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DESIGN AND IMPLEMENTATION OF ELECTRONIC TRAFFIC LIGHT

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ABSTRACT

The control of traffic at road junction, which was done purely by human effort, proves to be inefficient owing to the increasing rate of both motorists as well as the complexity of road networks. This inadequacy brought about the use of discrete solid-state electronics up to the usage of a computer controlled microprocessor, but the intelligence of this method was still limited to meet the demand of modern age. Thus, the need for the development of a microcontroller-based standard traffic light control system. Traffic lights are signalling devices situated on the road at intersection points which are used to control the completing flows of traffic. In generally, a traffic light consists of a set of three lights. They are red, yellow and green. This paper explores the design and implementation of a microcontroller-based standard traffic light system for road intersection control. The traffic light system is designed using Programmable Integrated Circuit (PIC) 16F84A microcontroller, power section, crystal oscillator and light emitting diode (LED). Then, for effective traffic control, the PIC is implemented via an IC programmer using a mikroC program written in C- language. The developed traffic light control system is tested by constructing a prototype that resembles the real application. The overall system design for the implementation of developed microcontroller-based traffic light control system entails four subunits. The subunits include the power supply unit, the sensing unit, the control unit and LED display unit. The functionality of the prototype shows that the developed system can be used for a real life traffic control at road intersection. Besides, the developed system can be employed as a training kit in learning traffic light control system design and operation. Also, it can be used as a teaching aid in schools for various road users.

Keywords: Electronic Traffic Light, PIC, MikroC,

1. INTRODUCTION

Nowadays, vehicular travel is increasing through the world and many countries are facing many problems at traffic light intersection which are caused many accidents between the emergency vehicle and other vehicle. Traffic light control at the intersection point is a matter of concern in large cities. As the number of road users constantly increase and resources provided by current infrastructures

are limited, modern control of traffic will become a very important issue in the future. One way to develop traffic light flow and safety of the current transportation system is to apply a modern traffic light control system. Traffic light controlled by microcontroller is becoming a common place in many cities because these units can easily adjust for different timing sequence.
Traffic lights are signalling devices situated on the road at intersection points which are used to control the completing flows of traffic. In generally, a traffic light consists of a set of three lights. They are red, yellow and green. When illuminated the red light, it indicates for vehicles facing the light to stop and the yellow light indicates caution to prepare for stop short of the intersection. The green light is to proceed in the direction denoted. The traffic light sequence may differ from other, and they may be special rules or set of lights for traffic turning in the particular direction.
After installation of this system we will not have to stop all vehicles on the road at the time of passing of the junction which would have adverse implication over common citizen some time.

2. LIETERATURE REVIEW

Ever since Roman times, society has tried to control traffic. Even the fabled Roman road system created a conflict between pedestrian and equine travellers. However, a practical solution was not developed until the mid-nineteenth century, when J. P. Knight, a railway signalling engineer, created the first traffic signal, which was installed near Westminster Abbey in London, England in 1868. Unfortunately, the device exploded, killing a police officer, and its use was discontinued after being in operation for only a short time.
The modern traffic light was invented in America. New York had a three colour System in 1918 that was operated manually from a tower in the middle of the Street. Other cities soon adopted the idea of having someone on the scene to control the lights. Garrett Morgan, inventor of the gas mask, also developed traffic signalling devices. Having witnessed an accident between a car and a carriage, Morgan felt compelled to devise a system to prevent such collisions at street intersections. In 1923 he patented an electric traffic light system using a pole with a cross section on which the words STOP and GO were illuminated.

These basic designs were soon improved. In 1926 the first automatic signals Were installed in London; they depended on a timer to activate them. In the 1930s vehicle-activated lights were created in which cars rolled over half-buried rubber tubes. Air in the tubes was displaced by the weight of the car rolling over

them, and the increased pressure operated an electric contact, activating the lights. But these tubes wore out quickly. A better idea was the inductive-loop device: a loop of wire was imbedded in the road itself and connected to a box controlling the lights; a current of electricity passed through the loop, and when the steel body of a car passed overhead, it produced a signal that activated the light.

