Density Based Traffic Control Using Arduino & IR Sensors

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Abstract- *Congestion is a serious issue due to vehicle traffic jams. The most common causes of traffic congestion is the amount of time spend waiting for the red light to change to green. The changing of traffic light is predetermined by timer and it is not reliant on traffic volume. There is therefore need to simulate and optimize traffic control to better accommodate density based traffic rather than time based. This system attempts to solve the problem caused by traffic lights which leads to congestion of vehicles. This project, a density based traffic control system is been implemented to solve this problem. The system entails programming an Arduino using Arduino integrated development environment (IDE) to enable traffic lights give the right of access to the road by selecting the lane with the high number of cars. The traffic lights are modified to control traffic congestion and maintain a steady flow of traffic. The sensor identifies an object (I.e. a vehicle, a motorcycle etc) and signals the Arduino to control the traffic lights for its individual path. Once there is no sign identified by any of the four sensors the traffic lights keep on dealing with the traffic flow. Further research is recommended to produce the device on a large scale to be deployed to all roads in the country.*

Keywords- Traffic, IR sensors, Arduino, Density.

I. INTRODUCTION

In the present world, with growing technologies and adverse development in the metropolitan cities, traffic administration has become one of the most important fields to be dealt with. Traffic management in many cities is a major concern. A traffic light is a signalling device which controls a traffic flow at road intersections. It consists of three basic lights which include red, yellow and green. Red signal is used to stop the traffic from proceeding; yellow signal alerts vehicles to slow down for a stop, while green signal alerts vehicles to proceed in the indicated directions. Traffic congestion is a situation that happens on road networks in which vehicles travel slower than usual due to the increased physical use of vehicles (traffic) on the road at that moment. Also known as traffic jams, traffic congestion may result from roads being blocked, rough roads, accidents on the road that may occur, lack of proper traffic light system to control vehicles, inappropriate driving by road users etc. This would make the journey longer due to the slow movement of the traffic and increased queuing of vehicles. Urban communities started to make traffic tenets to minimize crashes, while traffic flags and cops were utilized to coordinate options to proceed at major urban convergences. Traffic control development in urban streets has aided easy movement and use of automobiles in big cities. Most of the major roads have an effective traffic control system, which has facilitated easy flow of vehicles.

Objectives:

1.Our project aims at reducing traffic congestion and unwanted long time delay during the traffic light switch overs especially when the traffic is very low.
2.It is designed to be implemented in places nearing the junctions where the traffic signals are placed, in order to reduce the congestion in these junctions.
3.It keeps a track of the vehicles in each road and accordingly adjusts the time for each traffic light signals.
4.The higher the number of vehicles on the road the longer will be the time delay allotted for that corresponding traffic light signal.

The main purpose of this project is, if there will be no traffic on the other signal, one shouldn't wait for that signal. The system will skip that signal and will move on the next one.

II. MOTIVATION FOR PROJECT

This is our final year project, which will draw attention of all the faculties. So, I want to make a project through which everyone can relate to it. Also in our day to day life I am always observing at the crossing of roads that in some lane there are lot of traffic compared to others lane but all the signals in our country is timing based .So we cannot manage our time. Also due to timing based the lighter dense roads are sometimes empty due to which many people start

crossing the road but due green signal in that lane vehicle moves at high speed which increases the risk of accident.

So, the best solution of these problem is to make traffic control system which control the whole traffic by density. From this we got the motivation to work on this project.

At the starting of the project we were not able to visualize it practically, but slowly we are getting information from the Internet and taking help of some of our faculties of our college to implement it practically. Any random person won't be able to visualize our efforts put in the completion of the project because after completion it looks a bit easy.

