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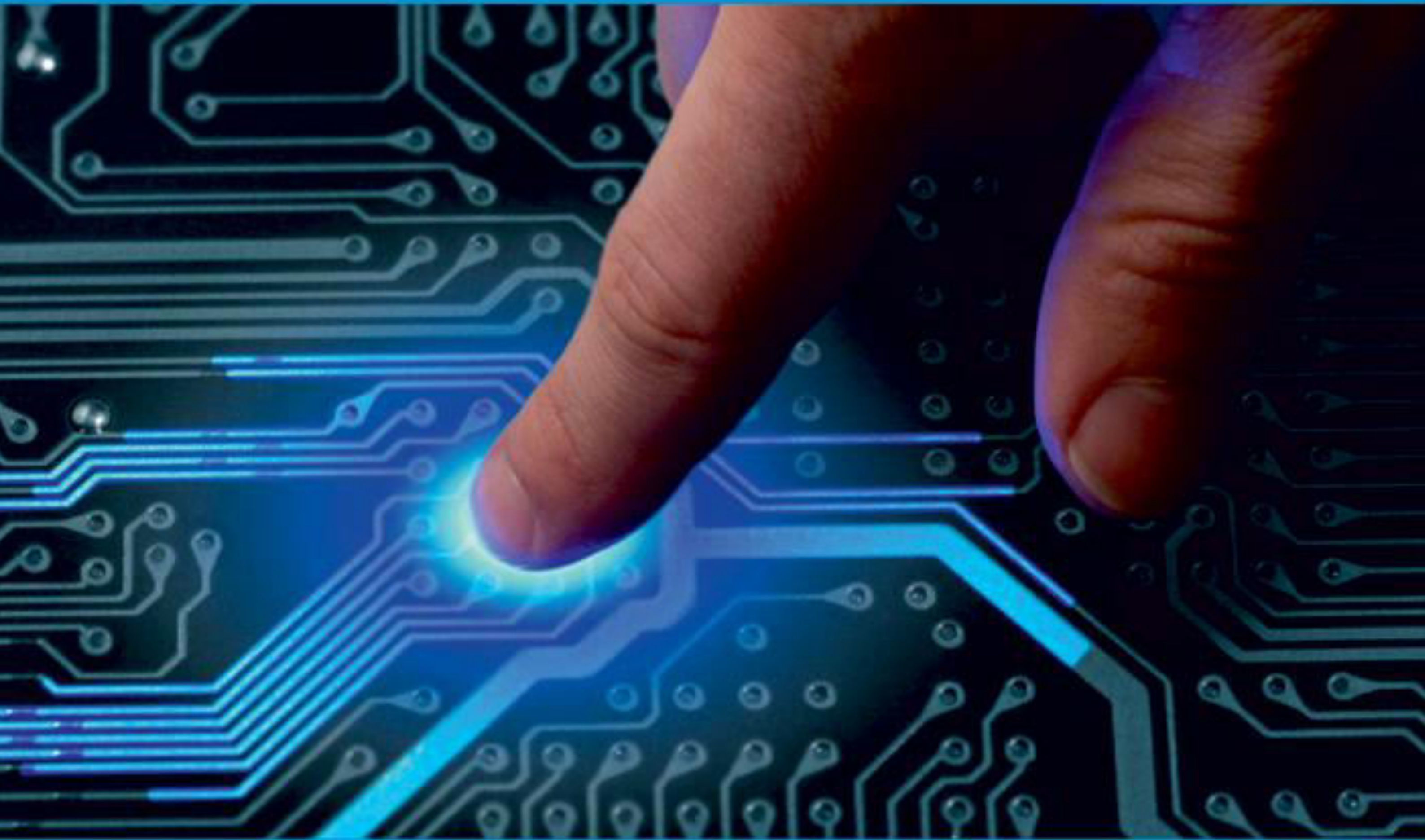

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Detection of Ambulance Using Computer Vision

Dr. S.A Sahaaya Arul Mary[1], Sanjay SP[2], Saran S[3], Sherwin Harold F[4], Steve Philip S[5]

