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CAR SAFETY SYSTEM FOR EMERGENCY FLOOD SITUATION

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Abstract— Flood-related vehicle accidents increase every year during heavy rainfall and urban waterlogging. Many drivers fail to identify dangerous water depth while driving, which leads to vehicle damage, passenger trapping, and loss of life. This project presents a smart car safety system designed for emergency flood situations using water level sensors, ultrasonic sensors, GPS, GSM, and a microcontroller-based control unit. The system continuously monitors water levels around the vehicle and alerts the driver when the water reaches unsafe conditions. If the water level crosses a critical threshold, the system activates automatic safety measures such as engine cutoff warning, emergency alerts, location tracking, and rescue notifications. The proposed system improves passenger safety by providing real-time monitoring and communication during flood emergencies. Sensors placed near the vehicle detect rising water levels and send data to the microcontroller. The controller processes the data and activates alarms, display messages, and communication modules. The GPS module tracks the vehicle location, while the GSM module sends emergency messages to predefined contacts and rescue authorities. The system also includes an LCD display and buzzer for immediate local alerts. This project helps reduce flood-related accidents and increases survival chances during sudden waterlogging situations. The design is cost-effective, energy-efficient, and suitable for integration into modern smart vehicles. The proposed model supports smart transportation and disaster management systems. Experimental testing shows that the system detects water levels accurately and responds quickly during emergency conditions. The project provides an efficient solution for improving road safety in flood-prone areas.

Index Terms - Flood Detection, Vehicle Safety, IoT, Water Level Sensor, GSM Module, GPS Tracking, Emergency Alert System, Smart Transportation.

I. INTRODUCTION

Floods are one of the most dangerous natural disasters affecting transportation and public safety. Heavy rainfall, poor drainage systems, and waterlogging create unsafe road conditions for vehicles. Many drivers fail to identify the depth of water on flooded roads, which often leads to vehicle breakdowns, engine damage, accidents, and loss of life. During severe flooding, passengers may become trapped inside vehicles, making rescue operations difficult. Most modern vehicles include safety features for accidents and engine protection, but they do not provide dedicated systems for flood detection and emergency response. Therefore, there is a growing need for smart vehicle safety systems capable of monitoring flood conditions and warning drivers before a dangerous situation occurs.

The proposed project, "Car Safety for Emergency Flood Situation Using IoT," is designed to improve passenger safety during flood emergencies. The system uses water level sensors, ultrasonic sensors, GPS, GSM modules, and a microcontroller to monitor water levels around the vehicle. When the detected water level crosses a predefined safety limit, the system activates alarms and warning messages to alert the driver. At the same time, the GPS module identifies the vehicle location, and the GSM module sends emergency notifications to rescue teams or family members. This helps passengers receive immediate assistance during emergency situations.

The proposed system is low-cost, compact, and suitable for integration into smart vehicles. It reduces flood-related accidents and minimizes vehicle damage caused by water exposure. The project demonstrates how IoT and embedded systems improve road safety and disaster management in flood-prone areas.

II. SYSTEM AND METHODOLOGY

Methodology

This project follows a structured and systematic approach to develop a smart flood safety system for vehicles using IoT and sensor technology. The system integrates water level monitoring, emergency alert communication, GPS tracking, and automatic warning mechanisms to improve passenger safety during flood situations.

Phase 1: Requirement Analysis and System Design

Target Application: Vehicle safety and emergency response during flood and waterlogging conditions.

Core Components: Arduino Nano, water level sensor, ultrasonic sensor, GPS module, GSM module, buzzer, LCD display, relay module, and 12V battery.

Architecture: Water Level Sensor + Ultrasonic Sensor → Arduino Nano → Warning System + GPS Tracking + GSM Alert System → Emergency Response.

Phase 2: Hardware Prototyping and Sensor Integration

Component Assembly: Water level sensor and ultrasonic sensor mounted near the lower section of the vehicle for flood detection.

Monitoring System: Sensors connected to Arduino Nano for continuous water level monitoring. Alert System: Buzzer and LCD display connected for real-time warning indication.

Communication System: GPS module connected for live location tracking and GSM module connected for emergency message transmission.

Power Supply: 12V rechargeable battery used for powering the complete system.

Phase 3: Controller Programming and Emergency Management

Development Environment: Arduino IDE used for embedded system programming.

Control Functions: Implemented water level monitoring, flood detection logic, emergency alert generation, GPS tracking, and GSM communication using Arduino Nano.

