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Smart Aquashield Jacket

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Abstract**—** *Water-related accidents such as floods, boating incidents, and drowning cases result in a significant number of fatalities each year. In many situations, delayed rescue operations occur due to the inability to quickly locate victims. Conventional life jackets provide buoyancy but do not offer real-time location tracking or health monitoring. This paper presents the Smart Aquashield Jacket, an intelligent wearable life-saving system designed to enhance water safety. The jacket features automatic inflation upon contact with water, along with a manual activation mechanism for additional safety. It integrates pulse and oxygen level monitoring sensors to assess the user's health condition. A GPS module is used to determine the exact location, while a GSM module transmits emergency alerts via SMS and call notifications to predefined contacts. The proposed system is designed to be cost-effective, user-friendly, and reliable. Partial simulation results demonstrate the feasibility of the system and its potential to significantly reduce rescue response time during water emergencies.*

Keywords— Emergency Alert, GPS Tracking, GSM Communication, Smart Life Jacket, Wearable Safety.

I. INTRODUCTION

Water-related accidents are very common and very dangerous. Floods, rivers, seas, lakes, and boats are places where people can easily face drowning situations. Every year, many lives are lost because help does not reach the person on time. One of the main safety tools used in water is the life jacket.

Traditional life jackets are designed mainly to help a person float on water. They are useful, but they have many limitations. These jackets do not indicate where the person is located. They also do not provide any information about the person's health condition. In most cases, the person must manually wear and adjust the jacket, which may not be possible during sudden accidents.

The Smart Aquashield Jacket is designed to overcome these problems. It looks like a normal jacket but becomes active during an emergency. When the jacket touches water, it inflates automatically. It checks the person's health condition, finds the location, and sends alerts to rescue teams. This makes rescue faster, easier, and more effective.

II. LITERATURE REVIEW

Zhang et al. (2024) presented an intelligent self-powered life jacket system integrating multiple triboelectric fiber sensors for drowning rescue. The wearable jacket using six triboelectric fiber sensors and machine learning achieved 100% accuracy in detecting drowning motions, demonstrating that sensor-ML integration can save lives in aquatic emergencies [1].

To and Huang (2024) demonstrated computer-vision motion analysis and biomechanical modeling to identify optimal energy harvesting methods from life jacket motion, showing the feasibility of self-powered systems [2].

Sarkar (2025) developed an IoT-enabled jacket integrating GPS, wireless sensors, and oxygen monitoring for flood rescue, enabling real-time tracking, oxygen sensing, and improved rescuer and victim safety [3].

Renusha et al. (2024) presented a LoRa-based system enabling ultra-long-range distress signaling (~15 km). Machine learning on vital-sign data detects emergencies (immersion/hypothermia) early, representing a significant advancement in water-safety technology [4].

III. METHODOLOGY

The Smart Aquashield Jacket is designed as an integrated wearable safety system that operates automatically during water-related emergencies by combining sensing, control, and communication technologies. The system is built around a microcontroller-based architecture, where an **Arduino Uno** acts as the central processing unit responsible for continuously monitoring inputs from various sensors and controlling overall system operation.

3.1 Water Detection and Inflation

The methodology begins with real-time detection of environmental conditions using a **water sensor** strategically placed on the jacket to detect immediate contact with water. Once water is detected, the sensor sends a signal to the microcontroller, which triggers the inflation mechanism. The inflation system is based on a **CO_2 cartridge** that rapidly fills the jacket with air, ensuring buoyancy and keeping the user afloat without requiring manual intervention. A **manual pull mechanism** is also incorporated as a backup to ensure reliability in case of sensor or system failure.

3.2 Health Monitoring

Simultaneously, the system integrates a health monitoring unit consisting of a pulse sensor or oxygen sensor that continuously measures the user's vital parameters such as heart rate or blood oxygen level. This data is processed by the microcontroller to assess the physical condition of the user during the emergency.

