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Intelligent Traffic Control System for Congestion Control Using Image Processing, Ambulance Clearance, and Stolen Vehicle Detection

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***Abstract*— This paper presents an Intelligent Traffic Control System using Image processing techniques to know about the congestion of traffic. The system comprises of three units. such as Image processing based congestion controller system,. Ambulance detection / stolen vehicle detection and police control unit. Depending on the congestion, traffic light will be altered by using ARM 11. Ambulance vehicles will be detected by using its unique license plate number and it will be transmitted using ZigBee to the traffic controller system and signal will be altered. If the stolen vehicle's number is identified it will send the information to the police control unit.**

***Index Terms*— ZigBee, CC2500, GSM, SIM300, PIC16F877A, ambulance vehicle, stolen vehicle, congestion control, traffic junction.**

I. INTRODUCTION

INDIA is the second most populous Country in the World and is a fast growing economy. It is seeing terrible road congestion problems in its cities. Infrastructure growth is slow as compared to the growth in number of vehicles, due to space and cost constraints. Also, Indian traffic is non lane based and chaotic. It needs a traffic control solutions, which are different from the developed Countries. Intelligent management of traffic flows can reduce the negative impact of congestion. This project describes an approach to overcome a situation of monitoring and controlling congestion, clearance of ambulance and detection of stolen vehicle.

In recent years, wireless networks are widely used in the road transport as they provide more cost effective options. Technologies like Image Processing ,ZIGBEE and GSM can be used in traffic control to provide cost effective solutions. Image processing is a technique that used to sense the image and it convert that image from RGB model to grey level model using webcamera. A GSM modem is a specialized type of modem, which accepts a SIM card and operates over a subscription to a mobile operator, just like a mobile phone. The ZigBee operates at low-power and can be used at all the levels of work configurations to perform predefined tasks. It operates in ISM bands(868 MHz in Europe, 915 MHz in USA and Australia, 2.4 GHz in rest of the world). The ZigBee uses 11 channels in case of 868/915 MHz radio frequency and 16 channels in case of 2.4 GHz radio frequency. It also uses 2 channel configurations, CSMA/CA and slotted CSMA/CA.

II. LITERATURE SURVEY

Traffic congestion is a major problem in cities of developing Countries like India. Growth in urban population and the middle-class segment contribute significantly to the rising number of vehicles in the cities . Congestion on roads eventually results in slow moving traffic, which increases the time of travel, thus stands-out as one of the major issues in metropolitan cities. In, green wave system was discussed, which was used to provide clearance to any emergency vehicle by turning all the red lights to green on the path of the emergency vehicle, hence providing a complete green wave to the desired vehicle. A ‘green wave’ is the synchronization of the green phase of traffic signals. With a ‘green wave’ setup, a vehicle passing through a green signal will continue to receive green signals as it travels down the road. In addition to the green wave path, the system will track a stolen vehicle when it passes through a traffic light. Advantage of the system is that GPS inside the vehicle does not require additional power. The biggest disadvantage of green waves is that, when the wave is disturbed, the disturbance can cause traffic problems that can be exacerbated by the synchronization.

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Fig. 1. Traffic in Bangalore city.

In such cases, the queue of vehicles in a green wave grows in size until it becomes too large and some of the vehicles cannot reach the green lights in time and must stop. This is called over-saturation .

The use of Frame segmentation traffic control to avoid problems that usually arise with standard traffic control systems, espe-cially those related to image processing and beam interruption techniques are discussed. Christo Ananth et al. [2] proposed a system about Efficient Sensor Network for Vehicle Security. Today vehicle theft rate is very high, greater challenges are coming from thieves thus tracking/ alarming systems are being deployed with an increasingly popularity .As per as security is concerned today most of the vehicles are running on the LPG so it is necessary to monitor any leakage or level of LPG in order to provide safety to passenger. Also in this fast running world everybody is in hurry so it is required to provide fully automated maintenance system to make the journey of the passenger safe, comfortable and economical. To make the system more intelligent and advanced it is required to introduce some important developments that can help to promote not only the luxurious but also safety drive to the owner. The system "Efficient Sensor Network for Vehicle Security", introduces a new trend in automobile industry.

