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AUTOMATIC TRAFFIC CONTROL SYSTEM

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Abstract

Traffic congestion is a severe problem in many major cities across the world and it has become a nightmare for the commuters in these cities. Traffic can be controlled in several main junctions by incorporating either automatic traffic light control or traffic police. But conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot be varied as per varying traffic density. At some times, priority of traffic light needs to be changed based on more number of vehicles waiting in same road, VIPs vehicles and Ambulance vehicles etc. We propose to design and develop a density based traffic signal system. The signal changes automatically on sensing the traffic density at the junction. The prototype model was developed using ultrasonic sensors and Arduino.

On Arduino IDE Embedded C is used to write programming according to our requirements due to its simplicity and economy and ultrasonic sensors is used to measure the traffic density in a particular road. ultrasonic sensors may have limitations that it will work in normal light also. As a result, traffic light works in improper way. In future, it may be improved by using some suitable sensors. ultrasonic sensors are arranged on each road in accurate manner to detect traffic density properly; these sensors always sense the traffic on that particular road. All these sensors are interfaced to the arduino. Based on these sensors, controller detects the traffic and controls the traffic system.

Keywords: Traffic density, Ultrasonic sensors, Arduino IDE, Embedded C.

1. Introduction[1,2,5]

In modern life we have to face with many problems one of which is traffic congestion becoming more serious day after day[1]. It is said that the high volume of vehicles, the inadequate infrastructure and the irrational distribution of the development are main reasons for increasing traffic jam. The major cause leading to traffic congestion is the high number of vehicle which was caused by the population and the development of economy. Traffic congestion[2] is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. The most common example is the physical use of roads by vehicles. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, these results in some congestion .As demand approaches the capacity of a road (or of the intersections along the road), extreme traffic congestion sets in. When vehicles are fully stopped for periods of time, this is colloquially known as a traffic jam or traffic snarl-up.

Traffic congestion can lead to drivers becoming frustrated and engaging in road rage. In order to avoid the congestion in the traffic. In traffic environments, Traffic Sign Recognition[2] (TSR) is used to regulate traffic signs, warn the driver, and command or prohibit certain actions. A fast real-time and robust automatic traffic sign detection and recognition can support and disburden the driver, and thus, significantly increase driving safety and comfort.

Generally, traffic signs provide the driver various information for safe and efficient navigation Automatic recognition of traffic signs is, therefore, important for automated intelligent driving vehicle or driver assistance systems[1]. However, identification of traffic signs with respect to various natural background viewing conditions still remains challenging tasks. Real time automatic vision based traffic light control has been recently the interest of many researchers, due to the frequent traffic jams at major junctions and its resulting wastage of time. Instead of depending on information generated by costly sensors, economic situation calls for using available video cameras in an efficient way for effective traffic congestion estimation. Thus, given a

video sequence, the task of vision based traffic light control list: 1) analyze image sequences; 2) estimate traffic congestion and 3) predict the next traffic light interval.

Researchers[5] may focus on one or more of these tasks, and they may also choose different measures for traffic structure or add measures. For more Density Based Traffic Signal System[3] comprehensive review on vision based traffic light control Due to the massive growth in urbanization and traffic congestion, intelligent vision based traffic light controller is needed to reduce the traffic delay and travel time especially in developing countries as the current automatic time based control is not realistic while sensor based traffic light controller is not reliable in developing countries. Traffic congestion is now considered to be one of the biggest problems in the urban environments.

Traffic problems[5] will be also much more widely increasing as an expected result of the growing number of transportation means and current low-quality infrastructure of the roads. In addition, many studies and statistics were generated in developing countries that proved that most of the road accidents are because of the very narrow roads and because of the destructive increase in the transportation means. This idea of controlling the traffic light efficiently in real time has attracted many researchers to work in this field with the goal of creating automatic tool that can estimate the traffic congestion and based on this Variable, the traffic sign time interval is forecasted.

2. Existing System[4]

Nowadays traffic lights are set in different directions with fixed time delay .following a particular cycle while switching from one signal to other .this creates unwanted congestion during peak hours. This is time consuming system.

