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Intelligent Traffic Light Controller

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ABSTRACT

Now a day's every system is automated in order to face new challenges. In the present days automated systems have less manual operations, flexibility, reliability and accurate. Due to this demand every field prefers automated control systems. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem.

The main aim of this research is to design an intelligent traffic light controller using embedded system. This research also aims to design a safe and efficient traffic flow, to assign the right way and minimizes the delay or waiting time at road.

Keywords: Intelligent traffic light controller, traffic flow, embedded system

INTRODUCTION

Present Traffic Light Controllers (TLC) are based on microcontroller and microprocessor. These TLC have limitations because it uses the pre-defined hardware, which is functioning according to the program that does not have the flexibility of modification on real time basis. Due to the fixed time intervals of green, orange and red signals the waiting time is more and car uses more fuel. To make traffic light controlling more efficient, we exploit the emergence of new technique called as "Intelligent traffic light controller". This makes the use of Sensor Networks along with Embedded Technology. The timings of Red, Green lights at each crossing of road will be intelligently decided based on the total traffic on all adjacent roads. Thus, optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions. GSM cell phone interface is also provided for users those who wish to obtain the latest position of traffic on congested roads. This is a unique feature of this research which is very useful to car drivers to take an alternate route in case of congestion. The various performance evaluation criteria are average waiting time, average distance traveled by vehicles, switching frequency of green light at a junction, efficient emergency mode operation and satisfactory operation of SMS using GSM Mobile. The performance of the Intelligent Traffic Light Controller is compared with the Fixed Mode Traffic Light Controller. 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 average vehicles and efficient operation during emergency mode and GSM interface. Moreover, the designed system has simple architecture, fast response time, user friendliness and scope for further expansion.

The proposed operations of Intelligent Traffic Light Controller are shown in Figure 1. In this figure the junctions are shown by letters A to F. The Infrared Sensors to detect vehicles is mounted on road. The presence or absence of a vehicle is sensed by a sensor assembly mounted on each road. This acts as an input to the ITLC unit. This input signal indicates the length of vehicles on each road. The ITLC unit generates output signals for Red, Green and Orange Signal and monitors their timings taking into considerisation 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 GSM mobile phone to ITLC unit, the driver will get message indicting congestion status of road. In this case it will inform that junction A is congested and the best possible route at this instant is Route 1 via junction E. In addition to above, in the emergency mode, for a vehicle like ambulance, fire fighter or police car, the signals are altered for the fast and easy movement of these vehicle. Consider Figure 1, if an

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emergency vehicle is passing by the route A-B-C-F, the signals on the roads which are crossing this route will be immediately made red to stop vehicles on these routes. This is a very important feature which is very useful in case of emergency. The basic operation of ITLC can be realized by using embedded system which has advantages of simplicity, user friendly, easily programmable and a facility for GSM mobile interface. In our proposed model the basic operations are implemented using Microcontroller89c51AT.

The main reason for selecting this microcontroller is ease of programming, sufficient number of input output lines, manageable size of RAM and ROM and simple architecture. The block diagram of the proposed model is shown in Figure 2.

The heart of the system is microcontroller AT89c51. For communicating with the external signals additional ports and multiplexers are used. Additional RAM and ROM are used for storing system program and application program. The block diagram consists of the microcontroller, input switching matrix, serial communication interface, GSM interface, Real Time Clock 1307, Clock circuit,

LED interfacing circuit. The signals from sensor assembly will be applied to input switching circuit. These input signals from sensors will be in the form of digital signals which corresponds to presence or absence of a vehicle. These digital signals from each lane will be given to the input port of microcontroller, where the microcontroller will determine the length of vehicle at each lane.

This information is the input to microcontroller to determine various timing signals. The on and off time of the four junctions will be calculated by microcontroller, in order to keep waiting time minimum. These signals will be applied to two relay drivers which consist of ULN 2003. These relay drivers are level shifters and current amplifiers. The output of relay driver is applied to Red, Green and Orange LED at each Junction.

IC 24C04 is used for I2C interface. One LCD Display will be provided with each signal. LCD Display is 1088 shown only for prototype mode LCD Display will indicate the time left for the signal to become green i.e. it indicates the time a vehicle has to wait at a particular junction. In practice a good contract LED displays are to be used, which will be visible from a longer distance.

