

Automated Traffic Light System with Roadblocks using IR Sensors and Arduino

Himanshu Kumar Saxena, Tejas Malik, Ankur Bhardwaj

Abstract- In the paper portrayed, we design the automation system using an Arduino ATMEGA microcontroller board for traffic light on a cross road. We created a mechanism by utilizing IR sensors governed with an Arduino ATMEGA board. In the portrayed technique of Arduino program mechanism, the timer of the traffic light will depend upon the traffic blocked by the IR sensor pair and eventually the roadblocks appear as the signal is red. The structure comprises the interconnection of drivers to a motor connected to the roadblocks. The IR pair sensors are responsible for the traffic light timer delay and emerging of the roadblocks. The Arduino ATMEGA is power-driven by a battery and an LED is coupled for its indication purpose.

Keywords- Arduino ATMEGA, microcontroller board, Photodiode, Control Algorithm, IR Sensors, DC Shunt Motor, LED, DC power supply.

I. INTRODUCTION

In the present scenario, the traffic light generally has a constant time delay for any types of traffic i.e. it will have a constant delay of timer whether the traffic is long, or traffic is short. Besides traffic lights are just indications to stop or go, due to this many people break the signal which may further cause accidents. Due to large progress of development and as well as population in India, there are large number of automobiles on the road. Because of this, there is a chance of traffic jam, especially at the traffic lights at the cross roads, which is going to consume a lot of time for drivers. To prevent any traffic jam or accidents, we have prepared a hypothesis for the same. Generally, our project will be applicable on cross roads. The IR pair sensor which comprises a transmitter and a receiver, are fastened on each side of a road i.e. on all four roads in a cross road. This is done on all four roads of the cross road. As the vehicles block the IR sensors, there will be 10 seconds as time limit on the timer and will have traffic signal as green, and rest all three roads will have red signal with 15 second time limit. This is achieved by the interconnection of IR sensors with the 40 pin Arduino ATMEGA. As, there are red signal on rest of the three roads, the roadblocks will come into play.

The roadblocks will appear to stop the vehicles to pass or break the signal when it is red. The roadblocks will only appear if the signal is red for the same time and will go under the ground when the signal turns green. As the traffic increases, the timer will also increase. There will be many layers of IR pair sensor on same lane. If the vehicles block the first layer of IR sensors then there will be time limit of 30 seconds and if the vehicles block the second layer IR sensor then there will addition 30 seconds and so on. The emerging of roadblock is controlled by a motor under the ground. So, IR sensors are responsible for the delay of traffic lights and emerging of road blockers when there is a red signal. Our proposed model can be considered as an extension to the “Density Based Automated Traffic Light System”.

II. EXISTING WORK

The population, especially in India, is growing rapidly. Due to this reason, there is a lack of decorum and discipline in following the traffic rules. There is a huge number of proposed solutions to overcome the following problems. Under the following topic, we would like to highlight some of those proposed solution. As specified above, the resulting study is an extension to research “Density Based Computerised Traffic Light System” which is grounded on the cause of eddy currents or inductive loops. The existing method uses eddy currents to measure the density of the traffic. The following research is disadvantageous due to the initial cost and maintenance cost would be very high. Another method is implemented using a piezoelectric device. The piezoelectric instruments are exercised to evaluate the compactness of the traffic and send the resultant output to its corresponding microcontroller board which in turn gives the time interval for green signal. Moreover, another exploration has been prepared which is, Traffic Light System using the employment of PLC. The existing hypothesis, includes a smart ambulance technique which allows the ambulance to signal to be green till it passes, using RFID. Our model is also based on the same principle, but we are adding an extension to it which is the usage of roadblocks when there is a red signal. So, our proposed model not only includes smart and automated traffic control system but also an addition of roadblocks will prevent accidents and will maintain the discipline of traffic rules and regulations, especially in a densely populated area.

