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Traffic Signal Control System With Ambulance Assistance

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Abstract: *Traffic congestion problem is a phenomenon which contributed huge impact to the transportation system in our country. This causes many problems especially when there are emergency cases at traffic light intersections which are always busy with many vehicles. A traffic light assistance system is designed in order to solve these problems. This system was designed to be operated when it received signal from emergency vehicles based on radio frequency (RF) transmission and used the Programmable Arduino Atmega 328 microcontroller to controls the LEDs used in the traffic signals. The use of hazard LED in the system which helps the emergency vehicles to pass the traffic easily. This system will reduce accidents which often happen at the traffic light intersections because of other vehicle had to huddle for given a special route to emergency vehicle. As the result, this project successful analyzing and implementing the traffic assistance system for emergency vehicles.*

Keywords: *Traffic congestion, Arduino, Traffic light assistance system, Hazard LED.*

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I. Introduction

The aim of this project is**,** India is one of the most populous Country in the World and is a fast growing financial prudence. It is seen that terrible road congestion problems in cities. Infrastructure growth is slow as compared to the growth in number of vehicles, due to space and cost bounds .Also, Indian traffic is non-lane based. Moreover, the situation is getting worse when emergency vehicles have to wait for other vehicles to give way at intersections with traffic lights. This causes a delay of time and may affect the emergency case. Besides, the collisions with other vehicles from other direction might occur at intersections when emergency vehicles had to override the red traffic lights. All these difficulties faced by emergency vehicles can be avoided using this traffic light control system based on radio frequency transmission. It needs a traffic control solutions, which are different from the other Countries. The system will reduce accidents which often happen at the traffic light intersections because of other vehicle had to huddle for given a special route to emergency vehicle. As the result, this project successful analyzing and implementing the traffic assistance system for emergency vehicles.

II. Literature Survey

The traffic light system designed by **Levi L. Rose** [1] used only for emergency vehicle. Sensor is used to transmit signal that has been installed in every emergency vehicle to the receiver which has been placed at every traffic light intersection. The traffic light system designed by **M. R. Smith** [2] provided early warning of the approaching an emergency vehicle to find a way out from traffic congestion and lead the emergency vehicle to the destination. The traffic light system designed by **Salim Bin Islam** provided a design and development of a microcontroller based intelligent traffic control system. He proposed a new intelligent traffic control system that is to control the traffic system through traffic signal on the basis of current traffic density.

Before the the invention of Ardunio the PIC Microcontroller board was introduced by general instruments in 1985 was one of the most used toll for the electronic enthusiasts. The PIC microcontroller board was preferred because of it's a speed and ease of its programming through simple language including PBASIC.

W. L. Mitchell has designed traffic light control system [3] which had overcame the traffic congestion problem and provided an emergency path for the emergency vehicle.

W. E. Brill introduced an emergency vehicle detection system [4] for alerting a driver of an approaching emergency vehicle includes a sound signal-producing unit mounted on an emergency vehicle, a sound signal detection unit mounted on a non-emergency vehicle, and a display unit remotely located on the non-emergency vehicle.

III. HARDWARE REQUIREMENT'S

LED
SMPS
RF Transmitter module and Receiver module
Ardunio programmer card with IC
Atmega 328

3.1 LED

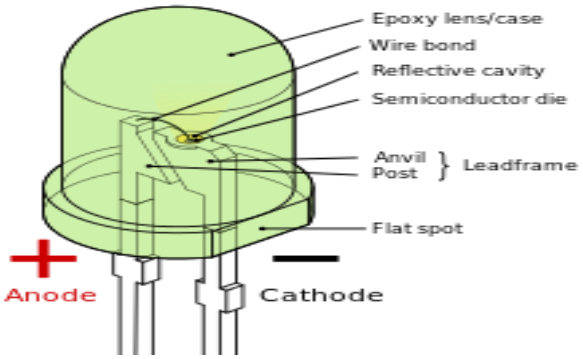

Fig 3.1 LED Structure

A light emitting diode (LED) is essentially a pn junction diode. The LED lighting is a light that uses LEDs as a source of lighting and most illumination comes from an incandescent or fluorescent light bulb. This is very different from the traditional one.LEDs can be installed into traditional lights an used like most other light bulb. The LED has to be structured so that the photons generated from the device are emitted without being reabsorbed. One solution is to make the p layer on the top thin, enough to create a depletion layer. There are different ways to structure the dome for efficient emitting.

