ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014

Design of an Intelligent Auto Traffic Signal Controller with Emergency Override

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Abstract- ***The main objective of this project is to design an intelligent auto traffic signal control system. Traffic congestion is one of the major issues to be considered.Generally Vehicular traffic intersects at the junctions of the road and are controlled by the traffic signals.Traffic signals need a good coordination and control to ensure the smooth and safe flow of the vehicular traffic.During the rush hours, the traffic on the roads is at its peak. Also, there is a possibility for the emergency vehicles to stuck in the traffic jam.Therefore; there is a need for the dynamic control of the traffic during rush hours. Hence,I propose a smart traffic signal controller.The proposed system tries to minimize the possibilities of traffic jams, caused by the traffic lights, to some extent by clearing the road with higher density of vehicles and also provides the clearance for the emergency vehicle if any. The system is based on the PIC 16F877A micro controller, IR sensors and Radio Frequency Identification (RFID) technology. The code for this project is compiled in high tech C compiler and the simulated with Proteus software.***

Index Terms**-Emergency vehicle clearance, Higher density, IR sensor, Micro controller, RFID Technology.**

I. INTRODUCTION

Traffic congestion is one of the major problems, the world is facing today. Traffic monitoring and controlling is a difficult task. The aim of the traffic research is to optimize the flow of vehicular traffic and goods. The flow of the traffic constantly changes depending on the time of the day, day of the week and time of the year. At times, road work and accidents further influence the complexity. Hence, traffic light optimization is a complicated process. Even for single junctions there might be no obvious solution and the problem becomes even more complex for the multiple junctions, as the state of one light in one junction directly influences the flow of traffic towards many other lights.

With the ever increasing vehicles on the road and the number of road users, the limited resources provided by current infrastructure lead to ever increasing travelling times.Hence, an intelligent control of traffic is a important issue to be considered. The Traffic Monitoring Authority need to find new methods of overcoming this problem like construction of new roads, flyovers etc., and also development of sophisticated traffic monitoring and control systems. One way to improve the traffic flow and safety of the current transportation system is to apply automation and intelligent control methods to roadside infrastructure and vehicles.

There are several models for traffic simulation. In our research, we have developed a cost effective system using Radio frequency identification (RFID) technology, IR sensors and latest high speed micro controller [1] to achieve the desired results. The primary objective of this proposed project is to identify the road with the higher density of vehicles and identify the road with emergency vehicle if any. Traffic jams may arise due to large red light delays which are hard coded and is independent of traffic [2]. The proposed system tries to reduce the traffic jams to some extent. The system is based on the microcontroller[3].PIC 16F877A microcontroller is used in the proposed system .The system contains IR transmitter and IR receiver which are mounted on the either sides of roads respectively .The IR system gets activated whenever a vehicle passes on road between IR transmitter and IR receiver. IR system is controlled by the micro controller. Conventional technologies for identifying the emergency vehicle use some image processing systems. But these image processing systems are affected by the bad weather conditions like wind, rain, fog, etc., during the bad weather conditions, the image received by the camera is distorted by noise and it is not clear for the system to identify the vehicle. Thus, we have developed a proposed system using RFID tag and RFID reader [4-5]. The advantage of RFID is that it is a cost effective system and it provides uninterrupted communication even in bad weather conditions. The proposed system is compiled by using High-tech C compiler [6] and circuit making is done through Proteus software.

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II. BLOCK DIAGRAM

The basic block diagram of the proposed system is illustrated in Fig 1.The heart of the system is the PIC 16F877A micro controller. The proposed system also comprises of a power supply unit, a RFID reader, a RFID tag, an IR transmitters, an IR receivers, light emitting diodes (LEDs) and liquid crystal display (LCD).

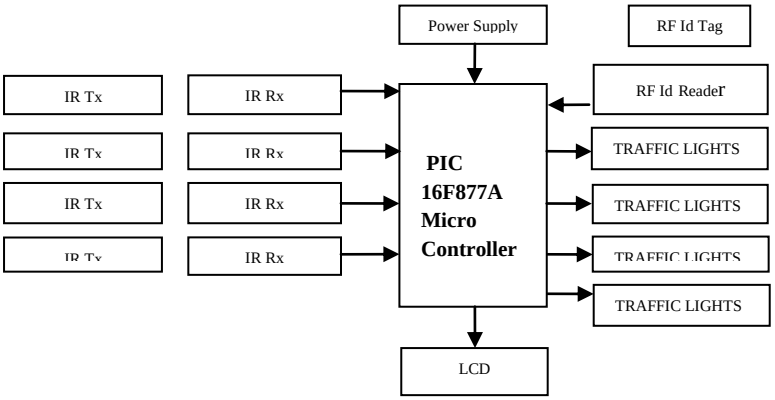

Fig.1: Basic block diagram of an intelligent auto traffic signal controller.

