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TRAFFIC CONTROL SIGNAL BASED ON DENSITY WITH EMERGENCY OVERRIDE

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Abstract: **Traffic light control systems are widely used to monitor and control the flow of automobiles through the junction of many roads. They aim to realize smooth motion of cars in the transportation routes. This paper is designed to develop a traffic signal based on traffic density and also innovative control to clear the traffic for ambulance. During normal situation, the signal timing changes automatically by sensing the density of vehicles. Conventional traffic light system is based on the fixed time concept allotted to each slots. The proposed system uses and PIC16F877A micro controller (Harvard architecture family) interface with sensors that change the junction timing automatically to avoid unnecessary waiting of drivers. IR sensors are used in this paper to detect the density of the traffic. The Bluetooth operated by Android device override the set timing and give green signal in the desired directions whereas blocking other roads by red signal. Thereby providing traffic clearance for emergency vehicles.**

Keywords: **Traffic light control systems, automobiles, transportation routes, traffic signal, emergency vehicles.**

1. INTRODUCTION

Traffic congestion is a severe problem in many modern cities around the world. Traffic congestion has been causing many critical problems and challenges in the major and most populated cities. To travel to different places within the city is becoming more difficult for the travelers in traffic. Due to these congestion problems, people lose time, miss opportunities, and get frustrated. Traffic congestion directly impacts the companies. Due to traffic congestion there is a loss in productivity from workers, trade opportunities are lost, delivery gets delayed, and thereby the costs goes on increasing.

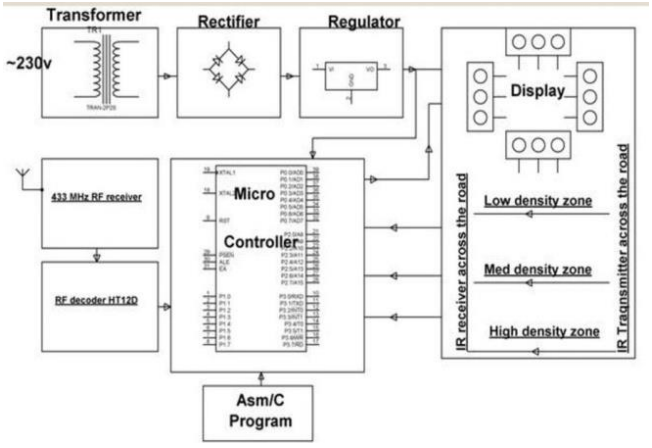
To solve the congestion problems, we have to build new facilities and infrastructure but at the same time make it smart. The only disadvantage of making new roads on facilities is that it makes the surroundings more congested. So for that reason we need to change the system rather than making new infrastructure twice. Therefore many countries are working to manage their existing transportation systems to improve mobility and safety. The paper uses simple electronic components includes LED as a traffic light indicator and microcontroller for changing signal timing automatically. As the port pin of microcontroller is high the LED's are automatically ON and OFF. This paper uses IR sensor which is placed across either side of the road in order to measure the traffic density. Bluetooth operated by Android device helps to decrease the possibility of stucking of emergency vehicles in the traffic jam. Thus the conventional traffic control system need to be upgraded to reduce traffic jam and waiting time of passengers.

2. LITERATURE REVIEW

A green wave system which is used to provide the clearance to any emergency vehicle by turning all the red lights to green on the path of the emergency vehicles, for this reason providing a complete green way to the desired vehicle. A "green wave" is the synchronization of the green phase of traffic signals. With a green wave setup, a vehicle through a green signal will continue to receive green signals as it travels down the road. Advantage of the system is that GPS inside the vehicle does not required additional power. The biggest disadvantage of green waves is that, when the wave is

disturbed then the disturbance can cause traffic problems that can exacerbated by the synchronization. In such cases, the line of vehicles in a green wave grows in size until it becomes too large and some of the vehicles cannot reach the green lights in time and vehicles must stop. This is called over-saturation.