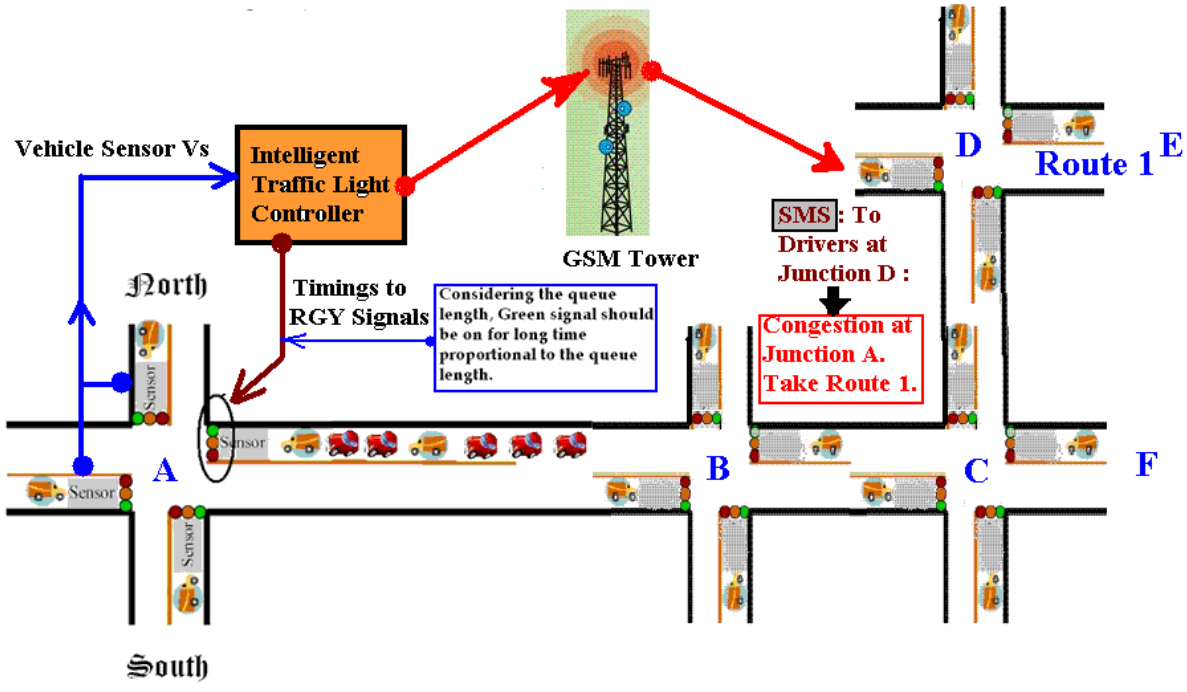


Figure1. *Basic Concept of Proposed Intelligent Traffic Light Controller*

TECHNOLOGY

Now a day's every system is automated in order to face new challenges. Due to this demand every field prefers automated control systems. Especially in the field of electronics automated systems are giving good performance. And this is realized by making use of Zigbee technology for communication. Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network

standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies.

It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps. 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps.

DESCRIPTION

In this research we require operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

In this research we have 4 sections, which are

1. Junction 1 Section,
2. junction 2 section,
3. Base junction,
4. Emergency vehicle section.

These 4 sections are used to implement an intelligent traffic management which in turn reduces the manual operation in traffic related issues.

Each junction will have the traffic signal poles and the traffic density measurements such as (IR and Photodiodes) or camers and RTC (real time clock) and EEPROM (Electrically Erasable programmable Read Only Memory) for storing the data of conjustion at that junction for temporally likewise as day or week. In this research junction 1 & junction 2 used at traffic signals jucntion, these LEDS of Red and Green are switching on / off depending upon the RTC (Real Time clock) such as if suppose the one way of four ways is green, the remaining ways will have to be red to stop the other way people not to go. This is as usually called as a conventional traffic signal system, if suppose if density of any one of the way is high at the junction1, it will clear the traffic in high density way for that junction by enabling the Green LED in that way and the remaining ways will have red and store this information with particular time will be stored in EEPROM and this total information will be also send to the BASE station and the next junction as 2 by using GSM modem which will be used for the receiving and sending messages. So that the conjustion at any of the junction is stored in the BASE station.

