Turkish Journal of Computer and Mathematics Education Vol.12 No.11 (2021), 6953-6962

Research Article

Smart Automatic Movable Road Divider

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Article History: Received: 11 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 10 May 2021

Abstract: As population is increasing day by day, the vehicles are also increasing, which causes heavy traffic in the highly populated cities. We have observed that the traffic is high in peak hours and also construction of new roads and repair of them also increases the traffic. As vehicles are waiting in the same place for long time the pollution in that particular area will also become high. We have scrutinized the situation and understood that the vehicle queue is high on one side of the lane (either left or right side of divider) and other side of the lane would be free or less vehicles, to overcome such issues we can use the medial strip (road divider) which moves automatically, where it consists of sensors to detect the intensity of traffic. Based on the intensity, the medial strip could move on any one side of the lane and reduces the conjunction of vehicles. With IOT technology we could also clear the traffic for emergency vehicles (by changing the traffic signal from red to green) and we could save a precious life.

Keywords: IOT, Movable road divider, Sensors, Traffic clearance

1. Introduction

In this present period the vehicle conjunction is increasing rapidly in highly populated cities like Bangalore which is causing time lag for people during the period of working hours and also due to this time lag the accidents have also become more as they are trying to reach the destination in time, which cause a loss of human life, financial losses to their family and the time taken is more to clear that accident vehicle too. To overcome this hurdle produced by the traffic, it is necessary to find an adequate solution, which helps them to reduce the time lag or delay. The movement of road divider to less conjunction of road lane could reduce the traffic, increases the clearance of vehicle and decreases the accident.

According to 13 hours inspection made on traffic conjunction at Maharashtra's Wester Express road, to gather the information on vehicle movement, we came to know that the traffic will be high in any one of the tracks and another track will either be free or very few vehicles. Speed of vehicles will always be more during that road rage (rush hours). We came to know that during that rush hour the clearance of traffic for emergency vehicle is very less as everyone is rushing to reach their destination in respective time without any time lag.

To reduce this vehicle rush we can use our project, so that we could move the medial strip to any one of tracks depending on intensity of conjunctions, if any vehicle is detected during the movement of strip there will be buzzer which will create an alarming sound, indicating that driver should clear his vehicle so that the divider could continue its movement. During the rush hours, we observed that the clearance for emergency vehicle is difficult, so with the help of IOT we could develop an app which could be used by traffic controller or by the emergency vehicle driver which will change the traffic signal and displays the LEDs on either lane, which indicates the path in which the emergency vehicle would like to turn in respective direction so that vehicles could clear traffic for emergency vehicle and save a human life. As emergency vehicle is cleared, the signal would be change to GREEN state.

2. Literature survey

The idea of smart movable road dividers was initiated during 90"s period. At that time the machine was referred to as zipper machine, that is instructed to shift the divider from one lane to a different lane based on traffic density. The 1st operating model of the zipper machine was bought by the Hawaii Department of transport within the late '90s. The disadvantages of these Zipper machines are: Not economical, Time overwhelming, it's not versatile and not flexible, traffic density cannot be detected mechanically and hence needed human help.

In reference to "Design and Implementation of sensible Movable Road Divider through IOT" [1] the author

uses IOT primarily based approach to investigate the traffic density during an explicit time. The photographs are captured through the camera and traffic density are analyzed from the IoT platform. The model was enforced optimization of raspberry pi and servo motors but the usefulness of this approach may be a serious concern because of the price of its implementation.

In reference to "Movable Traffic Divider: A Congestion unleash Strategy" [2] A study was conducted on the Western categorical road near to Goregaon, Mumbai, in Reference, a ten-lane road was chosen once noting the congestion points. The western categorical route was therefore selected to know this traffic situation for long distances. A survey was meted out for a span of 7.00 am to 9.00 pm, information collected from the survey was number of the vehicle passing to some extent and speed of the vehicle. The speed of the vehicle and number of vehicles reduces considerably throughout the height hours.

