Intelligent Traffic Control System for Ambulance Clearance and Stolen Vehicle

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***Abstract* - 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, RFID reader for detecting the RFID tag placed in the emergency vehicle. The information on detecting the emergency vehicle is sent to the traffic system through RF transmitter and receiver system, for automatically controlling the traffic light until 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. In addition to this scheme, the system also detects the stolen vehicle passing through that path. On detecting the stolen vehicle the information is sent to the control room through GSM for immediate action.**

***Index Terms* - RFID reader, RFID tag, ARDUINO, GSM SIM900, IR sensor, RF transmitter and receiver**

I. INTRODUCTION

As we all know India is the most populated country next to china. This makes it difficult to maintain and control the roads, traffic and congestion. The migration of population from rural to urban and sub-urban areas makes the condition even more critical [1]. As a result of this the number of road accidents also increased to a great extent. The non-lane based Indian traffic makes it difficult for the ambulance to reach the destination on time [2]. 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.

This intelligent traffic control system uses Arduino to control the traffic light by using wireless communication which makes it cost effective [3]. This system has a transmitter and a receiver part. The RFID system in the transmitter part detects the ambulance and sends the information to the traffic signal (receiver) through RF transmitter.

The RFID system uses radio frequency to transmit information wirelessly. The range and RFID tag and RFID reader varies from few centimeter to 100 meter and more.

The RF module is an electronic device that communicate wirelessly using radio frequency signal. This RF module is often used over optical communication because it does not require line of sight. Commercial RF modules use several carrier frequencies that include (ISM) radio bands such as 433.92MHz, 915MHz, and 2400 MHz The short range modules may also use several unlicensed user frequencies like 315MHz, 868MHz.

The Arduino Uno is a physical prototyping platform that uses open source hardware and software for developing and implementing processing and wiring language. The coding language is simple that it can be easily understood by the beginners at the same time flexible to implement complex operations.

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.

The following sections deals with the hardware architecture, simulation using Proteus software, result, conclusion and future scope.

II. HARDWARE ARCHITECTURE

The existing system which uses image processing cannot be implemented during bad weather conditions. The driver of emergency vehicles is not aware of the congestion density in the traffic path before reaching that junction and also that the existing systems are costlier. For solving the current problem section, we have implemented the Intelligent Traffic control System. This system consists of three sections. In the first part we are detecting the emergency vehicle passing through the specified path. This is practically implemented using RFID reader, RFID tag. The RFID reader connected to ARDUINO reads the tag positioned in the emergency vehicle. This information on detecting the vehicle is sent by the RF transmitter to the RF receiver connected to the ARDUINO of the traffic control system. The traffic turns to green light for the emergency vehicle to pass the junction and then the traffic turns normal. In the second part for determining the congestion IR sensors are used. First IR sensor adds the count of arrived vehicles and the other IR sensor subtracts the count when the vehicle leaves the junction. This information about the traffic density is conveyed

to the Emergency vehicle before arriving at the junction so that the emergency vehicle could take an alternative path which has lower congestion or no congestion. This information is transferred through GSM SIM900 via SMS to the driver's number. The third part in this designed module is for detecting the stolen vehicle and conveying the information to the control room. For this, the RFID reader detects the tag of the Stolen vehicle, which is already been attached with the tag and intimates the information using GSM SIM900 via SMS to the controller. This system uses RF transmitter and receiver system for wireless communication. We are using ARDUINO controller to reduce the cost of the module and also to have a developed environment for writing the software. Arduino controller is used for developing interactive objects and also for taking inputs from a variety of switches and sensors as well as controlling various outputs

