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A PROJECT ON:
Automatic Pothole Detector

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INTRODUCTION

Roads are the essential means of transportation for a country to provide commutation facilities nationwide. The roads are usually made up of asphalt pavement and are prone to different structural damages with the passage of time.



The asphalt pavement distresses have been a concern of authorities to avoid unwanted circumstances. These pavements are vulnerable to scenarios such as traffic load, weather conditions, age, poor material used for construction, and a miserable drainage system, exhibiting two major pavement failures such as cracks and potholes. Potholes are essentially the concave-shaped depressions in the road surface that require attention as they induce awful circumstances such as accidents, unpleasant driving experiences, and malfunctioning of vehicles.

Pothole death: A father's lengthy fight for justice

Court To Hear Charges Against Firm's Directors On Aug 9

► Continued from P1

WHAT HAPPENED OVER LAST 5 YEARS

Feb 16, 2014 3-year-old Parthiv killed after the bike he was travelling on lost balance because of a pothole on NH-2

Feb 26 FIR lodged; police blame unknown vehicle

May 31 Complaint saying wrong FIR was lodged sent to joint CR, Faridabad

June 17 Reinvestigation by ACP and DCP finds pothole to be the main cause of accident

July 16, 2014 NHAI asked to respond within 3 months

July 27, 2017 Contempt hearing against NHAI

July 30, 2018 HC orders police to name agencies responsible

October 12 Faridabad court takes up the case; police name six accused

March 26, 2019 Court seeks exact details of L&T directors

April 25 Police file challan with names of L&T board members, including chairman

ce jail term for such an offence is less than seven years, they did not arrest the directors and requested the court to issue notices.

Police had submitted the supplementary charge sheet after a court order of March 26 which said, "By looking at all the circumstances, the investigating agency, through the applicant, is directed to specify the names of the director L&T company who was directly responsible for supervising the said project, by filing point-wise and detailed reply to the application. If required, the investigating agency is at liberty to do further investigation on this point."

After going through the supplementary charge sheet on May 1, the court said, "The

After three rounds of investigation through different wings of police, Faridabad police named six accused and a final report was filed on October 12, 2018.

The NHAI had asserted the work of widening the Dabhi Agre stretch to DA Yell Road Pvt Ltd (DATRPL), an SPV set up by Hindustan Infrastructure. DATRPL said the stretch where the accident took place was given to L&T and it was responsible for repairing and filling of potholes.

"We never knew this since creation, people thought DATRPL was responsible. After they shared the details, we sought the name of the L&T project officer who was responsible for this stretch and

According to the prediction made by WHO (World Health Organization), road accidents will become the fifth leading cause of death in 2030.

The Automatic Pothole Detector is a step towards solving this serious issue. It will sense these irregularities and alert the driver immediately. When the user sees the indicator, they can act accordingly. Hence, this device can be especially useful in monsoon season when road damage cannot be clearly seen. It is especially beneficial to two-wheeler vehicle drivers since they do not have an inbuilt facility to provide this service.

OBJECTIVE & SCOPE

The device should satisfy the following parameters:

- Range: Potholes or speed bumps should be accurately detected within a sufficient range.
- Depth: Approximate depth of the pothole should be known by the device.
- Indicator: The Detector should appropriately signal the user based on the severity of the road damage.

Application domain of the device:

- During monsoon season: Due to the rain and/or fog, it is difficult for the drivers to see the road clearly and distinguish the water-filled potholes from the flooded road.
- At places like construction sites, muddy roads: In these types of roads, mud or dust covers the entire road. The coating seems to be uniform, thus hiding the road damage underneath.
- Night drivers: Many people travel during the night, often to cover a large distance. The streetlights are sometimes not sufficient for the drivers to see the potholes or speed breakers. In many areas, there are roads having no streetlights at all. In such instances, a device that can detect obstacles is very useful.