Hemlata Dalmia, KareddyDamini, Aravind Goud Nakka, "Implementation of Movable Road Divider using IOT" [3] advised employing a sensible temporary divider that may curl in and out of the road. This approach uses RFID-based car detection which clears the lanes for an emergency vehicle. This approach appears to be a lot appealing because of its sensible applications. however, implementing this is often terribly troublesome.

S.Jyothirmayee, G.VamshiAvatar, J.Nanditha, B.Shashank Yadav, "Controlling Of Traffic through Movable Road Dividers,"[4] suggests an approach toscale back traffic density by creating use of 2 dividers particularly traditional and extended. The author has shown the results through a way of traffic optimization sensors, however in this period of time the divider movement is in both directions often in additional than in one direction.

In Reference [5], Using computer vision the traffic density on both the sides can be visualized. This is implemented using a camera installed for video recording. Python 3script is mainly used in this project. Integration of this software model with the security domain will lead to a greater advantage.

China is testing a moving road barrier in which the central divider moves with a tap on a smartphone. The central divider works on railings and hence movement would be easier. It takes around 30 seconds to move the railings. The movement of the divider is controlled by traffic police. This technology is currently tested in Jiangsu province.

3. Methodology

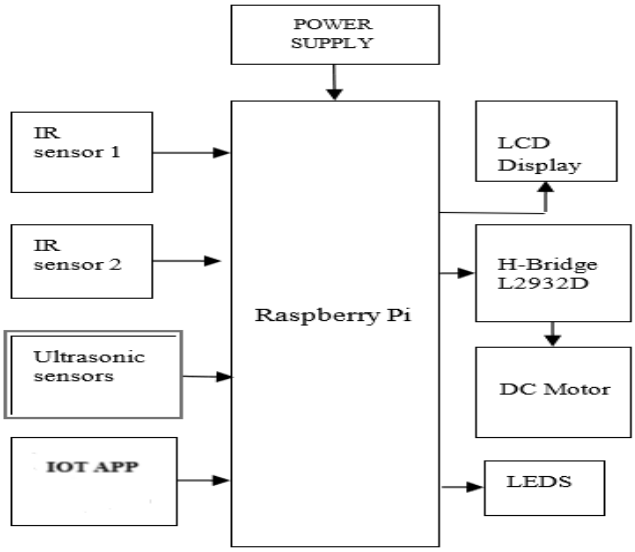

Fig. 1. Block Diagram of Smart Automatic Movable road divider

In this proposed model, we are specifically using raspberry pi zero, IR sensors, ultrasonic sensors, LCD display, motor and motor drivers. IR sensor will send the infrared rays, when the vehicle comes closer, the infrared rays will be reflected and received by the receiver and it will be sent to the raspberry pi. Then raspberry pi will count the number of times the reflections taken from both the tracks. Based on the times of reflection, the intensity of the traffic is calculated. Based on intensity, the raspberry pi will make the motor driver to drive the motor (divider is attached to the motor) either to right or left based on the intensity obtained (if intensity is less

on left lane the divider will move towards the left and vice versa). The motor movement direction and the intensity will be displayed on LCD display. The Ultrasonic sensor is used, where it will be sending the ultrasonic waves continuously, if any objects come closer to it, then reflected ultrasonic wave is received by the receiver and it will be sent to raspberry pi, then it will make an alarming sound through a buzzer.

When an emergency vehicle is appeared on the traffic, the IOT application is used to change the signal from RED to GREEN signal and it will also display the red light on the sides of the track based on the direction it wants to move (if driver wishes to take left turns then track left side light will glow and vice versa), which alerts emergency to other drivers to clear the lane for the vehicle. Once after clearing the lane for emergency vehicle the signal will be back to its initial position based on the traffic.

