SMART ROAD SAFETY: SPEED BREAKER IDENTIFICATION AND DRIVER WARNING SYSTEM WITH REAL-TIME ALERTS

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ABSTRACT

In recent years, car accidents have become commonplace. On interstates, using speed breakers excessively causes motorist distraction. Additionally, drivers frequently lose control of their vehicles when unmarked speed breakers arrive and cause major accidents with fatalities. There are a few time-consuming and extremely error-prone approaches to alert on-road drivers about approaching speed breakers in the literature.

Furthermore, none of them give a damn about tracking the data of violating speed limiters. In this study, we present a system that enables dynamic speed breaker recognition, autonomous data gathering, and alert generating for on-road drivers. The proposed system will detect the speed breaker at a particular distance and indicates the distance of the speed breaker in the LCD display and it also alerts the driver by an alarm.

In this system we have used ultrasonic sensor which detects the distance of the speed breaker using ultrasonic sound waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. When the input is given it flows into the voltage regulator 7805. It maintains the voltage of a power source within acceptable limits.

The setup is arranged in a PCB board. A Node MCU (Node Microcontroller Unit) is used here in which we have dumped C coding. When the input is passed the coding runs and it displays speed breaker and its distance on the display. The buzzer also starts to indicate with a beep sound. This is mainly implemented to prevent accidents during night times and in bad climatic conditions.

Keywords: *Ultrasonic sensor, Voltage regulator 7805, PCB board, Node MCU, Buzzer.*

CHAPTER 1

EMPHATHIZE PHASE

Traffic calming devices, also referred to as vehicle speed reducers, are the simplest and most common method of traffic control. Around the world, vertical and horizontal speed breaker devices are employed to lower speeds to manageable limits for the easy enforcement of legislation. The world is moving towards intelligent speed breakers today, which could be safer and more environmentally friendly than traditional speed breakers. Some poorly designed and abnormal speed breakers also cause various accidents, so these speed breakers are always in the spotlight of criticism. This review article looked into the cutting-edge speed breakers used globally. According to a World Health Organisation survey, accidents were responsible for 1.35 million fatalities worldwide. Indian Highways Ministry reported that over Speed breakers, often known as speed bumps, are traffic calming devices that are the cheapest and most effective means to reduce vehicle speed.

For user safety, equipment like speed limiters are implemented . These speed breakers can operate as vehicle destroyers and could increase traffic noise if they are implemented incorrectly and designed unnaturally without using the necessary criteria . Even at relatively low speeds, poorly built speed humps can be dangerous for drivers and challenging for vehicles with low ground clearance to traverse [6]. Many sports cars have experienced various issues with these speed humps.speeding incidents resulted in 97,588 fatalities in 2018, accounting for 64.4% of all fatalities in India. This figure also showed an increase in road accidents of 0.49 percent over the previous year, 2017.

In the most recent year, States and Union Territories (UTs) reported a total of 4,67,044 road accidents with 1.5 lac fatalities and 4,69,418 injuries, where over speeding was only responsible for 97,588 deaths. According to a World Road Statistics report, India ranked #1 among the 200 countries for the number of road accidents, and it is responsible for roughly 11% of accident-related deaths. Speed breakers, often known as speed bumps, are traffic calming devices that are the cheapest and most effective means to reduce vehicle speed. For user safety, equipment like speed limiters are implemented . These speed breakers can operate as vehicle destroyers and could increase traffic noise if they are implemented incorrectly and designed unnaturally without using the necessary criteria . Even at relatively low speeds, poorly built speed humps can be dangerous for drivers and challenging for vehicles with low ground clearance to traverse . Many sports cars have experienced various issues with these speed humps.

CHAPTER 2

DEFINE PHASE

2.1 DEVICES USED FOR SPEED BREAKER DETECTION :

So to detect the speed breaker two commonly used devices for speed breaker detection are,

2.1 1 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. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound. There are mainly two essential elements which are the transmitter and receiver. Using the piezoelectric crystals, the transmitter generates sound, and from there it travels to the target and gets back to the receiver component (fig.1). To know the distance between the target and the sensor, the sensor calculates the amount of time required for sound emission to travel from transmitter to receiver.