System Operation: The controller continuously checks water levels around the vehicle. When the water exceeds the predefined safety limit, the system activates warning alerts and sends emergency messages with location details.

Safety Mechanism: The system provides immediate alerts to drivers and emergency contacts for quick rescue support.

Phase 4: System Testing and Performance Evaluation

Performance Analysis: Tested system performance under different water level conditions.
Parameters Monitored: Water level detection accuracy, sensor response time, GPS tracking performance, GSM alert delivery, and buzzer response.
Evaluation: The system was analyzed for reliability, emergency response efficiency, passenger safety improvement, and flood detection accuracy.

III. SYSTEM

The proposed system consists of sensing, monitoring, communication, processing, alert generation, and emergency response units. The integration of water level sensors and communication modules ensures continuous flood monitoring and rapid emergency response. The system performs real-time flood detection, driver alert generation, GPS location tracking, and emergency message transmission.

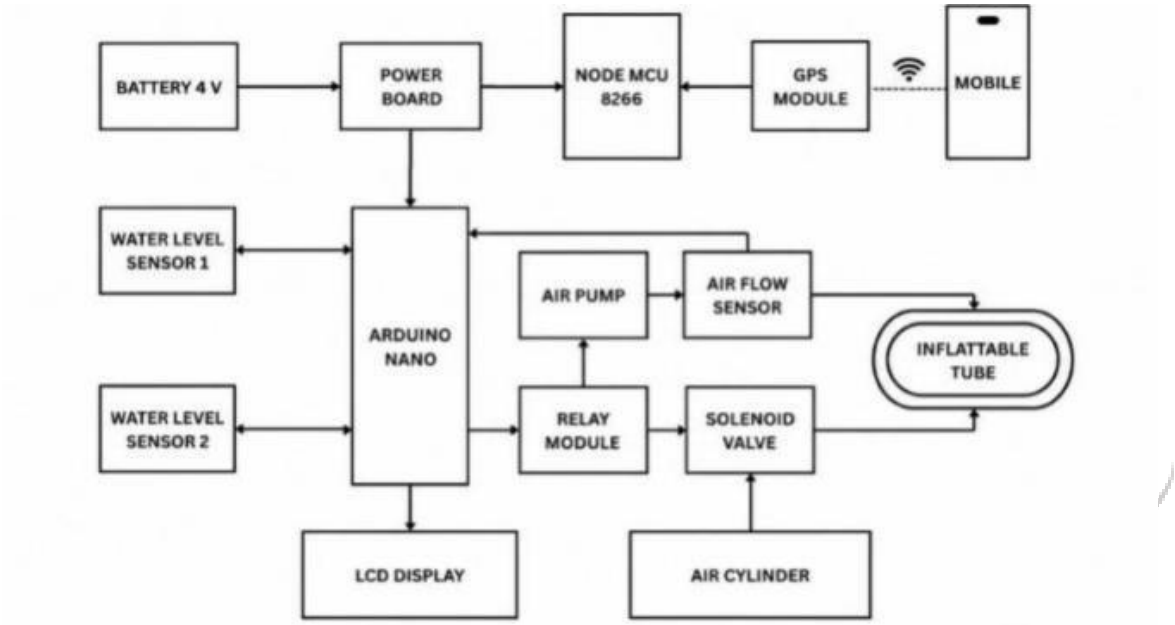

fig 1: system block diagram of car safety system

A. System Overview

The proposed system consists of sensing, monitoring, communication, processing, alert generation, and emergency response units. The integration of water level sensors and communication modules ensures continuous flood monitoring and rapid emergency response. The system performs real-time flood detection, driver alert generation, GPS location tracking, and emergency message transmission.

B. Flood Detection Unit

The flood detection unit consists of a water level sensor and ultrasonic sensor. The water level sensor detects the presence of water near the vehicle, while the ultrasonic sensor measures the water height around the vehicle body. These sensors continuously monitor flood conditions and act as the primary input devices of the system.

C. Monitoring and Alert Unit

The monitoring and alert unit includes a buzzer and LCD display. When unsafe water levels are detected, the buzzer generates an audible warning signal and the LCD display shows warning messages to alert the driver about the flood condition.

D. Sensing Unit

The sensing unit continuously collects water level data from the sensors and sends the information to the Arduino Nano controller for processing and decision-making. The sensors provide accurate real-time monitoring of surrounding flood conditions.

