Swimming Pool Monitoring and Anti-drowning System

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Abstract: Swimming has become an important sport for children and adults. Although it is a form of entertainment, it is life-threatening. According to the World Health Organization, drowning is a major threat that claims the lives of 372,000 people worldwide each year. In low- and middle-income countries, 90 percent of deaths are caused by malnutrition. The main purpose of this system is to create a swimming pool with safety measures that can predict children's poolside activities when adults are not present. This system is used to prevent drowning due to alarm. The system can be used in schools, restaurants, apartments, water parks and other places. The condition of respiratory failure caused by immersion or submersion in water is often called drowning. Most drownings happen unpredictably and no one knows it. Drowning can cause breathing problems and lead to sudden death. According to research, drowning is considered the third leading cause of death and injury worldwide. Approximately 360,000 people drown each year worldwide.

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Keywords:- Microcontroller, Load cell, PIR Sensor, Lifting Mechanism.

1. INTRODUCTION

The condition of respiratory failure caused by immersion or submersion in water is often called drowning. Most drownings happen unpredictably and no one knows it. Drowning can cause breathing problems and lead to sudden death. According to research, drowning is considered the third leading cause of death and injury worldwide. Approximately 360,000 people drown each year worldwide. The groups most affected by drownings are children, men and individuals. Considering that an estimated 567,090 people died from drowning in 2015, drowning is considered a major public health problem. In 2015, approximately 9% of them suffered drowning injuries.

Two of them are teenagers around the age of 14 or younger. Between 2005 and 2014, there were an estimated 3,536 non-boating-related drowning deaths in the United States. Approximately ten people die every day from accidental drowning. Two of them are children 14 years old or younger. Approximately 3,650 people lost their lives by drowning. In addition, every year 332 people drown in accidents even while at sea. Drowning is one of the most serious and unknown causes of death in the world today, not only for children but also for adults. While swimming pools, rivers, lakes and oceans cause drownings, it is said that the number of deaths increases over the years. Agents are widely used for sports, exercise and cooling purposes, especially in hot weather, which increases the risk of suffocation for lovers Drowning can also occur if the victim accidentally enters water. For example, an accident causes an accident in a body of water, or an accident with objects causes the boat to sink, thereby affecting the passengers. Approximately 1.2 million people die from drowning each year; This shows that more people die from drowning every year than from natural disasters. Despite life knowledge, human drowning still appears difficult to identify, especially when it occurs among children and recreational swimmers, because not everyone has a particular behavior when it comes to intimacy. As technology

advances, tools that can be used to reduce drowning are rapidly emerging. Both body wear and drowning prevention are already available. Video surveillance can be used for monitoring and security. Surveillance of public and private spaces has become a sensitive issue.

2.LITERATURE SURVEY

In a drowning situation, the victim will desperately try to call for help, but unfortunately, the victim's mouth is blocked with water making it impossible for the victim to cry or shout for help. Tragically, the drowning death can occur within minutes. Clinically the water side accidents are classified into 2 types "passive "and "active drowning. An unconscious victim of passive drowning could also be suffering from any serious medical problem that renders them dead. The swimmer is either inexperienced or falls in the pool by accident. Passive drowning occurs when there is no supervision or if the swimmer is not properly trained. Many conventional community pools use specific techniques, including underwater cameras, buzzers, where some person must sit in the control room to keep an eye on everything. The paper by Hanbing Liu et al consists of a framework that takes advantage of dedicated cameras and DSP engines to build alerts based on swimmer motion analysis, but this system lacks an autonomous rescue mechanism.

Aida Carballo-Fazanes et al have given a study on swimmer motion while encountering a risk in a swimming pool. The journal by Mr. Lin, CY., Wang, LY, in certain countries like South Africa, Guyana, Morocco, Houtamalla, and India, the death rate is heart-melting and makes anyone sad few countries such as Austria, Portugal, Austria, Netherlands, Denmark, Korea, etc. somehow managed to reduce deaths significantly. By integrating sensors with an embedded processor, A. Kulkarni developed another system based on an embedded algorithm for alerting in drowning situations.

