Ambulance And Fire-Engine Detection for Allowing Path Them Using AI

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***Abstract*—Ambulance and Fire engine Detection Using Image Processing and alerting the other vehicle users is much needed task to save lives. Because the number of vehicles using the road is increasing every day over the past couple of years, resulting in traffic congestion. This results thousands of peoples to lose their lives. Hence to make the quickest way to ambulance and fire engines from cars and other four-wheeler vehicles proposed system identifies the ambulance and Fire engines at the designated intersections, and the software detects the ambulance and fire engines approaching using the AI model called Res Net deep learning technique. Once an ambulance or fire engine is detected, the system generates an alert message and transmits it to digital display boards installed at upcoming traffic junctions. The system can also be integrated with GPS and wireless communication technologies to track emergency vehicle locations and send alerts to multiple upcoming intersections. The main objective of this project is to improve emergency vehicle movement, reduce response time, minimize traffic-related delays, and provide faster access to emergency services.**

***Index Terms*—Ambulance Detection, Fire Engine Detection, Image Processing, Artificial Intelligence (AI), Deep Learning, ResNet (Residual Neural Network), Traffic Management System, Emergency Vehicle Detection, Real-Time Detection, Digital Display Board, Intelligent Transportation System (ITS)**

I. INTRODUCTION

In today's modern world, the number of vehicles on roads is increasing rapidly due to population growth, urbanization, and industrial development. This increase in vehicles has resulted in heavy traffic congestion, especially in crowded cities and at major road intersections. Traffic congestion creates serious problems for emergency vehicles such as ambulances and fire engines, which need to reach their destinations as quickly as possible.

During medical emergencies, accidents, and fire incidents, even a small delay can result in the loss of human lives and damage to property. Therefore, providing a clear and quick path for emergency vehicles has become an important requirement of modern traffic management systems.

A significant number of automobiles on the road has rapidly increased the amount of vehicle traffic in cities. Due to the heavy traffic, there are frequently traffic delays on the roadways, which can result in human lives being lost when emergency medical vehicles like ambulances and fire engines become stopped in the gridlock. Current traffic control systems are static, requiring cars to wait until the microcontroller turns on the green light for that lane after a predetermined length of time. The traffic police can provide precedence to the ambulance if it is stuck close to a traffic light by displaying the appropriate symbols or signals to the passing vehicles, allowing the ambulance to exit the traffic as swiftly as feasible. Additionally, if the emergency vehicles are blocked in a lane distance from the traffic signal, the ambulance's siren won't be able to reach the traffic police, forcing us to wait until the traffic is cleared or rely on other cars to move aside, which is not always possible in traffic. The use of Image Processing technology has been implemented in the proposed system. This system uses a CNN (Convolutional neural network) and Resnet modules. Following the predetermined stage, the features are taken from the provided input picture using different layers of the CNN. And Resnet also same work but accuracy is more than and used to express the view that one should make the most of the present moment without worrying about the future. The detection outcome's projected bounding boxes are used. The ambulances seen in the traffic data are the product of the process. The CNN network is the basis for the proposals. We will do an image detection

following the image capture in order to further define the detection process and focus it on the ambulance.

Ambulance and fire engine detection using image processing is an important technology that helps save human lives by providing a clear and faster route for emergency vehicles. In today's world, the number of vehicles on roads is increasing rapidly due to population growth, urbanization, and industrial development. As a result, traffic congestion has become a major problem in many developing and developed countries, including India, Japan, and other countries.

The next phase of the procedure is bilateral filtering, where the intensity value of each pixel is saved using the weighted intensity of the nearby pixels that was collected in the previous step. In this stage, the edges' pixel values are saved. The data from this dataset file is sent on to the following CNN layer for additional filtering. This line contains the target. The ambulance is detection next stage signals is controlled then main target is to send the message into the traffic controller.

In many cities, separate emergency lanes are not available because of limited road space and increasing traffic density. Therefore, it becomes necessary to develop an intelligent traffic management system that can automatically identify emergency vehicles and alert other road users in advance.

