TRAFFIC SIGNAL MANAGEMENT AND CONTROL SYSTEM FOR EMERGENCY VEHICLES

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ABSTRACT:

Traffic congestion is a major problem in utmost metropolises all over the world and it has come to agony for the citizens. It's caused by detainments in signals, indecorous timing of traffic signaling, etc. Thus, for optimizing traffic control, there's an adding demand for a methodical quick automatic system. This paper is designed to develop a quantity-based dynamic traffic signal control and also innovative control to clear the traffic for emergency vehicles. The signal timing changes automatically on detecting the traffic density at the junction. The microcontroller used in this design is ARDUINO MEGA 2560. At the traffic junctions, IR sensors are fitted at every side of the junction, and since the number of passing vehicles to each side of the junction are interfaced with the Arduino. After receiving the input from sensors, we know the density of traffic at every side of the junction and alter the traffic light as per the need also by using the mutual induction of coil we are giving the priority to emergency vehicles.

Keywords— Traffic Congestion, Intelligent traffic Control System, Emergency vehicles, Arduino, IR sensor

INTRODUCTION

Congestion in urban areas has given rise to the gradual increase in automobiles and vehicles due to the migration of people into urban settlements bringing about different pros and cons.One of the principal reasons why congestion exists on the roads is due to the increase in the number of vehicles i.e. when the number of vehicles exceeds the capacity of the available framework such as good roads, traffic lights, and road regulators.

The rapid increase in the number of vehicles without a rapid increase in road networks is the main cause of congestion which is a major concern in society. While it may be difficult to tackle congestion, there are a few different ways to control its future rate of increment like the quick response to traffic-blocking incidents and accidents and removing mischances from major roads quickly.The ambulance service is the most affected by traffic congestion. There may be emergency or critical patients in an ambulance who needs immediate medical care and to be taken to the nearby hospital as early as possible. The appropriate treatment for the patient will be provided as soon as the patient reaches the

hospital so that chances of living increase in serious conditions. Many lives will be lost if the time taken by the ambulance to reach the hospital is high. Based on the surveys, heart attacks can be treated in 95% of the cases, if there is no delay by the ambulance and reaching the hospital without any traffic issues at the correct time. It is very essential to provide a way for the ambulance. Still, it wastes a lot of time and results in loss of lives by staying for the traffic to get cleared, if the ambulance gets stuck in traffic occasionally. We can overcome these problems with upcoming technology like IoT i.e., the Internet of Things.

The aim is to optimally control the duration of green or red lights for a specific traffic light at an intersection. The traffic signals shouldn't ash the same stretch of green or red all the time but should depend on the number of vehicles present. When traffic is massive in one direction, the green lights should stay on longer; less traffic should mean the red lights should be on for a longer time span. This solution is expected to abolish inefficiencies at intersections and minimize the cost of migrating and pollution.

It is given this challenge that this work is carried out to regulate traffic control and to provide a way for the ambulance. The method being proposed here is different from the current design which has a fixed time to control and monitor traffic irrespective of the traffic flow. This is because it will be a waste of productive time and inappropriate time-sharing formula when a congested lane is allocated the same “go time” as a relatively less busy lane at a junction. The proposed design would provide the quickest possible clearance to congested vehicles in all directions at any junction. The design would reduce the frequent occurrence of accidents resulting from the lack of patience by road users.

RELATED WORK

In the last few years, a huge number of research have been done to reduce problems regarding these jams. For example, a traffic light with a microcontroller, ultrasonic sensor, automatic switch, manual controller switch, circuit, and displayer which were functioning to handle all the system processes, figure out jammed levels in traffic, switch between manual and auto mode, control traffic light manually, make sure process happened and display the wanted output, respectively was created [2].