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III. PROPOSED WORK

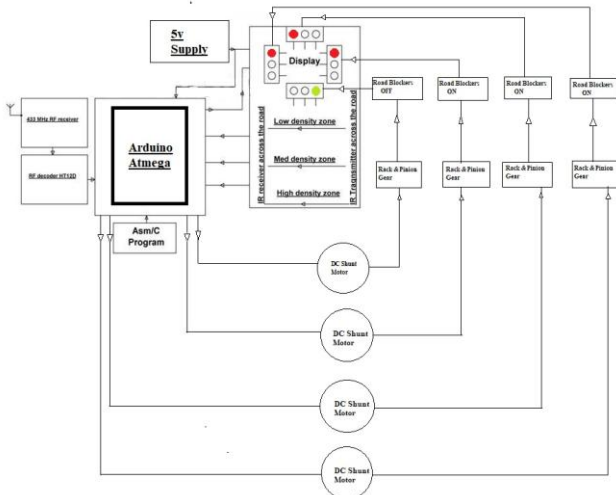


Fig 3.1: Block Diagram of Smart Traffic Light System with roadblocks

The work is to measure the density of traffic and switch signals respectively with road blockers emerging out whenever there is a red signal and going down when the green light appears. There are three IR sensors placed at four lanes of a cross road. The main thesis of our presented model resides Arduino itself. The model fully battery operated and therefore efficient. A constant 5 voltage is supplied using the interconnection of IC7805 and capacitors. This supply is linked to the Arduino, traffic lights and the motor. On the road, there are IR pair sensors attached at either side of the lanes. These IR sensors are used to detect the density of the traffic notify the Arduino about the behaviour traffic according to which the traffic lights will be manipulated, and the roadblocks will emerge out accordingly. The distance between the IR sensors is assumed to be the average length of a car. When IR sensors sense the occurrence of any vehicle, it will send the signal to the comparator which then sends the digital signal to Arduino. When the input voltage is less (V_{in}) than the reference voltage (V_{ref}) the LOW signal would be passed but if input voltage (V_{in}) is greater than reference voltage (V_{ref}) of the comparator then HIGH signal is passed. If the IR sensor finds any vehicle, the comparator output will go low and vice versa. According to the established program, the Arduino sends the signal to traffic lights for required delay for green signal which is proportional to number of vehicles passing through IR sensors. When the green signal given to a lane, the three lanes will get red signal. So, Arduino sends the signal to the DC shunt motors further which is attached to rack and pinion gear, which is responsible for emerging of the roadblocks. Furthermore, RFID concept is also involved for ambulance, police vehicles and fire trucks. When an ambulance is stuck in the traffic, then they can use RFID transmitter to send signal to the 433 MHz receiver and decoder, which is connected to Arduino itself. The signal of the traffic light will be green till the ambulance passes the traffic signal or the receiver stops receiving signals from the transmitter. Road Blockers are generally be made of softer material instead of hard metals to avoid injuries to the driver when his car collides with the road blockers. Furthermore, the road blockers will have proximity sensors on its top so that, whenever a vehicle is stranded over a road blocker, then they won't emerge until the car is removed from there.

The system would be perfectly waterproof and dustproof so as to reduce any fault in the machines during rainy or stormy weather. The Arduino bionetwork is encompassed of an assorted grouping of hardware and software. The adaptability of Arduino and its ingenious interface sorts it a foremost choice for an inclusive range of users every part of the world from hobbyists, inventors, and performers to product samples. The Arduino board is linked to a CPU via USB, where it links with the, Arduino development environment (IDE). Arduino program code is written in Embedded C with an additive of unique methods and functions.