Ultrasonic Sensor Specifications :

Knowing the specifications of an ultrasonic sensor helps in understanding the reliable approximations of distance measurements.

- The sensing range lies between 40 cm to 300 cm.
- The response time is between 50 milliseconds to 200 milliseconds.
- The Beam angle is around $5^{0.}$
- It operates within the voltage range of 20 VDC to 30 VDC
- Preciseness is ±5%
- The frequency of the ultrasound wave is 120 kHz
- Resolution is 1mm
- The voltage of sensor output is between 0 VDC – 10 VDC
- The ultrasonic sensor weight nearly 150 grams
- Ambient temperature is -25^{0}C to $+70^{0}$C
- The target dimensions to measure maximum distance is 5 cm × 5 cm

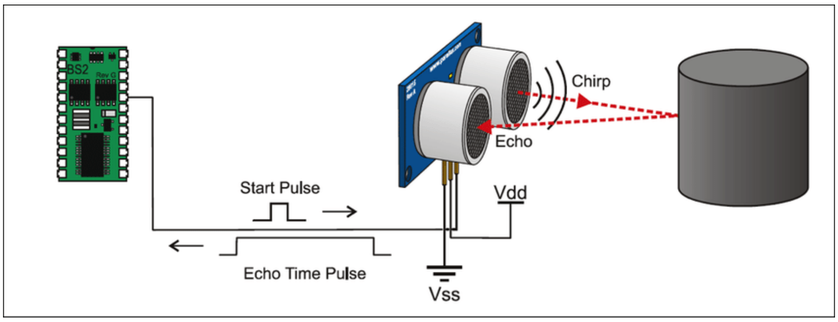

Fig.1 Block diagram of ultrasonic sensor

2.1 2. NODE MCU (Node Microcontroller Unit)

NodeMCU (fig.2) stands for Node Microcontroller Unit. It is an open-source Lua-based firmware that is designed for IoT(Internet of Things) applications. The module that runs this firmware is ESP-12E and that module is based on 32-bit ESP8266 MCU. It has 2.4 GHz Wi-Fi that supports WPA/WP2. The ESP-12E comes with a programmer and a 3.3v SMPS unit. So, you do not need any external programmer to program this board and you can easily run this board directly on 5V from USB.

Features of NodeMCU ESP-12E development board :

- Operating Voltage: 3.0-3.6 V
- Operating Current: 80mA
- Operating temperature: -40 to 125 degree Celsius
- 32-bit MCU
- Integrated 10-bit ADC
- 802.11 b/g/n
- Integrated TCP/IP protocol
- 2.4 GHz Wi-Fi that supports WPA/WPA2
- It supports UART, SPI, I2C, IR remote, PWM, SDIO 2.0
- It has 20 I/O ports

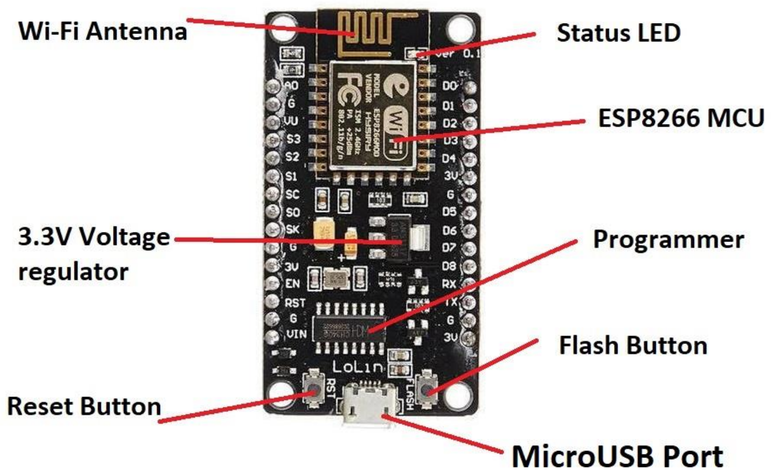

Fig.2 (Block diagram of NodeMCU)