In 2014, a Traffic light controlling system using a microcontroller and Light emitting diode (LED) was initiated by Ganiyu R. The microcontroller's job is to receive a logic one instruction indicating that a switch, in this case, a pressure switch sensed the weight of a car which passed on it. Each time microcontroller received logic one, time will be added to another 15 seconds and eventually trigger the LED to light on at a 15-second delay in that particular lane or traffic light [4]

In 2014, the authors proposed a system that uses a Raspberry pi as its microcontroller to provide the signal timing based on the traffic density i.e., the signal timing alters automatically on sensing the traffic density at the intersection. The image captured in the signal was first processed and then converted into a grayscale image. Its threshold was calculated based on the contour which has been drawn to compute the number of vehicles present in the picture. After the calculation of the number of vehicles was done, the outcome helped to know which side the density is more, based on which signals will be allotted for a specific side [3]. In 2018, Deepak Rasaily, Ishani Dey, and Raja Gosh designed an Auto-density sensing traffic control system using an AT89S52. The design was to control the traffic

depending on the traffic density by placing an IR transmitter-receiver at both ends of the lanes. The AT89S52 activates the green light to glow for the lane with more density. As observed, the system doesn't follow the conventional sequence of traffic lights i.e., red, amber(yellow), and green but allocates only red and green. Emergency vehicles are not accommodated in this traffic system [10].

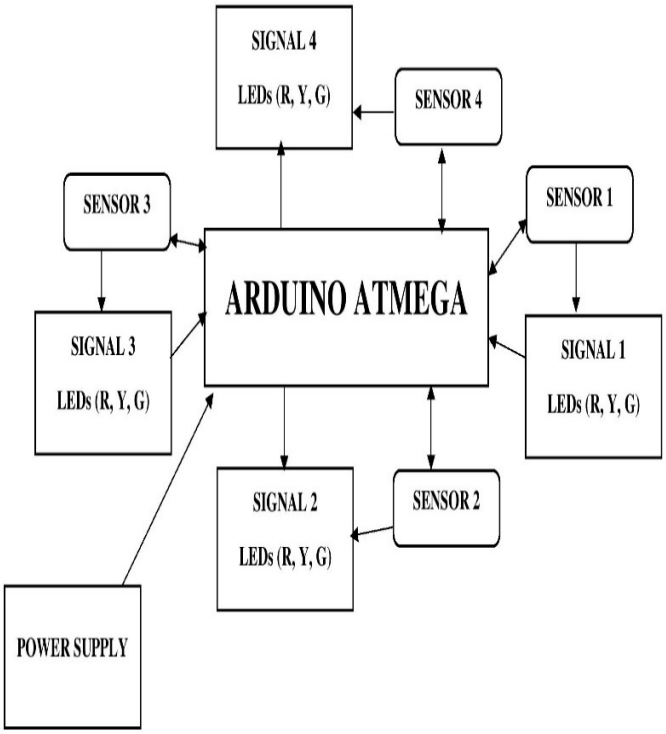
Traffic management (TIM) makes a systematic effort to detect and respond to traffic accidents.It aims to offer the rapid recovery of traffic safety and capacity and lead to many measurable benefits, such as a decrease in fuel consumption, accident duration, secondary accidents, and traffic jams. In the past thirty decades, ITS technologies were recognized as a valuable tools and are being used worldwide in traffic accident detection, verification, response, and communication [5].This was presented in the Priority Based Traic Lights Controller Using Wireless Sensor Networks by Shruthi K R and Vinodha. In this, a wireless sensor network is being considered. To define the direction of any emergency vehicle, the system uses fuzzy logic and by collecting all the information the central monitoring system gives the corresponding appropriate response [1].

The project concentrates on the improvement of a congestion controller in a city using an IR sensor and evolved visual monitoring using a microcontroller.Even for single crossroads, there might be no obvious optimal solution. With multiple junctions, the problem becomes even more complicated, as the state of one light influences the stream of traffic against many other lights. In this paper, we propose three approaches, the originally- to give authority to ambulances to pass the separate lane without delay, secondly – allow smooth passage of vehicles with maximum precedence (buses, POLICE cars), and thirdly – traffic density of cross-roads by appending the green light time[8].