Today, traffic is automatically routed onto limited access highways courtesy of a computer activated guidance system that determines traffic volume on the Highway. Global positioning satellite systems (GPS) are installed in many cars. These systems connect with a satellite and inform drivers where they are and Possible routes to their destination. Such systems will eventually enable a drive to determine the best route to a destination given prevailing traffic conditions.
A large number of approaches are presented to minimize the problems of the traffic light jams, bellow a literature survey for some solution in the last few years:
Ganiyu R. A., 2014 Introduced a traffic light control system; the design consists of the microcontroller, and light emitting diode (LED). The sensing unit is designed utilizing a pressure switch which will sense the weight of any car that steps on it. When the pressure switch is pushed, a logic one is applied on the microcontroller to inform the control unit that there is car at that particular node. The system was designed to sample all the lanes in turn to detect whether there is an automobile on any lane and this action added a period of 15sec to the delay time by the microcontroller which is configuring the traffic light action.
Sachin Jaiswal, 2013 Presented control system consist of microcontroller, IR sensors, in line of sight configuration across the loads to detect the density at the traffic signal, and for VIP automobile RF transmitters are installed on it while the receivers installed on traffic light control circuit to control the state of the traffic light. Three levels of jam and delays are defined high, medium, low density.
Rashid Hussian, 2013 Presents system of Intelligent Traffic Routing using a Wireless Sensor Networks. The Wireless sensor network technology is used to sense presence of Traffic near any node and then able to route the Traffic based on density in the desired road. The system uses microcontroller with the Wireless sensor for Traffic management.
A. Ms PromilaSinhmar, 2012 Propose multiple traffic light control and monitoring system. The system is based on microcontroller. The system contains IR sensors are mounted on the sides of roads respectively. The IR sensors network sense the vehicle passed through it. Microcontroller controls the IR

system and counts the number of vehicles passing on the road. The vehicle count is stored in microcontroller memory. Based on a different vehicle count, the microcontroller takes decision and updates the traffic light delays as a result. Administrator sitting on the computer can command system (microcontroller) to down-load recorded data, update light delays, erase memory, etc. Thus administrator of a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent.

Shilpa S. Chavan, 2009 Introduced Intelligent Traffic Light Controller, which consist of infrared sensor mounted on the road to detect the vehicles, this acts as an input to the ITLC unit. This input signal indicates the length of vehicles on each road. The controller generates output signals for Red, Green and Orange Signal and monitors their timings, taking into consideration the length of vehicles on each road. The same information is transmitted to the mobile user which will request for congestion status. If a vehicle driver at junction sends SMS on GSM mobile phone to ITLC unit, the driver will get a message indicting congestion status of the road. The microcontroller that used is AT89c51.

3. SYSTEM ANALYSIS

3.1 BASIC COMPONENT USED

3.1.1 Light Emitting Diode

A light-emitting diode (LED) is a two-lead semiconductor light source as shown in figure 2. It is a p–n junction diode, which emits light when activated..

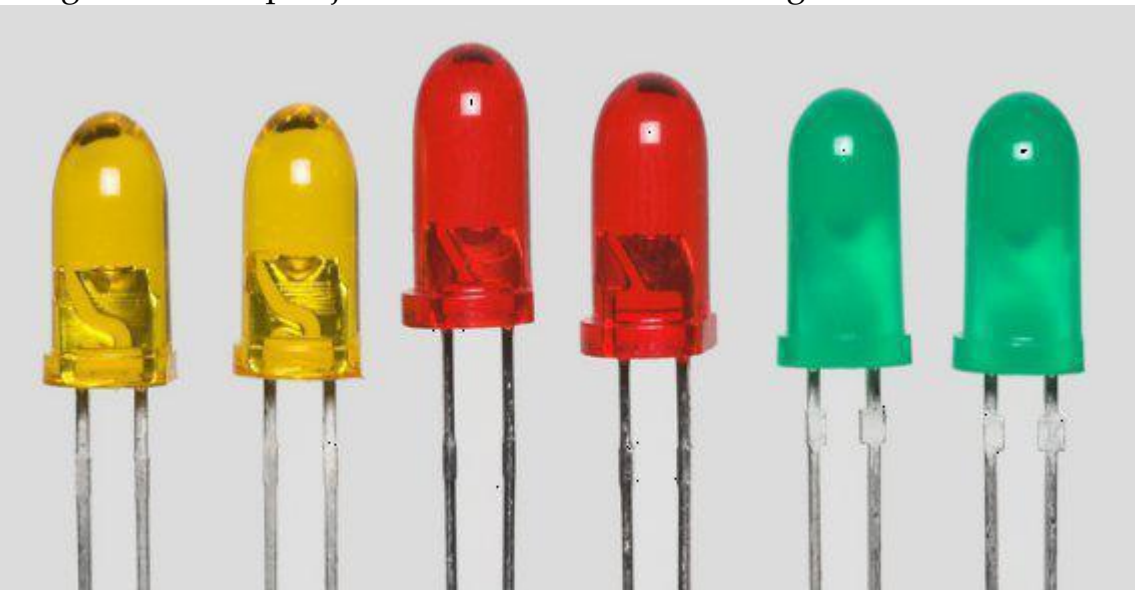

Fig.1 LED lights

3.1.2 Resistors

A **resistor** is a passivetwo-terminalelectrical component that implements electrical resistance as a circuit element.

