

U Turn Accident Prevention System using IoT

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Abstract - The proposed smart vehicle safety and monitoring system integrates multiple sensors and renewable energy to enhance road safety and sustainability. Ultrasonic sensors are strategically placed on the right and left sides of the vehicle to continuously measure surrounding distances, which helps drivers perform safer U-turns and significantly reduces the risk of collisions. For environmental monitoring, a DHT11 sensor is used to track temperature and humidity conditions, while a Light Dependent Resistor (LDR) measures ambient daylight intensity to support automatic lighting control, thereby improving visibility and road safety during low-light conditions. To ensure energy efficiency, a solar panel is employed to harvest solar energy and charge the battery, providing a stable and eco-friendly power supply to all system components. The ESP32 microcontroller acts as the central processing unit, collecting sensor data and transmitting it to the cloud for real-time monitoring and wireless notifications to authorized personnel. Additionally, LEDs are incorporated to provide visual warnings and daytime accident-prevention signals on roadside infrastructure, making the system effective, reliable, and suitable for smart transportation applications.

Keywords - IoT, U-Turn Accident Prevention System, Road Safety, Ultrasonic Sensors, Microcontroller, Vehicle Detection, Real- Time Warning System, Cloud Monitoring, Solar Power, Collision Prevention.

INTRODUCTION

The proposed system is designed to improve road safety and environmental monitoring through the integration of multiple sensors with an ESP32 microcontroller. By combining sensing, processing, and communication technologies, the system aims to reduce

accidents and provide real-time awareness of surrounding road conditions. Ultrasonic sensors are installed on the right and left sides of the vehicle to measure nearby distances, particularly during U-turns. This real-time distance monitoring helps drivers avoid obstacles and minimizes the risk of collisions in critical driving situations. To further enhance safety, LED indicators are incorporated to provide immediate visual warnings and movement guidance under roadside conditions. In addition, a white LED is used to improve daytime visibility, supporting effective signaling and contributing to accident prevention by making vehicles and roadside alerts more noticeable to drivers. These visual cues play a vital role in ensuring safer navigation in both normal and high-risk traffic environments.

Environmental conditions are continuously monitored using DHT11 and LDR sensors. The DHT11 sensor measures temperature and humidity, while the LDR sensor detects ambient light intensity during daytime. This environmental data enables the system to assess surrounding conditions accurately and supports intelligent decision-making for safety and monitoring applications.

To ensure sustainable and uninterrupted operation, the system employs a renewable energy-based power supply using a solar panel and battery. The solar panel converts sunlight into electrical energy, which is stored in the battery and used to power the ESP32 and all connected sensors. Additionally, IoT connectivity allows wireless transmission of sensor data and alerts to authorized personnel, enabling real-time monitoring and quick response. Overall, the system offers an efficient, eco-friendly, and reliable solution for smart road safety and environmental monitoring applications.

PROPOSED SYSTEM

The proposed system focuses on enhancing roadside and vehicle safety by integrating multiple sensors with an ESP32 microcontroller and renewable energy sources. Ultrasonic sensors are employed to measure the distance on the left and right sides of a vehicle, particularly during U-turn movements. This real-time distance measurement helps in avoiding obstacles and significantly reduces the risk of collisions. In addition, a white LED is used to improve daytime visibility, supporting accident prevention and ensuring continuous roadside safety. The ESP32 microcontroller acts as the central processing unit of the system. It collects and processes data from various sensors, including ultrasonic sensors for proximity detection, a DHT11 sensor for monitoring temperature and humidity, and an LDR sensor for detecting ambient light intensity. By efficiently coordinating sensor inputs, the ESP32 enables real-time decision-making and reliable system operation. To support sustainable and uninterrupted functioning, the system incorporates a solar panel and battery arrangement. The solar panel harvests sunlight and charges the battery, which supplies power to all sensors, LEDs, and the ESP32 controller. This renewable energy-based design reduces dependency on external power sources and makes the system suitable for long-term, maintenance-free operation in remote roadside environments. Furthermore, the processed sensor data is transmitted to the cloud through IoT connectivity, allowing authorities to receive real-time updates and alerts. LED indicators provide immediate local warnings and movement guidance on the roadside, enhancing overall safety and enabling timely responses to potential hazards. Overall, the system presents an efficient, eco-friendly, and intelligent solution for smart road safety applications.