Professor, Department of Computer Science and Engineering, Saranathan College of Engineering, Trichy, India[1]

Department of Computer Science and Engineering, Saranathan College of Engineering, Trichy, India[2, 3, 4, 5]

ABSTRACT: The number of vehicles have increased in recent days. Managing this huge number of vehicles is a tedious process. Traffic Signals are used to control the flow of the vehicles in an orderly manner. Sometimes an ambulance may need to wait for long time in a traffic signal and if it waits for too long, it would put the patient's life at risk. Traffic police can manually identify an ambulance and try to clear the traffic jam, but it is not possible with today's enormous vehicles.

KEYWORDS*:* YOLO, CNN, Ambulance, Emergency Vehicle

I. INTRODUCTION

Emergency vehicles play an important role in every life-threatening situation. Traffic jam takes more than 20% patient lives in an ambulance but when the patient's condition is very serious the percentage of patient death is increased. These are situations when an emergency patient needs to go to the hospital immediately and the ambulance got stuck in the traffic jam. This scenario is dangerous in case of heart patients who needed to be rushed to hospital in time. In traffic jams, many people do not bother to give pass-way for the emergency vehicle and also traffic police can't see which lane they should clear for the ambulance. Therefore many patients lose their lives before reaching hospitals.We can reduce these problems by introducing an intelligent automated system integrated with a traffic control system that will detect and give priority to emergency vehicles.. After detecting every vehicle, they have classified it into an emergency vehicle and regular vehicles. If an emergency vehicle is found, the computer can notify the traffic police or an automated system to clear its way**.**

II. LITERATURE SURVEY

[1]Agarwal et al Ambulance tracking system is activated at the mapped junctions and that program detects the ambulance coming close to it and turns the traffic light to Green for the next 15 seconds. This uses geofencing technique for tracking ambulances which is not so accurate

Shuvendu Roy have proposed a model that can [2]detect emergency cars on a heavy traffic road. It is difficult or sometimes impossible for traffic police to handle ambulance vehicles which have no time for waiting in traffic. For this reason, an automated system is proposed that will be able to detect an emergency car in heavy traffic road, let the controller know or automatically navigate other cars to clear its path.

H. Songs et al. [3] Intelligentvehicledetectionandcountingarebecomingincreasinglyimportantinthefield of highway management. However, due to the different sizes of vehicles, their detectionthe proposed methods. The experimental results verify that using the proposed segmentation method can provide higher detection accuracy, especially for the detection of small vehicle objects.

K Rubini et al. [4]focuses on controlling the speed of the surrounding vehicles near ambulance, and hence the ambulance can reach the hospital on time. It can be done by using RSSI (Received Signal strength Indication) which works based on Message Queuing Telemetry Transport algorithm. Node MCU acts as transmitter and server acts as receiver. Node MCU has the inbuilt Wi-Fi module (EP8266). It receives the signal from server and identifies that signals strength which is used to reduce the speed of other vehicles within the particular limit. An APR voice module is used to provide intimation to the surrounding vehicles about the arrival of ambulance.

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Nellore et al. [5] calculated the distance of an emergency vehicle using the camera and informing the Traffic Management Center (TMC). They used visual sensing technique. A camera was used to record 1920 × 1080 pixels video with 30 frames per second. First, the images are converted RGB to grayscale then threshold the images. Some morphological operations were applied to each image and after that, they measured the distance between the camera and the emergency car in a different technique like Euclidean distance in MATLAB.

P Jadhav et al. work aims to [6] solve traffic problem intelligently with automated smart traffic control system.Image Processing techniques have been implemented. A web camera is placed on the lanes to capture the incoming traffic and this traffic footage is processed by the system and the traffic is routed based on the density of vehicles.

