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INTELLIGENT ADAPTIVE TRAFFIC LIGHT SYSTEM

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Abstract

Vehicle growth leads to many problems in India especially in crowded cities. The proposed Adaptive Traffic Control Algorithm allows the system to control traffic lights by measuring the intensity of traffic on roads. This whole system is based on Sensor Network where the traffic light of one intersection can communicate with traffic light of neighboring intersection. Also traffic clearance will be prioritized for emergency vehicles like ambulance with the help of Sensors & RF Technology. This method will increase the traffic efficiency.

Key Words: - RF Technology (Radio-Frequency), Sensors.

Introduction

Fast transportation and rapid transit systems are nerves of economic development for any country. In crowded and metropolitan cities, it is difficult to implement a normal or traditional traffic control system because of the variation of flow of vehicles on roads during different period of time. Many parameters must be considered to develop a certain traffic control system. These parameters are concentrated on the flow of vehicles, emergency vehicles and rush hours. The amount of traffic congestion has major impacts on accidents, loss of time, loss of money, delay of emergency, etc.

Many traffic light systems operate on a timing mechanism that changes lights after a given (pre-defined) interval. But the proposed intelligent traffic system senses the presence or absence of vehicles and reacts accordingly. It reacts to motion to trigger the light changes. Once the Infrared object detector picks up the presence of a car, a switch causes lights to change.

The prototype of this system here is created by using different components like Step-Down Transformer, Diode (Ln-4007), Regulator (7805), LEDs, Resistors (1k, 470 ohm, 10k, 220k), Capacitor (1000uf, 10uf, 27pf), RF Module, Encoder/Decoder, Crystal Oscillator & Comparator.

Methodology

We have set the minimum default time of Red Light to 5 seconds. After 5 seconds, light changes and the adjacent traffic light becomes Red. This cycle will be repeated again and again. In this proposed work, we took two pairs of Infrared Sensors and LEDs and placed on the road sides of two adjacent roads. When there is no vehicle between the sensors, the light send by LED on sensor will be uninterrupted and then comparator sends the positive signal to microcontroller. But microcontroller works on negative input so there will be no change in the timing of red light. When any vehicle enters the road, the LED-Sensor light will be interrupted and comparator sends the negative signal to the microcontroller. We programmed the microcontroller to increase the time. So, now, red light time of adjacent road is increased by 2 seconds. Now, this 5 seconds time becomes 7 seconds.

When both the Sensor-LED pairs on one road are interrupted then the adjacent red light time becomes 9 seconds. System automatically checks for density of vehicles. This information is then provided to microcontroller which controls the traffic light. System automatically checks the status of traffic and increases the counter value or timing of green light accordingly. The level of traffic intensity is shown by LEDs in the control room. More the LEDs glow, more will be the traffic, more time will be added.

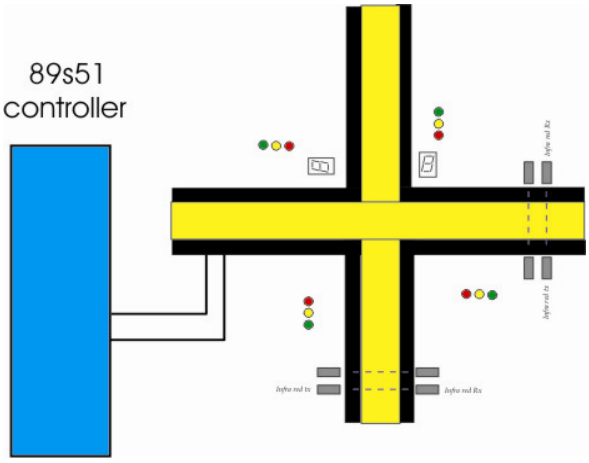

Figure 1. Schematic Diagram

1. Circuit Details

In prototype, a step-down transformer is used. It steps down the voltage from 220V AC to 12V AC. This AC voltage is further converted into DC with the help of rectifier circuit. In rectifier circuit, four diodes are used which are arranged as a bridge – rectifier circuit. Output of this rectifier is pulsating DC.

To convert this pulsating DC into smooth DC, a capacitor is used as a filter component. Capacitor converts the pulsating DC into smooth DC with the help of its charging and discharging effect.