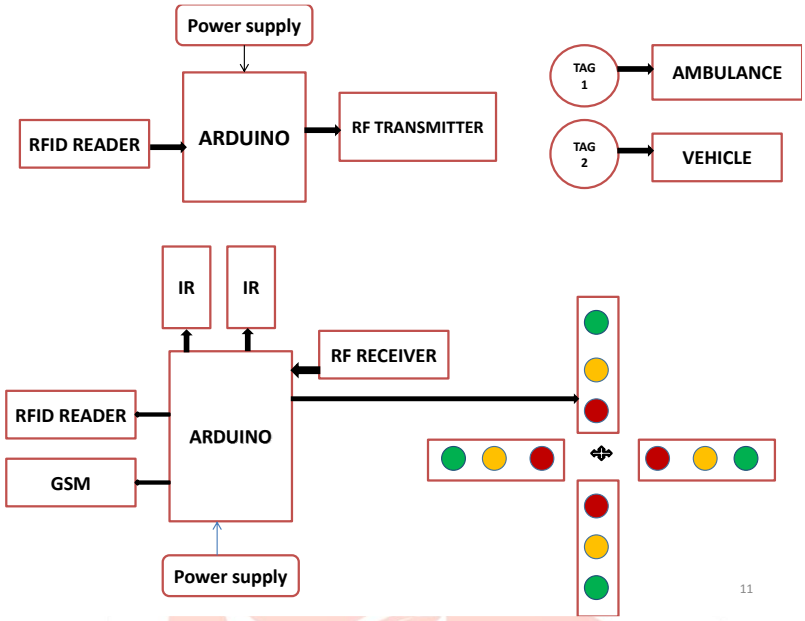

Fig 1

III. ARDUINO UNO CONTROLLER

Arduino can be used as an open source physical computing platform based on simple microcontroller board. It provides a development environment for writing software. It is based on ATmega328 [14]. It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a16 MHz ceramic resonator, a USB connection, an ICSP header, a power jack, and a reset button. It has everything that a controller needs .It is a simple procedure to connect it with USB port to power it with AC-TO-DC adapter to start. It features AT mega 16U2 programmed as a USB to serial convertor. The ATmega328 has 32 KB (with 0.5 KB used for the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM. Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write ( ), and digital Read ( ) functions. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus

GSM/GPRS –SIM900A

GSM/GPRS –SIM 900A modem has a built in RS232 which helps to connect it with PC as well as microcontroller. It is a dual band modem which works on frequencies 900/1800MHz. Baud rate is configurable from 9600-115200 through AT commands. The baud rate is nothing but the modulation rate in symbols per second. This modem also has an internal TCP/IP stack which makes it enable to connect with internet via GPRS (General Packet Radio Service).This is suitable for SMS, voice as well as data transfer applications in M2M interface. This modem also has on board regulated power supply that allows it to be connected to wide range of unregulated supply. This GSM modem is used to make audio calls, send and read SMS, attend incoming calls, internet, etc through AT commands. AT refers to Attention.