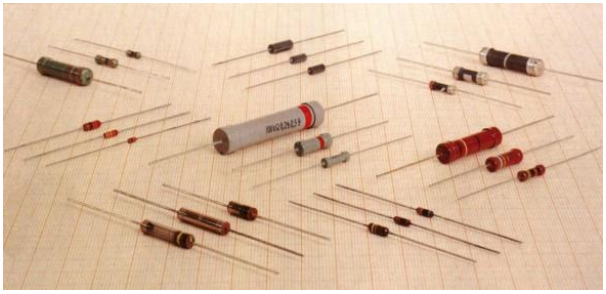

Fig. 2a: Some low-power resistors

Fig. 2b: High-power resistors and rheostats

3.1.3 Microcontroller (PIC16F84A)

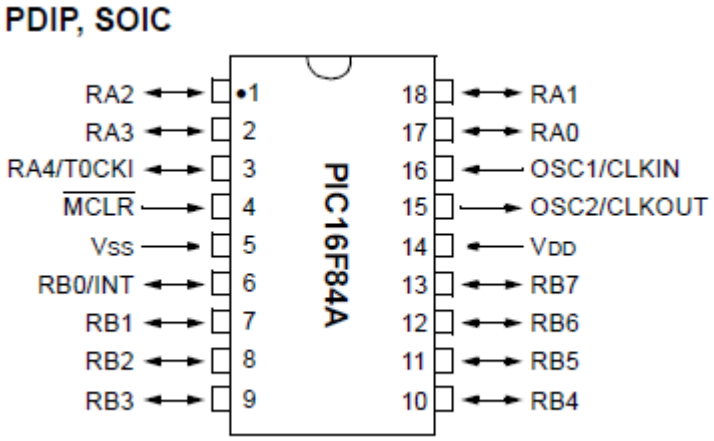

Fig 3: Microcontroller

This microcontroller acts like the brain of this project. The microcontroller chip that has been selected for this purpose is PIC16F84A manufactured by Microchip.

3.1.4 Crystal Oscillator

Quartz crystal oscillators were developed for high-stability frequency references

Fig 4: Frequency standard

3.1.5 Diode

Fig 5: Diode

In electronics, a **diode** is a two-terminal electronic component with an asymmetric transfer characteristic, with low (ideally zero) resistance to current flow in one direction, and high (ideally infinite) resistance in the other.

3.1.6 Capacitor

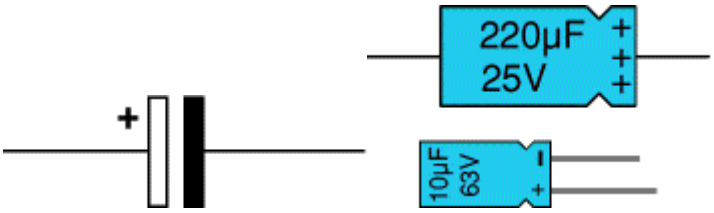

Fig 5: Capacitor

A **capacitor** (originally known as **condenser**) is a passive two terminal electrical component used to store energy in an electric field.

3.1.7 Transistor

Transistor are active component which are often found in many different electronic circuit. They play their roles in circuit as amplifier or switch+ component. they have their lead which must be connected at the correct way round, The two type of stand transistor are NPN and PNP , with different circuit symbol .

Fig 7: Transistor

4. HARDWARE DESIGN

4.1 Power supply unit

The system is powered by the 240V AC mains. The 240V is applied to a step down transformer, which stepped the voltage from 240 to the required 12 volts AC. The output of the transformer is then passed through a rectifier which converts the AC supply to a DC voltage. The output of the rectifier is filtered by connecting a capacitor across its terminals to remove the AC ripples. The filtered output is then passed through a regulator that will limit the voltage to 5V needed by the TTL IC (PIC16F84A). The output of the regulator is supplied to every part of the circuit.

4.2 Control unit

The control unit is basically a programmable interface controller (PIC), which serves as the traffic controller based on the program written and sent into its flash memory and with consideration for the input signals that comes from the pressure sensors. The PORTB register of the PIC is used to control the LED display while the PORTA register is used to sense the input from the pressure

sensors. Fig. 2 shows the control unit of a four way traffic controller. A crystal oscillator of 8MHz is connected to the oscillator input and output pins with a coupling capacitor of 22pF.

