

Fog Condition Animal Detection and Driver Alert System

Shubham Bajad¹, Prajwal Gawade², Jagnath Gholve³, Yash Girme⁴, Prof. Mohite B.S⁵

Department of Electronics & Telecommunication Engineering, JSPM's Bhivrabai Sawant Polytechnic Wagholi, India¹⁻⁵

ABSTRACT: Fog and low visibility conditions are major causes of road accidents, as drivers are often unable to clearly see the road ahead. To address this issue, this paper presents a Fog Condition Detection and Driver Alert System using ESP32-CAM, an LDR sensor, and an ISD1820 voice alert module.

The system detects low visibility by monitoring changes in ambient light intensity using the LDR sensor. When a fog condition is identified, the ESP32-CAM processes the sensor data and activates a voice-based alert mechanism. A pre-recorded warning message is played through a speaker to alert the driver in real time.

Experimental results show that the proposed system is reliable, fast in response, and cost-effective. The developed prototype can help improve driver awareness and reduce accidents in fog-prone areas.

I. INTRODUCTION

Road safety has become a major concern due to the increasing number of accidents caused by poor visibility conditions such as fog, smoke, dust, and darkness. These conditions significantly reduce a driver's ability to clearly see the road ahead, leading to delayed reaction time and a higher risk of accidents. This problem becomes more critical on highways and forest-area roads, where sudden obstacles or animals may appear unexpectedly.

Several studies indicate that timely warning systems can greatly reduce accident rates by alerting drivers before a dangerous situation occurs. However, many existing solutions are either expensive, complex, or require advanced infrastructure, making them unsuitable for low-cost and prototype-level implementations. To address this issue, this paper presents a Fog Condition Detection and Driver Alert System based on the ESP32-CAM platform. The proposed system focuses on identifying low visibility conditions using a simple sensing mechanism and providing an audio-based warning to the driver. A Light Dependent Resistor (LDR) is used to monitor ambient light intensity, which serves as an indicator of fog or poor visibility. When a low visibility condition is detected, the ESP32-CAM processes the sensor data and activates a voice-based alert system. A pre-recorded warning message is played using an ISD1820 voice recording and playback module connected to a speaker. Audio alerts are especially effective in foggy conditions, as drivers may fail to notice visual indicators. The proposed system is designed as a low-cost, simple, and reliable prototype, suitable for academic applications and basic road safety demonstrations. The system can be further enhanced in future work by integrating advanced sensing and intelligent detection techniques to improve accuracy and real-world applicability.

II. LITERATURE SURVEY

Road safety has been an active research area due to the increasing number of accidents caused by low visibility conditions such as fog, smoke, dust, and darkness. Researchers have proposed various techniques to detect unsafe environmental conditions and alert drivers in advance. Several studies have utilized Light Dependent Resistors (LDRs) to detect reduced visibility and low light conditions. LDR-based systems are widely preferred in prototype-level applications because of their simplicity, low cost, and ease of implementation. These systems effectively indicate poor visibility conditions by monitoring changes in ambient light intensity. Recent research has also explored the use of microcontroller-based safety systems to process sensor data and control alert mechanisms. Embedded platforms similar to the ESP32 family have gained attention due to their compact size, processing capability, and suitability for real-time applications. Such controllers enable quick decision-making based on sensor inputs and can efficiently manage alert systems.

Studies highlight that audio-based alert systems are more effective than visual indicators in foggy or dark environments. Visual alerts may go unnoticed due to reduced visibility, whereas voice alerts immediately capture the driver's attention. As a result, voice playback modules are commonly used in driver assistance and warning systems.

Modules such as the ISD1820 voice recording and playback module are widely used in educational and prototype safety applications. These modules allow pre-recorded warning messages to be stored and played back when triggered by a control signal. Their simple interface and low power requirements make them suitable for low-cost alert systems. From the literature review, it is observed that many existing systems focus either on visibility detection or on alert generation independently. Limited work has been reported on combining low visibility detection using LDR with a voice-based alert mechanism controlled by a microcontroller. The proposed system addresses this gap by integrating visibility sensing with an audio warning system to improve driver awareness during fog and low visibility conditions.

III. METHODOLOGY

The proposed system aims to enhance road safety during fog and low visibility conditions by providing a timely audio alert to the driver. The methodology is based on sensing environmental visibility conditions, processing the sensed data using a microcontroller, and generating a warning message when a hazardous situation is detected.

1. System Design Methodology

The system is designed using a modular architecture consisting of input, processing, and output units.

The input unit comprises an LDR sensor, which detects changes in light intensity caused by fog or low visibility conditions. The sensor output is converted into an electrical signal suitable for processing.

The processing unit is implemented using the ESP32-CAM microcontroller. The controller continuously reads the sensor data, compares it with a predefined threshold value, and makes a decision based on the detected condition.

The output unit consists of an ISD1820 voice recording and playback module connected to a speaker. When the processing unit detects low visibility, it triggers the output unit to generate an audio warning. This system design provides a simple, reliable, and cost-effective solution for driver alert applications.