On the other hand, Djahel et al. [7] designed an advanced traffic control system that minimized the emergency vehicle congestion level. A traffic management controller architecture was made with the help of fuzzy logic controller for emergency services. Their method had got the control of changing the traffic light, changing the speed limit, lane clearance etc. Fuzzy logic determinates most accurate evaluation of the low, medium, high congestion level

Another idea was given by Parthasarathi et al. [12] that an intelligent traffic system that implements some embedded system for giving more priority of an emergency vehicle in a traffic control system. They measured the density of the vehicle by the infrared detector but could not work efficiently in real time scenarios. The toy car was used to make the prototype of a traffic model. At first, the images were cropped into the region of interest like only roadside images. Thered and the blue color were only selected in the images and measured the distance between each red and the blue color.The noise of the images was is removed by the Gaussian filter and counted the set of connected pixels.

Baghdadi Sara et al. [10] aim to develop a computer vision system to detect ambulance by observing using a static camera. These aim to find the shortest possible path for an ambulance to reach its destination. If an emergency vehicle get stuck in traffic jam, it can cause damage to life and properties. The approach is based on two main stages: Feature extraction step and classification step.For the first step, using descriptors to extract features, such as HOG (Histogram ofOriented Gradient), LBP (Local Binary Patterns), and Gabor filter. Then, it is classified using machine learning algorithms like SVM (Support Vector Machines) and kNN (K-nearest neighbor) for classification.

III. EXISTING SYSTEM

The simplest way of controlling a traffic light uses timer for each phase in round robin fashion. Another way is to use electronic sensors to capture the location of the vehicle and check whether it is waiting in a signal or not. This method requires installing some sensors in that particular vehicle which is not possible for the huge number of vehicles available

The use of RFIDs and Bluetooth in the existing work has been used in vehicle detection for a long time. These devices however have a few drawbacks when being used for detecting vehicles such as more number of sensors, low response speed, high cost and low range

IV. PROPOSED SYSTEM

In our work, the only piece of hardware we propose to use is the surveillance camera itself. The system will detect vehicle through images instead of using electronic sensors embedded in the pavement. A camera will be installed within certain distances from the traffic light it will capture the footage of the vehicles at regular intervals. The captured footage is then converted to frames andYOLO algorithm is used to extract the vehicles. The extracted images is then processed by our CNN model to detect whether it is an ambulance or not.

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V.ARCHITECTURAL DESIGN

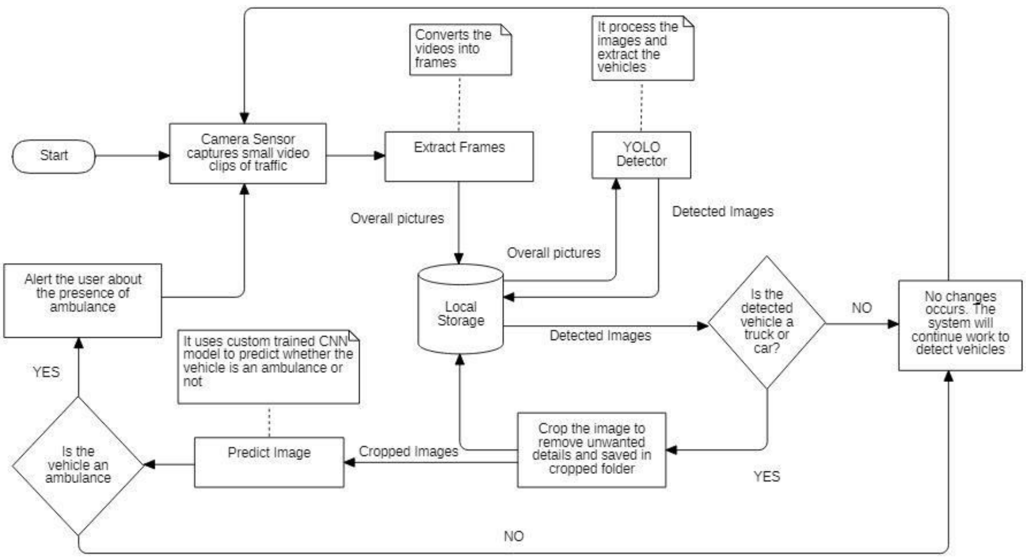

Fig.1 Architecture Diagram

The Architecture Diagram displays how the images are going to the YOLO program, then it is detecting whether the vehicle is a truck or not. Since we are using CNN, it helps us to generate our dataset, where in the filtered data from the YOLO program comes as input(i.e, trucks).With dataset generated, using CNN, we detect whether the detected truck as an ambulance or not.