E. Processing and Control Unit

The Arduino Nano serves as the central processing and control unit of the system. It performs the following functions:

- Monitoring water level sensor data.
- Processing flood detection conditions.
- Generating warning signals.
- Controlling GPS and GSM communication modules.
- Managing emergency alert operations.

The controller ensures smooth coordination between all system components.

F. Communication and Tracking Unit

The communication unit consists of GPS and GSM modules. The GPS module identifies the exact location of the vehicle during emergency situations. The GSM module sends emergency alert messages containing location details to predefined contacts or rescue authorities for quick assistance.

G. Power Supply Unit

A 12V rechargeable battery is used as the power supply unit. The battery provides continuous power to the sensors, controller, communication modules, and alert systems during flood emergencies.

H. Emergency Safety Unit

The emergency safety unit activates warning alerts and emergency communication when critical water levels are detected. This unit improves passenger safety, supports rescue operations, and reduces flood-related vehicle accidents.

IV. WORKING

The proposed car safety system for emergency flood situations works through the integration of flood detection sensors, intelligent control, emergency communication, and alert mechanisms. The following describes the complete operational workflow of the system:

*4.1*Water Level Detection

At system startup, the water level sensor continuously detects the presence of water around the vehicle. The sensor measures the water level near the lower section of the vehicle and sends the detected values to the Arduino Nano controller. This helps identify rising water levels during flood or waterlogging conditions.

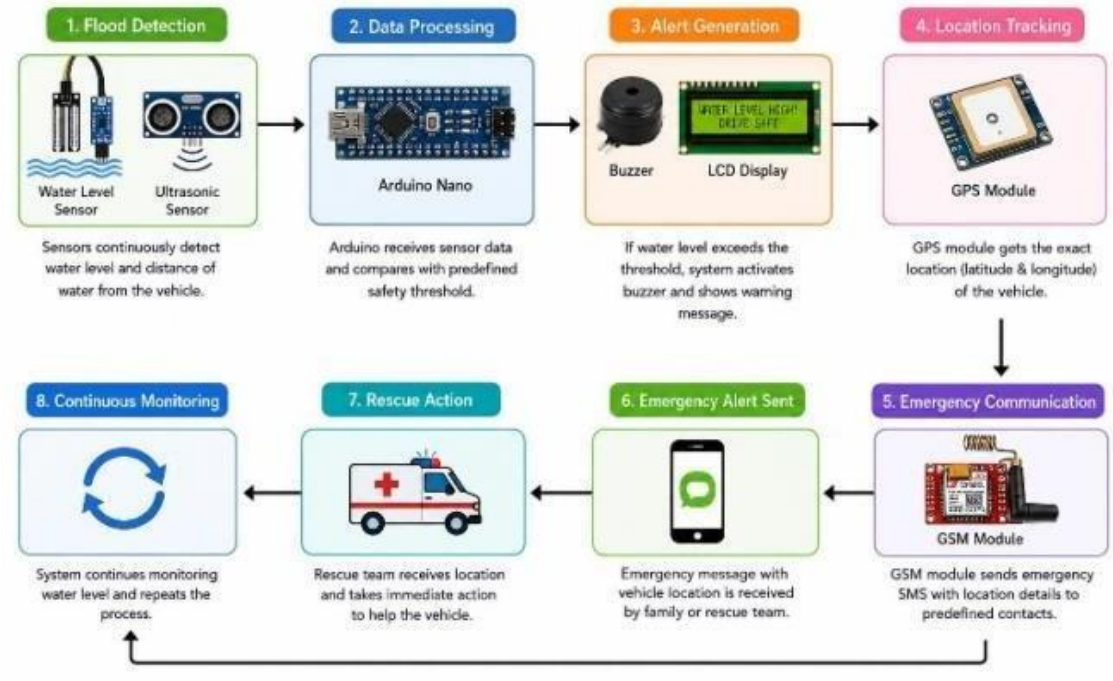

fig 2: work flow diagram of car safety system

*4.2*Ultrasonic Sensor Monitoring

The ultrasonic sensor measures the distance between the vehicle body and surrounding water surface. It provides accurate flood level measurement and supports real-time monitoring of dangerous water conditions. The measured data is transmitted to the Arduino Nano for processing and analysis.

*4.3*Real-Time Sensor Data Processing

The Arduino Nano acts as the central processing unit of the system. It continuously receives data from the water level sensor and ultrasonic sensor. The controller compares the detected water level with predefined safety limits stored in the program. This enables the system to identify safe and dangerous flood conditions automatically.