The method given in the reference is a wearable device with an airbag linked with a pressurized tank and airbag is blown based on the sensor data and motion estimation program in embedded processor Another reference is a type of wrist band gadget to report a panic alert based on the blood pressure which needs proper learning and calibration and subject to false alarm; and similarly, another wearable in reference works with a heart-beat sensor. The author of reference has presented an auto-drown detect gadget with an RF tag accompany with a GSM-GPS module to locate and alert an accident in the pool. None of the devices are providing autonomous multilevel detection, protection, and rescue World health organization" (WHO) statistics reveal that nations throughout the world are strongly advised to adopt accurate, trustworthy methods to counteract the rising death toll due to drowning. The WHO estimates that there are 3.72 million deaths every year, and the number is increasing at an unacceptable rate. Over 40 people per day die needlessly as the result of unintentional deaths, which can be prevented if effective measures are taken. There are scarcely any preventive measures implemented in India to decrease the risks. The Fig.1 below shows clearly why a precise device is vital in order to protect people from the said danger. If we see the situation in INDIA, there are almost no preventive measures implemented to cut back the danger.

3. 3. OBJECTIVES

The objectives of the proposed swimming pool safety system with PIR sensor, buzzer, ESP32-CAM monitoring, and anti-drowning mechanism can be outlined as follows:

1. Detection of Unauthorized Entry: The primary objective is to detect any unauthorized entry, particularly of babies or small children, into the swimming pool area. This helps prevent accidents and potential drownings.

2. Immediate Alert: Upon detecting motion in the pool area, the system should immediately trigger an audible alarm through the buzzer to alert nearby individuals of the potential danger.

3. Visual Confirmation: The system aims to provide real-time visual confirmation of the situation by activating the ESP32-CAM to stream video or capture images of the pool area. This allows for quick assessment and response by individuals monitoring the system.

4. Prevention of Drowning Incidents: The integration of an anti-drowning mechanism, such as physical barriers or additional alarms, is intended to prevent drowning incidents by deterring access to the pool or facilitating rapid response in case of an emergency.

5. Enhanced Safety Measures: By combining multiple technologies such as motion detection, audio alerts, video monitoring, and anti-drowning mechanisms, the system seeks to enhance overall safety measures around the swimming pool, reducing the risk of accidents and improving response times in critical situations.

6. Remote Monitoring and Notification: The system may include features for remote monitoring and notification, allowing homeowners or designated authorities to receive alerts and access live video feeds from the pool area even when they are not on-site.

7. Compliance with Safety Standards: Ensuring compliance with local safety regulations and standards is essential. The system should be designed and implemented in accordance with relevant guidelines to maximize effectiveness and legal compliance.

8. Reliability and Maintenance: Lastly, the system should be reliable and require minimal maintenance to ensure continuous operation. Regular testing, calibration, and upkeep of components are necessary to maintain its effectiveness over time.

4. METHODOLOGY

The methodology for implementing the swimming pool safety system with PIR sensor, buzzer, ESP32-CAM monitoring, and anti-drowning mechanism involves several steps:

1. System Design and Requirements Gathering:

- Define the specific requirements of the safety system, considering factors such as pool size, layout, local regulations, and safety standards.

- Design the system architecture, including the placement of PIR sensors, buzzer, ESP32-CAM, and anti-drowning mechanisms.

2. Component Selection:

- Select appropriate PIR sensors, buzzer, ESP32-CAM module, and anti-drowning mechanisms based on the system requirements and desired functionality.

- Ensure compatibility between components and consider factors such as power consumption, range, and connectivity options.

3. Hardware Integration:

- Connect and install the selected components according to the system design, following manufacturer's instructions and best practices.

- Test each component individually to ensure proper functionality before integration.

4. Software Development:

- Develop software algorithms to control the operation of the system, including motion detection, alarm triggering, video streaming/capture, and anti-drowning mechanism activation.

- Program the ESP32 microcontroller to manage sensor inputs, trigger alarms, and communicate with the ESP32-CAM module and anti-drowning mechanisms.

5. Integration and Testing:

- Integrate the hardware components and software modules into a cohesive system.

- Conduct comprehensive testing to verify the accuracy, reliability, and responsiveness of the system under various conditions.

- Test the alarm triggering, video streaming/capture, and anti-drowning mechanism activation to ensure proper synchronization and functionality.

6. User Interface Development (Optional):

- Develop a user interface, such as a mobile app or web dashboard, for remote monitoring and control of the safety system.