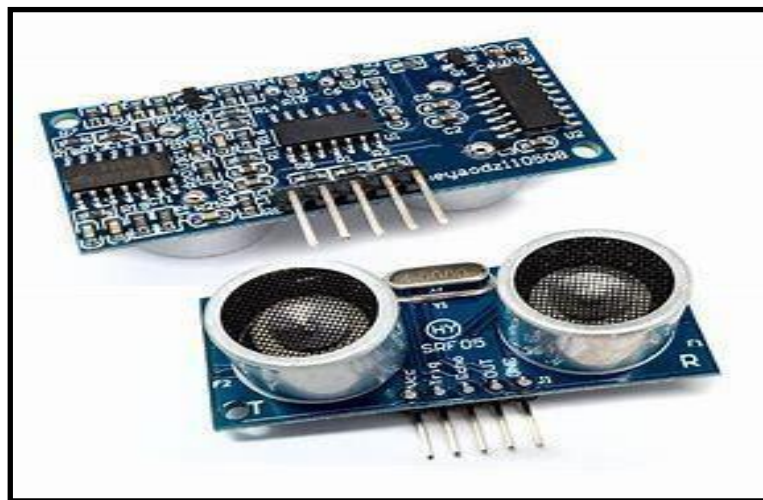
THEORETICAL BACKGROUND

- Ultrasonic sensor:

Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals.

Ultrasonic sensors overcome many of the weaknesses of IR sensors - they provide distance measurement regardless of color and lighting of obstacles. They also provide lower minimum distances and wider angles of detection to guarantee that obstacles are not missed by a narrow sensor beam.

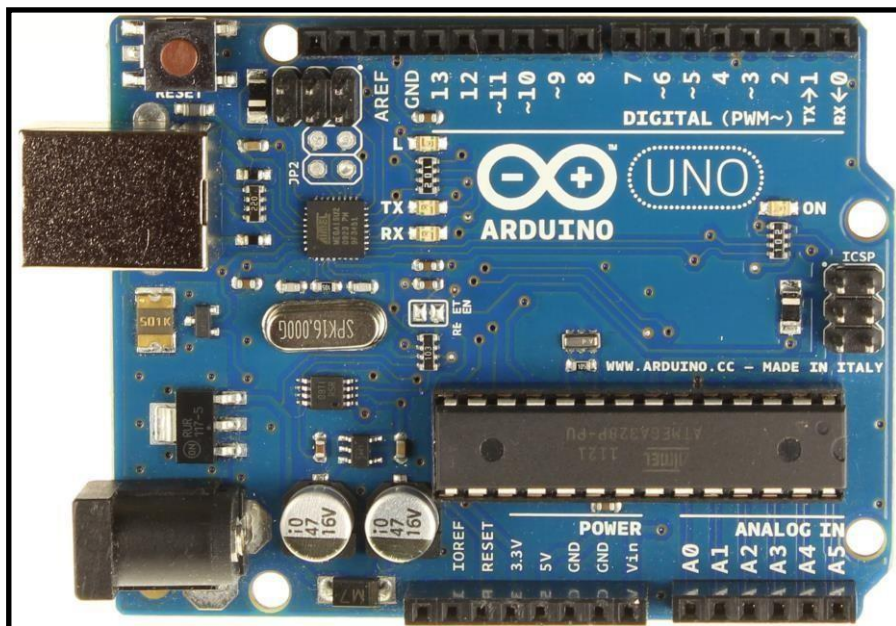
The ultrasonic **HC-SR05** Module, which is used for the project, has a working voltage of 5V. The detection range of the sensor is 3 cm to 4 m. It has detection precision of up to 0.3cm. It has a static current of less than 2mA.



- Arduino UNO microcontroller:

A **microcontroller** is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. It has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.

