DENSITY BASED 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 people in these cities. Traffic can be controlled in several main junctions by incorporating either automatic traffic light control or traffic police. Conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot to be varied as per varying traffic density. At some times, priority of traffic light needs to be changed based on number of vehicles moving on road, and emergency vehicles like fire brigades, very important person 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 including Infrared sensors and Arduino, which helps to overcome the limitations of traffic congestion over time based traffic control system.

***Keywords* -: Arduino, Infrared sensors, Light emitting Display.**

I. INTRODUCTION

Traffic congestion is a severe problem in many modern cities all over the world. To overcome the problem we have come up with an exclusive idea for a dynamic and automatic traffic light control system combined with a simulation mode Traffic research has the goal to optimize traffic flow, as the roads have become overloaded with increasing number of vehicles and resources are limited. However, still there are some limitations in existing traffic control which are not environmental and economic. [1] Angus, P. D. 'Modeling of Traffic Signal Control and Transit Signal Priority'. Massachusetts Institute of Technology, 2001.There is several models which give solutions for traffic simulation. In our project we have focused on optimization of traffic light controller in a city using sensor traffic light optimization is a big problem. Even for single junction there is no optimal solution. The problem becomes even more complex with multiple junctions, as the state of one light is responsible for the flow of traffic of that road only. Another complication is that the flow of traffic density frequently changes, depending on the time of day, the day of the week, and the time of year very problem in many modem cities world will overcome.

II. LITERATURE REVIEW

Amit Kumar Bhakata. (2016) Published paper "Density Based Dynamic Control System" He aimed at designing a "Density Based Dynamic Control System" where the timing of signal will change automatically on sensing the traffic density at any junction. Traffic congestion density, speed, and flow are the three critical parameters for road traffic analysis. High-performance road traffic management and control require real-time estimation of space mean speed and density as input for large spatial and temporal coverage of the roadway network. This article studied about the dynamic traffic control system and based on radio propagation model for predicting path loss &link. The author suggests in concluded destination information for calculating load traffic on road for reducing the conjunction on road. The general belief was more difficult to estimate and predict traffic density than traffic flow. [2]

Jan St Tulsiramji Gaikwad-Patil (2019) published paper on **"**Density Based Traffic Control System with Priority for in that system time manipulation was used for controlling Traffic Light. This system Controls Traffic over multiple intersections, such as, it is becoming very crucial to device efficient, adaptive and cost-effective traffic control algorithms that facilitate and guarantee fast and smooth traffic flow that utilize new and versatile technologies. In a dynamic vehicle detection method and a signal control algorithm to control the state of the signal light in a road intersection using the Wireless sensor networks (WSNs) technology was proposed. Traffic light controlling or optimization is a complex problem. With multiple junctions, the problem becomes even more complex, as the state of one light agree the flow of traffic towards many other traffic lights. The complication is the fact that flow of traffic frequently changes, depending on the time. In this paper, an intelligent traffic light control system based on WSN is presented. The system has the potential to revolutionize traffic surveillance and control technology because of its low cost and potential for large scale deployment. This system gives priority to the emergency vehicles such as ambulance. [3]

Saiba Afeefa Aruna (2017) published paper on "Density Based Traffic Signal System Using PLC and Microcontroller" In Traffic System track traffic density at junctions using Road Side Unit (RSU) and control the traffic signals Red &Green indication. The delay given for Red or Green Signal at a square will dynamically determine traffic density by communicating with the vehicles Road Side Unit (RSU). The uniqueness of our work is that the control is not just based on traffic density calculation but also priority. The Improved Priority Based Signal Management in Traffic system is capable enough to track multiple priority based vehicles. Vehicular Ad Hoc Network (VANET) is a network in which each node represents a vehicle equipped with wireless communication technology and can communicate with other nodes like other vehicles or Road Side Units. [4]

Gerard P. Michon (1985) published paper on "Priority Based Traffic Management Systems" The main goal of VANET is to provide safety and comfort for passengers on road. A Road Side Units (RSUs) is an access points, used together with the vehicles, or collect count of the traffic from no of vehicles to allow information dissemination in the roads. The concern data can be used to create Priority Based Traffic Management Systems, which can automatically update traffic light delay. Congestion in road traffic is a serious issue and timing of traffic light is pre-defined or fixed in the traffic light and it is independent on traffic density. [5]

Satya Priya Biswas (2017) published paper on "Intelligent Traffic Monitoring System through Auto and Manual Controlling using PC and Android Application". Priority Based Signal Management in Traffic System will calculate the density of vehicle on the road for flow traffic smoothly without conjunction. The system also proposes the Priority Based traffic light signaling which helps to assign the priority to the lanes with highest traffic density as per demand in order to control the traffic smoothly. To reduce the wastage of time, we can implement the system that controls the traffic based on the heavy flow of vehicles at any particular side. With this system, we shall count the number of vehicles at each side at the junction and give the path to the particular side which has heavy flow of vehicles and keep remaining stop position, so that for this to count the number of vehicles at side of the junction.[6]

III. PROBLEM STATEMENT

In time based traffic control system, there are various limitations and problems regarding this algorithm, it consumes time and energy and also wastage there is also wastage of vehicle fuel energy. Our project density based traffic control eliminates all these limitations and provides smooth flow of traffic.