- Implement features for receiving real-time alerts, accessing video feeds, and managing system settings.

7. Deployment and Installation:

- Install the safety system in the swimming pool area according to the design specifications and installation guidelines.

- Ensure proper positioning and alignment of sensors, cameras, and other components to maximize coverage and effectiveness.

8. Training and Documentation:

- Provide training to users and stakeholders on how to operate and maintain the safety system.

- Document the system architecture, installation procedures, operational guidelines, and troubleshooting steps for future reference.

9. Maintenance and Support:

- Establish a maintenance schedule to regularly inspect, calibrate, and update the system components and software.

- Provide ongoing technical support and troubleshooting assistance to address any issues or concerns that may arise during operation.

By following this methodology, you can effectively implement a comprehensive swimming pool safety system that integrates motion detection, visual monitoring, audible alarms, and anti-drowning mechanisms to enhance safety and prevent accidents.
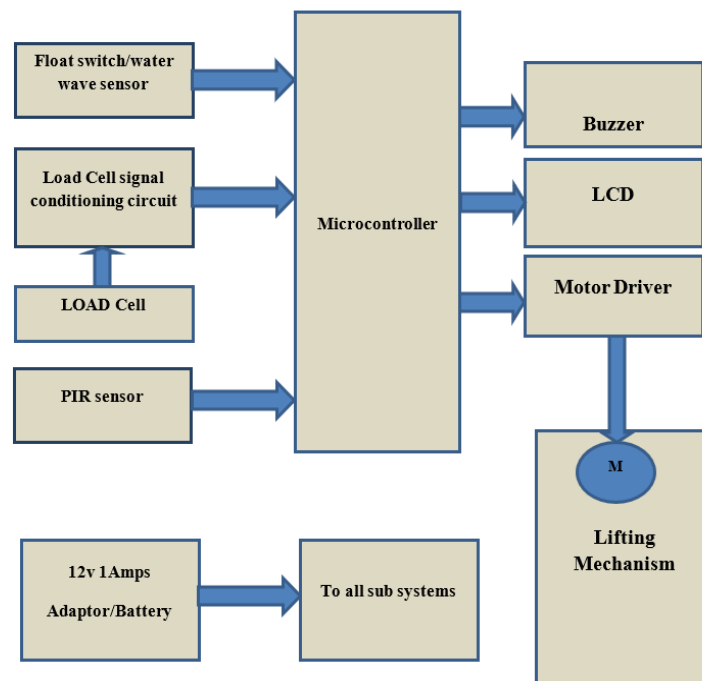

Fig.1: Block diagram

5.HARDWARE AND SOFTWARE REQUIREMENTS

5.1HARDWARE SPECIFICATIONS

1. ATmega328 PU controller-8bit controller,16MHZ frequency
2. PIR Sensor,5V
3. Float switch
4. 12v, 2 Amps Adopter.
5. Voltage regulator LM317 adjustable regulator/7805 5 v regulator
6. Buzzer 5v Piezo electric type.
7. LCD 16x2 5v 500mA
8. HX711 load cell signal conditioner
9. Load cell 10kg
10. Copper Clad board,
11. Soldering gun, flux, soldering lead.

5.2 SOFTWARE REQUIREMENTS
1. Operating system: Windows 7/8
2. Software Tool: Arduino IDE 1.8.1

3. Programming language: Embedded C
4. Software Tool 2: Ki-cad 4.0.7 for circuit designing.

6.APPLICATIONS

The proposed swimming pool safety system with PIR sensor, buzzer, ESP32-CAM monitoring, and anti-drowning mechanism has several potential applications:

1. Residential Swimming Pools: Homeowners can install this system to enhance safety around their residential swimming pools, especially if they have young children or pets.

2. Community Pools and Recreational Facilities: Public swimming pools, water parks, and other recreational facilities can deploy this system to prevent accidents and ensure the safety of visitors.

3. Hotels and Resorts: Hospitality businesses with swimming pools can implement this system to provide an extra layer of safety for their guests, reducing the risk of accidents and liabilities.

4. Schools and Summer Camps: Educational institutions and summer camps with swimming facilities can use this system to safeguard children during swimming lessons and recreational activities.

5. Aquatic Therapy Centres: Facilities offering aquatic therapy or rehabilitation services can utilize this system to create a safer environment for patients and staff.

