Discerning Gridlock Avoidance and Consent for Emergency Vehicles besides Pothole Detection

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Abstract-*Traffic management has become a challenging task in the urbanized cities and also Indian roads claim the maximum lives due to the improper guidance of the traffic and the bad road conditions. This paper presents a intelligent gridlock clearance system along with the system that detects potholes and humps which has also become a reason for accidents. RFID is placed at a strategic location in every vehicle along with a PIC microcontroller. Traffic signals accomplished with the RFID reader and GSM helps in immediate motion of those vehicles in traffic signals, without any blockage of those vehicles. Besides the RFID reader and receives the vehicles possess ultrasonic sensors which detects potholes and humps in road conditions can be avoided. The vehicles which are stolen can be recognized by the RFID which is placed in the vehicle at a strategic location if the vehicle passes through the traffic signal in roads.*

Keywords: RFID, PIC 16F877A, gridlock, emergency vehicles.

1. INTRODUCTION

The most populous country and one of the fast growing economies in the world is India, which has a gigantic network of roads which are the dominant means of transportation in the country. Road transport system serves the function of carrying people and goods around the city, which resembles blood vessels circulating nutrients to feed human body. Besides the large number of vehicles running on roads, blockage of traffic in local areas is customarily caused by various activities competing for the use of road space. Unplanned traffic, adverse public transport infrastructure, migration and rapid legal sophistication makes the metropolitan areas in India as the worst traffic hit cities in the world. Traffic management is an extremely high challenging task and traffic is controlled by the traffic lights. These signaling devices are located in the intersection points of roads. These lights are operated based on the predefined fixed timing. But the average number of vehicles passing through a lane might differ sometimes and moreover the vehicles may be locked by the red signal for few minutes even though there is not much traffic. This is a waste of time for the people in those vehicles. The bad road conditions leads to many accidents. Overloading in roads, awful construction of roads and heavy rain fall causes potholes and humps.

2. RELATED WORKS

Congestion on roads leads to slow movement of vehicles which proportionally increases the travel to reach the destination. Still camera placed in the traffic signals captures consecutive images periodically (1 or 2 sec). Emergency vehicles can be easily categorized by the edge detection technique. LABVIEW helps in converting AVI file as a series of JPEG images. This makes the particular signal as green and turns the remaining signals as red. Despite of the advanced techniques, there is no discussion about the signal if it is already red when the emergency vehicle arrives at that particular junction. In addition to that there is no information about the communication between the emergency vehicles and the traffic signals [16]. Every traffic intersection contains 8 RFID readers. The Vehicle Identification Number which is unique is assigned to all the vehicles. This VIN provides the details of the priority of the vehicles and the type of the vehicle. VIN has three sections in which each section provides information about the priority of the vehicles, type of the vehicle and the vehicle number respectively. The vehicles are categorized into four. Ambulance, fire brigade vehicles and the VIP vehicles are grouped as one category and are assigned with the highest priority. School buses, college buses and other buses are assigned with the second highest priority.

Whereas the third category includes vehicles such as cars, motor cycles etc. The heavy vehicles are assigned with the lowest priority. The traffic light controller uses the method of round robin sequence of the lights until an emergency vehicle is detected at the junction. The presence of an emergency vehicle makes the lights to turn to green if they are red [9]. But the system mainly focuses on the clearance of way to the emergency vehicles and the VIP vehicles.

The lane clearance for ambulance includes two units namely Ambulance clearance and the Junction unit. Ambulance unit comprises RFID reader, microcontroller interfaced with a transceiver. Similarly the junction unit interfaces the microcontroller with the transceiver. The received signal from the ambulance unit and the specific co-ordinate points which are already programmed, allows the traffic light in that particular lane to be green and simultaneously LCD indicates the arrival of the ambulance to the motorists in that lane. The limitation of this system is that the government ambulances does not have specific regular place from where they leave to pick the patients [11]. The vehicles are equipped with the RFID tag and the microcontroller. The communication is proceeded through the serial communication bus, UART [3]. Access points stores details about the pothole, gets the feedback from the vehicles, updates information in the database and simultaneously broadcasts the information to other vehicles. The mobile mode in the vehicles, senses potholes, if there is no prior information about that particular pothole. In turn this updates the database about the newly located pothole. But the system does not have any measures to locate the humps along with the potholes [1]. The pothole detection is carried over by the laser detector along with transmitting device to the vehicles under carriage [14]. The visual data which has been collected by the optical device identifies the presence of potholes. The optical device comprises light/optical part; video part and GPS control/total control part. The image processing technique called Gaussian Blur has been used to simplify the image. Since the pothole detection is based on the video data, the acquisition of clear data is challenging in the time of snow or fog [15].

