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Drowning Detection Device Using Esp8266

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Abstract: Drowning is a leading cause of accidental death in aquatic environments. This paper presents an IoT-based drowning detection system using ESP8266. It continuously monitors physiological and environmental parameters including heart rate, body motion, and submersion status. Using multiple sensors and real-time data analysis, the system can detect potential drowning scenarios and alert rescuers via mobile notification using Blynk IoT platform. The prototype aims to bridge the gap between traditional monitoring methods and advanced safety technology to reduce drowning-related fatalities.

***Index Terms* -** Drowning Detection, Smart Life Jacket, IoT, ESP8266, NodeMCU, Heartbeat Sensor, Waterproof Ultrasonic Sensor, Blynk IoT, Water Sensor, DHT11, Real-Time Monitoring, Emergency Alert System.

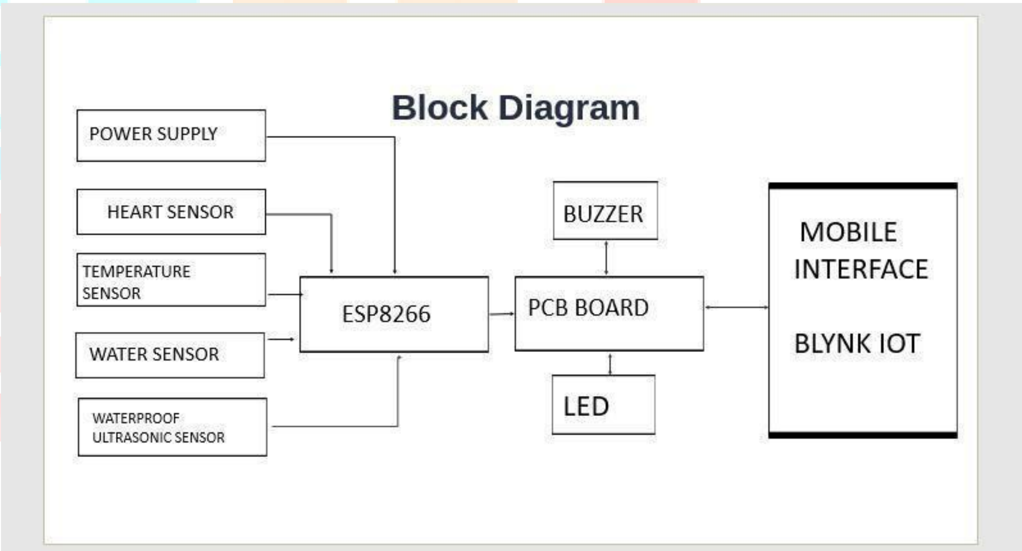
I. INTRODUCTION

Drowning is one of the leading causes of accidental death globally, accounting for over 1.2 million fatalities each year, as per the World Health Organization (WHO). Traditional safety measures such as lifeguards, surveillance cameras, and life jackets, although essential, are often limited by human error and delayed response times. These limitations are particularly critical in environments such as crowded swimming pools, beaches, and remote water bodies, where swift and accurate detection of drowning incidents is vital. Recent advancements in technology have led to the development of smart drowning detection systems that utilize sensors, artificial intelligence (AI), and Internet of Things (IoT) platforms. These systems are capable of continuously monitoring swimmers' vital signs and movement patterns, enabling real-time alerts when irregularities suggest potential drowning. This project proposes an IoT-based solution using the ESP8266 microcontroller integrated with various sensors and the Blynk platform, aiming to provide an efficient, automated, and cost-effective system to enhance water safety and reduce drowning- related incidents.

