research theme of this AI products also focuses on the challenges presented by the Sustainable Development Goals (SDGs).

IARE Sustainability Development Goals (SDGs) highlighted with Blue Colour Font	
SDG #1	End poverty in all its forms everywhere
SDG #2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG #3	Ensure healthy lives and promote well-being for all at all ages
SDG #4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG #5	Achieve gender equality and empower all women and girls
SDG #6	Ensure availability and sustainable management of water and sanitation for all
SDG #7	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG #8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG #9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG #10	Reduce inequality within and among countries
SDG #11	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG #12	Ensure sustainable consumption and production patterns
SDG #13	Take urgent action to combat climate change and its impacts
SDG #14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG #15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG #16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG #17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

The following research domains are recommended for PCAI products, and selected students should find the research gap and frame the problem statements from any one of the themes below.

S.No	Name of the Theme	SDGs
1	**Sustainable Waste and Resource Management:** AI to reduce urban waste, increase recycling, and manage resources efficiently.	SDG #6, SDG #11, SDG #12
2	**Smart Transportation and Mobility:** Enable intelligent, responsive transportation systems to improve mobility, reduce emissions, and support multimodal travel.	SDG #9, SDG #11, SDG #13
3	**Public Safety Assistant:** Uses computer vision to detect suspicious activities or violence in public areas.	SDG #3, SDG #9, SDG #11, SDG #16
4	**AI-Based Recommendation Systems for City Services:** Helps citizens file complaints, pay bills, or find local information.	SDG #4, SDG #9, SDG #10, SDG #11, SDG #16

To participate in **PCAI Projects**, you must formally apply and be accepted by the project coordinator. To proceed, please contact the project coordinator, **Dr. M Nagaraju** (m.nagaraju@iare.ac.in), Assistant Professor, Department of CSE (AI&ML). This process will help you explore all available open positions aligned with AI technologies.

When submitting your project proposal and updated résumé, please include a clear statement explaining why you are interested in contributing to the People-Centric AI-based solutions towards cities development team. Your motivation, along with any prior experience in AI, machine learning, deep learning, robotics, will help to determine team placement.

Please note that participation in the AI product development initiative requires registration under a valid research or design project title focused on key domains such as computer vision, embedded systems, Internet of Things (IoT), environmental science, mobile/web application development, machine learning, deep learning, reinforcement learning, embedded and edge computing, cyber security, and cloud computing. More detailed information, guidelines, and deliverables will be shared with all selected applicants who are offered a position.

If you have any questions regarding a specific sub-project or specialization track, feel free to reach out to the assigned faculty mentor(s) for further clarification.

We strongly encourage you to explore this cutting-edge opportunity to work on real-world AI-based solutions towards risk-free living in cities. We look forward to your application and the exciting innovations you will help build!

Sustainable Waste and Resource Management

Dr. M. Nagaraju, Assistant Professor, CSE (AI&ML), Faculty Mentor

GOALS

Urban areas face growing challenges in managing solid waste due to increasing population, limited landfill space, poor citizen engagement, and inefficient collection systems. AI-driven waste management can enable smarter collection, real-time monitoring, and promote a culture of recycling and sustainability through automation and behavioural nudges.

The specific objectives and goals include improving the efficiency and sustainability of waste collection and segregation, encourage citizen participation in responsible waste disposal, reduce environmental impact through optimized logistics and smart recycling, and promote circular economy models using data insights from waste generation patterns. The project theme can be extended further to develop smart bins with AI-powered image or sensor-based waste classification, use machine learning models to optimize waste collection routes and schedules based on bin fill-level prediction and traffic patterns, enable real-time waste monitoring dashboards for municipal authorities, create a gamified citizen mobile app to promote eco-friendly behaviors (e.g., proper segregation, e-waste disposal), and integrate IoT devices with AI models to forecast waste generation based on seasonality and events.

METHODS & TECHNOLOGIES

Smart navigation systems employ various advanced methods such as:

Computer Vision-Based Waste Classification: Use a CNN (e.g., MobileNet, ResNet) trained on images of different waste types to classify objects when dropped into the dustbin.

Sensor Fusion: Use ultrasonic, IR, and load sensors to monitor fill level, presence detection, and bin capacity in real time.

Real-Time Notifications and Alerts: Integrate an IoT module (e.g., ESP32, Arduino + GSM/WiFi) to send alerts when bins are full or need attention.

Edge Computing: Process image classification locally using edge devices like Raspberry Pi or Jetson Nano for fast, low-latency predictions.

Route Optimization Algorithms: Use GPS and data from multiple smart bins to suggest optimized garbage truck routes using A* or Dijkstra's algorithm.

Cloud Connectivity: Store and process data in real time using platforms like AWS IoT, Google Firebase, or Azure IoT Hub.

Technologies such as Google Maps API, HERE Maps, OpenStreetMap, and onboard vehicle infotainment systems power real-time navigation. For large fleets and autonomous systems, cloud-integrated dashboards and route analytics engines are commonly used.