The traffic lights that are in widespread use today to not do much intricate reasoning when deciding when to change the lights for the various road users waiting in different lanes. How long the signal stays green in one lane and red in another is most often determined by simple timing that is calculated when the crossing is designed .Even though today's methods are robust and work well when the traffic load is distributed evenly across the lanes in the intersection. The systems are very inefficient because they are unable to handle various simple situations that arise throughout the day Unnecessary waiting time in the signal can be avoided by determining in which side the green signal should be large during the traffic.

3. Proposed System[1]

The paper density based traffic light control is an automated way of controlling signals in accordance to the density of traffic on the roads .ultrasonic sensors are placed in the entire intersecting road at the fixed distances from the signal placed in the junction .the entire time delay in the traffic signal is set based on the density of vehicles on the road. The ultrasonic sensors are used to sense the number of vehicles on the road .According to the count Arduino mega takes appropriate decisions as to lane is to be given the highest priority and the longest time delay for the corresponding traffic light.

The results realized from the practical work and examines whether ideas and solution approaches recommended in research are met by the practical implementation.

4. Methodology

As per the methodology diagram ,initially the signals are started by giving the power supply. The first step is to make sure that the signals are all in ON condition . During this all the traffic signals will blink in yellow light. This indicates that they are all in the working condition .The next step is to check for density of traffic in these roads . By density what we

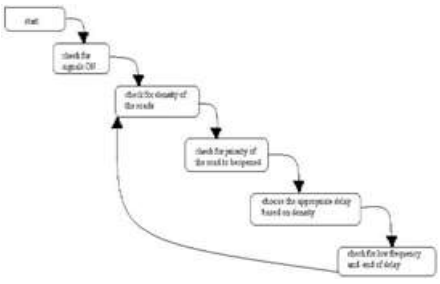

Figure 1: Methodology of the Process

are trying to mean in that the number of vehicles available in a particular at a certain period of time .The density is calculated over here by means of using an ultrasonic sensors .

Depending on the number of vehicles that cut the light travelling from the receiver to transmitter of the Ultrasonic sensors the count of the vehicles is registered in the arduino mega 2560. This is followed by the next step in which the

microcontroller decides as to which road should be given the highest priority .this is based on the density on each road and also it depends on the speed at which an ultrasonic sensors register the count The very next step is to assign time delays for each road .

The time delays have been already been set for certain specific counts from the ultrasonic circuit it will immediately detect the density of each road and accordingly allot the time delays for which each signal will show the given light . The higher the traffic density, the longer will be the time delay allotted In the final step the arduino makes sure that the lowest density road is also opened and that the delay of the green light for the particular signal also comes to an end .Once all the roads are opened in a sequence then the arduino again goes back to the second step where it checks for the density of the traffic in each road . the whole process is repeated like a cycle .The main point that is to noted regarding this process is that , whenever a particular road has no traffic correspondingly ,the yellow light in the traffic signal will glow .

5. Block Diagram

5.1 Sensors[10]

A sensor is always used with other electronics .sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base besides innumerable applications of which most people are never aware

.with advances in micro machinery and easy to use microcontroller platforms , the uses of sensors have expanded beyond the traditional fields of temperature, pressure or flow measurement for example into MARG sensors . more over analog sensors such as potentiometer and force sensing resistors are still widely used . applications include manufacturing and

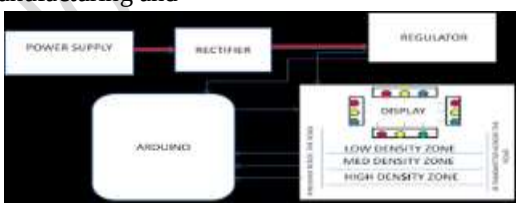

Figure 2: Block Diagram

machinery , airplanes and aerospace , cars , medicines , robotics and many other aspects of our day to day life.

A sensors sensitivity indicates how much the sensors output changes when the input quantity been measured changes . for instance , if the mercury in a thermometer moves 1cm when the temperature changes by 1 centigrade , the sensitivity is (1cm /1 centigrade) . some sensors can also affect what they measure ; for instance , a room temperature thermometer inserted into a hot cup of liquid cools the liquid when the liquid heats the thermometer . sensors are usually designed to have a small effect on what is measured , making the sensor small often improves this and may introduce other advantages.

