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Intelligent Traffic Control System for Congestion Control, Emergency Vehicle Clearance and Stolen Vehicle Detection

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ABSTRACT

Due to the heavy traffic in the road many people are suffering. Even though there is traffic signal available at various places it is not easy to control the crowd. In order to avoid traffic problem heavily on the road, we designed and developed a system so called as traffic controller with wireless control for ambulance and VIP vehicles. In this paper, we proposed an Implementing Intelligent Traffic Control for Congestion, Ambulance clearance, and Stolen Vehicle Detection. This system was implemented based on present criteria that tracking three conditions in those one is heavy traffic control and another one is making a root of emergency vehicle like ambulance and VIP vehicle. In this paper we are going to implement a sensor network work which is used to detect the traffic density and also use RFID reader and tags. We use AVR system-on-chip to read the RFID tags attached to the vehicles. It counts number of vehicles that passes on a particular path during a specified duration using infrared sensor. If the RFID tag read belongs to the stolen vehicles. GSM SIM900 used for message sending towards the police control room. In addition, when an ambulance or some VIP vehicle if approach the junction, it will communicate the traffic controller in the junction to turn on the green light in the path.

Keywords: Zigbee, RFID, GSM SIM900, Stolen vehicle detection, Emergency vehicle detection and Traffic control.

1. 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. In order to avoid this excess time consumption an intelligent traffic control system is used which turns the signal in the path of the ambulance to green as well as estimate the congestion in the signal junction and sends it to ambulance through GSM so that the Driver can decide whether he should take that path or not. The same system is also used to detect stolen vehicle. The RFID tag of the stolen vehicle should be saved in the database so that when it is detected in any signal junction an SMS is sent to the control room. Zigbee is used to communicate between the traffic signals and emergency vehicles. Zigbee uses three frequency bands for transmission- 868 MHz band with a single channel has a raw data rate of 20 kb/s. RFID is a wireless technology that uses radio frequency electromagnetic energy to carry information between the RFID tag and RFID reader. Some RFID systems will only work within the range inches or centimeters, while others may work for 100 meters (300 feet) or more. 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 IR sensor transmits IR light and measure the light reflected from an object. An IR sensor can measure the heat of an object as well as detects the motion here the IR sensors are used to detect the vehicle moment and microcontroller counts the density of vehicles and the traffic signals are controlled based on the density of vehicles in four ways. In this model, there are mainly 3 modules as follows.

1.1 Traffic Control System

In this module, for experiment purpose, we have used passive RFID tags and RFID reader with frequency 125 KHz. RFID tag, when vehicle comes in the range of the receiver will transmit the unique RFID to the reader. The microcontroller connected to the RFID reader will count the RFID tags. Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. The IR sensors are used to detect the vehicle and the controller counts the vehicle density based on the density of vehicles in particular road junction the traffic signals are controlled automatically.

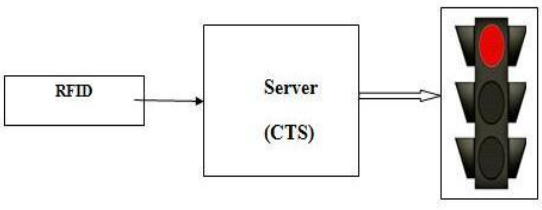

Fig.1. Stolen Vehicle Detection Module

1.2 Stolen Vehicle Detection System

In this module, for testing purpose, we compare the unique RFID tag read by the RFID reader to the stolen RFIDs stored in the system. If a match is found, then the traffic signal is immediately turned to red for duration of 30 seconds. Also an SMS is sent specifying the RFID number by using GSM module SIM900. The LCD display will indicate that stolen

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vehicle. Here input is taken from RFID reader and pass to the central computer system. CCS will perform matching of lost vehicle RFID tags database &input. And traffic light of the signal will switch to Red.

1.3 Emergency Vehicle Clearance System

In this module, there are 2 parts, first part which is ZigBee transmitter is placed in the emergency vehicle. When the switch is pressed, it will transmit the signal. The signal contains unique id and security code. The transmitter contains atmel162 .A microcontroller and ZigBee module. The microcontroller sends the commands and data to the ZigBee via serial communication. Second part is the receiver, which is placed at traffic pole. It also contains microcontroller and ZigBee module. The receiver compares the security code received to the security code present in its database. If it matches, then it will turn the green light on. For testing purpose, we used short range RFID reader in our prototype. First, the receiver part is turned on.

The red and green signal will be on for 10 seconds duration and orange light will be on for 2 seconds duration one after the other. Secondly, we bring the RFID of stolen vehicle into the range of RFID reader. Then the signal will turn to red for duration of 30 seconds and a SMS is received. Thirdly, we bring 12 RFIDs into the range of RFID reader, and then the green light duration will change to 30 seconds. Fourthly, we bring an emergency vehicle carrying ZigBee transmitter into the range of ZigBee receiver, and then the traffic light will change to green till the receiver receives the ZigBee signal. In the default condition, red and green light will set for 10 seconds. The time period will be varied according to the traffic conditions, stolen vehicle, and emergency vehicle.