Emergency vehicle as keys or buttons of (NORMAL, EMERGENCY, WAY1, WAY2, OUT and JUNCTION Keys) as respectively as given. If any emergency vehicle is coming in any of one of the way the emergency vehicle will send that information through ZIGBEE trans receiver .Junctions will receive that information and clear the traffic in that way up to that vehicle is went from that junction. If emergency vehicle is coming in the way1 of junction 1, this emergency vehicle has the keys to intimate to the junction through wireless zigbee network and specifying the way in which vehicle is coming and nearby which junction. Like this the innovation of intelligent traffic management serves the need for emergency vehicles such as ambulances, fire vehicles, VIP vehicles and other public service vehicles.

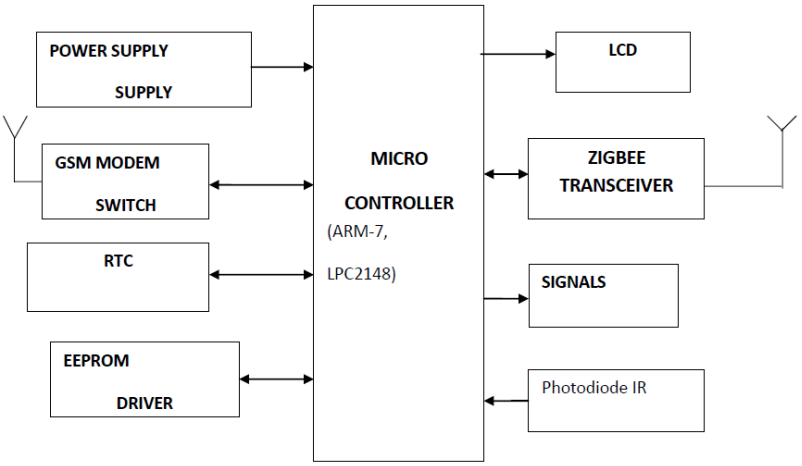
The Base junction will store the information about all the junctions. If any person want to know the traffic density at any of the junction, that corresponding person needs to send a message with STATUS at that junction to Base station. The base station will receive that information reply to that the traffic status to that particular phone number. So the traffic information for each and every person will be able to know. Through this the traffic at the main junctions will be reduced as possible in the busy hours.

So that the intelligent traffic control management system will reduce the problems like the conjustion at the junction at the busy hours, and intimating the alternative path for that near route by reply the message to that corresponding person, auto clearance at the traffic junctions for the emergency

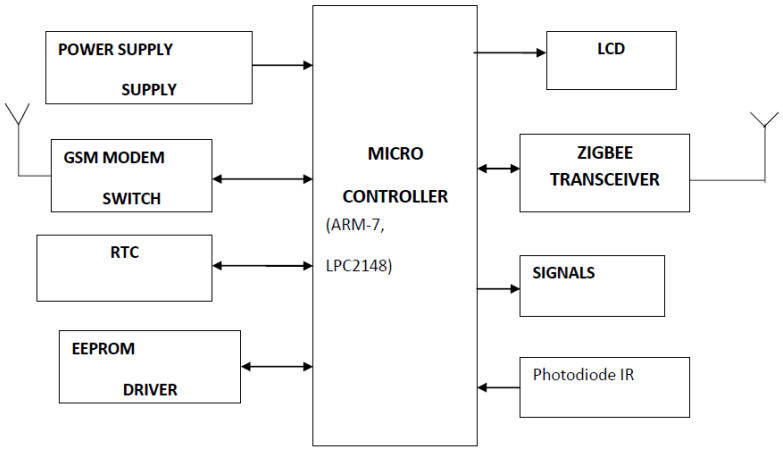
vehicles like Ambulances, Fire Engines and the vehicles of the respected VIP vehicles at the time of their meetings and etc.