This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required.

The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

.Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave, we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

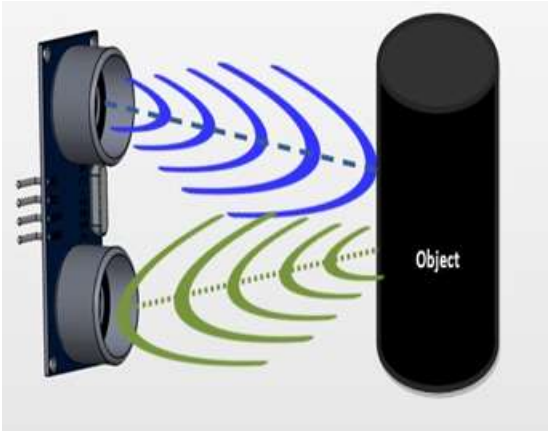

Figure 3: Ultrasonic sensor HC-SR04 Module

5.2 Timer[10]

A timer is a specialized type of clock used for measuring specific time intervals. Timers can be

categorized into two main types. A timer which counts upwards from zero for measuring elapsed time is often called a stopwatch, while a device which counts down from a specified time interval is more usually called a timer. A simple example of this type is an hourglass. Working method timers have two main groups: Hardware and Software timers. Most timers give an indication that the time interval that had been set has expired. Time switches, timing mechanisms which activate a switch, are sometimes also called "timers".

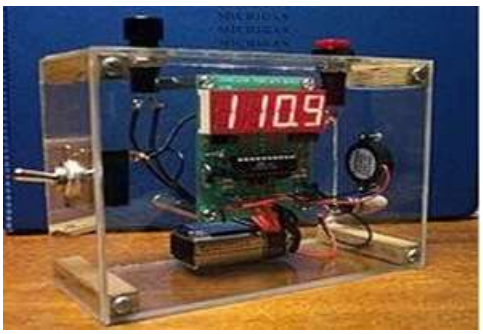

Figure 4: An Electronic Timer

5.3 ARDUINO Mega 2560[10]

Arduino is an open source hardware and software project that designs and manufactures single-board microcontroller kits for building digital devices. An arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards. Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on chip flash memory. Arduino and arduino compatible boards use printed circuit expansion boards called shields, which plug into the normally supplied arduino pin headers.

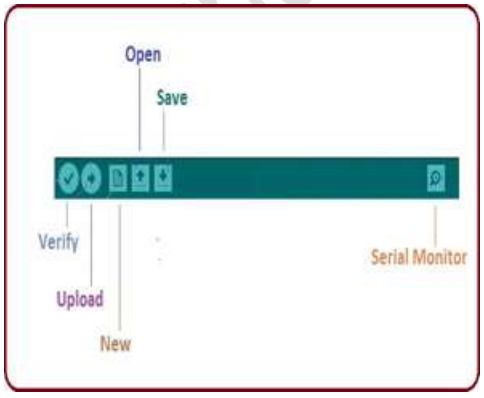

Figure 5: Various operations in Arduino IDE Software

Arduino Mega 2560 can be programmed using Arduino Software called IDE which supports C programming. The code you make on the software is called sketch which is burned in the software and then transferred to the board through USB cable. This board comes with a built-in boot loader which rules out the usage of an external burner for burning the code into the board. The boot loader communicates using STK500 protocol.

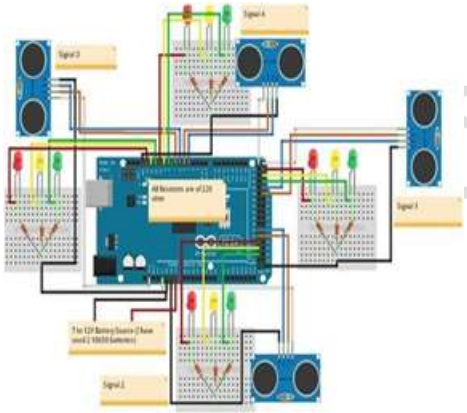

Figure 6: Arduino Mega 2560 Circuit Diagram

Once compile and burn the program on the board is done , unplug the USB cable which eventually removes the power from the board. When you intend to incorporate the board into your project, you can power it up using power jack or Vin of the board. Multitasking is another feature where Arduino mega comes handy. However, Arduino IDE Software doesn't support multitasking feature but you can use other operating systems like Free RTOS and RTX to write C program for this purpose This gives you the flexibility of using your own custom build program using ISP connector.

