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Cloud based automated Traffic light scheduling and efficient Pathway clearance for Emergency vehicles

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Abstract: As the population increases, the number of motorized vehicles on the roads also increases. As the number of vehicles increases, traffic congestion occurs. Traffic lights are used at road junctions, intersections, pedestrian crossings, and other places where traffic needs to be controlled to avoid traffic chaos. In recent times, traffic congestion has been one of the most concerning factors in INDIA. It not only affects our scheduled lives but also brings about a major threat to patients in need. This increase is accomplished by the road accidents and signal jumping is the major cause. In future, a traffic control system of smart features is an important issue as the people using the road increase and the existing resources and infrastructures are narrow. An intelligent traffic control system is designed to overcome the increasing demand of all these essentials. A system should be designed to optimize the control of traffic. The goal of the proposed concept is to help the ambulance reach the nearest hospital in the least possible time quickly and safely. In order to achieve this traffic signals are being monitored and controlled, using microphone which distinguishes sound decibel level of ambulances to that of other vehicles. In addition to this, a camera takes pictures of jammed traffic signals for further verification. On successful detection, the signal will be made to turn green, hence clearing a pathway for ambulance. A solution and a related application have been developed so privileged vehicles can reach their target destination as soon as possible. In this study, a route is determined between the current location of an emergency vehicle and its target location in an emergency. Communication between traffic lights is provided with a mobile application developed specifically for the vehicle driver. In this process, the person controlling the lights can turn on the traffic lights during the passage of vehicles. After the vehicles with priority to pass passed, traffic signalling was normalized via the IOT application. This process was repeated until the vehicle reached its destination.

Keywords: Internet of things, Smart city, Traffic management, barrier, intelligent system, emergency vehicle, signalling, smart traffic lights.

INTRODUCTION Today's modern world requires fast processing of almost everything. With this busy life accidents occur from time to time and place to place. Ambulance is the only emergency vehicle that saves the affected one's life. There are people who do not care much to clear a path for the ambulance to move further. In this regard, we create a model where ambulances are detected from long distances in a traffic signal or a junction and clear path for them, so that they could move towards their desired destination without any delay. The main objective of this system is to help emergency vehicles reach their destination in time. Traffic congestions are the primary reason for ambulances not reaching their destination in time. Traffic is one of the most widespread problems in the world. Traffic includes pedestrians, vehicles, riding and farm animals, trains, and other vehicles that use the roads for travel and transportation. Population growth in urban areas has undoubtedly led to an increase in the number of vehicles on the roads and, hence, an increase in traffic problems. However, traffic management techniques are being used to avoid these problems through the Internet of Things (IoT) [1,2] and ad hoc vehicle networks [3,4]. The most common and effective traffic management techniques include speed bumps, road closures, turn restrictions, traffic signs, raised pavements, signaling systems, and electronic monitoring systems.

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Most problems are related to highways, the most widely used mode of transport in the world [5]. Traffic accidents are one of the main problems on motorways. Most of these accidents occur on motorways in residential areas. The causes of these accidents in residential areas include traffic congestion (heavy traffic), inadequate technical infrastructure, and inadequate structures such as underpasses and flyovers. The main causes of traffic congestion, which ranks first among the most important causes, include inadequate public transport, unsuitable parking, road works, accidents, excessive traffic on the same route, and too many pedestrians. Vehicles, apart from the rude behavior of drivers, are also a major cause of traffic congestion. Due to this and similar behavior, emergency vehicles such as ambulances and fire brigades, where safety and timing are important, face major problems.

Another important reason is the lack of technological infrastructure. The most important elements used to manage traffic in settlements are traffic light signaling systems [6]. Traffic lights are signal devices placed at road intersections, pedestrian crossings, and other locations to indicate that it is safe to drive, ride or walk. Signalization systems are divided into two basic groups according to their working principles. These are isolated systems and coordinated systems [7,8,9,10].

With the increase in population worldwide, the number of vehicles in traffic is also increasing. This situation brings along many problems. One of the most important methods to reduce these problems is smart signaling systems. Many researchers have tried to make traffic smoother by developing various methods in this regard. Intelligent signaling systems prevent traffic density, accidents, etc., as well as minimize time losses. Time loss is an important problem that needs to be addressed, especially for emergency vehicles traveling in traffic. Every second counts for emergency vehicles. Traffic jams on signalized roads greatly hinder the speed of emergency vehicles. Although these vehicles have the advantage of running red lights, they are not safe and heavy traffic prevents them from doing so.

