



IoT-enabled Dynamic Road Dividers for Adaptive Traffic Management.

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Abstract: The implementation of a movable road divider using IoT (Internet of Things) involves the integration of smart technology with traditional road safety measures. The objective is to create a road divider that can be moved to adjust the flow of traffic and to prevent accidents. This system consists of sensors, controllers and actuators that work together to detect and respond to changes in traffic flow. The sensors monitor the traffic flow and communicate with the controllers, which process the data and send signals to the actuators to adjust the position of the road divider. The use of IoT technology allows the system to be remotely controlled and monitored, providing real-time updates to traffic authorities. This paper presents the design and implementation of a movable road divider using IoT, highlighting its benefits in terms of safety, efficiency, and cost-effectiveness.

Index Terms - Road Divider, traffic density, ESP32, Ultrasonic Sensors, DC motor, L298N motor driver.

1. INTRODUCTION

IoT stands for "Internet of Things." It is a network of physical devices, vehicles, buildings, and other objects that are embedded with sensors, software, and connectivity, allowing them to collect and exchange data with each other by using internet. The purpose of IoT is to create a more connected world where devices can communicate and interact with each other to improve efficiency, convenience, and quality of life. IoT technology has applications in many industries, including healthcare, transportation, manufacturing, and agriculture, among others. Some examples of IoT devices include smart thermostats, fitness trackers, connected cars, and industrial sensors that monitor machinery and equipment. These devices can collect data on their environment or usage and use that data to make decisions or trigger actions.

In this 21st century, road traffic congestion is a critical problem which is arising in most of the metropolitan cities like Hyderabad, Pune, Mumbai, etc. There are numerous different situations where different strategies are applied to break them, then in this design we came up with a result which solves a type of traffic issue. Now-a-days operation of private motorcars is making urban traffic more and more rush area as a result traffic control has come one of the most important problem which is performing in vain attempt and pollution. Hence it is vital to find an effective solution for traffic control. Road divider is generally used for dividing the road for managing the ongoing and incoming traffic. The stationary road separator divides the number of lanes into equal halves where the separator is fixed.

To overcome this problem, we have developed a moving road separator/divider that based on the advancement of traffic. Here, we have used ultrasonic sensors, the sensors are used with the ESP32 microcontroller to get information from detectors, also RFID is used to identify the emergency vehicles, such that the vehicle like ambulances will get a direction to reach their desired location. For case, road dividers with IR detectors. We see that there will be having high traffic congestion on one side of the road than the other. In this type of situation, it can be considered a controlled area due to the fact that it reduces traffic related problems.

2. LITERATURE SURVEY

I. "Implementation of movable road divider using IOT", Hemlata Dalmia[1] :

This survey focuses on the development of a project on movable road divider which changes its position based on the density of traffic i.e high or low density. RFID was also used to detect the presence of the emergency vehicles.

II. "Design and Implementation of Smart Movable Road Divider using IOT", B Durga Sri[2] :

For this survey the road of western express ,Bombay was inspected. Research has been done between 7.00am to 9.00pm, data extracted from the above observation was number of vehicles passing a road and velocity of vehicles. He came with conclusion that the vehicles density was decreasing during peak hours.

III. "Density based traffic control" ,Er Faruk Bin Poyen et al.[3]:

In this implementation, the PIR sensors were used to detect the traffic density. On the basis of gathered results the timers for the red and green lights were fixed.

IV. "Smart traffic optimization using image processing" ,Pranav Maheshwari[4] :

In this survey the complete implementation is based on image processing. Here the signal poles were fixed with the cameras and these cameras were used to capture the images , which are processed later. After gaining the results of the image processing a timer was set for the signal lights.

V. "Movable Traffic Divider: A Congestion Release Strategy", Advait Kawle[5] :

A inspection was conducted covering the wagholi chowk traffic volume on the Pune-Nagar highway and showing a critical traffic problem in the area.

3. ANALYSIS OF THE PROBLEM

Road traffic congestion is among the most challenging issues that current road traffic authorities as well as peoples are facing Among all these impacts, the delay of emergency services delivery to the emergency location is the most critical due to the incurred cost in terms of deaths, injuries and financial losses in case of fires, car crashes, terrorist attacks, etc. Such as the emergency vehicles like ambulances get delayed to reach their destination due increased traffic , which may apparently result in death of the patient .It is not surprising ,because the conditions of roads in many cities across the globe have been same for decades. There is no significant development or technological adaptation in the way road transportation has evolved.