MAJORS & AREAS OF INTEREST

This theme spans several interdisciplinary majors and fields, including:

Computer Vision

Focus areas: image classification, object detection for waste recognition

Embedded Systems

Focus areas: working with micro controllers and sensory data, real-time data collection, cloud-based monitoring, communication protocols.

Environmental Science

Focus areas: solid waste categories, segregation technique, impact on sustainability.

Mobile/Web Development

Focus areas: UI for viewing bin status, notifications, and control panel.

Researchers and developers in this domain aim to enable intelligent mobility solutions whether for public transport systems, ride-hailing platforms, autonomous vehicles, or e-commerce delivery chains improving speed, safety, and sustainability.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Smart Transportation and Mobility

Dr. D Khalandar Basha, Assistant Professor, CSE (AI&ML), Faculty Mentor

GOALS

Vision-Based Traffic Understanding and Compliance systems aim to enhance road safety, enforce traffic regulations, and optimize traffic management by utilizing computer vision and artificial intelligence technologies. These systems are designed to automatically interpret visual data from roadside and vehicle-mounted cameras to identify violations such as signal jumping, lane departures, speeding, and helmet or seatbelt non-compliance. The overarching goals include improving compliance with traffic laws, reducing human intervention in enforcement, minimizing accidents, and enabling data-driven urban planning. By automating traffic monitoring and violation detection, these systems contribute to more efficient, fair, and scalable traffic governance frameworks.

The main objectives of this project theme is to develop AI-based traffic signal control systems that adapt to real-time conditions and reduce wait times, use predictive modeling to estimate public transport delays and inform commuters via apps, build intelligent pedestrian assistance systems for crosswalk safety using computer vision and sensors, design multi-modal journey planning tools that combine public transit, walking, and ride-sharing with sustainability ratings, and deploy computer vision-based tools for detecting traffic violations, accidents, or illegal parking.

METHODS & TECHNOLOGIES

Key methods and technologies used in vision-based traffic understanding include:

Computer Vision and Image Processing: Detect and track vehicles, recognize license plates, and monitor behavior in real-time.

Deep Learning: Used for object detection, classification, and segmentation of road users and signs.

Optical Character Recognition (OCR): For automatic number plate recognition (ANPR).

Video Analytics and Motion Tracking: Analyzes video frames to identify anomalies, violations, or congestion patterns.

Edge Computing and IoT Integration: Enables on-site processing of camera data for faster response times.

Cloud-Based Data Storage and Dashboards: Support centralized violation reporting, analytics, and urban traffic trend visualization.

Technologies include CCTV surveillance systems, smart cameras, Raspberry Pi with vision modules, TensorFlow, OpenCV, and cloud platforms such as AWS or Azure for real-time analytics.

MAJORS & AREAS OF INTEREST

This domain intersects multiple majors and interest areas, including:

Computer Science & Artificial Intelligence

Focus areas: deep learning for object detection, real-time vision systems, AI-based decision support

Electronics & Communication Engineering

Focus areas: smart camera design, embedded vision systems, sensor integration

Transportation Engineering

Focus areas: traffic behavior modeling, road safety analysis, compliance monitoring systems

Data Science & Urban Informatics

Focus areas: violation pattern analysis, predictive traffic behavior, policy optimization

Law Enforcement and Public Policy

Focus areas: automated traffic law enforcement, surveillance ethics, smart governance

Through interdisciplinary collaboration, these systems offer smart, scalable, and effective solutions for real-time traffic monitoring and compliance enforcement, contributing to safer roads and smarter cities.

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PARTNERS & SPONSORS

None

Public Safety Assistant

Ms. Bidyutlata Sahoo, Assistant Professor, CSE (AI&ML), Faculty Mentor

GOALS

The goal of Public Safety Assistant project combines real-time data processing, computer vision, natural language understanding, and alert systems to proactively detect threats, manage emergencies, and assist citizens. The project is built around intelligent surveillance, incident reporting, emergency response coordination, and citizen safety tips dissemination.

The **Public Safety Assistant** is a multidisciplinary project blending AI, software engineering, and public service. It focuses on proactive citizen safety through automation and intelligence.

METHODS & TECHNOLOGIES

Key methods and technologies used in this theme include:

Computer Vision and Video Analytics: Used to detect anomalies in live CCTV feeds (e.g., crowd surges, weapons, violence, or accidents) using models like YOLOv8, OpenCV, or Detectron2.

NLP-based Modules: Help in analyzing social media posts or emergency texts to identify panic messages, public distress, or rumors.

Geospatial Analytics assist: Identifying locations of incidents, hazards, and emergency responders, using GPS and maps.

Alert Management Systems: built to send automated push notifications, SMS, or app alerts to law enforcement and citizens.

MAJORS & AREAS OF INTEREST

This theme brings together disciplines focused on:

Computer Vision
Focus areas: Object detection and tracking, activity recognition and anomaly detection, face and license plate recognition.

Natural Language Processing
Focus areas: emergency text classification, sentiment and misinformation detection from public messages.

