

IoT based Traffic Management System and Congestion Control

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Abstract- This paper deals with the effective use of wireless technology and IR sensor which is to detect the density of the traffic and to provide smooth and clear flow of traffic for emergency vehicle to reach the destination on time. The system employs assistance to such emergency vehicles without any human effort. This system is implemented based on present criteria that tracking two conditions in those one is heavy traffic control and another one is making a route of emergency vehicle like ambulance, which is implemented by using ARDUNIO, GSM module, IR sensor and Sound sensor to detect the emergency vehicle. The information on detecting the emergency vehicle is sent to the traffic system through GSM SIM800A transmitter and receiver system, for automatically controlling the traffic light until the emergency vehicle passes through. This system is capable of addressing problems such as traffic congestion, early warnings regarding jams, vehicle spotting and emergency vehicle clearance.

Keywords: Arduino UNO, GSM, Sound sensor, IR sensor.

I. INTRODUCTION

The Internet of Things (IoT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects. IoT is expected to spread rapidly over the coming years and this convergence will unleash a new dimension or service that improve the quality of life of consumers and productivity of enterprises, unlocking an opportunity that the GSMA refers to as the 'Connected Life'. For consumers, the IoT has the potential to deliver solutions that dramatically improve energy efficiency, security, health, education and many other aspects of daily life.

For enterprises, IoT can underpin solutions that improve decision-making and productivity in manufacturing, retail, agriculture and other sectors. Road traffic involves directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public. Traffic control also includes the use of CCTV and other means of monitoring traffic by local or state roadways authorities to manage traffic flows and providing advice concerning traffic congestion. Road Traffic control is an outdoors occupation, night or day for long hours in all weathers, and is considered a dangerous occupation due to the high risk of being struck by passing vehicles. Safety equipment is vitally important. Many drivers are annoyed by the disruption to their route, and some are sufficiently antisocial as to aim at traffic controllers.

This paper presents an intelligent traffic control system to pass emergency vehicles smoothly. It counts number of vehicles that passes on a particular path during a specified duration.

It also determines the network congestion, and hence the green light duration for that path. In addition, when an ambulance is approaching the junction, it will communicate to the traffic controller in the junction to turn ON the green light. This module uses GSM and Arduino system-on-chip for wireless communications between the ambulance and traffic controller.

This paper deals with the effective use of wireless technology and high speed micro controller to provide smooth and clear flow of traffic for emergency vehicle to reach the destination on time. This is implemented by using ARDUINO, GSM module, IR sensor and Sound sensor to detect the emergency vehicle passes through. Pair of IR sensors is used to estimate the congestion near the traffic and this information is provided to the ambulance driver using GSM.

The organization of this paper is as follows, Section II summarizes the related areas of its benefits and problems. Section III gives the brief description about the proposed system with block diagram. Section IV and V describes the Hardware and software requirements. Section VI deals with the results and discussion of the model followed by conclusion in the Section VII.

II. RELATED WORKS

In real world there are many traffic management schemes established already. These schemes are described in the following sections.

A. Conventional traffic management Scheme

In conventional traffic management scheme, a police officer stands in middle of the road monitors and controls flow of traffic. At the time of road blocking or emergencies congestion office in charge can decide the lane which requires more priority and gives signals to the vehicle driver whether to drive or stop. This scheme is most proficient than any other technique. But as it includes human as a part of system this scheme is inadequate. Efficiency of system depends on experience and capability of the person[2].

B. Automatic Traffic Management Scheme

Here fixed traffic poles with green, yellow and orange colors bulb / LEDs (light emitting diode) are used at the traffic junctions that display the traffic signals. In this case, the control system is programmed to display traffic signal lights in predefined sequence [2]. In some circumstances, it is not feasible for drivers to view from different angles of the road if they are behind a heavy motor vehicle or being unmindful of the traffic light. This system cannot identify emergency vehicle and therefore there are chances of delay in emergency services. In absence of police, drivers are tempted to disobeying signal rules causing serious accidents

C. Intelligent Traffic Management Scheme based on Image Processing

This scheme contains cameras, which are meant to measure length of traffic in the system. Cameras are mounted on a high pole so that they can cover long distance. Video footage covered by camera is analyzed by a computer chip in order to detect object (i.e. car, truck, etc.) on road by using different object detection techniques [2]. Here image processing and fuzzy logic tool boxes of MATLAB are used where the final output is sent to microcontroller to drive the traffic signals in the desired manner. The results obtained show an improvement of 26% in the overall outcome of traffic management as compared to the conventional traffic controller, marking great feasibility and practicality of the current model.

