SPEED BREAKER WARNING SYSTEM

A DESIGN PROJECT REPORT

Submitted by

JEEVESHWARAN.J

PRITESH.S

PRIYAGANTH.K

SANTHOSH.H.S

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SAMAYAPURAM -621112

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K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY
(AUTONOMOUS)
SAMAYAPURAM - 621112

BONAFIDE CERTIFICATE

Certified that this design project report titled **"SPEED BREAKER WARNING SYSTEM"** is the bonafide work of **JEEVESHWARAN.J (REG NO: 8117212430020), PRITESH.S(REG NO:811721243040),PRIYAGANTH.K (REG NO: 811721243041), SANTHOSH.H.S(REG NO: 811721243048)** who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
Dr.T.Avudaiappan,M.E.,Ph.D.	Mrs. S.Geetha,M.E.
HEAD OF THE DEPARTMENT	**SUPERVISOR**
Associate Professor	Assistant Professor
Department of Artificial Intelligence	Department of Artificial Intelligence
K.Ramakrishnan College of Technology(Autonomous)	K.Ramakrishnan College of Technology(Autonomous)
Samayapuram – 621 112	Samayapuram – 621 112

Submitted for the viva-voce examination held on ………………

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We jointly declare that the project report on "**SPEED BREAKER WARNING SYSTEM"** is the result of original work done byus and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF TECHNOLOGY**. This design project report is submitted on the partial fulfilment of the requirement of the award of Degree of **BACHELOR OF TECHNOLOGY**.

SIGNATURE

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JEEVESHWARAN.J

____

PRITESH.S

____

PRIYAGANTH.K

____

SANTHOSH.H.S

PLACE: SAMAYAPURAM

DATE:

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ABSTRACT

Bad visibility conditions which occur due to fog in winters or night time driving are the major causes of road accidents in India. Speed breaker detection systems in cars utilize advanced sensor technologies to enhance driver safety and comfort. These systems typically employ sensors like uLiDAR, radar, or cameras to scan the road ahead and identify speed breakers. LiDAR sensors emit laser pulses and measure their reflection to create detailed 3D maps of the surroundings, enabling precise obstacle detection. Radar sensors use radio waves to detect objects' presence and speed, while cameras capture visual data for analysis. Once a speed breaker is detected, the system alerts the driver through visual or auditory cues, allowing them to adjust their speed accordingly. Some systems can even integrate with the vehicle's suspension to optimize ride comfort when traversing speed breakers. By providing real-time awareness of road conditions, speed breaker detection systems contribute to safer and more comfortable driving experiences.

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LIST OF ABBREVIATION

SBWS	Speed Breaker Warning Systam
FL	Federated Learning
IOT	Internet Of Things
GPS	Global Positioning System
GSM	Global System For Mobile Communication
UART	Universal Asynchronous Receiver Transmitter

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

A speed breaker detection system is designed to identify and alert drivers about the presence of speed breakers or road bumps ahead. It's a safety feature aimed at preventing accidents and minimizing vehicle damage caused by unexpected road obstacles. This system typically utilizes sensors or cameras mounted on vehicles to detect speed breakers on the road. Once a speed breaker is detected, the system triggers visual or auditory alerts for the driver, prompting them to slow down to navigate the obstacle safely.

The introduction of such a system serves to enhance road safety by providing drivers with advanced warning of upcoming road irregularities, especially in low-visibility conditions or unfamiliar areas. It can also contribute to smoother and more comfortable rides for passengers by allowing drivers to adjust their speed accordingly. Additionally, by reducing the likelihood of sudden braking or swerving to avoid speed breakers, this system can help mitigate traffic congestion and improve overall traffic flow.

LiDAR sensors, known for their exceptional distance measurement, accurately detect speed breakers. Integrated IoT modules then wirelessly transmit this real-time data to a central hub. This processed information is subsequently relayed to drivers through a mobile app or in-vehicle display, providing timely warnings about approaching obstacles.

1.2 OBJECTIVE

The Speed Breaker Warning System (SBWS) using IoT and LiDAR technology strives for a multi-pronged approach to improve traffic safety and efficiency. Its core objectives focus on empowering drivers, mitigating risks, and aiding traffic management.

