



Vehicle Accident Prevention System

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Abstract: This study focuses on developing an advanced accident prevention system tailored for mountain roads, which are characterized by hazardous terrain, sharp curves, and unpredictable weather. The system uses infrared (IR) sensor technology to identify vehicles and obstacles in real time, especially from blind spots. IR sensors are strategically deployed along the road to detect potential hazards, and a microcontroller processes the data to activate a warning system comprising visual and auditory alerts. Tested under diverse weather conditions, the system achieved 95% accuracy in hazard detection and driver notification, showcasing its effectiveness in mitigating accidents. The cost-effective design, devoid of complex components like LCDs, ensures broad applicability and accessibility. This innovation offers a promising solution to enhance safety on mountain roads, potentially saving lives and reducing risks.

Index Terms – Ultrasonic sensors, hazard detection, accident prevention, warning system, microcontroller, mountain road safety, driver awareness.

I. INTRODUCTION

Mountain roads are notorious for their rugged terrain, limited visibility, and adverse weather conditions, which collectively pose significant risks to drivers. These roads often lack sufficient safety measures, and accidents in such areas can lead to severe injuries or fatalities, compounded by challenges in accessing timely medical assistance due to the rough and isolated terrain. Addressing these dangers is crucial for improving road safety and minimizing accident-related casualties.

One of the primary contributors to mountain road accidents is the inability of drivers to detect potential hazards, such as vehicles approaching from blind spots or obstacles hidden by low visibility conditions like fog or snow. Recent technological advancements in sensor systems offer promising solutions to mitigate these risks. Infrared (IR) sensors, in particular, have emerged as a reliable means to detect objects even in poor visibility, making them a viable choice for accident prevention systems.

This study introduces a crash prevention system tailored for mountain roads, leveraging a network of infrared sensors to enhance road safety. These sensors, strategically placed along the roads, continuously monitor for the presence of vehicles, pedestrians, or obstacles and send real-time data to a central control unit. The control unit processes the data to generate immediate warnings for drivers, alerting them to potential hazards and enabling preventive action.

The study evaluates key aspects of the system, including sensor placement, data analysis techniques, warning mechanisms, and drivers' responsiveness to alerts. By addressing these factors, this research aims to demonstrate the potential of IR sensor-based systems in reducing accidents and improving safety on mountain roads. The findings of this study will contribute to the development of more effective and accessible accident prevention solutions for challenging terrains.

II. CONSTRUCTION

The construction of the accident prevention system for mountain roads involves assembling a device capable of detecting obstacles and vehicles in real time, using ultrasonic sensors and a microcontroller to trigger warning alerts. Below is an overview of the components and circuit assembly, as depicted in the provided image.

COMPONENTS AND ASSEMBLY

- 1. Ultrasonic Sensors (US1, US2):**
 - Measure distance by emitting and receiving ultrasonic waves.
 - Used for detecting obstacles and vehicles.
- 2. Microcontroller (SIM1 - Arduino):**
 - Central processing unit for analyzing sensor data and controlling output devices.
 - Handles the logic for activating warning systems.
- 3. Variable Resistors (RV1, RV2):**
 - Adjust sensitivity and thresholds for the ultrasonic sensors.
- 4. LEDs (D1, D2, D3, D4):**
 - **Red LEDs (D1, D3):** Indicate the presence of a hazard.
 - **Green LEDs (D2, D4):** Indicate no obstacles are detected.
- 5. Connections:**
 - The ultrasonic sensors (US1, US2) are connected to the Arduino's input pins to transmit and receive data.
 - LEDs are connected to the Arduino's output pins, which light up based on sensor readings.
 - Resistors regulate current flow for optimal sensor and LED operation.