PIC16F877A micro controller is a 40 pin, CMOS, Flash based with 256 bytes of EEPROM data memory ,a frequency of 20Mhz and 200 ns time period for instruction execution .It consists of 2 comparators,3 timers,5 I/O ports, synchronous serial port, USART/SCI, parallel slave port, , self programming ,an LCD, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions etc., The power supply unit is one of the most important one. This power supply unit shown in Fig 2 converts 230V AC to 5V DC .Power supply unit consists of a transformer, bridge rectifier, voltage regulator and capacitors.

RFID tag is a micro chip combined with an antenna. A passive RFID tag is a device which doesn't have a battery by its own, it receives the energy from the RFID reader. In this proposed project, RFID tag is embedded inside the dash board of the vehicle during the manufacturing of the vehicle such that it is invisible to human eyes. RFID reader is a device that is used to interrogate the tag. Reader also contains a antenna which emits the radio waves. In the proposed system, reader is installed on one road excluding the other three roads. The reader reads the unique identification number (UID) present on the tag, whenever tag enters the frequency range of reader and sends the unique identification number to the micro controller.

In the proposed system, IR transmitter is made of 555 timer.555 timer acts a astable multi vibrator. The transmitter section consists of a 555 timer IC functioning in astable mode. The output from IR transmitter is fed to an infrared LED, which limits its operating current. This astable multi vibrator which is acting as a IR transmitter, provides a square wave output with a frequency of 38 kHz at 50 per cent duty cycle, which is necessary for the infrared detector/receiver module. The IR receiver section consists of an infrared receiver module, a 555 mono stable multi vibrator, and a LED indicator. Upon receiving the infrared signals from the IR transmitter, 555 timer (mono stable vibrator) turns on and remains in that state as long as the infrared signals are received from the IR transmitter. When the signals are interrupted from the IR transmitter, the mono goes off after a certain time period.LCD is used for displaying the signal status and used for displaying the arrival of emergency vehicle. It contains three control signals RS (register select), R/W (read/write) and Enable.Fig.2 and fig.3 shows the basic pin diagram of the PIC16F877A micro controller and power supply unit of the micro controller respectively.

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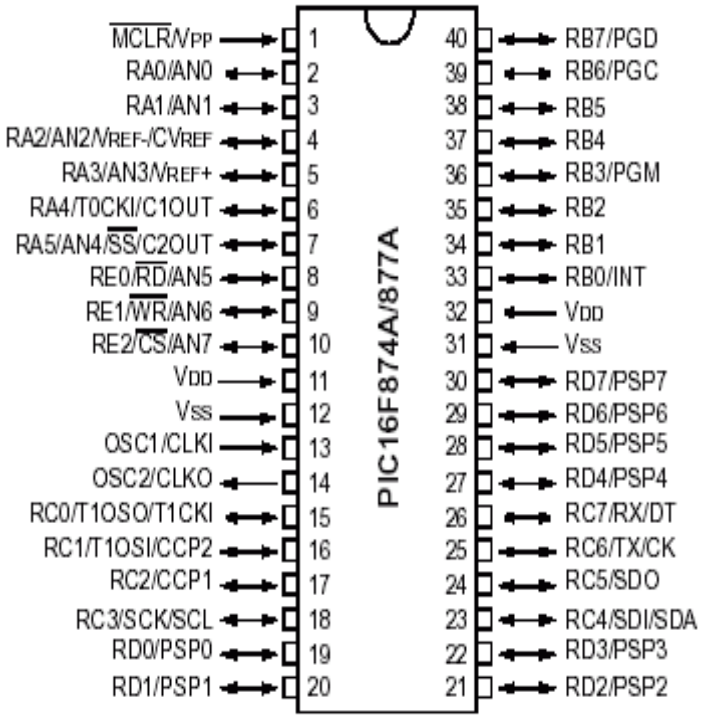