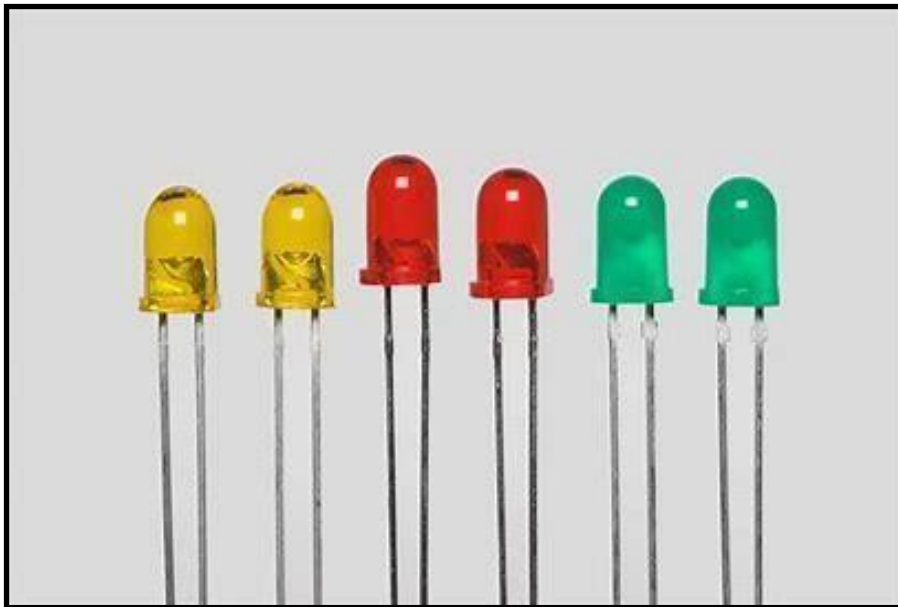


- LEDs:

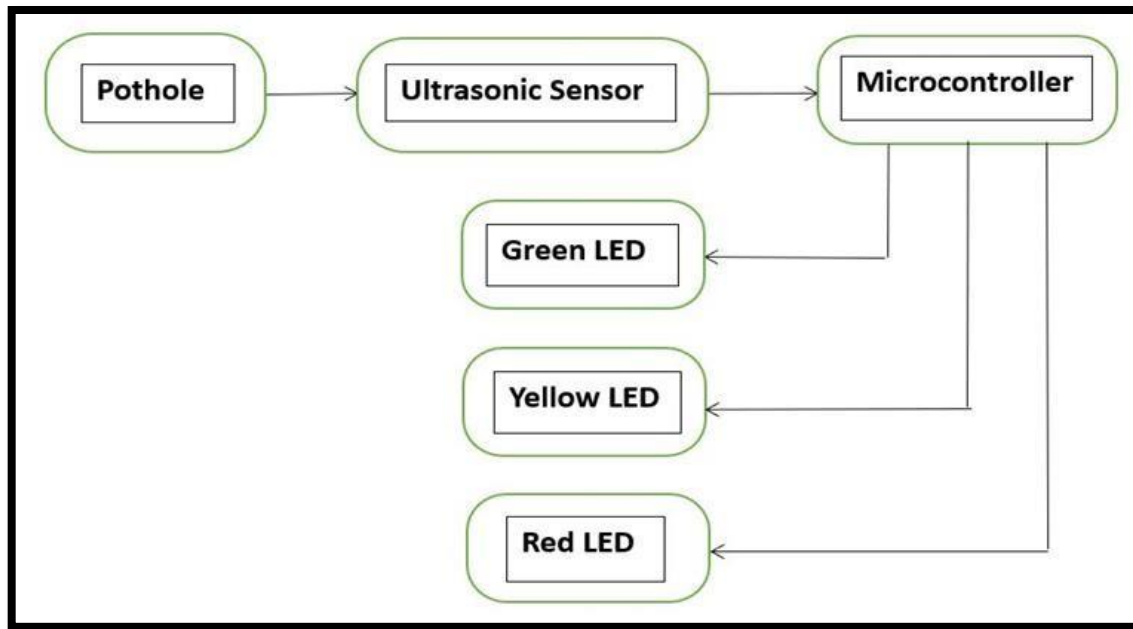
LED (Light Emitting Diode) is a semiconductor device that emits light when current flows through it. Based on the semiconductor material used and the amount of doping, an LED will emit colored light at a particular spectral wavelength when forward biased.

One of the main applications of LEDs is as visual signals to the user to convey a message or meaning, especially in projects.

In this project, three different-colored LEDs are used, namely, red, yellow and green. The colors were chosen for their universal meaning.