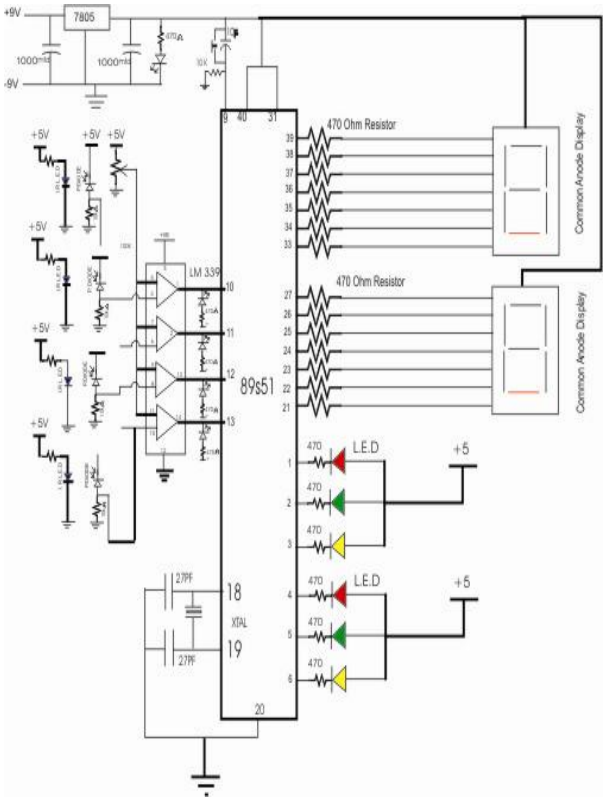

Figure 2. Circuit Diagram

Output of the regulator is now regulated with the help of IC regulator circuit. Here, positive voltage regulator circuit is used with 3 pin regulator. Output of the regulator is regulated voltage. If we use 7805 regulator then it means it is 5V regulator and if we use 7808 regulator then it means it is 8V regulator.

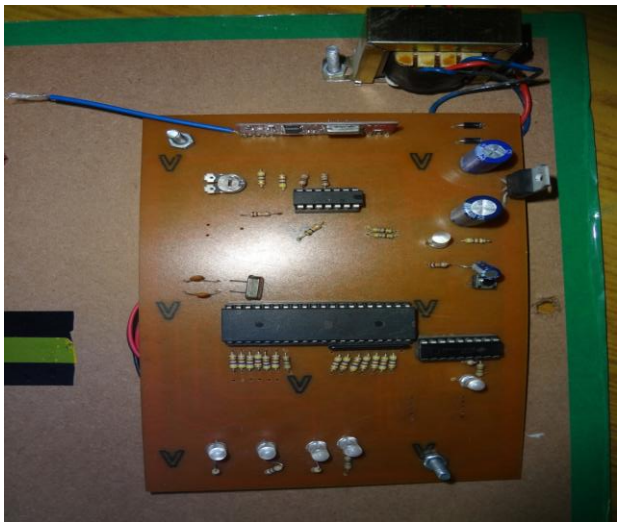

Figure 3. Circuit Board Used In Prototype

2. Case of Emergency Vehicles

Usually during traffic jam, the emergency vehicles such as ambulance, police van, fire brigade truck, etc., stuck in traffic as drivers have to wait to turn the light green. This problem is very complicated. With the help of encoder/decoder, RF wireless technology, this problem can be solved. One RF module is set up in emergency vehicles with encoder and one RF module is set up on the main circuit board with the decoder. We set two buttons on circuit board in ambulance. Let the roads be R1 and R2, switches be S1 and S2. When an ambulance enters the road R1, the driver switches the S1 button ON and the time of red light becomes 0 (Zero) that is, green light becomes permanently active till the ambulance crosses the intersection. Similar is the case when ambulance enters road R2.

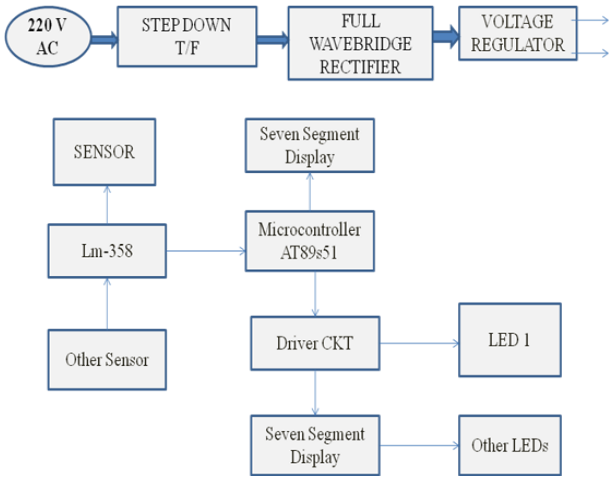

Figure 4. Block Diagram

When the driver of the ambulance switches the S1 button ON, the signal in the form of encoded radio waves travels through the sending antenna to the receiving antenna in the control room. There, these radio waves are passed through another RF module and then decoder. The signal now attained its original form and then oscillator sends the clock pulses to the microcontroller. Microcontroller sets the green light temporarily active till the ambulance crosses the intersection.