1. **Problems connected with population growth.** Now days in increasing traffic congestion, air pollution, and fuel consumption, excessive delay due to time allocated by the traffic signals is a major problem, the roads in our country are overcrowded specially in the cities
2. **Traffic at intersection.** Most of the junctions are connected to the highway which has small amount of traffic because of regular flow of vehicles in small city area where the amount of vehicle running is very high and when this all road is connected to a point the traffic under that point is very high, so the main problem is if only one lane have high traffic because it comes from high population area.
3. **Time Based algorithm for traffic**. The problem with the traffic system is that for every minute the vehicles at the 4-way road will be heavy and the traffic lights shall be changed to each side for some fixed time. Even though there are no vehicles at particular side, the traffic signals will glow red for given fixed time..

IV. METHODLOGY

As we all know that traffic congestion is a major problem from a long time and traffic administration is also trying to overcome this serious from a long time. So as a result one solution has been deduced which controls traffic on time delay. The basic idea of this paper has been taken from the foresaid concept. According to that idea the traffic signal switches after a certain interval of time. The approach to this design is realized through the design and implementation of its input subsystem, control unit (control program) and output subsystem. The input subsystem is made of sensors, programmed and implemented using some already existing principles to achieve best performance. The control unit is realized by an Arduino-based control program, which reads the input and qualifies it to produce a desired output. The block diagram of the entire system as presented in Figure no 3 shows the major components of the system.

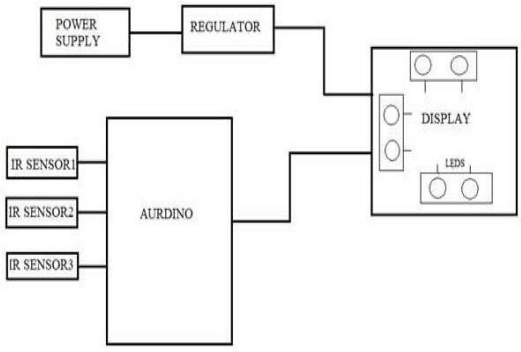


Fig 1 Block diagram

V COMPONENTS USED

1. ARDUINO

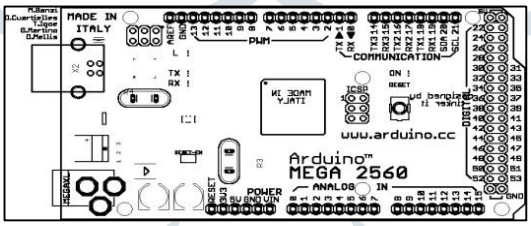


Fig 2. Arduino Board

Arduino is an open-source project that created microcontroller based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using microcontrollers. The Arduino project provides an integrated development environment (IDE) based on a programming language named processing which also supports the languages C and C++.

2 IR Sensor:

IR (infra-red) transmitter looks like an LED. This IR transmitter always emits IR rays from it. The operating voltage of this IR transmitter is 2 to 3V. These IR rays are invisible to the human eye. But we can view these IR rays through camera. Infrared is an invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers.

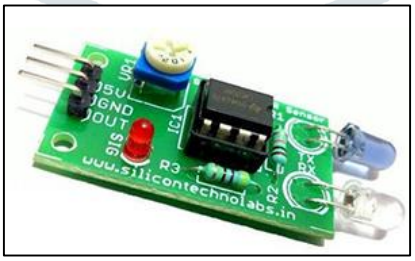


Fig 3 IR Sensor

Power supply: As per the power requirement of the hardware of the density based traffic light control system, supply of +5V with respect to GND is developed. The complete circuitry is operated with TTL logic level of 0V to 5V. It comprise of 0V to 9V transformer to step down the 220V AC supply to 9V AC. Further a bridge rectifier converts the 9V into 9V√2 DC. It is further filtered through a 1000uF capacitor and then regulated using 7805 to get +5V. To isolate the output voltage of +5V from noise further filtering 220uF capacitor is used.

