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Intelligent Traffic Control System

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Abstract: ***Managing traffic maintaining order is the most demanding tasks in the contemporary day and age. Emergency vehicles such as an ambulance face lot of hardships when they get stuck in traffic, valuable human life is lost due to poor traffic management. In this paper a model is proposed for calculating traffic heaviness on roads using processing techniques for images with ambulance detection system and controlling model for traffic signals with the information extracted from images of vehicles on roads captured by video camera. The traffic intensity depends on the total vehicles on the road. The proposed model counts the vehicles in the lane and checks for the presence of emergency vehicles , whenever an emergency vehicle is detected that particular lane is allowed to move and the signal is turned to green.***

Keywords **:** ***CNN, YOLO ,OpenCV, Image Processing.***

I. INTRODUCTION

One of the complications in most metropolitan cities in the world is poor traffic management. To have a trusted transportation system it is paramount to have an efficient traffic management system. Gathering the traffic information is the essential step towards having an efficient traffic management system. This data can be procured from varied sources such as sensors and surveillance feeds. Induction loop, infra-red-light sensor, optical flow are a few ways to gather information. In the day and age of artificial intelligence and image processing it is easy to process and handle the issue of inefficient traffic management system. Over the years lot of techniques to overcome this situation has been proposed. Pixel based detection is the centre of the all these proposals. However, this method has a drawback, pixels just detect the density of vehicles but not the kind of vehicle which is in the given lane. This creates issues for the emergency vehicles which are on the road.

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The countries which have high population density witness heavy traffic, at time this can be a serious issue to emergency vehicles and keep lives at stake. Emergency vehicles such as ambulance are affected by this as they cannot reach out on time to help people who are suffering, in this paper a model is proposed that finds out total vehicle number in a video frame which and also the emergency vehicles in it. Detecting emergency vehicles in a particular lane helps to clear that lane irrespective of vehicles in that particular lane.

II. PREVIOUS WORKS

As the city road network is growing day by day, the question of how to obtain information about the road is becoming more and more challenging. Traffic problems now are on the raise due to the steep increase in number of vehicles and the resource which are limited by current infrastructures. Initially proposed method relied upon the daytime sequences using tradeoff between vanishing points and object collision methods. The other works which followed made amends to the previous system by addressing the issues such as the calibration of cameras which are used to detect the vehicles, priori camera calibration system helps in better analysis of the vehicles. Further improvisations such as two K nearest object detection was implemented in order to assess the density of traffic by using time spatial image method. This paper emphasizes on using the YOLO modules and CFRN module for detecting the vehicle count in a lane and the presence of emergency vehicles.

III. METHODOLOGY

A. DETECTING VEHICLES

Various methods are available to detect the vehicles in a road, methods such as installing laser scanners, induction loops, infra-red sensors, optical flow, sound sensors etc. All these methods have drawbacks of their own, as these sensor based detection can be easily abused by using various external factors.

B. VIDEO BASED IMAGE DETECTION

Video processing-based detection have undergone various evolutions in the recent few decades. With the advent of machine learning and artificial intelligence the use of classifiers has played significant part in video and image detection. The classifiers are used to detect the objects in a video by trimming them down to frames. Each frame is scanned for match along with the defined classifiers, if there is a match in the frame with the classifiers then the object in that particular frame gets detected.

C. COUNTING THE NUMBER OF VEHICLES

The three main components which are important in a vehicle counting system are: a detector, tracker and counter. The detector is required to identify the vehicles in a given frame of video and returns a list of bounding boxes around the vehicles to the tracker[1]. The tracker uses the bounding boxes to track the vehicles in subsequent frames[1]. The detector is also used to update the trackers periodically to ensure that they are still tracking the vehicles correctly. The counter counts vehicles when they leave the frame or makes use of a counting line drawn across a road.