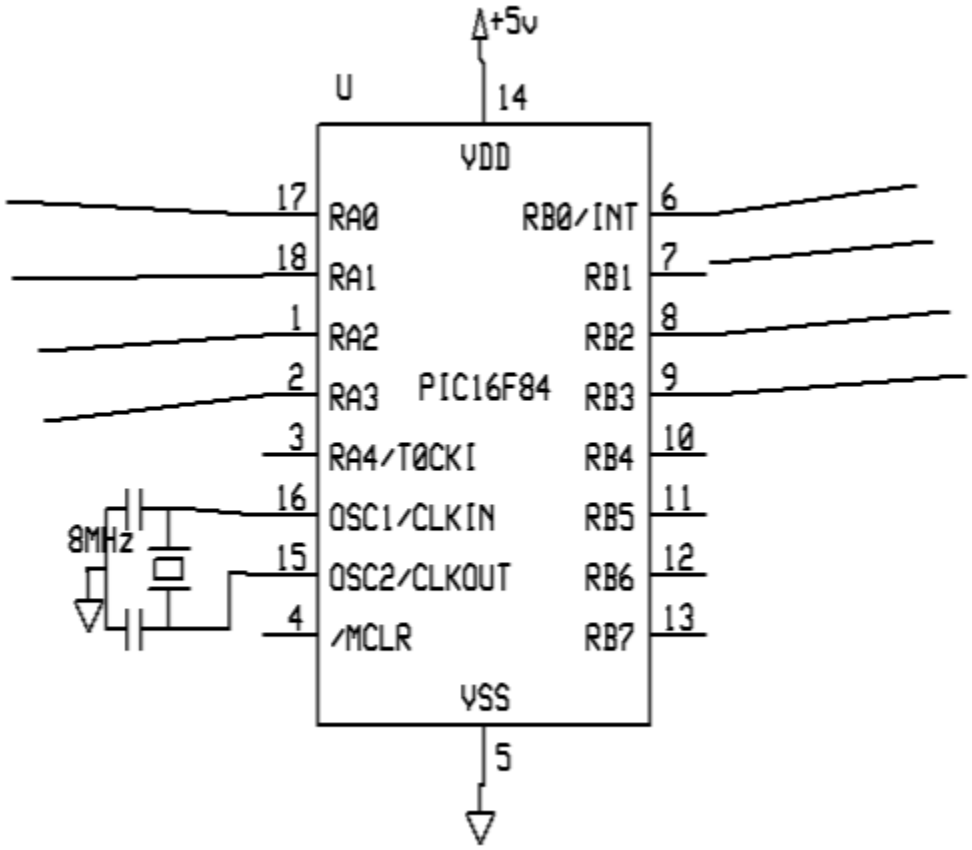

Fig. 8: Control unit of a standard traffic light controller

4.3 The Microcontroller

A microcontroller is a complete computer on a chip having the elements of a basic micro-processor along with other specialized functions. The PIC16F84A microcontroller employed in this work belongs to the mid-range family of the PICmicro® microcontroller devices. Its program memory contains 1K words, which translates to 1024 instructions, since each 14-bit program memory word is the same width as each device instruction. The data memory (RAM) contains 68 bytes. There are also 13 I/O pins that are user-configured on a pin-to-pin basis. Some pins are multiplexed with other device functions. These functions include:

- External interrupt
- Change on PORTB interrupts
- Timer clock input

5. SOFTWARE DESIGN

The microcontroller is a very resourceful chip and can be programmed to carry out a number of functions. The PIC16F84A was programmed with the aid of the computer software known as MikroC IDE; mikroC is a registered trade mark of mikro-Elektronika. The C language was used to program the IC on this software. The software generated the hexadecimal equivalent of the code written which was loaded into the linker(IC prog IDE) that transfers the hexadecimal file into the memory of the IC.

5.1 Design Details

The overall design of the microcontroller for road intersection is depicted in Fig. 4. Three different colour LEDs are placed on the lanes for displaying purposes.

