KANTIPUR ENGINEERING COLLEGE

DHAPAKHEL, LALITPUR

(AFFILIATED TO TRIBHUVAN UNIVERSITY)

MINOR PROJECT REPORT ON:

"DENSITY BASED AUTOMATIC TRAFFIC LIGHT CONTROL SYSTEM"

PROJECT MEMBERS:

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AUGUST 2016

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SUBMITTED TO:

DEPARTMENT OF COMPUTER AND ELECTRONICS ENGINEERING

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Abstract

This project “Density Based Automatic Traffic Light Control System” is a simple project that controls the traffic lights at junctions based on the traffic density. This project uses a simple concept that involves interfacing multiple components with a single microcontroller to allow prediction of traffic density on the road and use that data to effectively govern the traffic light control system.

In the recent years, due to the enormous growth of automobile industry, vehicles have become plenty in every city. The traffic signals in many countries are based on time or controlled by traffic police manually. This makes delay in traffic flow since the concerned person need sufficient time to judge and in such high traffic it is very difficult to observe the presence of emergency vehicles. This system will detect the density of traffic on each road and changes the signal timings as per the density.

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CHAPTER 1: INTRODUCTION

This project “Density Based Automatic Traffic Light Control System” is based on the area covered by the vehicles and their density at their junctions to control the traffic lights. An ultrasonic sensor used to detect the density, speed and flow. The IR counts the vehicles and density on the road and Microcontroller atmega328p generates the results.

1.1. General Background

Street lights are controlled manually in olden days. These days automation of street lights has emerged. But one can observe that there is no need of high intensity in peak hours i.e. when there is no traffic and even in early mornings. By reducing the intensity in these times, energy can be saved to some extent.

AVR 32-bit microcontroller is based on the RISC microcontroller architecture and is produced by Atmel. It has a large number of registers and built in features and consumes very low power which makes it ideal for use in embedded systems.

Smart Traffic Management is mainly improvised for looking after the Set off data of a region to manage the Traffic along that area and implement various useful technologies which are been required by various persons like vehicle owners, pedestrians, police officers. Mainly the purpose of Smart traffic management system is to give the details which can be used and they can be implemented in their daily life. The problems which have been occurred at their presence can be solved by this Smart Traffic.

1.2. Rationale

Now a days the use of vehicles is maximum, it has resulted in losing millions of money and time every hour. Traffic congestion is caused by many factors. One of the factors is the current traffic controller cannot accommodate the variety of

traffic volume. In our country the traffic control system is mostly based on sequential logic. There are three lights red for stop, yellow for get ready and green for go. Each light operates for a given period one after the other. The programming is so done that two lanes won't have the green light at the same time. The traffic control system at a certain places are even controlled manually by traffic personnel but human error calls for automation to prevent undesirable incidents on road. The traffic signals control the vehicle movements. They are connected to electronics system which control the signals. A pre-timed and coordinated traffic controller system can be implemented based on an ATmega microcontroller. Controller cannot accommodate the variety of traffic volume. A pre-timed and coordinated traffic controller system can be implemented based on an ATmega328p microcontroller. A pre-timed and coordinated traffic controller system can be implemented based on an ATmega328p microcontroller

1.3. Objectives

a. To develop an efficient automatic traffic light control system.
b. To determine traffic density using ultrasonic sensors.
c. To implement manual override control in traffic control via control panel or Bluetooth module using smartphones.

1.4. Features

a. The system work with AVR family Microcontroller that is interfaced with the Ultra sonic sensors and photodiodes aligned in line of sight configuration across the load for detecting the density.
b. The density is calculated in three ways such as low, medium and high according to timings are allotted for signals.
c. The system featured with a control panel that overrides the signal timings by immediately giving green signal in the vehicle direction like ambulances and fire trucks and red signal for all other.
d. The control panel can also be used to control the traffic lights manually in case of road accidents.

1.5. Feasibility

1.5.1. Technical Feasibility

Real time based controllers are among the most fundamental traffic signal system components. These controllers operate by using programmed cycle lengths and time of day operations to manage traffic at junctions. The main component used for the expected system consist of a Microcontroller (Atmega328/p) and Ultrasonic Sensor. All the components are easily available in local Electronics Market and College. Traffic signal controllers and detection devices are incorporated into a variety of different arrangements in order to accommodate the needs of each roadway junctions.