An **Encoder** is a device, circuit, transducer, software program, algorithm or person that converts information from one format or code to another for the purpose of standardization, speed, secrecy, security or compression. A **Decoder** is a device which does the reverse operation of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode. It is a combinational circuit that converts binary information from n input lines to a maximum of 2^n unique output lines.

3. Architecture of 8051

The 8051 is one of the most popular micro controller in use today. It has a reasonably large amount of built in ROM and RAM. In addition it has the ability to access external memory. The generic term `8x51` is used to define the device. The value of x defining the kind of ROM, i.e. x=0, indicates none, x=3, indicates mask ROM, x=7, indicates EPROM and x=9 indicates EEPROM or Flash.

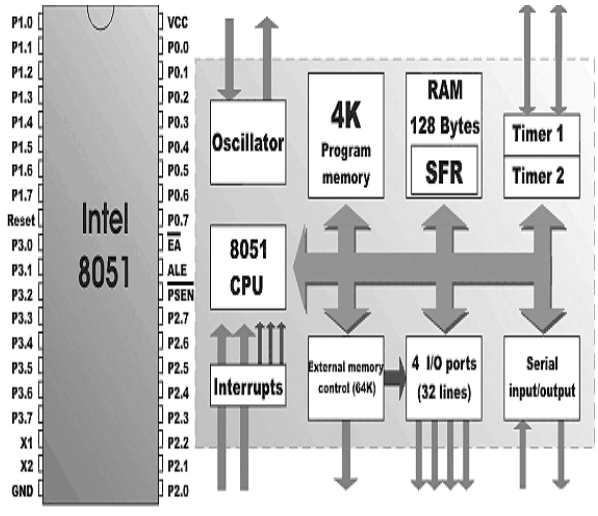

Figure 5. 8051 Architecture

Architecture makes us to know about the hardware features of the microcontroller. The features of the 8051 are:

1. 4K Bytes of Flash Memory.
2. 128 x 8-Bit Internal RAM.
3. Fully Static Operation: 1 MHz to 24 MHz.
4. 32 Programmable I/O Lines.
5. Two 16-Bit Timer/Counters.
6. Six Interrupt Sources (5 Vectored).
7. Programmable Serial Channel.
8. Low Power Idle and Power Down Modes.

4. Execution Time

The speed with which a microcontroller executes instructions is determined by what is known as the crystal speed. A crystal is a component connected externally to the microcontroller. The crystal has different values, and some of the used values are 6MHZ, 10MHZ, and 11.059 MHz, etc. Thus a 10MHZ crystal would pulse at the rate of 10,000,000 times per second. The time is calculated using the formula:
No of cycles per second = Crystal frequency in HZ / 12.

For a 10MHZ crystal the number of cycles would be,

10,000,000/12=833333.33333 cycles.

This means that in one second, the microcontroller would execute 833333.33333 cycles.

Software

There are three embedded software required that is, Proteus Software, Topwin & Keil Uversion 4. **Proteus** is used for circuit diagram. Proteus incorporates many functions derived from several other languages: C, BASIC, Assembly, and Clipper/dBase. The functions of proteus includes accessing file system, sorting data, manipulating dates and strings, interacting with the user & calculating logical/mathematical expressions. For programming of IC, **Topwin** is used. For assembly coding, **Keil Uversion 4** is used. It is also used to display message on LCD or Seven Segment Display.

Advantages & Future Scope

The advantages of Intelligence Adaptive Traffic Light System are:

1. Avoid wastage of time due to traffic.
2. Fully automatic.
3. Low power consumption.
4. It provides the easy access in the traffic light.
5. Low cost in design & maintenance of circuit.

By using this system configuration we try to reduce the possibilities of traffic jams caused by traffic lights to an extent and we'll successfully get the results. Number of passing vehicles in the fixed time slot on the road decides the density range of traffic and on the basis of vehicle count

microcontroller decides the traffic light delay for next recording interval. The recorded data can be downloaded to the computer through communication between microcontroller and the computer.

The Administrator sitting on computer can command system (microcontroller) to download recorded data, update light delays, erase memory, etc. Thus administrator on a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent. In future this system can be used to inform people about different places traffic condition.