APPLICATIONS
1. Devices, Medical applications, Clothing, Toys
2. Remote controls (TV's, VCR's)
3. Lighting
4. Indicators and Signs
5. Optoisolators and Optocouplers

3.2 SMPS (Switched mode power supply)

Switched Mode Power Supply (SMPS) is the most prevailing architecture for DC power supply in modern systems, primarily for its capability to handle variable loads. Apart from efficiency the size and weight of the power supplies is becoming a great area of concern for the Power Supply Designers. In this thesis an AC to DC converter SMPS circuit, having a power MOSFET for switching operation and a PWM based Feedback circuit for driving the switching of the MOSFET, is designed and simulated in NI MULTISIM circuit design environment. Further the same circuit is Hardware implemented and tested using NI ELVIS Suite.

Fig 3.2 SMPS

In this design the line voltage at 220V/50Hz is taken as input, this voltage is stepped down, rectified and passed through filter capacitor to give an unregulated DC voltage. This unregulated voltage is chopped using a MOSFET switch, driven by PWM feedback signal, to control the output voltage level.

The main advantages are
1. The switch mode power supply has a smaller in size.
2. The SMPS has light weight.
3. It has a better power efficiency typically 60-70%.
4. It has a strong anti interference.
5. SMPS has a wide output range.
6. Low heat generation in SMPS

3.3 RF Module (RF Transmitter and Receiver Module)

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications .Next, RF transmission is more strong and reliable than IR transmission.

RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

3.3.1 RF Transmitter and Receiver module

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.

The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs.

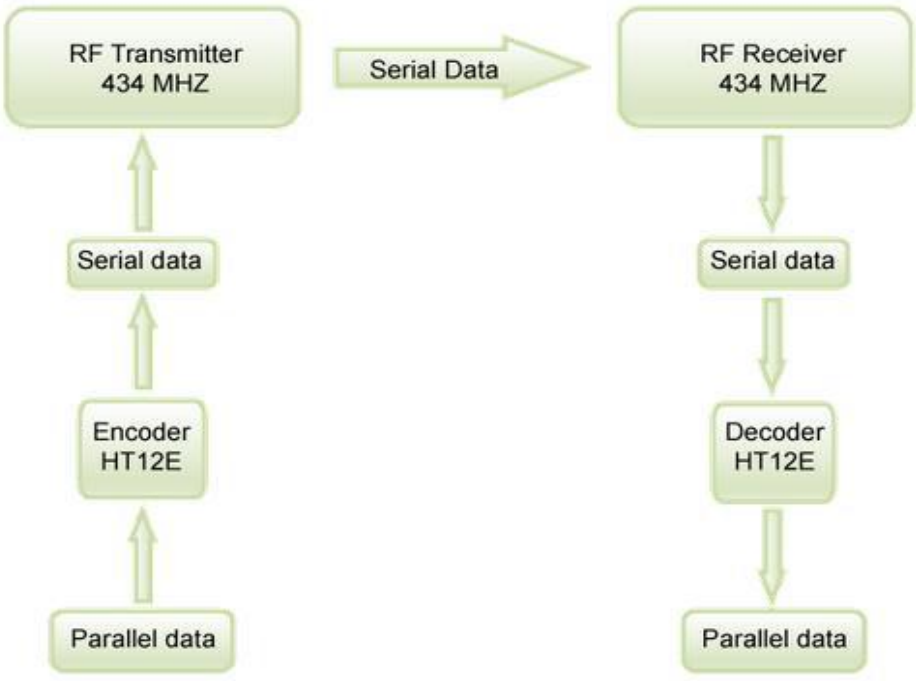

Fig 3.3.1 RF Transmitter and Receiver Encoding & Decoding Module

3.3.2 HT12E

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format.

Fig 3.3.2 HT12E

HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

3.3.3 HT12D

HT12D IC comes from HolTek Company. HT12D is a decoder integrated circuit that belongs to 212 series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 212 series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format.