The communication between the ambulance and traffic signal post is done through the transceivers and GPS. The system is fully automated and requires no human interven-tion at the traffic junctions. The disadvantage of this system is it needs all the information about the starting point, end point of the travel. It may not work, if the ambulance needs to take another route for some reasons or if the starting point is not known in advance.

Traffic is a critical issue of transportation system in most of all the cities of Countries. This is especially true for Countries like India and China, where the population is increasing at higher rate as show in figure 1. For example, Bangalore city, has witnessed a phenomenal growth in vehicle population in recent years. As a result, many of the arterial roads and intersections are operating over the capacity (i.e., v/c is more than 1) and average journey speeds on some of the key roads in the central areas are lower than 10 Km/h at the peak hour. In, some of the main challenges are management of more than 36,00,000 vehicles, annual growth of 7–10% in traffic, roads operating at higher capacity ranging from 1 to 4, travel speed less than 10 Km/h at some central areas in peak hours, insufficient or no parking space for vehicles, limited number of policemen. In, currently a video traffic surveillance and monitoring system commissioned in Bangalore city. It involves a manual analysis of data by the traffic management team to determine the traffic light duration in each of the junction.

III. Proposed Model

From the current problem section, it can be seen that, existing technologies are insufficient to handle the problems of congestion control, emergency vehicle clearance, stolen vehicle detection, etc. To solve these problems, we propose to implement our Intelligent Traffic Control System. It mainly consists of three parts. First part contains automatic signal control system. Here, each vehicle is sensed from ARM 11 microprocessor by using web camera. When the vehicle in traffic, the web camera sense the no number of vehicles are standing in the traffic. It will count and sense the vehicle in RGB format and convert it to grey level format. According to the vehicle count the web camera will sense it and sets the green light duration for that path. Second part is for the emergency vehicle clearance. Here, each emergency vehicle contains ZigBee transmitter module and the ZigBee receiver will be implemented at the traffic junction. The buzzer will be switched ON when the vehicle is used for emergency purpose. This will send the signal through the ZigBee transmitter to the ZigBee receiver. It will make the traffic light to change to green. Once the ambulance passes through, the receiver no longer receives the ZigBee signal and the traffic light is turned to red. The third part is responsible for stolen vehicle detection. Here, when the ZigBee receive the signal from ZigBee trasnsmitter, it compares it to the list of stolen vehicle's number. If a match is found, it sends SMS to the police control room and changes the traffic light to red, so that the vehicle is made to stop in the traffic junction and local police can take appropriate action. List of components used in the experiment are ARM 11, Microchip PIC16F877A, ZigBee module CC2500,SIM300 GSM module and webcamera AH5020B23-S1-2Z1. Figure 2 shows the pin diagrams (or pictures) of components used.

A.Raspberry Pi model B+

Raspberry Pi model B+ is a portable, powerful, and mini computer. The core architecture used is ARM 11.The board length is only 85mm and width is only 56mm.Its size only as big as a credit card but it is a capable little PC. It can be used for many of the things that your desktop PC does, like high-definition video, spread sheets, word-processing, games and more. Raspberry Pi also has more wide application range, such as music machines, parent detectors to weather stations, tweeting birdhouses with infra-red cameras, lightweight web

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server, home automation server, etc.

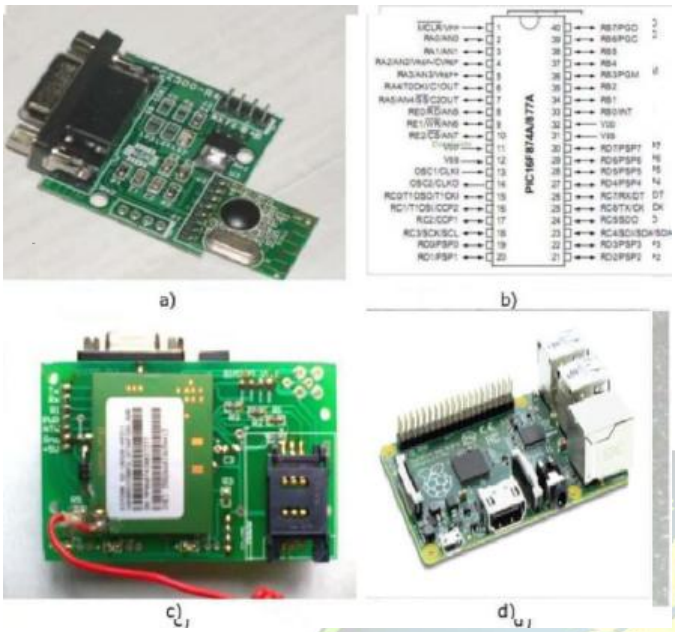

Figure 2, PIN diagrams of different components used in our prototype. (a) ZigBee module CC2500. (b) Pin diagram of PIC16F877A. (c) GSM Module SIM300. (d) Raspberry Pi model B+.