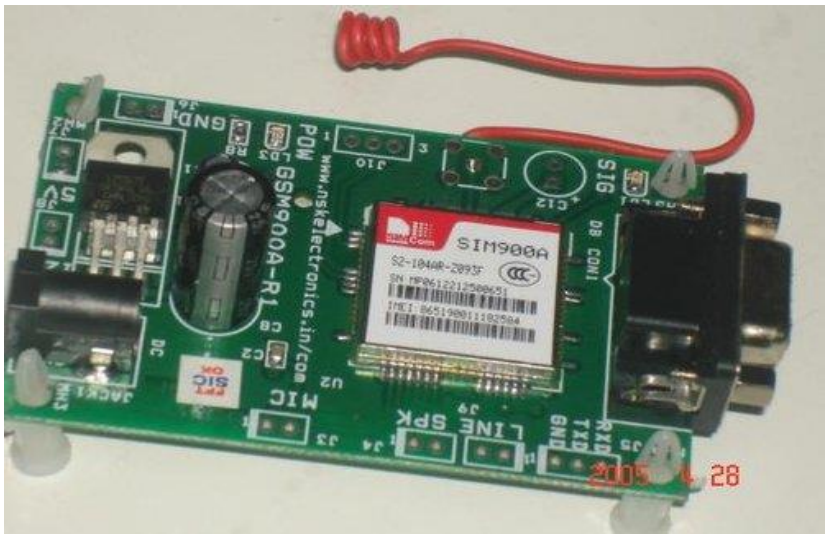

Fig 2 GSM SIM900A

RF TRANSMITTER AND RECEIVER

An RF transceiver model is a small PCB sub-assembly capable of transmitting a radio wane and modulating that wave to carry data. They are usually implemented with a microcontroller for providing data to transmit. The RF receiver module demodulates the received modulated RF signal. The system operates at the frequency range of 30 kHz & 300 GHz. Two types of RF receiver modules are super-heterodyne receivers and super-regenerative receivers. RF transmitter has four pins such as VCC, GND, DATA, and ANT. Voltage of 5V is given to VCC with (0V) GND, DATA pin is used for giving serial input and the ANT pin for antenna output. It consists of HT12E Encoder. The encoder ICs are series of CMOS LSIs for Remote Control system applications. It consists of 18 pins and is capable of encoding 12 bits of information consisting of N address bits and 12-N data bits. The RF receiver has 2 VCC, 3 GND, DATA, and ANT pins and NC pins. 5V is given to VCC with (0V) GND, DATA pin is used for giving serial output and the ANT pin for antenna input. It consists of HT12D Decoder. The HT12D Decoder ICs are series of CMOS LSIs for remote control system applications. The Decoder receive the serial address and data from its corresponding encoder, transmitted by a carrier using an RF transmission medium and gives output to the output pins after processing the data. Both consumes low power and possess high noise immunity.

RFID READER

RFID refers to Radio Frequency Identification. It has two parts a RFID reader and a RFID tag.

It is an Automated Data Collection technology that is used to gather information from an RFID tag which is used to track the movement and location of individual objects. The communication between the tag and reader takes place through radio waves. Each and every RFID tag has unique identity which gives uniqueness to the object in which it is placed. The RFID tag doesn't have to be in line - of- sight for the reader to detect it but, it has to be in range within the RFID reader. The RFID reader works with 125 KHz tag. The reader includes attached reader antenna and reader control and application software [15]. The antenna sends power (for passive tags) as well as data and commands to the tags. The most commonly used antennas are linear and circular polarized antenna [16]. These antennas convert electrical current into electromagnetic waves that are radiated into space so that they are received by tags where they are converted back to electrical current. The range is either short range (near field) that is less than 30cm or long range (far field) that is up to range of several tens of meters.