4. Implementation

4.1. Calculating the traffic on both the lanes using IR sensors

On the designed road divider, IR sensors are set on both the sides facing towards the road. The primarily function of this sensor is to take readings of traffic density and to calculate them in terms of percentages. The IR radiations from the sensor are reflected back whenever an obstacle is in its proximity. It records the time for which the radiations are reflected and this analysis of the sensor is taken for a fixed time (20 sec). The backscattering of infrared rays specifies the number of vehicles passing by the road and the reflection time is directly proportional to the number of vehicles and also to the velocity of vehicles. The analysis of reflection time acquired from both sides of the road are translated into percentages with regard to the total time of readings taken. The two percentages acquired from either side of the divider are appropriately displayed on the LCD Display panel as in fig 4. These two percentages are then compared with each other to decide the highest density relative to each other. Then the divider automatically moves towards the lower density side of the road divider giving an extra path to higher density side. The direction and movement of the divider on either side of the road is intimated to the vehicles in advance by showing in the LCD display so there wouldn't be any uncertainty in clearing the lane or path of the divider movement.

4.2. Settling Unpredictable data

There is always an uncertainty of traffic in roads during anytime observed. The traffic is uneven during these times. Amidst the early part of the day, like morning till afternoon the lane of the road facing the commercial premises of the area will be more overloaded. Then in the later part of the day, from evening till night, the contrary which goes to the residential premises would be more crowded. Hence the free space obtained on either side can be made an extra path for the other side which reduces the traffic to a greater extent.

Depending on the traffic densities obtained from the sensors, we follow up on the below actions:

- No Movement of the divider(ideal)
- Movement of the divider to the left direction.
- Movement of the divider to the right direction.

The first action is the ideal situation where no action is done. Whenever there is an equal proportion of traffic densities on either side then this action is followed. Then the next two actions are followed/observed depending on the comparison of traffic densities on both the sides whether the movement should be right or left directions as in fig5.These activities are repeated. This mechanism shouldn't be exaggerated and hence the divider movement should be minimum.