*4.4*Warning Alert Operation

When the detected water level exceeds the warning threshold, the Arduino Nano activates the buzzer and LCD display unit. The buzzer produces an audible alert signal to warn the driver immediately, while the LCD display shows warning messages regarding flood danger and unsafe driving conditions.

*4.5*GPS Location Tracking

During emergency conditions, the GPS module identifies the exact location of the vehicle in real time. The location coordinates are continuously monitored and transmitted to the controller. This enables accurate tracking of stranded vehicles during flood situations.

*4.6*GSM Emergency Communication

The GSM module is used for emergency communication and alert transmission. When critical flood levels are detected, the Arduino Nano sends control signals to the GSM module. The GSM module automatically sends emergency alert messages containing vehicle location details to predefined contacts, family members, or rescue authorities for immediate assistance.

*4.7*Power Supply and Continuous Operation

A 12V rechargeable battery powers the complete system. The battery supplies continuous power to sensors, communication modules, alert systems, and the Arduino Nano controller. This ensures uninterrupted system operation even during severe flood conditions or vehicle power failure.

*4.8*System Performance and Safety Improvement

The proposed flood safety system continuously operates by monitoring water levels and providing immediate emergency response support. The system improves passenger safety, reduces flood-related vehicle accidents, and supports rescue operations during natural disasters. The integration of IoT technology and embedded systems increases system reliability and efficiency for smart vehicle safety applications.

V. RESULTS

The proposed car safety system for emergency flood situations was successfully designed and tested under different flood conditions. The system demonstrated effective flood detection, real-time monitoring, emergency alert generation, GPS tracking, and GSM communication performance. Experimental testing confirmed reliable operation of all hardware and software components integrated in the system.

A. Flood Detection and Sensor Performance Results

The water level sensor accurately detected rising water levels around the vehicle under different test conditions. The ultrasonic sensor successfully measured the distance between the vehicle body and surrounding water surface with stable output values. When the detected water level exceeded the predefined safety threshold, the Arduino Nano activated the buzzer and LCD display immediately. The warning system responded within a few seconds, providing fast alerts to the driver during emergency conditions. Continuous monitoring tests showed stable sensor operation without major signal fluctuations or failures.

B. GPS and GSM Communication Results

The GPS module successfully identified the real-time location of the vehicle during flood conditions. Accurate latitude and longitude coordinates were generated and processed by the controller. The GSM module transmitted emergency SMS alerts containing vehicle location details to predefined contacts

and rescue authorities. Testing confirmed reliable message delivery with minimum delay. The integrated GPS and GSM communication system improved emergency response capability and enabled faster rescue support during critical situations.

C. System Performance Results

The complete system operated efficiently under different water level conditions and maintained continuous monitoring throughout testing. The Arduino Nano processed sensor data accurately and controlled alert operations without interruption. The proposed system effectively reduced response time during flood emergencies by generating instant alerts and emergency notifications. The prototype demonstrated reliable performance, low power consumption, and stable operation during long-duration testing. Overall, the system improved passenger safety, reduced flood-related risks, and provided an efficient solution for smart vehicle safety applications in flood-prone areas.

A. FLOOD DETECTION AND SENSOR PERFORMANCE RESULTS

Component	Test Condition	Input / Condition	Measured Output	Status	Observation
Water Level Sensor	Low Water Level	Water below threshold	Safe indication (LED OFF)	Stable	System detected safe condition correctly
Water Level Sensor	High Water Level	Water above threshold	Warning triggered (LED ON)	Success	Flood condition detected accurately
Ultrasonic Sensor	Distance Measurement	Water near vehicle	Distance measured (10 – 300 cm)	Stable	Accurate water level monitoring observed
Arduino Nano	System Operation	Continuous monitoring	Sensor processing active	Stable	Real-time processing performed successfully
LCD Display	Flood Alert	High water detected	Warning message displayed	Success	Driver alert generated instantly
Buzzer	Emergency Alert	Critical water level	Alarm activated (Continuous Beep)	Success	Audible warning provided immediately