3. PROPOSED WORK

From the above section, it can be noted that the existing technologies though manages traffic in many way, they are insufficient to take over the problems of congestion control, detection of stolen vehicle, paving way for the emergency vehicles and pothole detection. To overcome the above problems mentioned in the previous section, the proposed system handles traffic management, emergency

vehicle clearance and stolen vehicle detection along with the pothole detection. The proposed system comprises of three units namely Traffic junction unit, Ambulance unit and Vehicle unit. The RFID reader, RF receiver are interfaced with the microcontroller. Every individual vehicle is equipped with a RFID tag which has a unique number. The vehicles when come into the range of the RFID reader, RFID tag sends a signal to the RFID reader.
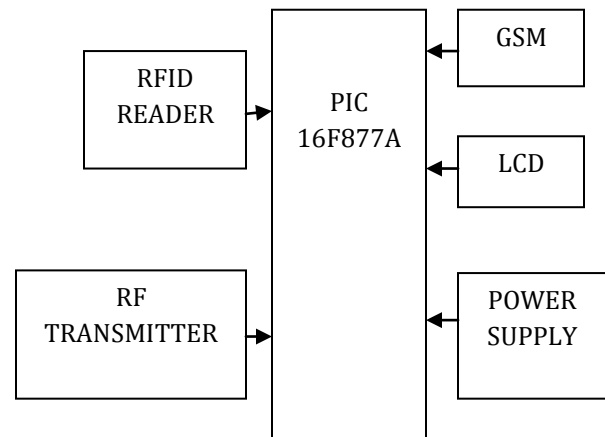

Fig-1: Block diagram of Traffic Control Section

Thus the number of vehicles that are crossing that particular RFID reader helps in determining the congestion volume in that lane. Depending upon the congestion volume, the traffic lights are turned ON.
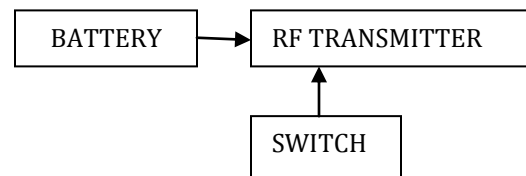

Fig-2: Block Diagram of Emergency Vehicle Section

Emergency vehicle clearance unit includes the RF transmitter. When the emergency vehicle starts in a need to reach the destination earlier, the switch which has been connected to the RF transmitter is turned ON which in turn makes the RF transmitter to send a signal to the RF receiver at the traffic junction.
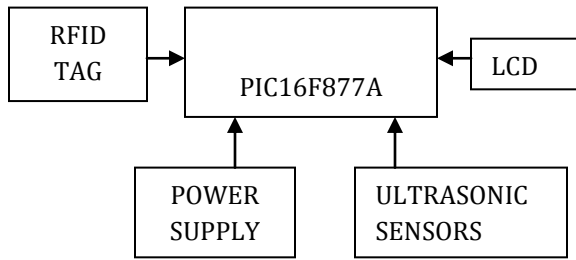
Fig-3: Block diagram of Pothole and hump detection

Except emergency vehicles, each and every vehicle is equipped with a RFID tag as well as the ultrasonic sensors. The ultrasonic sensor detects the potholes and humps by the reflected sound waves.

3.1 RFID

Radio Frequency Identification is an electronic device which consists of a small chip and an antenna. The chip can

(a)   (b)
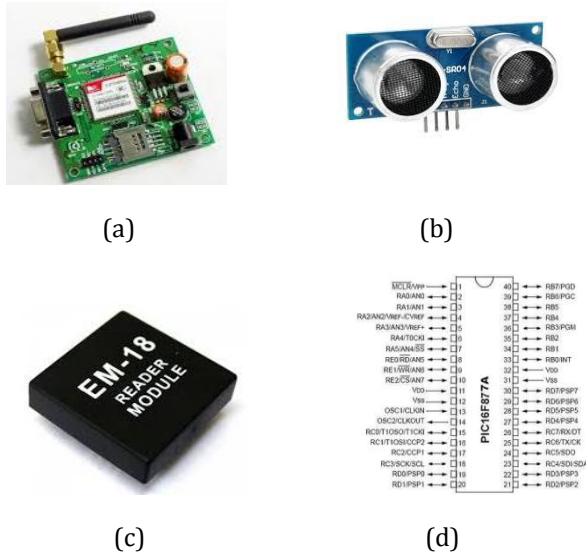

(c)   (d)

Fig-4: Components used in the Proposed Prototype (a) GSM SIM900 (b) Ultrasonic Sensor HC-SR04 (c) RFID Reader (d) Pin diagram of PIC 16F877A

The chip can carry a data of about 2000 bytes. RFID is similar to the barcode which provides a unique identifier for that object. RFID device is scanned to retrieve the information. RFID tag is scanned and categorized by means of Unique Identification Number (UIN) by the RFID reader and it is not necessary that the RFID tag should be in the line-of- sight to a reader. The RFID reader is capable of scanning the RFID tag if it is within the range of the reader.