D. DETECTION

An important aspect of OpenCV and image processing concerned with identifying instances of objects of a certain class, like vehicles or people, in images and videos[1]. Popular areas of interest in object detection include pedestrian detection and face detection[1]. Object detection can be applied in solving hard problems in areas like image search and video surveillance[2]. It is used widely in computer vision tasks including face detection, face recognition, and object tracking[3]. All object types have special attributes that help in classifying them. For instance, all faces are round. Object detection algorithms use these special attributes to identify objects in images and videos[4]. The model is experimented with several object detection techniques, most notably background subtraction, Haar Cascades and YOLO[1].

E. BACKGROUND SUBRTACTION

The first detector used to identify the vehicles was a background subtractor. Background or image subtraction is the process of extracting the foreground of an image from its background. If you have a background image like a road without vehicles in it, you can subtract this image from another image of the same road (from the exact same view) which contains vehicles to detect those vehicles. The background pixels would cancel each other out and the objects in the foreground would pop out.

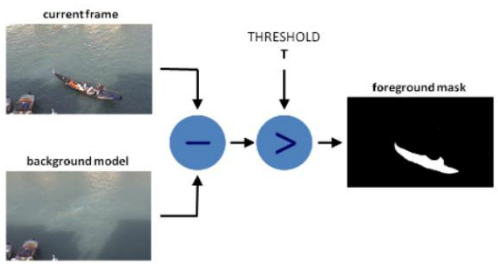

Fig .1 Background Subtraction

The fig.1 describes how background subtraction happens for each image in a video frame. While background subtraction is easy to implement and superfast, it is difficult to arrive at a suitable threshold for detecting vehicle blobs[1]. Objects not only pertain to that of vehicles but also to other factors such as people walking on road, animals, carts which are being pulled by people or wheelbarrows, skateboarders etc. Perspective plays an important role in the objects size and shape as they move across the view and vehicles may be interpreted as one object.

dest(x, y) = (1-alpha).dst(x, y) + alpha.src(x, y)[5]

H. HAAR CASCADE

Haar Cascades are object detection models depending on the concept of Haar-like features developed by Paul Viola and Michael Jones[1]. They work with image intensities i.e. the RGB values of the images and help in feature calculation. Haar Cascade data set model is generated from the data obtained in the testing VCS. Haar Cascade are generally more faster than deep learning models and can run the VCS on devices with minimal hardware requirements when compared to the hardware requirements needed to run a deep learning model[6].

I. YOLO

OpenCV supports the deep learning module which can help and import YOLO which is a popular deep learning module and algorithm. YOLO model is used to train the dataset for the vehicle detection system. YOLO uses CNN(convolution neural network). It applies a only one neural network for the image as a whole, then dividing the image into multiple small regions and helps in predicting the bounding boxes with each regions probability. The algorithm only looks once at the image which means there is only one forward pass neural network which is used to predict. It implicitly encodes the entire image about classes and their appearances

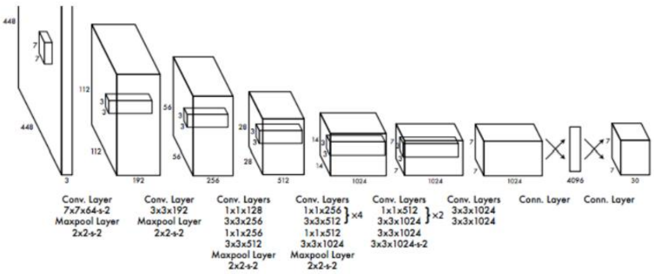

Fig.2 Convolution Neural Network

The fig.2 describes how a convolution neural network process a data in it.

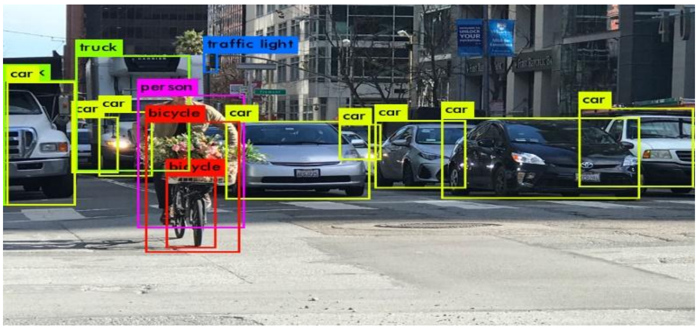

Fig.3 YOLO

The fig.3 shows how a YOLO model detects the vehicles and displays output to the user.

