NIT Rourkela Researchers developed an efficient Intregated Smart City Management System

Authors Name: Dr. Santos Kumar Das, Vinod Kiran Kappala, Prashant Deshmukh, Rashmiranjan Nayak

About the Research

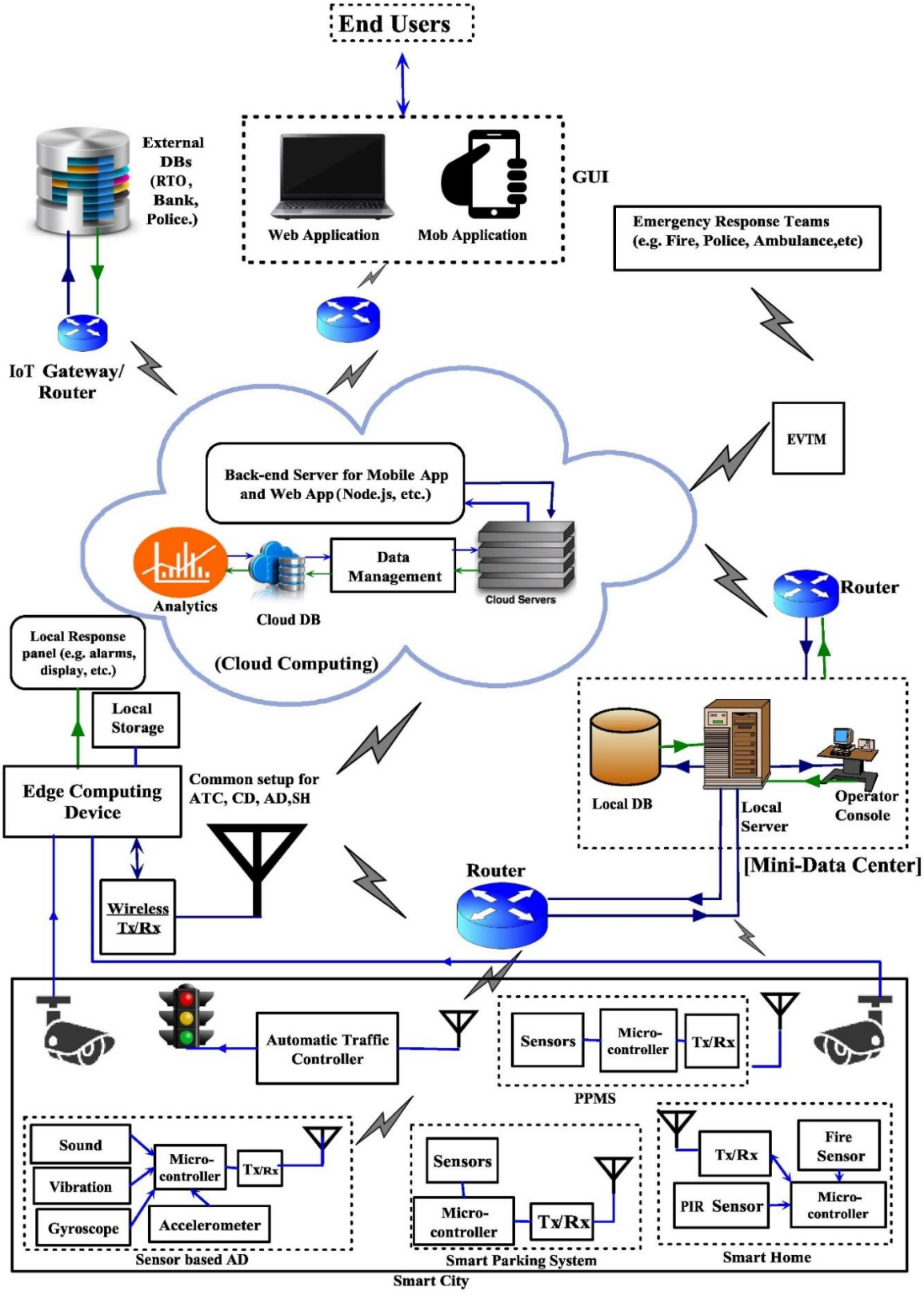
The massive data received from various sensors (camera and sensors) is complicated to analyze for various applications for smart city users. It needs a lot of resources and technical analysis to make it worthwhile for application development [1]. Hence, this project work provides a state-of-art solution that can collect, store and analyze the different sensors' data to make real-time applications such as efficient traffic management, accident detection, suspicious activity detection, environmental hazards, and predictions for the future.