VI. MODULE DESCRIPTION

Step 1: Training the Neural Network

A Convolutional Neural Network(CNN) is designed to work as a classifier.It is trained using images of trucks and cars from the COCO(Common Objects in Context) dataset and ambulance images collected from googleIt works as a binary classifier to tell whether the vehicle is an ambulance or not

Step 2: Extracting frames from video

This module used OpenCV library toconvert the video input into frames.A snapshot of the video is captured at certain time interval.These snapshots/frames are then sent to yolo_detector to extract the vehicle images

Step 3: Using YOLO algorithm to detect vehicles

This is where we have implemented the YOLO(You Only Look Once) algorithm.The images of vehicles alone without additional background will be extracted from the snapshot that was captured previously.The extracted vehicle images are saved and sent to the classifier.

Step 4: Classify vehicle as an ambulance or not

The trained model is saved and used in this module to actually detect the image.The extracted images are processed by this module and it returns the class number of the vehicle. We have 0 for non-ambulance vehicles and 1 for ambulance vehicle

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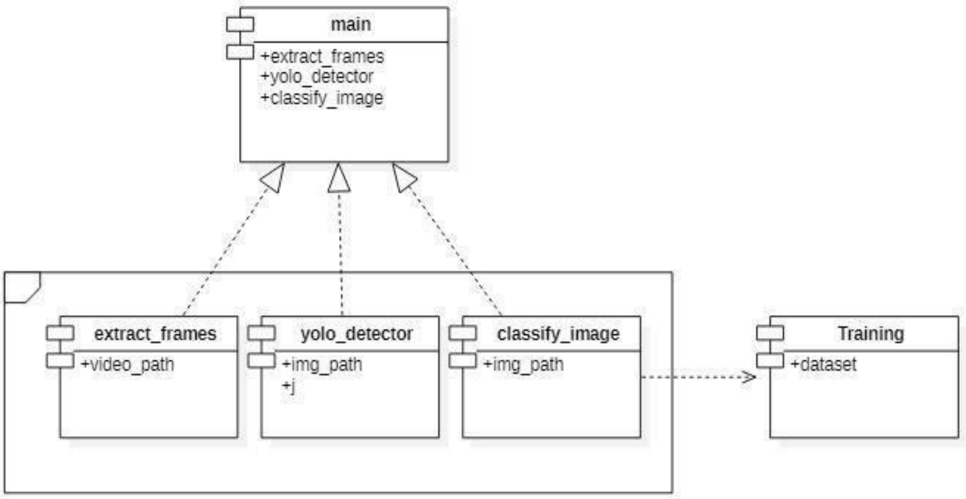

Fig.2 Module Description

VII. IMPLEMENTATION

The implementation is segregated into 4 Modules and considered as 2 Phases: Training and Detection. The videos captured by the camera sensor are converted into images and these images are processed by various algorithms and finally, the program gives the output whether the vehicle detected is an ambulance to not. After that it will alert the user if the ambulance is present or not

A. *Training*

Before the detection of the vehicle and giving output based on the result, the machine must be taught how an ambulance looks like. For this, we created a tiny dataset consisting of a thousand images, and a model must be trained which will be called in the confirmation segment.TensorFlow 2.1.0 algorithm is particularly used to avoid compatibility issues and is installed. Validation and trained images generated after training are stored in their respective folders in google drive and the drive is linked to the training algorithm. Matplotlib is used to give the output graphs.

1) *Pre-processing*:More than 1000 images were downloaded from various internet sources and given as input for training to generate a trained dataset that can be used for detection. ImageDataGenerator function is used to manipulate the existing images and make more copies, to increase the dataset size. Train generator and Validation generator functions are used to resize and segregate the images and save them in Train and Validation folders in the drive, both have 2 folders each - 0 and 1, Images that have ambulance are saved in 1 and others in 0. Batch size for training the data is set as 32 and the images are resized to 224x224 pixels.