D. Intelligent traffic management scheme using Wireless Technologies

In this scheme, emergency / VIP (very important vehicle) vehicle and traffic signal are equipped with wireless antennas and receiver. As emergency vehicle come near to traffic junction, transmits a signal, to notify traffic signal about its presence. As soon as traffic control unit receives signal from emergency vehicle, it gives green light to that particular lane, in which emergency vehicle is coming. An intelligent traffic signal control system using IR sensors, AVR32 microcontroller with and built in 8 -channels ADC has been designed [2]. Thus optimization of traffic light switching increases road capacity, traffic flow and can prevent traffic congestions.

The density of Traffic has grown tremendously in the past few years and due to which lot of problems arises because of delay in traffic. To avoid and overcome these problems we are proposing the traffic management system and congestion control, to pass emergency vehicles smoothly.

III. PROPOSED SYSTEM

The block diagram of the proposed traffic management system is shown in figure 1.

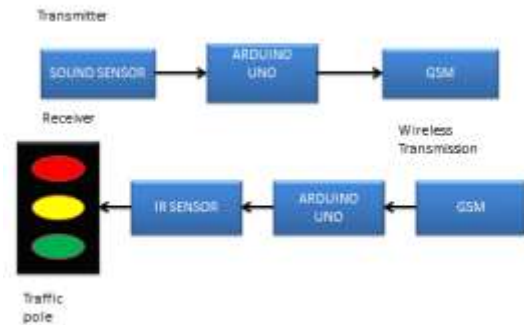


Fig.1 Block diagram of Proposed Traffic Management System

The system employs to such emergency vehicles without any human effort. This system was implemented based on present criteria that tracking two conditions in those one is heavy traffic control and another one is making a root of emergency vehicle like ambulance. We are going to implement a sensor network which is used to detect the traffic density. GSM is used for sending message from transmitter which is in sensor network to the GSM module in the receiver section. When an ambulance is approaching the junction, it will communicate the traffic controller in the junction to extend the green light duration. The model architecture for traffic management system shown in figure 2.



Fig.2 Model Architecture for Traffic Management System

IV. HARDWARE REQUIREMENTS

A. Arduino

Arduino uno is a microcontroller board based on the Atmega 328p(datasheet). It has 14 digital input/output pin (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The schematic view of Arduino uno shown in figure 3.



Fig.3 Schematic view of Arduiniouno

B. Sound Sensor

The Sound sensor module is a simple microphone. Based on the power amplifier LM386 and the microphone, it can be used to detect the sound strength of the environment. The value of output can be adjusted by the potentiometer. It provides not only an audio output, but also a binary indication of the presence of sound, and an analog representation of it is amplitude. Speakers work by connecting to a source, wires inside the speaker transfer signals and then an electromagnet produces vibrations that take the electricity and convert it into the required sound. The schematic view of Sound sensor is shown in figure 4.



Fig.4 Schematic view of Sound sensor

C. GSM

GSM900 is the original GSM system. It uses frequencies in the 900 MHz band (numbered one to 124), and is designed for wide area cellular operation with maximum output powers of 1 W to 8 W allowed for mobile applications. GSM uses a digital modulation format called 0.3 Gaussian minimum shift keying, or 0.3 GMSK. The 0.3 describes the bandwidth of the Gaussian filter in relation to the bit rate. The schematic view of GSM module is shown in figure 5.



Fig.5 Schematic view of GSM module

D. IR Sensor:

The schematic view of IR Sensor is shown in figure 6. Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near IR region, mid IR region and far IR region.



Fig.6 Schematic view of IR SENSOR

V. SOFTWARE REQUIREMENTS

A. Proteus

It is a software suite containing schematic, simulation as well as PCB (Printed circuit board) designing. ISIS 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. ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components.