VI. BLOCK DIAGARAM:

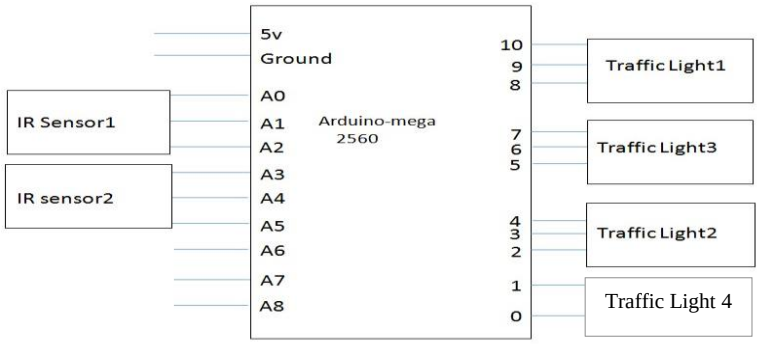


Fig 4 Block diagram

As shown in figure 4, it can be seen that the main heart of this traffic system is Arduino. IR (sensors) receivers are connected to the analog pins of the Arduino (i.e.) A0-A8 and traffic lights are connected to digital pins (i.e.) 0-10. If there is traffic on the road, then that particular sensor output becomes low. By receiving these IR sensor outputs, coding is written to control the traffic system. Low output from these sensors will activate the green signal on that particular road side and other road sides are made to be red and yellow depending on the density of the road. The sensors are monitored for specified time interval.

Circuit Diagram

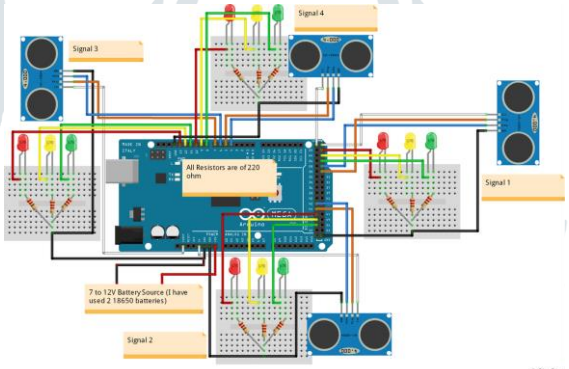


Fig 5. Circuit Diagram

For the four lanes of traffic to be controlled, requirements according to the aim as described in this paper would demand more than 35 Input-Output pins. For the aim to be achieved with the available pins of the controller, the inputs from the four sensor arrays were multiplexed using AND gates as shown in Figure which is the complete programmable circuit layout as designed using the Dip trace Schematic Capture Software; PORT U8 represents the sensor input port for lane 1; and so does PORT U9, U11, U12 represent the sensor input port for lane 2, lane 3 and lane 4 respectively. Additionally; PORT U10, U3, U4 and U5 represent the output ports for the traffic lights of lane 1, lane 2, lane 3 and lane 4 respectively. AND gates are used to reduce the complexity of the circuit. The surveillance camera is interfaced with the microcontroller using PORT U14 which is the camera module, a serial communication module as designed using the Dip trace software because there is no representation of this in the Proteus Software; where the connector for the camera is placed and is operated in the 8-bit mode.

VII. DETAILED METHODLOGY

1. Two IR sensors, one closer to the centre of the crossroad and another one at farther point, are setup on each side across the crossroad.
2. They are setup at a fixed distance from each other between which the density of vehicles is to be measure.
3. Both the IR sensors work as a counter to count the number of vehicles passing by it.
4. The density is being calculated by proper calculation of net counts made by both the counter on each side.
5. Depending upon these calculated densities, microcontroller takes decision whether the system has to work in normal mode or in heavy rush mode.
6. The microcontroller is programmed in such a manner to deal with all the normal and abnormal conditions.

7. Normal mode is same as traditional way of traffic control being used presently while in heavy rush mode microcontroller does the proper comparison between density of each side and gives preference to the higher one.
8. The signals on each side are being controlled accordingly by the microcontroller and thus traffic is managed very smoothly.
9. This whole process of density calculation and comparison goes on repeatedly again and again

VIII. DESIGN

Road Layout

For the implementation of this design of the road, the road layout for this design is the "+" road intersection represented in Figure 7 similar to the road layout used. The trouble spot is chosen and a model developed, because of its constant traffic logjam. It is observed that smaller streets like which often times had little traffic were allotted equal 'GO' time when compared.