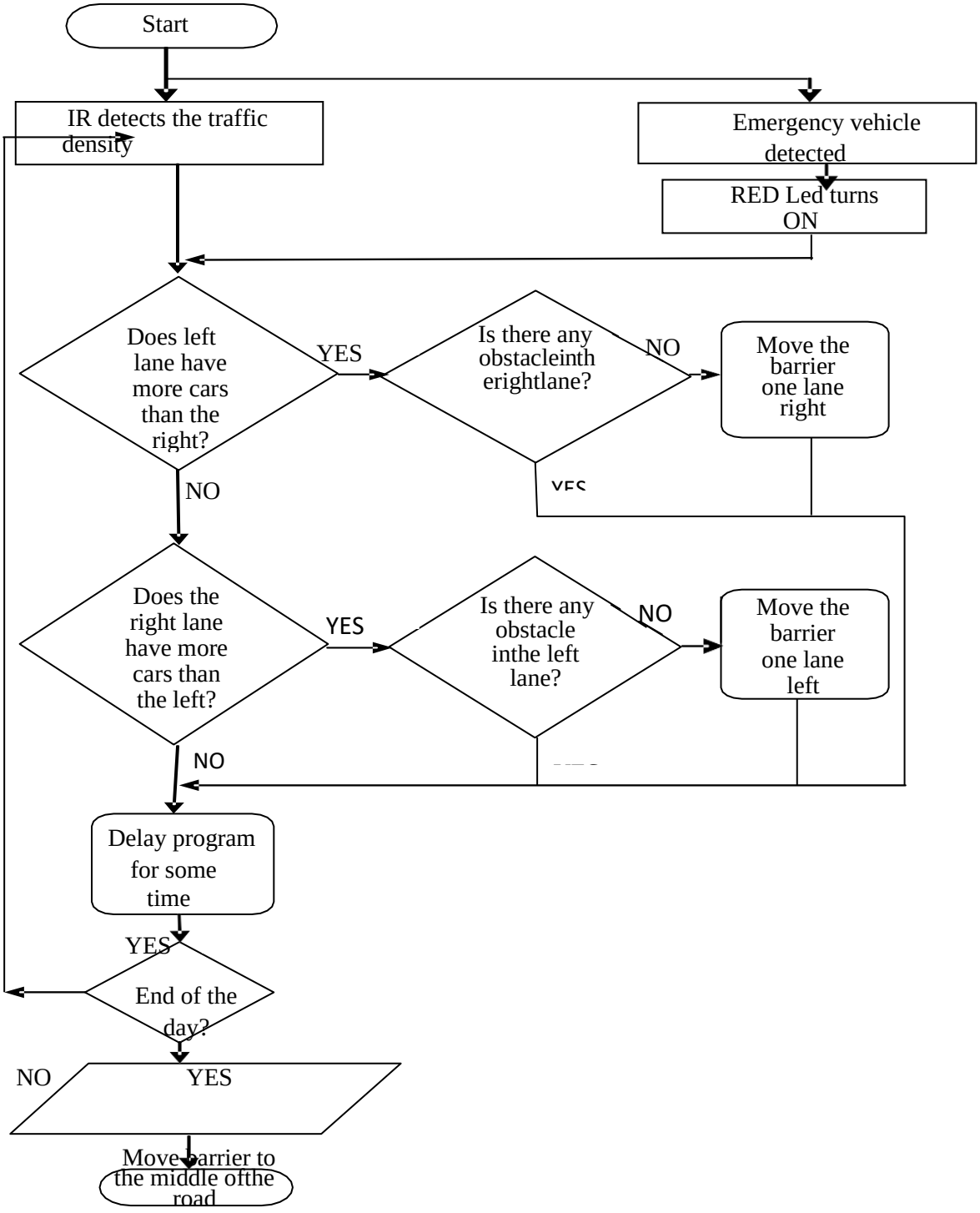

Fig. 2. Flowchart representing the algorithm of the project

4.3. Detecting any obstacles while moving the road divider using Ultrasonic Sensor

After observing the percentages of traffic congestion on both the sides, the divider starts automatically to move. But it is important to check if there are any obstacles in the direction of the divider movement. The obstacles can be anything from vehicles moving close to the lane or things which obstruct the barrier movement. We have considered the vehicles moving close to the divider as the obstacles in the project. Ultrasonic sensors are fixed on both the sides, its function is to determine the distance at which there is an obstruction to the divider movement. We would pre-set distance of 2cm for the ultrasonic sensing. A sounding system is deployed whenever any vehicles passes the proximity range of the sensor set to 2cm. Buzzer is used as the beep sounding system. The divider will continue its movement only after the obstacle is cleared from its way.

4.4 Movement of the barrier according to the data processing by an appropriate program

Data processing required for the model is done by a suitable program written in python. In order to move the divider first we need to determine which lane has the greatest density depending on that appropriate action is done. IR sensors calculate the percentages of density from both right and left and through the program code it will be shown in the LCD display as in fig.4. The direction of the divider movement will also be displayed as in fig.5. A desired distance is chosen for the sensing capability of ultrasonic sensor. According to the pre-set distance, it is programmed in such a way that whenever the vehicle is in its close proximity the divider movement is halted and will only continue after that vehicle passes.

The program which was running will come to a halt state after the divider had finally completed its movement. The automatic movement of the divider to the mid position is not seen in the model. The comparison between the traffic density on both the sides are done using conditional statements for handling decisions. Both the traffic density on left lane and right lane are compared and appropriately the divider moves. Then the implementation(process) is repeated to move divider either to leftmost lane or the rightmost lane from the mid position. As long as there is bock or congestion on either side this activity would be repeated several times all through the day.