1.5.2. Economic Feasibility

The main components used for the expected system are easily available in local electronics market and inside college and the cost of all the components are reasonably cheap.

CHAPTER 2: LITERATURE REVIEW

2.1. Literature Review

Traffic signal systems have been implemented since the early twentieth century as a process of continuously managing traffic flow and for smooth and safe automobile transportation. Due to the continuous increase of vehicles in urban areas, there is a need for further evaluation and implementation of traffic signal systems.

Density, speed, and flow are the three critical parameters for road traffic analysis. For a high performance real time traffic management analysis and control require estimation of mean speed effective area and density of space is needed. The position and speed from the vehicles is utilize to optimize the traffic control

The smart Traffic light is implemented in various countries such as Indonesia, China, USA and soon which is commercially made by Surtrac based on the research done by Carnegie Mellon University. The project has been attempted by the past students of KEC but controlling the traffic using density hasn't been done yet. The research and study of smart traffic control is being carried out by National Institute of Technology and IIT based on PLC and cement based piezoelectric sensor for real time application. The research system specifies the use of onboard sensors in vehicles and standard wireless communication protocol specified for vehicular applications by implementing various traffic signal Control Algorithm. By integrating ITS into its traffic signal system, the city of Seattle, Washington, has witnessed notable improvements to both motor vehicle flow and capacity. Through a combination of loop detectors and traffic signals as illustrated in Figure 3, Interstate 5 in Seattle has improved rush hour capacity by 10% to 100% while also increasing highway speeds. Additionally, the accident rate was reduced by 39%. Table 3 confirms that other cities have seen similar benefits from this method of metering freeway entrance ramps.

The expected system contains Ultrasonic Sensor. The Sensor counts the vehicles and density on the road and Microcontroller atmega328p generates the result. Density based Signal Management in Traffic System shows how traffic light signal control, including with the implement of Traffic Scheduling Algorithm which gains information of the vehicles speed and position. If the density of the road traffic is high then Maximum density of traffic will allow maximum default timing for traffic lights. Minimum density of traffic will allow traffic with minimum timing for traffic lights. If the traffic rate on both side is Equal or gap within traffic then according to arrival time traffic light signal set to minimized. The system also proposes the Priority Based traffic light signaling which help to assign the priority to the lanes with highest traffic density as per demand in order to control the traffic smoothly. When there is an emergency situation like ambulance, fire brigade stuck in traffic, accident then the system is switched to manual mode. The density is measured in three ways low, medium and high according to which the timings are allotted for signals. The timing overridden is done using Bluetooth technology in android device or by manual controller. When the traffic density increase more than a limit at one particular side, it needs a longer green light duration to ease traffic flow. The system uses a microcontroller that is interfaced with Ultrasonic sensors. These sensors are used for line of sight object detection using which the system gets an input of the traffic density. Traffic density is measured as “low, medium and high”. Based on this density reading the system adjusts and varies the traffic signal duration for that particular way.

CHAPTER 3: SYSTEM REQUIREMENT

3.1. Hardware Requirement

3.1.1. AVR Microcontroller

The AVR is a modified Harvard architecture 8-bit RISC single-chip microcontroller. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM,EPROM, or EEPROM used by other microcontrollers at the time. The main heart of this traffic system is microcontroller. The smart traffic light management system is controlled by using Atmega328p because it is easy to program, sufficient number of input output lines, manageable size of RAM and ROM and simple architecture. System program and application program are stored using RAM and ROM. It determines traffic on each road based on sensor's value.

3.1.2. Sensor

i. Ultrasonic Sensor

The principle by which ultrasonic sensors yield measurements is that of evaluating the time taken for the sound to travel between transmission and reception (direct detection), or a process of checking whether the transmitted signal has been received (detection by beam interruption). The sensing range covers 10 g/m² paper to 2000 g/m² carton. Theoretically the sensor has a range of 50m but it can detect up to 40m. The area cover by the sensor determines the density of the traffic. It can easily be interface with a microcontroller.

3.1.3. Basic components

Instead of traffic lights, The LEDs (RED, GREEN, YELLOW) can be used. In normal traffic system, the LEDs are turned on time basis. If the traffic density is high on any particular path, then glows green LED of that particular path and glows the red LEDs for remaining paths. Basic hardware components are

- PCB board
- Voltage Regulator
- Serial cable
- Connecting wires
- Oscillator

3.2. Software Requirement

3.2.1. Proteus

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. It is a CAD Design software used for Schematic Capture, Microcontroller Simulation and PCB Design. Before hardware implementation, the whole circuit is simulated in this Cad designing software and based on the result the product is made.