1. Vehicle Distance Measurement and Safety System

The system integrates ultrasonic sensors mounted on the left and right sides of the vehicle to continuously measure surrounding distances, especially during U-turn movements. This real-time distance monitoring helps in detecting nearby obstacles and vehicles, thereby improving driving safety and effectively preventing collisions. Additionally, a white LED is used to enhance daytime visibility, supporting accident prevention and ensuring continuous roadside safety.

2. Sensor Data Acquisition and Processing System

An ESP32 microcontroller serves as the central processing unit of the system. It collects, processes, and manages data from multiple sensors, including ultrasonic sensors for vehicle proximity measurement, a DHT11 sensor for monitoring temperature and humidity, and an LDR sensor for detecting ambient light intensity. The ESP32 enables real-time sensor coordination and supports intelligent decision-making based on environmental and proximity data.

3. Renewable Power Supply and Energy Management

System A solar panel is incorporated to harvest sunlight and charge a rechargeable battery. The stored energy is used to power the ESP32 controller, sensors, and LED indicators. This renewable energy-based design ensures sustainable, cost-effective, and maintenance-free operation, making the system highly suitable for remote roadside and outdoor environments.

4. IoT-Based Monitoring and Alert System

The processed sensor data is transmitted to the cloud through IoT connectivity using the ESP32's wireless capabilities. Real-time alerts and notifications are sent to authorized personnel for continuous monitoring and quick decision-making. LED indicators provide local warnings and movement guidance on the roadside, enhancing safety and enabling timely responses to potential hazards.

