

Design of Smart Traffic Management System based on RF Technology and Global System for Mobile Communication (GSM)

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Abstract— This paper is about integration of intelligent traffic control system, for the congestions and traffic rules. This paper primarily deals for the problems facing by the common human being and Emergency vehicles like ambulances waits unnecessarily at the traffic signal. The problem of traffic light control can be solved by a Smart system. With this system, we can consider the priority of different type of vehicles using RFID and also consider the density of traffic on the roads by installing IR sensors on the road intersections.

Key words: Radio frequency identification (RFID); Global system for mobile communications (GSM); Wi-Fi; Traffic congestion; TMS; Vehicular ad-hoc network (VANET); Arduino; AT Commands; Printed circuit board

I. INTRODUCTION

A Smart Traffic Control System automatizes the traffic control activities by using certain logical and mathematical operations and hence controls the traffic in an optimized manner.

In this Prototype of smart traffic management system we have improved the efficiency of traffic lights by using accurate RFID detection techniques and Sensor networks to sense the traffic density [1]. To make this paper more effective we are using Global System for Mobile communications (GSM) [2]. It provide webpage server for the users to check the status of traffic density during the whole day online before they start their journey. To make this prototype Energy efficient we are going to use solar energy as an alternate source of power supply.

A. Need of Smart Traffic System:

Increasing number of vehicles has led to traffic congestion problem. Time of travel, environment quality, quality of life and road safety are all adversely affected as a result of traffic congestions. Human errors and Emergency situations like medical emergencies, accidents etc requires smart traffic management system [3]

B. System Requirements:

A system can be recognized by its characteristics i.e. its functional and non-functional requirements.

The system's functional requirements are as follows:

- System must provide accurate and continuous real-time controlling.
- System must effectively perform traffic management.
- System must use minimum power.
- System must be compact and cost effective.
- System must mostly use off-the-shelf devices, components and standards.
- System Reduces frequency and severity of certain kind of clashes.

The nonfunctional requirement for the system indicates that the system is reliable, portable, accurate,

maintainable, secure, accessible, and usable and energy efficient.

C. Origin of traffic Management system:

Swarm Intelligence (SI), are algorithms based on collective behavior of self-organized systems which is widely used in the field of optimization and researchers that have simulated the behavior of various animals in nature, such as ants, bees, fish, termites and birds. The most famous, successful swarm intelligence model is Ant Colony Optimization (ACO), which was first proposed by Marco Dorigo in 1992 in his PhD thesis [4].

II. RELATED WORK

There are a lot of researches that focus on improving the road traffic to gather the real-time information from different hardware components, for instance the inductive loop, magnetometer, acoustic sensors, ultrasonic, radar, passive RFID readers etc.

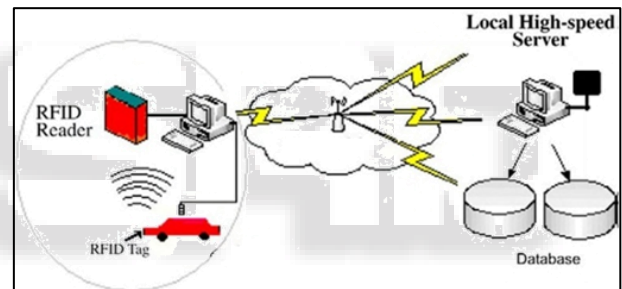


Fig. 1: Framework of previous model [9]

The vehicle detection accuracy was improved using Wireless Sensor Network (WSN) based on magnetic sensors [5]. The magnetometer sensor nodes have been used for vehicular detection [6]. Reviews of CCTV techniques have been proposed [7]. In April 2010, the Kingdom of Saudi Arabia applied a traffic control system known as SAHER program that covers the main cities in Saudi Arabia [8]. In United Arab Emirates, the Salik (means open or available) toll system has been implemented by the Dubai Roads and Transport Authority (RTA) in July 2007 which uses RFID readers to detect passive tags installed on fast moving vehicle windshields from a distance of 5 meters [9]. Finally, A.Peinado has proposed road traffic management system using passive RFID tags with high frequency or ultra-high frequency tags [10].