In this age of advanced technology, we need a breakthrough where technology is used to help people be safe. A technology that can detect density of traffic, and which would save lives and prevent people from accidents by performing desired actions.

4. AIM AND OBJECTIVE

Aim:

We are designing a movable road divider which moves depending on the flow of traffic. The IoT compiles the real-time data of vehicular traffic that finds out the current traffic operation and traffic flow conditions. The IOT will be connected with each and every part of traffic such as roads , dividers with the help of ultrasonic sensors.

Objectives:

- Movable road divider will eliminate traffic congestion and avoid delay in traffic.
- To increase the efficiency of flowing traffic.
- To reduce the complexity at the junction.
- To reduce the accidents.
- To make the people follow the traffic rules.

5. SYSTEM ANALYSIS

This project is namely divided into:

- 1.Hardware development
- 2.Software Development

5.1 Hardware Development

In hardware development the following components are used to build the system;

a)EM18:- EM18 is a RFID reader which is used to read RFID tags of frequency 125 kHz. RFID tags are the unique ids which are given to the emergency vehicles like ambulances.



Fig:Em-18 RFID Tag Reader

b)ESP32:-ESP32 is a Microcontroller with an integrated Wi-Fi and Bluetooth.



Fig: ESP-32 Microcontroller

c)LCD display:-Displays what actions are performed.



Fig: LCD display

d)Ultrasonic Sensors:-An ultrasonic sensor is a type of sensor that uses sound waves to detect objects and measure distances.



Fig: Ultrasonic Sensors

e)Motor Driver :- Motor drivers are used to give high power to the motor by using a small voltage signal from a microcontroller or a control system. It is used to move or rotate the devices.



Fig: Motor Driver L298N

f)PreSet :- A preset is a three legged electronic device which offers varying resistance in a circuit.

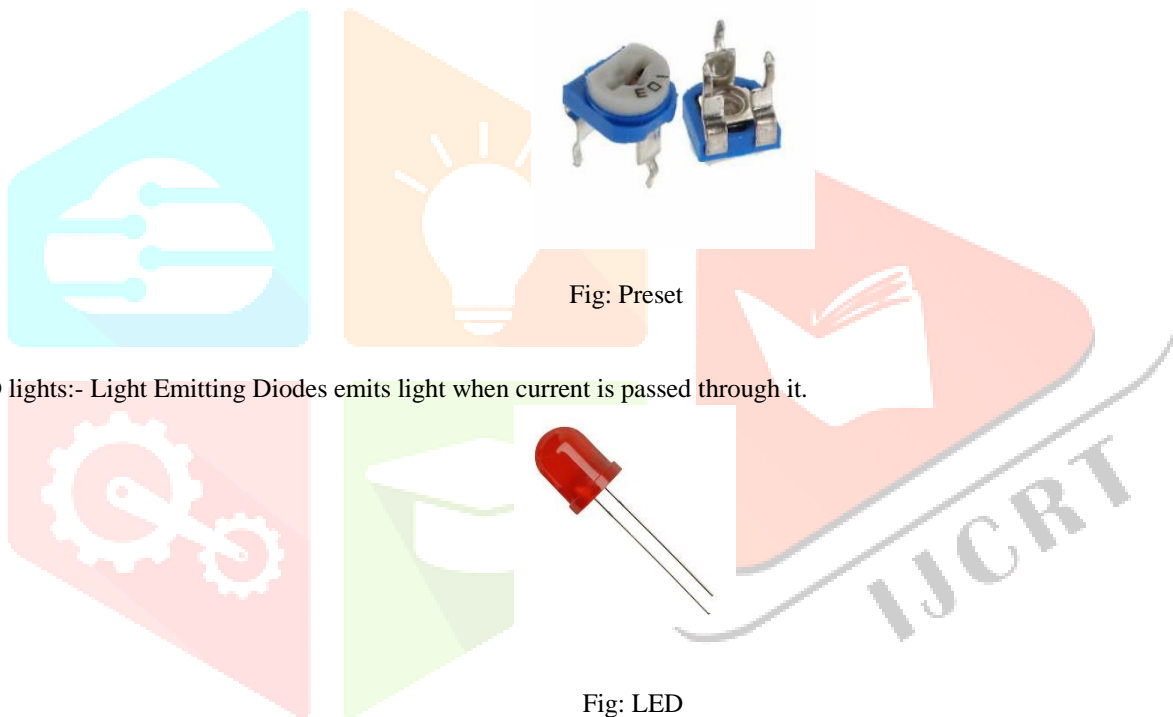


Fig: Preset

g)LED lights:- Light Emitting Diodes emits light when current is passed through it.