III. PRESENT TRAFFIC SIGNALING SYSTEM

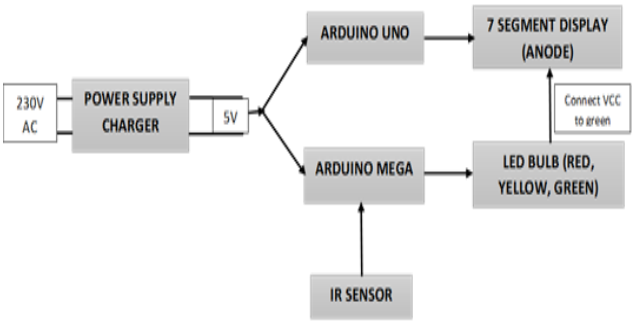
Under present scenario, traffic control is achieved by the use of a system of hand signs by traffic police personnel, traffic signals, and markings. A comparable and matching education program is needed, through driver-licensing authorities, to assure that those who operate motor vehicles understand the rules of the road and the actions that they are required or advised to take when a particular control device is present. Each traffic control device is governed by standards of design and usage; for example, stop signs always have a red background and are octagonal in shape.

Design standards allow the motorist to quickly and consistently perceive the sign in the visual field along the road. Standard use of colour and shape aids in this identification and in deciding on the appropriate course of action. Under current circumstances, traffic lights are set on in the different directions with fixed time delay, following a particular cycle while switching from one signal to other creating unwanted and wasteful congestion on one lane while the other lanes remain vacant.

Demerits of current traffic signal system :

1.Long waiting time.
2.It is unreliable.
3.This system cannot respond to unpredictable events.
4.Sometimes leads to accidents during traffic

IV. BLOCK DIAGRAM

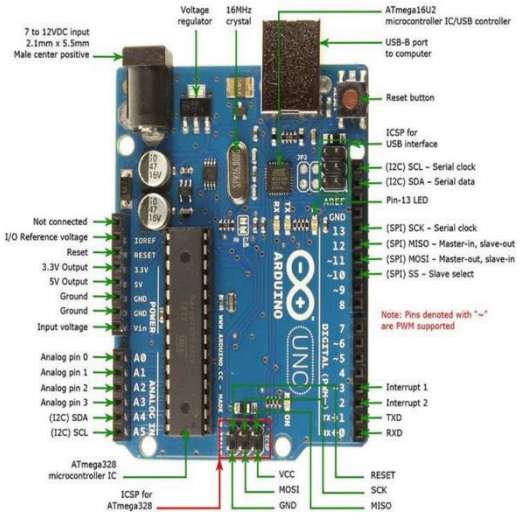


List of components used :

1.POWER SUPPLY : A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load.

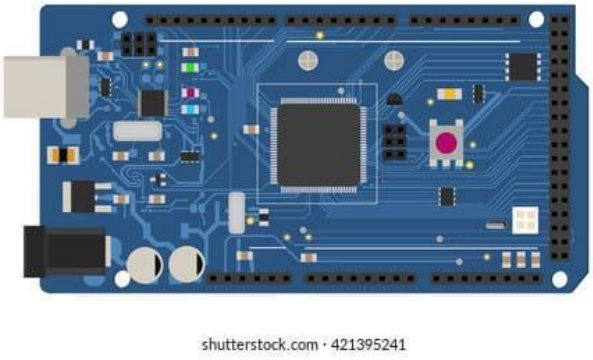
2.ARDUINO UNO :

1] Arduino is an opensource hardware based on microcontroller Atmel AT mega 328P.
2] AT mega 328P is 8bit microcontroller based on Reduced Instruction Set Computer (RISC).
3] RISC have operational speed of 20Million Instruction Per Second (MIPS) when operated at 20 MHZ.
4] It is equipped with various system namely – Memory system, Port system, Analog to digital convertor (ADC), Interrupt system & serial communication.



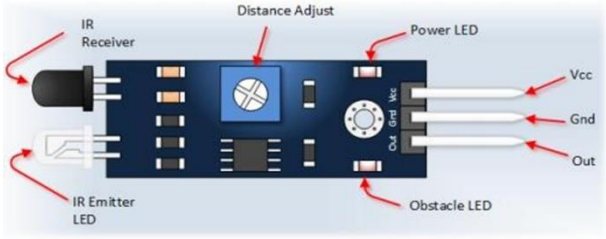
3.ARDUINO MGA 2560:

1] The Arduino Mega 2560 is a microcontroller board based on the ATmega2560.
2] It has 54 digital input/output pins, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.
3] It contains everything needed to support the microcontroller.



