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Traffic Monitoring System with Road Safety

Rakeshkumar Girdharlal Shankar[1*], Dharmit Jagdishbhai Kakadiya[2], Arunsingh B. Rajput[3], Vinas Rameshbhai Gondaliya[4], Kishan Rameshbhai Gabani[5], Parshant Shantibhai Rupapara[6]
[1]*Assistant Professor, Department of Electrical Engineering Department, Shree Swami Atmanand Saraswati Institute of Technology, Surat, India*
[2,3,4,5,6]*UG Student, Department of Electrical Engineering Department, Shree Swami Atmanand Saraswati Institute of Technology, Surat, India*
*Corresponding author: rmali1986@gmail.com

***Abstract*: This paper explain design of traffic monitoring and controlling system with advance road safety management. This advance technique is specially design by considering the current issue related to traffic problem and safety of human being. Same approach is applied to prevent accidents on road and to control the traffic on road automatically and manually. This technique use features like emergency ambulance root clearance, traffic controlling & vehicle density monitoring either by manually or automatically. The ultrasonic sensor will sense the density of vehicle and accordingly it operate lane to release traffic. In addition, provision for emergency condition like ambulance will also covered.**

***Keywords*: Arduino mega, LED display, Power supply, Ultrasonic sensor, Wireless remote.**

1. Introduction

Smart traffic system use for monitoring and control of vehicle density, emergency traffic control and for smooth flow of vehicle traffic. This system save the valuable time of human being and also it reduce the human effort by the use of advancement in system technologies. This advance approach implement the use of ultrasonic sensors on the side of road. This sensor continuously sense the vehicle density on each available lane and based on vehicle traffic density input it provide the priority to the lane so that traffic will resume as soon as possible. Indirectly it control the time of operation of traffic light signal based on input of traffic density. Usually the lane having too much vehicle traffic will be provided more time to release traffic and time for the lane which are having less vehicle density will reduce accordingly. If the traffic on both the lane are same, the traffic signal operate on standard specific time of traffic rules of country. The system can be operated either manually or automatic through the use of Arduino mega controller. This also cover the medical emergency pass for ambulance that fulfill the purpose of life saving of human in case of any accidental or emergency condition.

The ultrasonic sensor is used to detect the density of vehicle and provide input the Arduino mega controller. The controlled control the vehicle traffic based on preloaded programming that cover normal and emergency traffic situation. The system utilize the use of three ultrasonic sensor which placed on each and every lanes and every sensor has its specified operating time. The first, second and third sensor will count from the traffic center point. The first sensor of any lane sense the vehicle then it allow the signal light to run for 52 second. The sensing of second and third sensor allow the traffic signal light to run for 62 second and 72 second respectively. The sensing of second and third sensor denote the more traffic density for that particular lane. If the density of vehicle or vehicle traffic is even not sensed by first sensor then it will be considered as zero traffic lane and for this case 42 second is allow for traffic light signal.

The traffic is control either by manually or automatically. The toggle switch is provided to switch the operation either manual or automatic. If the position of the toggle switch is set to '0' position the system run automatically and if it set to '1'position the system run manually. In addition to this toggle switch one panic button/switch is provided in each traffic lane pole. This panic button provide provision for of immediate traffic clearance under the emergency condition, for ex. when ambulance detect in any lane the other three lane traffic will stop immediately and only that lane operate to release ambulance immediately.

The operation of system like auto-manual, remote operation as well as functioning of various lane and its traffic light signal operational timing will be observed by using 7 segment display. The advance component of the system make the traffic system smooth and easy to operate and maintain.

2. Block diagram and Simulation

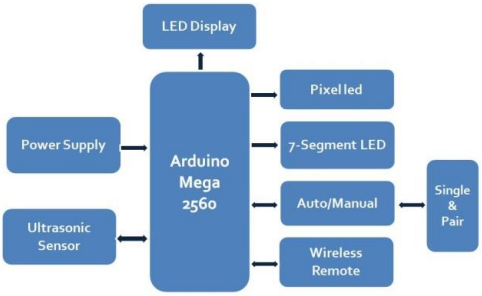

Fig. 1. Block diagram of the system

The system block diagram and various component used in the system are shown in figure. 1. The heart of system is Arduino mega 2560 controller. The preloaded program is used to control the traffic and to solve the emergency conditions. The signal sense by ultrasonic sensor will be applied as an input to the controller. In addition to this signal, controlled will also sense the user selected input operation like manual/automatic or remotely. Program code that preloaded in controller will operate system based on input signal sense by sensors. The current operation and the switching to different operation will be observed by display unit.