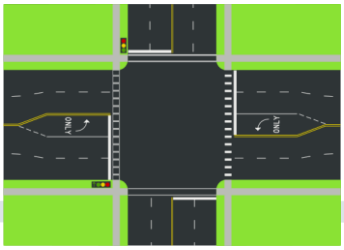


Fig 6. Road Layout

Infrared Sensors Arrangement and Implementation

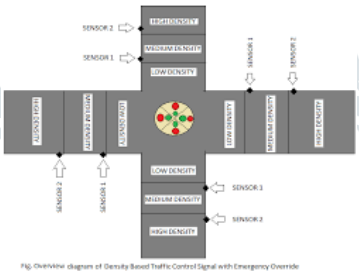


Fig 7. Sensors Arrangement

Since the design is focused on sensing the traffic level on each of the lanes of the road depending on the density of each lane using infrared sensors, the arrangement of the infrared sensor on the road layout was positioned to perform this function

3 Traffic Light Indicators

Fig 8 Traffic Light Indicators

Just like the conventional traffic light indicator as shown in Figure 8, this design controls traffic using three light emitting diodes, 'GREEN', 'YELLOW' and 'RED', each having their usual meaning of 'GO', 'READY' and 'STOP' respectively. They are controlled by the output of the sensors of the microcontroller depending on the logical decisions taken by the controller to control the lanes of traffic according to their densities

IX. WORKING PROCESS

Once the traffic control begins operation, the states of all the sensor arrangements on each lane of traffic is read and given as input to the microcontroller for logical operations. The system allots serial number to each lane based on their density, where the lane with the most density is assigned lane one. Accordingly, the system sets the ready flag for lane one where the YELLOW light shows; in preparation for the passing of traffic in that lane and delays for a certain time before giving the go signal with the GREEN light.

X. APPLICATION

Our project solves many problems on traffic congestions in the present time and coming era. This project based on no of vehicles in the intersection. This Project can be applied to the real-time city traffic light signaling system. This would change things for the better road experience and save time for road users. Based on that we just make a priority for all the 4 sides, Moreover, in our project, we have made some complex algorithm that monitoring the traffic density based on the IR sensors, this is just too makes the Things faster in the morning times when we are going to offices. [7]

XI. RESULT

After knowing about the above said hardware and using appropriate programming for the microcontroller the following results have been obtained. When there is normal traffic at the junction the traffic light continues as time delay. It shows that where there are more vehicles in any lane as compared to the other lane is given priority and the signal is green as soon as the lane is not cleared. The venture is intended to build up a thickness based element activity flag framework. The flag timing changes consequently on detecting the movement thickness at the intersection. Activity blockage is a serious issue in many significant urban areas over the world and it has turned into a bad dream for the suburbanites in these urban areas. Routine activity light framework depends on settled time idea distributed to every side of the intersection which can't be changed according to shifting movement thickness.

Table 1 Results of density of IR sensors

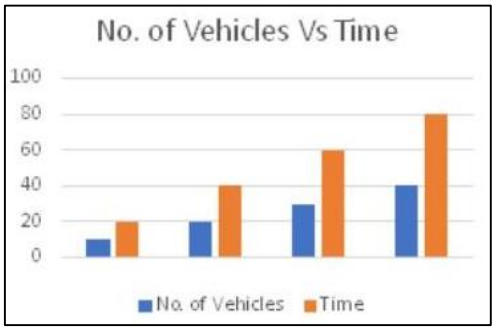
S/N	Distance (cm)	Vehicle detected
1	0.0	No
2	5.0	Yes
3	10.0	Yes
4	20.0	Yes
5	40.0	Yes
6	50.0	Yes

Table 2 Sensitivity results in voltage flow

S/N	Voltage Level	Sound detected
1	High voltage	Yes
2	Low voltage	No

STATISTICAL DATA

The statistical data shows the advancement of density based traffic management system compared with static based



Graph 1 showing No. of vehicles vs. time in density based traffic management

XII. CONCLUSION

1. In this design work, a density based traffic light control system is developed for traffic control at '+' road intersection to reduce unnecessary time wastage and minimize road traffic casualties which the existing conventional traffic light control system has failed to achieve. As demonstrated by the test results in the simulation and the prototype implementation as shown in the design has shown that the system developed is a viable tool for traffic control and the incorporation of a surveillance system would help reduce road casualties caused by road users who ignore traffic signals. Lastly. This paper has presented a means of controlling traffic at '+' road intersection using infrared sensors with an embedded microcontroller chip. Specifically, it demonstrates a working software solution for controlling traffic based on the density of traffic on each lane at the intersection.

Limitations of this Circuit:

- IR sensors sometimes may absorb normal light also. As a result, traffic system works in improper way.
- IR sensors work only for close distances.
- Arrangement of IR sensors in accurate manner otherwise they may not detect the traffic density.

XIII. REFERENCES

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