Fig 3.3.3 HT12D

HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin. HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

3.4 ARDUINO

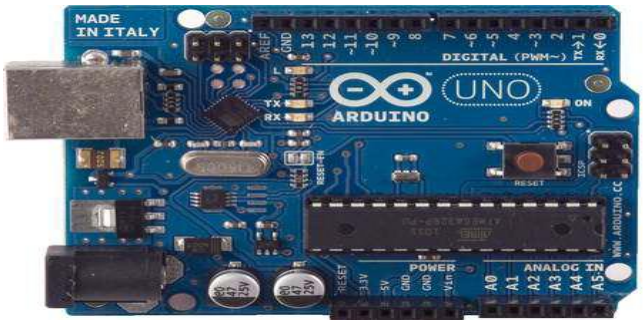

Fig 3.4 Arduino UNO Board

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. The Arduino project was started in Italy to develop low cost hardware for interaction design. An overview is on the Wikipedia entry for Arduino.

The Arduino programming language is a simplified version of C/C++. If you know, C programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino is that you can create a control program on the

host PC,download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery,the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

3.4.1ARDUINO Hardware

The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labeled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches.

Each digital pin can sink or source about 40 mA of current. This is more than adequate for interfacing to most devices, but does mean that interface circuits are needed to control devices other than simple LED's. In other words, you cannot run a motor directly using the current available from an Arduino pin, but rather must have the pin drive an interface circuit that in turn drives the motor. A later section of this document shows how to interface to a small motor.

Fig 3.4.1 ARDUINO Input-Outout pin board

3.5 ATmega328 Microcontroller

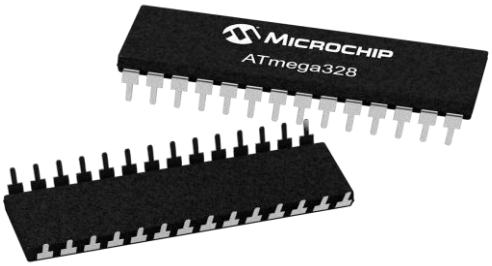

Fig 3.5 ATmega328 Microcontroller

The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6- channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run.

IV. Figures and Tables

4.1 PROPOSED SYSTEM

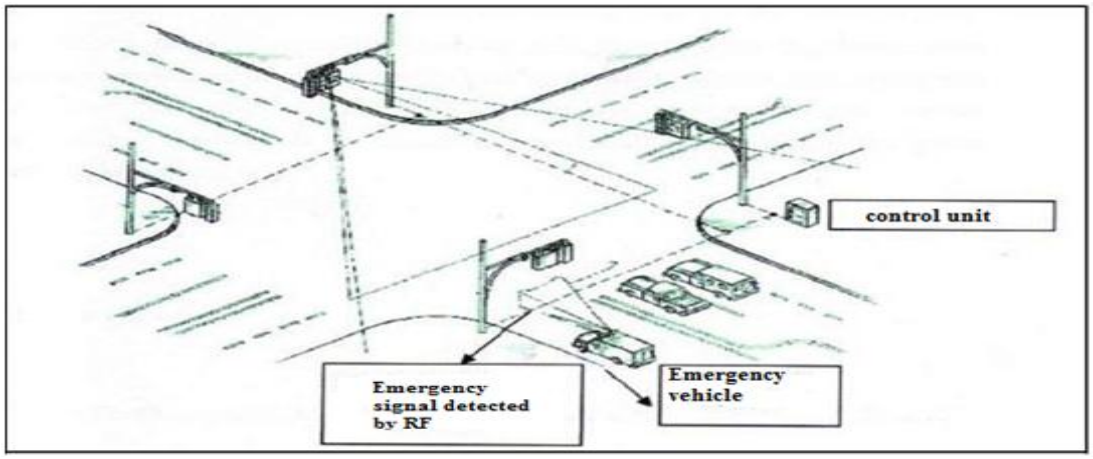

Figure.4.1 Proposed System

Many countries in the world are facing the problem at traffic light intersection that causes accident between emergency vehicle and other public vehicle. The emergency vehicles such as ambulances are difficult to reach the destination on time because of the traffic congestion. So we are proposing a system which we can overcome the hectic worst conditions caused by Traffic congestion.

