

Scout: A Smart Collision System using Ultrasonic Technology

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Abstract - The project provides a small vehicle safety prototype which focuses on two situations that may difficult for drivers to notice objects in the blind spot and the wet road areas. These system uses ESP32 microcontroller, ultrasonic sensors, moisture sensor, LCD, buzzer, DC motor, a motor driver, and power supply. Ultrasonic sensors are placed on the left and right sides of the vehicle model to check for nearby objects. When a objects comes near the selected detection range, the ESP32 processes sensor readings and gives a warning through the buzzer and the LCD. A moisture sensor is used to detect road wet conditions near the wheels and to provide a caution. The model combines these two functions in one low cost system and to demonstrates how simple sensors can be used to improve driver awareness.

Keywords – blind spot detection, skid detection, ESP32, ultrasonic sensor, moisture sensor, vehicle safety.

I. INTRODUCTION

Road safety has become an important worry because the number of vehicles in roads increasing and the traffic accidents are continuing. One of the problem faced by drivers is presence of vehicles in hidden areas. A blind spot is an area near or around the vehicles that cannot directly seen by drivers through vision or mirrors. If another vehicle enters this area, the driver may not be able to notice it, especially while changing lanes, turning or overtaking the vehicle. A system that can detect such vehicle and warn the driver that can be useful for improving safety of driver and other vehicles safety. Another problem in this project is that vehicles skidding on wet roads or a slippery roads. Rainwater, moisture, or other slippery conditions can reduce the grip of the tyres and surface of the road. The proposed system combines blind spot monitoring with moisture skid detection. An ESP32 microcontroller receives an information from the ultrasonic sensor and the moisture sensors, processes it and gives warnings through the buzzer and the LCD. The DC motors and the motor driver are used in the model to demonstrate the vehicle movement.

II. LITERATURE SURVEY

Many researchers have studied about the vehicle safety systems which help drivers to detect or find objects in hidden areas to and avoid collisions. Zharfan Hamdan developed a blind spot vehicle detection system using a PIC16F873 microcontroller and SRF05 ultrasonic sensor. The system measures the

distance of near vehicles and it displayed the information on LCD while also using a servo motor for the side mirror. Other study by P. Nithin, M. Vijeykumar, C. Nanthakumar, and S. Vignesh explored hidden spot detection using ultrasonic waves and that showed ultrasonic sensors can be used as low cost option to find out vehicles in blind zones. M. H. Jamaluddin and co researchers studied sensor placement for vehicle blind spot detection and reported that suitable placement can improve detection performance. Shweta Raj, R. Ezhilarasie, and A. Uma maheswari proposed a ZigBee based collision avoidance system using ultrasonic sensors and wireless communication. More recently, Wira Dhaifullah, Dedi Junaedi, and Dewin Purnama developed a blind spot monitoring system using an Arduino and HC SR04 ultrasonic sensors, with warnings through LEDs and a buzzer. These studies show the usefulness of ultrasonic sensing for blind spot monitoring. The present project extends this approach by combining blind spot detection with moisture based skid detection using an ESP32 controller.

III. OBJECTIVES

The main objective of project is to develop smart vehicle system safety that can detect vehicles or obstacles present in hidden areas and to provide a warning to the driver. The system is designed to monitor the left sides and right sides of vehicle using ultrasonic sensors and provide real time alerts through buzzer and a LCD whenever an object enters the blind spot area. Another objective is detect wet road conditions using a moisture sensor and to find the possibility of vehicle skidding. This project also finds to process sensor data efficiently using the ESP32, simulate vehicle movement using DC motors and a motor driver, improve driver awareness, reduce accident, provide a low cost safety system.