Firstly, the SBWS aims to enhance driver awareness. By providing real-time alerts about approaching speed breakers, drivers can anticipate obstacles and adjust their speed accordingly. This translates to smoother braking, reducing the risk of accidents, especially in low-light conditions or areas with poorly marked speed bumps. Imagine driving through a school zone at dusk. The SBWS ensures you're aware of upcoming speed breakers, allowing for safe and controlled braking.

Secondly, the system seeks to minimize vehicle damage. Sudden maneuvers and harsh braking to avoid unseen speed breakers can damage a vehicle's suspension and undercarriage. The SBWS empowers drivers to adjust their speed gradually, promoting controlled braking and minimizing wear and tear. Think of navigating a busy commercial area with frequent speed changes. The SBWS ensures you're aware of upcoming speed breakers, allowing for a smoother transition and less potential damage to your vehicle.

The SBWS aims to create a smoother traffic flow. Traditional signage may not provide enough time for drivers to react to speed breakers, leading to sudden stops and congestion. The real-time alerts from the SBWS allow drivers to anticipate upcoming obstacles and adjust their speed accordingly. This promotes a more consistent and predictable traffic flow, eliminating sudden braking and congestion. Imagine driving on a highway with frequent speed changes. The SBWS ensures drivers are aware of upcoming changes, allowing them to adjust speed gradually and avoid disrupting the flow of traffic.

CHAPTER 2

LITERATURE SURVEY

2.1 INTELLIGENT SPEED BREAKER SYSTEM DESIGN FOR VEHICLES USING INTERNET OF THINGS

Authors: Malathi T,Selvamuthukumaran D,Diwaan Chandar C S,Niranjan

Year: 2013

Abstract

The Intelligent Speed Breaker System (ISBS) is an innovative approach to vehicular speed regulation using IoT technology. This system aims to enhance road safety by dynamically controlling vehicle speed in response to various traffic conditions. Utilizing IoT devices, the ISBS can communicate with approaching vehicles to adjust their speed automatically, ensuring compliance with local speed regulations and reducing the risk of accidents.

Merits

- **Enhanced Safety** By regulating vehicle speeds in real-time, the ISBS significantly reduces the likelihood of speed-related accidents.
- **Dynamic Response** The system's IoT framework allows for real-time adjustments based on immediate traffic conditions and road layouts.
- **Cost-Effectiveness** Implementing ISBS can lead to long-term savings by minimizing road maintenance and reducing the frequency of speed-related incidents.

Demerits

- **Implementation Complexity** The integration of IoT devices into existing infrastructure may pose challenges.
- **Privacy Concerns** Handling and storing vehicle data requires robust security measures to protect user privacy.

2.2 FEDERATED LEARNING FOR ACCURATE DETECTION OF SPEED BREAKERS ON THE ROAD

Authors: Heltin Genitha C, Rajaji P, Rahul S

Year: 2020

Abstract

This study explores the application of Federated Learning (FL) in the accurate detection of speed breakers on roads, contributing to enhanced vehicular safety and navigation. FL, as a collaborative machine learning approach, allows for the decentralized processing of data across multiple devices, ensuring privacy while aggregating diverse data sources to improve detection algorithms.Introduction.

Merits

- **Privacy Preservation** FL enables local data processing, which means sensitive information does not leave the user's device, bolstering data privacy.
- **Improved Accuracy** By leveraging data from a multitude of sensors and vehicles, FL enhances the accuracy of speed breaker detection.
- **Scalability** The decentralized nature of FL allows the system to scale efficiently with the addition of new data sources.

Demerits

- **Communication Overhead** The FL model requires frequent communication between devices, which can lead to increased network traffic.
- **Heterogeneous Data** Variations in data quality and sensor capabilities across devices can pose challenges to the learning process.

2.3 A REVIEW ON VEHICLE SPEED DETECTION USING IMAGE PROCESSING

Authors: A.G.Mangala,Dr.Balasubramani.R

Year: 2021

Abstract

This paper provides an overview of various image processing techniques for detecting vehicle speeds, which is essential for enforcing speed limitation laws and analyzing traffic conditions. The authors discuss several approaches, including edge extraction, object tracking, motion vector technique, absolute difference, centroid method, and background image subtraction, to detect vehicle speeds from real-time video traffic images.