4.2 PROJECT BLOCK DIAGRAM

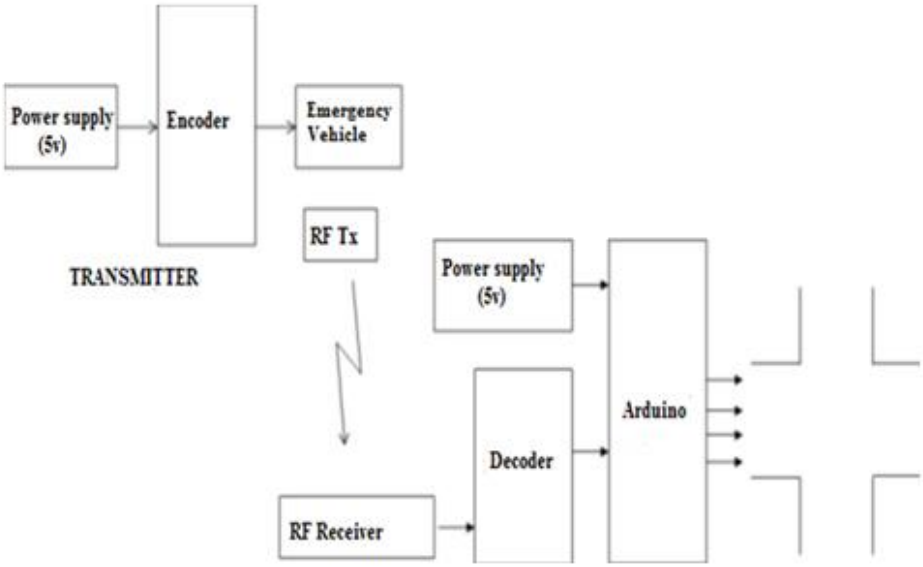

Figure.4.2 Block Diagram

4.3 WORKING

This project uses an ardunio UNO as a microcontroller. Ardunio gets one input from RF sensor which are set so that they receive signal from emergency vehicle coming towards the road. The RF readings are logged into ardunio memory for the first 7 seconds. After the initial 7seconds, the readings are compared to the set levels so that the output delay for LED is calculated. This happened for the one main control lines for the signal output. In traffic signal system, the green light allows traffic to proceed in the direction denoted. The amber (yellow) light warns that the signal is about to change to red and also indicates ready before signal is about to change to green. The red signal prohibits any traffic from proceeding. A flashing red indication is treated as a stop sign. Here we are adding a new blue traffic signal light called hazard light (It indicates emergency situation to both the traffic and pedestrians), which is triggered only when the emergency vehicles comes 100m far from the traffic signal. Here we are implementing a system in the existing traffic signal which is having four lanes.If the emergency vehicle comes through lane1, the ambulance siren indicates the free right vehicles in the traffic

have to move on to the left side. So that the passing of emergency vehicle is more easier. If in case we are getting a block before the traffic signal we have a free passage with a boom barrier on the dividers of the road which opens only for the emergency vehicles

4.3.1 Encoder

Encoding is a popular way of securing data and information; changing the format so that it can only be read by someone with the appropriate decoding equipment or software. An encoder is a device or entity that will encode information in a particular way, compressing, converting or securing it into a different format.

4.3.2 Decoder

The encoding process essentially scrambles all the pieces of the data up and they are then put back together at the other end by the decoder. A decoder is the device or entity that will remove the information from Traffic Light.

4.3.3 RF Transmitter and Receiver Module

A radio frequency transmitter and receiver module will be used in the circuit to implement wireless communication for this project.

4.4 PROJECT FLOW CHART

Complete design must be finalized before going to the end of all the processes in the project. The design system will be rechecked to ensure the design is valid for this project to be run successfully.

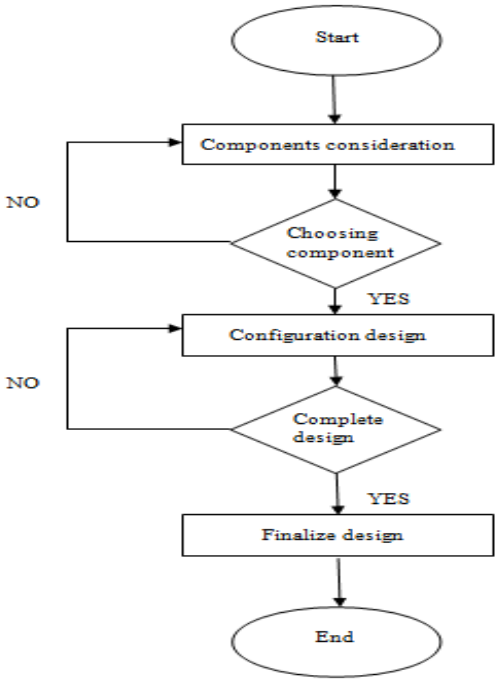

Fig 4.4 Project flow chart

V. Result/Finding And Discussion

This project is divided into two parts of electronic circuit. First part is the RF transmitter circuit which can override the sequence of the traffic light. Meanwhile, the second part is the RF receiver and the microcontroller circuit that generate the traffic light sequences for a four-traffic lights intersection.