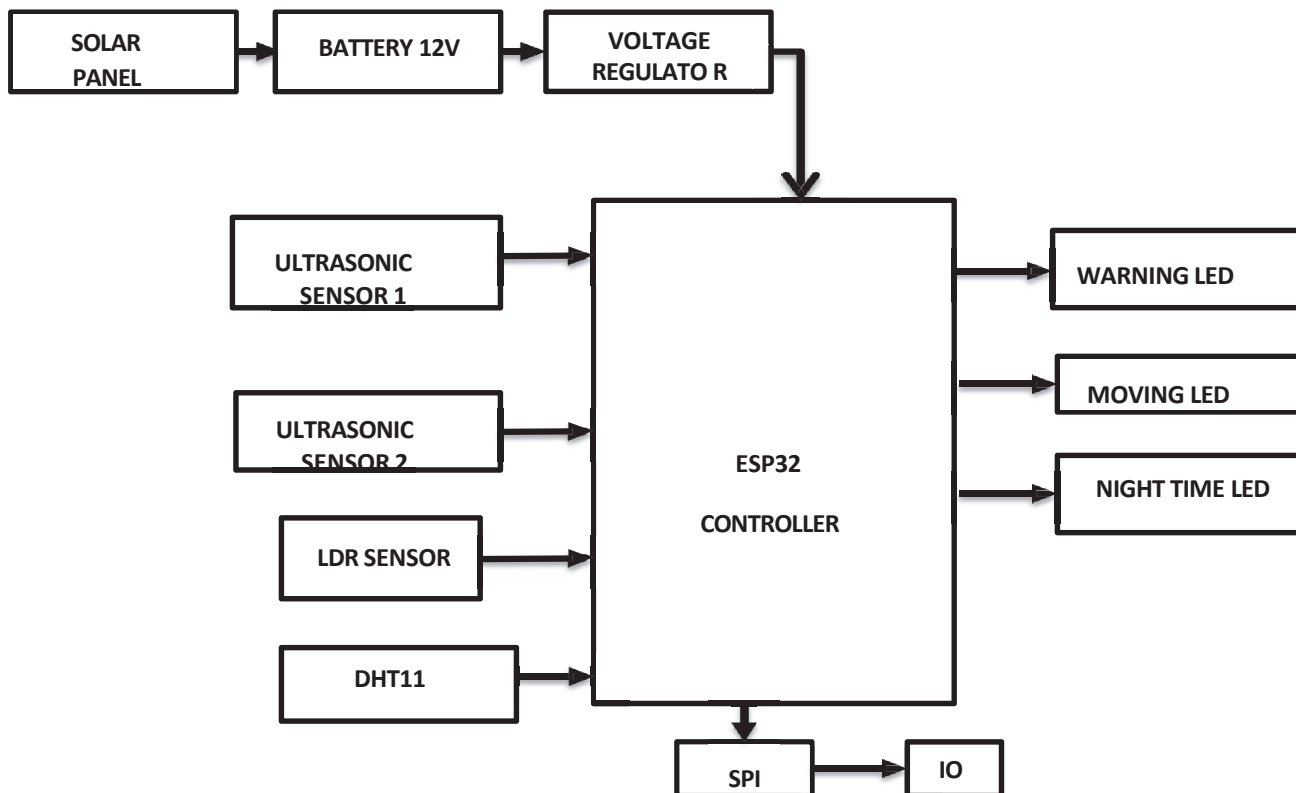


Fig. 4.1 Block Diagram

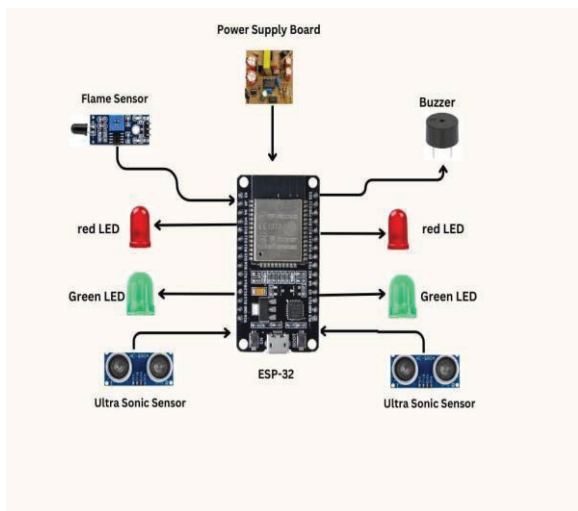


Fig:4.2 IoT Based System

CONCLUSION

The proposed system effectively enhances roadside and vehicle safety by integrating ultrasonic sensors, environmental sensors, and IoT technology with an ESP32 microcontroller. Real-time distance measurement during U-turns, combined with improved daytime visibility through

white LED indicators, significantly reduces the risk of collisions.

The use of DHT11 and LDR sensors enables continuous monitoring of environmental conditions, supporting intelligent and timely decision-making. By incorporating a solar-powered energy system, the design ensures sustainable, reliable, and maintenance-free operation, particularly in remote locations. Furthermore, IoT-based cloud connectivity

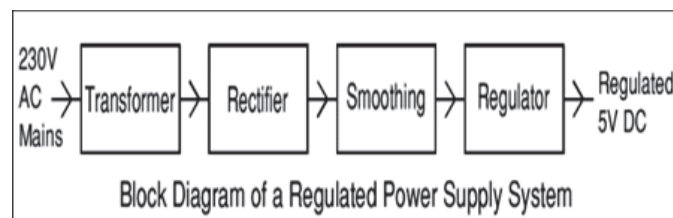


Fig:4.3 Power Circuit

allows real-time data transmission and alerts to authorities, enabling prompt responses to potential hazards. Overall, the system provides an efficient, eco-friendly, and scalable solution for smart road safety applications.

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