Merits

- **Comprehensive Review** The paper offers a thorough examination of different image processing methods used in speed detection.
- **Technological Advancement** It highlights the evolution of speed detection from traditional radar to advanced image processing techniques.
- **Practical Application** The review serves as a valuable resource for researchers and practitioners in traffic management and vehicle control systems.

Demerits

- **Complexity** Some of the discussed methods may require sophisticated algorithms and high computational power.
- **Environmental Limitations** Factors such as lighting conditions and weather can affect the accuracy of image-based speed detection.
- **Calibration Needs** Accurate speed detection using image processing

2.4 AUTOMATIC POTHOLE AND SPEED BREAKER DETECTION USING ANDROID SYSTEM

Authors: Vaibhav. V. Mainkar, Mr. Ajinkya B. Upade, Jyoti A. Katkar

Year: 2020

Abstract

Road surface monitoring is crucial for municipal corporations and travelers. This paper presents a vibration-based approach for automatic detection of potholes and speed breakers using android's built-in accelerometer. Tested on a 4 km flat road, the approach achieved an accuracy of 93.75%, making it cost-efficient and effective for road surface monitoring.

Merits

- **Accuracy of pothole and speed breaker detection** This metric measures how accurately the system is able to detect potholes and speed breakers on the road.
- **Response time** This metric evaluates how quickly the system is able to detect and alert the driver about potholes and speed breakers. A low response time ensures that the driver is informed about road hazards promptly.

Demerits

- **Limited coverage** The system may not be able to detect all potholes and speed breakers on the road, particularly in remote or rural areas with poor road infrastructure.
- **Dependence on GPS** The accuracy of detection may be affected in areas with poor GPS signal reception, leading to potential errors in identifying road hazards.

2.5 SPEED BREAKER EARLY WARNING SYSTEM

Authors: Mohit jain, Ajeet Pal Singh, Soshant Bali

Abstract

Speed breakers can cause accidents and injuries, especially in low visibility conditions. A smartphone-based system alerts drivers when approaching speed breakers and continuously monitors the accelerometer to detect unknown speed-breakers. The detection algorithm is easy to implement and does not require accelerometer reorientation. The system was evaluated using 678 Km of drive data and showed promising results, which can be improved by aggregating detection reports from multiple smartphones.

Merits

- **Reduction in accidents** The effectiveness of the system can be measured by the decrease in the number of accidents caused by drivers not being aware of speed breakers on the road.
- **Response time** The time it takes for drivers to be alerted to the presence of a speed breaker can be measured to assess the system's speed and efficiency.
- **User satisfaction** Surveys or feedback from drivers using the system can provide insights into their satisfaction with the system and its overall effectiveness.

Demerits

- **Cost** Implementing and maintaining the system can be expensive, especially in areas with numerous speed breakers.
- **False alarms** The system may occasionally give false alerts, leading to driver frustration and a potential decrease in trust in the system.
- **Maintenance** Keeping the system functioning properly may require regular maintenance and updates which can be time-consuming and costly

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Ultrasonic Sensors: Ultrasonic sensors emit high-frequency sound waves and measure the time it takes for the waves to bounce back after hitting an object. These sensors can be installed on vehicles to detect changes in road surface elevation, indicating the presence of a speed breaker ahead.

Camera-based Systems: Cameras installed on vehicles or roadside infrastructure can capture images of the road surface. Image processing algorithms to detect speed breakers based on their distinct visual characteristics, such as shape and color

Accelerometers: Accelerometers measure the rate of change of velocity of a vehicle. By analyzing the vehicle's acceleration patterns, especially when approaching a speed breaker, these sensors can infer the presence of a road obstacle.

GPS and Mapping Data: Some speed breaker detection systems utilize GPS technology combined with mapping data to pre-identify the locations of speed breakers along a route. When a vehicle approaches a known speed breaker location, the system can provide an alert to the driver.

IoT Connectivity: Incorporation of IoT modules to transmit the data collected by sensors to a central server or cloud platform.

