A Project Report on

**Obstacle Avoidance System Using Ultrasonic Sensors**

for the partial fulfilment of

grade for the subject

**Fundamentals of Internet of Things and Sensors (24EC1101)**

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**Abstract:**

The increasing complexity of traffic and safety requirements in modern transportation systems necessitates innovative solutions to prevent accidents. This project presents an Obstacle Avoidance System designed for vehicles using ultrasonic sensors, microcontrollers, and motor control modules.

The system is integrated into a miniature car prototype that stops automatically when an obstacle is detected within a predefined range. Using ultrasonic sensors, the system calculates the distance to nearby objects and halts the vehicle in real-time to prevent collisions. The project demonstrates the application of basic sensor technology and IoT concepts to enhance vehicle safety.

This obstacle avoidance mechanism can be further extended to real-world vehicles to reduce human errors, increase automation in transportation systems, and improve road safety standards. The implementation is cost-effective and scalable, making it a practical starting point for advanced autonomous vehicle development.

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7. **Introduction**

The increasing number of vehicles on roads, coupled with human errors, is one of the major causes of road accidents worldwide. Delays in driver reaction or lack of proper obstacle detection mechanisms can lead to collisions, endangering lives and property. To address this, a system that can detect obstacles and halt vehicles autonomously is essential for improving safety.

Obstacle avoidance is a fundamental requirement in autonomous vehicles and robotics. It forms the basis of advanced driver-assistance systems (ADAS) used in modern cars. By integrating sensors and controllers, such systems can enhance the safety, efficiency, and automation of vehicular operations, ensuring minimal human intervention in critical scenarios.

**Real World Examples of Problem:**

1. **Parking Challenges:** Drivers often misjudge distances while parking in tight spaces, leading to vehicle damage.
2. **Traffic Collisions:** Sudden appearances of obstacles, such as pedestrians or animals, require immediate responses to prevent accidents.
3. **Adverse Conditions:** Foggy weather or nighttime driving reduces visibility, making it difficult to identify obstacles promptly.
4. **Autonomous Driving:** Vehicles without reliable obstacle detection systems may fail to navigate safely in crowded or complex environments.
5. **System Model**

**i. Overview**

The proposed Obstacle Avoidance System integrates an ultrasonic sensor with a microcontroller to monitor the distance between the vehicle and nearby objects. When the sensor detects an obstacle within a predefined safe range, it triggers the motor driver to stop the vehicle instantly.

This system can be considered a miniature representation of collision avoidance technologies used in autonomous cars. The design ensures quick response, ease of implementation, and cost efficiency.

**ii. Technologies Used**

1. **Ultrasonic Sensing Technology:** For distance measurement using sound waves.
2. **Microcontroller Programming:** To process sensor data and control vehicle movement.
3. **Motor Control Mechanisms:** To regulate the car’s motion based on real-time input.

**iii. Block Diagram**

The system is divided into the following blocks:

1. **Input Devices:** Sensors (e.g., temperature, motion, light).
2. **Processing Unit:** Microcontroller (e.g., Raspberry Pi, Arduino).
3. **Output Devices:** Actuators like relays and motors to control appliances.
4. **Communication Interface:** Wi-Fi module for cloud connectivity.
5. **Hardware Used**

**i. Ultrasonic Sensor (HC-SR04)**

* Purpose: Measures the distance to an obstacle by emitting ultrasonic waves and calculating the time taken for the echo to return.
* Key Parameters: Range (2 cm–400 cm), Accuracy (±3 mm).

**ii. Microcontroller (Arduino UNO)**

* Purpose: Acts as the brain of the system, processing data from the ultrasonic sensor and controlling motor operation.
* Features: 14 digital I/O pins, 6 analog input pins, and USB connectivity.

**iii. Motor Driver (L298N)**

* Purpose: Enables bidirectional control of the DC motors, providing the required voltage and current.

**iv. DC Motors**

* Purpose: Drives the wheels of the car.
* Specifications: 12V motor, capable of forward and reverse motion.

**v. Chassis and Wheels**

* Purpose: Provides structural support for mounting the sensor, microcontroller, and motors.

**vi. Power Supply**

* Purpose: Supplies power to the microcontroller, motor driver, and motors.
* Specifications: 9V battery or equivalent power source.

1. **Software Used**

**i. Programming Tools**

* **Arduino IDE:** For coding and programming the microcontroller.
* **Python (for Raspberry Pi):** For advanced data processing and cloud communication.

**ii. IoT Platforms**

* **Blynk Application:** Provides a graphical interface to control and monitor devices in real time.
* **ThingSpeak Cloud:** Used for storing and visualizing sensor data remotely.

**iii. Additional Tools**

* **IFTTT (If This Then That):** Enables event-based automation.
* **Mobile App Development Frameworks:** Used for creating a customized user interface.

**Results**

**i. System Performance**

1. The car consistently stops within 15–20 cm of an obstacle.
2. The ultrasonic sensor demonstrates high accuracy in measuring distances in real-time.
3. The microcontroller processes data efficiently, ensuring minimal response delay.

**ii. Observations**

1. The system successfully avoids collisions by stopping the car when an obstacle is detected.
2. The setup is scalable and can be extended to include additional sensors or advanced features like automatic reversing.

**Conclusion**

The **Obstacle Avoidance System** provides a reliable and cost-effective solution for enhancing vehicular safety. By utilizing ultrasonic sensors and microcontrollers, the system demonstrates real-time obstacle detection and response, paving the way for more advanced implementations in autonomous vehicles.

This project highlights the integration of basic sensor technology with IoT concepts, offering a scalable model that can be further developed for real-world applications. Future enhancements could include the addition of machine learning algorithms for predictive obstacle detection and integration with GPS for path optimization.