NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI –15

ECPE12: MICROPROCESSORS AND MICROCONTROLLERS LAB

Project Report

Automatic Traffic Light Controller using 8051 Microcontroller

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ABSTRACT

Vehicular traffic at intersecting streets is typically controlled by traffic control lights. The function of traffic lights requires sophisticated control and coordination to ensure that traffic moves smoothly and safely as possible.

In recent days electro-mechanical controllers are replaced by electronic circuits. The accuracy & fault tolerant drive towards electronic circuits.

We need a system that can handle such a situation effectively. Today's traffic control system can handle such a situation but not that much effectively because they are static in nature. We need a system which is dynamic in nature so that it can handle traffic smoothly and such a system is called Automatic Traffic Control System.

This project is developed to meet the requirements of solid state traffic light controller by adopting microcontroller as the main controlling element, and LEDs as the indication of light. A micro controller is interfaced to LEDs provide for centralized control of the traffic signals. Microcontroller is programmed in such a way to adjust their timing and phasing to meet changing traffic conditions. The circuit besides being reliable and compact is also cost effective.

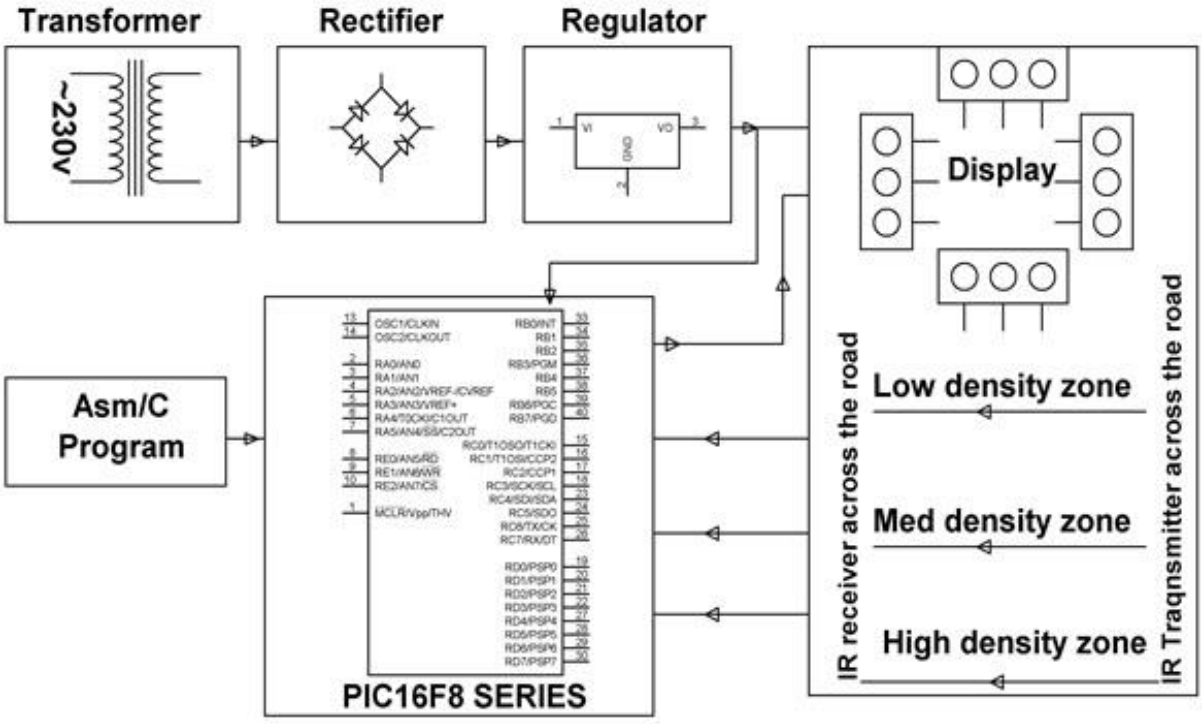
INTRODUCTION

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 travellers 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 go on increasing.

To solve these congestion problems, we must build new facilities & 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, safety, and traffic flows in order to reduce the demand of vehicle use. The project uses simple Electronic components such as LED as TRAFFIC LIGHT indicator and a MICROCONTROLLER for auto change of signal after a pre-specified time interval.

This system uses 8051 microcontroller, 7-segments and LEDs for indication. The LED's which was used as lights was connected to the Microcontroller by means of common Anode configuration. In this configuration the Microcontroller was used to sink the current from the LED to its ports. That means logic 0 signal in the Microcontroller switches the LED ON and logic 1 signal switches the LED off. Here we are using 12 MHz crystal for the 8051 Microcontroller operation.

BLOCK DIAGRAM



IMPLEMENTATION:

1. A 5 volt power supply and external frequency is provided by 12 MHz crystal and a reset circuit is connected to reset pin(9).
2. Ports 0 and 1 are used to switch ON and OFF the traffic lights.
3. Port 2 is connected to all the 7-segment displays. Pins of port 2 perform the function of illuminating each LED in 7-segment display LED.
4. Port 3 connects to enable pins of all 4 7-segment displays. This one enables the use of LEDs in the circuit.
5. Traffic lights module displays the present instruction to the driver whether to stop vehicle or to move.
6. 7 seg display displays the countdown timer which enables the driver to know the remaining time to the next traffic light state.

- There are blocks I, II, III and IV which provide desired output. Each block contains a set comprising a traffic lights module and a 2 digit 7-segment di splay. Each port contributes to different functions: activating 7-segment display and to activate traffic lights.