Data transfer between the microcontroller and computer can also be done through telephone network, data call activated SIM. This technique allows the operator to gather the recorded data from a far end to his home computer without going there. Traffic lights can be increased to N number and traffic light control can be done for whole city by sitting on a single place.

Results & Discussions

By default red light timing is set to 5 seconds. After 5 seconds, it turns to green. This cycle continues. There are different combinations of possibilities in this prototype:

Test 1: When vehicles were between pair S1L1 only on road R1 and no vehicles on road R2.

Traffic Light T1 changed from 5 seconds to 7 seconds and no change in Traffic Light T2.

Test 2: When vehicles were between both pairs S1L1 on road R1 & S2L2 on road R1 and no vehicles on road R2.

Traffic Light T1 changed from 5 seconds to 9 seconds and no change in Traffic Light T2.

Test 3: Vice-versa results obtained when vehicles were on road R2.

Test 4: When vehicles were between both S1L1 on road R1 and S3L3 on road R2.

Traffic Light T1 changed to 7 seconds and Traffic Light T2 also changed to 7 seconds.

Test 5: When vehicles were between S1L1 on road R1, S3L3 on road R2 and S4L4 on road R2.

Traffic Light T1 changed to 7 seconds and Traffic Light T2 changed to 9 seconds.

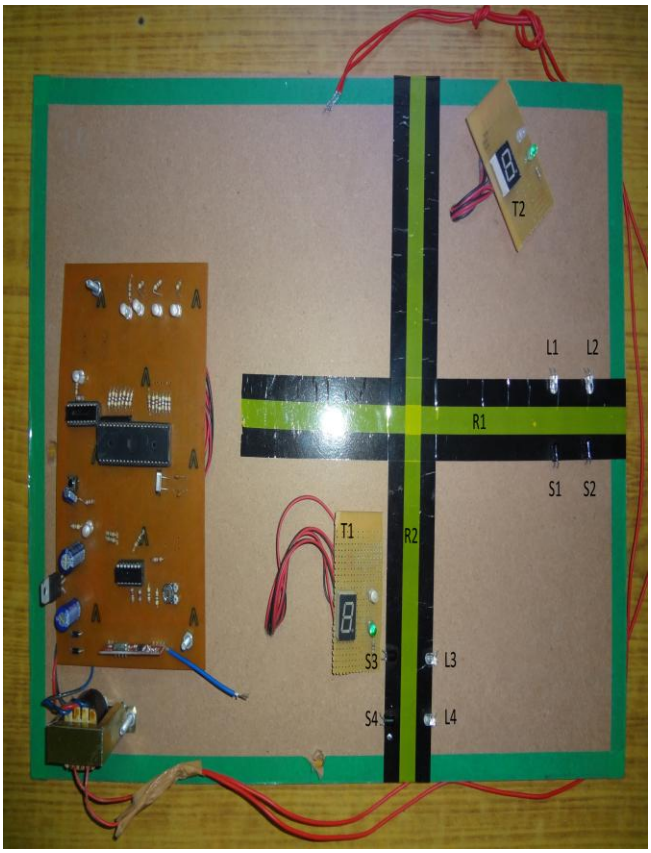

Figure 6. Prototype of Intelligence Adaptive Traffic Light System

Conclusion

The project may be used where the traffic signal is to be controlled efficiently & where we need to fulfil the need of the automation. By using this project in future we can know traffic density in the city and so that remedies can be made according to that.

The improvement of town traffic condition is largely dependent on the modern ways of traffic management and control. Advanced traffic signal controllers and control system contribute to the improvement of the traffic problem. The intelligent of traffic signal controller is introduced in this project with powerful functions and hardware interface.

This project has two major phases. The first stage is to design a program, which consists of reading, research, planning and designing a program. Design a traffic light using the state machine is very difficult compare to design using the logic gates. Microcontroller Assembly Language was chosen to write a program code for simulation only to get a timing diagram. After that, second phase continues with the

hardware implementation using the gate logic and the interface light using LED.

The blinking is depending on the state machine transition. It is observed that the proposed Intelligent Traffic Light Controller is more efficient than the conventional controller in respect of less waiting time, more distance traveled by vehicles and efficient operation during emergency. Moreover, the designed system has simple architecture, fast response time, user friendliness and scope for further expansion.

Acknowledgments

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Biography

AKSHAY SHARMA received the B.Tech. Degree in Electrical & Electronics Engineering from the ABES Institute of Technology (Uttar Pradesh Technical University), Ghaziabad, Uttar Pradesh, in 2015. His research areas include control systems and embedded system design and may be reached at ksharma.akshay@gmail.com.