After the pre-processing, the standard TensorFlow algorithm runs to train the dataset. Using Keras open-source library, a sequential list is created. As we are working on CNN, 4 layers of 2D convolutions are set, and after each convolution – Max-pooling operation runs, and the least relevant results are dropped out. The whole process runs 20 times (epochs = 20) and takes a maximum of 25 minutes.

2). *Combining:*The whole data is combined and optimized using adam optimizer and losses are calculated to make the model more efficient. Using the Fit generator, the model is created, and later, it is saved in the drive folder. The whole model is based on the metrics accuracy and loss and the graphs for the same are plotted. Confusion Matrix and Classification Report are generated to measure the performance of the model

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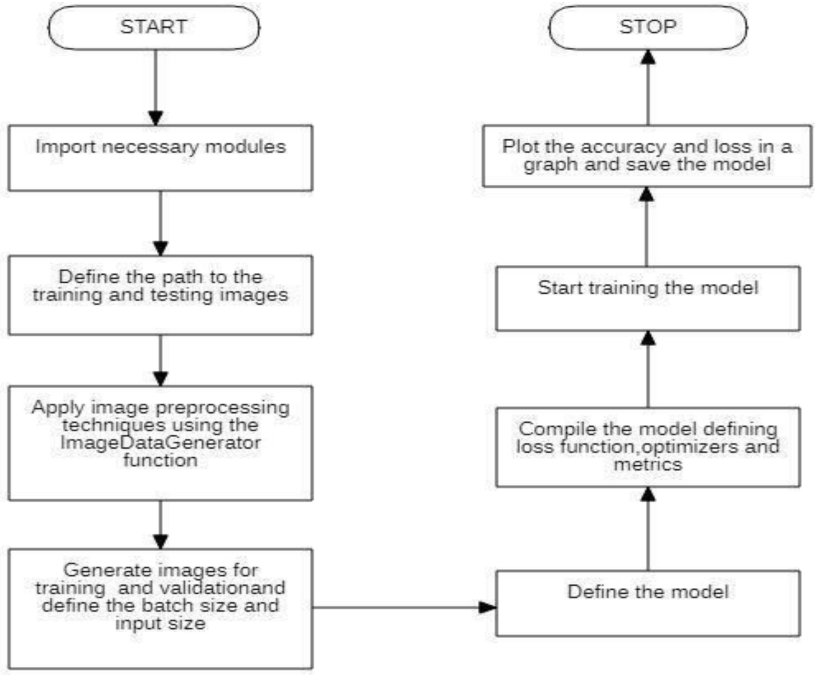

Fig.3 Training Flowchart

B. *Detection*

*1) Frames Extraction:*Camera Sensor captures small video clips of traffic, these Clips are taken as input and are sent to the processor. Clips are converted into pictures and are sent for processing. First, they are saved in the “overall” folder of the attached google drive

*2) YOLO Detection:*Images in the overall folder go to the YOLO program that detects if the vehicle is a truck. It is a predefined algorithm that uses the COCO dataset developed by Microsoft. YOLO algorithm detects that the image that is passed through it contains are truck or not. If the vehicle qualifies as a truck, then a copy of these images is saved in the “detected” folder after adding a bounding box around it. The images are cropped on their bounding boxes and the cropped image is saved in the “crops” folder

3) Image Classification: The image then passes to the main function, where our model is called, and the image is processed to check if it is an ambulance. If it qualifies as an ambulance then, yes is returned by the main function. On returning yes, a message is sent of the respective mobile no. for conveying that an ambulance is detected and then the images are saved in the “final” folder.