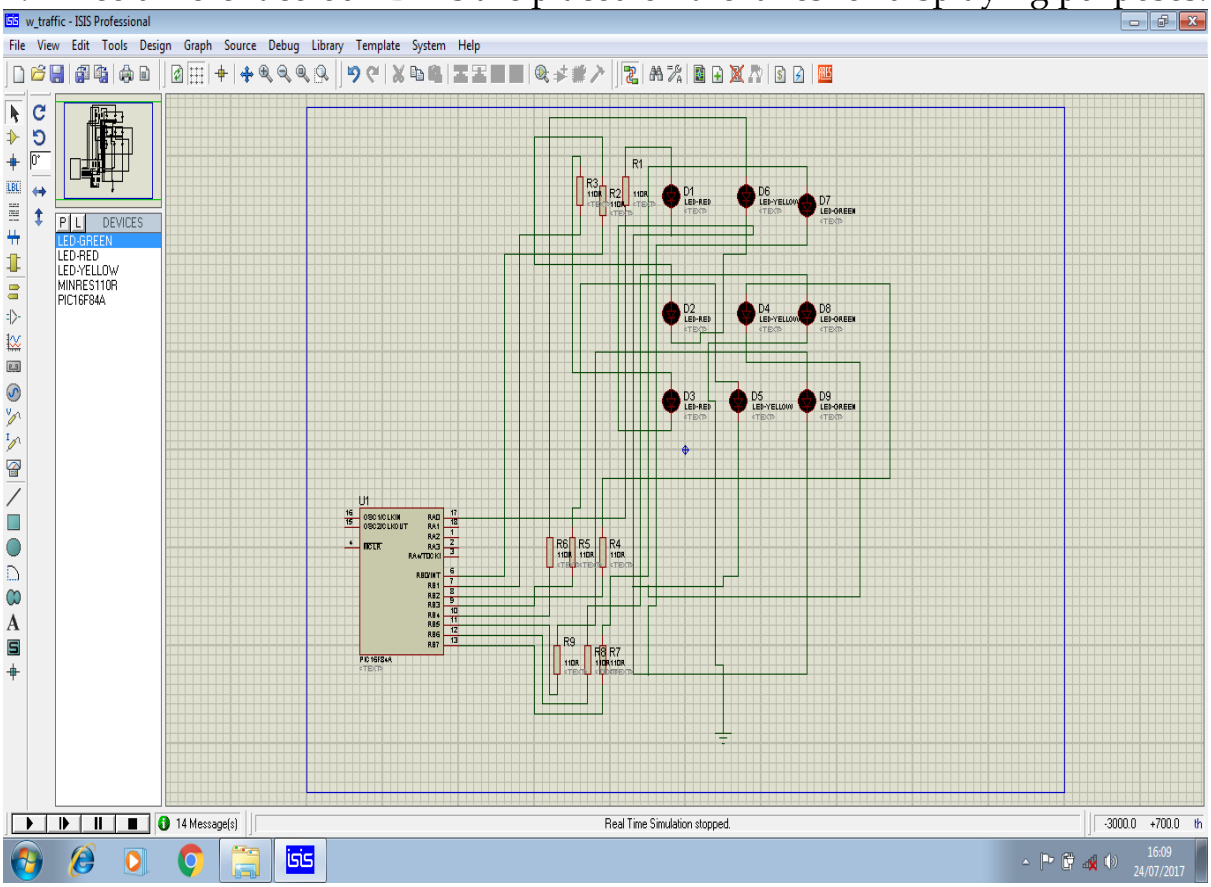

Fig. 9: Complete circuit diagram of the designed microcontroller-based traffic light system

6. THE SYSTEM OPERATION

The microcontroller-based traffic light system for road intersection control was developed to direct the movement of vehicles meeting at a road junction without any collision. To achieve this, the microcontroller allocates time for each path when the vehicles along that path will move and the other vehicles from the other path will stop. When the time allocated for a specific path has been exhausted, the **red light** will be ON meaning stop and the next line will be ON (**green light**) which means the vehicle in that path should start moving. When the time is about to be exhausted, **the yellow light** will be ON in the third path informing the vehicles in that path to be ready to move, and after some seconds the green light will be ON.

7. CONCLUSION

This paper has been successfully presented a functional and low cost microcontroller-based traffic light system for road intersection control. The traffic light system is designed using programmable integrated circuit (pic) 16f84a microcontroller, power section, crystal oscillator and light emitting diode (led). Then, for effective traffic control, the pic is implemented via an IC programmer using a mikroc program written in c- language. The developed traffic light control system is tested by designing a prototype that resembles the real application. The functionality of the prototype shows that the developed system can be used for a real life traffic control at road intersection. Also, developed system can be employed as a training kit in learning traffic light control system.

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Andreas Richter (2005*) Geschwindigeitsvogabeantichtsignalanlagenduv*page 33-34 Traffic Light Sequence *drivingtestips.bic*