IMPLEMENTATION

This section will provide an explanation of the steps involved in implementing and the operating principle of the proposed Traffic Signal Management and Control System. Moreover, the section will feature presenting the outcomes obtained during the heavy traffic.

Block Diagram:



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ig. 1: Block diagram of Traffic Signal Management and Control System

The system design in this work is a small prototype and it is divided into two units namely; the Control unit, Sensor unit.

Control unit:

The control unit is a microcontroller-based control system. It works by interpreting the input, qualifying it, and producing a desired output. Arduino mega 2560 is part of the family of Arduino microcontroller boards which is manufactured under the principle of AT mega 2560. It was made with the intent of having a fully self-sufficient microcontroller, consisting of 54 digital input/output pins, 16-MHZ crystal oscillators, a power jack, a reset button, and a USB port/connection to be configured by an end-user computer. It is charged by a 9-V DC supply. The specification of the Arduino Mega2560 is displayed in Table 1.

AT mega 2560	Specifications
Operating Voltage	5-V
USB Port	Yes
Recommended Input Voltage	7-V to 12-V
Digital I/O Pins	54
DC Power Jack	Yes
DC current on I/O Pins	20 mA
SRAM	8 kb
EEPROM	4 kb

Flash Memory	256

Table 1: Arduino Mega 2560 Specifications

Sensor unit:

In this system, we will utilize 4 IR sensors to estimate traffic density. We have to place one IR sensor for each road; these sensors every time sense the traffic on that specific road. All these sensors cooperate with the microcontroller. Based on these sensors, the controller determines the traffic and controls the traffic system. An IR (Infrared) sensor is an electronic device that can be used to sense certain parameters of its surroundings by either emitting or detecting radiations. It can also measure the heat of an object and detect motion. It uses infrared light to sense objects in front of them and depict or estimate their distance. IR transmitter looks like an LED. This IR transmitter every time emits IR rays from it. The working voltage of this IR transmitter and Receiver is 2 - 3v. These IR (infrared) rays are hidden from the human eye. But we can see these IR radiations through the camera. IR transmitter transmits IR rays that are received by the IR receiver. In general, an IR receiver has high resistance in the order of mega ohms but when it is receiving IR rays the resistance is extremely low [12]. We have to place these IR sets in such a way that when we place a barrier in front of this IR pair, the IR receiver should be able to receive the IR rays. When power is supplied, the transmitted IR rays hit the object and reflect the IR receiver.

Flow chart

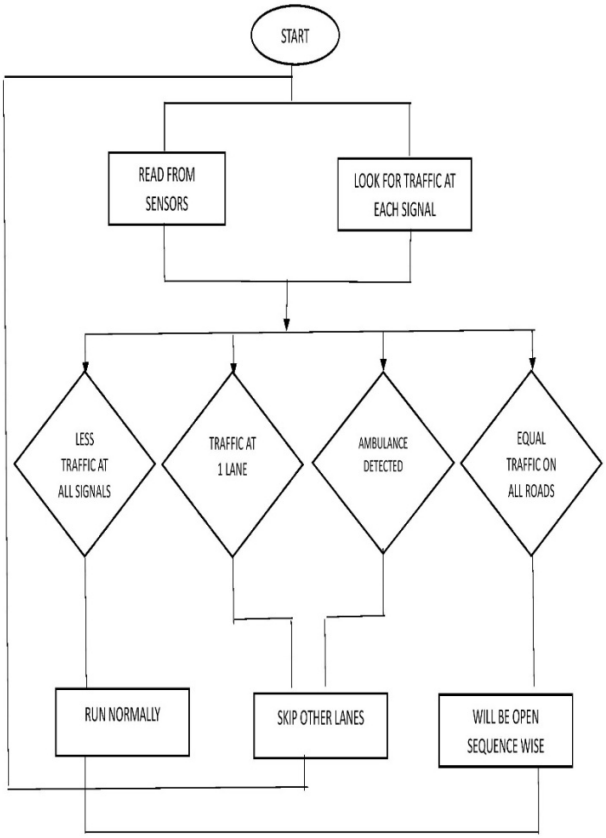

Fig. 2: Flow Chart of Traffic Signal Management and Control System for Emergency vehicles

