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Alert System to Prevent Drowning using IoT- A Survey

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Abstract

Swimming is a popular sport as it is a pleasant recreational hobby. Aside from its physical benefits, it also relieves stress and gives a sense of peace. So, it is highly preferred by children's, adults, and sometimes even elderly people. Many countries have made swimming and other life skills compulsory activities in school to avoid fatalities in the event of disaster. While swimming has many advantages, safety precautions are paramount to avoid unintentional deaths. While various drowning prevention systems and technologies have been developed, many of them lack accuracy in detecting drowning incidents and fail to provide an effective rescue mechanism for swimmers in distress. To develop a smart anti-drowning and alert system, this study presents a comprehensive survey of existing drowning systems and suggests a proposed model in response to the identified gaps and challenges in current systems. The suggested framework includes Arduino microcontrollers, voice recognition technology, ultrasonic sensors, and alert generators. The proposed approach not only addresses the constraints of existing systems, but it also provides a cost-effective and scalable solution that can be used in a variety of water environments, including pools and natural bodies of water. The suggested system has the potential to reduce reaction times in emergency circumstances, adding to the overall enhancement of water safety. Future research could focus on practical implementation, testing, and improvement of the proposed model to improve its usefulness in reducing drowning accidents.

Keywords: Drowning Prevention, IoT System, Swimmer Safety, Detection Systems

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1. Introduction

Swimming is an excellent recreational physical activity for people of all ages. It gives a low-impact workout as well as a relaxing and refreshing experience. This can combine the health benefits of a vigorous workout with the excitement and thrill of competition. Swimming is an excellent workout because it causes the entire body to move against the resistance of the water. It offers many benefits, like reducing stress and improving body flexibility, and also serves as a therapy for many injuries and conditions.

As swimming is seen as a recreational activity in many countries, some countries prioritize it as one of the important life skills that have to be compulsorily known to avoid fatalities in the event of disaster. Though swimming has many benefits, there are safety measures to be taken while swimming. Failing to take the precautionary actions that are suggested in public pools or any other aquatic environment results in mishaps such as drowning deaths. To avoid such fatalities, the survey aims to present a comprehensive study and a suggested model integrating the internet of things to avoid drowning deaths..

The study presents a comprehensive survey of the existing drowning alert system and suggests a model integrating Arduino microcontrollers, voice recognition technology, ultrasonic sensors, and alert generators as a response to the challenges and the research gap that were identified in the existing system.

The Arduino platform serves as the central processing unit, coordinating real-time data from ultrasonic sensors strategically positioned throughout aquatic environments. The device uses voice recognition technology to distinguish between normal water noises and distress signals, resulting in accurate identification of probable drowning situations.

In addition, an alert generator is built in to warn necessary authorities and anyone nearby when a potential drowning situation is detected, and the IoT technology allows for the seamless integration of devices and systems, creating an interconnected network that can enhance real-time monitoring and response capabilities.

This innovative solution not only addresses existing system limitations but also presents a cost-effective and scalable approach applicable to diverse water environments, from pools to natural bodies of water.

The suggested system aims to significantly reduce response times in emergency situations, providing a marked improvement in overall water safety. Future efforts may

concentrate on the practical implementation, rigorous testing, and refinement of the suggested model to further enhance its effectiveness in preventing and mitigating drowning incidents.

2. Related Study

Post-mortem diagnosis of drowning is vital for forensic investigations and public health. This study explores the effectiveness of 2.5D deep learning in interpreting post-mortem computed tomography (PMCT) images, showing superior sensitivity, specificity, and overall accuracy compared to manual methods. The findings enhance forensic pathology, offering a reliable approach to improve drowning diagnosis, potentially influencing public safety measures. [1].

As water-related accidents, notably drownings, are a global concern, necessitating advanced safety measures. Traditional methods rely on human vigilance, leading to errors and delays. The Bathing Accident Monitoring System (BAMS) addresses this gap by utilizing depth sensors to continuously assess water surface depth, detecting irregularities through real-time analysis. Preliminary testing validates its capabilities, showcasing BAMS as a technologically advanced solution for enhanced water safety in public swimming areas. This system holds promise in improving surveillance and response mechanisms, ultimately minimizing the impact of water-related incidents and bolstering public safety in recreational aquatic environments. [2].