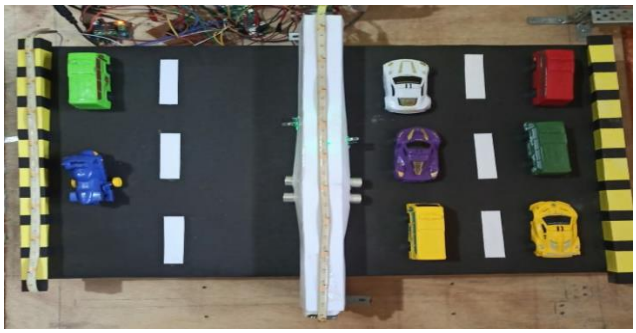

Fig. 3. Right side of the lane has more vehicles compare to left

Fig. 4. Density of traffic displayed on LCD

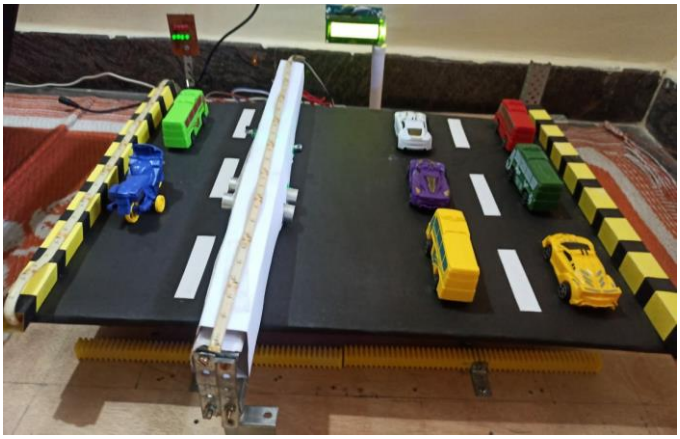

Fig. 6. Movement of the divider based on traffic density

4.5 Detection and Clearance of emergency Vehicles using IOT

In the last phase, we have added an extra application for clearance of emergency vehicles in traffic congestion using an IOT application. The traffic congestion with the presence of emergency vehicle is shown in fig.6. The traffic signal is in RED state. By clicking on a button created in UBIDOTS(IOT) application, the driver can change the traffic signal from red to green state. UBIDOTS is an IOT application mainly used for this type of application. According to the destination path of the emergency vehicle, LEDs deployed on the lanes, will glow on either side of divider or at the extreme ends. When the LED's glow at any one of the sides whether towards the divider or on the lane, it specifies that other vehicles have to make clearance for the emergency vehicle to leave the traffic.

Whenever the emergency vehicle is in traffic, the other vehicles which are near to it should leave way in giving a path for the vehicle to pass as shown in fig.7by seeing the LED's glow on either side. During this time the signal would be in red state. Till the time at which the emergency vehicle is in the congestion the traffic signal will be in green signal. After the movement of emergency vehicle depending on the driver destination paths, the signal will turn to its initial state(red).

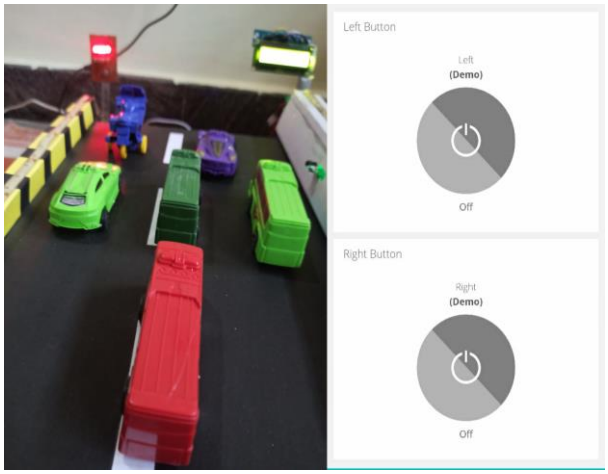

Fig. 7. Arrival of Emergency vehicle

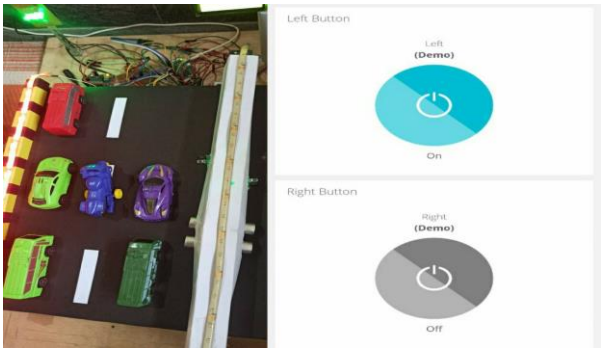

Fig. 8. Signal turns to green and left lane turns to red based on direction of emergency vehicle.