3. BLOCK DIAGRAM

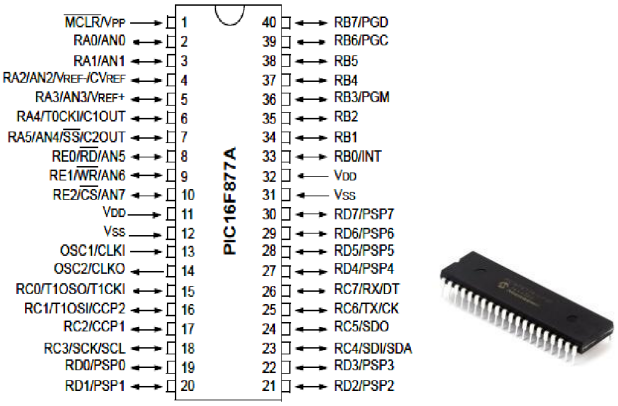


HARDWARE REQUIREMENTS:

This paper uses the hardware devices includes PIC microcontroller unit, IR transmitter and Receiver, RF transmitter and receivers, sensors. The briefly explanation about the hardware elements are discussed below.

1. Microcontroller unit

The paper uses PIC 16F877A Microcontroller which is the family of Harvard Architecture microcontrollers made by Microchip, is an integrated circuit (IC) consisting of a simple Central Processing Unit (CPU), RAM, ROM, and EEPROM memories. It contains also clock, timers, A/D converters, and five inputs/output ports. On the other hand, its 35 instructions make it easy and simple to program. Moreover, its power consumption is low and it has a wide operating voltage range (2V to 5.5V) while its input clock operates at up to 20MHz. The PIC microcontroller consist of 5 bidirectional input/output ports and it can be classified as: A is a 6-bit general purpose port which can be also classified as Analog to Digital converter (A/D); B,C and D are 8 bit general purpose ports, while port E is only 3 bit port. These ports are used to input data that may be generated from keypad, sensors, push button, switch, etc. or to present command signals or data to output devices such as LCD, 7 segment display, LED, motor driver, relay, etc.

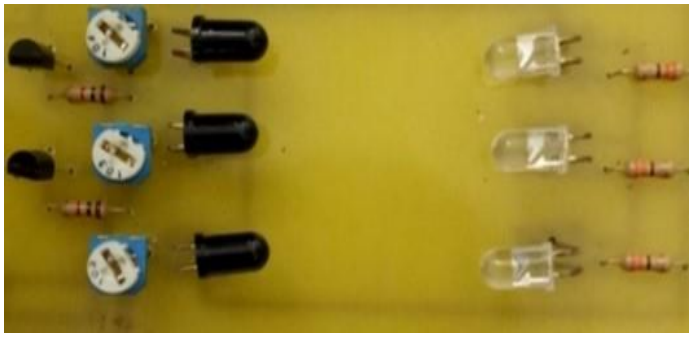


Each port has its own associated TRIS Register. The configuration of this register used to select data transfer direction between the microcontroller and the difference peripheral devices through the ports. When a TRIS Register is cleared, its corresponding port acts as output, otherwise is operates as input.

On the other hand, many microcontroller port pins can be extended to perform incremental functions and operates specific purposes. The PIC microcontroller is backed up by Universal Synchronous Asynchronous Receiver Transmitter (USART) module that permits the PIC to communicate with the range of devices.

IR-TRANSMITTER:

The symbol and operation of IR Transmitter is very similar to ordinary LED IR Transmitter generates infrared signals. It is made up of Gallium Arsenide. If the current pass to the Gallium Arsenide, then it will produce IR rays. The emitted ray from IR Transmitter is directly proportional to the current flow through the sensor. It can withstand upto 35 MA. For shortest distance 5MA have been used. If the distance is more then it need to be increase the current flow to the transmitter.