3.1.1 Demerits

Cost Implementing such a system involves the cost of sensors, IoT modules, data processing hardware, and software development, which may increase the overall cost of the vehicle.

Complexity Integration of IoT systems and sensors adds complexity to the vehicle's design and may require specialized expertise for development and maintenance.

False Positives/Negatives The system may occasionally fail to detect a speed breaker or provide false alerts, which can be frustrating for the driver and reduce confidence in the system.

Power Consumption Continuous operation of sensors and IoT modules may increase the vehicle's power consumption, impacting fuel efficiency or requiring additional battery capacity in electric vehicles.

3.2 PROPOSED SYSTEM

LiDAR Sensors High-precision LiDAR sensors will be strategically placed on roadsides or lamp posts. These sensors will continuously emit pulsed laser beams and measure the reflected light to create a detailed 3D map of the surrounding area, accurately detecting speed breakers and their dimensions.

IoT Modules Each LiDAR sensor will be integrated with an IoT module. These modules act as mini-computers equipped with wireless communication capabilities. They will process the raw data from the LiDAR sensors and transmit it securely to a central hub or cloud platform via cellular network or Wi-Fi connectivity.

Cloud Platform This central processing unit receives and processes real-time data from all the distributed LiDAR sensors.Filter and clean the data to ensure accuracy and consistency.Analyze the data to identify the precise location and characteristics of each speed breaker.Generate a real-time map of speed.

3.2.1 Merits

Enhanced Driver Awareness Real-time alerts about approaching speed breakers allow for smoother braking and safer driving, especially in low-light conditions.

Reduced Vehicle Damage Gradual braking based on alerts minimizes wear and tear on vehicle.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 HARDWARE SPECIFICATION

Micro-Controller: Arduino Uno

RAM: 4GB

Sensor: Lidar Sensor

Power Supply: DC Power

Audio: Buzzer

4.2 SOFTWARE SPECIFICATION

Operating System: Windows OS

Programming Language: C

Web Application: Ardiuno Uno

CHAPTER 5

ARCHITECTURAL DESIGN

5.1 SYSTEM ARCHITECHTURE

The architectural design for speed breaker detection in a car using IoT involves a cohesive system of components working together seamlessly. At its core are onboard sensors, such as accelerometers and ultrasonic sensors, responsible for detecting changes in the road surface. These sensors feed data into an onboard processing unit, which preprocesses and analyzes the sensor data in real-time.