Each of the preceding techniques is essential, but is not enough still because of its power consumption and the expensive costs of implementation and maintenance. These technologies only solve a part of the problem of traffic management. The basic problem is that these systems are not mature enough to deal with real-time traffic control. Traffic congestion is considered as a major problem in India. So a new approach is proposed to specifically detect the real time traffic congestion and emergency situations in India. This

approach is inspired by the behavior of the ant colonies using GSM and IR sensors with fewer infrastructures which makes it more reliable and less expensive.

III. HARDWARE DESIGN

This system is an integration of-

- 1) Arduino Mega 2560
- 2) GSM module
- 3) Wi-Fi Module
- 4) IR sensors circuit
- 5) RFID Transmitter and receiver section
- 6) Solar Panel section

A. Hardware Description:

1) Arduino Mega2560:

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

2) GSM Module:

GSM is an international standard for mobile telephones. It is an acronym that stands for Global System for Mobile Communications. Among other things, GSM supports outgoing and incoming voice calls, Simple Message System (SMS or text messaging), and data communication (via GPRS). In our paper we use SIM800A GSM Module to send an alert message to the registered mobile no. when the traffic at any lane is at maximum.

3) Wi-Fi Module:

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers! The ESP8266 module is an extremely cost effective board.

4) IR sensors circuit:

Photodiode and IR LED used in pair to detect the interrupt of vehicles at the lane. This circuit gives the output in analog form which is converted by Arduino in digital form to control the LCD display LED's.

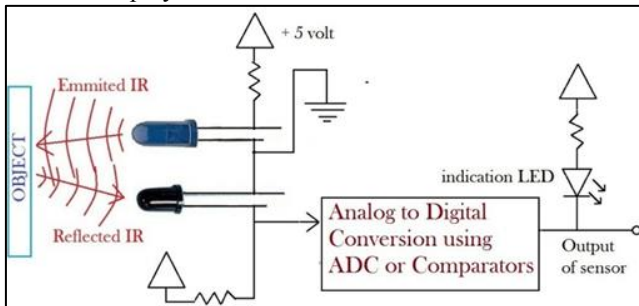


Fig. 2: IR sensors circuit diagram

5) RFID Transmitter and receiver section:

On Tx side we use HT12E IC as RF transmitter which is an encoder IC that provides a serial conversion and an address

also. On Rx side we use HT12D decoder IC as RF receiver. We are using 433 MHz frequency for RF communication. Output of the HT12D is connected to the microcontroller port P1, LCD is connected to the port P0 and traffic light LED's are connected to the port P2 pin.

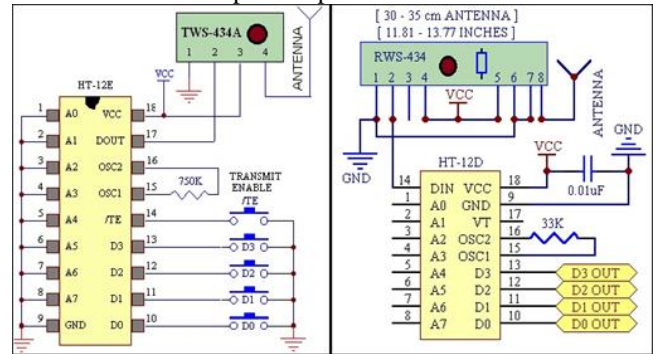


Fig. 3: Transmitter and Receiver circuit

6) Solar panel section:

Solar panel is used as an alternate source of Power supply with a chargeable battery. LM7805 IC is used for regulated power supply with two capacitors of 1000 µF, 25V.