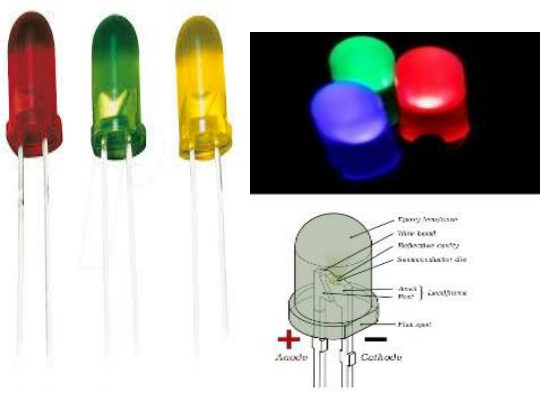


IR-RECEIVER:

IR Receiver having the reverse characteristics of IR transmitter. It will conduct as long as the rays fall on it. The circuit is mainly used for counting application since IR can be used only during proper alignment position.

LED DISPLAY:

LEDs are semiconductor devices. Like transistors other diodes, LEDs are made up of silicon. What makes an LED give off light there are small amount of chemical impurities like Gallium, arsenide, Indium and Nitride are added to the silicon.



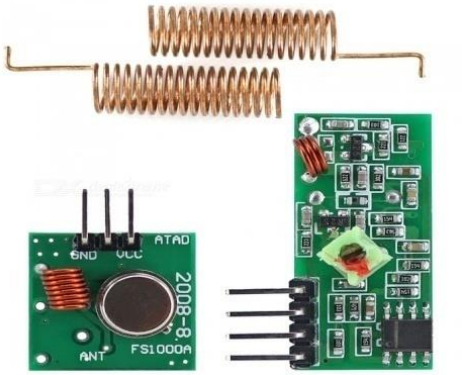
When current passes through LED, it emits photons. Normal light bulbs produce light by heating a metal filament until its white hot. LEDs produce photons directly not through heat; they are more efficient than incandescent bulbs.

RF-TRANSMITTER

The transmitter will generate the signal which is then encoded with the help of an encoder. This is done to increase the security. Since RF signal moves in every direction they need to be supported so that the loss of energy is reduced. The modulator is used to bind the RF signal with the carrier signal. Once the signal is bounded with a carrier signal it is then amplified and transmitted through the antenna. The signal travels in all direction and then will be caught by the receiver with same crystal frequency. In this system, the matching crystal frequency of 433MHz is used. When the signal is transmitted by the RF TX of 433MHz it is caught by the receiver of 433MHz. hence security is improved.

RF-RECEIVER

The RF receiver will perform the reverse operation as of RF transmitter. First the receiver will capture the signal of matching crystal frequency. It is then amplified since the signal loses energy due to interference. This amplified signal is demodulated to remove the carrier signal. Here also once again amplitude shift key is used. Once the original signal is regained, it is processed through decoder which decodes the fragments from the signal.



SOFTWRE FEATURES:

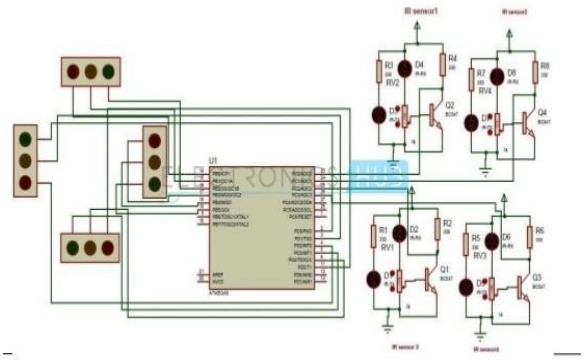
Slave default baud rate: 9600, data bits: 8, stop bit:1, parity: No parity. PIO9 and PIO8 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1 time /2s in interval, while disconnected only blue led blinks 2 times /s. permit pairing device to connect as default. Auto-pairing PINCODE: ”1234” as default. Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

SOFTWARE IMPLEMENTATION

Software used to design, program and configure the hardware. Keil an ARM company makes C compliers, macro assemblers, real time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/cortex-M Compilers are programs used to convert a high level language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for others microprocessors. 3, XC16x/C16x/ST10, 251 and 8051 MCU families.