BLOCK DIAGRAM

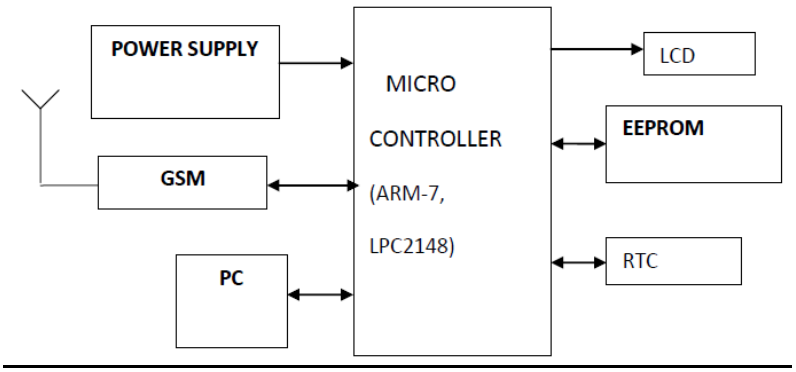
Junction1



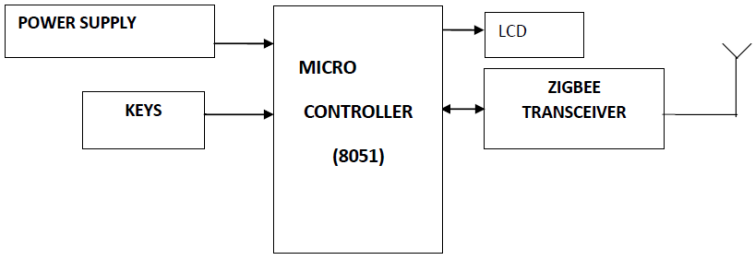
Junction2



Base Station



Emergency Vehicle



BLOCK DIAGRAM EXPLANATION

Micro Controller

In this research work the micro-controller is plays major role. Micro-controllers were originally used as components in complicated process-control systems. However, because of their small size and low price, Micro-controllers are now also being used in regulators for individual control loops. In several areas Micro-controllers are now outperforming their analog counterparts and are cheaper as well.

Power Supply

In this research we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

LCD

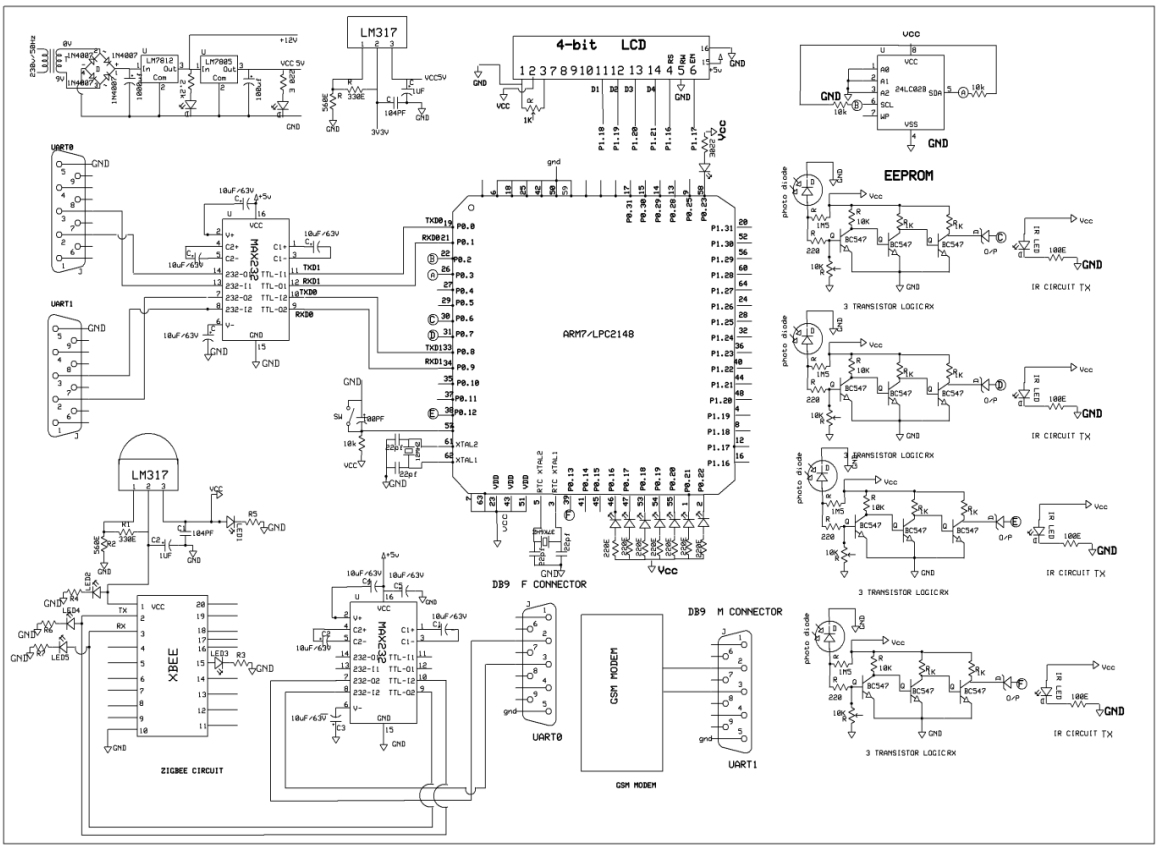
LCD is used to display the information about the current process.