2. Hardware Methodology

1. ESP32-CAM is selected as the main controller due to its compact size, processing capability, and suitability for embedded applications.
2. LDR sensor is used to sense ambient light intensity and detect fog or low visibility conditions.
3. ISD1820 voice recording and playback module is used to store and play warning messages.
4. A speaker is connected to the ISD1820 module to produce an audible alert.
5. All components are mounted on a zero PCB to form a compact prototype.
6. A suitable power supply is provided to ensure stable operation of all components.

3. Software Methodology

1. The ESP32-CAM is programmed using the Arduino IDE.
2. The LDR sensor input pin is initialized to read light intensity values.
3. The sensor values are continuously monitored and compared with a predefined threshold.
4. When the light intensity falls below the threshold, a low visibility condition is detected.
5. The ESP32-CAM activates the ISD1820 module to play the warning message.
6. The process runs continuously to ensure real-time alert generation.

4. Working Methodology

1. The LDR continuously monitors ambient light conditions.
2. Reduced light intensity indicates fog or poor visibility.
3. ESP32-CAM processes the sensor data.
4. When low visibility is detected, the ISD1820 module is triggered.
5. A pre-recorded voice message is played through the speaker.
6. The driver receives an immediate audio warning to take precautions.

Block Diagram:

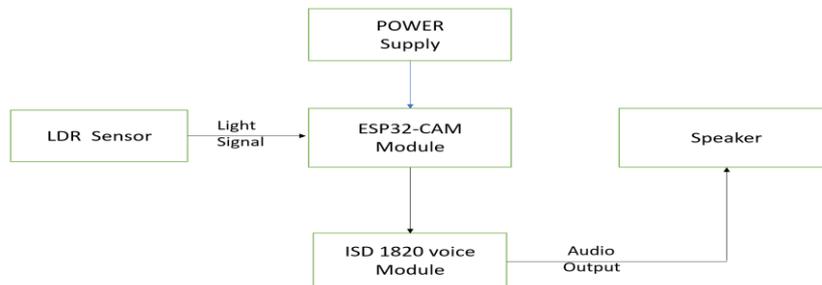
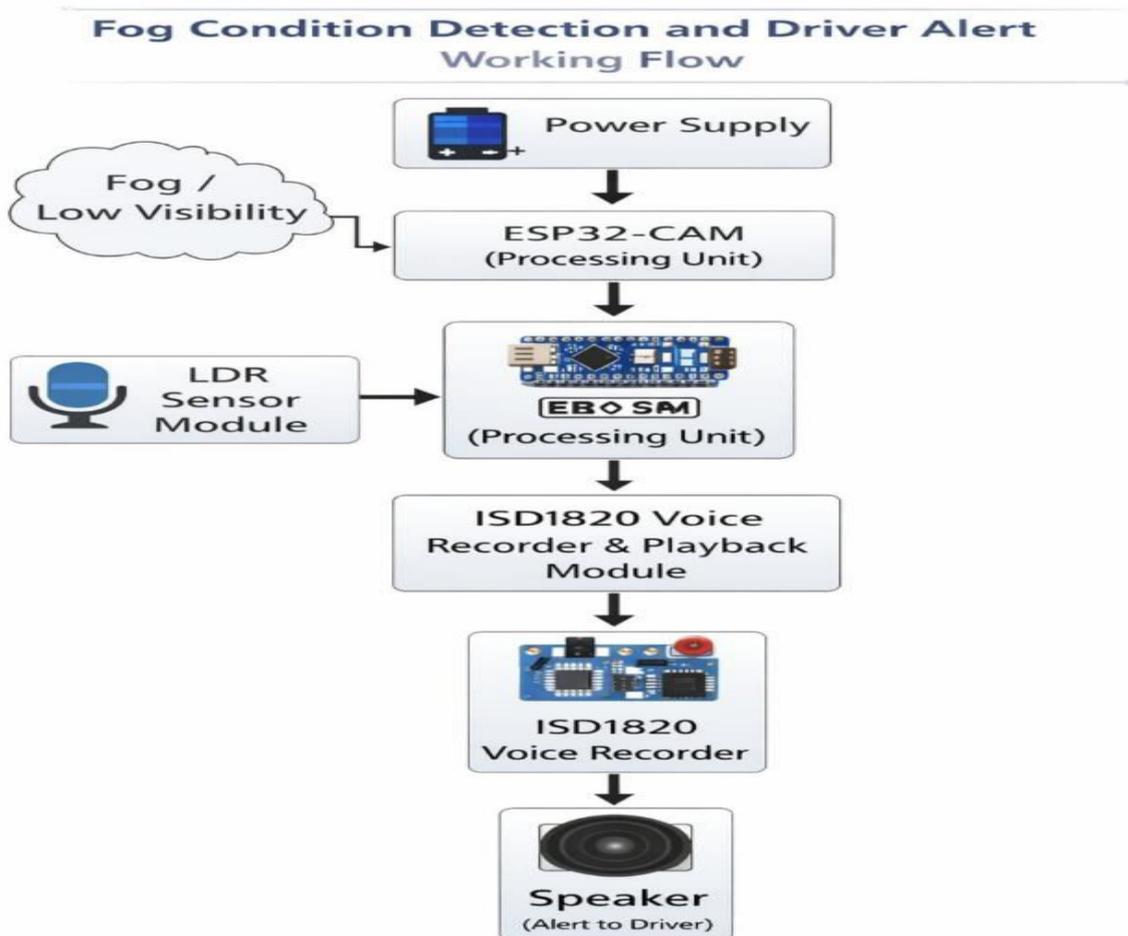