3.IR SENSOR MODULE :

1] IR proximity sensor is an electronic instrument which compromises of an IR light emitting diode, IR photodiode, an op-amp, couple of Resistors, & Capacitors.
2] ICLM 393 op-amp is used as comparator.
3] When IR receiver does not detect any of signal the potential at the inverting input of comparator is high & output is low.
4] If IR receiver detect some signals, the potential at the inverting terminal will be low. hence output is high.



4.LIGHT EMITTING DIODE

1] LED is an active electronic device, comparable to general purpose diode except for its ability to emit light with different wavelengths.
2] When potential difference applied across its terminals, electrons recombine with the holes.
3] It releasing the energy in the form of photons.
4] These all phenomenon is known as Electroluminescence
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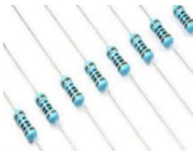
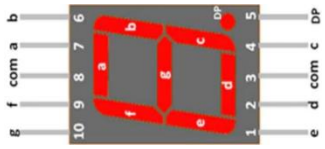
5.RESISTORS :

1] Resistors are used as current limiters for LED.
2] They prevent the damage of the LED due to high current.

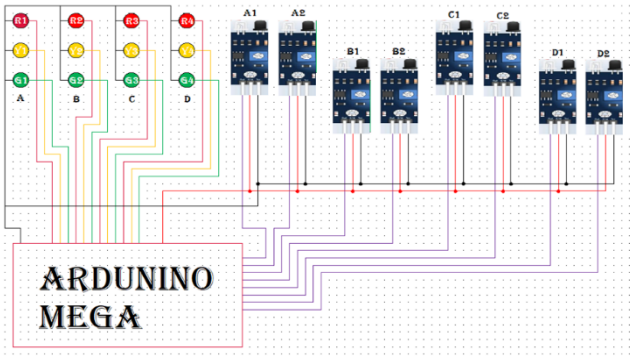


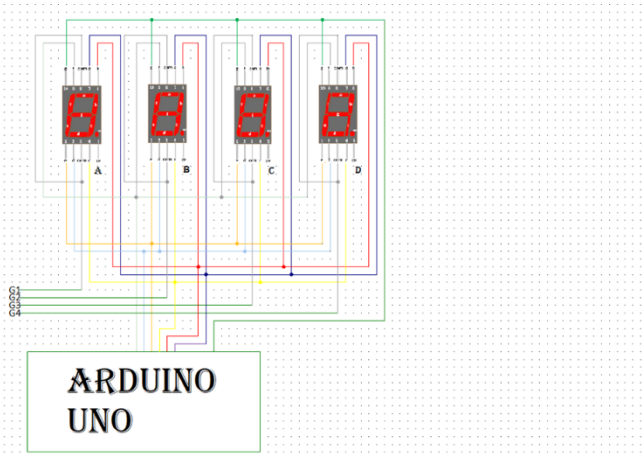
6.7 SEGMENT DISPLAY:

1] A seven-segment display is a form of electronic display device for displaying decimal numerals.
2] The numerical digits from 0 to 9 are most common characters displayed on seven-segments display.



V. CIRCUIT DIAGRAM





VI. CIRCUIT DESCRIPTION

1.Dot present in the circuit is representing the connection between two wires.
2.A1, A2, B1, B2, C1, C2, D1 and D2 are representing the IR sensors.
3.A, B, C, and D are representing the 4 traffic lights and their respective timers.
4.R1, R2 and R3 are representing red light.
5.Y1, Y2 and Y3 are representing yellow light.
6.G1, G2 and G3 are representing green light

WORKING OF THE CIRCUIT

The model works on the principle of changing of Traffic signals based on the density through an assigned section of the road. There are eight sensors placed at four sides of four way road which checks the density of the area covered by the sensors.