II. Working Model

In this model, there are mainly 3 modules as follows.

A. Traffic Congestion Control System

In this module when the vehicle stops due to the red indication of traffic light the web camera captures video or image. The captured format will be in RGB format . As we interface ARM 11 to the system through Ethernet port the captured image will be send to the Raspberry pi and that raspberry pi is configured by separate IP address in the system. The configured port has LINUX operating system. Now the captured image or video send to ARM 11where the captured image is split into frames in order to convert it from RGB image into GREY scale image using image processing technique. In GREY scale image the BLACK region indicates the presence of object where as the other area will be kept it as white by using OPEN CV programming language. The object count in the image is determined by compiling it in GCC complier. According to the number of object the duration of GREEN light is assigned. If there are less than 3 vehicles the GREEN light duration will be for 3 seconds. If it is more than 3 vehicles the GEEN light duration is for 6 seconds, more than that the GREEN light duration will be more than that according to our wish. Through this technique we can shorten or extent the duration of GREEN light signal.

B.Emergency Vehicle Clearance System

The second module is mainly deals with getting information about the arrival of ambulance from a particular distance. It consists of PIC and ZIGBEE transmitter which is attached to the ambulance and ZIGBEE receiver is attached to the traffic junction. The traffic light will be turned to green when the vehicle is used for emergency purpose. This will send the signal through the ZIGBEE receiver. It will make the traffic light to change to green.