The global mental health crises, particularly depression and anxiety, impact diverse demographics. This study employs personal journaling, machine learning, and thematic analysis to explore individual experiences. The findings aim to enhance understanding, informing targeted interventions that foster resilience and support those facing mental health challenges, ultimately improving well-being and quality of life. [6].

As drowning is a global concern, necessitating swift responses to prevent fatalities. This paper introduces an innovative Drowning Alert System, merging RF communication and GPRS/GSM technology for enhanced water safety. As millions engage in water-based activities, the subsequent sections explore the technical details, including sensor networks and communication integration, showcasing the system's potential impact. [10].

This paper addresses the critical public safety concern of drowning incidents by introducing an Anti-Drowning System. Utilizing wearable sensors, the system monitors swimmers and swiftly detects potential emergencies, triggering remote alerts to authorities.

This proactive technology aims to reduce response times, minimize casualties, and enhance safety in diverse aquatic environments, with further technical insights explored in subsequent sections. [4].

This paper introduces the Smart Wearable Anti-Drowning System, utilizing wearable sensors and real-time data analysis to monitor swimmers' movements and vital signs. The system employs wireless communication for swift detection of potential drowning incidents, offering a proactive solution across diverse aquatic settings. Technical aspects, including the sensor network, data analysis, wireless communication, and wearable technology integration, will be explored in subsequent sections. The Smart Wearable Anti-Drowning System represents a promising advancement in water safety, aiming to protect swimmers and prevent drowning incidents in various aquatic environments. [3].

This paper addresses the global concern of drowning with an innovative Internet of Things (IoT)-based anti-drowning device. Utilizing a sensor network, data analytics, and real-time communication, the system monitors swimmers, swiftly detecting potential drowning incidents and sending alerts to lifeguards and rescue teams. This multi-layered approach enhances water safety in diverse aquatic settings. The subsequent sections delve into the device's technical aspects, including the sensor network, data analytics, real-time communication, and IoT integration. This technology marks a significant advancement in drowning prevention, showcasing the potential of IoT to save lives and emphasizing the importance of innovation in aquatic safety. [5].

This paper introduces an Anti-Sinking system for marine safety, addressing the inherent risks in boating and maritime activities. Integrating alert mechanisms and GPS-based tracking, the system utilizes sensors to monitor watercraft conditions, detecting water ingress and triggering immediate alerts to authorities. GPS coordinates are relayed for swift response in emergencies, offering a proactive approach to enhancing safety in marine environments. Technical aspects, such as the sensor network, alert mechanisms, and GPS-based tracking, are explored in subsequent sections. This technology underscores the significance of innovation in preventing and mitigating vessel sinking incidents, potentially saving lives and advancing maritime safety. [9].

The table. 1 below presents the findings of the study.

Table 1. Comparative Table

Ref. No	Publication & Year	Methodology	Merits	Demerits
[1]	2023	2.5D method that converts 3D data into 2D images to train 2D deep learning models for drowning diagnosis.	Improved Accuracy, Rapid Diagnosis	Lack of close supervision
[2]	2022	Automatic detection rate of the drowning state was at the applicable level.	Real-Time Monitoring, Early Detection, Reduced Human Error	Technical Challenges, False Alarms
[3]	2022	Rescues the swimmer experiencing drowning and alerts the necessary authorities	Enhanced Safety, Continuous Monitoring	Privacy Concerns, Cost
[5]	2022	Created a wristband transmitter strap and lifeguard alert modules with a pulse reader	Real-Time Monitoring, Early Detection	Technical Challenges, Dependence on Technology
[6]	2022	To deliver interventions for health and wellness	Improved Mental Health Interventions	Technological Challenges

[10]	2021	Monitoring systems using LASER and LDR	Location Information, Data Transmission	Cost
[7]	2020	Predict movement of children near the pool in the absence of adults.	Child Safety, Early Detection	Network Connectivity
[8]	2021	Monitor the heart rate	Reduced Drowning Incidents, Location Information	Technical Failures
[12]	2023	Control system for vehicles falling into water requires careful consideration of suitable control mechanisms.	Enhanced Safety, Automation	Cost, Training Requirements

3. Existing System

Anti-drowning existing systems encompass a range of technologies, approaches, and safety measures designed to prevent or mitigate drowning incidents. These systems can be implemented in various aquatic environments to enhance water safety. Some existing traditional anti-drowning systems include:

Lifeguards: Trained lifeguards play a critical role in preventing drowning incidents by monitoring swimmers, providing assistance when needed, and initiating rescue operations in emergencies.