Working:

In this IR sensor senses the vehicles and conveys this data as input to the controller, based on this the controller determines the traffic and controls the traffic system. Still, the system will work typically by controlling the signals one by one If there's traffic at all the signals. However, also the system will skip this signal and will move on to the coming one If there's no traffic near a particular signal. For example, if there's no vehicle at signals 2, or 3, and presently the system is allowing vehicles at signal 1 to pass. Also, after signal 1, the system will continue to signal 4 skipping signals 2 and 3. still, also the system will work typically by controlling the signals one by one If there's no traffic at all of the 4 signals. We are placing one coil on one of the roads and another under the emergency vehicle. So, when the emergency vehicle appears on that road causing a mutual induction and allowing that signal by skipping all other signals. This is because when two coils are brought in adjacent to each other, the magnetic field in one of the coils tends to link with the other. This further gives rise to the generation of voltage in the second coil. This property of a coil that affects or alters the current and voltage in a secondary coil is called mutual induction. So finally, we are telling that if there is traffic at all signals or there is equal traffic on all roads the signals will be altered sequentially. And if there is traffic at a particular signal or if any emergency vehicle is detected then priority is given to that signal by skipping other lanes.

RESULTS& CONCLUSION

In this model, we proposed a solution to overcome this problem and this model works on traffic density. To know the traffic density IR sensor is installed at all sides of the junction to the total number of passing vehicles from that road. IR sensor senses the vehicle and conveys this data as input to the microcontroller. Microcontroller (Arduino) count the number of vehicles on all side of the junction and turns the green signal on that side of the junction which has a high density of traffic, by using mutual induction of coil, priority is given to emergency vehicles.

Traffic Lane 1	Traffic Lane 2	Traffic Lane 3	Traffic Lane 4	Ambulance Detected	Sequence of Lanes
1	0	0	0	Yes, at Lane 1	1-2-3-4
0	1	0	0	No	2-3-4-1
0	0	1	0	No	3-4-1-2
0	0	0	1	Yes, at Lane 3	3-4-1-2
1	0	0	0	Yes, at Lane 2	2-3-4-1
0	0	0	1	No	4-1-2-3
0	0	0	1	Yes, at Lane 4	4-3-1-2

Table 2: Lanes Automation based on the logic at the junctions

CONCLUSION

This proposed model is designed to analyze delays at the time of traffic congestion because of static traffic lights which have fixed time allocation. Because of fixed time allocation traffic lights are not able to change the color of traffic signals according to traffic density and it's also a reason for high traffic congestion on road. In this model, we proposed a solution to overcome this problem and this model works on traffic density. To know the traffic density IR sensor is installed at all sides of the junction to the total number of passing vehicles from that road. IR sensor senses the vehicle and conveys this data as input to the microcontroller. Microcontroller (Arduino) count the number of vehicles on all side of the junction and turns the green signal on that side of the junction which has a high density of traffic, by using mutual induction of coil, priority is given to emergency vehicles.

FUTURE ENHANCEMENTS

Though the prototype model worked very effectively with remarkable outputs, the real-life situation is going to be way more challenging and demanding. A few of the challenges that should be taken into account are i.e., Low range IR sensors may not be an answer for long-range signaling systems. We may resort to ultrasound or radar techniques for big-scale formats.Periodic checking of accuracy and precision is a must for the efficacious operation of this model prototype. As part of future advancements, the traffic check post may be connected by wireless transmitters by which the crossings ahead may be a prediction 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 signaling system even more smooth and congestion free. We will also update this system with modern technology so that when a vehicle tries to move even during a 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 image.

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