ZIGBEE

Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies. It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps.

SCHEMATIC

Junction1 & 2



Schematic Explanation

Junction 1&2

In this research we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

ZIGBEE is connected to the UART 0.

GSM is connected to the UART 1.

EEPROM:

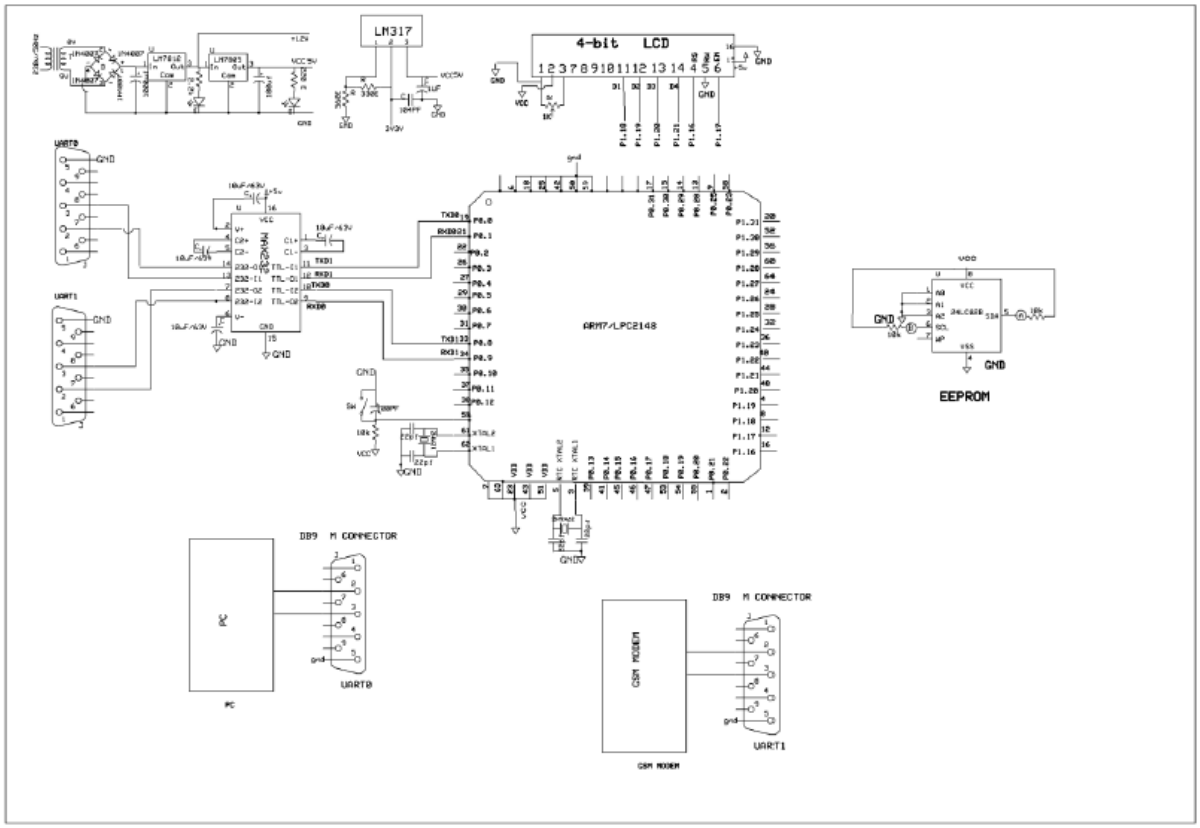
SDA is connected to the port P0.3.