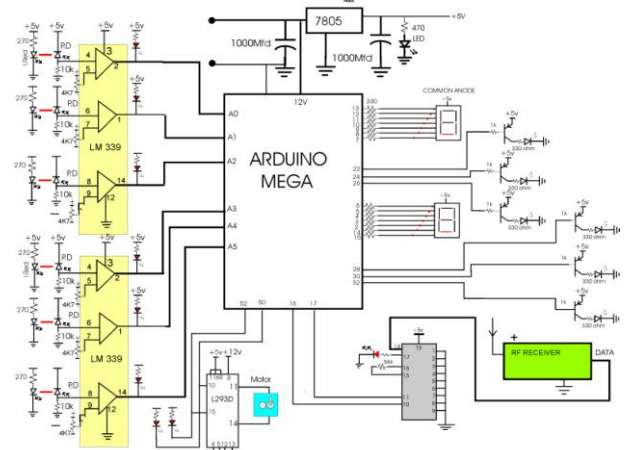


Fig 3.2: Circuit Diagram of Smart Traffic Light System with roadblocks

From the presented hypothesis, we configured the delay time by programming interface using Arduino. The IR sensors are coupled with the Arduino, it is seen that, according to our model the number of IR pair sensors covered by the vehicles are directly proportional to the delay time of green signal. So, the delay time for red signal would be the summation of delay time of yellow signal and delay time of green signal.

$$t_{r2} = t_{g1} + t_y$$

where,
 t_{r2} is the time delay for red signal for second lane which is adjacent to first lane
 t_{g1} is the time delay for green signal for first lane
 t_y is the time delay for yellow signal

$$t_y = 5$$

As delay for yellow signal is independent of the number IR sensors covered by vehicles therefore, it is set constant. So, the value for delay time of yellow signal is set as 5 seconds in the Arduino using the Arduino IDE. So, the equation becomes,

$$t_{r2} = t_{g1} + 5$$

So, the time delay for other lanes in a cross would be as follows,

$$t_{r3} = t_{r2} + 5$$

$$t_{r4} = t_{r3} + 5$$

$$t_{r1} = t_{41} + 5$$

The delay time for green signal and red signal is also given through the programming interface which can be seen by the data given below in the table.

Table 4.1: Time Delay for Signals

IR Sensors covered by Vehicles	Delay for Green Signal (in sec.)	Delay for Yellow Signal (in sec.)	Delay for Red Signal (in sec.)
0	10	5	15
1	20	5	25
2	30	5	35
3	40	5	45

IV. CONCLUSION

We have a proposed solution to the problems that still remain in the Indian system and cause the commuters to face numerous effects like accidents due to faulty lights, illegal crossing while the signal says red, heavy traffic jam, etc. The proposed solutions, if implemented properly and applied strictly, would make a versatile traffic crossroad which will be able to handle every problem efficiently. The various ideas we include in the system are density-controlled traffic lights, roadblocks and IOT based vehicle recognising and managing systems. Internet of Things is deemed to show an imperative role in supervising traffic signals. Out of these, the density of the traffic lights can be achieved either by infrared sensors, or inductive loops or employing specialised density calculator software. This has already been proposed by many scholars in the past. What lets our system stand out is the integration it offers with roadblocks and IOT. The roadblocks will pop out, if one tries to jump the light illegally. They will be carefully timed so as to not harm the speeding traffic when light changes from green to yellow. The third integration that we have offered is the incorporation of IOT based devices in the working of the traffic light. They will manipulate traffic and manage it efficiently when situations demand. As an example, when an ambulance is stuck in the traffic, the devices after recognising it using RFID technology, will try to give that side of the crossroad a go in the least time. They can also be tasked to find out the route to the nearest hospital with the lowest number of red lights. Then they will inform the ambulance using IOT. It is a fun and effective way of regulating the term 'safety rule'. Not only safety wise, our model will be made dust proof and water proof, so that no further fault or maintenance will be required. Another application allows us to recognise a stolen vehicle in the traffic and send its possible route to the nearby police station or traffic police. This will be immensely useful due to its RFID and interconnected networking abilities. Various other methods can interface with the model we propose, which will be very effective and easy for other authorities in the future. These together will make one a versatile traffic crossroad.