Aim:

To design a traffic lights controller with a countdown timer using 8051 microcontroller.

Software required:

Keil µVision4, Proteus VSM

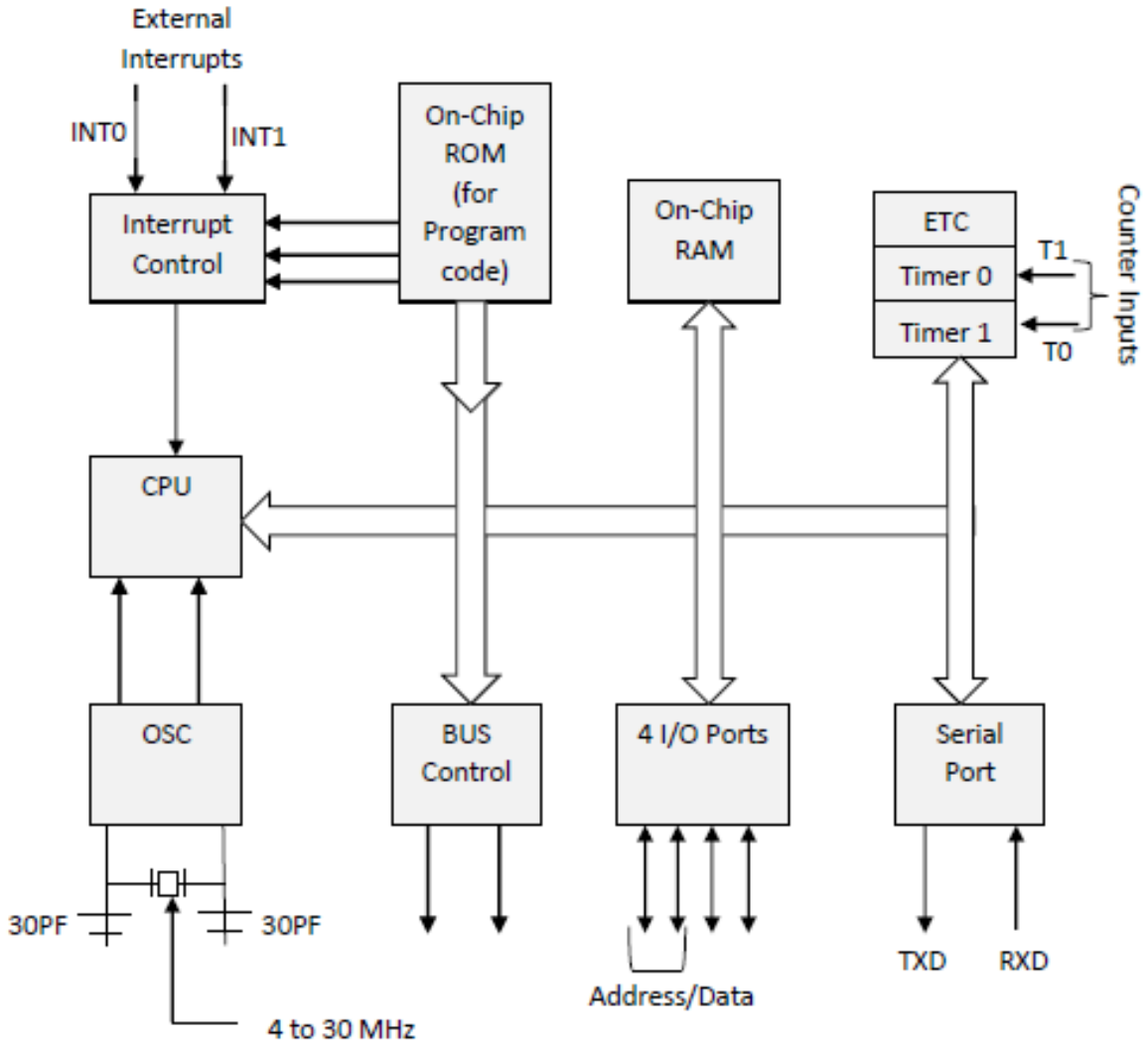
Components:

S.NO	COMPONENT	QUANTITY
1.	80C51 MICROCONTROLLER	1
2.	PUSH BUTTON	1
3.	CAPACITOR (1nF)	3
4.	RESISTOR (10kΩ)	1
5.	TRAFFIC LIGHTS MODULE	4
6.	2-DIGIT 7-SEGMENT COMMON ANODE DISPLAY (BLUE) (7SEG-MPX2-CA-BLUE)	4
7.	8-RESISTOR PACK	1
8.	QUARTZ CRYSTAL (12MHz)	1

Microcontroller Unit:

8051 Microcontroller is designed by Intel in 1981. It is an 8-bit microcontroller. It is built with 40 pins DIP (dual inline package), 4kb of ROM storage and 128 bytes of RAM storage, 2 16-bit timers. It consists of are four parallel 8-bit ports, which are programmable as well as addressable as per the requirement. An on-chip crystal oscillator is integrated in the microcontroller having crystal frequency of 12 MHz.

In the following diagram, the system bus connects all the support devices to the CPU. The system bus consists of an 8-bit data bus, a 16-bit address bus and bus control signals. All other devices like program memory, ports, data memory, serial interface, interrupt control, timers, and the CPU are all interfaced together through the system bus.



