SmartAffineYOLO; A System to Perform Real Time Traffic Management and Emergency Responding

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ABSTRACT: **The urbanisation process has resulted in a rise in the number of on-road vehicles, which has resulted in a decrease in air quality and an increase in the frequency of road accidents. In this paper an intelligent system has been proposed. It is well equipped with a network of cameras that provide real-time videos of accidents as well as it alerts the authorities, nearest hospital, and family members with location. The system has three main functions: accident detection, licence plate detection and alerting systems. It is a highly effective, real-time, light weight, reliable, low-power consuming and a cost-effective system for the government officials as well as the citizens. Cameras detect the crash using the yolo system and the licence plate details are recorded. GPS modules are used for sharing the location.**

Keywords: Ultrasonic sensor, Artificial Intelligence, Real-time traffic management, Emergency response system, Accident detection, RTO number, Phone number, Email address, Hospital trigger, Traffic-free route, Alternate route, Traffic congestion, Traffic flow.

I. Introduction

In India the occurrence of accident is day by day increasing, according to the Ministry of road transport there were 4,12,432 unfortunate incidents of road accidents during 2021 which claimed 1,53,972 lives and caused injuries to 3,84,448 persons [1]. The lives of people can be saved if they were given medical services in the golden hour and avoid further disability [2,3,4]

Here we propose a system which detects the accident, scans the smart tag or driver's licence plate to get the victim's information and then it is sent to the nearest hospital for medical attention, nearest police station and to the victim's emergency contact [5].

II. Literature survey

Previous technology	Features	Success rate	Disadvantages
Automatic Traffic Accident Detection Based on the IoT and Support Vector Machine[9]	Real-world traffic data as sound signal & magnetic field signal	It varies from 89% to 99.15% according to accident type.	Uses accelerometer which many phones do not have

A Novel Approach to Automatic Road-Accident Detection using Machine Vision Techniques[7]	Image captured within 2 metres & 20 metres. .	81.83 % for an image captured within 2m & 64.37% within 20m.	Only applicable for short distances
IoT Based Car Accident Detection And Notification Algorithm For General Road Accidents.[8]	Real-world data Arduino IDE, Heart Rate Sensor with GSM and GPS.	It is not specified.	Use of accelerometer sensor which only smartphones have

a. Advantages of the proposed system

The proposed system offers several advantages over traditional traffic management and emergency response systems [6]. By using ultrasonic sensors and artificial intelligence, the system can detect and respond to accidents in real-time, improving emergency response times and reducing the negative impact of accidents on society. Additionally, the system can show the traffic-free route for the ambulance to reach the accident site, minimising delays and improving emergency response times. The system can also deviate users to alternate routes, reducing congestion and improving traffic management in the affected area[7].

III. Methodology

a. System Architecture:

The proposed system can be divided into three main components: The ultrasonic sensor module, the YOLO module[8], and the emergency response module. The ultrasonic sensor module is responsible for detecting traffic flow and identifying accidents or crashes. The YOLO reads the RTO number of the vehicle involved, retrieves the phone number and email address associated with the vehicle, and sends an emergency trigger to the hospital and family members. The emergency response module uses maps to show the traffic-free route for the ambulance and deviates users to alternate routes to avoid congestion.

b. Ultrasonic Sensor Technology:

Ultrasonic sensors are used to detect the presence and distance of objects in the system. They emit high-frequency sound waves and measure the time it takes for the sound waves to bounce back to the sensor. By calculating the distance between the sensor and the object, the sensor can detect the presence of objects in its range[9].

b. YOLO systems:

YOLO (you only look once) uses computer vision and machine learning algorithms to read the RTO number of the vehicle involved in the accident. The system can then retrieve the phone number and email address associated with the vehicle owner from a central database [10]. The system can also use natural language processing to send an automated message to the family members of the vehicle owner, informing them of the accident and the location.

c. Emergency Trigger:

Upon detecting an accident, the system sends an emergency trigger to the hospital and family members of the vehicle owner [11]. The emergency trigger can be sent via SMS, email, or a mobile application. The message contains important information such as the RTO number, location of the accident, and contact information for the hospital.

d. ***Maps Integration:***

The system uses maps to show the traffic-free route for the ambulance to reach the accident site. The map integration can also show alternate routes to avoid congestion, improving traffic management in the affected area. The system can also use real time traffic data to update the route in real-time, ensuring that the ambulance reaches the accident site as quickly as possibl[12].

d. Central Database:

The proposed system can use a central database to store important information such as vehicle registration details, contact information for vehicle owners, and hospital contact information. The central database can be accessed by the artificial intelligence module to retrieve information in real-time. The hardware unit of the system configuration is shown in fig 1 which contains system prototype for ultrasound sensor configuration.