The reader consists of a RF module which behaves as the transmitter and receiver for the radio signals. The transmitter itself is a combined unit of oscillator, modulator and an amplifier. The modulator impinges the data command upon the carrier signal created by the carrier signal created by the oscillator. The boosting of the signal is over by the amplifier so that taken the signal can awaken the tag. The microprocessor stores the data and it is the control unit which employs an operating system and memory. The reader employed in this system operates at a frequency of about 125 KHz.

3.2 RF Module

An electronic device which allows the transmission and/or reception of radio signals between two devices is termed as the RF module. The RF transmitter and RF receiver together forms the RF module and the RF transmitter/receiver pair operate at a frequency of 434 MHz. The RF transmitter is capable of transmitting a radio wave and modulating that radio wave to carry the data signal. Amplitude Shift keying modulation is used to represent the digital data as the variations in amplitude of the carrier wave. The RF receiver demodulates the received signal from the RF transmitter. RF transmitter possesses an antenna which receives the data and the received data is transmitted through the antenna. RF module uses serial communication for the data transmission.

3.3 GSM- SIM 900

Global System for mobile Communication provides user authentication to ensure the communication in wireless system secured. The microcontroller is interfaced with the GSM and the controller allows the GSM modem to communicate over the mobile network. GSM permits sending and receiving messages as it supports "Extended AT command set". GSM SIM 900 is allied by an L- shaped big package which exhausts the voltage of range 3.4V to 4.5 V.

3.4 Microcontroller

Peripheral Interface Controller has lot of controllers in which 16F series has the most importance when compared to other series. PIC16F877A is a 40 pin controller which is most commonly used in most of the applications and its operating voltage is 2 to 5.5V. Microcontroller helps to store and send the Unique Identification Number of the

RFID tag which is read by the RFID reader. All the peripheral components are interfaced together only by the microcontroller. The features of PIC16F877A make it more advisable for A/D applications in automotive, industrial, electronic appliances and consumer applications.

3.5 Ultrasonic Sensors- HC SR04

Ultrasonic sensor employs sound waves to descry crooked surfaces, liquids, clear objects and in the objects in unclean environments. Ultrasonic sensors well suits for the application that requires precise measurements between the moving objects and the stationary objects. The transmission and reception of sound waves is accomplished by using a special sonic transducer. The sound waves get reflected by the object and the transducer receives the reflected sound waves. The time period between the transmission and reception of sound waves depends upon the distance of the object from the sensors. The frequency range of HC-SR04 is about 40KHz with 15° as the angle detection.

4. WORKING MODEL

The major tasks achieved in the proposed system are traffic signal control, emergency vehicle clearance, pothole and stolen vehicle detection.

4.1 Traffic Signal Control System

The system is initialized when turned on as shown in Fig. 5(a). The traffic signal is changed depending upon the density of the vehicle arriving the junction at that particular lane. When the vehicles arrive at the junction, the RFID tag which has Unique Identification Number is being detected by the RFID reader. During every red signal, the microcontroller which has been interfaced with the RFID reader, counts the number of tags read by the RFID reader for a 30 seconds as shown in Fig. 5(b).

(a)

(b)

Fig-5: Results of the Traffic Control System (a) Initialization of the system (b) Vehicle Count with the vehicle number

For testing, if the count of the vehicle is less than or equal to 5 seconds, the duration of green light is set to 20 seconds. If the count of the vehicle is in between 5 to 10, the green signal is set to 40 seconds. If the count is greater than 10, the duration of the green light is set to 60 seconds.

4.2 Emergency Vehicle Clearance

As soon as the emergency vehicle starts, the switch is made 'ON' if it has to reach the destination very soon. The switch in turn makes the RF transmitter in the emergency vehicle to transmit a signal. The RF signal sent by the transmitter in the vehicle is received by the RF receiver in the traffic signal.
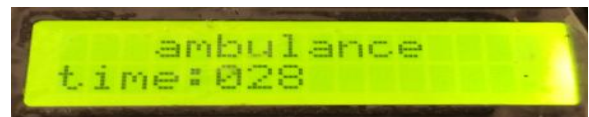

Fig-6: Detection of ambulance in the traffic signal

The RF receiver has its range over a large distance and once it receives a signal from any emergency vehicle, it clears the vehicles to pave way for the emergency vehicle light and turns ON the green light. The detection of the ambulance in the traffic signal is shown in the Fig. 6. When the ambulance reaches within the range of the RF receiver, the LCD indicates the arrival of ambulance, and until the emergency vehicle crosses the traffic, the signal is green. The controller is programmed in such a way that when the emergency vehicle is detected the signal is turned to green for 30 seconds.