Vcc(pin 40) - Vcc provides supply voltage to the chip. The voltage source is +5V. GND(pin 20):Ground XTAL1 and XTAL2(pins 19,18):These 2 pins provide external clock.
EA(pin 31):The *EA* (External Access) pin is used to control the internal or external memory access. The signal 0 is for external memory access and signal 1 for internal memory access.

- There is no on-chip ROM in 8031 and 8032.
- The *EA* pin is connected to GND to indicate the code is stored externally.

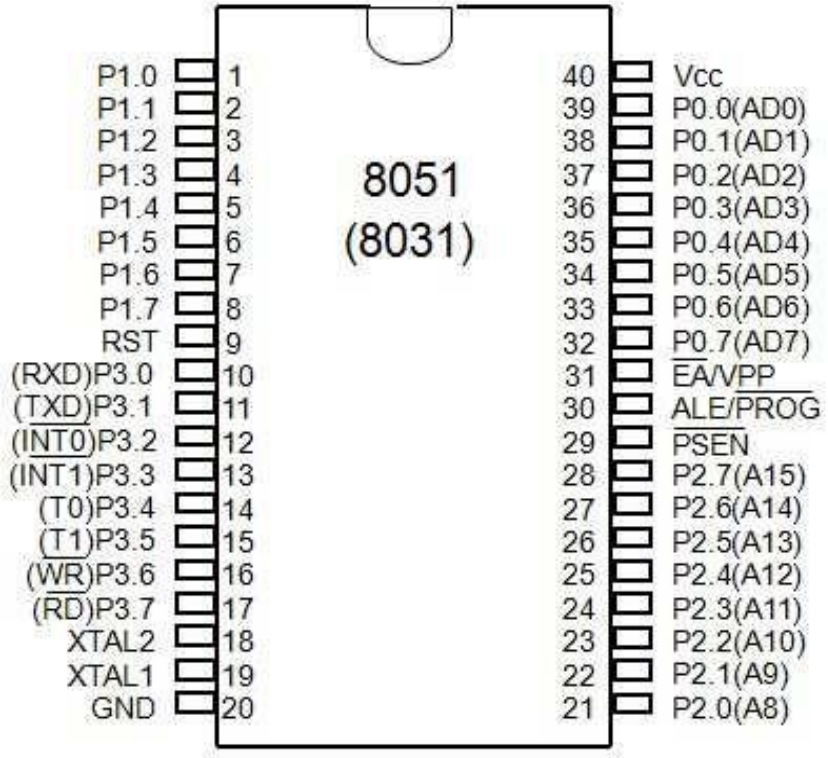


Figure: Pin Configuration of 8051 Microcontroller.

PSEN (pin 29): Program store enable This is an output pin and is connected to the OE pin of the ROM. The *PSEN* (Program Store Enable) is for reading external code memory when it is low (0) and *EA* is also 0. The ALE (Address Latch Enable) activates the port 0 joined with port 2 to provide 16 bit external address bus to access the external memory. The ALE multiplexes the P0: 1 for latching address on P0 as A0-A7 in the 16 bit address buss, 0 for latching P0 as data I/O.

- *PSEN* and ALE are used for external ROM

- For 8051, $\overline{EA}$ pin is connected to Vcc

RST(pin 9):Reset

It is an input pin and is active high normally low. The high pulse must be high at least 2 machine cycles.
4 I/O port take 32 pins(4 x 8 bits) plus a pair of XTALS pins for crystal clock . A pair of timer pins for timing controls, a group of pins $\overline{EA}$, ALE, $\overline{PSEN}$, $\overline{WR}$, $\overline{RD}$for internal and external data and code memory access controls.
The 8051 requires an external oscillator circuit. The oscillator circuit usually runs around 12MHz. The crystal generates 12M pulses in one second. The pulse is used to synchronize the system operation in a controlled pace. An 8051 machine cycle consists of 12 crystal pulses (clock cycle). The first 6 crystal pulses (clock cycle) is used to fetch the opcode and the second 6 pulses are used to perform the operation on the operands in the ALU.

Port P1 (Pins 1 to 8): The port P1 is a port dedicated for general I/O purpose. The other ports P0, P2 and P3 have dual roles in addition to their basic I/O function.

Port P0 (pins 32 to 39): When the external memory access is required then Port P0 is multiplexed for address bus and data bus that can be used to access external memory in conjunction with port P2. P0 acts as A0-A7 in address bus and D0-D7 for port data. It can be used for general purpose I/O if no external memory presents.

Port P2 (pins 21 to 28): Similar to P0, the port P2 can also play a role (A8-A15) in the address bus in conjunction with Port P0 to access external memory.

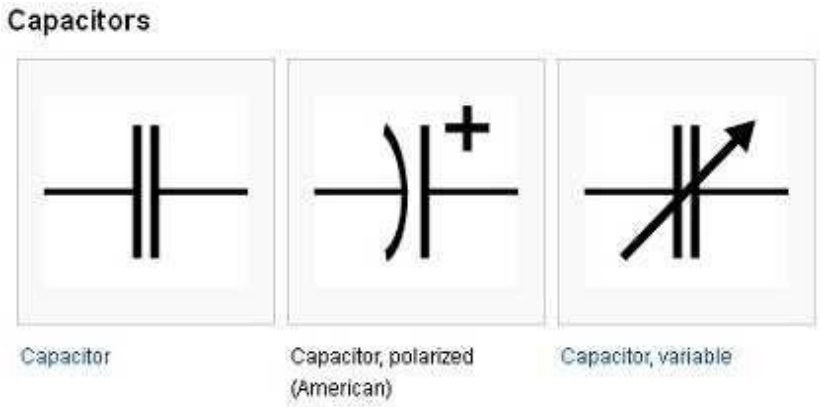
Port P3 (Pins 10 to 17): P3.0 can be used for serial receive input pin(RXD) P3.1 can be used for serial transmit output pin(TXD) in a serial port, P3.2 and P3.3 can be used as external interrupt pins(INT0’ and INT1’), P3.4 and P3.5 are used for external counter input pins(T0 and T1), P3.6 and P3.7 can be used as external data memory write and read control signal pins(WR’ and RD’)read and write pins for memory access.