3.2.2. Atmel studio

Atmel Studio is the integrated development platform (IDP) for developing and debugging Atmel SMART ARM-based and Atmel AVR microcontroller (MCU) applications. Studio supports all AVR and Atmel SMART MCUs. The Atmel Studio IDP gives a seamless and easy-to-use environment to write, build and debug the applications written in C/C++ or assembly code. It also connects seamlessly to Atmel debuggers and development kits. Atmel Studio can also able seamlessly import your Arduino sketches as C++ projects, providing a simple transition path from Maker space to Marketplace.

CHAPTER 4: METHODOLOGY

The basic concept is to make use of the Ultrasonic Sensor to send the ultrasonic waves to the object so that it can detect its presence and also calculate the total area occupied. The sensor is used to detect the reflected waves from the incident objects. The use of the Ultrasonic sensors can detect the density of the vehicles on the road that can be used to detect the total area occupied by the traffic on the specific path. The signals that are generated from the sensor are applied to the input switching circuits. These input signals generated are in digital form that indicate the presence of absence of the vehicles. These digital signals from each road will be given to the input port of the microcontroller, where the microcontroller will determine the density of the vehicles at each. Then the microcontroller decides the road where the traffic light signal should be green. The continuous comparison of the density of the vehicles makes the whole system intelligent than the present time based systems.

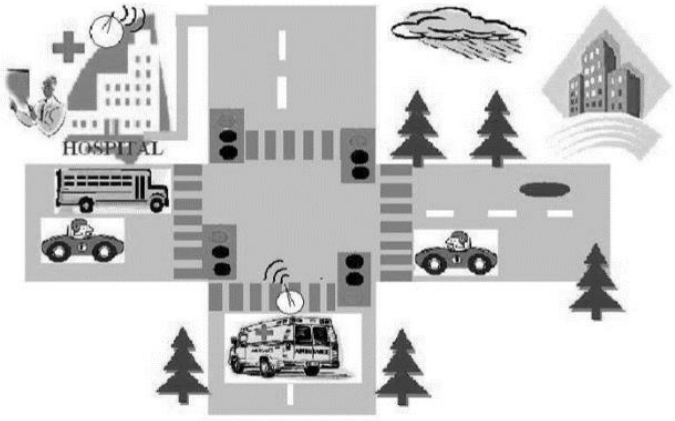

Figure 4.1: Simple model of the system in operation

The system consist of a manual control mechanism which can be access by switch driven circuit using a wired system or by a Bluetooth module that access by using smartphones via an app. The system is constantly monitor by an operator that overrides the control over automatic operation. The system is also capable of the manual override and can be wirelessly controlled via Bluetooth in case of

emergency. The system is fully automatic and intelligent so the system requires less manpower. This is how the system is mainly works.