The purpose of all signaling systems is to reduce the likelihood of accidents and reduce delays by ensuring that traffic flows pass uninterruptedly and without following each other and by providing control at uncontrolled intersections. Even when signalization systems are used to control crossings, some vehicles have the right of way and the right of way over these systems. The superiority of the pass is that certain vehicle drivers are not bound by traffic restrictions and prohibitions while on duty, provided that they do not endanger the safety of life and property.

Literature Survey: There are studies and conducted research in the literature for solving this and similar problems. When the research studies are examined, it is seen that the studies designed for the passage of ambulances and implemented on prototypes are generally encountered to solve this problem. The authors of [11] developed a system that can operate while receiving signals from emergency vehicles due to radio frequency transmission. They used a Programmable Integrated Circuit (PIC) 16F877A microcontroller and a frequency of 434 MHz to return to normal operation after the emergency mode was activated. The authors of [12] developed an Emergency Vehicle Signal Stop system (TJ-EVSP) based on vehicle-to-vehicle and vehicle-to-infrastructure systems called Collaborative Vehicle-Infrastructure Cooperation. They applied it to real traffic in Taicang City, China, and showed that it could improve the efficiency of emergency vehicle operations. In [13], a study on the passage of an ambulance was carried out. The authors used radio frequency (RF) technology in their study. A new signalling system was provided by placing an RF transmitter in the ambulance and an RF receiver in the traffic system. After the signal from the ambulance was detected, information was sent to the PIC microcontroller controlling the traffic light. When the ambulance is detected, the light in the signalling system turns green. In the absence of an ambulance, the routine operation was ensured with signalling. In [14], the authors calculate the distance between an emergency vehicle and an intersection using visual sensing methods. Manhattan, Euclidean, and Canberra distance techniques are used for distance calculation. They developed the PE-MAC protocol based on the MAC protocol to transmit the emergency vehicle's information to the Traffic

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Management Centre. In study [15], which focuses on the problems faced by ambulances in traffic, signaling control is provided using RFID technology so that the ambulance can reach the target destination on a road with four intersections without traffic disruption. A receiver is placed at a certain distance from the signaling system. When the RFID placed in the ambulance was detected by the receiver, the traffic lights were controlled according to the timer. In addition, the system controls the lights according to the traffic density during routine working hours. In study [16], the authors designed and developed an experimental setup that can access vehicle status and location information and mobile software that can share this information with other vehicles. The designed system was built in an experimental setup and tested on two vehicles. It used OBD-II (On-Board Diagnostics) compatible ELM327 and OPCOM diagnostic devices to access the in-vehicle communication network. The data rates for the connection between the mobile devices and the diagnostic device were measured, and the transfer rates of acquired data to the server were evaluated. In the event of a possible accident, drivers were warned by detecting surrounding vehicles within 1 km of the accident status information. The authors of [17] placed ZigBee modules in emergency vehicles that communicate via radio frequency. When the ZigBee in the vehicle came within range of another ZigBee, they sent a message via radio frequency. The message was received by the ZigBee receiver and processed by the microcontroller to control the traffic light. In this study [18], they proposed a traffic signalization system based on traffic density. The system automatically changes the signalization timing according to the traffic density at intersections. Their system is also configured with a camera. Images were captured with the camera, and the number of vehicles was calculated from the captured image. They used the masking algorithm for calculation and image processing. The camera also detects the siren of emergency vehicles and turns on the green light for these vehicles. They used the Arduino board for light control. In [19], they discussed the problems faced by emergency vehicles in traffic in India and designed a traffic signaling system for emergency vehicles to overcome crises. In their system, they used Radio Frequency (RF) technology and an Arduino UNO board to clear the traffic and ensure that an emergency vehicle reaches its destination on time. In the designed signaling system, the transmitter module is placed in the emergency vehicle, and the receiver modules are placed in the traffic lights. When the button on the transmitter module in the emergency vehicle is pressed, the transmitter module sends a signal to the receiver module. After receiving the signal from the emergency vehicle, the Arduino activates the green signal to clear the road and allow the vehicle to pass.