3.3 Location Tracking and Communication

A **GPS module** is used to acquire real-time location coordinates, which are essential for tracking the user's position accurately. Once the emergency condition is confirmed, the microcontroller activates the **GSM module**, which is programmed to send predefined alert messages along with location data to emergency contacts via SMS and initiate a phone call if required. This ensures immediate communication with rescue teams or family members.

3.4 Power and Software

The entire system is powered by a rechargeable battery that is properly insulated to ensure safe operation in wet conditions. The software implementation involves embedded programming in the microcontroller, where continuous looping logic is used to monitor sensor data, execute conditional decisions, and control output actions such as inflation and communication. The methodology ensures that all operations are performed automatically and sequentially without human intervention.

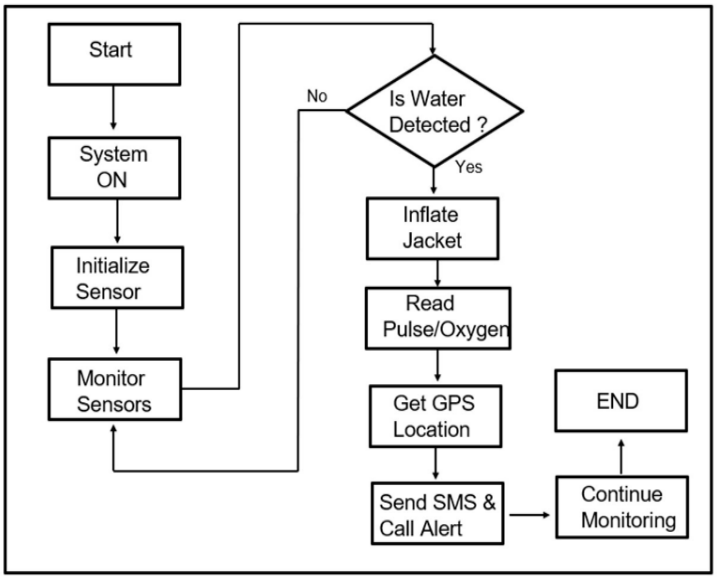

Figure 1: Block Diagram of Smart Aquashield Jacket

IV. RESULTS

The Smart Aquashield Jacket project is currently under progress. At this stage, partial simulation and initial testing of individual modules such as the water sensor, GPS module, and GSM communication have been carried out.

The simulation results indicate that the proposed logic for water detection and alert generation works as expected in a controlled environment. The GPS module is able to provide location data, and the GSM module is capable of sending SMS

messages and initiating calls. Complete hardware integration and real-time water testing are planned as part of future development. These initial results show that the proposed system is feasible and suitable for further implementation.

Component	Test Result
Water Sensor	Detects water contact correctly
GPS Module	Provides accurate location coordinates
GSM Module	Sends SMS and initiates calls successfully
Inflation Mechanism	Activates upon sensor trigger (simulated)
Health Monitoring	Pulse/O2 sensor data readable