SCL is connected to the port P0.2.

Photo diode IR are connected to the port P0.6&P0.7,P0.12 toP0.13 .

LEDS are connected to the port P0.16 toP0.23.

Base Station



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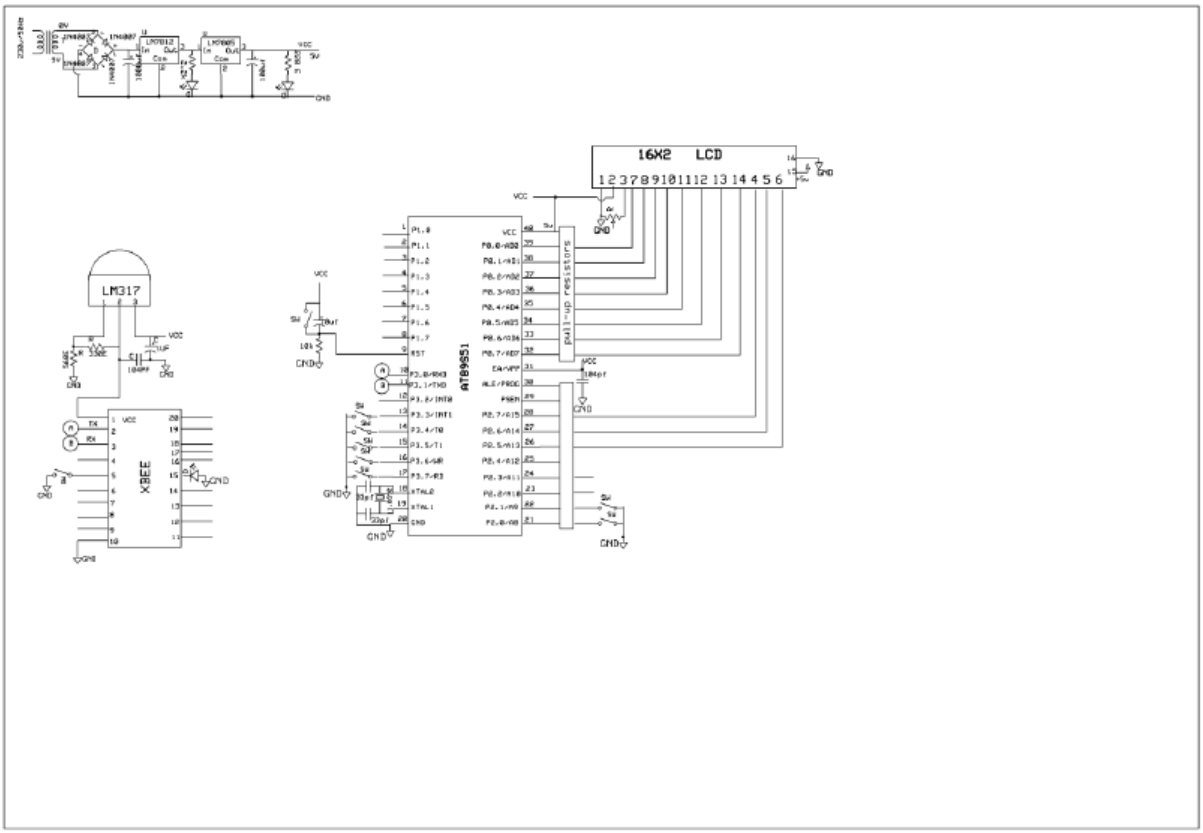
SDA is connected to the port P0.3.

SCL is connected to the port P0.2.

pc is connected to the UART 0.

GSM is connected to the UART 1.

Emergency Vehicle



Schematic Description

Firstly, the required operating voltage for Microcontroller 89C51 is 5V. Hence the 5V D.C. power supply is needed by the same. This regulated 5V is generated by first stepping down the 230V to 18V by the step down transformer.

In the both the Power supplies the step downed a.c. voltage is being rectified by the Bridge Rectifier. The diodes used are 1N4007. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator allows us to have a Regulated Voltage. In Power supply given to Microcontroller 5V is generated using 7805 and in other two power supply 12V is generated using 7812. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from the first section is fed to 40th pin of 89c51 microcontroller to supply operating voltage and from other power supply to circuitry.