Proposed methodology:

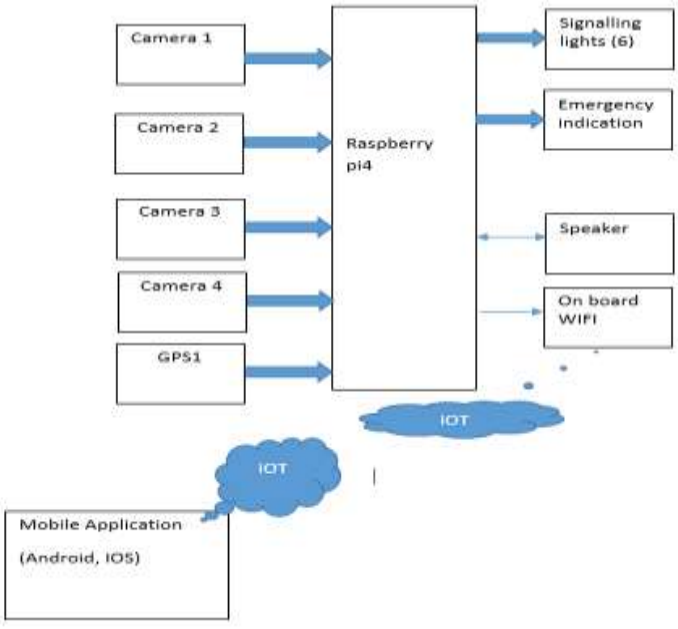

Fig1: Proposed block diagram at signalling junction

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Above block diagram consists of raspberrypi4, High definition cameras (4), GPS, Signal lights(6), emergency light indication, speaker and on board WIFI along with mobile application for users, emergency vehicles. High definition cameras plays vital role in above signalling application like finding number of vehicles in all four directions. Based on vehicle count calibrated by cameras, this prototype will take a decision to make on/off signal lights in those corresponding directions. Each and every camera initially searches for emergency vehicles, if it was not founded; then vehicle counting in generic manner takes place to make on/off signal lights. Otherwise, emergency indication glows on in which direction emergency vehicle founded. The same prototype is placed at each and every signal junction to monitor traffic. All these together connected in cloud to monitor whole city traffic conditions. If any route is fully jammed, automatically indications along with jammed route will be displaced in mobile application.

Vehicle count involves three steps as follows

A. Vehicle Detection B. Vehicle Tracking C. Vehicle Counting

Vehicle Detection: Computer vision paradigm provides vision for identifying objects that belong to classes that might be a vehicle or person in a video. The use of object detection in computer vision paradigm is to solve real world challenges in areas like image search and video surveillance to detect a person or vehicle. To detect vehicles, we subtract image of the road without vehicles from another image having vehicles on road. The background pixels would cancel each other out and the vehicles or objects present in the foreground will appear.

Background subtraction: is easy to implement and suitable threshold is given for detecting vehicles is an area that remains less than 20000. Also, objects change in size and shape as they move across the view. Masking is done to highlight the desired objects in a video frame. The objects with an area smaller than the threshold value are ignored. Selecting Region of Interest (ROI) helps in detecting objects, for vehicle detection and further implementation is done by tracking the detected Vehicles. Background Subtraction Background subtraction is process of extracting the target image from original image. ID Origin: It is the original image is coloured or gray scaled image of 8-bit or 32-bit floating point. Target: The target image is either 32-bit or 64-bit floating point. Alpha: Weight of input image. Speed of updating is decided by alpha, set a lower value for this variable in existing frames. Target(x,y)=(1-alpha). target(x,y) + alpha. origin(x,y)

Vehicle Tracking: Path followed by an object with the purpose to determine the observed direction of target on a near real-time surveillance and security for traffic control without affecting human computer intervention. The major goal of tracking is to determine the target object in sequential frames of video. Object change in shape and size over time in such scenarios so motion model for recovering trajectories and models with high accuracy for a small number of vehicles. Bounded boxes around a detected object are seen. Centroid of bounding boxes determines the object detected for tracking current object centroids and compute the distance between each pair of object such as Euclidean distance. The object needs to be registered if the number of consecutive frames of the objects is disappeared. In order to register a new centroid as a trackable object it must satisfy condition that input centroid as a trackable object it must satisfy condition that input centroids should be greater than the number of existing centroids.