RF Transmitter Circuit

The transmitter circuit consists of a RF transmitter module, an encoder, a set of four push-on switch and a power supply. The connection of the circuit is shown below.

Push ON-Switches

A set of four push-on switches is there in the RF transmitter circuit. Each switch labeled with number 1, 2, 3, and 4 to indicate which traffic light at the intersection. One of these switch need to be push (switch on) in order to trigger the emergency sequence mode of the traffic hazard light intersection.

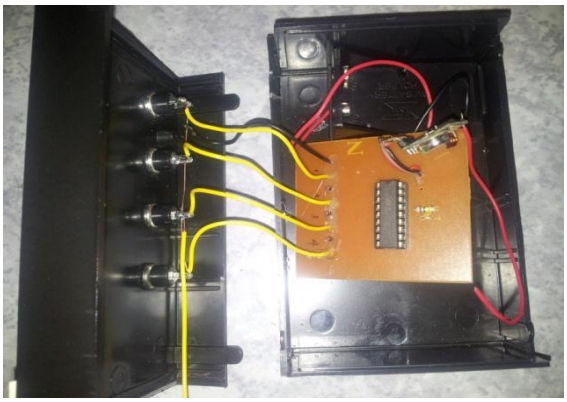

Fig5.1 RF Transmitter Circuit

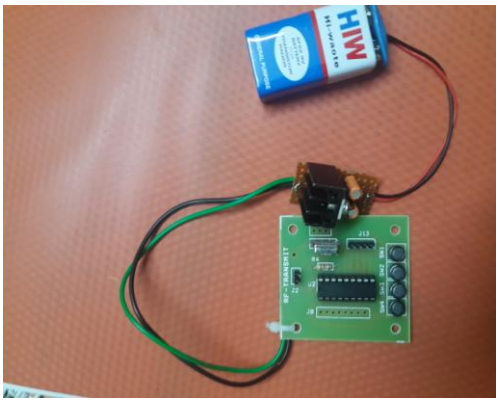

Fig5.2 Four push ON Switch

RF Receiver Circuit

The RF receiver circuit consists of a RF receiver module, a decoder, relays and LEDs. A LED is connected to pin14 of the decoder to indicate that the RF transmitter is in the range with the RF receiver. A LED is connected to each relay to indicate which traffic light has been triggered by the signal transmitted from the RF transmitter.

Fig 5.3 RF Receiver Circuit

Fig 5.4 Traffic Light Circuit

Traffic Light Circuit

A circuit of four traffic light intersection has been designed for this project using a PIC 16F877A microcontroller [10]. The sequence of the traffic lights is generated by the PIC 16F877A. The input from the RF receiver circuit has been used to override the sequence.

RESULT

The system working has successfully designed and verified from the above truth table, with thehelp of triggered emergency hazard light and red light in the traffic signal we managed to control emergency vehicle 100m far from the traffic signal.

LED's	LANE 1	LANE 2	LANE 3	LANE 4
GREEN	0	0	0	0
YELLOW	0	0	0	0
RED	1	1	1	1
BLUE	1	1	1	1

Fig 5.5 Resultant Truth Table

VI. Conclusion

As a conclusion, this project have achieved the main objective stated earlier which is analyzing and implementing the wireless communication; the radio frequency (RF) transmission in the traffic light control system for emergency vehicles. The prototype of this project is using the frequency of 434 MHz compared to the range of about 3 kHz to 300 GHz of frequency which have been reserved for the RF theoretically. Besides, the functionality of this project proved that the other objectives have been successfully attained which are designing an emergency sequence mode of traffic light when emergency vehicles passing by an intersection and changing the sequence back to the normal sequence before the emergency mode was triggered. The sequences for this project have been developed using the programming in the Arduino. In future, this prototype system can be improved by controlling the real traffic situation and the study can be done by investigating the length, reception and transmission issue for the system to be operated with this traffic light.

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