VIII. VALIDATION

The performance of the training model and the overall application can be validated using the accuracy graph and classification report. The precision and recall values are above 0.80 and the weighted average accuracy is more than 80%. This shows that our model is capable of detecting the ambulance with good speed and accuracy. The confusion matrix shows the situations when the model’s output is wrong

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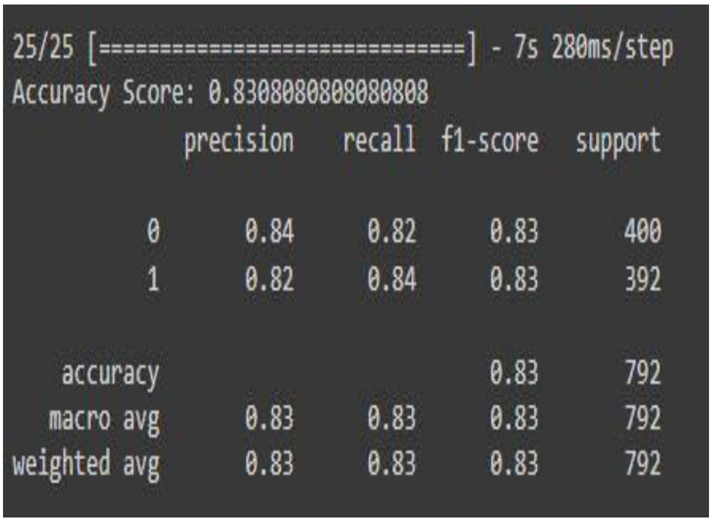

```
25/25 [==============================] - 7s 280ms/step
Accuracy Score: 0.8308080808080808
              precision    recall  f1-score   support

           0       0.84      0.82      0.83       400
           1       0.82      0.84      0.83       392

    accuracy                           0.83       792
   macro avg       0.83      0.83      0.83       792
weighted avg       0.83      0.83      0.83       792
```

Fig.4 Classification Report

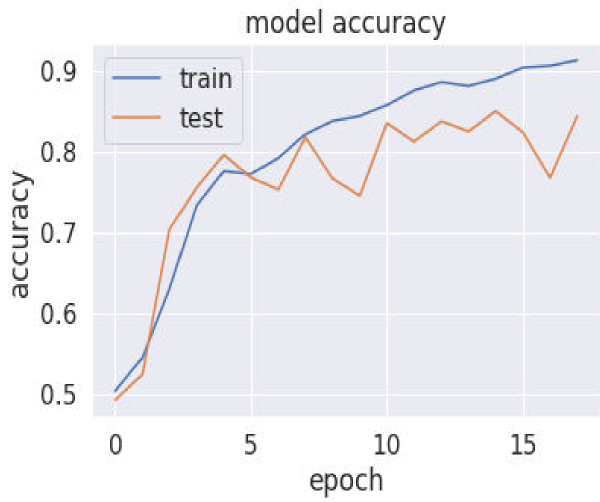

Fig.6 Accuracy Graph

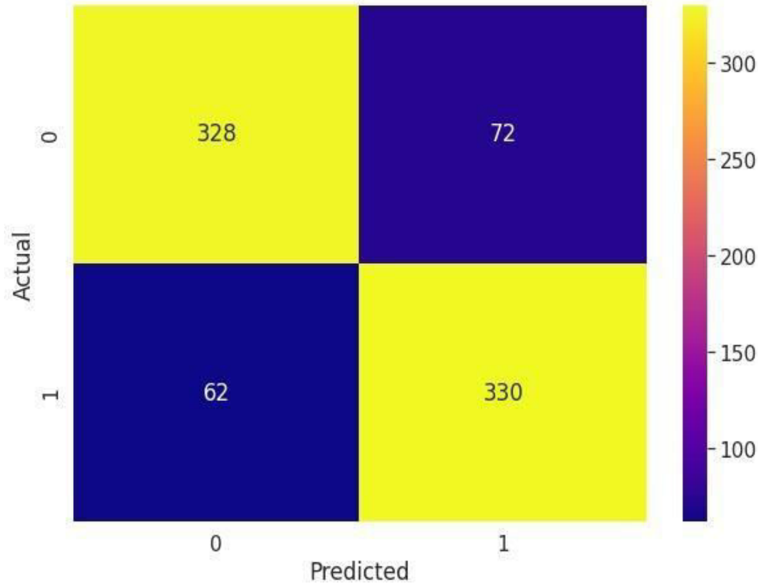

Fig.7 Confusion Matrix

IX. RESULTS

. The accuracy is satisfactory and the total time taken for the whole process is minimal. The classification report gives all the necessary metrics to evaluate the training model. Apart from these, other aspects such as the time taken to extract the frames from the video, the accuracy of YOLO algorithm in detecting the vehicles and the removal of noise from the vehicle image, all these are done at faster rate and greater accuracy. Overall the system works as expected