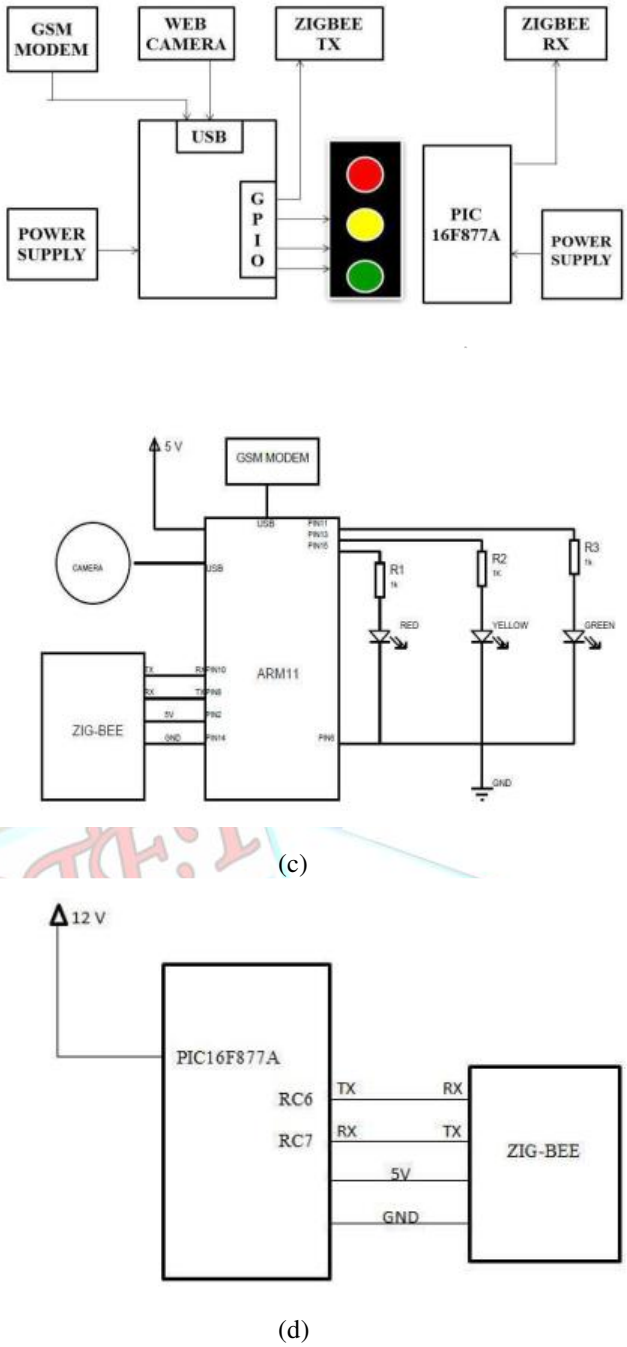

Fig. 3. Implementation for automatic signal control and stolen vehicle detection system. (a) Block diagram for automatic signal control system. (b) Block diagram for Ambulance Clearance and Stolen Vehicle Detection. (c) Circuit Diagram for automatic signal control (d) Ambulance Clearance and stolen vehicle detection system.

Once the ambulance passes through, the receiver no longer receives the ZIGBEE signal and the traffic light is turned to red. The ZIGBEE transmits and receive analog signal simultaneously turns over a distance of 100 meters.

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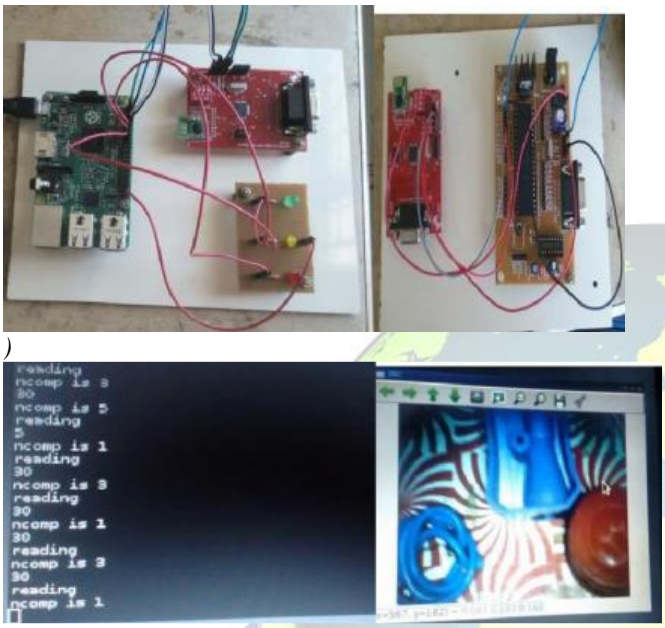
The system will search for the number plate in its database by using OPEN CV language that turns the traffic light in to green. The ambulance transmit the signal till it goes beyond the coverage range and the traffic light remains green. The traffic light is turns to red. Through this module the delay of ambulance to reach the hospital is reduced.



(a) (b) (c) (d) (e) (f)

Fig. 4. Proposed model images transmitter and receiver. (a) vehicle count by web camera (b)sensed sample object (RGB format) (c)GREY level format (d) sample output of ambulance detection (e) When stolen vehicle is detected. (f) sms from mobile for stolen vehicle detection

C. Stolen Vehicle Detection System

The third module is similar to that of second module the only difference is once getting the signal from stolen vehicle which has a PIC controller and ZIGBEE. Using the vehicle number from the ZIGBEE transmitter the server will scan the vehicle number with stolen vehicle number list. Once the number matched the GSM modem will send the message to the police control room. So due to this the stolen vehicle location is determined and necessary steps can be taken by the police to retrieve the vehicle which was thefted .the following output is shown in the server side.

V. Conclusion and Enhancements

With automatic traffic signal control based on the traffic density in the route, the manual effort on the part of the traffic policeman is saved. As the entire system is automated, it requires very less human intervention. With stolen vehicle detection, the signal automatically turns to red, so that the police officer can take appropriate action, if he/she is present at the junction. Also SMS will be sent so that they can prepare to catch the stolen vehicle at the next possible junctions. Emergency vehicles like ambulance, fire trucks, need to reach their destinations at the earliest. If they spend a lot of time in traffic jams, precious lives of many people may be in danger. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. The signal turns to red, only after the emergency vehicle passes through. Further enhancements can be done to the prototype by testing it with longer range. Also GPS can be placed into the stolen vehicle detection module, so that the exact location of stolen vehicle is known. Currently, we have implemented system by considering one road of the traffic junction. It can be improved by extending to all the roads in a multi-road junction.

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