Fig: LED

5.2 Software Development

In software development phase, the code was constructed using C programming language which and was targeted to Blynk Cloud.

A.Arduino IDE:- The Arduino Integrated Development Environment consists of a text editor for writing code and a toolbar for the execution of common operation. It connects with hardware components to upload programs and communicate with them.

B.Blynk Cloud:- Blynk is an IoT platform that is used to control Arduino, Raspberry Pi via the Internet. This application is used to build a graphical interface or human machine interface (HMI).

6. PROPOSED METHODOLOGY

we have proposed a model of movable road divider which will move on the basis traffic density. The model consists of Ultrasonic sensors that will detect the traffic density ,microcontrollers, EM-18 which is a RFID tag reader, motor driver and LCD display. Our model works in two modes i.e 'Manual mode' and 'Auto mode' as per the choice of the user. Also, we have used Blynk Cloud ,which is an IOT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface.

The data which is collected through sensors and EM-18 is sent to the ESP-32 microcontroller , which acts as a main component of the whole system ,it processes the whole collected data. This processed data is then sent to the motor driver which is responsible for the movement of divider (the motor either moves anti-clockwise or clockwise such that the divider can be shifted to left or right side to manage the traffic).

I. Circuit Diagram:

The following is the circuit diagram of the model, which shows how the components are connected with each other to make the model work:-