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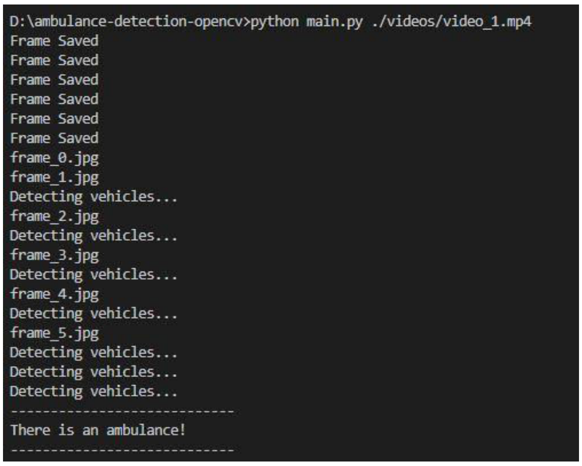

Fig.8 Command Line Output

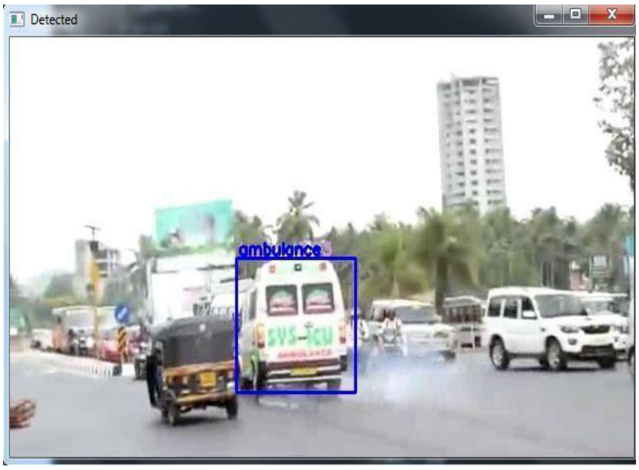

Fig.9 Ambulance detected in the frame

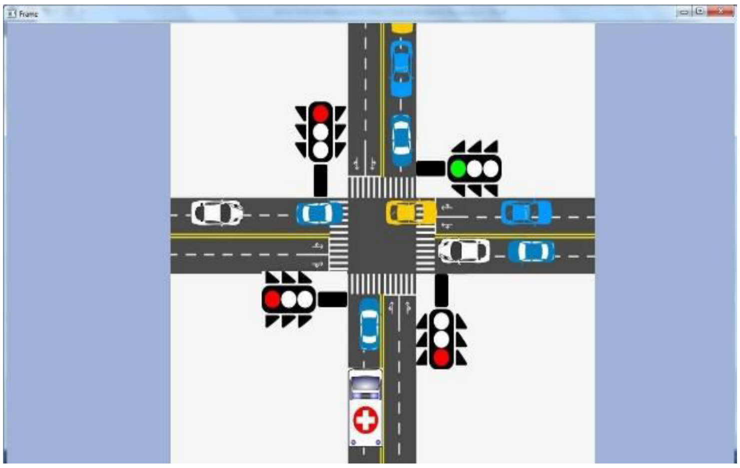

Fig.10 Simulation of traffic signal

X. CONCLUSION

In this work, an approach is proposed to automate the detection of ambulance in a traffic signal. It is more consistent in detecting vehicles because it uses actual traffic images. Based on the experimental results, it is shown that the system is working fine and produces desired results such as:

- Extracting frames from the video captured
- Detecting vehicles at an given frame of the feed
- Classifying the vehicle as an ambulance or not

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