The main goal of this project is to provide an integrated end-to-end service to the citizens in smart cities. The complete integrated system has been designed for various applications, such as Automatic Traffic Control (ATC) [2], Accident Detection (AD) [3], Criminal Activity Recognition (CAR) [4], Pollution Monitoring and Alerting System (PMAS) [5], Data Analytics and Emergency Vehicle Response System (EVRS) [6] etc. Integration of hardware, software and IoT servers are implemented for all the above applications. All the cases/modules are tested in real time at the National Institute of Technology Rourkela campus and outside the campus.

This work performs analysis on two types of data. First is the video data received from surveillance cameras; another is text data from wired sensors. These data are stored in the cloud database. Deep learning algorithms are applied to the video data for vehicle detection, counting, and criminal activity detection. ATC uses vehicle counting information at the traffic junction, calculates the density at that junction, and performs real-time traffic signal switching based on the density. Similarly, CAR performs loitering detection, video anomaly detection, and criminal activity classification, such as fighting, shoplifting, murder etc. machine learning algorithms are applied to the sensors data for accident detection and pollution prediction. AD and PMAS modules use the sensors' data and perform the respective applications.

This work also provides real-time notification by using the EVRS module in case of an emergency. EVRS module is the extension of the CAR and AD modules. EVRS alerts the respective authorities (Police control room, Fire station, Hospital authorities) whenever an accident or criminal activity is detected by using emergency notification. The emergency notification contains the victim's location details with a Google map URL and can be delivered via SMS, Whatsapp and Email. Based on the information, the respective authorities can establish an immediate rescue operation, which may save the lives of victims.

The complete integrated system architecture, methodology, product block diagram, and real-time testing images for Smart City Applications are mentioned below.



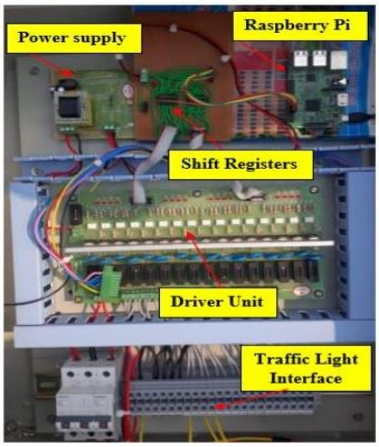
Integrated Smart City Management System

Product Images

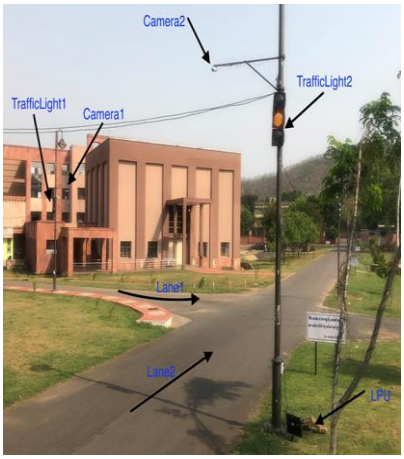
1. Automatic Traffic Control (ATC) System

Real-time vehicle detection and classification.

Vehicle Counting.