Fig: Transmitter and Receiver Sections

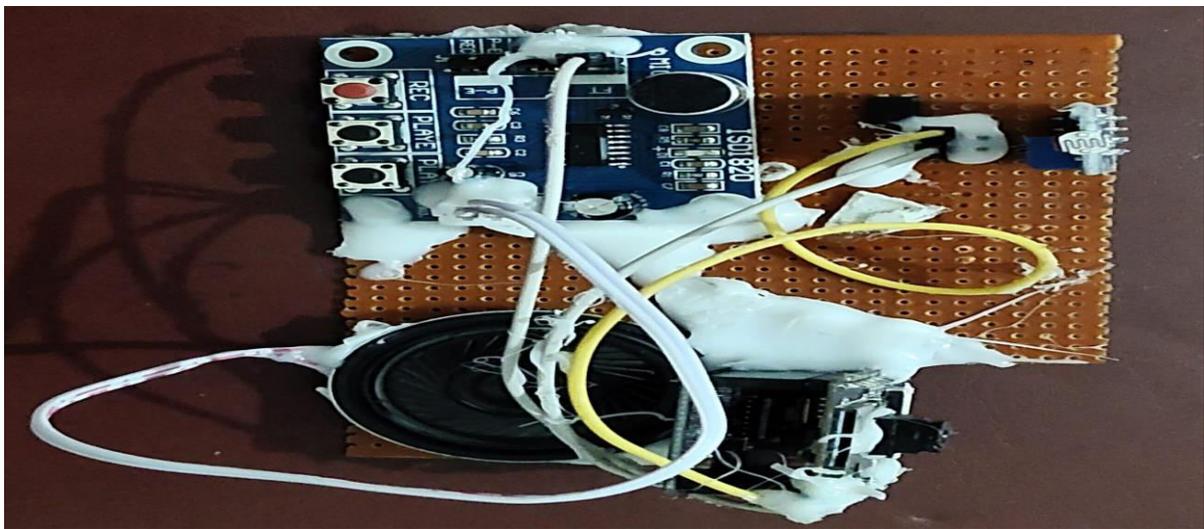
Flowchart:



IV. EXPERIMENTAL RESULTS

The proposed Fog Condition Detection and Driver Alert System was tested under normal and low visibility conditions. During normal light conditions, the system remained inactive and no alert was generated. When low visibility was simulated, the LDR sensor successfully detected the reduction in light intensity.

The ESP32-CAM processed the sensor data and activated the ISD1820 voice alert module. A clear and audible warning message was played through the speaker. The system responded quickly and operated reliably without false triggering. These results confirm that the proposed system effectively detects low visibility conditions and provides timely driver alerts.



V. CONCLUSION

This paper presented a Fog Condition Detection and Driver Alert System using ESP32-CAM, an LDR sensor, and an ISD1820 voice alert module. The system effectively detects low visibility conditions by monitoring changes in light intensity and provides an immediate audio warning to the driver.

Experimental results confirm that the system is reliable, fast, and cost-effective. The proposed approach enhances driver awareness during fog conditions and can help in reducing road accidents caused by poor visibility.

REFERENCES

- [1] M. A. Uddin, M. R. Islam, and M. M. Hasan, "Fog detection and driver alert system using light intensity sensor," *International Journal of Engineering Research and Technology (IJERT)*, vol. 9, no. 4, pp. 512–516, 2020.
- [2] Espressif Systems, "ESP32-CAM Technical Reference Manual," 2023. [Online]. Available: <https://www.espressif.com>
- [3] A. Kumar and R. Singh, "Design and implementation of low-cost driver alert system for low visibility conditions," *International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)*, vol. 8, no. 6, pp. 234–238, 2019.
- [4] ISD1820 Datasheet, "Single-Chip Voice Recording and Playback IC," Newton Technology Corporation, 2022.
- [5] S. Patil and P. Deshmukh, "Embedded system based safety alert system for vehicles," *International Journal of Scientific Research in Engineering and Technology (IJSRET)*, vol. 7, no. 5, pp. 45–49, 2018.
- [6] Arduino Documentation, "Arduino IDE and Embedded Programming," [Online]. Available: <https://www.arduino.cc>



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