During emergencies, ambulances and fire engines need to reach their destinations as quickly as possible. However, heavy traffic, overcrowded roads, and improper traffic management often prevent these emergency vehicles from moving freely. Even a small delay in reaching a hospital or an accident location can lead to serious consequences, including loss of human lives and property damage.

II. LITERATURE SURVEY

Kherraki, Amine et al explain a comparative study using eight famous CNN architectures to classify emergency vehicle images. The design and implementation of an efficient deep learning system, have been carried out to automatically classify emergency and normal vehicles in traffic scenes. First, author did a preprocessing on the Vidhya Emergency Vehicle dataset to unify the image sizes. author have added three layers to each CNN architecture, in particular, “GlobalAveragePooling2D” layer to reduce the dimensions of the input image and accelerate the training, “Dropout” layer to avoid overfitting, and finally, “Dense” layer where author put the number of output classes. Later, author made simulations of each architecture, and author notice that DenseNet121 is the most appropriate model in real-time emergency vehicle classification with an accuracy of 95.14%, a F1 score of 93.87%, and an average order memory of 27.5 MB. Therefore, reached results are very promising and will definitely give an important added value to applications that will use author’s best architecture for the classification of emergency vehicles.

S. Rafiq et al explain the existing system doesn't provide a transparent path for emergency vehicles during traffic congestion. Traffic Density Analysis, Ambulance, and Accident detection System Using Image Processing has been discussed in this proposed system. From the literature survey, we've found that RFID-based smart traffic control system provides an answer to the traffic congestion problem and this can be also an efficient method to supply a transparent path for the emergency vehicles when identified within the lane, as author also implemented sharing of patient's vital data with hospital author updated Arduino uno with Arduino mega board so it'd be sufficient for storing of patient vital parameter and simultaneously it performs capturing of present status of traffic signal present in different path and author also added another system in the junction which repeatedly scans the density of the lanes so that the system can automatically allow the lane which has high density by this technique the emergency vehicles experience less congestion and reach faster to the destination and thus many life's were been saved..

Patel, R et al introduced Emergency vehicle priority (EVP) systems could greatly reduce the traveling time for emergency vehicles like ambulances, which in turn could save many lives. The presented EVP used a neural network-based classifier to detect an ambulance siren. A mobile app was used to track the location of the ambulance. A decentralized network of IoT devices equipped with visual indicators was used to inform traffic of an incoming ambulance. Hence a makeshift emergency lane was set up on the roads. author’s EVP system didn’t require any modifications to be made to existing ambulances. Nodes could be added to the IoT network easily and without affecting the response speed of the system. As author’s system used audio signals and WiFi communication to

function, it was not affected by factors like rain, snow, fog, etc. author expect that author's proposed system enables ambulances and other emergency vehicles to reach their destinations as quickly as possible

K. Agrawal, M. K. Nigam, S. Bhattacharya, and G. Sumathi proposed a system for detecting ambulances using image processing and neural networks. The main objective of their research was to identify ambulances from traffic images and videos. The system uses image processing techniques and neural network-based classification to recognize ambulances among other vehicles. This approach helps in identifying emergency vehicles in congested traffic conditions and supports better traffic management.

III. PROBLEM STATEMENT AND OBJECTIVES

A.Problem Statement

To identify the Ambulance and Fire Engines in the congested traffic from the mounted cameras proposed system utilizes deep learning model Res-Net to efficiently identify the ambulance and fire engine to rise the alert to the other vehicle drivers through Digital display. Traditional traffic signals generally operate according to fixed timing or normal traffic density. They do not always identify emergency vehicles automatically. As a result, emergency vehicles may have to wait at multiple traffic signals, causing unnecessary delays.

B. Objectives

1. Enhance emergency vehicle response times using image processing.
2. To generate alerts when an emergency vehicle is detected.
3. Detect ambulances and fire engines in real-time at traffic intersections.
4. To detect ambulances and fire engines using image processing.