Capacitor:

Capacitor stores electric charge. They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge. They are used to smooth

varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC signals but they block DC signals.

Capacitance measures the ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in Farads, symbol "F". However, 1F is very large, so prefixes are used to show the smaller values. Three prefixes are used Micro, Nano and Pico [7] .Figure 3.6 shows the circuit symbol of Capacitor.



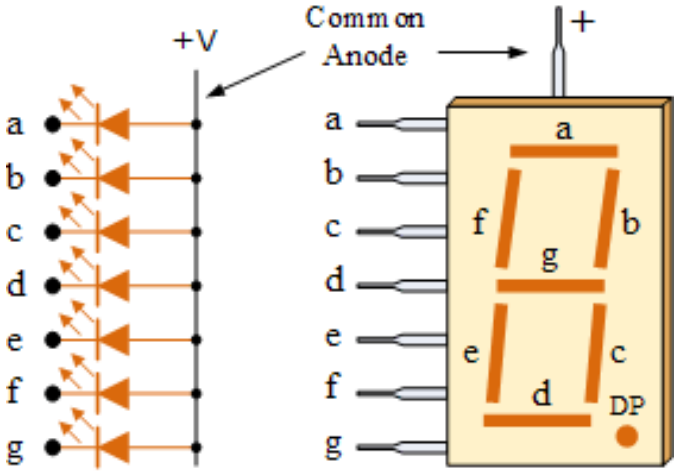
7-Segment Display:

The actual colour of the visible light emitted by an LED, ranging from blue to red to orange, is decided by the spectral wavelength of the emitted light which itself is dependent upon the mixture of the various impurities added to the semiconductor materials used to produce it.

Light emitting diodes have many advantages over traditional bulbs and lamps, with the main ones being their small size, long life, various colours, cheapness and are readily available, as well as being easy to interface with various other electronic components and digital circuits.

But the main advantage of light emitting diodes is that because of their small die size, several of them can be connected together within one small and compact package producing what is generally called a **7-segment Display**.

Common Anode 7-segment Display:



In general, common anode displays are more popular as many logic circuits can sink more current than they can source. Also note that a common cathode display is not a direct replacement in a circuit for a common anode display and vice versa, as it is the same as connecting the LEDs in reverse, and hence light emission will not take place.
Depending upon the decimal digit to be displayed, the particular set of LEDs is forward biased. For instance, to display the numerical digit 0, we will need to light up six of the LED segments corresponding to a, b, c, d, e and f. Thus the various digits from 0 through 9 can be displayed using a 7-segment display as shown.

The segments of a common anode display are illuminated using the switches. If switch a is closed, current will flow through the "a" segment of the LED to the current limiting resistor connected to pin A and to 0 volts, making the circuit. Then only segment a will be illuminated. So, a LOW condition (switch to ground) is required to activate the LED segments on this common anode display.

CODE:

```
ORG 00H
      LJMP MAIN
      ORG 300H
TBL:   DB 0C0H,0F9H,0A4H,0B0H,99H,92H,82H,0F8H,80H,90H    ;7seg data
for comm. anode type
      ORG 30H

MAIN:  MOV P2,#00H
      MOV P3,#00H
      ACALL FRONT
      MOV DPTR,#TBL
      CLR A
      MOV 40H,#10
      MOV 43H,#10
      MOV 46H,#20
      MOV 49H,#20
      MOV R0,#35
      MOV R6,#30
      MOV R7,#40

X1:    MOV A,40H
      MOV B,#10
      DIV AB
      MOV 41H,A
      MOV 42H,B


A1:    SETB P3.0
      CLR P3.1
      MOV A,41H
      MOVC A,@A+DPTR
      MOV P2,A
      ACALL DELAY
      MOV P3,#00H
      SETB P3.1
      CLR P3.0
```