Vehicle Counting: Vehicle tracked are counted when they leave the frame or cross a line at an exit point of the frame. To count vehicles moving in two different directions we make use of counting lines that is down count as red line and up count as blue line. Counted vehicles are classifies based on the

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perimeter, if the perimeter of bounding box is lesser than 300 it is counted as bike, if the perimeter of bounding box is less than 500 it is counted as car and if the perimeter of bounding box is greater than 500 it is counted truck/bus.

Results:

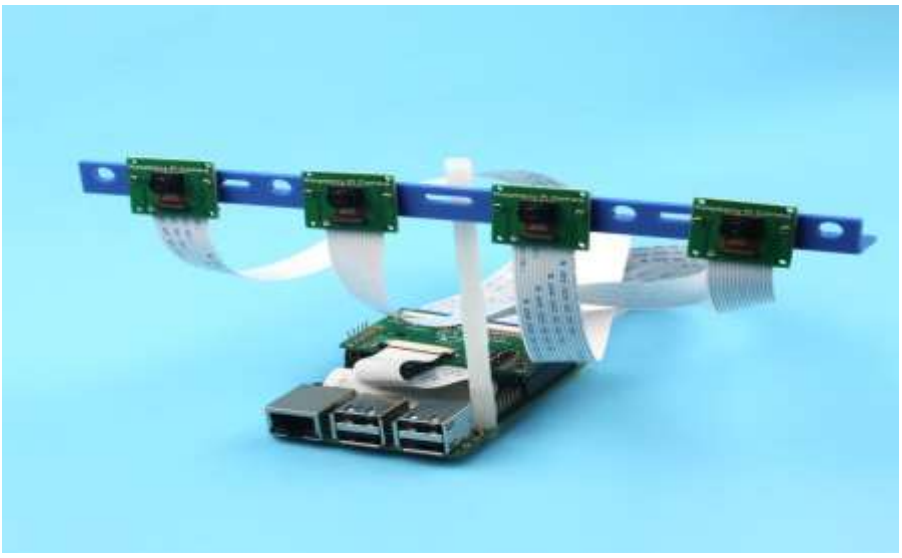

Fig2: Proposed prototype

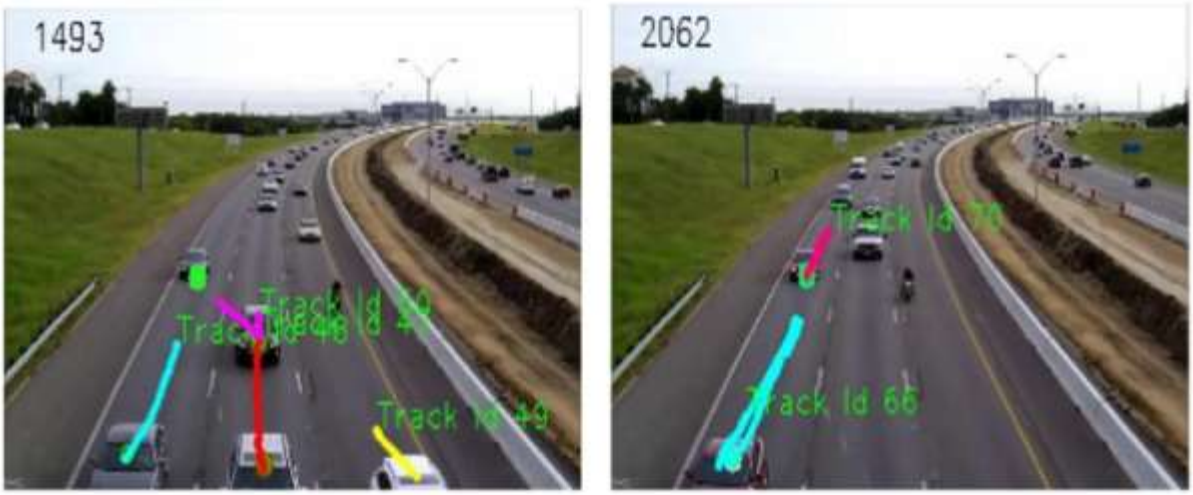

Fig3 Count of vehicles

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Fig4: information of vehicle crossed