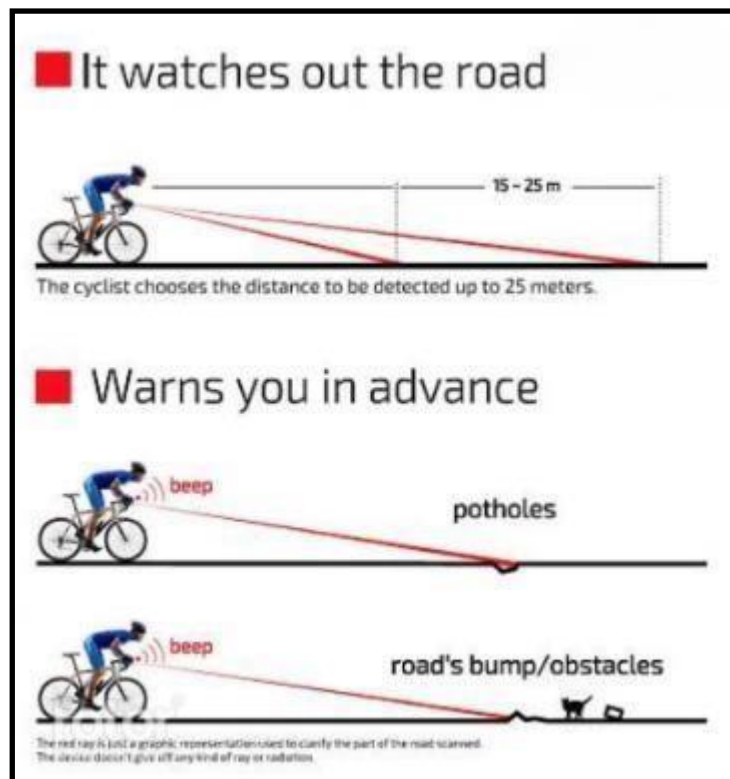
RESEARCH METHODOLOGY



The ultrasonic sensor constantly senses the road by measuring the distance between itself and the surface. It accordingly sends the same as feedback to the microcontroller. It will correspondingly take the necessary action by activating the indicators used.

The Arduino UNO microcontroller has already stored a predetermined value as the constant distance. This value is measured by taking into consideration the angle of the sensor, which is mounted on the vehicle as well as the height of its position from the road surface. Hence, Arduino stores the default value which should be sent by the sensor when the pavement is level.

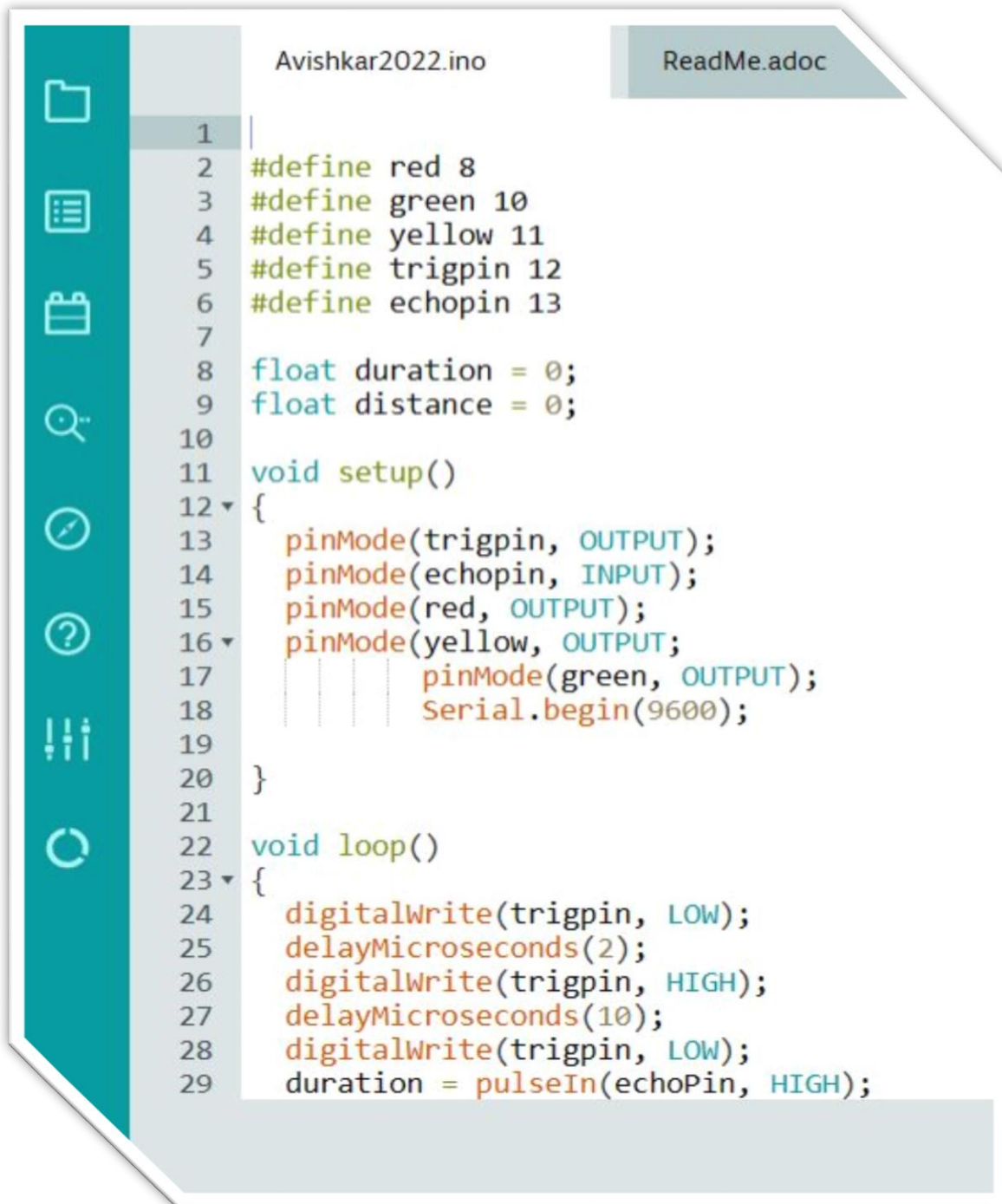
Now, if there is a pothole or a ditch, the ultrasonic sensor will transmit the distance from the hole to itself. This distance will be slightly higher than the constant value it had been sending when the road was uniform. Arduino processes this information and due to the inbuilt condition in the code to detect this case, it knows that there is a pothole. Hence, it activates the appropriate LED to warn the driver of the obstacle.