The microcontroller 89C51 with Pull up resistors at Port0 and crystal oscillator of 11.0592 MHz crystal in conjunction with couple of capacitors of is placed at 18th & 19th pins of 89C51 to make it work (execute) properly.

Port 0:

P0 is connected to the data pins of the LCD.

PORT 2:

Switches are connected to port P2.0 to P2.1.

P2.5, P2.6, P2.7 are connected to control pins of the LCD.

Port 3:

Switches are connected to port P3.3to P3.7.

20th is connected to GROUND

40th is connected to Vcc

Circuit Description

In this research we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

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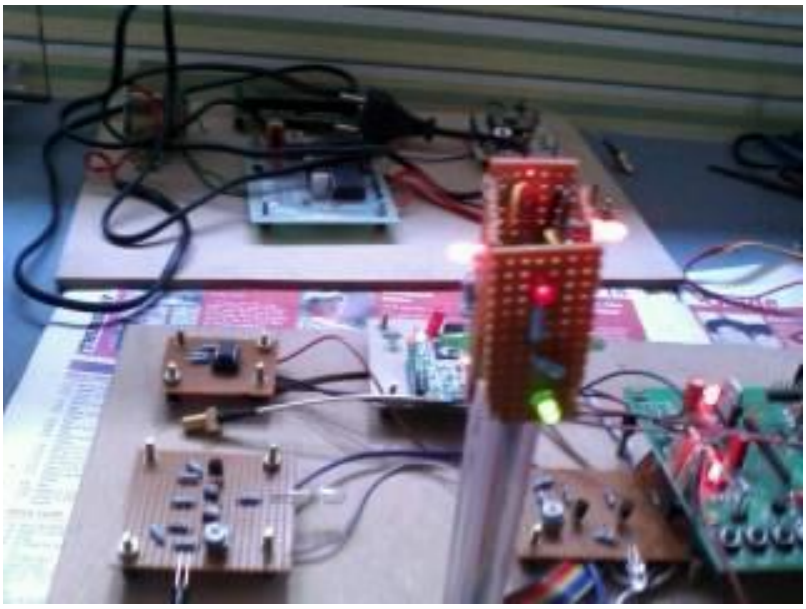
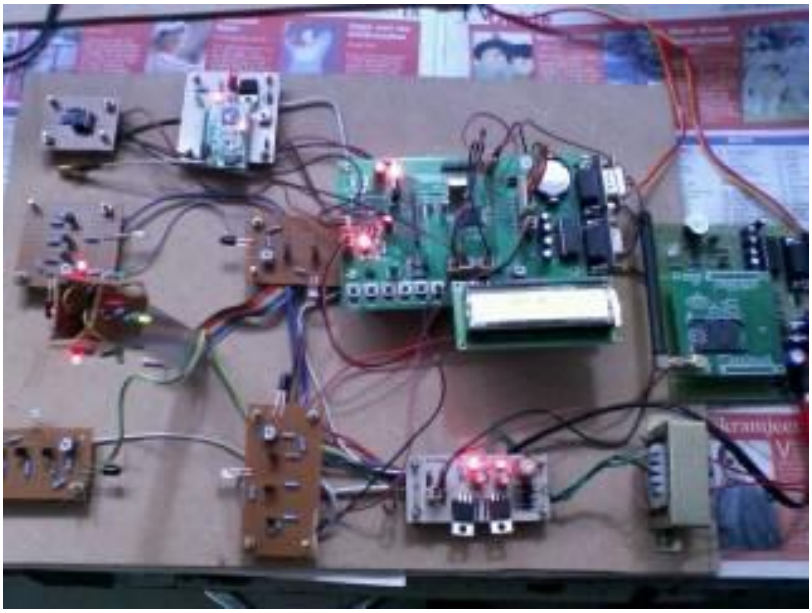
So that the intellegent traffic control management system will reduce the problems like the conjustion at the junction at the busy hours, and intimating the alternative path for that near route by reply the message to that corresponding person, auto clearence at the traffic junctions for the emergency vehicles like Ambulances, Fire Engines and the vehicles of the respected VIP vehciles at the time of their meatings and etc.