The transmitter part is placed in the ambulance. It transmits ZigBee signal continuously the LCD display status at different conditions (in that figure one is normal conjunction image (traffic signal running as per the default time period) and another one is LCD display status, when an ambulance coming near to junction the actual connections of different components like RFID, GSM, ZigBee, interfacing different microcontrollers the status updated at the time of stolen vehicle is found. The stolen vehicle RFID number should be updated in the database. If stolen vehicle is found, then it will immediately turn on red light in the signal.

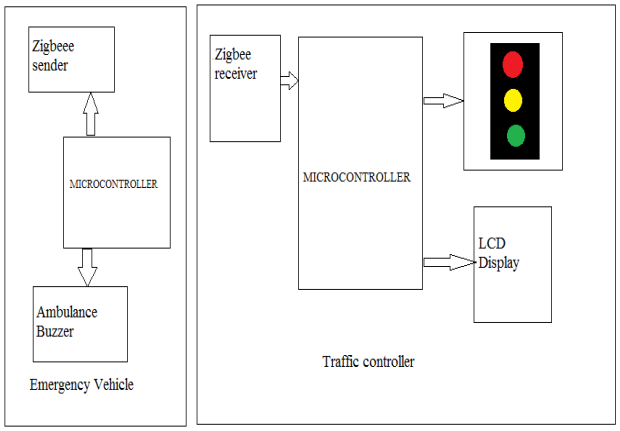

Fig.2. Emergency vehicle clearance system

2. PROPOSED SYSTEM

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. To solve these problems, we propose to implement our Intelligent Traffic Control System. In our proposed system the numbers of vehicles entering are detected by using IR sensors the IR sensors is connected to the microcontroller.

The microcontroller counts the vehicle density and controls the traffic signal automatically .The microcontroller is used to control the traffic signals in four road junction by automatically controlling the traffic lights. The stolen vehicle system can be implemented by using RFID tags. Each vehicle contains RFID tag .When it comes in the range of RFID reader, it will send the signal to the RFID reader. Here, when the RFID reader reads the RFID tag, it compares it to the list of stolen RFIDs. 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.

In Emergency vehicle clearance system 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. Zigbee uses three frequency bands for transmission- 868 MHz band with a single channel has a raw data rate of 20 kb/s. The 915MHz band with 10 channels has each channel's central frequency separated from the adjacent band by 2 MHz and data rate of 40 kb/s. BPSK modulated symbols are transmitted at 1 bit per symbol using Direct Sequence Spread Spectrum (DSSS) technique with 15 bit chips. The 2.4 GHz ISM band with 16 channels, 5 MHz wide offers 250 kb/s data rate. It employs O-QPSK modulation with 4 bits/symbol transmitted using DSSS with 32 Bit chips. To reduce the transmitted power, the Zigbee transmitters use Energy Detection (ED) and Link Quality Indication (LQI). It is the responsibility of the physical layer to perform channel assessment.

2.1 Microcontroller

This section discusses the Atmel AVR core architecture in general. The main function of the CPU core is to ensure correct program execution. The CPU must therefore be able to access memories, perform calculations, control peripherals, and handle interrupts. In order to maximize performance and parallelism, the AVR uses Harvard architecture – with separate memories and buses for program and data. Instructions in the Program memory are executed with a single level pipelining. The Program memory is In-System Reprogrammable Flash memory. The fast-access Register File contains 32 x 8-bit general purpose working registers with a single clock cycle access time. This allows single-cycle. These added function registers are the 16-bit X-,

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Y-, and Z-register, described later in this section. The ALU supports arithmetic and logic operations between registers or between a constant and a register. Single register operations can also be executed in the ALU. After an arithmetic operation, the Status Register is updated to reflect information about the result of the operation.

2.2 ZIGBEE CC2500

Zigbee uses three frequency bands for transmission- 868 MHz band with a single channel has a raw data rate of 20 kb/s. The 915MHz band with 10 channels has each channel's central frequency separated from the adjacent band by 2 MHz and data rate of 40 kb/s. BPSK modulated symbols are transmitted at 1 bit per symbol using Direct Sequence Spread Spectrum (DSSS) technique with 15 bit chips. The 2.4 GHz ISM band with 16 channels, 5 MHz wide offers 250 kb/s data rate. It employs O-QPSK modulation with 4 bits/symbol transmitted using DSSS with 32 Bit chips. To reduce the transmitted power, the Zigbee transmitters use Energy Detection (ED) and Link Quality Indication (LQI). It is the responsibility of the physical layer to perform channel assessment.

2.3 GSM SIM 900

GSM (Global System for Mobile communications: originally from *Groupe Special Mobile*) is the most popular standard for mobile phones in the world. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used.