B. Hardware assembly:

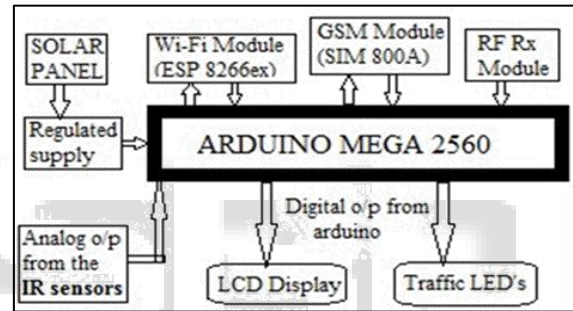


Fig. 4: Block diagram of system

C. Working of Prototype system:

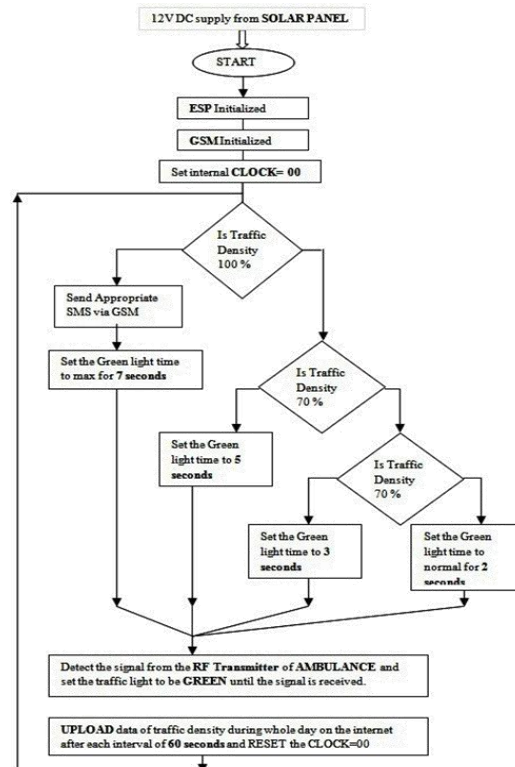


Fig. 5: Flowchart of operation

This prototype operates in a loop, starts from power supply to the uploading the data on the Webpage. Internal clock is a variable which stores the time period of hardware run.

IV. SOFTWARE ARCHITECTURE

A. GSM and Wi-Fi Module Programming:

The basic steps to start the modules are-

- The baud rate of 9600 is also selected for the modem.
- Start > Programs > Accessories > Communications > Hyper Terminal.
- COM port for mobile is chosen.

Some special AT commands used are:

- AT : To initialize the GSM & Wi-Fi Modules.
- ATE0 : To suppress the echo signal.
- AT+CWJAP : To connect with Wi-Fi Hotspot.
- AT+CIPMUX : To make the multiple connections ON.
- AT+CMGF=1 : This shows that SMS sent by GSM is in Text mode.
- AT+CMGS : To send message on mobile number.
- AT+CIPSEND : To send the required characters on given IP address.
- Millis () : This count the time of Hardware start in milliseconds.

B. Simulation tool: Proteus 8.6 version

Proteus is a Virtual System Modeling and circuit simulation application. It is a software suite containing schematic, simulation as well as PCB designing. In this paper, we are simulating our Embedded System design with ARDUINO MEGA Board having ATMEGA2560 microcontroller [11].

Proteus ISIS (Intelligent schematic input system) is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation.

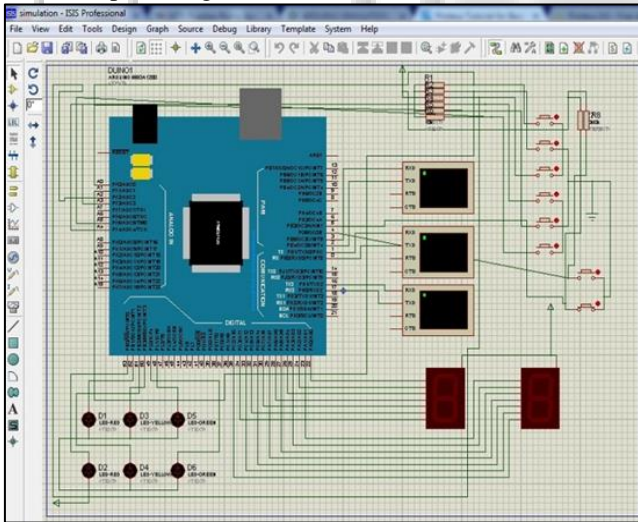


Fig. 6: Simulation of hardware

Proteus tool is also used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components. After the layout design is prepared etching process is to be done using Ferric chloride solution (FeCl3) also known as etching solution.