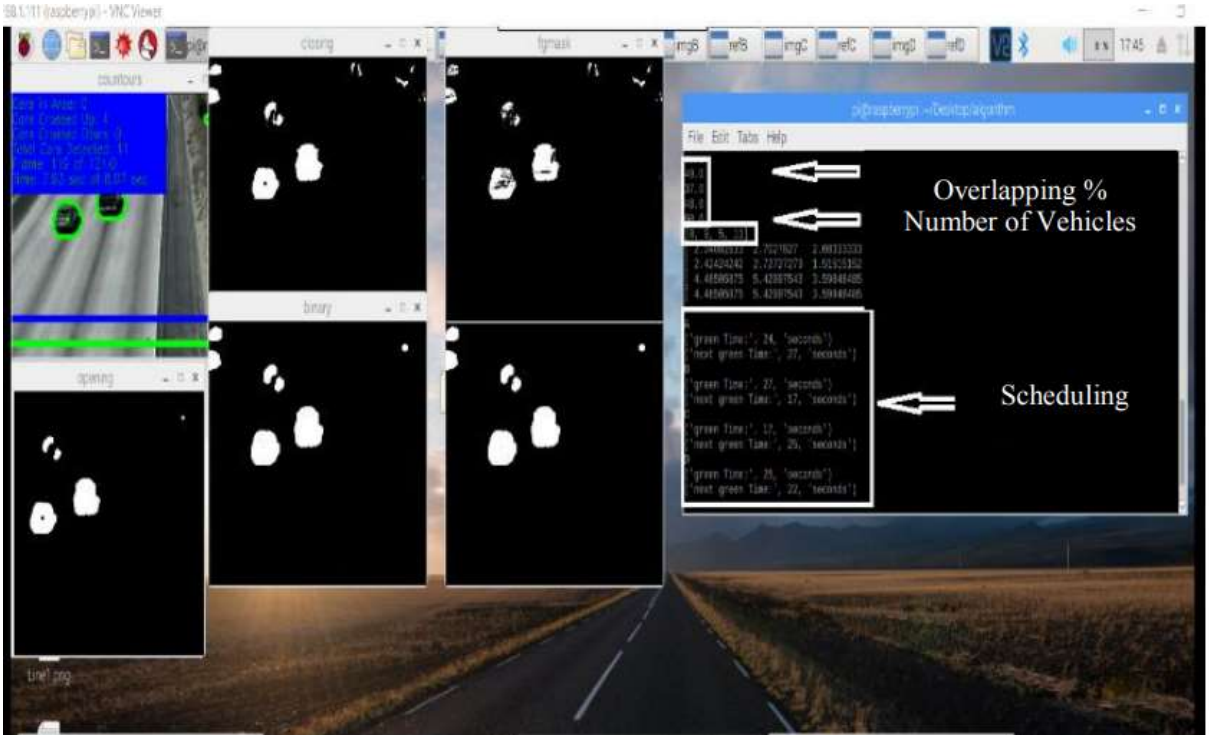

Fig: Vehicle detection in overlapping

Conclusion: From experimental analysis it is evident that vehicle detected at an accuracy rate of about 97.39% and vehicle tracked at a rate of about 98.26% as shown below. The objects within the given threshold are detected. It is observed that vehicle are not the only objects that move on/across the road. Masking is done to highlight the desired objects in a video frame. In present scenario, there is need of automatic appliances which increases standard of living, reduces the complexity of life. This Prototype may be very well used in where the traffic signal is kept and in many other places where we need to fulfill the need of the automation. Thus circuit proves to be helpful. To control the traffic, this prototype is merged with recognized technologies and implemented successfully.

Future Enhancement In future this project can be implemented in many commercial areas. Traffic jams occurred due to red light delays will be reduced and emergency vehicles are easily cleared by using this system. The present system uses a barrier for monitoring the signals and avoids jumping of red lights. By using different sensors for detection of explosions at each barrier as an intersection can improve the efficiency of the system in future. Depending on the geometrical shape of vehicle, categorization is done and large or heavy vehicles such as lorries can be blocked in daytime. By installing a GPS receiver in ambulance, emergency mode can be sophisticated such that base station can find ambulance location if it is required. By using this circuit it can be implemented in various applications, such as industries, hospitals and many commercial areas in future.

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