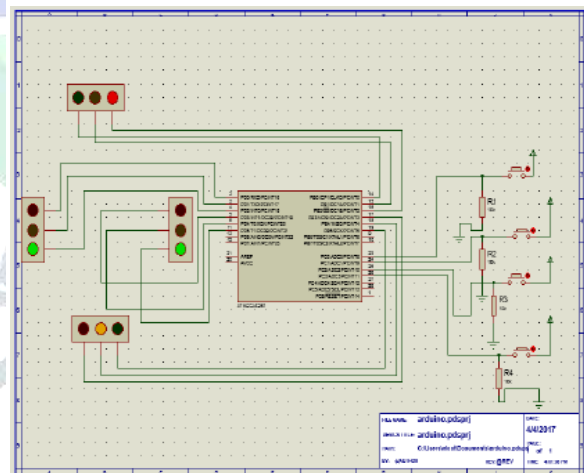


Fig.6 Proposed system simulation using Proteus software

Fig.6 gives the Proteus design part of hardware of our system. In which we have connected all the necessary hardware part with the microcontroller such as traffic lights, IR sensors and all necessary hardware that is needed to work the model. We burn the hex code file that is generated in the Arduino IDE software to the microcontroller and the total system performs as per the code written and exactly same behaviour with hardware.

VI. RESULT AND DISCUSSION

The proposed system to control Traffic density, it has grown tremendously in the past few years and due to which lot of problems arise because of delay in traffic. To avoid and overcome these problems we are proposing the traffic

management system and congestion control, to pass emergency vehicles smoothly. Primary work of our paper is to sense the ambulance before 1km of traffic pole and it is done by sound sensor. GSM is used for sending message from transmitter which is in sensor network to the GSM module in the receiver section. When an ambulance is approaching the junction, it will communicate the traffic controller in the junction to extend the green light duration. To detect the traffic density we are using IR sensor. IR sensor is placed near and far from the traffic pole which is referred as IR1 and IR2, IR1 triggering indicates the low traffic density and IR2 triggering indicates high traffic density. Depending upon the traffic density green signal will be glowing. By this technique we can control the traffic in easier manner. Pair of IR sensors is used to estimate the congestion near the traffic and this information is provided to the controller that is Arduino. The implementation of IoT based Traffic Management System is shown in figure no 8,9,10.



Fig.8 Implementation of Arduino with GSM module



Fig.9 Implementation of Arduino with IR sensor

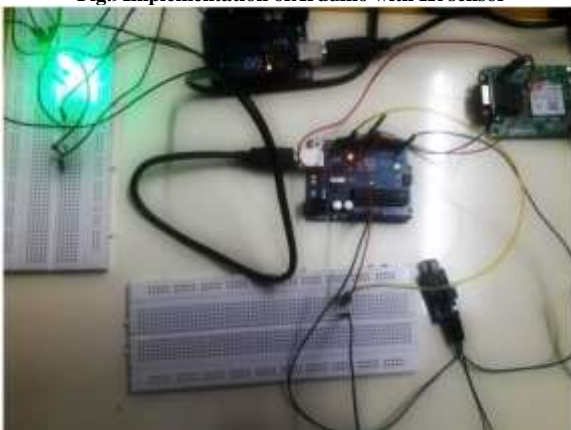


Fig.10 Implementation of IoT based Traffic Management System

VII.CONCLUSION

The development of Traffic management system and congestion control system based on Internet of things. This system is completely automated and wireless which avoids human intervention. The range of communication between the TX and RX has been increased by replacing the ZigBee module with GSM module and sound sensor. This helps to detect the ambulance in few hundred meters before the signal junction. This is of greater advantage because the ZigBee module is a short range device, so the ambulance will be detected close to the signal junction. But during heavy congestion time there will be several vehicles waiting near the signal junction. If those vehicles fully occupy the coverage area then, the ambulance will be far away to be detected and hence the signal will not be changed as green. By placing sound sensor, IR Sensor and GSM module in the range of few hundred meters away from signal the ambulance can be easily detected without any hurdle.

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