J. COUNTING

Vehicles are counted when they leave the frame or cross a line at an exit point of the frame. Whenever a vehicle crosses the couniting line the counter increase for that particular frame. Using a counting line makes it easier to count vehicles moving in a certain direction.

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IV. SYSTEM ARCHITECTURE

The cameras send in the input feed to the system which will process the input feed with the image processing techniques which are previously discussed and this process yield the result as in which lane has maximum number of vehicles and the availability of emergency vehicles. The microcontroller receives the information as in which lane should be allowed to move on and passes the information to the traffic signal mechanism and the LCD screen for display.

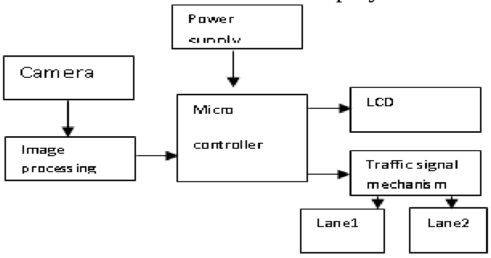

Fig.4 System architecture

Fig.3 describes the system architecture of the proposed model.

V. EXPERIMENTAL RESULT

To implement the proposed system the model uses an experimental setup consisting video feed from traffic cams installed , these video feeds are stored and are passed to the proposed module. The processing techniques are applied to the received video feeds. The output is transferred to the LCD an Arduino is required to control it and also the output is being projected in a window for the convenience of the users.

Fig. 5 Image acquired

Fig.5 shows how a image from the video frame looks before applying filters.

Fig. 6 Filtered Image

Fig.6 shows the image acquired in fig.5 with filters applied to it. This reduces the noises in the fig.5.

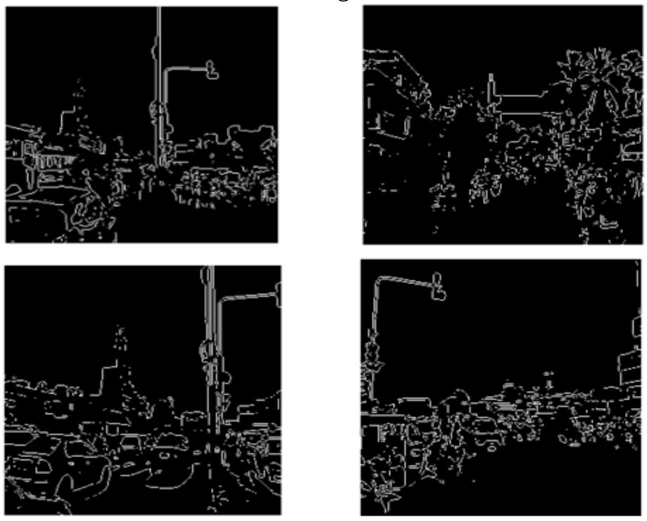

Fig. 7 Edge Detection

The fig.7 shows how edge detection is applied to the previous fig.6 this helps in reducing the unwanted noises which where present after applying background subtraction.

Fig. 8 vehicle counting in lane 1 and lane 2

The fig.8 shows the working procedure of the model counting the number of vehicles in lane 1 and 2. The model shows that there are 19 vehicles in lane 1 and 31 vehicles in lane 2.

Fig. 9 counting vehicles in lane 3 and lane 4.

The fig. 9 shows the model counting the vehicles in lane 3 and lane 4. The model found that there are 22 vehicles in lane 3 and 8 vehicles in lane 4.