By the same logic, when the sensor detects an obstacle in its path, like a speed breaker or small animal, the distance will be slightly smaller and the microcontroller will light up another LED as an indicator to the driver of the same.

PROGRAM

Code to interface Arduino Uno with Ultrasonic sensor and LEDs



```
1 |
2 | #define red 8
3 | #define green 10
4 | #define yellow 11
5 | #define trigpin 12
6 | #define echopin 13
7 |
8 | float duration = 0;
9 | float distance = 0;
10 |
11 | void setup()
12 | {
13 |     pinMode(trigpin, OUTPUT);
14 |     pinMode(echopin, INPUT);
15 |     pinMode(red, OUTPUT);
16 |     pinMode(yellow, OUTPUT);
17 |     pinMode(green, OUTPUT);
18 |     Serial.begin(9600);
19 |
20 | }
21 |
22 | void loop()
23 | {
24 |     digitalWrite(trigpin, LOW);
25 |     delayMicroseconds(2);
26 |     digitalWrite(trigpin, HIGH);
27 |     delayMicroseconds(10);
28 |     digitalWrite(trigpin, LOW);
29 |     duration = pulseIn(echoPin, HIGH);
```

Avishkar2022.inoReadMe.adoc

```
22 void loop()
23 {
24     digitalWrite(trigpin, LOW);
25     delayMicroseconds(2);
26     digitalWrite(trigpin, HIGH);
27     delayMicroseconds(10);
28     digitalWrite(trigpin, LOW);
29     duration = pulseIn(echoPin, HIGH);
30     distance = duration * 0.034 / 2;
31     if (distance < 3)
32     {
33         digitalWrite(yellow, HIGH);
34         delay(1000);
35         digitalWrite(yellow, LOW);
36     }
37     else if (distance >= 3 && distance < 5)
38     {
39         digitalWrite(green, HIGH);
40         delay(1000);
41         digitalWrite(green, LOW);
42     }
43     else if (distance >= 5 && distance <= 7)
44     {
45         digitalWrite(yellow, HIGH);
46         delay(1000);
47         digitalWrite(yellow, LOW);
48     }
49     else
50     {
51         digitalWrite(red, HIGH);
52         delay(1000);
53         digitalWrite(red, LOW);
54     }
55     delay(100);
56 }
```

RESULTS

LED	Implication
Green	Safe
Yellow	Small Pothole
Yellow	Speed Breaker
Red	Deep Pothole