IV. PROPOSED METHODOLOGY

A. *Phase 1: Data Collection and Preprocessing*

The final stage involves displaying emergency warning messages on digital display boards installed at important traffic junctions. When the system receives an alert from the detection software, the digital board displays a warning message according to the detected emergency vehicle.

B. *Phase 2: Emergency Vehicle Detection Using ResNet*

Train and implement the ResNet deep learning model to identify ambulances and fire engines from real-time traffic camera images and video frames. ResNet is a powerful deep learning architecture that can learn complex features from images using multiple layers and residual connections. The model is trained using the prepared dataset containing ambulance, fire engine, and normal vehicle images. After training, CCTV cameras or traffic surveillance cameras capture real-time video of vehicles moving on the road. The video is divided into individual frames, which are processed by the trained model.

C. *Phase 3: Alert Generation and Transmission*

Once an emergency vehicle is detected, generate an alert message and transmit it to upcoming traffic junctions using wireless communication. After training, CCTV cameras or traffic surveillance cameras capture real-time video of vehicles moving on the road. The video is divided into individual frames, which are processed by the trained model.

D. *Phase 4: Digital Board Display*

The final stage involves displaying emergency warning messages on digital display boards installed at important traffic junctions. When the system receives an alert from the detection software, the digital board displays a warning message according to the detected emergency vehicle.

V. SYSTEM ARCHITECTURE

The system architecture of the proposed project, "Ambulance and Fire Engine Detection Using Image Processing and Alerting Other Vehicle Users," represents the overall structure and working process of the system. The proposed system uses CCTV cameras, image processing techniques, a ResNet deep learning model, wireless communication, and digital display boards. Each module performs a specific function, starting from capturing traffic videos to displaying emergency alerts for other vehicle users.

A. CCTV Camera and Image Processing

The first stage involves capturing real-time traffic videos using CCTV cameras installed at important road intersections. The cameras continuously monitor

vehicles moving on the road, including ambulances, fire engines, cars, buses, and motorcycles. The captured video is divided into individual frames using frame extraction techniques

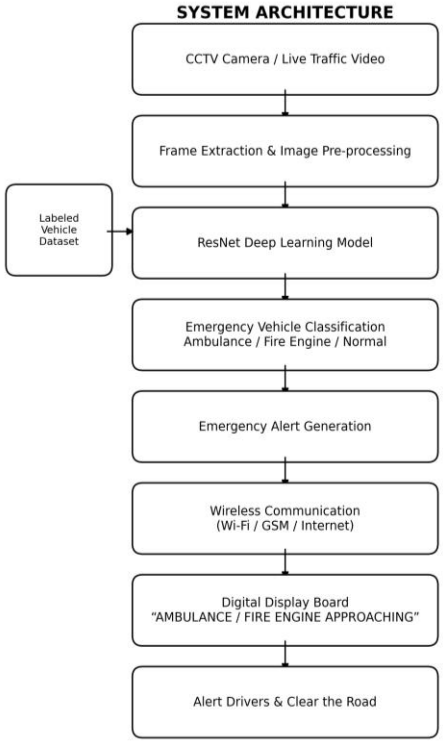

Fig. 1. Architecture of the Ambulance and Fire-Engine Detection System.

B. ResNet Deep Learning Model and Vehicle Detection

In the second stage, ResNet learns important visual features such as vehicle shape, colour, emergency symbols, and identifying markings. After training, the model analyzes real-time traffic images and classifies vehicles into three categories: ambulance, fire engine, and normal vehicle. If an emergency vehicle is detected, the system generates a detection signal for further processing.

C. Alert Generation and Wireless Communication

After detecting an ambulance or fire engine, the system automatically generates an emergency warning message according to the detected vehicle category. For example, an ambulance detection generates an ambulance warning, while a fire engine detection generates a fire emergency warning. GPS can also be integrated to identify the emergency vehicle's location and determine the upcoming junctions along its route.