Pool Safety Equipment: Swimming pools are often equipped with safety measures such as lifebuoys, reach poles, and ring buoys to aid in rescues and assist struggling swimmers.

Swimming Lessons: Formal swimming lessons and water safety education can help individuals, especially children, develop essential swimming skills and water safety knowledge.

Public Awareness Campaigns: Public awareness campaigns provide information about water safety and the importance of supervision and responsible behavior in and around water.

3.1 Disadvantages

Existing drowning alert systems have various drawbacks that limit their efficiency. One notable disadvantage is a lack of close supervision, which can result in monitoring gaps that cause delayed responses in critical situations. Another issue is that technical challenges, such as false alarms, may desensitize response teams, resulting in inefficient resource use. Privacy problems and associated expenses are frequently identified as downsides, limiting the widespread implementation of some alert solutions. Dependence on technology brings weaknesses, such as technical failures, network connectivity challenges, and associated expenditures, which reduce the reliability of these systems. Furthermore, the significant cost and training required to develop and operate these systems provide additional impediments to their broad and efficient adoption. To address these challenges and overcome the research gaps the study suggests a smart drowning alert system that uses the capability of the IoT , sensors and the micro controllers.

4. Proposed System

The proposed drowning prevention framework incorporates a cost-effective and lightweight IoT node designed to consistently identify a person's voice. This IoT-based alert system can recognize the drowning person's voice and emit an alert sound for nearby individuals. The system comprises three interconnected layers: voice recognition, dissemination of alerts and messages about the victim, and communication with nearby people. These layers serve distinct functions and are wirelessly connected to enable efficient monitoring of drowning victims. The alert device is designed for universal communication, featuring ultra-low power consumption, compact size, easy maintenance, and environmental friendliness. The Figure. 1 shows the overall flowchart of the proposed method. and the figure .2 shows the block diagram of the proposed.