IV. METHODOLOGY

The proposed system is designed to detect vehicles in blind spot areas and to find the wet road conditions. The main controller in this is ESP32, which receives signals from the sensors, process the information, controls the output devices. A regulated power supply is used for the ESP32, sensors, LCD, motor driver, and other elements. DC motors connects through the motor driver used to simulate the vehicle movement in the model. For blind spot detection, ultrasonic sensors are placed on the both sides of the vehicle model. They transmit ultrasonic waves and receive the reflected signals from near objects. The time taken for the echo to return is used to determine the

distance between vehicle and object. If object is detected within fixed safe distance, ESP32 find it as a possible risk and activates the buzzer and LCD. The model includes the skid detection using moisture sensor placed near wheel area of the model. When sensor detects moisture above selected threshold, the road may be considered wet road or slippery and ESP32 generates a warning through buzzer and LCD display. This warning helps the driver to take safety measure such as driving at controlled speed. The complete system is programmed and tested in different conditions such as when objects are present in the blindspot area and when the road surface is wet, to check how the system to be respond. The main components used in this system and their purposes are listed in Table I. Test conditions and system response is shown in Table II.

TABLE I. COMPONENTS USED IN THE SYSTEM

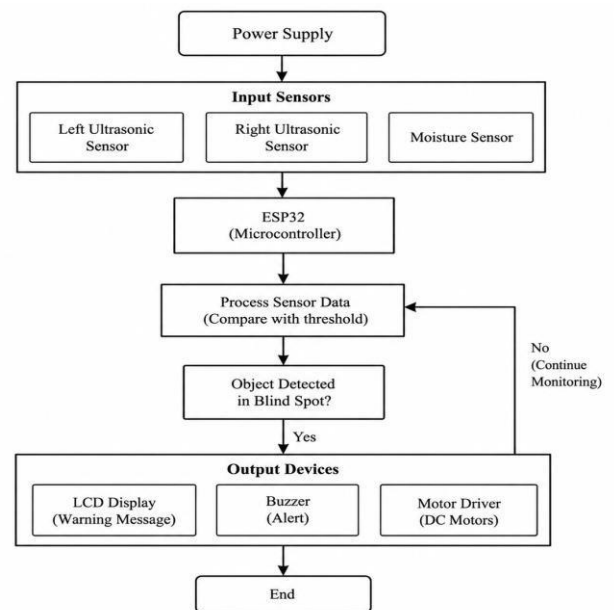
SL.NO	COMPONENT	PURPOSE
1.	ESP32	MAIN CONTROLLER FOR PROCESSING SENSOR DATA
2.	ULTRASONIC SENSOR	DETECTS OBJECTS IN THE BLIND SPOT
3.	MOISTURE SENSOR	DETECTS WET OR SLIPPERY ROAD CONDITIONS
4.	LCD DISPLAY	SHOWS WARNING MESSAGES
5.	BUZZER	GIVES AN ALERT TO THE DRIVER
6.	DC MOTOR	SIMULATES VEHICLE MOVEMENT
7.	MOTOR DRIVER	CONTROLS THE DC MOTORS
8.	POWER SUPPLY	PROVIDES POWER TO THE SYSTEM

TABLE II. TEST CONDITIONS AND SYSTEM RESPONSE

TEST CONDITION	SENSOR INPUT	SYSTEM RESPONSE
OBJECT IN LEFT BLIND SPOT	LEFT ULTRASONIC SENSOR DETECTS NEARBY OBJECT	BUZZER SOUNDS AND LCD DISPLAYS WARNING
OBJECT IN RIGHT BLIND SPOT	RIGHT ULTRASONIC SENSOR DETECTS NEARBY OBJECT	BUZZER SOUNDS AND LCD DISPLAYS WARNING
WET/SLIPPERY ROAD	MOISTURE SENSOR DETECTS MOISTURE	CAUTION WARNING IS DISPLAYED

NO OBSTACLE / DRY ROAD	NORMAL SENSOR READINGS	SYSTEM CONTINUES NORMAL OPERATION
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V. BLOCK DIAGRAM