Simulation and detail connection diagram of the system are shown in figure 2. Simulation is done by considering a traffic point having four lane.

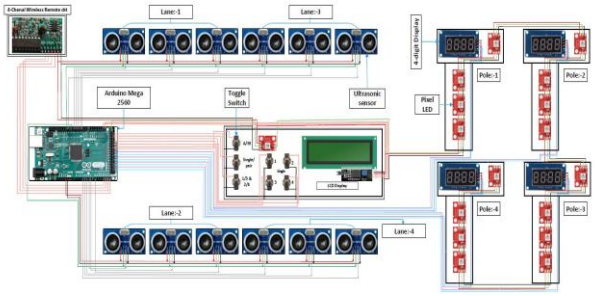

Fig. 2. Simulation of the system

3. Simulation Result

A. *Measurement of vehicle traffic density*

In this section the simulation and its result for different cases are discuss in brief. The density of vehicle observed by each lane, its operation and timing for traffic light signal are well explain by referring Table 1. By resetting and restarting system all thee sensor of each lane will first sense the vehicle density of their particular lane. Table. 1 explain the operation of lane-1 and lane-3. For simplicity the sensor of each lane-1 are numbered by 1-2-3 and that of lane-3 are numbered by 4-5-6. The cm range of each sensor denote that if is there any vehicle present on that particular lane. Here result of sensor indicate that there is no vehicle on both lane-1 and lane-3 because maximum range of ultrasonic sensor to sense any object is up to 10 cm. so traffic light signal will operate for its normal running time 42 sec as there is no traffic found in lane. The same result will be represent in graphical form shown in Figure. 3. The result for lane-2 and Lane-4 will obtain and explain in similar manner.

Table 1
Measurement of vehicle traffic density

Traffic density measurement of lane- 1&3			
Lane-1		Lane-3	
Sensor No	Range (Cm)	Sensor No	Range (Cm)
1	10.052	4	10.052
2	10.052	5	10.052
3	10.052	6	10.052

Time(Sec)	42	52	62	72

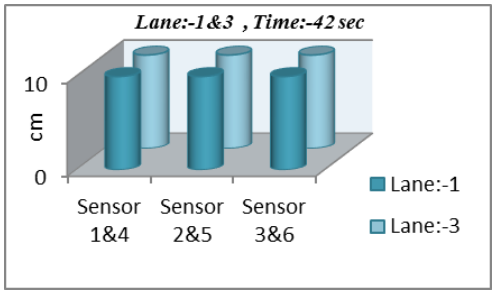

Fig. 3. Graphical representation of table 1

B. *Operation under automatic mode*

Selection of lane and its operating time under the automatic operation mode will be well explained by referring Table. 2. As show in table all 12 sensor of all 4 lane and its sensing data will be analyze by controller and based on result controller will decide the operation of particular lane and time for light signal for that operated lane. Usually opposite lane are operate simultaneously for ex. lane-1&3 and lane-2&4. If there is no traffic found in each lane it will operate for 42 second: lane 1-3 operate first and then lane 2-4

Now suppose sensor-2 of lane-1 and sensor-5 of lane 3 will sense vehicle then lane-1 & lane-3 will operate for 62 second, and at the same time if sensor-7 of lane-2 and sensor-10 of lane-4 will sense vehicle it will operate for 52 second. In this case priority will be given to lane-1 & 3 because there is more traffic as compare to lane-2 & 3.

Further operation of lane and its timing of operation will explain in figure 4. It shows that if there is no traffic detected in all lane, traffic light signal will run for 42 second. If controller detect input from sensor 1-4-7 & 10 traffic light signal timing is of 52 second. Similarly, if controller sense input from sensor 2-5-8 & 11 signal timing is of 62 second and if input from sensor 3-6-9 & 12 signal timing is of 72 second.