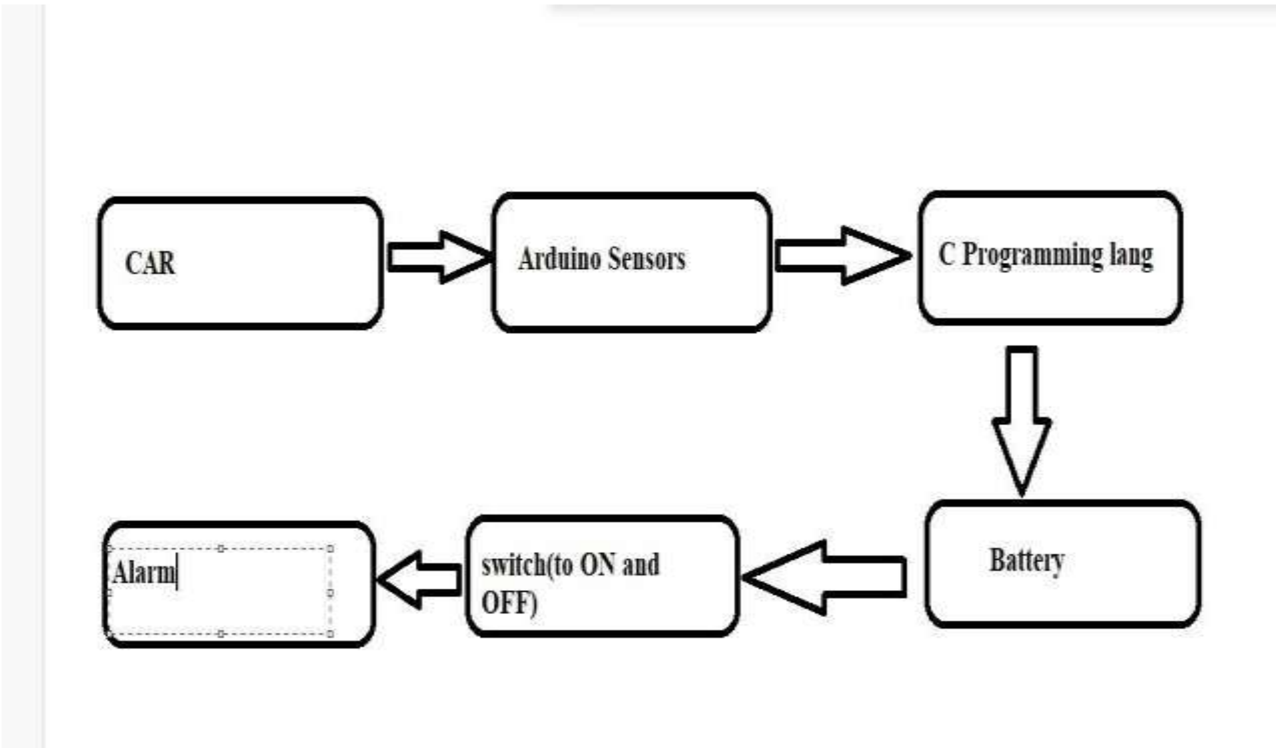

Figure.No.5.1 System Architecture

Following preprocessing, a detection algorithm is employed to identify potential speed breakers based on specific criteria, which could include sudden changes in acceleration or patterns in sensor readings. This algorithm may utilize machine learning models or rule-based systems to accurately identify speed breakers while minimizing false positives.

Once a speed breaker is detected, an alert is generated for the driver. This alert can take various forms, such as visual warnings on the dashboard, auditory signals, or haptic feedback through the steering wheel or seat. Simultaneously, the detection information is communicated to the car's central system via IoT protocols, enabling integration with other vehicle systems and external services.

CHAPTER 6

MODULE DESCRIPTION

6.1 LIDAR SENSOR MODULE

The LiDAR Sensor Module is responsible for detecting the presence of speed breakers and approaching vehicles by measuring distances accurately. It plays a crucial role in the speed breaker early warning system by providing precise distance measurements to the microcontroller for further processing.

Components

LiDAR Sensor A laser-based sensor capable of measuring distances with high accuracy. Examples include the Garmin LIDAR-Lite v3 or RPLIDAR A1.

Microcontroller A microcontroller like Arduino, ESP32, or Raspberry Pi that interfaces with the LiDAR sensor and processes its data.

Power Supply A stable power source, typically 5V DC, to power the LiDAR sensor and the microcontroller.

Wiring and Connectors Cables and connectors to establish electrical connections between the sensor, microcontroller, and power supply.

Functionality

The LiDAR sensor emits laser pulses and measures the time it takes for the pulses to return after hitting an object (e.g., a vehicle or speed breaker). This time is then converted into a distance measurement. The microcontroller reads this data and processes it to determine if an object is within a predefined range, indicating the presence of a speed breaker or an approaching vehicle.

6.2 MICROCONTROLLER MODULE

The microcontroller module is a crucial part of the speed breaker early warning system, responsible for processing data from sensors, making decisions, and coordinating communication with other modules.

Components

Microcontroller Board: Popular choices include Arduino (e.g., Arduino Uno, Arduino Nano), ESP32, or Raspberry Pi.

Digital I/O Pins

For interfacing with sensors and actuators. Communication Interfaces: UART, I2C, SPI for connecting with sensors and communication modules.

Functions

Sensor Data Processing

Collects data from the LiDAR sensor, which measures distances to detect approaching vehicles and speed breakers. Converts raw sensor data into meaningful information (e.g., distance in centimeters).

Decision Making

Implements logic to determine when a vehicle is approaching a speed breaker.Sets thresholds and conditions to trigger alerts (e.g., if the distance is less than a certain value).

Communication

Sends processed data and alerts to the communication module.Receives commands or updates from a central server or other modules.

Control Outputs

Controls warning systems like LED displays or buzzers to alert drivers. Can interface with other actuators if needed.