II. LITERATURE SURVEY

A variety of drowning detection systems have been developed in recent years, each leveraging different technologies such as IoT, artificial intelligence (AI), wearable sensors, and smart life jackets to improve aquatic safety. This section reviews relevant research contributions and commercial innovations that have influenced the development of modern drowning detection solutions. [1] Alharbi et al. (2024) introduced an advanced drowning detection system using the YOLOv8 deep learning model, achieving a detection accuracy of 90.1%, outperforming its predecessors. The system benefits from robust performance under different lighting and environmental conditions, thanks to effective data augmentation. However, it requires high-quality cameras, stable internet connectivity, and significant computational resources, which may not be feasible in all settings. [2] Kao et al. (2024) proposed a next-generation prevention strategy integrating AI and IoT technologies to analyze visual and environmental data for real-time drowning detection. The system offers potential integration with existing pool infrastructure, enhancing practicality. Nonetheless, the high complexity and cost of AI-IoT integration and environmental challenges like glare and water turbidity may affect its performance. [3] An intelligent self-powered life jacket system developed by researchers in 2024 integrates multiple triboelectric fiber sensors to detect drowning incidents. Using triboelectric nanogenerator technology, it harnesses mechanical energy from body movements, eliminating the need for external power sources. While offering continuous operation without batteries, the system's effectiveness may be influenced by sensor accuracy, environmental factors, and the need for further optimization in real-world applications.[4] A LoRa-based life jacket system developed by researchers from IPB University (2024) utilizes long-range communication to track fishermen in real time. Capable of transmitting data up to 12.98 km, it is well-suited for low-power, extended-use scenarios. However, signal degradation over distance, environmental obstructions, and battery limitations remain notable constraints.[5] This project aims to prevent drowning at beaches using a dual-sensor system: a water detector in a locket for shoreline visitors and an oxygen sensor in armbands for swimmers. When submerged for too long, the water detector triggers an alert to the coast guards. The oxygen sensor detects low oxygen levels indicating drowning and activates a floating device while sending alerts. An underwater network with modems enables communication between sensors and monitoring units.

III. BLOCK DIAGRAM



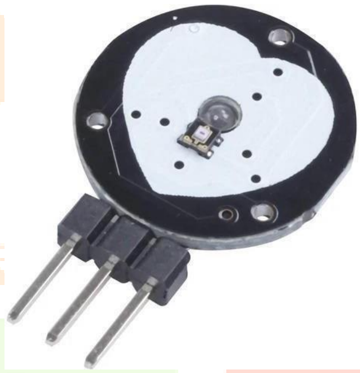
The block diagram of "Drowning Detection Device". Here the inputs of the system are Water sensor, Temperature sensor, Heart Rate sensor, Ultrasonic sensor. The outputs are Buzzer, Led and Mobile Interface (Blynk IOT). The working of the system is controlled by ESP8288 Microcontroller.

IV. METHODOLOGY

4.1 NodeMCU

The NodeMCU ESP8266 is a low-cost, Wi-Fi-enabled microcontroller used widely in IoT applications. It features a 32-bit Tensilica processor, built-in TCP/IP stack, and supports serial communication protocols like UART, SPI, and I2C. Its compact size, low power consumption, and programmability using the Arduino IDE make it ideal for real-time monitoring systems. The board includes multiple GPIO pins, an ADC, and USB interface for easy development. In this project, the NodeMCU is used to collect sensor data and transmit alerts via the Blynk IoT platform.

4.2 Heart Rate Sensor

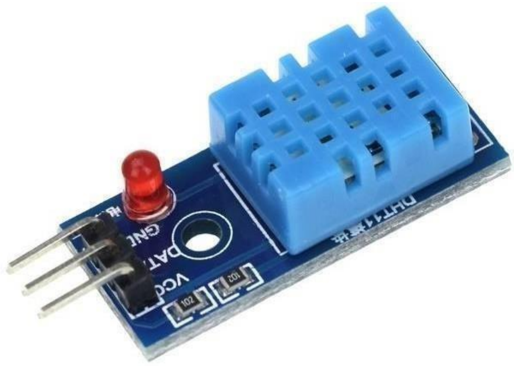


The heart rate sensor is a biometric device used to measure the pulse rate, typically in beats per minute (BPM). It operates based on photoplethysmography (PPG), using an LED and a photodetector to detect blood volume changes under the skin with each heartbeat. The sensor provides real-time physiological data, making it suitable for health monitoring and safety applications. In this project, it is used to continuously monitor the swimmer's pulse, enabling early detection of irregularities that may indicate a potential drowning event.

4.3 Waterproof Ultrasonic Sensor

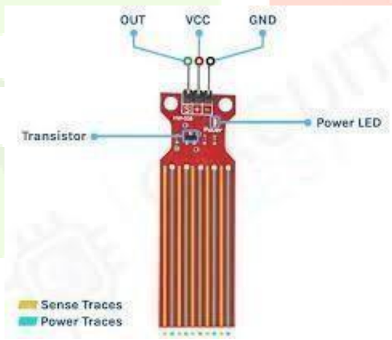
The waterproof ultrasonic sensor is a distance-measuring device that uses high-frequency sound waves to detect objects or movement in aquatic environments. It emits ultrasonic pulses and calculates the distance based on the time taken for the echo to return. Its waterproof design allows reliable operation in wet or submerged conditions, making it ideal for water-based safety systems. In this project, the sensor is used to monitor movement and positioning of individuals in water, aiding in the detection of potential drowning scenarios.