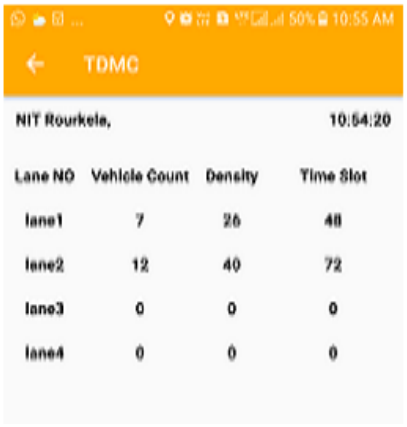


Wireless Traffic Controller



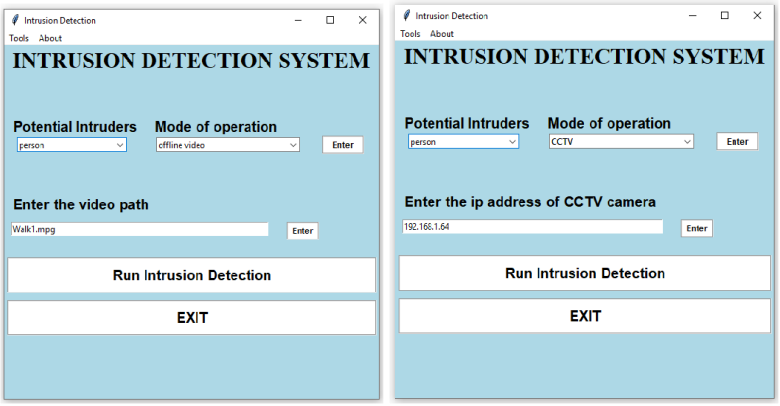
Prototype Setup

Adaptive Traffic Signaling.



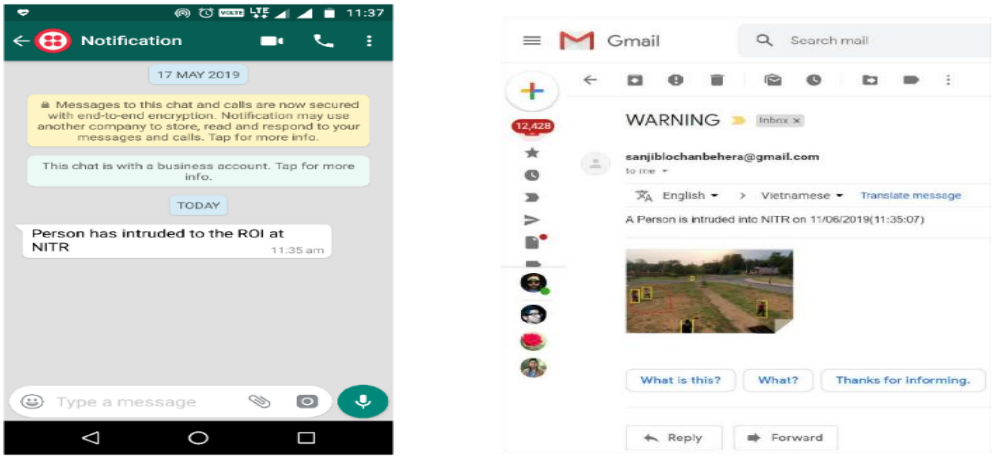
Traffic Dashboard

2. Criminal Activity Recognition (CAR) System



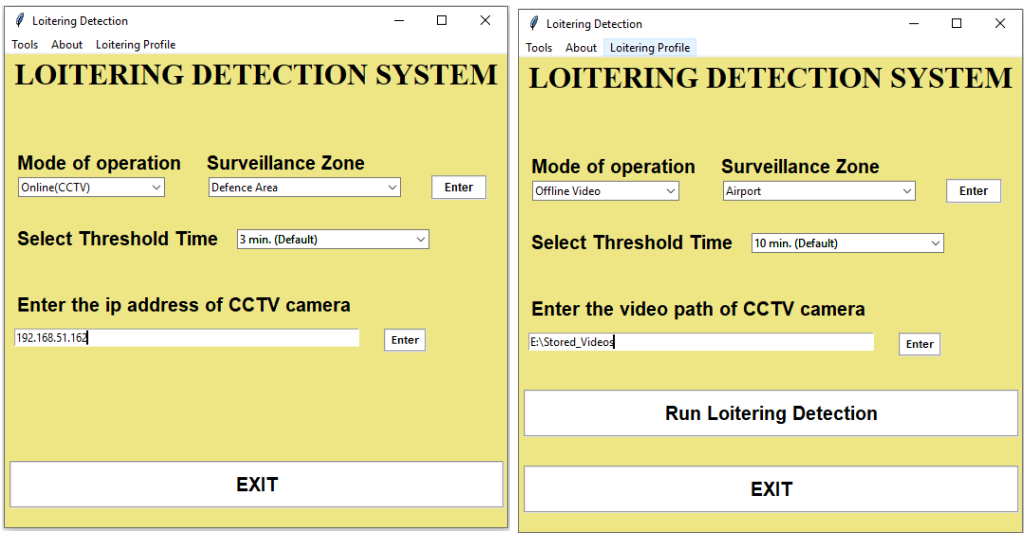
Developed GUI for the Intrusion detection system.

Field trial results of the Intrusion detection system.