6.3 COMMUNICATION MODULE

The communication module is a critical component of the speed breaker early warning system, responsible for transmitting data between the sensor nodes and the vehicles or a central server.

Components

Wi-Fi Module (e.g., ESP8266, ESP32) Provides wireless communication capabilities over local Wi-Fi networks. GSM Module (e.g., SIM800, SIM900)Enables communication over cellular networks, useful in areas without Wi-Fi coverage. Allows for long-range, low-power communication, ideal for remote or spread-out installations.

Function

Transmit Data Send sensor data and alerts from the microcontroller to a central server, cloud platform, or directly to vehicles.

Receive Data Receive commands, configurations, and updates from a central server or control unit.

Ensure Real-Time Communication Maintain low-latency communication to ensure timely alerts for approaching vehicles.

6.4 WARNING SYSTEM MODULE

The Warning System Module is a critical component of the speed breaker early warning system. Its primary function is to alert drivers about the presence of an approaching speed breaker to ensure they slow down and navigate it safely. This module can use various methods to deliver warnings, depending on the specific application and available infrastructure.

Components

Visual Alert Systems

LED Display Provides clear and visible warnings to drivers using bright LED lights or text messages.

Digital Signage Larger, more sophisticated displays that can show detailed messages or symbols.

Auditory Alert Systems

Buzzers/Alarms Emit sounds to grab the driver's attention, particularly useful in scenarios where visual alerts might not be sufficient.

Detection and Notification

Receives signals from the microcontroller indicating the detection of a vehicle approaching a speed breaker.Processes these signals to determine the appropriate warning to be issued.

Auditory Alerts

Activates buzzers or alarms to produce sound alerts when a vehicle is approaching the speed breaker.The sound intensity and pattern can be varied based on proximity and speed of the vehicle.

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

7.1 CONCLUSION

In conclusion, implementing speed breaker detection in cars using IoT holds significant promise for enhancing road safety and driver comfort. By leveraging a combination of sensors, data processing algorithms, and IoT connectivity, this system can effectively identify speed breakers on the road ahead and provide timely alerts to drivers.

The integration of sensors such as accelerometers, ultrasonic sensors, or cameras enables real-time monitoring of the road surface, detecting changes in elevation characteristic of speed breakers. Advanced data processing algorithms analyze sensor data to accurately identify speed breakers while minimizing false positives.

IoT connectivity facilitates seamless communication between the car's onboard system and external servers or cloud platforms. This enables centralized processing of detection data, allowing for continuous refinement of detection algorithms and the ability to provide updated information to multiple vehicles in real-time.

7.2 FUTURE ENHANCEMENT

Integration with Navigation Systems Seamless integration with popular GPS navigation systems would allow for visual and auditory alerts about upcoming speed breakers directly on the driver's navigation interface. This eliminates the need for a separate mobile app and provides a more integrated user experience.The SBWS data can be used to dynamically adjust speed limits displayed on navigation apps, reflecting real-time conditions near specific speed breakers.

Advanced Data Analytics and AI Integration Implementing advanced data analytics can extract valuable insights from the SBWS data. This data can be used to identify accident-prone areas, analyze traffic patterns near specific speed breakers, and optimize traffic light timings for smoother flow.Artificial intelligence (AI) can be integrated to analyze historical data and learn from traffic patterns. This can enable the system to predict traffic congestion near speed breakers and suggest alternative routes to drivers.

Advanced LiDAR and Sensor Fusion Utilizing next-generation LiDAR sensors with longer range and higher resolution can improve detection accuracy and provide detailed information about the shape and size of speed breakers.Fusing data from LiDAR sensors with cameras or radar sensors can enhance the system's ability to detect not only speed breakers but also other potential hazards like potholes, debris, or even pedestrians near the road.

Sustainability and Energy Efficiency Exploring low-power LiDAR sensors and energy-efficient communication protocols can improve the overall sustainability of the SBWS. This ensures long-term operation and reduces the system's environmental footprint.The data collected by the SBWS can be used to optimize traffic flow, potentially reducing congestion and fuel consumption for vehicles.