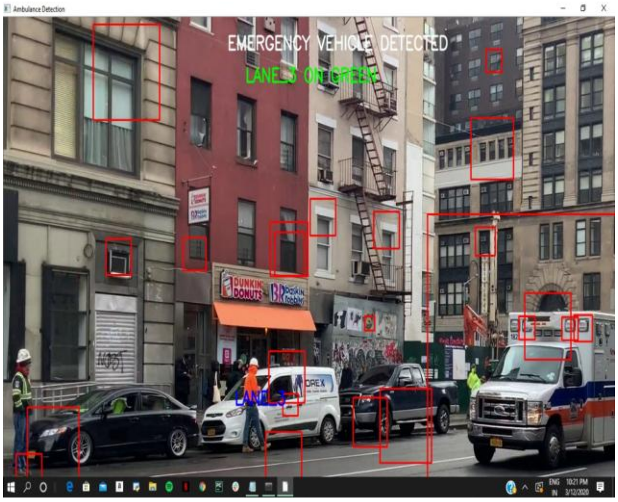

Fig. 10 Detecting ambulance

The fig. 10 shows the model detecting ambulance in lane 3. This will signal the model to turn the traffic lights to green in lane 3.

By processing all the input data using image processing techniques the system has detected an ambulance in lane 3 of the video The system then sends this input to the signal controller to turn the signal to green on lane 3 so that the emergency vehicle can proceed without any hassles.

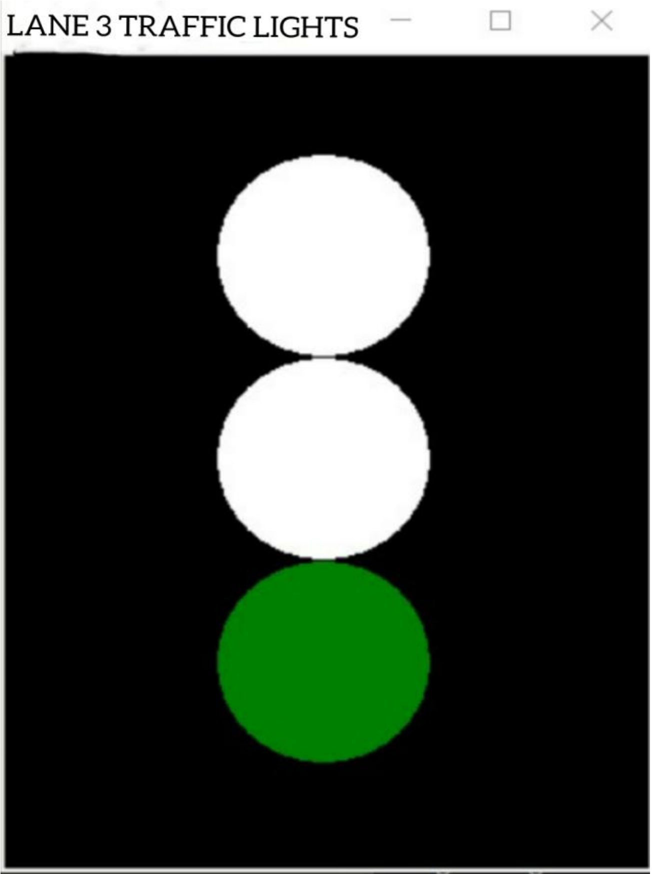

Fig. 11 Traffic signal

The fig.11 shows that the traffic lights in lane 3 turned to green to allow free passage of the emergency vehicle detected in the given input video.

VI. FUTURE IMPLEMENTATION

The system can be further used in future for tracking the vehicles, assessment of intrusion , in insurance sector predict the frequency of claims in a particular route and pot hole detection.

VII. CONCLUSION

In this paper the model proposed is a system for detecting the density of traffic and the emergency vehicle using image processing techniques. The system focuses on using image processing techniques as an efficient way of detecting emergency vehicles since this method reduces the chances of failures and helps in ensuring that the emergency vehicles have a hassle free movement while trying to perform their duties.

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