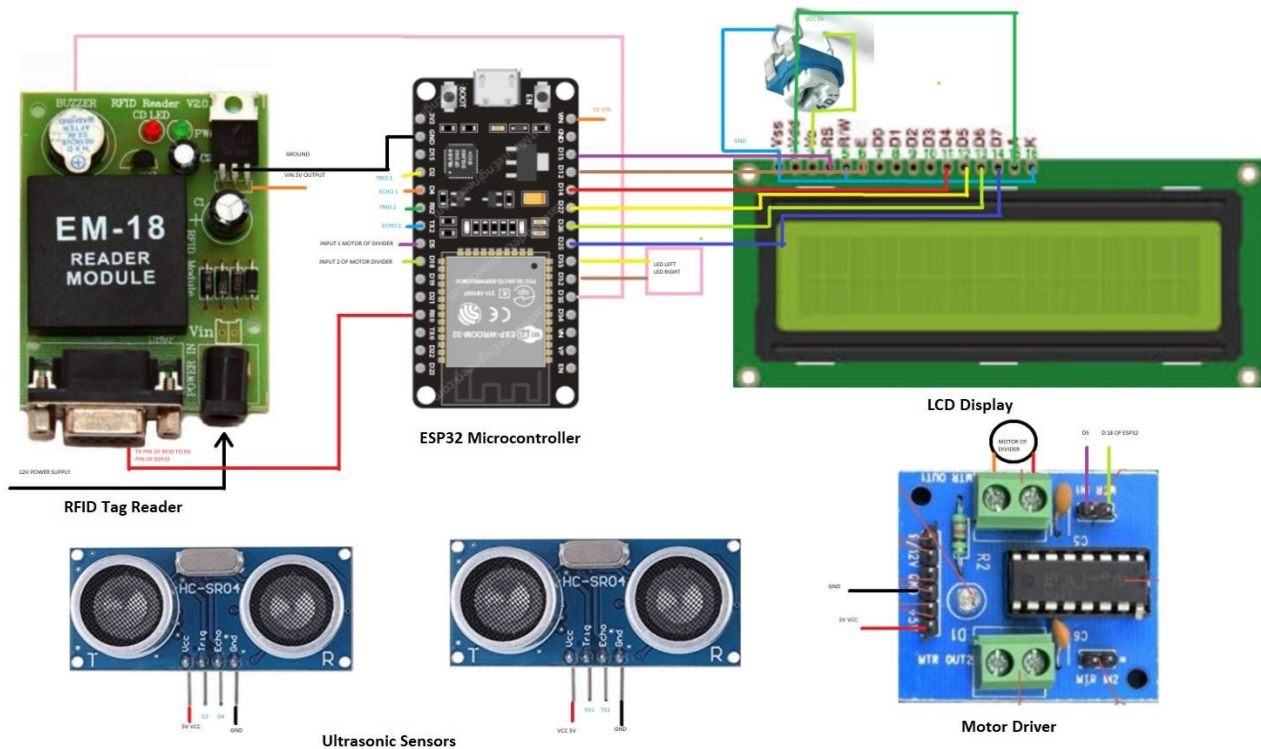


Figure: Circuit Diagram

II. Pin Connections:

ultrasonic sensor:-

trigPin1 = pin number 2
 echoPin1 = pin number 4
 trigPin2 = pin number 16
 echoPin2 = pin number 17

LCD screen:-

lcd(13,12,14,27,26,25)

LED:-

32(right side),33(left side)

Buzzer:-

(23)

Motor A:-

Motor pins(5,18),19(enable pin)

III. Algorithm for Manual Mode:

Step 1: Start the System.

Step 2: Select the Mode between “Manual” and “Automatic”.(Consider that, manual mode is selected)

Step 3: Choose left or right button on the Blynk Cloud Application on mobile device.

Step 4: Will check if there exist traffic or vehicle on the side where the divider will move.

Step 5: If there exist any traffic or vehicle no changes will be made that is the divider will not move anywhere.

Step 6: If there is no traffic or vehicle, then the divider will move on the requested side.