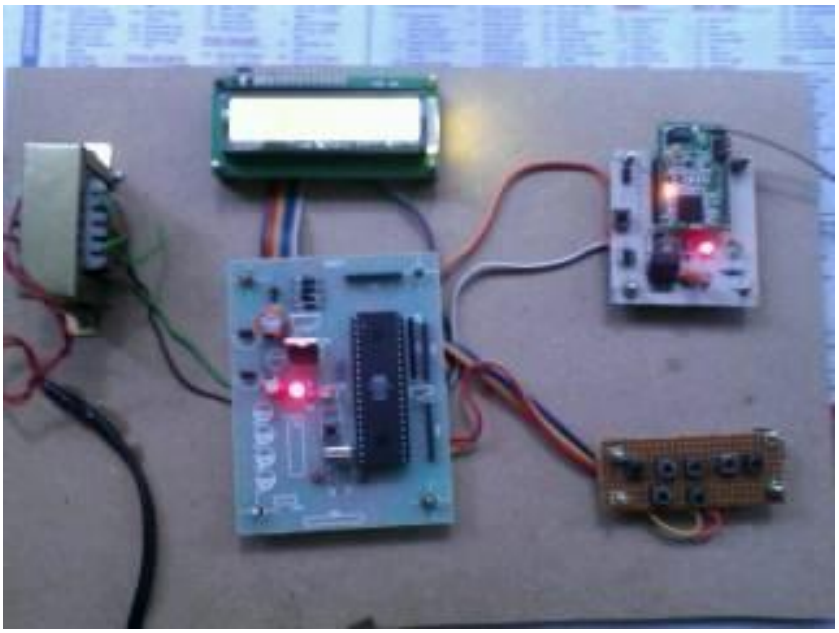
RESULTS

Junction Section





Ambulance Section

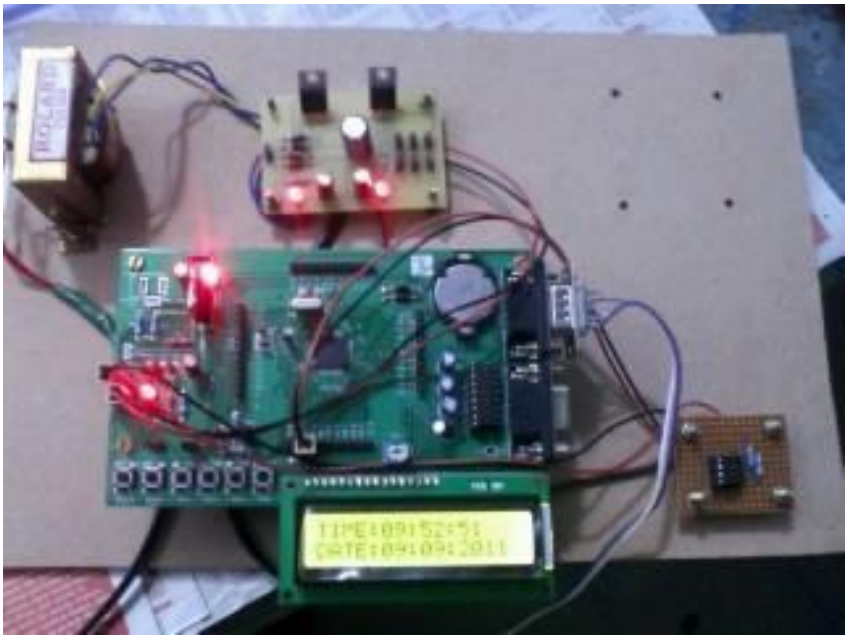



JUNCTION 1
WAY2


JUNCTION 2
WAY1


JUNCTION 2
OUT

Base Station



FUTURE ENHANCEMENT

In this research we have designed a system to give complete solution for traffic clearance on the busy roads. By using this Intelligent Traffic light controller one can easily monitor the traffic flow especially in the cities. The wastage of time can be eliminated as it is one of the important criteria for one in life.

Using this proposed system we can also get reports of heavy traffic prone areas which help the government to construct necessary flyovers in the busy roads. The ambulance need not give a signal for its arrival as the traffic gets automatically cleared with its arrival.

The future can be designed such that vehicle can be made itself to communicate with the base station and show the appropriate way by avoiding the traffic jams.

CONCLUSION

The proposed system "**Design of Intelligent Traffic Light Controller Using Embedded System**" has been successfully designed and tested.

It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

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