4.4 DHT 11(Humidity and Temperature Sensor)



The DHT11 sensor is a low-cost digital sensor used to measure temperature and humidity. It contains a thermistor and a capacitive humidity sensor, which provide accurate environmental readings with a digital output. The sensor communicates using a single-wire protocol, making it easy to interface with microcontrollers like the ESP8266. In this project, the DHT11 helps monitor ambient conditions around the swimmer, contributing to the overall analysis of drowning risk factors.

4.5 Water Sensor



The water sensor is a simple electronic device used to detect the presence or level of water in a given environment. It operates by measuring changes in conductivity when water bridges the sensor's conductive traces. This allows the sensor to identify submersion or water contact. In this project, the water sensor plays a crucial role in determining whether the individual is submerged, helping to trigger alerts in potential drowning situations.

V. RESULTS AND DISCUSSION

5.1 Working model of Drowning Detection Device

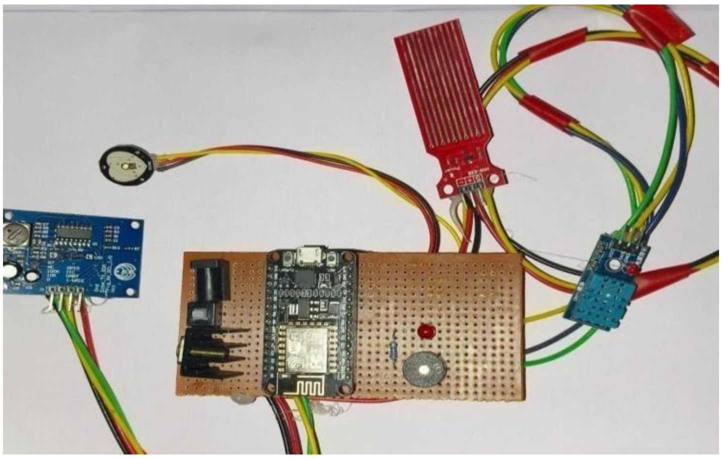


Figure shows the overall working model of the Drowning Detection Device System. Here in the above model all the pieces are connected without giving power supply.

5.2 Initial Display of Sensors

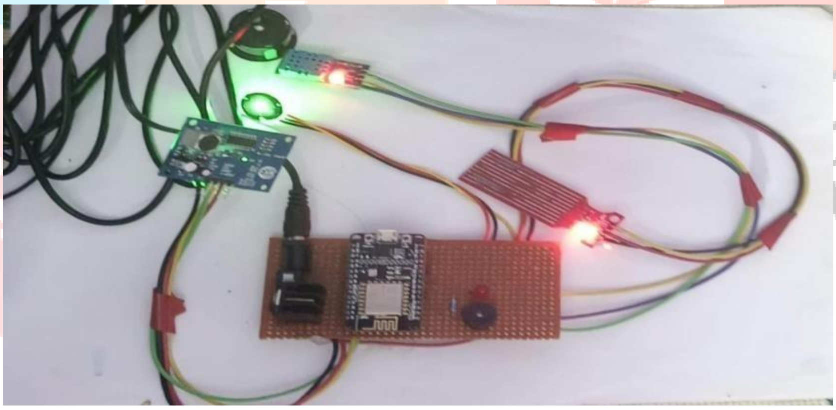


Figure shows the initial display of Sensors. The device measures sensors values. All the measures can be viewed through Blynk IOT platform.

5.3 Sensor outputs and notification through BLYNK IOT

Figure shows the Blynk IoT dashboard monitoring real-time data for a Smart Life Jacket. The dashboard displays three key parameters: Heartbeat, Temperature, and Distance, plotted over different time frames. A notification at the top alerts the user about shark detection, warning them to move away for safety. The live graphs indicate fluctuations in heartbeat, temperature, and distance, suggesting active sensor readings. This setup demonstrates how IoT technology can enhance water safety through real-time monitoring and instant alerts.

VI. FUTURE SCOPE

The smart life jacket integrated with Blynk IoT has vast potential for future enhancements and broader applications. In the future, the system can be improved by incorporating AI based predictive analysis to detect potential drowning incidents before they occur. Enhanced GPS tracking can provide real-time location updates to emergency responders, improving rescue operations. The addition of more advanced sensors, such as oxygen level monitors and motion detectors, can further enhance safety measures. Integration with satellite communication can allow operation in remote areas where cellular networks are unavailable. As IoT technology advances, this smart life jacket can become a standard safety gear for swimmers, sailors, and rescue teams worldwide, significantly reducing water-related fatalities.

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