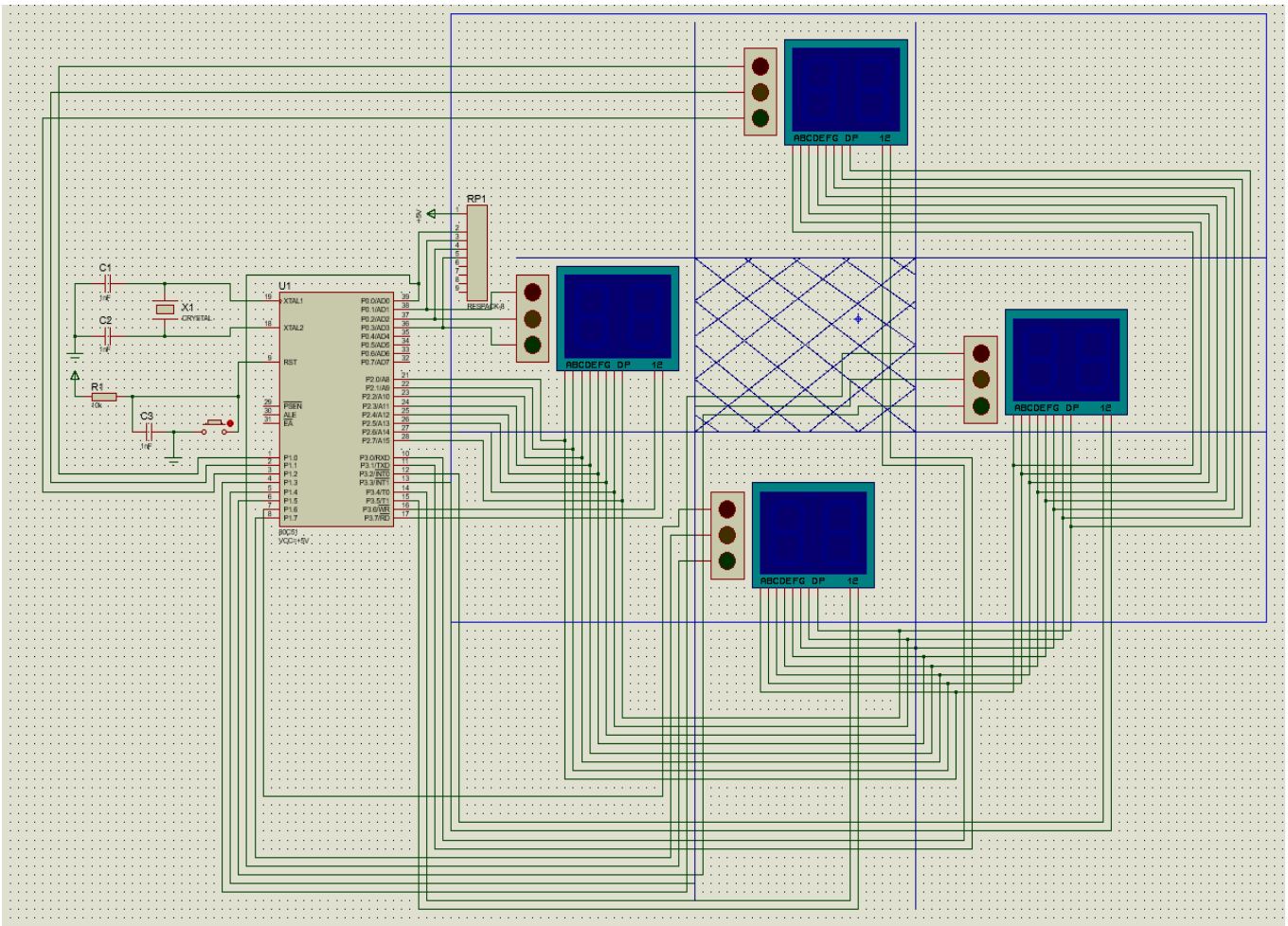
```
        MOV A,42H
        MOVC A,@A+DPTR
        MOV P2,A
       ACALL DELAY
        MOV P3,#00H
        SJMP X3
X2:     SJMP X1
X3:     MOV A,43H
        MOV B,#10
        DIV AB
        MOV 44H,A
        MOV 45H,B
        SETB P3.2
        CLR P3.3
        MOV A,44H
        MOVC A,@A+DPTR
        MOV P2,A
        ACALL DELAY
        MOV P3,#00H
        SETB P3.3
        CLR P3.2
        MOV A,45H
        MOVC A,@A+DPTR
        MOV P2,A
        ACALL DELAY
        MOV P3,#00H


        MOV A,46H
        MOV B,#10
        DIV AB
        MOV 47H,A
        MOV 48H,B
        SETB P3.4
        CLR P3.5
        MOV A,47H
        MOVC A,@A+DPTR
        MOV P2,A
```

```
ACALL DELAY
MOV P3,#00H
SETB P3.5
CLR P3.4
MOV A,48H
MOVC A,@A+DPTR
MOV P2,A
ACALL DELAY
MOV P3,#00H


MOV A,49H
MOV B,#10
DIV AB
MOV 50H,A
MOV 51H,B
SETB P3.6
CLR P3.7
MOV A,50H
MOVC A,@A+DPTR
MOV P2,A
ACALL DELAY
MOV P3,#00H
SETB P3.7
CLR P3.6
MOV A,51H
MOVC A,@A+DPTR
MOV P2,A
ACALL DELAY
MOV P3,#00H


DJNZ R0,X2
MOV R0,#35

DJNZ 40H,Q1
MOV 40H,#20
```