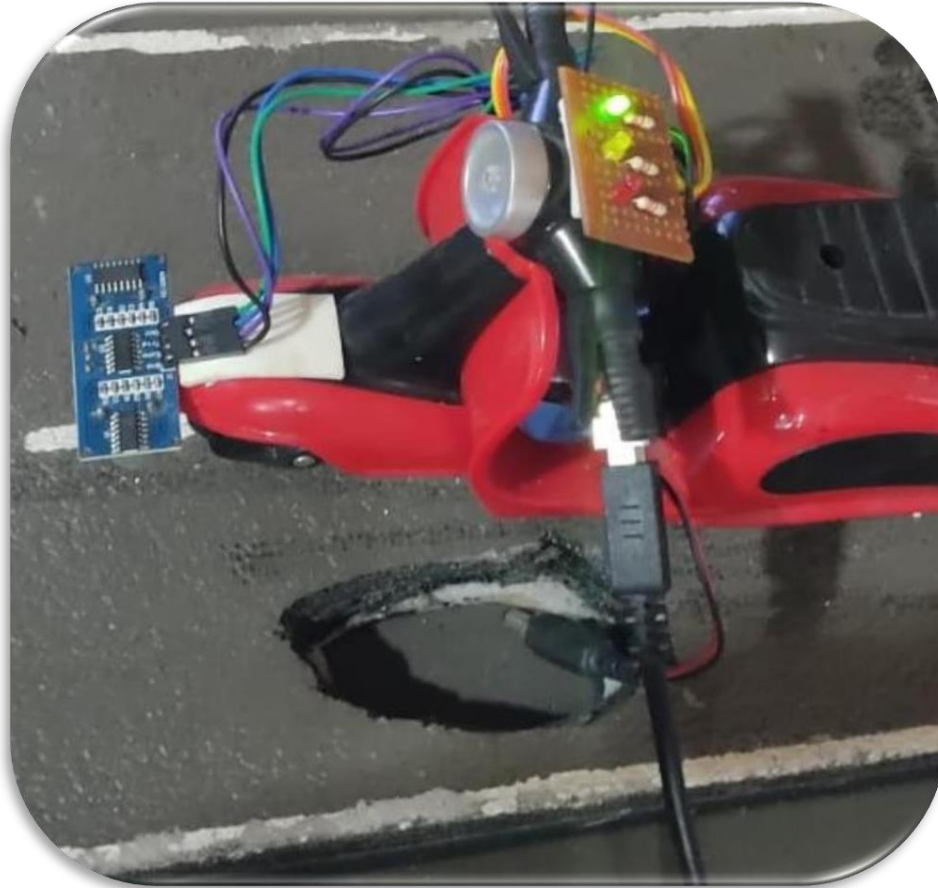
From the given table, it can be seen that the color of the activated LED has an implicit meaning.