(a) Notification in WhatsApp (b) Notification in Email

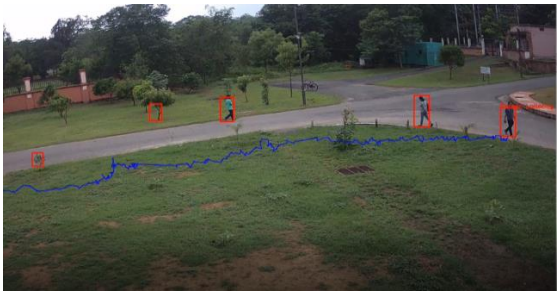
Real-time notification received in user's registered (a) WhatsApp and (b) email.



Developed GUI for the Loitering detection system.

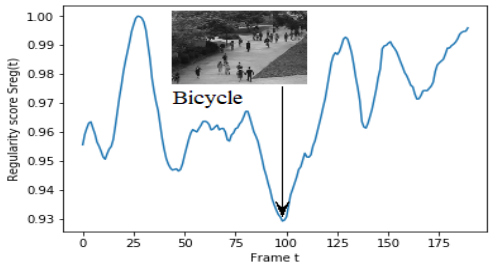
(a) No loitering is detected at Cam-1

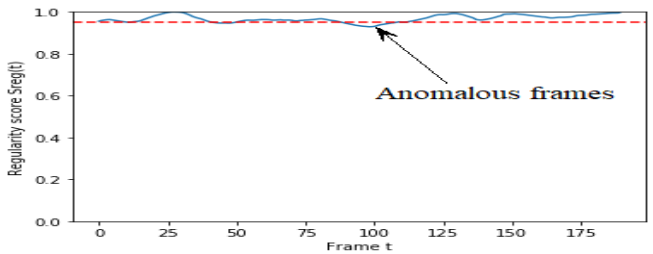
(b) Loitering is detected at Cam-1



(c) Loiter is re-identified at Cam-2

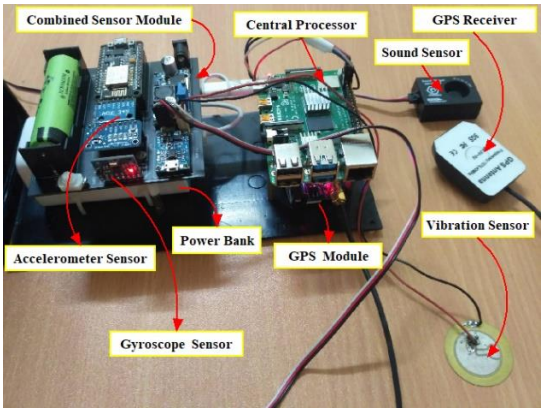
(d) Loiter is re-identified at Cam-3



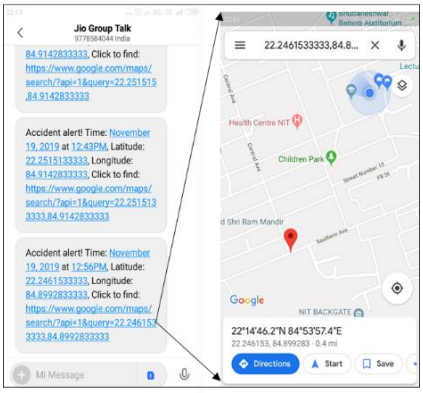


Video anomaly detection (a) bicycle detected as video anomaly, (b) thresholding operation for video anomaly detection.

3. Acident Detection (AD) System

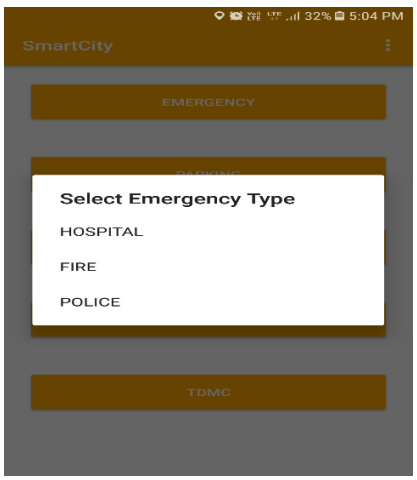


On-board diagnostics (OBD).