By exploring these future enhancements, the SBWS can evolve into a comprehensive traffic management system that goes beyond simply notifying drivers about speed breakers. It has the potential to create a truly intelligent transportation network, promoting safety, efficiency, and a more sustainable future for our roads.

APPENDIX 1 SAMPLE CODE

```
// Include the library for the ultrasonic sensor
#include <Ultrasonic.h>
// Define the pins for the ultrasonic sensor
#define TRIG_PIN 12
#define ECHO_PIN 11
// Define the pin for the alarm
#define ALARM_PIN 9
// Define the distance threshold (in centimeters)
#define DISTANCE_THRESHOLD 1000 // 1000 centimeters = 10 meters

// Create an instance of the Ultrasonic sensor
Ultrasonic ultrasonic(TRIG_PIN, ECHO_PIN);
void setup() {
  // Initialize the serial communication
  Serial.begin(9600);
  // Set the alarm pin as an output
  pinMode(ALARM_PIN, OUTPUT);

} void loop()
{
  // Measure the distance using the ultrasonic sensor   unsigned int
distance = ultrasonic.read();    // Convert the distance to meters    float
distanceMeters = distance / 100.0; // Convert centimeters to meters
  // Print the distance to the serial monitor
  Serial.print("Distance: ");
  Serial.print(distanceMeters);
  Serial.println(" meters");
```

```
  // Check if the distance is less than the threshold   if (distance >
0 && distance <= DISTANCE_THRESHOLD) {

    // Activate the alarm
digitalWrite(ALARM_PIN, HIGH);


    // Print a message to the serial monitor
    Serial.println("WARNING: Object detected within 10 meters!");
  } else {

    // Deactivate the alarm
digitalWrite(ALARM_PIN, LOW);
  }
```

APPENDIX 2 SCREENSHOTS

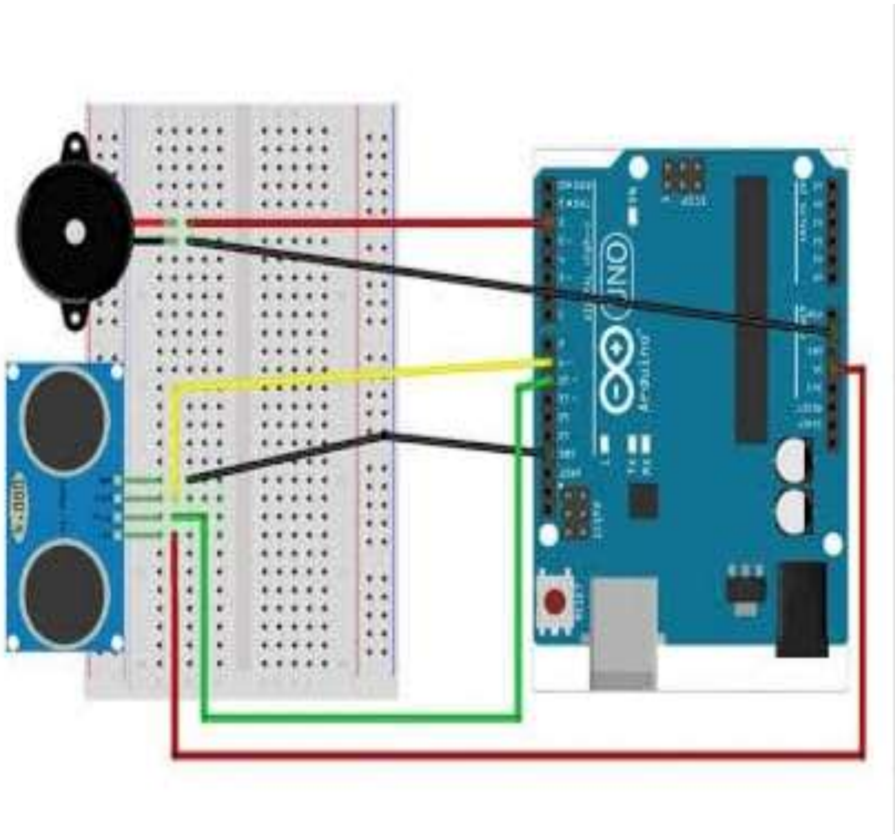

Figure.No.A.2.1 Circuit Diagram

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