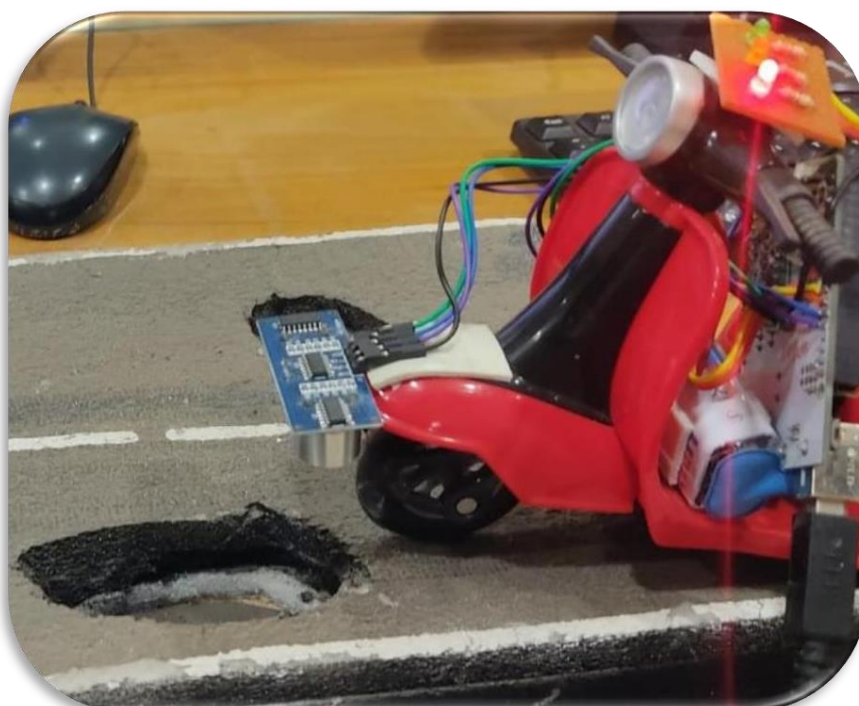
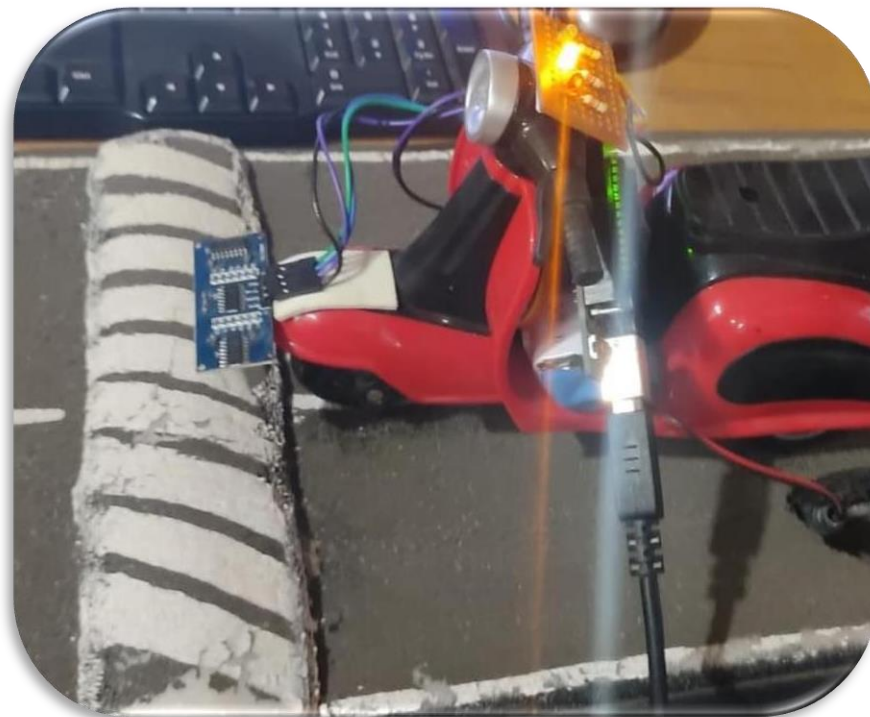
The green LED will emit light the most since it not only indicates that the power supply is on and the circuit is working but also the fact that the road is even and has no obstacles on it. Hence, the green LED implies *normal*.