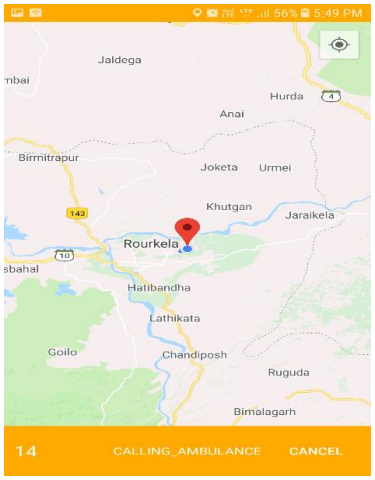


Real-time notification received in user's registered email.

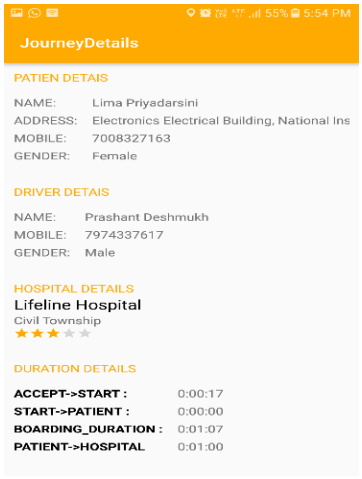
4. Emergency Vehicle Response System (EVRS)



EVRS Response System



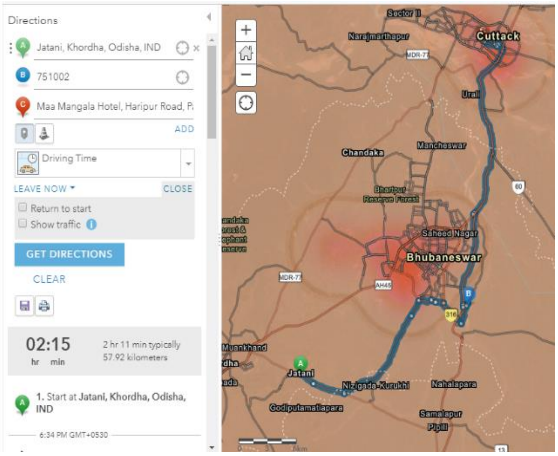
Emergency Calling



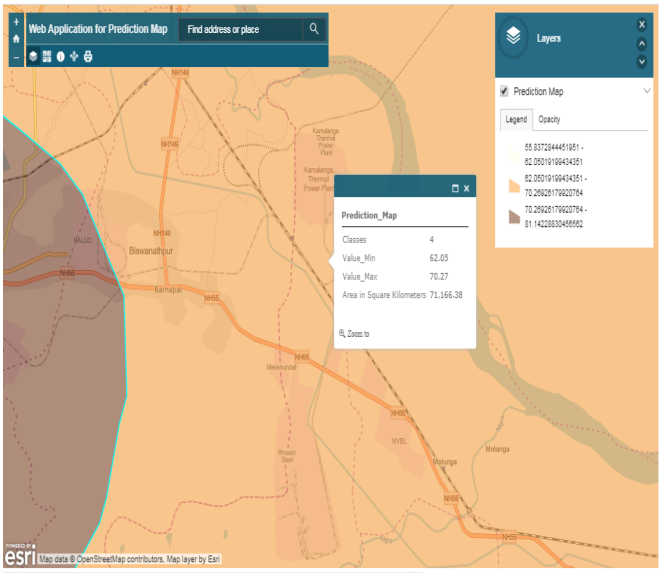
Application Testing

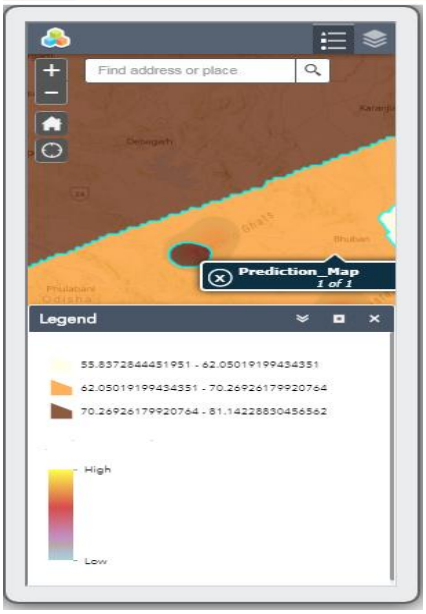
5. Pollution Monitoring and Alerting System (PMAS)

Developed Hardware Prototype



Predicted the least air polluted route





Web Application Mobile Application

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