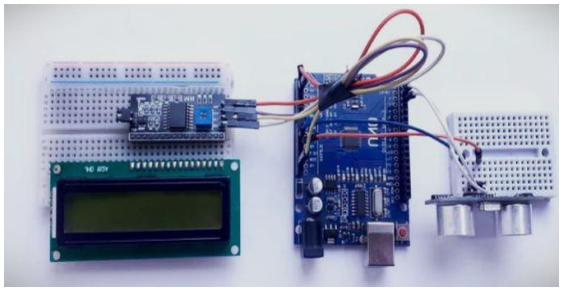

Fig 1: System Prototype

The system for detecting the accident is shown in a block diagram for the proposed system as in fig 2.

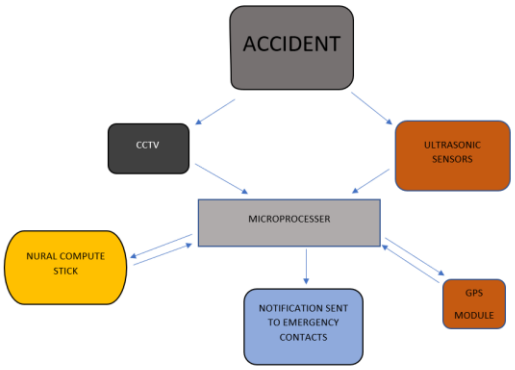

Fig 2: Block diagram for crash detection

The above architecture can be illustration for accident detection and remaining phases are taken care by Artificial Intelligence technology. The input for the system is an image of the number plate of a vehicle where accident has detected. The fig 3 shows CCTV cameras that are installed at appropriate levels.

Fig 3: CCTV cameras at every street lamp.

The proposed method for detection of number plates was done through an Artificial Intelligence inspired image segmentation method such as YOLO. To get a better accuracy the features of YOLO have been taken through a series of mathematical transformations for scaling and rotation given by a homogeneous matrix of points known as Affine representation. This AI phase is explained in fig 4 with the high-level architectural diagram.

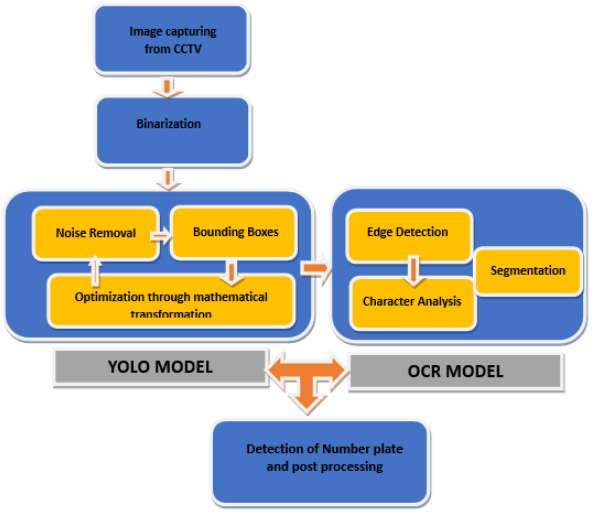

Fig 4: Architectural diagram for the detection of number plate through Affine model

Further, the optimization is achieved through affine transformation by applying a series of mathematical models through it. YOLO algorithm gives the segmentation of image by taking bounding boxes. They are rectangular ones. Further the accuracy of segmentation can be improved by taking any 3 corner points from rectangular bounding boxes and apply transformation until the proper orientation of image is obtained. The homography matrix is represented in equation 1.

$$\begin{pmatrix} Yh11 & Yh12 & Yh13 \\ Yh21 & Yh22 & Yh23 \\ Yh31 & Yh32 & Yh33 \end{pmatrix} \quad \ldots\ldots\ldots\ldots\ldots(1)$$

Where Yhij indicates YOLO transformation Homography values.