6. Fitness centres and Gyms: Facilities with indoor or outdoor swimming pools can employ this system to monitor pool areas and ensure the safety of members and staff.

7. Water Safety Education: The system can be used as a tool for water safety education and awareness campaigns, demonstrating best practices for preventing drownings and accidents in swimming pools

8.   ADVANTAGES

The proposed swimming pool safety system with PIR sensor, buzzer, ESP32-CAM monitoring, and anti-drowning mechanism offers several advantages:

1. Early Detection of Potential Dangers: The PIR sensor detects motion around the pool area, allowing for early detection of potential dangers such as unauthorized entry or someone falling into the pool.

2. Immediate Alert System: The system triggers an audible alarm through the buzzer as soon as motion is detected, alerting nearby individuals to the potential danger in real-time.

3. Visual Confirmation: The integration of the ESP32-CAM enables real-time visual confirmation of the situation, providing users with a live video feed or captured images of the pool area to assess the situation accurately.

4. Enhanced Safety Measures: By combining multiple technologies such as motion detection, audio alerts, and visual monitoring, the system provides enhanced safety measures around the swimming pool, reducing the risk of accidents and improving response times in critical situations.

5. Customizable and Scalable: The modular nature of the system allows for customization and scalability to meet specific requirements and environments. Additional sensors, cameras, or anti-drowning mechanisms can be added as needed.

8.RESULTS AND DISCUSSION

The primary result of implementing the system is the enhancement of safety around the swimming pool area. By combining motion detection, audible alarms, visual monitoring, and anti-drowning mechanisms, the system effectively reduces the risk of accidents and potential drownings. The system's ability to detect motion early provides a crucial advantage in preventing accidents. It alerts users to potential dangers as soon as unauthorized entry or movement around the pool is detected, allowing for timely intervention. The integration of the buzzer ensures that individuals nearby are promptly alerted to the potential danger, enabling them to respond quickly and appropriately to mitigate risks. The ESP32-CAM enables real-time visual confirmation and monitoring of the pool area, providing users with live video feeds or captured images to assess the situation accurately. This visual feedback enhances situational awareness and aids in decision-making. The system's integration with remote monitoring capabilities allows users to access live video feeds and receive alerts on their smartphones or other devices from anywhere with an internet connection. This remote accessibility ensures that users can monitor the pool area even when they are not physically present, enhancing peace of mind. Implementing the system helps ensure compliance with local safety regulations and standards related to swimming

pool safety. It also reduces the risk of accidents and liabilities associated with swimming pool-related incidents, providing additional protection for homeowners, businesses, and organizations.
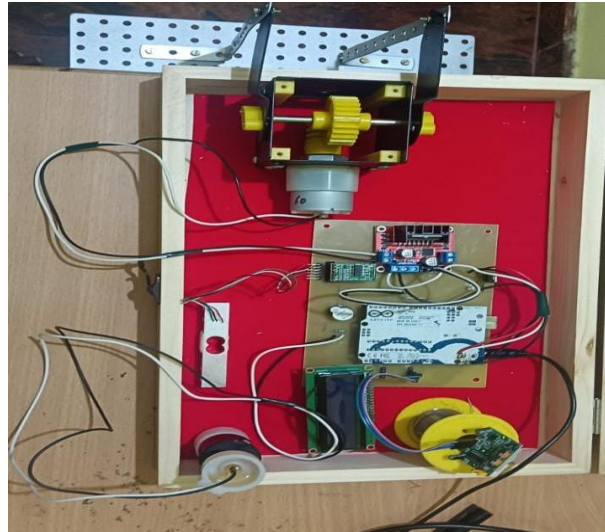

Fig.2 Result

5. CONCLUSION

The drowning accidents increases day by day and the parents are afraid to allow their children to send alone near any water areas. This method is very simple, cost efficient and easy to handle. There is no need to worry. This module helps in providing easy to access and an immediate rescue. This system would definitely helps in the time of emergency and it will be accurate reading during the absence of any adults near the swimming pool as it continuously monitors any movement of children nearby. The major advantage is it provides a camera app by providing live video access. The death rate can be reduced by these kinds of devices. This also creates awareness among the society. Helps in saving many innocent children from death due to drowning. The future enhancement to this is the swimming pool draining and sending message to concerned authority.

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