IV. Flowchart for Auto Mode:

The following flowchart depicts the working of Auto Mode:-

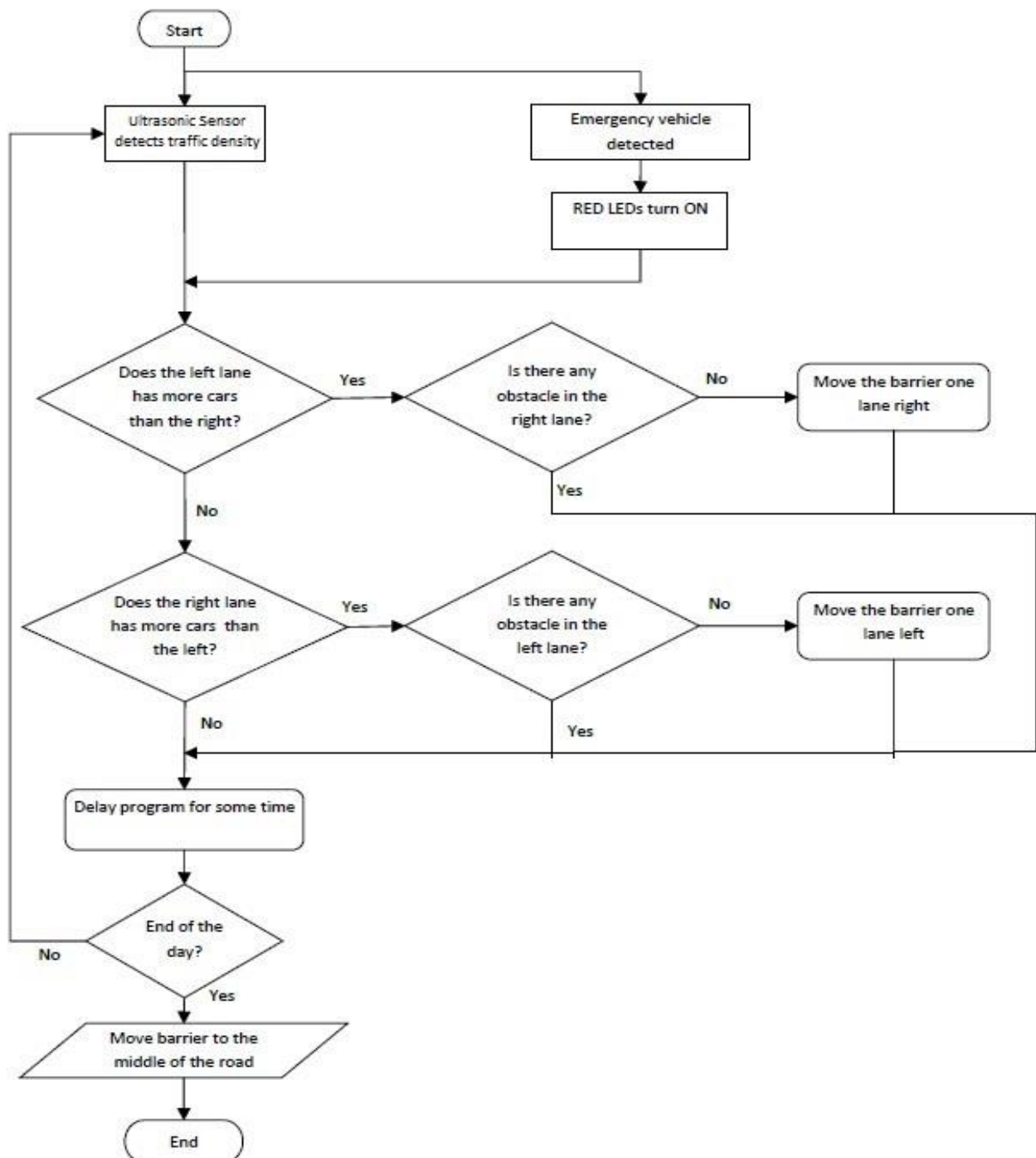


Figure: Flowchart for working of Auto mode

7. LIMITATIONS

Cost: The cost of implementing an IoT-based movable road divider system can be high, which could limit its adoption in certain areas.

Maintenance: The system requires regular maintenance to ensure that it functions properly, which can add to its overall cost.

Power supply: The system requires a reliable power supply, which may not be available in all locations, especially in remote areas.

8. IMPLEMENTATION

The implementation phase is the stage of a project where the plan or design is put into action. It involves the actual execution of the project plan, and the resources required for the project are mobilized. Thus, it is the most important phase out of all phases.