Cloud Computing
Focus areas: real-time event processing with serverless architecture, scalable data storage and deployment.

Mobile and Web Application Development
Focus areas: admin dashboards to monitor live events, citizen-facing applications for incident reporting, safety tips, and alerts.

Geospatial Analysis
Focus areas: mapping of incidents and high-risk areas, route planning for emergency responders.

Human-Computer Interaction (HCI)
Focus areas: designing user interfaces, accessibility and usability under stress or panic.

Students must explore a combination of Computer Vision, NLP, Mobile Computing, Cloud Deployment, and Emergency Communication Systems to build a meaningful, real-time product that could be adopted by municipalities or smart city initiatives.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

AI-Based Recommendation Systems for City Services

Dr. M. Nagaraju, Assistant Professor, CSE (AI&ML), Faculty Mentor

GOALS

The main goal of the *AI Recommendation Systems for City Services* project is to create an intelligent, accessible, and multilingual conversational interface that enables citizens to seamlessly interact with municipal systems. This system acts as a digital assistant, helping users inquire about, report, and receive updates on various public services. By doing so, the project aims to bridge the gap between the public and city administrations, thus enhancing civic engagement, transparency, and the overall efficiency of urban governance.

One of the primary objectives of the system is to improve citizens' access to essential services. It functions as a 24/7 virtual assistant, providing real-time information on waste collection schedules, traffic updates, public transport, utility bill payments, and more. By automating frequently asked questions and providing timely responses, the chatbot simplifies communication with municipal authorities, reducing the need for lengthy bureaucratic procedures.

Another important goal of the project is to promote transparency and good governance. The chatbot can notify users about emergencies, service disruptions, and administrative updates. It supports a responsive feedback and grievance redressal system, allowing users to lodge complaints about civic issues such as potholes, garbage accumulation, or water leaks. These complaints are automatically categorized and routed to the appropriate departments, and users can track the status of their issues through the same interface.

Inclusivity is also a core focus. The recommendation systems support communication in multiple local languages, thereby ensuring accessibility for citizens who may not be fluent in English. Voice and text input options are also integrated to assist elderly individuals, people with disabilities, and others who may be less familiar with digital tools. This inclusiveness ensures that all demographics can participate equally in the smart city ecosystem.

The recommendation systems also serve as a valuable data-gathering tool for city administrators. By analyzing user queries and complaints, city planners can identify recurring issues, assess service effectiveness, and make data-driven decisions to improve infrastructure and resource distribution. Over time, these insights can lead to more proactive urban management and better policy formulation.

Ultimately, the AI recommendation systems contribute to the broader vision of digital transformation in smart cities. By integrating with existing smart city platforms, IoT systems, and public service APIs, it enables a more interactive, responsive, and intelligent urban experience. It not only improves the quality of life for residents but also encourages them to take an active role in shaping the future of their city.

METHODS & TECHNOLOGIES

Key methods and technologies used in this theme include:

Natural Language Understanding: to integration with urban service APIs. The development process follows a combination of artificial intelligence, software engineering, and urban informatics approaches to ensure the chatbot is intelligent, responsive, and aligned with the needs of a smart city ecosystem.

Transformer-Based Models: To support diverse populations, multilingual and transliteration models are integrated to facilitate communication in regional Indian languages.

Messenger: typically hosted using Flask or FastAPI and deployed on platforms like Heroku, Firebase, or AWS Lambda for serverless execution. Integration with WhatsApp, Telegram, Facebook Messenger, or mobile applications using Flutter or React Native allows easy access for users across devices.

API Integration: enables the chatbot to fetch real-time data regarding electricity bills, transport schedules, complaint statuses, and more. RESTful APIs provided by local government portals are consumed to ensure a seamless backend connection.

Analytics and Dashboard: To ensure intelligent decision-making and continuous improvement, the chatbot system can include analytics and dashboards using tools like Power BI, Google Data Studio, or Matplotlib to visualize frequently asked questions, common complaints, and service usage trends. This helps city officials monitor public engagement and optimize service delivery.

MAJORS & AREAS OF INTEREST

This theme brings together disciplines focused on green technology, artificial intelligence, and human computer interaction:

Natural Language Processing
Focus areas: text preprocessing, intent recognition, sentiment analysis, language modelling, multilingual text handling, and contextual understanding.

Conversational AI
Focus areas: dialog management, response generation, multimodal interfaces, and error handling.

Software Engineering
Focus areas: system design and architecture, testing and debugging, code modularity and reusability, documentation, and security best practices.

Cloud Computing
Focus areas: infrastructure and platform as a service, storage and databases, load balancing and auto-scaling, cloud security, monitoring and logging.

APIs and Web Services
Focus areas: API design, authentication and authorization, data serialization, API management, and service integration.

Mobile Application Development

Focus areas: cross-platform development, UI/UX design, backend integration, push notifications, offline support, application deployment and security.

With a strong emphasis on energy efficiency, sustainability, and intelligent automation, this system envisions the future of eco-friendly delivery operations in urban and semi-urban environments.

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PARTNERS & SPONSORS

None