SOFTWARE COMPONENTS

PROTEUS SOFTWARE FOR DESIGN CIRCUIT IMPLEMENTATION



I.e. the programs written in one of the HLL like ‘C’ will compile the code to run on the system for a particular processor like x86.

WORKING PRINCIPLE:

In normal conditions, i.e. when there is no vehicle on the road, the IR transmitter or the IR LED transmits IR light which is received by the photodiode, with starts conducting. As the photodiode conducts, the corresponding transistor also conducts giving an output of low logic signal to the microcontroller. The same principle works for all other IR sensor-transistor arrangement. The microcontroller makes each LED glow for a fixed amount of time. Now if there is presence of vehicles, the communication between the IR transmitter and the receiver is interrupted, i.e. the photodiode receives less or no amount of light from the IR diode and accordingly the base current to the transistor reduces eventually making the conductor go to off condition. This causes an output of high logic signal from the transistor, to the microcontroller. The microcontroller accordingly changes the glow time of the green LED of the corresponding junction to a higher value. Thus as number of vehicles increases, the green light glows for more time, allowing a quick flow of traffic from the junction side. Thus dynamic time control is achieved based on the traffic density.

The paper uses the IR interruption concept for generation logic states to the input of the MC. To achieve the same a number of IR diodes are used facings photodiodes.

II. OVERVIEW OF DENSITY BASED TRAFFIC CONTROL SYSTEM

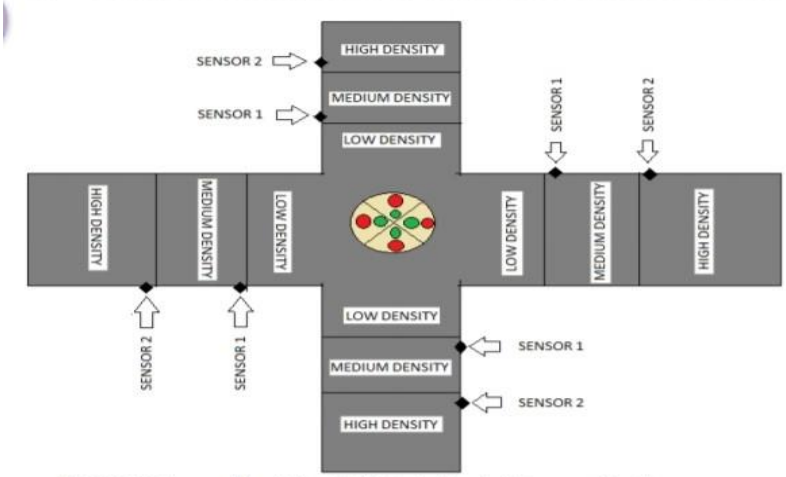


Fig. Overview diagram of Density Based Traffic Control Signal with Emergency Override

While the IR light falls on the photodiode increasing the bias voltage. The voltage at the non-inverting terminal will be greater than that of inverting terminal and the led connected to the comparator glows continuously. Whenever there is obstacle between the IR led and photodiode the resistance of the photodiode increases to a high value and the voltage at the non-inverting terminal will be less than that of inverting terminal and the output obtained is of negative logic. The led connected to the comparator turns of indicating that there is a vehicle passing the road. Depending on the number of vehicles passing the time required to turn the green signal also increases. Whenever an emergency vehicle and these causes to clear the way to the emergency vehicle. Logic high sensed by the MC input changes the green ON time to a higher value for allowing more vehicles to pass through. After sometime in case any other way gets more logic high, the sequential timing gets automatically increased for that way. Based on the IR interruption the green ON time increases, thus more the vehicle longer will be the green signal time. Thus dynamic time control is achieved based on the traffic density.