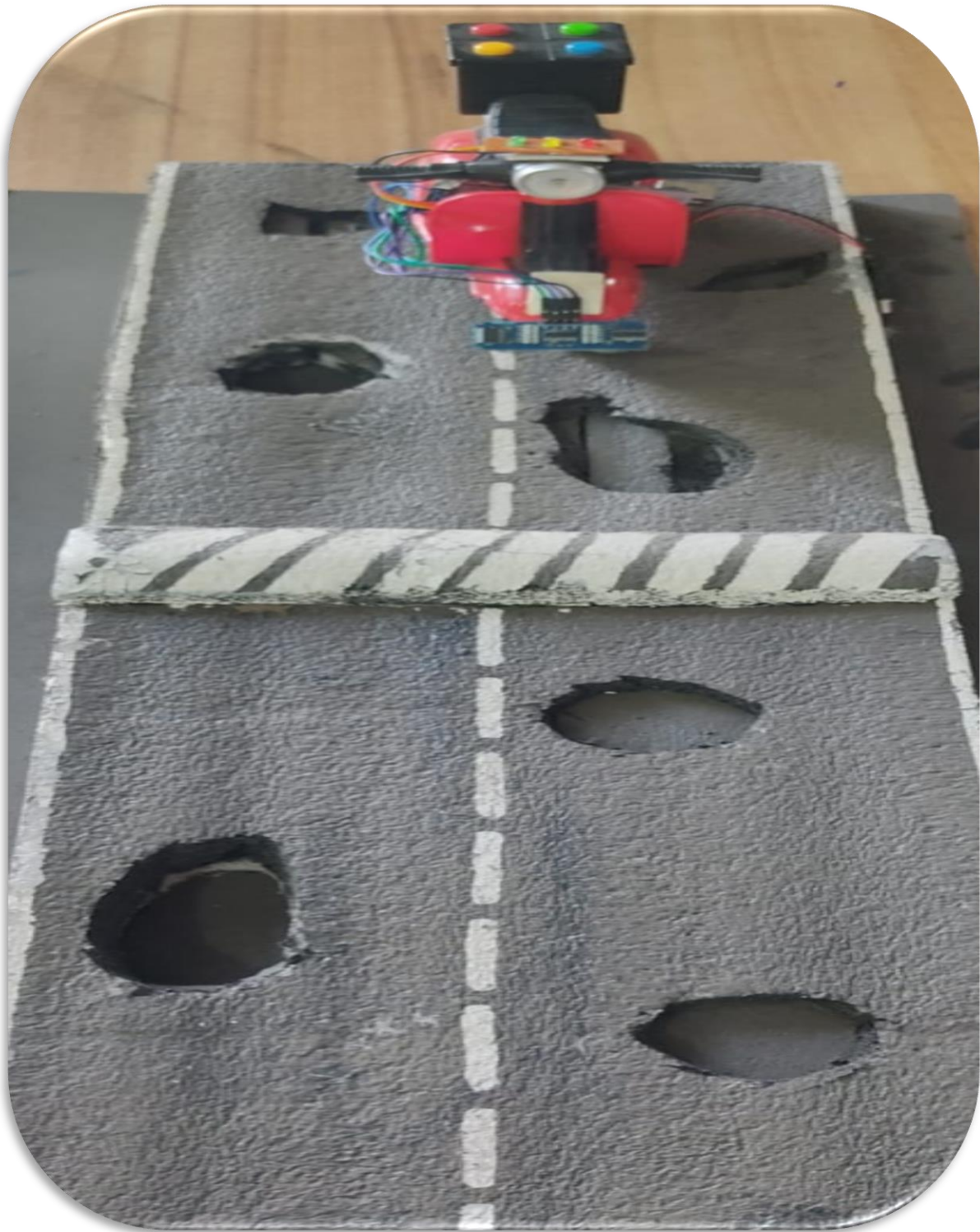
Similar to green, the yellow LED also has two meanings; either there is an obstacle or there is minor road damage. In either case, the driver needs to slow down. Hence, the main message this LED says is to *reduce speed*.

The red LED is only for extreme circumstances, when there is a deep pothole, ditch or even a cliff. Any of these cases can lead to serious injury, at best. Hence, it conveys the message to *stop*.

A functioning prototype has been developed which demonstrates the following results:







CONCLUSION

The working prototype of the Automatic Pothole Detector is functioning as required. It is able to detect speed breakers and potholes and indicate the same to the user via LEDs.

This device can be very beneficial to have while driving. It can act as a road damage detector. But as stated earlier, it can also be used to sense obstacles in its path. Hence, the accidents that often occur due to the driver not seeing a stray animal, child or object will also be reduced. Aside from that, disabled people, ambulances, people driving near cliffs, etc. are some instances where the device can also be useful.

LIMITATIONS

- Range: In the working prototype, the range of the sensor is very low. This is in part due to the sensor module used and the angle of its position on the toy vehicle.
- Power consumption: As the green LED is continuously ON when there is no impediment, there is always one LED activated, which can consume a lot of power.
- Sensor sensitivity: The sensor needs to be protected from the environmental conditions like dust, water, etc. to maintain its efficient working

FUTURE ENHANCEMENT

- ❖ **Better range**: Using an industrial grade ultrasonic sensor and fitting it onto the vehicle more securely than duct tape on a wider angle would significantly increase the sensor's area of detection.
- ❖ **LCD interfacing**: Currently, the indicator used is an LED that does not give much information. The user has to remember the distance range and only gets a rough idea about the obstacle ahead. An LCD can display the exact distance of the pothole from the vehicle and its depth. Both the parameters are already being determined in the working prototype but are not able to be displayed.
- ❖ **More indicators**: It may happen that the driver can miss the LED light, especially in foggy or rainy days. Hence, an audio indicator like a buzzer can also be added. With some refinement, its duration of activation can be changed according to depth of pothole or height of speed bump, similar to the LED colors. There can also be an additional setting to turn ON/OFF buzzer/LED settings to suit user preferences.

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