Here we are using IR sensors to design an intelligent traffic control system. In order to measure the density of traffic on each side, IR sensors will be kept on either side of the road at a specific distance. Each of the IR sensors consists of an IR transmitter and an IR receiver. Just as the name suggests, the IR transmitter transmits the IR rays and the receiver is responsible to receive the rays. The whole system is controlled by the microcontroller which is the Arduino. Arduino is interfaced with Serial to parallel IC (74HC595) and IR sensors. As the vehicle passes through these IR sensors, the IR sensor will detect the vehicle & will send the information to the Arduino. The total no. of IR sensors required are 8 and LEDs 12.

Three sets of LEDs via Green, Yellow and Red are used to indicate the 'GO' state, 'Ready to Go' state and 'WAIT' state. The traffic signal will be tuned with a default timing of 10 seconds of green light and all other signal will be red. After 10 seconds two signals will be yellow for 4 seconds and another two will be red. This condition will be followed till all the IR sensors receiving the signals or all the IR sensors are not getting signals. The LEDs G(green), Y(yellow) and R(red) glow in the following sequence:

G1-R2-R3-R4
Y1-Y2-R3-R4
R1-G2-R3-R4
R1-Y2-Y3-R4.
R1-R2-G3-R4
R1-R2-Y3-Y4
R1-R2-R3-G4

Y1-R2-R3-Y4
i.e., time based traffic signal will be automatically implemented when all the signals having same condition.

When condition changes, let us suppose when first side traffic signal is green and at that time third side traffic signal's IR sensor receiving data then after first traffic signal it will automatically shifts towards third traffic signal without moving to second traffic signal.

G1-R2-R3-R4
Y1-R2-Y3-R4
R1-R2-G3-R4

Similarly, let green light is On in the fourth traffic signal for 10 seconds and during that time second traffic signal's IR sensor receiving data then after green light it will take 4 seconds delay for yellow light or we can say that the delay for pedestrians to walk in order to ensure their safety and then it will automatically shifts towards second traffic signal.

R1-R2-R3-G4
R1-Y2-R3-Y4
R1-G2-R3-R4

Just taking into consideration the above conditions more further and let us suppose after second signal again forth signal's IR sensor receiving data then after 10 seconds and 4 seconds delay signal is green for forth lane.

R1-G2-R3-R4
R1-Y2-R3-Y4
R1-R2-R3-G4

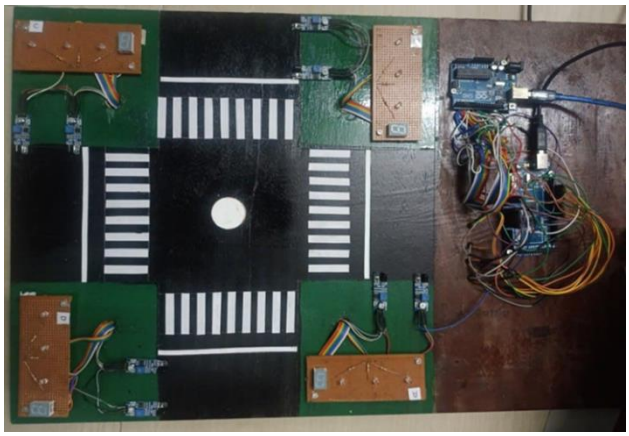
ADVANTAGES OF DENSITY BASED TRAFFIC SYSTEM

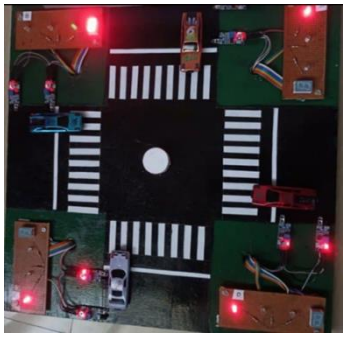
1.It provides the easy access in the traffic light.
2.Avoid wastage of time due to the traffic.
3.We can avoid unnecessary occurrence of traffic jams.
4.This System is fully automatic.
5.This requires low power consumption.