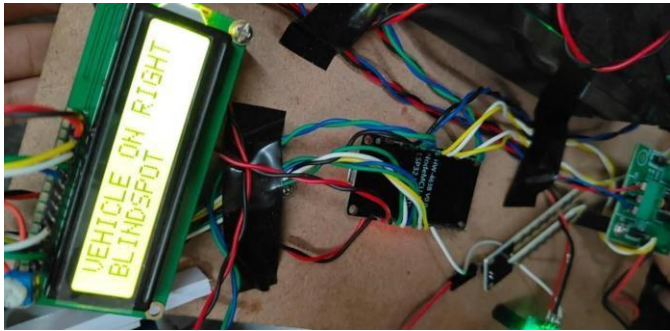


The block diagram represents the complete working arrangement of the proposed system. The power supply provides power to the system, while the left ultrasonic sensor, right ultrasonic sensor, and moisture sensor provide the input information. These sensor signals are sent to the ESP32 microcontroller, which acts as the central controller and processes the received information. After processing the sensor data, the ESP32 controls the LCD display and buzzer to provide information and warnings to the driver. The controller also operates the motor driver, which controls the DC motors used to simulate vehicle movement in the prototype.

VI. RESULTS AND OUTPUT



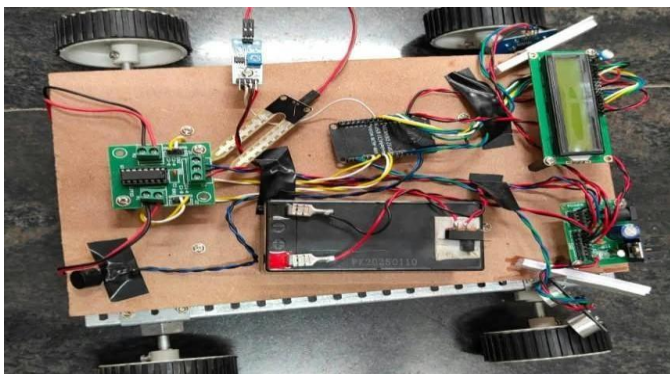
(a) Vehicle on left blind spot



(b) Vehicle on right blind spot



(c) Slippery Road



(d) Vehicle prototype

VII. ADVANTAGES

The proposed system improves driver awareness by detecting vehicles or obstacles in the blind spot areas and providing real time warnings. The LCD display and buzzer make the warning easy to notice, which can help the driver during lane changing or overtaking. The system also detects slippery road conditions using a moisture sensor. By using ultrasonic and moisture sensors along with an ESP32, the prototype is affordable and relatively easy to build. Overall, the system can be used as an additional safety feature to support safety.

VII. DISADVANTAGES

Ultrasonic sensors may be affected by the environment changes like rain, dust or noise. The detection range is also limited compared with radar based system. Sensor correct positioning is important because poor placement can effect blind spot detection. The moisture sensor may give incorrect readings if it is not placed or correctly configured. The system may also not detect very fast moving vehicles in some circumstances. Since the project is implemented as a model, its functioning may not fully represent actual vehicle conditions.

IX. CONCLUSION

The developed Blind Spot and Skid Detection System provides a simple method to developing vehicle safety by solving two common problems: blind spots and slippery road conditions. Ultrasonic sensors placed on the both sides of the vehicle to monitor the blind spot areas. When an object enters the detection zone, ESP32 stages the sensor information and provides a alert through the buzzer and LCD display. This can help the driver become made aware of vehicles or road hazards that may not be visible through mirrors. The moisture sensor adds other safety feature by identifying wet road conditions and alert the driver about the possibility of skidding. The combination these two functions makes the model more useful than a system that focuses on only one condition. Overall, the project shows how sensors and an ESP32 can be combined to build a low cost vehicle safety model that improves driver awareness.

X. FUTURE SCOPE

The system can be further improved by adding radar or camera modules to increase the detection range and accuracy. Image processing and machine learning techniques can also be explored to identify vehicles, pedestrians, and other road hazards more effectively. Wireless communication through Wi Fi or Bluetooth can connect the system with a mobile application and send alert to driver. GPS and IoT technologies can be added to monitor road conditions and share safety information with connected vehicles. Other warning methods, such as LED indicators on side mirrors or voice alerts, could make the system easier to use. With further development, the system can be integrated with Advanced Driver Assistance Systems and may also be explored for use in autonomous vehicles.

XI. REFERENCES

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