CHAPTER 3

IDEATE PHASE

0ne of the major problems in developing countries is the road maintenance, most of the accidents happen due to unmarked speed breaker in the national highway which leads to a threat to drivers. An Intelligent transportation system plays a vital role in the advanced driver assistance system. The speed breaker recognition is used for vehicle and human safety. Earlier speed breaker detection method involves sensors, accelerometer and GPS. In this paper, a novel method for speed breaker detection and recognition is developed to alert the driver before the vehicle hit the speed breaker. In BLOB analysis, image processing techniques are used to detect the speed breaker in the given image. Camera fixed in the vehicle is used to capture the image of the road and it is analysed in the real time to detect the presence of speed breaker. This technique can be used for the painted speed breaker.

Another way of detecting breaker is a real-time solution and is developed as an android service that runs in the background and relies on Google Maps application in the smartphone. This service will throw an alert giving early warning if the user is approaching the speed breaker or a bumpy road. Apart from just giving an early alert to the user, it also provides the user with an alternative and a better route. The solution proposed in this work is a form of crowdsourcing where users share and get data, therefore making the system cost effective.

Road detection is a critically important task for self-driving cars. By employing LiDAR data, recent works have significantly improved the accuracy of road detection. However, relying on LiDAR sensors limits the application of those methods when only cameras are available. In this paper, we propose a novel road detection approach with RGB images being the only input. Specifically, we exploit pseudo-LiDAR using depth estimation and propose a feature fusion network in which RGB images and learned depth information are fused for improved road detection. To optimize the network architecture and improve the efficiency of our network, we propose a method to search for the information propagation paths. Finally, to reduce the computational cost, we design a modality distillation strategy to avoid using depth estimation networks during inference.

To address this acute problem, the study is undertaken with the objectives like, to make a survey of Indian roads, to suggest the method to detect lanes, potholes and road signs and their classification and to suggest automated driver guidance mechanism. In this regard, Hough Transformation method is adopted for Lane detection, where as Color Segmentation and Shape Modeling with Thin Spline Transformation (TPS) is used with nearest neighbor classifier for road sign detection and Classification.

CHAPTER 4

PROTOTYPE PHASE

In this system we have used ultrasonic sensor which detects the distance of the speed breaker using ultrasonic sound waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. When the input is given it flows into the voltage regulator 7805. It maintains the voltage of a power source within acceptable limits. The setup is arranged in a PCB board. A Node MCU (Node Microcontroller Unit) is used here in which we have dumped C coding. When the input is passed the coding runs and it displays speed breaker and its distance on the display.

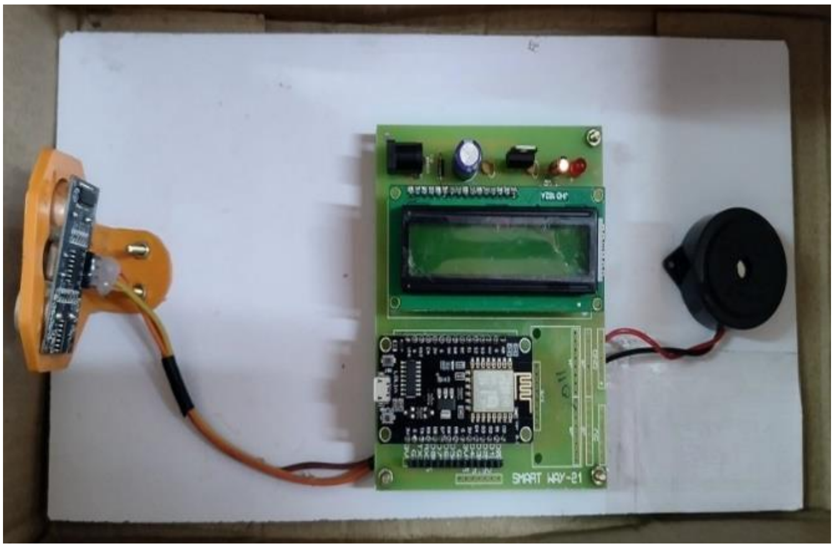

Fig.3(prototype)