## 4.3 Detection of Pothole and Stolen Vehicle

The stolen vehicle can be detected by means of the RFID number. The UIN of the stolen vehicle is registered in the controller and when the RFID reader comes across the UIN which has been enrolled as abducted, it alerts the police control room by means of GSM and simultaneously it seizes the vehicle for few moment by turning the signal to red.

(a)

(b)
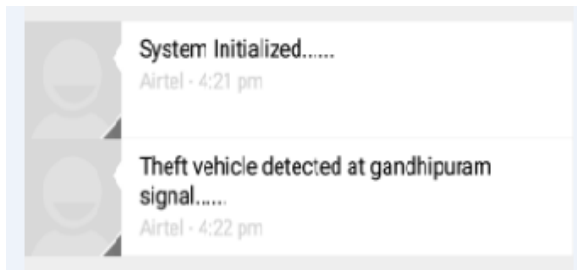
(c)

Fig-7: Result of the Theft Vehicle Detection and giving alert (a) Detection of vehicle. (b) Indicating the detected vehicle as Theft Vehicle (c) Alert to the control room.

The pothole and hump detection is achieved by the transmission and reflection of the sound waves. If the value received is based on the reflected distance, the controller decides the road possesses any potholes or humps by matching the received distance with the threshold value. The ultrasonic sensor detects the uneven surfaces by the distance of the reflected signal. For testing, the controller is programmed that it if the received distance is between 4 to 8 inches, the surface is normal as shown in Fig. 8(a). And if the distance is less than 4 inches it is indicated as hump and on the other hand, if the distance is greater than 8 inches, it is denoted as pothole Fig. 8(b) and (c) respectively.
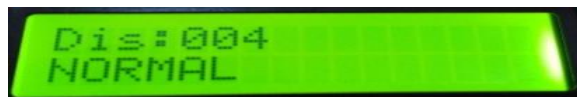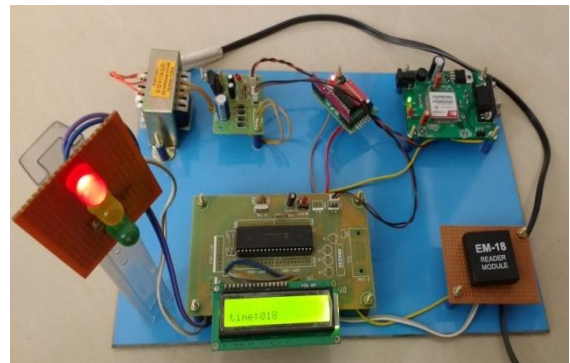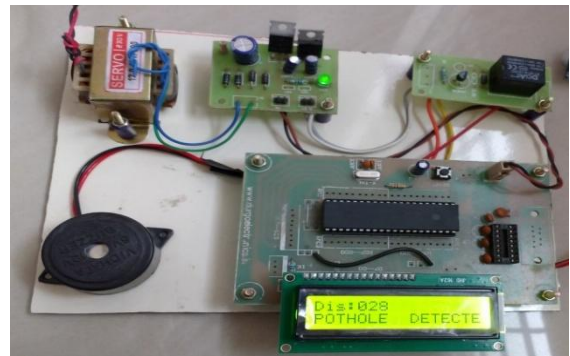

(a)

(b)

(c)

Fig-8: (a) Normal surface (b) Detection of Hump (c) Pothole Detection

The prototype of the proposed system is shown in the Fig.9

(a)

(b)

Fig-9: (a) Prototype of Traffic Control section (b) Pothole and hump detection section.

5. CONCLUSION

The effort of mankind to control the traffic is large to avoid the vehicle congestion. The automated system consumes a small amount of human intervention. At the moment of stolen vehicle detection, the signal changes to red without any human work. The delay in reaching the destination by the emergency vehicles causes the danger to the human lives. So as to reduce the risk of human lives, due to the delay in traffic, the signal automatically changes to green on the arrival of emergency vehicles until it crosses the

range of the RF receiver and the RFID helps to manage the traffic automatically.