2.4 RFID

Radio Frequency Identification (RFID) is an IT system that transmits signals without the presence of physical gadgets in wireless communication. It is categorized under automatic identification technology, which is well established protocol. The working of an RFID system is very simple. The system utilizes tags that are attached to various components to be tracked. The tags store data and information concerning the details of the product of things to be traced. The reader reads the radio frequency and identifies the tags. The antenna provides the means for the integrated circuit to transmit its information to the reader. There are two types of RFID categories, active and passive tags. The tags that do not utilize power are referred to as passive and they are driven by an antenna that enables the tag to receive electromagnetic waves from a reader. On the contrary, active tags rely on power and they have inbuilt power sources that enable it to send and receive signals from RFID reader.

RFID range depends on transmit power, receive sensitivity and efficiency, antenna, frequency, tag orientations, surroundings. Typically, the RFID range is from a few centimeters to over hundred meters. RFID reader uses frequency 125 KHz with a range of 10 cm

3. WORKING MODEL

3.1. Block Diagram

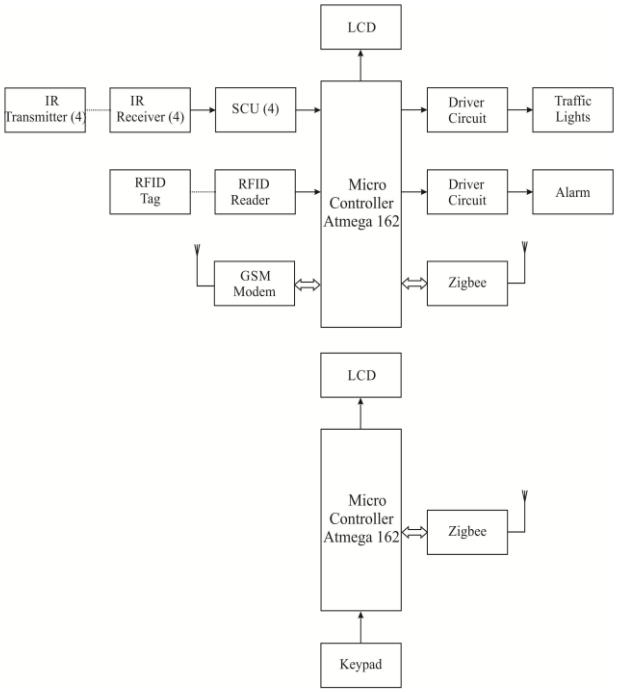

Fig.3. Block diagram

3.2 Block Diagram Description

3.2.1 Traffic control and Stolen vehicle detection

The four IR transmitters and IR receivers are used to detect the vehicles in four way roads. Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver receives the signal and transmits the signal to microcontroller. The microcontroller counts the density of vehicle .For demo purpose if the density of vehicle is four then the Traffic signals are turned to green lights after 10 seconds in such a way traffic signals are controlled in four ways. In stolen vehicle detection system for testing purpose, we compare the unique RFID tag read by the RFID reader to the stolen RFIDs stored in the system. If a match is found, then the traffic signal is immediately turned to red for duration of 30 seconds. Also an SMS is sent specifying the RFID number by using SIM900 GSM module. The LCD display will indicate that stolen vehicle is present.

3.2.2 Emergency Vehicle Clearance

In this module, there are 2 parts, first part which is ZigBee transmitter is placed in the emergency vehicle. When the switch is pressed, it will transmit the signal. The signal contains unique id and security code. The transmitter contains a microcontroller and ZigBee module. The microcontroller sends the commands and data to the ZigBee via serial communication. Second part is the receiver, which is placed

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at traffic pole. It also contains microcontroller and ZigBee module. The receiver compares the security code received to the security code present in its database. If it matches, then it will turn the green light on. The time period will be varied according to the traffic conditions, stolen vehicle, and emergency vehicle. It transmits ZigBee signal continuously. The stolen vehicle RFID number should be updated in the database. If stolen vehicle is found, then it will immediately turn on red light in the signal. It sends immediately a message to authorized person.

4. OUTPUT

Fig.4. Traffic control system and Stolen vehicle detection

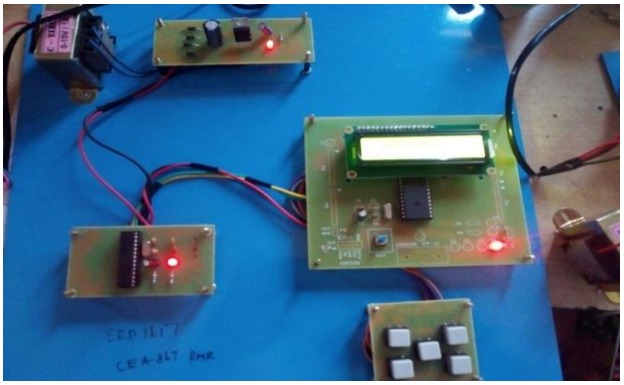
Fig.5. Emergency vehicle clearance

Fig.6. LCD display

5. RESULTS AND CONCLUSION

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 regarding the location 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. This system is implemented in four way roads. Further enhancements can be done to improve traffic control for multi way road junction. Also, in stolen vehicle system GPS system can be added to track the stolen vehicle.

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