DENSITY BASED TRAFFIC CONTROL SYSTEM-OVERVIEW

MEASUREMENT OF DENSITY:

The density of traffic is measured by IR sensor which are placed either side of roads. Two IR sensors are used for each road to determine the traffic condition. The road is divided into three sections to know the low medium, and high traffic level to which predefined time intervals or assign to achieve time efficient traffic control.

Low density zone:

To show low traffic level no sensor is used, no input to microcontroller from sensor assumed as low traffic level and minimum time interval is assigned.

Outdoor range measurements:

RANGE	DATA TRANSMIT
5m	Yes
10m	Yes
15m	Yes
20m	Yes
25m	No
30m	No
35m	No

Indoor range measurements:

RANGE	DATA TRANSMIT
5m	Yes
10m	Yes
15m	Yes
20m	Yes
25m	Yes
30m	Yes
35m	No

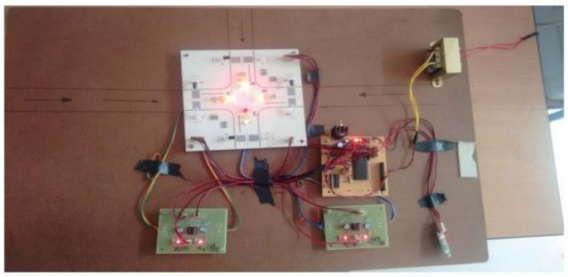
Medium density zone:

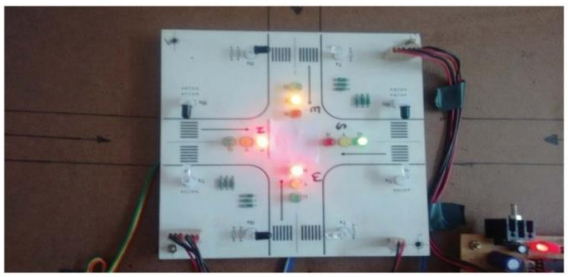
Medium traffic level shown using sensors placed on second section of road. When these sensors give output to microcontroller indicates medium traffic level.

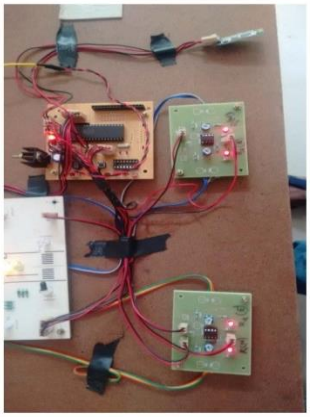
High density zone:

High traffic level measured by using two sensors mounted on road. When both the sensor give output to microcontroller it means that the road is in high traffic. Then the signal is send to the PIC microcontroller unit.

Output images:







ADVANTAGES:

- Avoids wastage of time due to traffic.
- Fully automatic.
- Low power consumption.
- It provides the easy access in the traffic light.
- Easy convenience to handle.

4. RESULTS

From the series of experiments we have conducted the following results were obtained:

- Fuel is saved to about 70% compared to normal timer based traffic control.
- Traffic can be cleared without any irregularities.
- Time can be shared evenly for all intersections.
- Effective time management.
- By using this microcontroller IC we can create many more control to the application.

5. CONCLUSION

The scope of the paper is to provide clearance to the emergency vehicles and to decrease the occurrence of traffic jams. The proposed system provides time efficient system by avoiding unnecessary waiting time for drivers at traffic junctions due to density based control. It is a priority based system as it provides emergency override to avoid possible damage.

Finally, the traffic light controller could be powered by solar power panels to reduce grid electricity consumption and realize green energy operations.

FUTURE SCOPE

In future it will give traffic free environment to metropolitan cities and will be helpful for traffic control and accident reduction.

- Real time traffic information update on traffic department website.
- Automatic generation of E-CHALLAN
- Automatic tracking of traffic laws defaulters.
- Implementation of above system at night using thermal cameras.
- Detection of other emergency vehicles.

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