Table 2
Operation under automatic mode

Different automatic operation mode							
Lane- 1&3				Lane- 2&4			
Sensor No.	object	Sensor No.	object	Sensor No.	object	Sensor No.	object
1	Y/N	4	Y/N	7	Y/N	10	Y/N
2	Y/N	5	Y/N	8	Y/N	11	Y/N
3	Y/N	6	Y/N	9	Y/N	12	Y/N

Time(Sec)	42	52	62	72

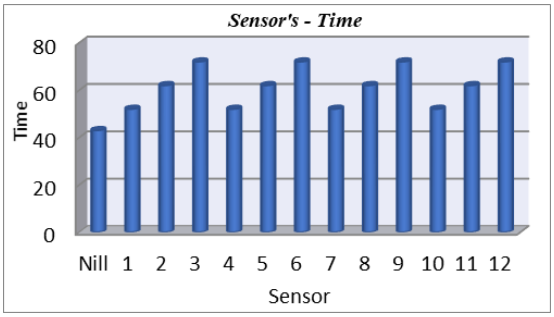

Fig. 4. Graphical representation of table 2

C. Operation under manual mode

1) Selection of lane pair

Table 3
Selection of lane pair

Lane pair selection		
Lane- 1&3	☑	☒
Lane- 2&4	☒	☑
Select lane pair- 1&3 or 2&4 or all 4 lane.		

Table 3 represent selection of lane in pair. In this mode traffic attendant can select lane pair, either lane 1&3 or lane 2&4 using manual mode of operation. When such option is selected traffic attendant can select either running of lane 1&3 can select lane 2&4. Traffic attendant can select pair of lane can select all lane run at the same time.

2) Selection of lane

Table 4
Selection of single lane

Single lane selection				
	Switch-1	**Switch-2**	**Switch-3**	**Switch-4**
Lane-1	☑	☒	☒	☒
Lane-2	☒	☑	☒	☒
Lane-3	☒	☒	☑	☒
Lane-4	☒	☒	☒	☑
Select Lane- 1-2-3-4 one by one				

Table 4 represent selection of particular lane by using manual mode. Here four toggle switch are used for selection. Traffic attendant can select this switch as per traffic density of particular single lane. For ex. If attendant need to select lane-1 he can turn on toggle switch-1 and rest of switch remain off so only lane-1 will open. Similarly, he can select lane 2-3-4 based on traffic density of that particular lane.

3) Selection of lane under emergency condition

Table 5
Selection of emergency lane

Ambulance Remote Control				
Lane: 1	Switch-1	Switch-2	Switch-3	Switch-4
ON	☑	☒	☒	☒
OFF	☒	☑	☒	☒
Emergency lane-1 start				

Table 5 represent selection of lane under emergency condition. Here traffic attendant can select any lane out of four lane where the emergency condition is created. Selection of lane-1 will explain in Table.5. To select lane-1 toggle switch-1 will be turn on either by manual or at remote location by using remote controller. To turn off lane-1 toggle switch-2 will be turn on. Similarly, the selection of other lane can be done.

4. Hardware

The implementation of hardware and its result are shown in figure 5.

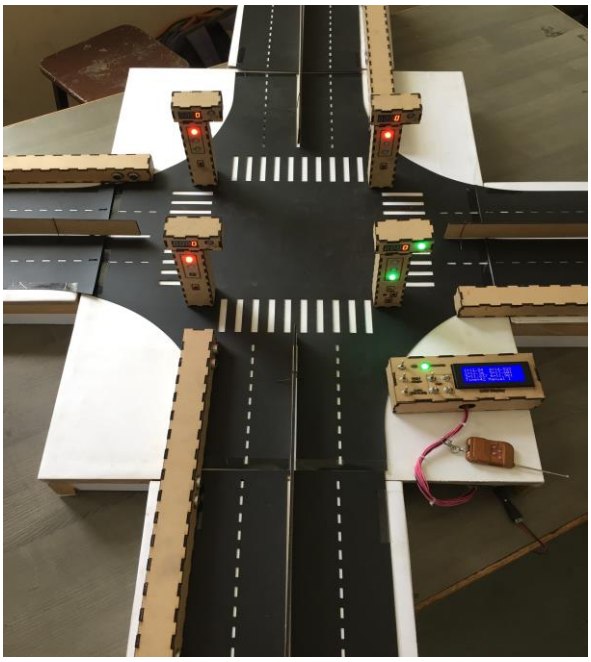

Fig. 5. Hardware of system

5. Conclusion

The 'traffic monitoring with road safety' itself name suggest to control the traffic with advance way and provide better safety option to the human being. The use of highly efficient controller and sensor make the system operation simple and fast even in a condition of high level traffic. The system also cover solution to save human life by providing fast released to ambulance under the emergency medical condition. The manual, automatic, remote and emergency control of traffic and road safety make the system more reliable.

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