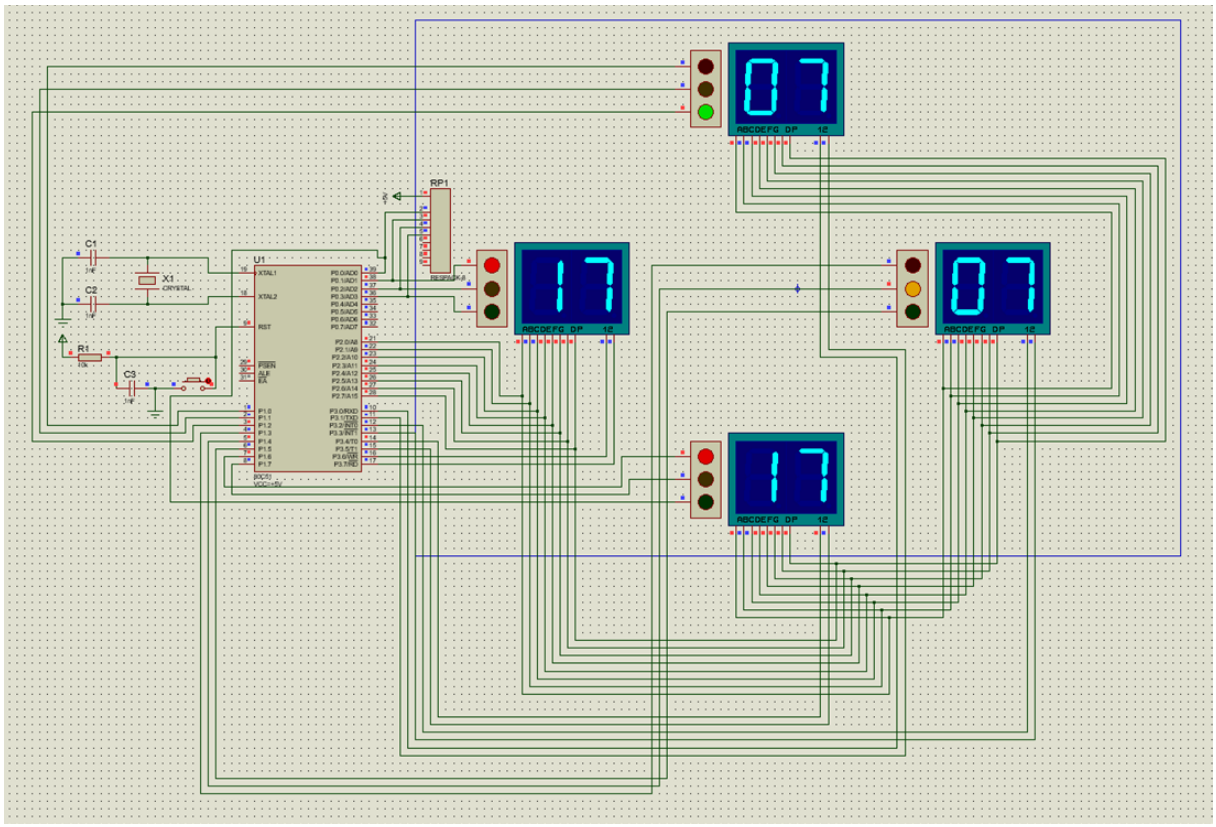
```
Q1:  DJNZ 43H,Q2
     MOV 43H,#10
     ACALL RIGHT

Q2:  DJNZ 46H,Q3
     MOV 43H,#20
     MOV 46H,#10

Q3:  DJNZ 49H,Q4
     MOV 49H,#10
     ACALL BACK

Q4:   DJNZ R6,X4
     ACALL LEFT
     MOV 40H,#10
     MOV 43H,#10
     MOV 46H,#30

X4:  DJNZ R7,L1
     LJMP MAIN
L1:   LJMP X1

DELAY:  MOV R4,#5
H2:     MOV R5,#0FFH
H1:   DJNZ R5,H1
     DJNZ R4,H2
     RET

FRONT:  MOV P1,#54H
     MOV P0,#02H
     RET

RIGHT:  MOV P1,#0A1H
     MOV P0,#02H
     RET

BACK:  MOV P1,#09H
     MOV P0,#05H
```

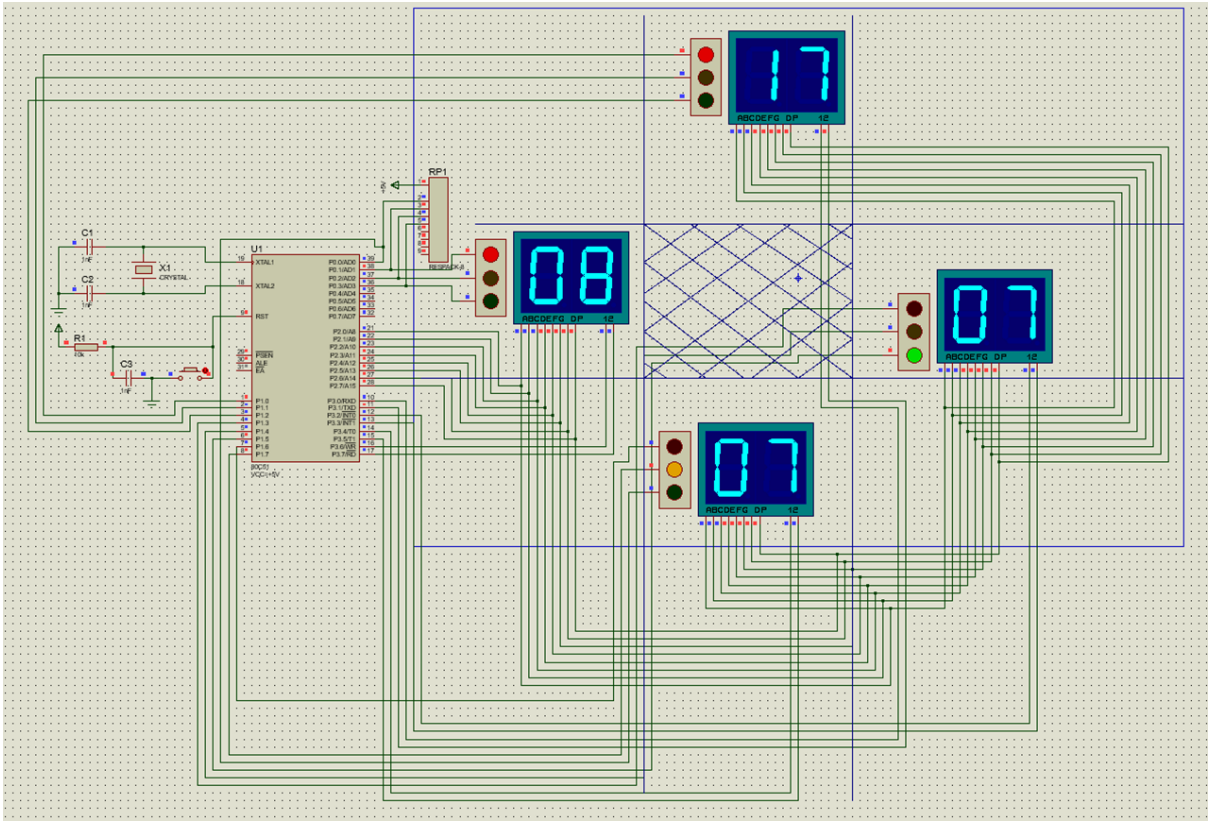
```
        RET

LEFT:  MOV P1,#4AH
       MOV P0,#08H
       RET
```