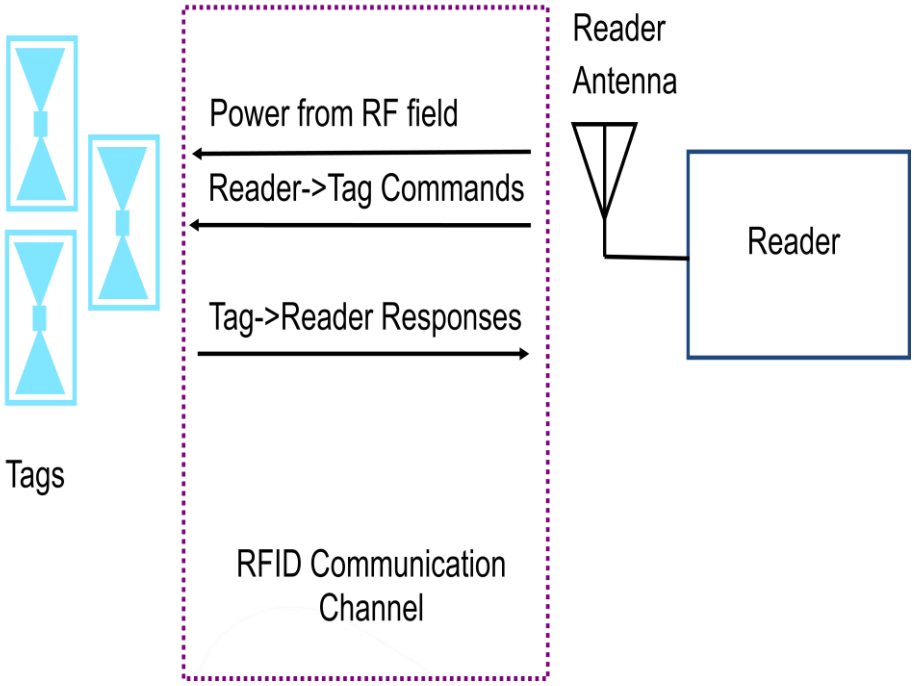

Fig 3 RFID READER

RFID TAG

An RFID tag uses small radio frequency identification devices for identification and tracking purposes .The tagging system includes the tag, a read/write device, and a host system application for data collection, processing, and transmission. It is comprised of an integrated circuit (called an IC or chip) attached to an antenna [16] that has been printed, etched, stamped or vapor-deposited onto a mount which is often a paper substrate or Poly Ethylene Terephthalate (PET). The chip and antenna combo, called an inlay, is then converted or sandwiched between a printed label and its adhesive backing is inserted into a more durable structure. The electronic product code (EPC) stored in the tag chip's memory is written to the tag by an RFID printer and takes the form of a 96-bit string of data. There are two types of RFID tags namely active and passive tags. Passive tags do not utilize power and are driven by antenna that enables to receive electromagnetic power from the RFID reader. Active tags depend on power and has inbuilt power sources that enables to send and receive signals from RFID reader .The operating frequency range is 125 KHz and covers about 10 cm.

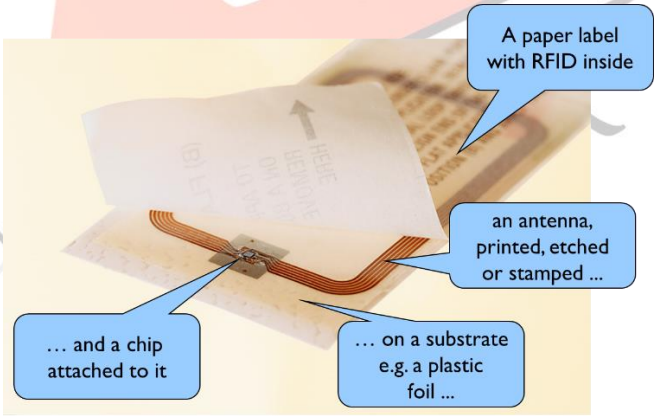

Fig 4 RFID TAG

IR SENSOR

An IR sensor is an electronic device used to detect an object and its motion. The sensor consists of an emitter which is an IR LED and the detector is an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltage change in proportion which is equivalent to the magnitude of the IR light reflected by the object. The output voltage generated will be very small to be detected. Therefore, it is sent to an amplifier circuit (LM358 IC) and the output of the amplifier is sent to the Arduino board.

The operation of IR sensor is that the IR LED continuously transmits light. When a vehicle crosses the path of the light, the light gets reflected which is detected by the IR photo diode. An IR photodiode output varies depending upon reflected IR rays. Since this variation cannot be analyzed as such, the output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 358 is used as comparator circuit.

When the IR photodiode does not receive a signal, the potential at the inverting input goes higher than that at the non-inverting input of the comparator IC LM358. Thus the output of the comparator goes low, and hence the LED does not glow. When the IR photodiode receives signal the potential at the inverting input goes low. Thus the output of the comparator LM 358 goes high and

the LED starts glowing. Resistor R1 (150 ohm), R2 (10k) and R3 (10k) are used to ensure that minimum 10 mA current passes through the IR LED, Photodiode and normal LEDs respectively.

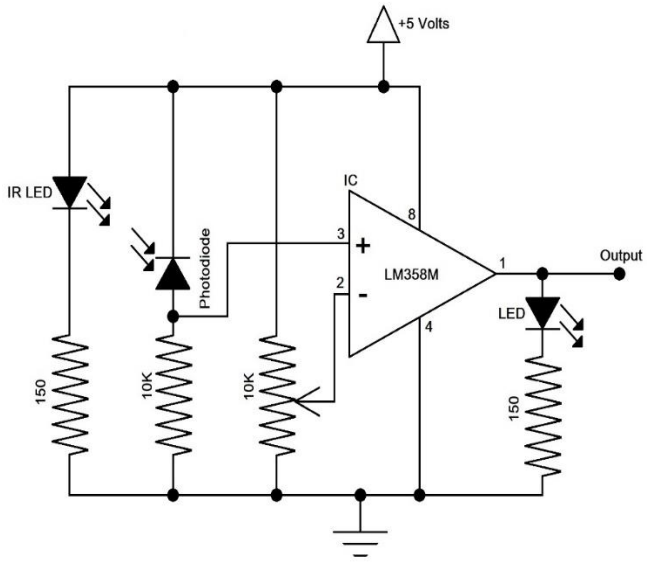

Fig 5 IR Sensor Circuit Diagram

IV. WORKING MODEL

The working of this system consists of three modules:

AMBULANCE CLEARANCE

In this model we have used RFID reader, RFID tag, ARDUINO, RF transmitter and receiver system for automatically controlling the traffic signal when the emergency vehicle is detected. Initially the traffic signal works normally. When an emergency vehicle crosses the path the RFID tag positioned at the vehicle get driven by the antenna that enables to receive electromagnetic power from the RFID reader. The RFID reader detects the ID and transmits the information through wireless communication using the RF transmitter and receiver system operating at the range of 30 kHz & 300 GHz. On receiving the information at the receiver system, the ARDUINO controller controls the traffic light. By this way the traffic light turns to green signal until the ambulance passes the traffic junction. Thus the emergency vehicle can pass the junction without any delay and could reach the hospital on time.

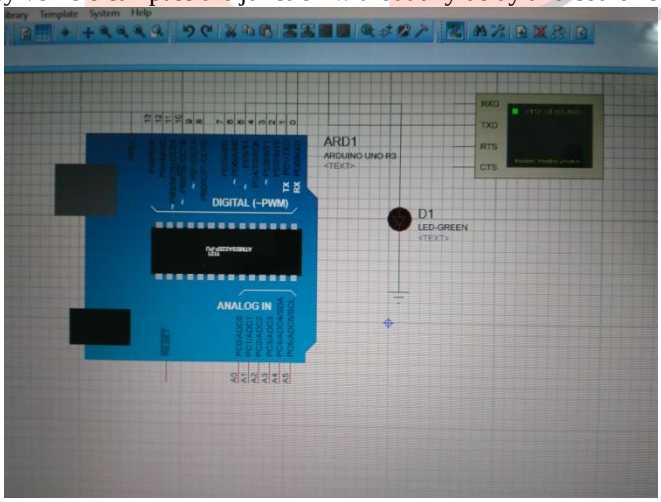

Fig 6 Ambulance not detected. RF TX does not transmit signal

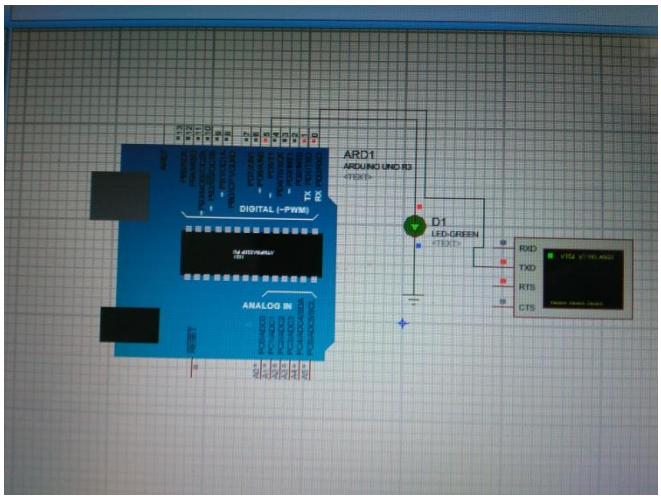

Fig 7 Ambulance detected. RF TX transmits signal

STOLEN VEHICLE DETECTION

In this part for detecting the stolen vehicle we have used RFID reader, RFID tag, GSM SIM900.The intimation about the stolen vehicle is given to the control room. When that vehicle passes that path the RFID tag which is present in that particular vehicle is sensed by the RFID reader connected to the ARDUINO controller. This information about the stolen vehicle is sent by GSM SIM900 to the control room via SMS. Thus the stolen vehicle can be easily tracked and identified for further action

CONGESTION ESTIMATION

This project includes the estimation of congestion in a signal junction. This main aim is to provide the driver of the emergency vehicle with congestion information way before he reaches the signal so that he can decide whether he can take that path or any other alternate path. The driver will be intimated with the information in the form of SMS through GSM.