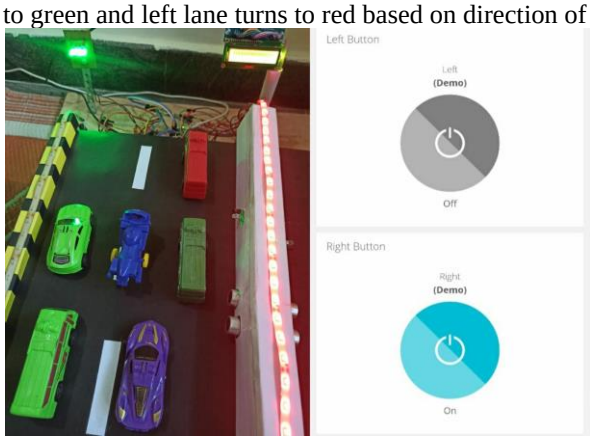

Fig.9. Signal turns to green and right lane turns to red based on the direction of emergency vehicle

5. Result

TABLE1.Traffic Density duringmorning time

MORNING		**Timings: 9:00AM**		
Time insec	**Numberofvehicles in rightlane**	**Right lanetrafficdensity percentage**	**Numberof vehicles in leftlane**	**Left lanetraffic densitypercentage**
0-20	16	73.5%	6	23.3%
20-40	17	65.6%	3	35.7%
40-60	18	84.3%	8	26.3%
60-80	19	67.7%	4	16.9%
80-100	20	68.7%	3	9.4%
100-120	21	68.9%	6	31.6%

TABLE2.Traffic Density during Afternoon time

AFTERNOON			**Timings: 1:00PM**	
Timein sec	**Number of vehicles in right lane**	**Rightlane traffic density percentage**	**Numberof vehicles in left lane**	**Leftlane traffic density percentage**
0-20	9	41.3%	9	43.6%
20-40	10	43.8%	8	41.9%
40-60	9	48.9%	12	46.9%
60-80	8	47.9%	11	51.3%
80-100	11	53.4%	7	48.9%
100-120	10	49.7%	13	52.6%

TABLE3.Traffic density during Evening time

EVENING			**Timings: 6:00PM**	
Timein sec	**Number of vehicles in right lane**	**Rightlane traffic density percentage**	**Numberof vehiclesin left lane**	**Leftlane traffic density percentage**
0-20	5	24.5%	17	81.2%
20-40	4	22.7%	18	80.9%
40-60	6	15.6%	16	77.7%
60-80	6	36.6%	18	85.8%
80-100	5	29.4%	17	79.5%
100-120	5	26.4%	16	76.4%

The results obtained are satisfactory. As displayed in the above Tables 1,2 and 3 we could analyse the inconsistencies of density during morning and evening and depending on that there was an appropriate movement of the divider whether to right or left. This process was continued repeatedly. But there is a limitation that it cannot be capable to analyse that the traffic has reduced and divider has to move to its mid position automatically. The observation got from the model are shown in above figures. Whenever an emergency vehicle is in traffic, depending on the destination paths the LED's glowed when a button was clicked in an IOT application appropriately and the result was verified.

6. Conclusion

The execution of this model finds its application in the road and safety management domain. It explains a movable road divider which uses IOT and related sensors for its functioning. The one-sided traffic density during peak hours which was observed could be analysed and can drastically reduce the traffic using the model. The clearance of jams and blocks during traffic can be done using this model and also has an application to leave way for any emergency vehicle coming in the traffic is an added advantage. Hence the model could be used in future and can reduce the traffic to an extent. If this model with some improvement like providing cloud services is used in the future then it can bring a great change in the traffic and emergency control domain.

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