5.4 Arduino IDE[10]

An IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

5.5 EMBEDDED C[10]

Embedded C Programming is the soul of the processor functioning inside each and every embedded system we come across in our daily life, such as mobile phone, washing machine, and digital camera.

```
#include<TimerOne.h>
```

```
int signal1[] = {23, 25,  27};
int signal2[] = {46, 48,  50};
int signal3[] = {13, 12,  11};
int signal4[] = {10, 9, 8};

int redDelay = 5000;
int yellowDelay =  2000;

volatile long time; // Variable for storing the time traveled

volatile int S1, S2,  S3, S4; // Variables for storing the distance covered

int t = 5; // distance under which it will look for vehicles.
void setup(){
Serial.begin(115200);
Timer1.initialize(100000);          //Begin using the timer. This function must be called first. "microseconds" is the period of time the timer takes.
Timer1.attachInterrupt(softInterr);  //Run a function each time the timer period finishes.
```

Each processor is associated with an embedded software. The first and foremost thing is the embedded software that decides functioning of the embedded system. Embedded C language is most frequently used to program the microcontroller. Earlier, many embedded applications were developed using assembly level programming. However, they did not provide portability. This disadvantage was overcome by the advent of various high level languages like C, Pascal, and COBOL. However, it was the C language that got extensive acceptance for embedded systems, and it continues to do so. The C code written is more reliable, scalable, and portable; and in fact, much easier to understand.

The embedded system designers must know about the hardware architecture to write programs. These programs play prominent role in monitoring and controlling external devices. They also directly operate and use the internal architecture of the microcontroller, such as interrupt handling, timers, serial communication and other available features.

6. Results:

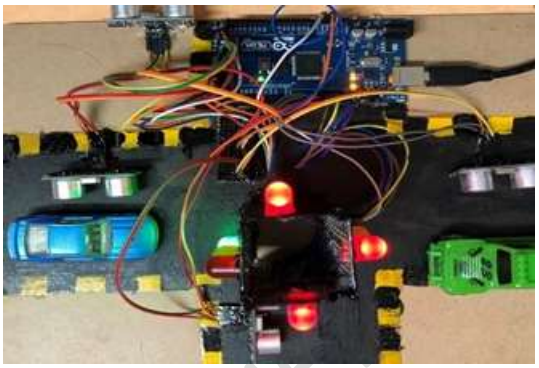

Figure 7: Line 1 Output

Figure 7 shows the output across lane 1 i.e, the green signal which is appearing across lane 1 indicating the density across lane 1 of the '+'junction.

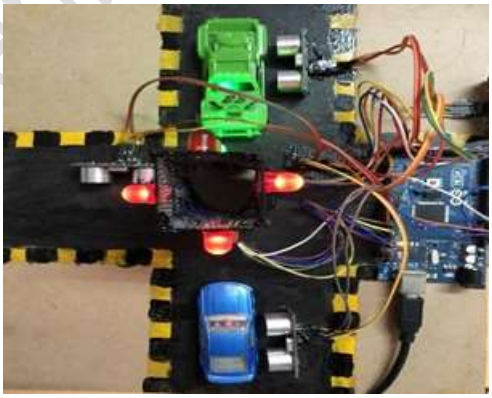

Figure 8: Line 2 Output

Figure 8 shows the output across lane 2 i.e, the green signal which is appearing across lane 2 indicating the density across lane 2 of the '+'junction.

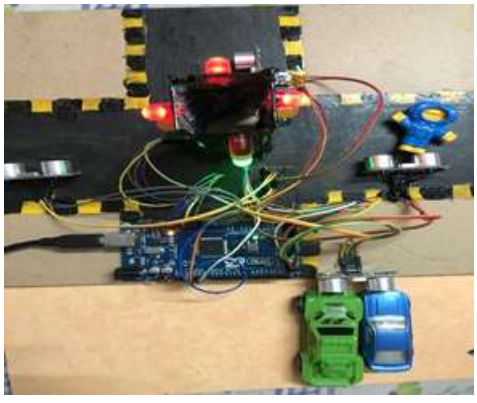

Figure 9: Line 3 Output

Figure 9 shows the output across lane3 i.e, the green signal which is appearing across lane3 indicating the density across lane3 of the '+'junction.