TABLE I Main Entities of the Data Model

Entity	Key attributes
CCTV Camera	Captures real-time traffic images and videos from roads and intersections.
Frame Extraction	Converts captured video into individual frames for processing.
Image Pre-processing	Resizes, normalizes, and improves image quality.
ResNet Model	Learns visual features and identifies emergency vehicles.
Vehicle Classification	Classifies vehicles into ambulance, fire engine, and normal vehicle categories.
Alert Generation	Creates suitable warning messages after emergency vehicle detection.
Wireless Communication	Sends alert information to upcoming traffic junctions.
Digital Display Board	Displays emergency warning messages to nearby drivers.
Driver Notification	Helps road users clear the path for emergency vehicles.

D. Digital Display Board and Driver Notification

The final stage involves displaying emergency warning messages on digital display boards installed at important traffic junctions. These messages inform nearby vehicle users about the approaching emergency vehicle. Drivers of cars, buses, motorcycles, and other vehicles can then move aside safely and provide sufficient space for the emergency vehicle to pass. This helps reduce traffic congestion, minimize emergency delays, and improve road safety.

VI. IMPLEMENTATION OF THE INITIAL VERSION

The initial version of the proposed system focuses on developing an intelligent emergency vehicle detection system using Image Processing, Artificial Intelligence, and Deep Learning techniques. The main objective is to detect ambulances and fire engines from real-time traffic images and videos and alert other vehicle users through digital display boards. The implementation combines different software and hardware components to identify emergency vehicles and provide advance warning messages.

After preparing the dataset, the ResNet (Residual Neural Network) deep learning model is implemented

using Python and suitable deep learning frameworks. The model is trained using the collected images to learn important visual features of ambulances and fire engines. These features include vehicle shape, body colour, emergency symbols, medical markings, and other identifying characteristics. The trained model is then tested using separate images to evaluate its ability to distinguish emergency vehicles from normal vehicles.

VII. EXPECTED RESULTS AND DISCUSSION

The expected result is that the system will successfully identify different categories of vehicles, including ambulances, fire engines, and normal vehicles. The trained ResNet model will analyze the captured images and recognize emergency vehicles based on their visual features, such as shape, colour, symbols, and emergency markings. This automatic identification process will reduce the need for manual monitoring and help improve emergency vehicle recognition.

TABLE II Expected Results of the Proposed Ambulance and Fire Engine Detection System

Test Scenario	xpected System Response
Ambulance Detection	Identifies an ambulance and generates an ambulance alert message.
Fire Engine Detection	Identifies a fire engine and generates a fire emergency alert message.
Normal Vehicle Detection	Classifies the vehicle as normal and does not generate an emergency alert.
Alert Generation	Creates a suitable warning message after an emergency vehicle is detected.
Wireless Communication	Transmits the emergency alert to connected or upcoming traffic junctions.

After detecting an ambulance or fire engine, the system is expected to generate an appropriate emergency alert message. The generated alert will be transmitted to upcoming traffic junctions through wireless communication technologies. Digital display boards installed at these junctions will show warning messages such as "AMBULANCE APPROACHING GIVE WAY" and "FIRE ENGINE APPROACHING CLEAR THE ROAD". These messages will inform nearby vehicle users about the approaching emergency vehicle and encourage them to clear the road safely.

VIII. CONCLUSION AND FUTURE SCOPE

Build a dataset so the software may need it for training and evaluation. The application used the design that was created in order to separate the ambulance and fire engine from most other vehicles. In order to facilitate the most efficient route to emergency medical services for vehicles such as cars and four-wheelers, the suggested system locates these vehicles at specific intersections and uses an artificial intelligence model known as Res- Net deep learning to detect when they are approaching. In the future, the system can be enhanced by integrating GPS and IoT technologies for more precise tracking and coordination of emergency vehicles. Expanding the system to cover more intersections across urban areas will increase its impact and efficiency. Improving the ResNet model with larger and more diverse datasets can further boost detection accuracy.

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