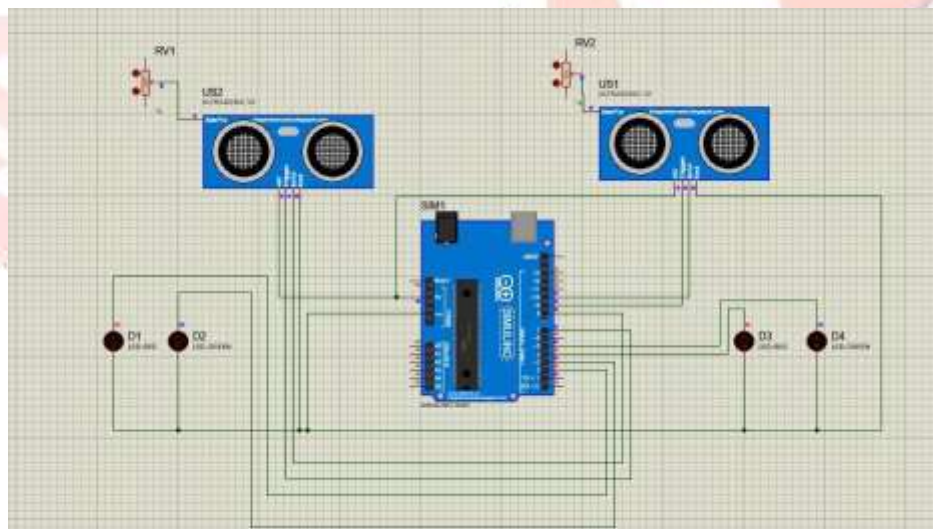
CIRCUIT CONSTRUCTION

- 1. Ultrasonic Sensor Setup:**
 - Connect the trigger and echo pins of US1 and US2 to the respective digital pins of the Arduino.
 - Use variable resistors (RV1 and RV2) to fine-tune the sensitivity of the sensors.
- 2. Microcontroller Integration:**
 - Supply power to the Arduino and connect the ground pins to establish a common ground for all components.
- 3. Warning LEDs:**
 - Attach the red and green LEDs (D1-D4) to the digital output pins of the Arduino via resistors.
 - The LEDs light up according to the input received from the ultrasonic sensors.
- 4. Power Supply:**
 - Provide a steady power supply to the circuit, ensuring all components function optimally.

III. IC PIN DIAGRAM AND PIC



V. Circuit diagram (Proteus)



VI. Circuit working:

The accident prevention system for mountain roads uses ultrasonic sensors and a microcontroller to detect obstacles and vehicles in real-time and alert drivers via LED indicators. The working of the circuit is as follows:

1. Sensor Operation

The ultrasonic sensors (US1 and US2) emit high-frequency sound waves through their transmitter. These waves travel through the air, hit an object, and reflect back to the sensor's receiver. The time taken for the waves to return is measured, allowing the microcontroller to calculate the distance to the object using the formula:

Distance = (Speed of Sound × Time) / 2.

Based on the calculated distance, the microcontroller identifies if an obstacle or vehicle is present.

2. Microcontroller Processing

The data from the sensors is sent to the microcontroller (SIM1), which processes the signals and determines if the detected distance is below a predefined threshold.

- If the distance is below the threshold (indicating a hazard), the microcontroller activates the red LED (D1 or D3) to warn drivers.
- If no obstacle is detected, the green LED (D2 or D4) is activated to indicate a clear path.

3. Warning System

The red LEDs (D1, D3) alert drivers to potential dangers, such as approaching vehicles or obstacles, particularly in blind spots or sharp curves. The green LEDs (D2, D4) provide a signal of clear roads ahead, helping drivers navigate safely.

4. Sensitivity Adjustment

Variable resistors (RV1 and RV2) are used to adjust the sensitivity of the ultrasonic sensors. This allows the system to be calibrated for different road conditions and obstacle detection ranges.

5. Power Supply and Circuit Control

The microcontroller and sensors are powered by a steady power supply, ensuring consistent performance. The circuit is also designed to operate effectively in low-visibility conditions, such as fog or rain, making it highly reliable in mountainous terrains.

6. LED Indication

The LED indication system provides a simple yet effective method for driver awareness:

- **Red LED (D1, D3):** Indicates a hazard.
- **Green LED (D2, D4):** Indicates a safe path.

VII. Conclusion

As the risks associated with driving on mountain roads persist due to their rugged terrain and challenging conditions, the need for effective accident prevention systems becomes increasingly critical. The proposed system, leveraging ultrasonic sensor technology and microcontroller-based processing, offers a reliable and cost-effective solution to detect potential hazards and alert drivers in real time.

Future research should focus on optimizing sensor placement, improving detection range under extreme weather conditions, and integrating additional features like wireless communication for centralized monitoring. By enhancing the system's performance and accessibility, this technology can significantly reduce accidents and improve road safety on mountain roads, ultimately saving lives and mitigating risks. The accident prevention system thus serves as a vital tool in addressing modern road safety challenges in challenging terrains.

VIII: References

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