4.1. Hardware Development

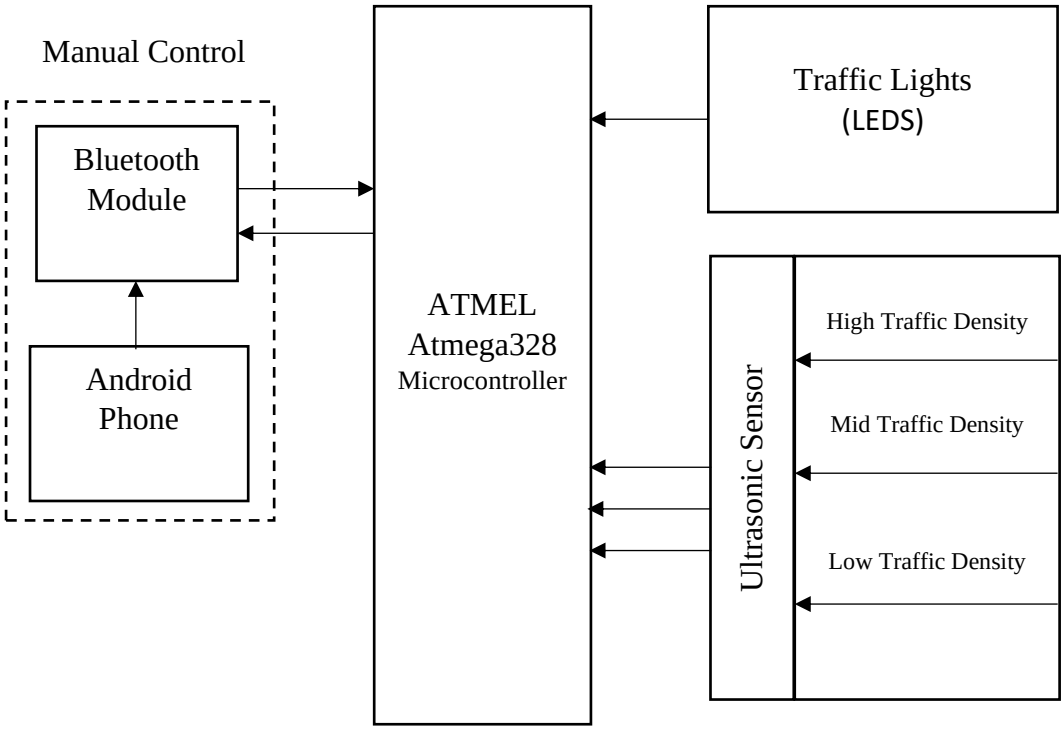

Figure 4.2: Block Diagram of System

4.2. Software Development

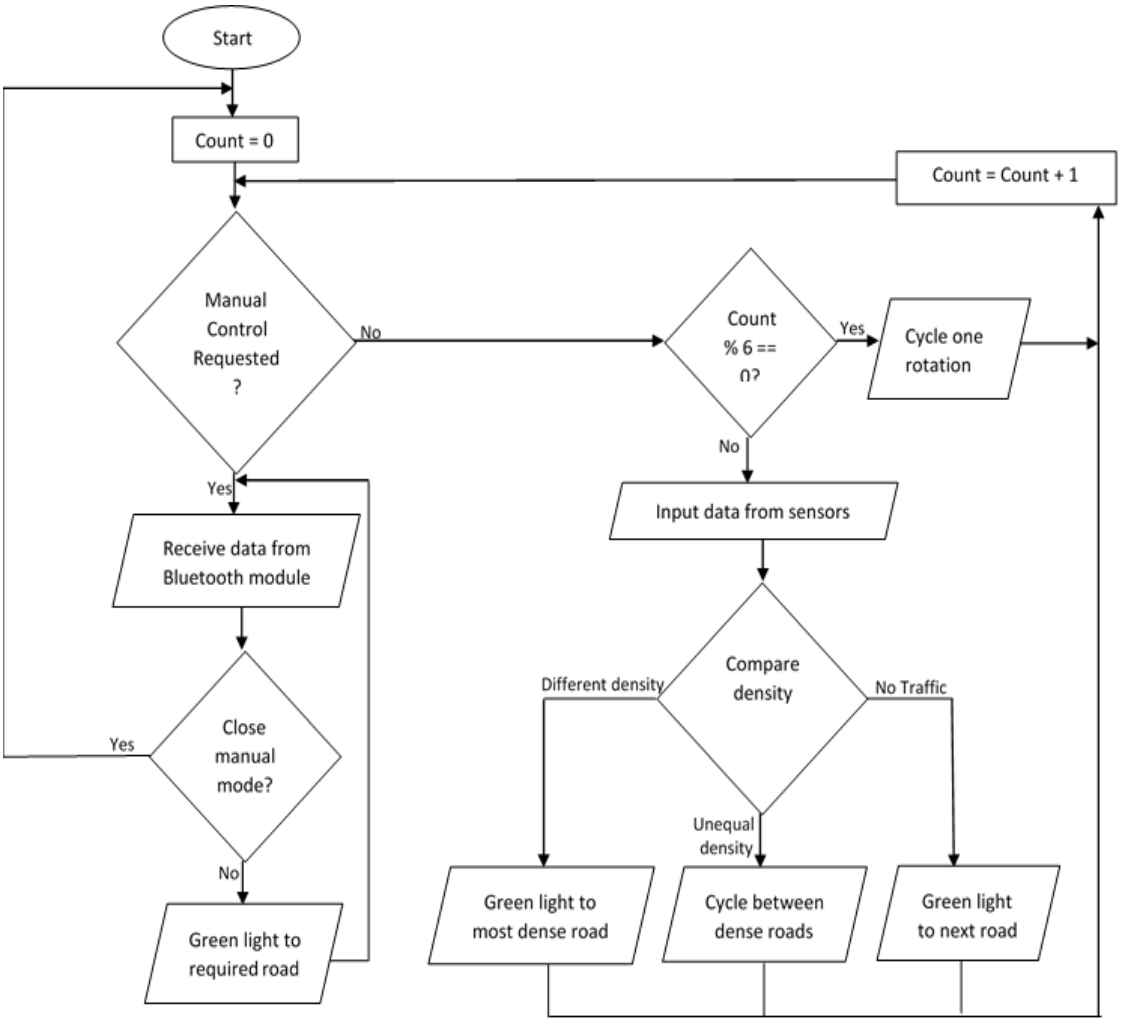

Figure 4.3: Flowchart of the System

4.3. Cost Estimation

With some relevant assumptions, previous trends and market analysis, we have estimated the cost of the components required for “Density Based Automatic Traffic Light Control System” as:

Table 4.1: Cost Estimation

S.N	Components	Quantity	Unit Price(RS)	Net Price(RS)
1.	ATmega328p	1	800	800
2.	Ultrasonic Sensor	8	300	2400
3.	Oscillator	2	150	300
4.	PCB board	1	200	200
5.	Resistors, Capacitors, Transistors, LED’s	-	-	600
6.	Voltage regulator	1	1	600
7.	IC base , Buttons, Switches	-	-	600
8.	Miscellaneous	-	-	1000
9.	Total			6500

CHAPTER 5: EPILOGUE

The Project “Density Based Automatic Traffic Light Control System” is expected to manage the traffic control with less manpower via controlling the traffic light using an Infrared light and a Microcontroller. The project is capable of detecting the traffic density and automatically controlling of the traffic. The signal is transmitted and receiver by using an Ultrasonic Sensor.

5.1. Application

There are many areas of application of this project. Some of them are:

- For smooth traffic control at urban areas.
- To reduced manpower for controlling traffic
- To reduce road accidents.

5.2. Result and Result Analysis

The output of this project is somehow similar to what was expected in the beginning. The Ultrasonic sensor, Bluetooth module works completely fine. They have been properly interfaced with the microcontroller ATmega32. Some issues related to sensors and led were seen since they had to be calibrated and fit to the traffic controlling module that we have made.

Analyzing the results, the conclusion has been made that the expectations in the beginning have become reality in the time frame. But some results are yet to be accomplished.

5.3. Limitations

Along with the advantages this project came up with, it has some limitations too.

- The system cannot automatically detect emergency vehicles.
- The system cannot automatically detect road accidents and adapt to the situation.
- The ultrasonic sensor must be well protected from the environmental factors so as the sensor are not covered by foreign objects.

5.4. Future Enhancement