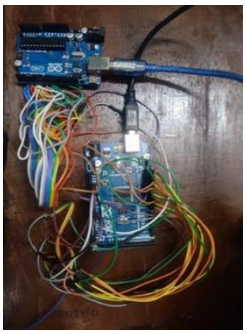
LIMITATIONS OF DENSITY BASED TRAFFIC SYSTEM

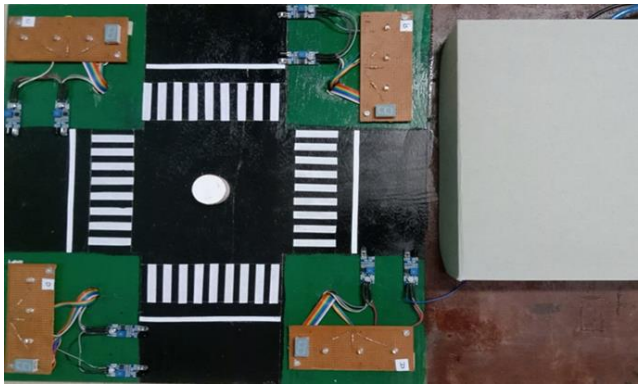
1. The sensors which are used are very expensive.
2. This system needs a lot of maintenance.
3. Low range IR sensors may not be an answer for long range signalling system. We may resort to ultrasound or radar techniques for big scale set-ups.
4. Next is the influence of stray signals that may alter the reading of sensor receptors and lead to conveying false information to the microcontroller.
5. Periodic checking of the accuracy and precision is a must for efficacious operation of this model prototype .

VII. PHOTOGRAPHS









VIII. RESULT AND DISCUSSIONS

The project is an output of 1 year of research and implementation. The circuits when implemented separately works as per the desired output however during integrating all, output fluctuates and shows different response every time. This could be a problem of loose connections of the wires or internal wiring of the bread board used. This project lists down the results realized from the practical work and examines whether ideas / solution approaches recommended in research are met by the practical implementation. For this project the main communication is by using IR technology.

From the series of experiments we have conducted the following results were obtained:

1.Traffic can be cleared without any irregularities
2.Time can be shared evenly for all intersections
3.Effective time management

IX. FUTURE WORK

Though the prototype model worked very efficiently with remarkable outputs, the real life situation is going to be way more challenging and demanding. So we need to provides powerful solution to improve existing system with new intelligent traffic light controller. Few of the challenges that should be taken into account are listed as follows:

Safety first: it has to be absolutely made sure that no compromise is being made on safety issues, i.e. a secondary stand-by set-up that can switch over from automated to manual mode, should be provided in case of sensor or circuit malfunctions so that vehicular crowd does not go beyond control. As part of future advancements, the traffic check post may be connected by wireless transmitters by which the crossings ahead may be an anticipation of the traffic that is approaching. This may be achieved the connecting the sensor network with GPS connectivity and short wave radio transmission signals. This will act as a feed forward system making the signalling system even more smooth and congestion free.

We will also update this system with modern technology so that when a vehicle try to move even during red signal it will turn on an alarm to warn the driver of the vehicle and will send the alert to the traffic warden with the picture.

X. CONCLUSION

There is exigent need of efficient traffic management system in our country, as India meets with 384 road accidents every day. To reduce this congestion and unwanted time delay in traffic an advanced system is designed here in this project. With field application of this technology, the maddening chaos of traffic can be effectively channelized by distributing the time slots based on the merit of the vehicle load in certain lanes of multi junction crossing. We have successfully implemented the prototype at laboratory scale with remarkable outcome. The next step forward is to implement this schema is real life scenario for first hand results, before implementing it on the largest scale. Presently in INDIA we face heavy traffic jams which in turn consumes lot of time & fuel, we hope these methods will be adopted as soon as possible. We believe that this may bring a revolutionary change in traffic management system on its application in actual field environment.

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