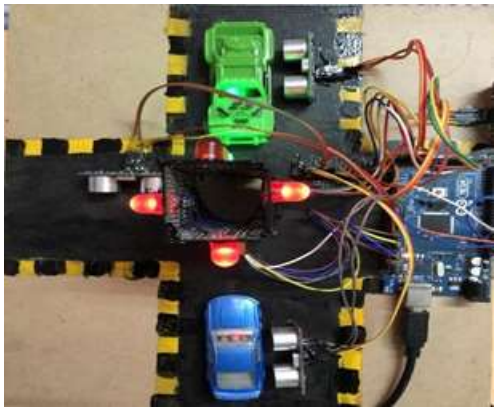

Figure 10: Line 4 Output

Figure 10 shows the output across lane 4 i.e, the green signal which is appearing across lane3 indicating the density across lane 4 of the '+' junction.

7. Conclusion

Continuous growth of population all over the world creates a great challenge to the transport management systems. The conventional methods are no longer effective enough for solving complex and challenging transportation management problems. More economical, more efficient and thus more intelligent methods have to be developed to deal with these challenging problems. Knowledge from different research areas is needed for developing these systems.

Very often complex transportation systems require integration of different methods from different branches of science. Due to the increased amount of vehicles, it is necessary to take effective steps in order to control the traffic and hence avoid all types of loses that is caused due to traffic. In this design work, a density based traffic control system was developed for traffic control at '+'road intersection to reduce unnecessary time wastage and minimize road traffic causalities which the existing conventional traffic light control system has failed to ignore traffic signals. The objectives of the design were achieved and this project presents the means of controlling traffic at '+'road demonstrates a working software solution for controlling traffic based on the density of traffic on each lane at the intersection. It provides a means of succor away from the conventional traffic control system associated with even timing of lanes of traffic irrespective of the number of vehicles on the lanes which is density associated with that lane.

8. Future Scope[1]

As the system takes care of few drawbacks of the existing system, there is a 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 such as fire engines and ambulances and have priority over other traffic. This system gives highest priority to emergency vehicles to pass them. A development of an intelligent traffic signal control (ITSC) system needed because present traffic signal controllers are based on old microcontroller such as AT89C51 which has very less internal memory and on in built ADC. These systems have limitations because they will use the pre-defined program that does not have the flexibility of modification on real time application.

References

[1] "Josef Kates Found Ways to Unsnarl Traffic and Solve Business Problems With Computers". James R. Hagerty, Wall Street Journal, July 27, 2018.

[2] Sanderson Associates, http://www.traffic-signal-design.com/terminology_main.htm

[3] MD.Hazrat ALI, Syuhei KUROKAWA, et al,"Autonomous Road Surveillance System proposed Model For Vehicle Detection and Traffic Signal Control "in Procedia Computer Science 19(2013).

[4] Vivek, Tyagi, Senior Member IEEE, Shivakumar Kalyanaraman, Fellow, IEEE, and Raghuram Krishnapuram, Fellow, IEEE "Vehicular Traffic Density State Estimation Based On Cumulative Road Acoustics" in IEEE Transaction on Intelligent Transportation System.Vol.23. No.3 September 2012.

[5] Department for Transport, General Principles of Traffic Control by Light Signals TAL 1/06 https://www.gov.uk/government/publications/traffic-advisory-leaflets-1989-to-2009.

[6] Basics Archived 2008-12-16 at the Wayback Machine, Traffic Signal Training, NIATT / University of Idaho.

[7] Jump up to:**a b c** Traffic Signals 101, Minnesota Department of Transportation, 2006.

[8] Engelmann, Frederick C. (1996) A History of the Austrian Migration to Canada, Carleton University Press, ISBN 978-0-88629-283-6, p. 184.
[9] McLean, James W. (1966) "The Phony Ogre of Automation", Montreal Gazette, February 26, 1966, retrieved 2010-10-31.
[10] www.google.com.

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