There are many places for enhancements in this project.

- Use of High sensitive camera or Satellite instead of Ultrasonic sensors to detect Vechile movements.
- Advance algorithm like image processing can be implented to automatically detect emergency vechile and road accidents.
- Addition database management of vechiles movements.
- Proper management of sensor to protect it from environment factors.

5.5. Problems Faced

We had a very little knowledge about the traffic light switching algorithm. Besides building the physical layout, there were many challenges in management of traffic switching. While doing this project we encountered numerous of problems. Some of them are mentioned below:

- Development of effective light switching algorithm covering various real life road scenarios was difficult to implement.
- We encountered gradual increase in the time taken to switch the traffic lights.
- The sensor that we were using was found to be unresponsive at close range.
- Bluetooth commands were facing certain time delays that made the system slower.

CHAPTER 6: CONCLUSIONS

After we started the project we have learnt a lot from the efforts that we have put into this project. We learnt about the microcontrollers, microprocessors and the criteria for the selections of them applicable in the project. We encountered various problems while we were discussing about the project and what to be done for its solution. This project not only was a challenge for us but it was also a platform for us. Gradually we started to learn and also implement. We selected At-mega328/p as the operating microcontroller in the system. We used Ultrasonic sensor as the main sensor for detecting the density of the road.

This improved technology makes the regulation easy, accurate and enhance the flow of traffic. This reduces the human effort in many countries where automated and intelligent traffic systems as above are not developed. This system is very important for emergency vehicles. This project was thought to be a fruitful project targeting a huge mass of people from the very beginning. Hence it tries to introduce those aspects suitable for everyone. Many problems were learned regarding the practical and theoretical implementation which was later solved by properly consulting supervisors.

CHAPTER 7: REFERENCES

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