REFERENCES

[1] Aastik Bushan, Prateek Mundra, Manjunath P.S.Narayana Reddy, " Zigbee based Pothole Detection system for VehicularSafety" *International Journal of Electronics and Computer Engineering*, vol. 4, Isssue 2,ISSN [Online]:2249-071X, ISSN(Print):2278-4209

[2] A. Carullo and M. Parvis, "An ultrasonic sensor for distance measurement in automotive applications," *IEEE Sensors J.*, vol. 1, no. 2, pp. 143–147, Aug. 2001.

[3] A. K. Mittal and D. Bhandari, "A novel approach to implement green wave system and detection of stolen vehicles," in *Proc. IEEE 3rd Int. Adv. Comput.*, Feb. 2013, pp. 1055–1059.

[4] A. Mednis, G. Strazdins, R. Zviedris, G. Kanonirs, and L. Selavo, "Real time pothole detection using Android smartphones with accelerometers," in *Proc. Int. Conf. Distrib. Comput. Sensor Syst. Workshops*, Jun. 2011, pp. 1–6.

[5] B. P. Gokulan and D. Srinivasan, "Distributed geometric fuzzy multiagent urban traffic signal control," *IEEE Trans. Intell. Transp. Syst.*, vol. 11, no. 3, pp. 714–727, Sep. 2010.

[6] Chong hua Li "Automatic Vehicle Identification System based on RFID", Anti-Counterfeiting Security and Identification in Communication (ASID), 2010, pp 281-284.

[7] Elisabeth ILIE-ZUDOR "The RFID Technology and Its Current Applications", MITIP 2006, ISBN 963 86586 5 7, pp.29-36

[8] F. Orhan and P. E. Eren, "Road hazard detection and sharing with multimodal sensor analysis on smartphones," in *Proc. 7th Int. Conf. Next Generat. Mobile Apps, Services Technol.*, Sep. 2013, pp. 56–61.

[9] Harpal Singh, Krishnan Kumar, Harbans Kaur " Intelligent Traffic Lights Based on RFID" *International Journal of Computing and Business Research, ISSN* [Online]:2229-6166 *Proc .I-Society 2012 at GKU,* Talwandi Sabo Bathinda, Punjab.

[10] K. Chen, M. Lu, X. Fan and M. Wei, "Roadcondition monitoring using on-board three-axis accelerometer and GPS sensor," in *Proc. Int. ICST Conf. Commun. Netw. China*, Aug. 2011, pp. 1032–1037.

[11] R. Hegde, R. R. Sali, and M. S. Indira, "RFID and GPS based automatic lane clearance system for ambulance," *Int. J. Adv. Elect. Electron. Eng.*, vol. 2, no. 3, pp. 102–107, 2013.

[12] S. Hegde, H. V. Mekali, and G. Varaprasad, "Pothole detection and inter vehicular communication" in *Proc. IEEE Int. Conf. Vehicular Electron. Safety (ICVES)*, 2014, pp. 84–87.

[13] S. Sharma, A. Pithora, G. Gupta, M. Goel, and M. Sinha, "Traffic light priority control for emergency vehicle using RFID," *Int. J. Innov. Eng. Technol.*, vol. 2, no. 2, pp. 363–366, 2013.

[14] S. Venkatesh, E. Abhiram, S. Rajarajeswari, K. M. Sunil Kumar, S. Balakuntala, and N. Jagadish, "An intelligent system to detect, avoid and maintain potholes: A graph theoretic approach," in *Proc. 7th Int. Conf. Mobile Comput. Ubiquitous Netw.*, 2014, p. 80.

[15] Taehyeong Kim, Seung-Ki Ryu, " System and Method for Detecting Potholes based on Video Data", *Journal of Emerging Trends in Computing and Information Sciences,* ISSN 2079-8407   vol. 5.no. 9,September 2014.

[16] Veera Venkatesh, Nazneen Syed, "Smart Traffic Control System for Emergency Vehicle Clearance," *IJIRCCE (An ISO 3297:2007 Certified Organization)* vol. 3, Issue 8, August 2015.

[17] Xue Yuan, XiaoliHao, Houjin Chen, and Xueye Wei, "Robust Traffic Sign Recognition Based on Color Global and Local Oriented Edge Magnitude Patterns," IEEE Transactions On Intelligent Transportation Systems, VOL. 15, NO. 4, August 2014.

[18] Z. Zhang, X. Ai, C. K. Chan, and N. Dahnoun, "An efficient algorithm for pothole detection using stereo vision," in *Proc. IEEE Int. Conf. Acoust., Speech Signal Process.*, May 2014, pp. 564–568.