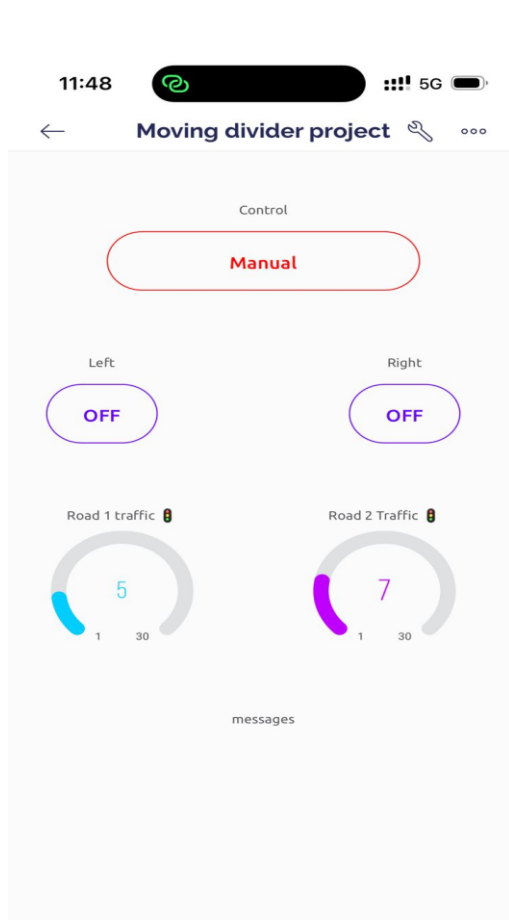


Fig: Blynk Cloud Interface
a)Manual Mode

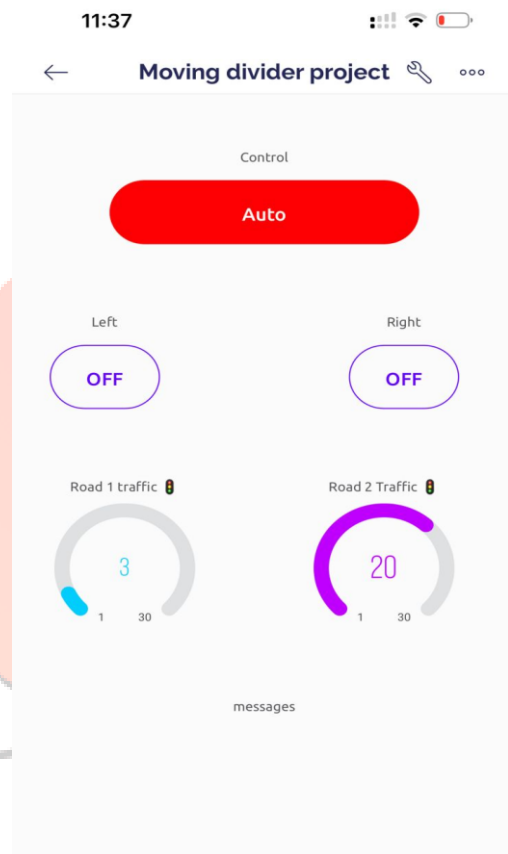


Fig: Blynk Cloud Interface
b)Auto Mode

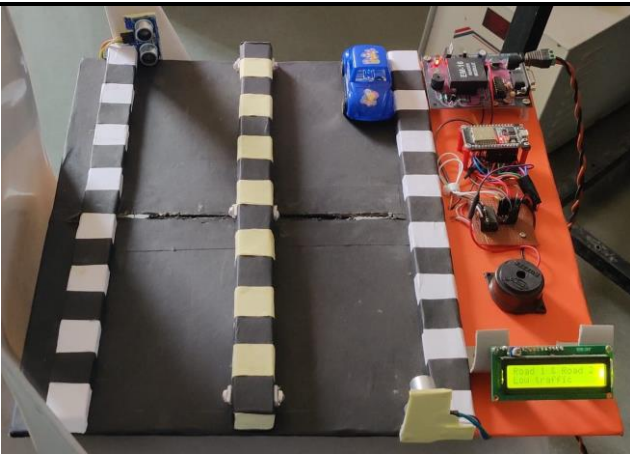


Fig: Road 1 & Road 2 with low traffic density.

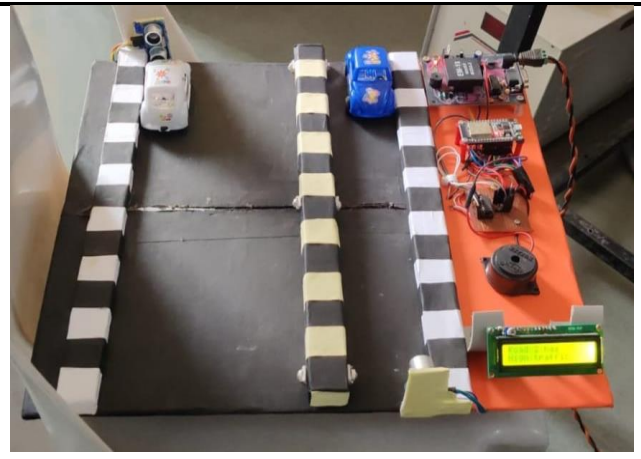


Fig: Road 2 has high traffic density.

As per the 3 conditions provided for traffic density like LOW, MEDIUM and HIGH, road divider is moved accordingly. If the traffic density is LOW then divider stays in its position. As we can see in the above figure, Road 1 and Road 2 has low traffic density, so the divider is not shifted. If the density is MEDIUM then divider moves by a small distance. If the traffic density is HIGH then divider moves by a large distance. As, we can see in the above figure that on Road 2 has high traffic density so the divider is shifted towards Road 1. The model also provides solution to traffic clearance for the ambulance. RFID i.e. Radio Frequency Identification can be used to detect the arrival of any emergency vehicles like ambulance and then to make a way specially for ambulance by moving divider of the road accordingly. Hence it is possible to avoid congestion in a given road by moving the divider to widen or narrow the road and clear the traffic. Also it is possible to provide a free way for the ambulance irrespective of the traffic jam on the road.

9. CONCLUSION

Through this study, we have successfully designed and implemented a demo model of 'IoT-enabled Dynamic Road Dividers for Adaptive Traffic Management', in which the results are satisfactory. The implementation of movable road divider describes a simple system, which uses IoT. With the use of movable road divider we reduce traffic congestion during peak hours. The proposed system reduces the chances of traffic jams and to provide clearance of road for the emergency vehicles thus saves a life.

10. FUTURE WORK

Advanced analytics: The system could be enhanced with advanced analytics and machine learning algorithms to analyze traffic patterns, predict congestion, and optimize the flow of traffic.

Integration with smart city infrastructure: The IoT-based movable road divider system can be integrated with other smart city infrastructure such as traffic lights, surveillance cameras, and emergency response systems to create a more efficient and effective transportation network.

11. REFERENCES

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