FUTURE SCOPE

Time is the most precious thing. We can't allow to spare even a second from our daily routine. Congestion of road plays a vital role. With the increase in population and concern for comfort 90% of the population have motor

vehicles and managing those vehicles on the road for smooth and efficient functioning of traffic is very important. Specially ambulance having patients in it face the most difficulties. There are numerous domains in which our scheme can be developed in the future. First and foremost is the idea adopted in the calculation of traffic density. As described in the literature survey, there are three ways commonly adopted in this area, viz, Infra-red techniques, image processing techniques and the conventional inductive loops. Another revolutionary idea that we could incorporate in our scheme is the RF technology. As we know, rf technology works on the radio frequency. This is a fairly busy frequency band. All our radio and television devices work on radio frequencies. But the attenuation caused by the noise persistently present drops fairly quickly as the distance between the communication transmitter and receiver decreases. Hence, the proper function of traffic and to avoid accidents, people are continuously coming up with better ideas. We all are very much familiar with the present scenarios and the future holds not less than what we have today. The future of our model proposed for traffic signals will surely enhance the lifestyle of human beings. It will also help in locating the ambulance and the and the information about the patient's health condition will be sent to its following hospital. So, before the ambulance arrives, the hospital will finish all the formalities to reduce fatigue to the patient improving the medical facilities especially in government hospitals. Moreover, the safety rule cannot be avoided. Cameras can be attached to all the traffic lights and anyone who violates the code of conduct, the cameras will capture the number plate and the car owner will be identified and the penalty will be issued against him and his driving license will be disabled temporary till he pays his penalty and this process is done by Internet of Things. In addition to the cameras coupled to the traffic light poles, it will also help the police or higher authorities to pin the location of the criminal's vehicle, by using the road blockers. Police can automatically enable the road blockers to emerge out using RFID. The future holds a great in terms of safety as well as it can be a efficient functioning of the human lifestyle.

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AUTHORS PROFILE



Tejas Malik has completed his 10th and 12th from Indraprastha International School and his B. tech from SRM Institute of Science and Technology. He is currently working in DXC technologies. He is an eager beaver and is fascinated by the new technological innovations and advancements happening all around the world. In the context, He make concerted efforts in

keeping himself abreast with exciting and emerging technologies beyond his core engineering field. Besides his academics, he kept himself engaged in activities and programs at his college and school. His involvement in various social events has allowed him to work closely with his peers while supporting the school and college community, which experiences have helped him develop strong leadership and communication skills.



Ankur Bhardwaj has completed his B. tech from SRM Institute of Science and Technology. Science has always fascinated him since he was a child. He has always been interested in the operation of machine and was always curious about knowing the working of machine. This interest leads him to opt science in his

high school. Time management is his key to success. Giving time to studies and other activities and games made his schooling easies. He also won student of the year in class 11th for his good performance in sports and academic. Throughout his undergraduate years, subjects like Power System and Analysis, Control Systems, Electrical Networks, Electrical Measurements, High voltage Engineering, and Electrical Machines all served to further his knowledge of, and appreciation because electricity and the modern world interact and intertwine. He utilized his time in the engineering to develop his knowledge about the basic concepts of power systems and electrical engineering, and He learned about the connections in circuits that allow for the use of a multiplicity of machines, and gained an understanding of motors, i.e. AC/DC, and synchronous Motors.



Himanshu Kumar Saxena is a graduate student in electrical and electronics engineering from SRM Institute of Science and Technology. He is 21 years old. He resides in New Delhi. As of his educational qualification parameters, he has an aggregate of 8.8 on a 10-point scale in his 10th, thus translating to 87.4 percent and 85.2 percent in his senior secondary level.

He has been able to score 7.6 on a 10-point scale in his engineering. As of his other activities, he is deeply interested in innovation in the practical areas of electronics and sciences. As of his hobbies, he likes reading books.