C. Webpage on Server:

To show the Real time traffic density data for the public use, we are using the open IOT platform on thingspeak.com. The

whole day density of the traffic is uploaded on the web through the Wi-Fi module in graphical form such that anyone can check the status of traffic before starting or planning their journey.



Fig. 7: Webpage outlook

V. RESULTS

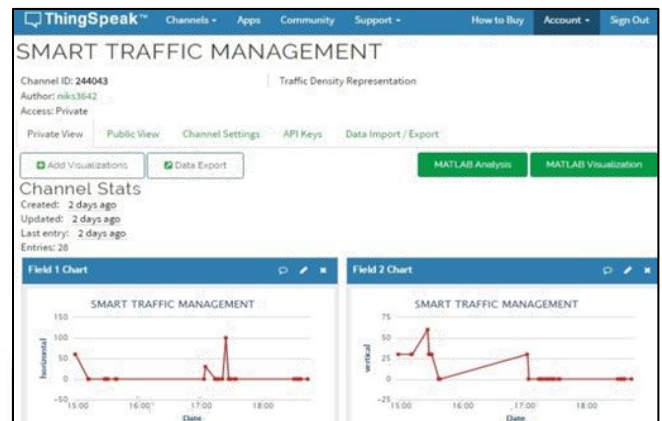


Fig. 8: Traffic density analysis data seen on the webpage

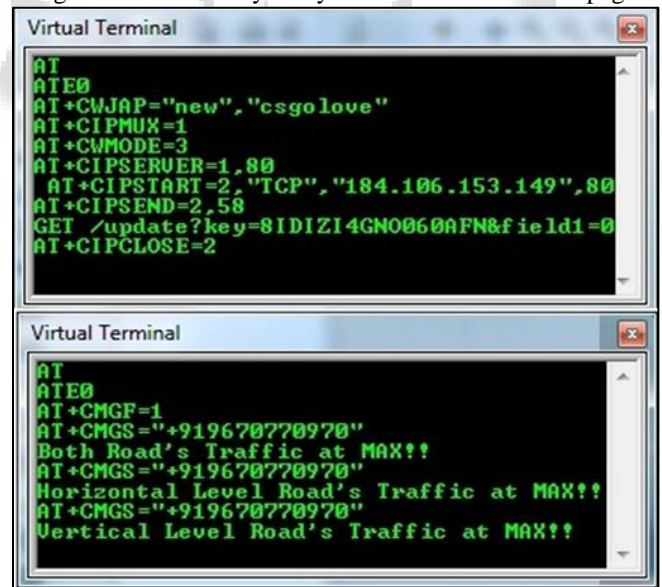


Fig. 9: Alert message sent when traffic density of any lane is full

VI. CONCLUSION

Improving the efficiency of TMSs is still an active and challenging research area due to the criticality of the transportation infrastructure being monitored by such systems. This paper has provided a comprehensive solution of the different phases of a modern traffic conditions, emphasizing the main challenges and shortcomings of the

existing systems and suggesting some directions to make the TMSs more efficient in future smart cities [12].

The result of this paper is used to minimize the traffic congestion of the road and emergency situations. The results also show that the proposed modeling approach could be used as a basis for the analysis of different road traffic congestion and it highlighted the main new technologies that can significantly improve the accuracy of the collected data.

VII. FUTURE SCOPE

For the future work, it is recommended that the actual proposed system would be implemented in real life world. In addition, it is recommended that proposed system should be integrated with mobile Global positioning system (GPS) technology or Image processing techniques in an efficient way. Further research is required to find an efficient way of controlling countries traffic congestion problem through a single platform, this will also helps in security concern of our country.

Another major issue for metropolitan city is pollution and main cause of pollution is vehicle on the roads. The increased number of population leads to vast number of vehicles which leads to several type of pollution and this adversely affects the population. From the measured data showed that the environmental protection departments: a car with one ton burned fuel emits harmful substances up from 40 to 70 kg. Emissions from 1000 cars per day, about 3000 kilograms of carbon monoxide, hydrocarbons of about from 200 to 400 kg and nitrogen oxide from 50 to 150 per kg [13]. So someone can think about to minimize the pollution problem aroused by the standing vehicles around the traffic lights.

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