The working of the crash detection system

The YOLO module will first determine what has happened at the site and then pop up a message on the victim's system demanding a reply within 25-30 seconds. In case the person responds to the text that appears on their screen “ARE YOU OKAY?” then the sensor will not notify any message to the police or the hospitals. But in case the user does not reply in time then the user is in trouble and the sensor will immediately notify the users emergency contacts and the nearest hospital and police station and the

victims details are collected by scanning the individual's number plate.

e. *Performance analysis:*

The proposed system id compared for segmentation and OCR part correction between the scanned images obtained from forming bounding boxes with respect to the ground truth. The Euclidean distance measure is taken between the generated coordinate values of ground truth bounding box with the YOLO detected one, and has shown 99% of accuracy as shown in table 1 below.

Table 1: Accuracy of algorithm

Ground Truth (x,y) as generated by image matrix	From actual output	Euclidean distance measure	% of Accuracy
(120,342) (340, 342) (120, 50) (225, 50)	(115,342) (338, 342) (118, 50) (226, 50)	0.012	**Approx 98.6 = 99%**

IV. Results and discussions:

The system is implemented in three stages; accident detection. Through CCTV cameras installed in the street lights accident is detected through ultrasonic sensors in real time and a trigger message are sent to relatives of victims, nearest police station and nearest hospitals through a messaging service as shown in fig 5a, b and c respectively.

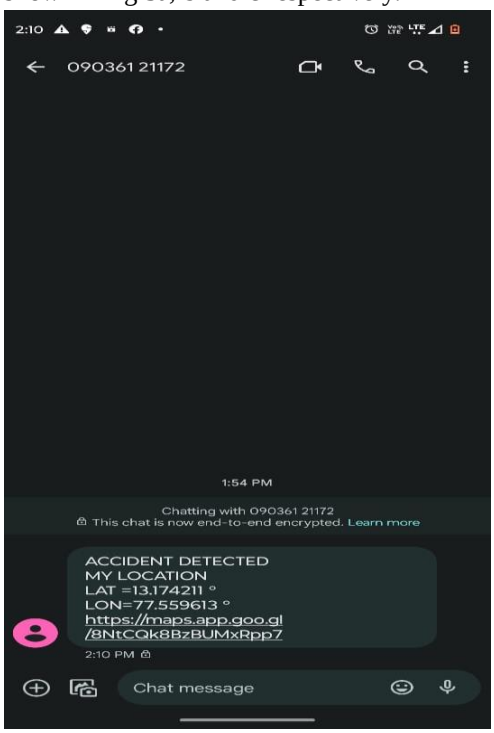

Fig 5a. Message to relatives of victims

Fig 5b. Message to ambulance

Fig 5c: Trigger message to the nearest police station.

Once initial level of triggering is done, the second phase is identification of number plate of the vehicle. This is implemented by YOLO segmentation module. The result of YOLO object segmentation is as shown in fig 6.

Fig 5: Image detected by YOLO

Using python tools and OPENCV libraries available, edge detection is taken care and number plate was extracted by OCR techniques. Thus, helps in detection of number plates by matching from the RTO database. To improve next level of accuracy all the testing images are subjected through series of affine transformations to get the accurately aligned images and thus we get good accuracy compared to non-applying of transformation method.

V. Future Scope:

The proposed system works well for real time applications of number plate detection and accident detection using AI technique. The system can also be extended to include other emergency services such as fire and rescue. Furthermore, the system can be extended to include real-time weather data to help emergency services prepare for adverse weather conditions.
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VI. Conclusion:

The proposed system offers a practical solution for real-time traffic management and emergency response systems. By using ultrasonic sensors and artificial intelligence technique called YOLO segmentation along with affine transformation. The system can detect and respond to accidents in real-time. The system can retrieve important information such as the RTO number, phone number, and email address of the vehicle owner, making it easier to notify family members and emergency services. Additionally, the system can show the traffic-free route for the ambulance to reach the accident site, minimising delays and improving emergency response times. The system can also deviate users to alternate routes, reducing congestion and improving traffic management in the affected area. Overall, the proposed system has the potential to significantly reduce the negative impact of accidents and other incidents on society. Program for Detecting the number plate as far as traffic management is concerned

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