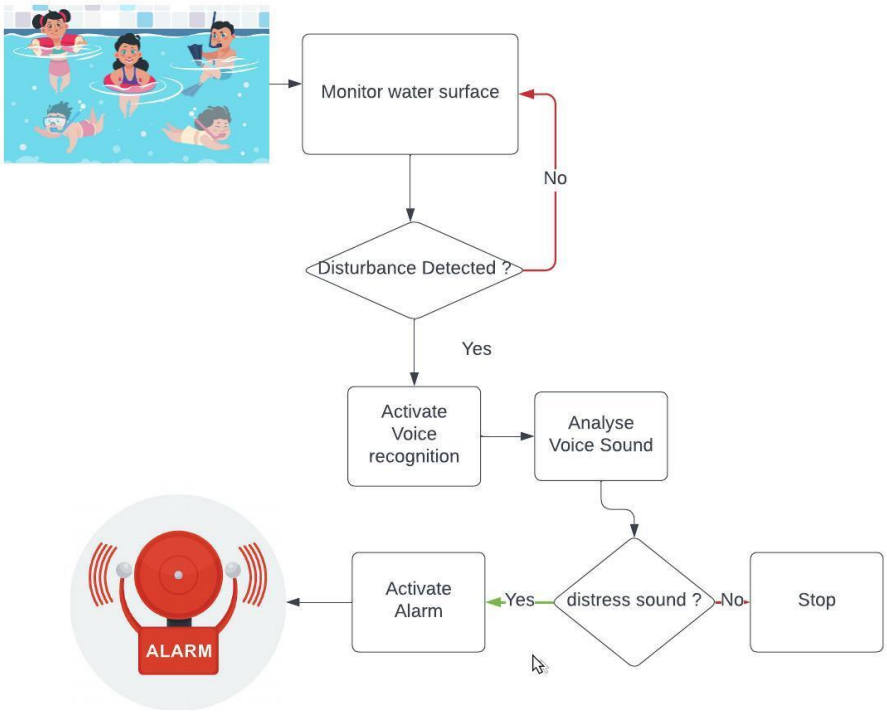


Figure 1. Proposed Flowchart

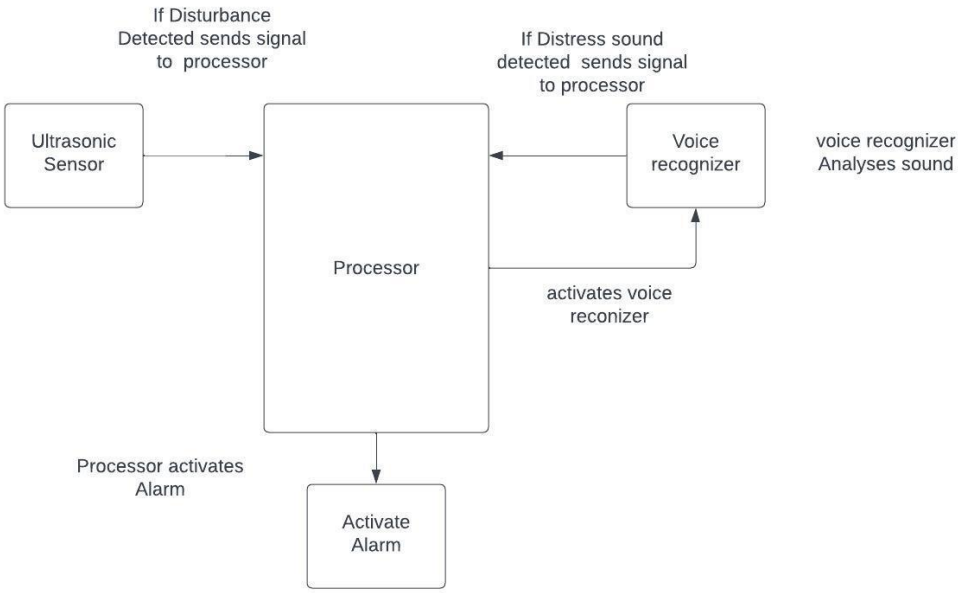
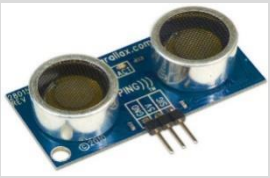


Figure 2. Proposed Block Diagram

The Table .2 below shows the technical specifications of the proposed work.

Table 2. Technical Specification

Components Used	Images	Purpose	Specification
Ultrasonic Sensor		Detects the disturbance in the water surface	HC-SR04 Frequency: 40KHz
Voice recognizer sensor		Analyses the voice and differentiates the distress sound from normal	Voice recognition module V3 Compatible with Arduino Recognition Accuracy: 99%
Processor		Process the signal received and activates the required components	ATmega328P

4.1 Advantages

The suggested drowning prevention system has various advantages, including real-time monitoring, which allows for fast response in critical situations. Automated alerts improve the system's efficiency by providing timely notifications to relevant authorities and individuals. A important element is the elimination of false alarms, which reduces the possibility of unwarranted fear and resource misallocation. By merging these features, the system helps to achieve the ultimate goal of minimizing drowning incidents while also delivering a proactive and technologically advanced water safety solution. With real-time monitoring, automated alerts, and a mechanism to eliminate false alarms, the proposed system provides a strong foundation for addressing and mitigating the hazards associated with drowning accidents.

4.2 Future Work

The future work will concentrate on the prototype development, implementation and evaluation of the proposed model based on its usability.

5. Conclusion

Implementing an IoT-based alert system for drowning prevention is crucial for enhancing water safety. By seamlessly integrating sensors, real-time data analysis, and swift communication channels, this system provides a proactive approach to identify potential drowning incidents. The ability to promptly alert lifeguards or emergency services significantly reduces response time, saving lives and fostering a safer aquatic environment.

The proposed study presents a short review on the different methods used as alert system for drowning and suggests a proposed methods using sensors and IoT overcoming the challenges faced in the proposed. The prototype development, implementation and the evaluation will be carried out in the future work.

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