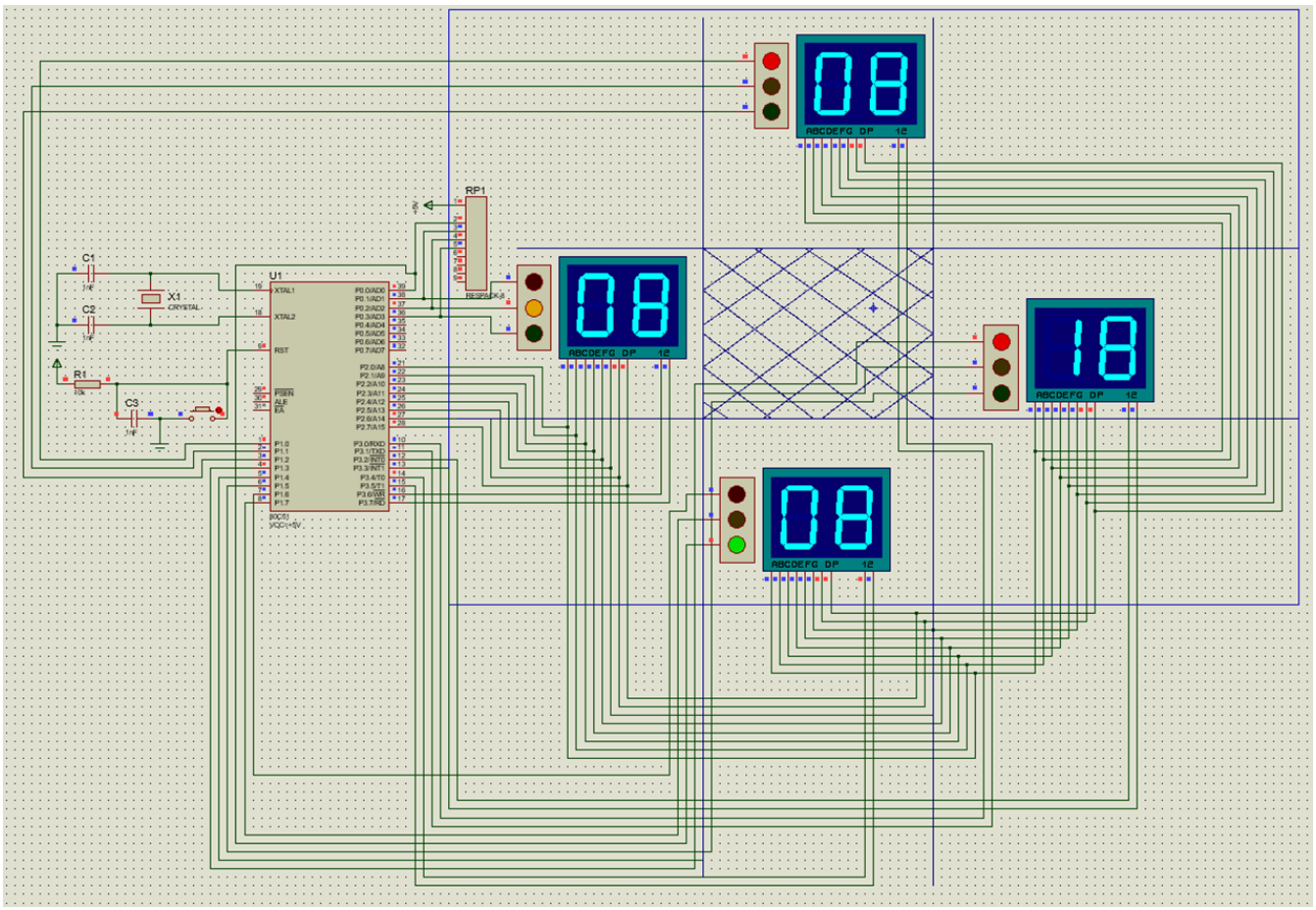
Interfacing Diagram:

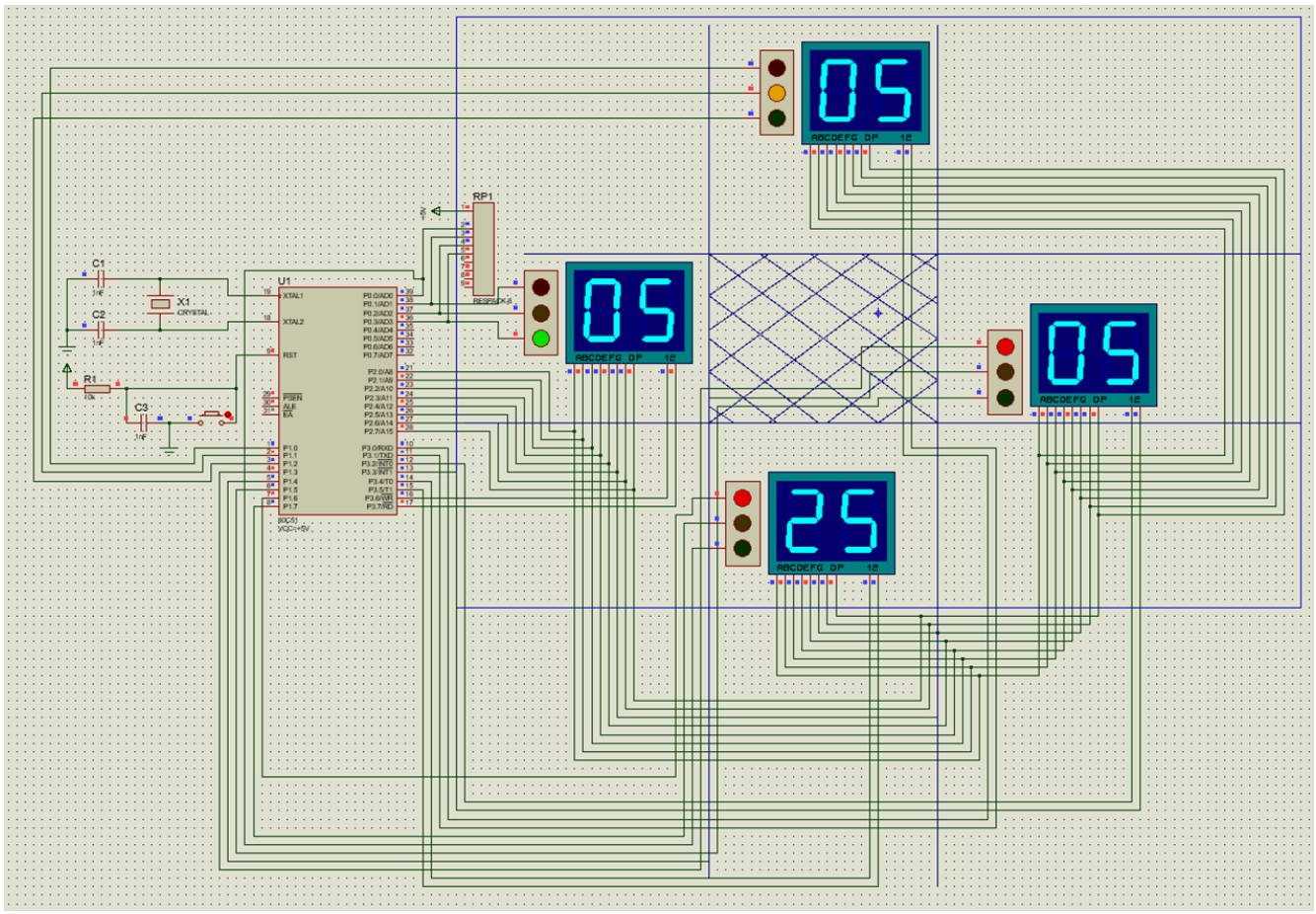


Simulations:






08
08
18
08
RP1
U1
C1
C2
C3
R1
X1
CRYSTAL


05
05
05
25
RP1
U1
C1
C2
C3
R1
X1
CRYSTAL

Summary

Designing of a system to control automatically the traffic lights on a four-way signal was the main concern. This circuit is designed by 8051 microcontroller. The pins of the various input output ports of the microcontroller are connected directly to the given 7-segment LED. The 8051 is programmed in a manner that the 7-segment LED glows by setting the required bit using assembly language and a certain amount of delay is provided depending on the user . The use of Embedded technology has proved to be very beneficial in present Traffic Light Control System and that will minimize waiting time of vehicle.

Result and Conclusion

The equipment is tested and result is obtained. This project is cost effective. Implementation of this project in present day will effectively solve the traffic congestion which is a severe problem in many modern cities all over the world.

Automatic Traffic control system is based on a very effective way of optimizing traffic, with redefinition of threshold values for a real time application. This proposed system will be able to build a developed country with less traffic jams and it will also help the emergency vehicle to reach in time to the destination. So, this intelligent system will help us to control traffic in more autonomous way.

In practice presently in India we are following time based control on traffic signals and we are experiencing a heavy traffic jams all over which in turn consumes lot of time and fuel. We hope this method will be adopted as soon as possible so that the limitations we are experiencing with present method can be overcome.

Future Scope

As the systems take care of few drawbacks of the existing system, there is scope for further improvement and expansion of this work. The system can be expanded with smart traffic light control and congestion avoidance system during emergencies emergency cars such as fire engines and ambulance and have priority over other traffic. This system gives highest priority to emergency vehicle to pass them.

Bibliography

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