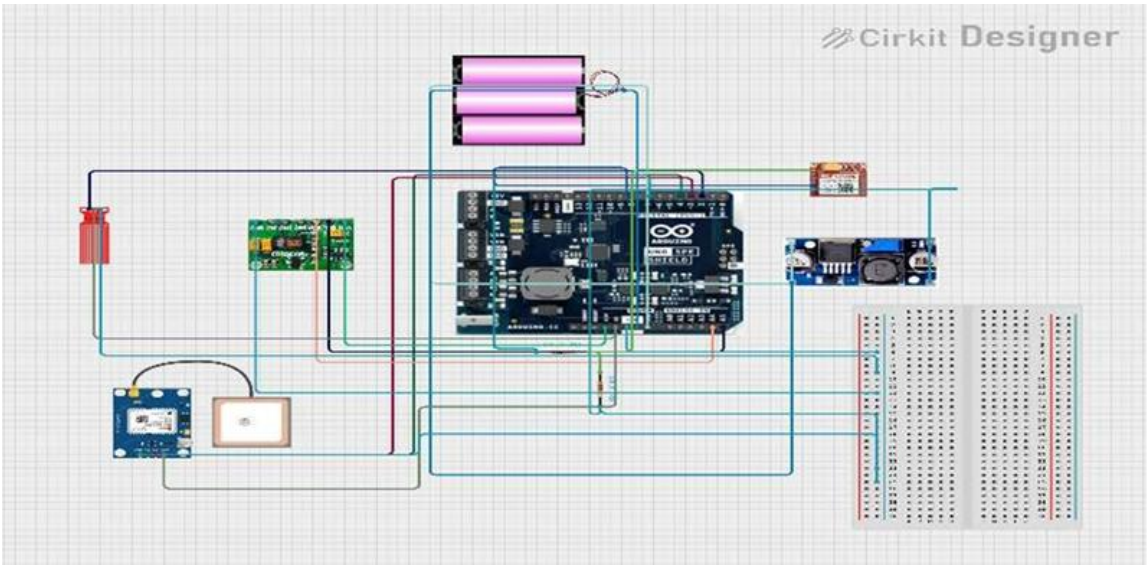

Figure 2: Circuit Diagram of Smart Jacket

Figure 3: Jacket

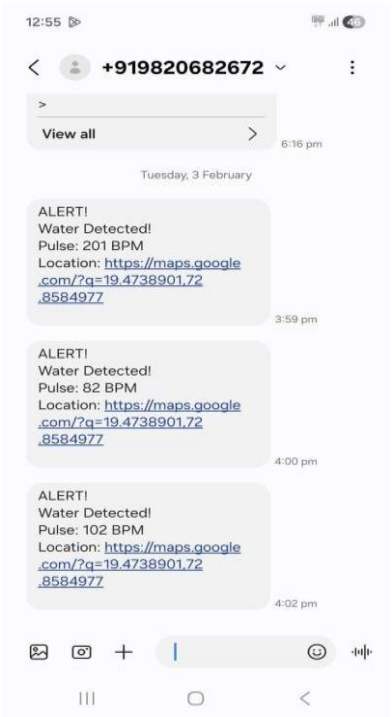

Figure 4: SOS Message

V. CONCLUSION

The Smart Aquashield Jacket presents an advanced and practical solution to the growing problem of water-related accidents by integrating multiple safety features into a single wearable system. Unlike traditional life jackets that only provide flotation support, the proposed system enhances safety by incorporating automatic inflation, real-time health monitoring, and communication technologies.

Key Features and Benefits:

Feature	Benefit
Automatic inflation on water contact	Immediate response even if user unconscious
Manual pull mechanism	Backup activation for reliability
Pulse/O2 monitoring	Real-time health assessment
GPS tracking	Accurate location for rescue teams
GSM alerts (SMS + call)	Instant emergency communication

The integration of GPS and GSM modules further strengthens the system by enabling real-time location tracking and instant transmission of emergency alerts to predefined contacts. This significantly reduces rescue operation delays, which is one of the primary causes of fatalities in drowning incidents.

Limitations and Future Work:

- Complete hardware integration pending
- Waterproofing of electronic components required
- Real-time field testing under various environmental conditions needed
- Future enhancements: advanced communication technologies, improved sensor accuracy, mobile application integration

Overall, the Smart Aquashield Jacket has strong potential to revolutionize personal safety in aquatic environments by reducing response time, improving rescue efficiency, and ultimately saving lives.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this research work. The project has been carried out purely for academic purposes under the guidance of faculty members as part of institutional requirements. No financial support, sponsorship, or funding has been received from any commercial organization or external agency. The guidance provided was strictly academic in nature and did not influence the results or outcomes of the study. All work has been conducted independently, and the findings are presented without any bias or external influence.

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