In order to find congestion two IR sensors are used. Let us take it as Sensor A and Sensor B. The system detects in number of vehicles that is present in the region between these two sensors. When a vehicle go past Sensor A the output goes high which is sent to the Arduino control board. The count is incremented whenever a vehicle passes through Sensor A. Sensor B is placed at a distance from Sensor A (depending on the requirement). When the vehicle crosses sensor B the count is decremented. In this way, whenever a vehicle enters the sensor region, count is incremented and whenever a vehicle leaves the sensor region, count is decremented. This will give the exact number of vehicle present near the traffic signal. This count is sent to the ambulance driver in the form of SMS through GSM. The congestion information is not sent to all the ambulances but, to the ambulances that are detected in that region (RFID reader which is placed few hundred meters away from the signal).

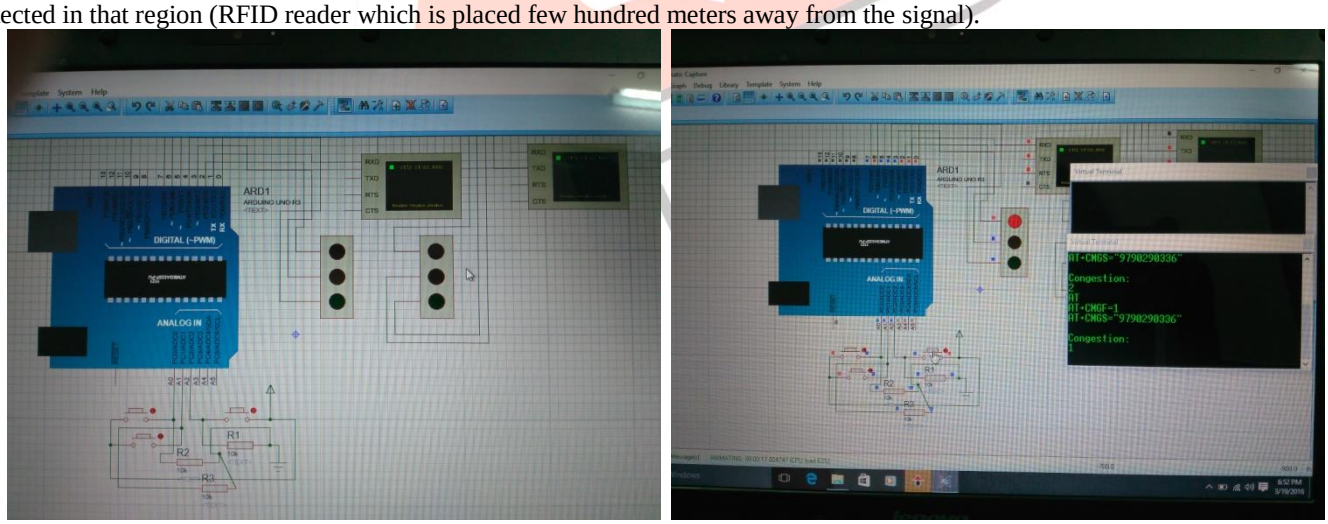

Fig 8 Estimation of congestion

V. CONCLUSION AND FUTURE SCOPE

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 RF Transmitter and Receiver module. This helps to detect the ambulance few hundred meters before the signal junction. This is of greater advantage because the ZigBee module is a short range device, so the ambulance has to be close to the signal junction to be detected. 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 won't go green. By placing RFID reader and RF transmitter in the range of few hundred meters away from signal the ambulance can be easily detected without any hurdle.

This project can be further improved by setting priority to the ambulances. For example, in 4 roads or 3 roads junction if more than one ambulance arrives at the junction from different sides then first priority can be given to the ambulance which is present in the

road with lesser congestion and so on. Otherwise the ambulance which is reaching the junction first can be given first priority and so on.

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