B. GPS AND GSM COMMUNICATION RESULTS

Parameter	Description	Test Condition	Output	Result	Observation
GPS Module	Vehicle Tracking	Flood condition	Live location generated (Lat: 17.3850, Long: 78.4867)	Success	Accurate vehicle coordinates received
GSM Module	SMS Alert	Emergency state	Alert message sent to predefined number	Success	Emergency notification delivered properly
Communication System	GPS + GSM Integration	Critical flood level	Location message transmitted via SMS	Reliable	Quick emergency communication achieved
Response Time	Alert Generation	Water threshold crossed	2 – 5 seconds	Fast	Immediate warning response observed

C. SYSTEM PERFORMANCE RESULTS

Parameter	Test Condition	System Response	Performance	Observation
Flood Detection	Low water level	Monitoring mode	Stable	Normal operation maintained
Flood Detection	High water level	Warning activated (Buzzer + LCD)	Efficient	Fast flood detection achieved
Emergency Communication	Critical condition	SMS + GPS activated	Reliable	Emergency support improved
Continuous Monitoring	Long duration testing	Stable operation	Excellent	No major system failure observed
Overall Result	Full system operation	All modules functional	Excellent	System improved flood safety and emergency response

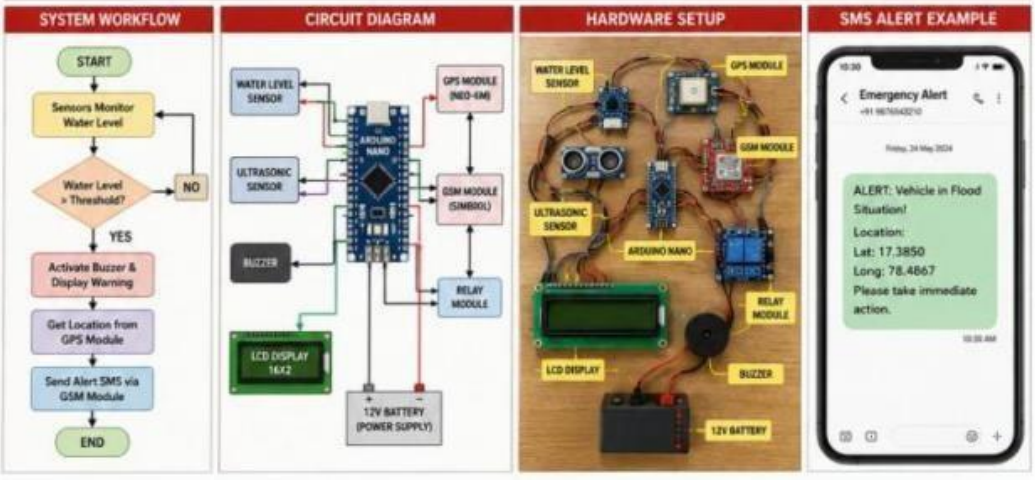

fig 3: results of car safety system

REFERENCES

[1] S. Kumar and R. Gupta, "IoT-Based Smart Flood Monitoring and Alert System," International Journal of Engineering Research and Technology, vol. 11, no. 5, pp. 1023–1028, May 2022.

[2] A. Sharma, P. Verma, and R. Singh, "Vehicle Safety System Using Water Level Detection and GSM Technology," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 10, no. 4, pp. 2150–2156, Apr. 2021.

[3] M. Patel and K. Shah, "Flood Detection and Early Warning System Using Arduino and IoT," IEEE International Conference on Smart Systems and Inventive Technology, pp. 455–460, 2021.

[4] R. Karthik and S. Naveen, "Smart Emergency Alert System for Vehicles in Flood-Prone Areas," International Journal of Innovative Technology and Exploring Engineering, vol. 9, no. 8, pp. 1350–1355, June 2020.

[5] V. Rao and P. Reddy, "GPS and GSM Based Vehicle Tracking and Emergency Communication System," International Journal of Scientific Research in Computer Science Engineering and Information Technology, vol. 7, no. 3, pp. 220–226, Mar. 2021.

[6] N. Ahmed and T. Rahman, "IoT Enabled Disaster Monitoring and Rescue Support System," Proceedings of the International Conference on Communication and Electronics Systems, pp. 978–983, 2022.

[7] B. Joseph and M. Francis, "Arduino-Based Intelligent Flood Monitoring System for Smart Transportation," International Journal of Computer Applications, vol. 175, no. 12, pp. 15–20, Oct. 2020.

[8] P. Mehta and D. Kulkarni, "Embedded System Design for Vehicle Safety Applications Using Sensors and Wireless Communication," IEEE Access, vol. 9, pp. 55210–55218, 2021.