SOURCE CODE :

```
#include <Wire.h>
#include <LCD_I2C.h>
LCD_I2C lcd(0x27);

int us1trigPin = D5; // Trigger
int us1echoPin = D6; // Echo

long us1duration,us2duration,
us1cm,us2cm, us1inches,us2inches;
```

```
#define buzzer D7
void setup() {
  // put your setup code here, to run once:
 Serial.begin(9600);
 Wire.begin(); //Use predefined PINS consts
 lcd.begin(); // The begin call takes the width and height.
                   // This should match the number provided to the constructor.

 lcd.backlight(); // Turn on the backlight.

 lcd.home();
 pinMode(buzzer,OUTPUT);

 pinMode(us1trigPin, OUTPUT);
 pinMode(us1echoPin, INPUT);

 lcd.setCursor(0,0);
 lcd.print("Hello world!");
 delay(3000);
 lcd.clear();
 }

  void loop() {

  digitalWrite(us1trigPin, LOW);
  delayMicroseconds(5);
  digitalWrite(us1trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(us1trigPin, LOW);

  pinMode(us1echoPin, INPUT);
  us1duration = pulseIn(us1echoPin, HIGH);

 // Convert the time into a distance
  us1cm = (us1duration/2) / 29.1; // Divide by 29.1 or multiply by 0.0343
  us1inches = (us1duration/2) / 74; // Divide by 74 or multiply by 0.0135

  lcd.setCursor(0,0);
  lcd.print("D :");



if(us1cm<=9){lcd.print("00"); lcd.print(us1cm);}
  else if(us1cm<=99){lcd.print("0"); lcd.print(us1cm);}

else if(us1cm<=999){lcd.print(""); lcd.print(us1cm);}

  if(us1cm<=50 && us1cm>1)
 {digitalWrite(buzzer,HIGH);
  lcd.setCursor(0,1);
  lcd.print("SPEED BREAKER");
  delay(2000);
  lcd.clear();}
```

```
else{digitalWrite(buzzer,LOW);
lcd.setCursor(0,1);
lcd.print(" ");}

delay(300);

}
```

CHAPTER 5

TEST PHASE

Trial 1:

In this case the prototype fails to display the distance of the speed breaker but it alerts the driver with the help of buzzer.

Trial 2:

In this case the LED in the prototype fails to glow which was not identified previously.

Trial 3:

In this case the problem with the LED is solved , but apparently the protype reacts to every obstacle including speed breakers.

Trail 4:

In this case all the problems are sorted and the prototype works successfully.

The aim of developing this project is to introduce a methodology for detecting speed bumps on road surfaces without having well-marked signals. The approach uses a mixture of artificial vision techniques and digital camera use. Specifically, Digital image processing, stereo vision, machine learning, and a convolutionary neural network are used to determine whether the images contain speed bumps or not. Inputs are stereo images of vehicle transit scenarios obtained through digital cameras, and output is the classification of images where it is identified whether or not there are speed breaker. The key contribution of this work is to develop a methodology using a pre-trained convolutionary neural network and supervised automatic classification, using stereo vision analysis of surface elevations to identify well-marked and no well- marked velocity bumps to enhance existing techniques. The dataset consists of images of different types of roads. We have separated the road images into two folders- one that contains speed breakers and the other that contains images of plain roads i.e., without speed breakers. To reduce computational complexity, image resize is mandatory.

CHAPTER 6

CONCLUSION & LEARNING OUTCOMES

From this project we have learnt how a ultrasonic sensor and NodeMCU works. This paper develops a system that detects the distance of the speed breaker and the driver before from a particular distance. We plan to bring forthmore component system in future which detects speed breakers, path holes and lanes by using machine learning and image processing.

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