Fig.2: Pin Diagram of a Pic16F877A Micro Controller

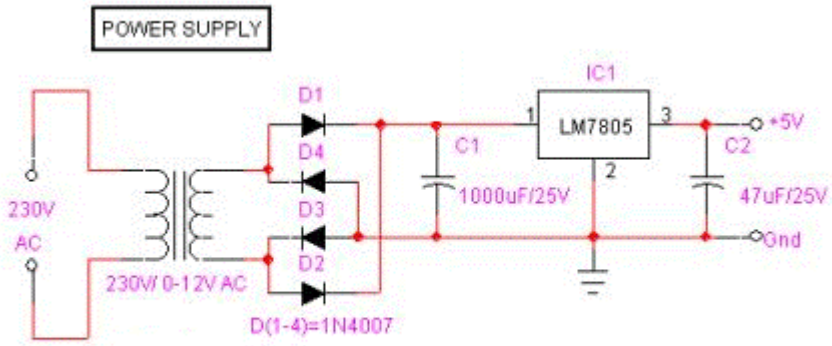

Fig.3: Block Diagram of the Power Supply Unit of the Micro Controller

III. CIRCUIT DIAGRAM

The circuit shown in the Fig. 4 is complete circuit diagram of an intelligent traffic light control and monitoring system with some peripherals interfaced to the PIC16F877A micro controller. Proteus software, is used to make the circuit. Basically Proteus software is a circuit making and simulation window bade software. Micro controller receives the 20MHz from the crystal oscillator at OSC1 and OSC2 pin. Pin 1 of micro controller provides the manual reset of the micro controller. Pull up resistances of 10K are provided at all the four ports to properly discriminate between high and low TTL signal.LCD contains three control signal RS (Register Select), R/W (Read/Write) and E (Enable).These three control signals are connected to the PIC micro controller pins 28,29,30(port D) respectively.LCD is used to display the status messages for the user. Port B is used to provide data to LCD to display as character. RFID reader is connected to port C,RC7/RX/DT pin. Generally, all the digital ICs work with CMOS or TTL voltage levels which is not useful to communicate with RS-232 protocol.

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Hence, a voltage or level converter is used to convert TTL/CMOS to RS232 and RS 232 to TTL/CMOS voltage levels.MAX232 is the most commonly used RS-232 level/voltage converter. MAX 232 provides full duplex communication.TXD and RXD pins of the micro controller are connected to MAX232 and TXD and RXD of the MAX232 are connected to Personal computer (PC), in this way data is transferred between PC and micro controller.

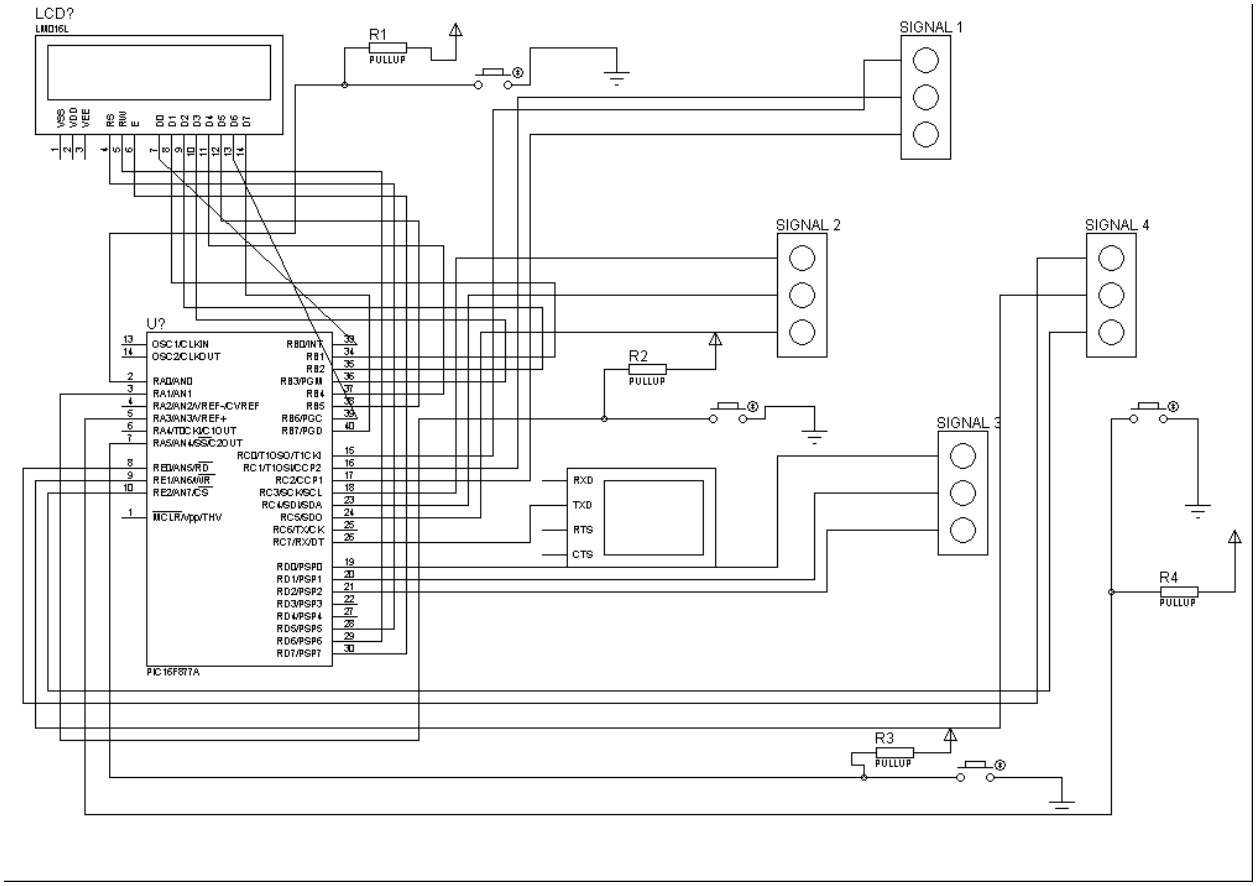

Fig.4: Circuit diagram of an intelligent auto traffic signal controller.

IV. PROTOTYPE IMPLEMENTATION

In our prototype, we have used PIC 16F877A [1] micro controller along with low frequency RFID reader, passive RFID tag, IR sensors. In our coding section, one UID (Unique identification code) of tag is stored in the program. A 16x2 (Liquid crystal display) LCD is interfaced with the micro controller to display the status of the signal with the traffic light model and to indicate the arrival of emergency vehicle (ambulance). The traffic light model is shown by red, yellow and green (Light emitting diode) LEDs.

The code written is compiled in High-tech C Compiler [6] and burned on micro controller using Universal serial bus (USBASP) programmer. The prototype structure is same as shown in Fig.4. The RFID tag [4] is fitted in one emergency vehicle. The RFID reader [5] reads the unique identification code (UID) from the tag; this unique identification code (UID) is fed into the micro controller unit for the further processing. Once the vehicle enters the range of the RFID reader, the reader reads the unique identification code (UID) on tag, and then the LCD displays ambulance. The red light is turned to green to provide easy movement for the ambulance.IR transmitter and IR receivers are situated on each road.

The system designed here control the traffic movement for four roads respectively [2]. IR transmitter and IR receivers are situated on each road. In this system, we use IR sensor to find the traffic density. When the IR cut in any one of the roads, that road is considered as the higher traffic density road. So the road with the highest priority is cleared first. The system designed here control the traffic movement for four roads respectively by

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giving high priority to the road with high density of vehicles [3].Four IR sensors are used in this proposed system, one for each road. Four IR sensors are connected to 2, 3, 7 and 5 pins of PIC microcontroller respectively. These 4 pins of the micro-controller drives the IR transmitter by generating 38KHZ square wave with 50% duty cycle. The output of four IR sensors are connected to 12 different pins of the micro-controller. The IR sensor detects the IR wave from IR LED. So whenever any vehicle passes through IR LED and IR sensor, the IR sensor provides the low output at the corresponding pin.

V. RESULTS AND CONCLUSION

In this proposed system, we have studied the optimization of traffic light controller in a city using IR sensors, RFID tag, RFID reader and PIC 16F877A micro controller.Fig.2 shows the basic block diagram of the system and fig.4. Shows the complete circuit diagram of micro controller board. This proposed system reduces the possibilities of traffic jams, caused by high red light delays and provides the clearance to the emergency vehicle, to an extent and successfully . Here we designed the system with the purpose to clear the traffic in accordance with priority .In this system, we use IR sensor to find the traffic density. When the IR cut in any one of the roads, that road is considered the higher traffic density road. So the road with the highest priority is cleared first. The proposed system also gives importance to the ambulance and also VIP vehicles. If any ambulance or VIP vehicle is waiting in a signal then the particular lane is given a higher priority and the traffic in that lane is cleared. Emergency vehicle is detected by using RFID technology. RFID tag is inserted in the emergency vehicle and RFID reader is interfaced with the PIC microcontroller. Whenever the emergency vehicle enters the lane, RFID reader reads the unique identification code of the tag and sends it to micro controller. Micro controller gives the high priority to the lane with the emergency vehicle and clears that particular lane..The program was successfully burned on the micro-controller using USB programmer. This proposed system is used to build a smart city with less traffic jams and it also helps the emergency vehicle to reach in time to the destination. The proposed system finds applications at toll gates. Further the project may be extended to the synchronization of all the traffic lights in the city.

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