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Mechanized Suffocating Location and Security inpool with IoT Server

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Abstract: The existing system is based on video surveillance using HSV color space analysis, An innovative technology has been developed to identify an individual in distress at a pool and trigger an alert for the lifeguard in case the individual cannot be located within the pool. The drawback of this existing system is that video surveillance may not be able to detect all instances of drowning, if the person is not fully submerged or the water is muddy. The proposed system consists of three main sensors, such as a temperature, heart rate and a respiratory rate sensor, which are used to detect the body conditions of the swimmer. If the swimmer's body condition exceeds the preset ranges, the buzzer sends an alert to the lifeguard for rescue. An IOT server is used to store the data of the swimmer. The experimental results shows that the proposed system improved in terms of accuracy and speed compared to existing setup.

Keywords: Anti-drowning, Arduino kits, Internet of things, Lifeguard alert ,Transmitter strap.

I. INTRODUCTION

Drowning is one of the leading causes of death for both children and adults worldwide. Swimming pools are popular recreational areas, but there is a considerable risk of drowning there as well, especially for young childrenwho may not yet be able to swim which leads to more number of deaths as shown Fig .1. To reduce drowning incidents, effective safety measures must be implemented, such as constant pool area surveillance. Here, one method to raise swimming pool safety is the incorporation of IoT technology with quantifiable sensors. An IoT server can gather and interpret data from a variety of sensors positioned around the swimming pool, including temperature sensors, respiration sensors, heart rate sensors, and buzzers used to alert lifeguards and other employees in the event of a potential drowning risk. The range of the temperature sensor will be set between 36°Cand 40°C, The respiratory sensor will detect breathing rates ranging from 12 to 16 breaths per minute, while the heartbeat sensor will monitor heart rates within the range of 60 to 100 beats per minute. In addition to constant surveillance, an IoT server can offer helpful information on pool usage trends. This information can be utilized to improve pool security and maintenance procedures. Overall, the use of IoT technology in conjunction with swimming pool SSsurveillance systems has the ability to significantly lower the number of drowning incidents and raise safety standards in these situations.

In the past, many of the systems attempted to provide a solution to this problem, such as by monitoring the swimmer's movements using surveillance cameras and also by displaying the values of heart rate, respiratory rate, and temperature by detecting the body condition of the swimmer using various methods.

The system employs a camera to watch the pool and transmits notifications to a distant server. The method was evaluated by the authors in a genuine swimming pool setting, and they showed that it worked well [1]. Smart Pool, a drowning detection and prevention system that keeps track on swimming pool activities using a variety of sensors. The system, which is based on IOT technology,can notify lifeguards or other staff when itdetects a potential drowning event.

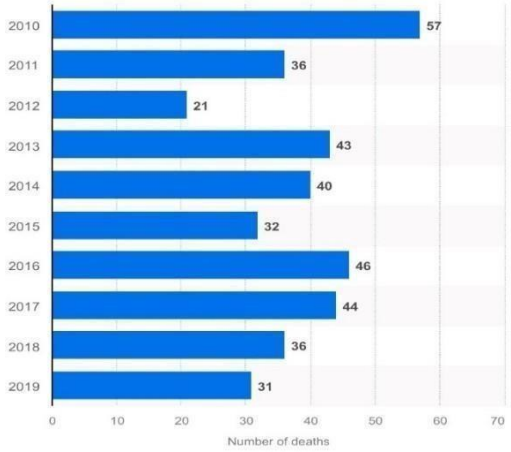

Figure 1 - Number of deaths every year

An IoT-based drowning detection systemfor public swimming pools uses a combinationof sensors, including underwater cameras and pressure sensors, to monitor pool activity and can send alerts to a remote server if a potential drowning event is detected [3]. A drowning detection system that uses deep learning and IOT technology to monitor swimming pool activity uses a combination of cameras and sensors to detect potential drowning events and can send alerts to a remote server [4].

An IoT-based drowning detection and prevention system for swimming pools uses a combination of sensors, including cameras and pressure sensors, to monitor pool activity and can send alerts to a remote server if a potential drowning event is detected [5]. An IoT-based and computer vision-based real-time drowning detection system for swimming pools uses cameras to monitor pool activity and can send alerts to a remote server if a potential drowning event is detected [6]. An intelligent drowning detection and rescue system for swimming pools that uses IoT technology consists of combination of sensors, including cameras and motion sensors, to monitor pool activity send alerts to a remote server if a potential drowning vision-based real-time drowning detection and alert system for swimming pools uses cameras and sensors to monitor pool activity and can send alerts to a remote server if a potential drowning event is detected and in addition to it also triggers an alarm at the pool site to alert nearby individuals [8]. The system can detect potential drowning events based on changes in water pressure and sends alerts to a remote server and an automatic rescue system that can be developed and activated in the event of a drowning incident and it was tested in a real- world swimming pool environment, and the results demonstrate its effectiveness in detecting potential drowning incidents and preventing accidents and to enhance pool safety and reduce the risk of drowning incidents [9].

A deep learning-based video processing system for a drowning detection system suggested approach extracts information from video frames and categories them as drowning or non-drowning frames using convolutional neural networks (CNNs) suggested system was highly accurate in identifying drowning instances [10]. In the above-mentioned related work, the use of video surveillance to detect drowning individuals may result in false alarms,which can cause unnecessary disruption and inconvenience to swimmers and lifeguards; the system may not be able to detect all instances of drowning, particularly if the person is not fully submerged or if the water is dark and muddy; the use of video surveillance raises privacy concerns for swimmers who may feel uncomfortable being constantly monitored while they swim; the installation and maintenance of video surveillance systems can be expensive, which may be a barrier to adoption for some swimming pool owners. However, the proposed system will constantly detect all the body conditions of the swimmer, store the values in an IoT server, and alert the lifeguard for rescue if the swimmer reaches an abnormal condition.

II. PROPOSED METHOD

The proposed system is mainly based on generating an alarm sound when an abnormal condition occurs for a swimmer. Fig.2 illustrates the system consists of a heart rate sensor, Temperature sensor, respiratory rate sensor, battery, push button, Arduino Pro Mini, buzzer, shock, GPS tracker, temperature sensor, etc. are the primary hardware elements used for the device system, which all comes under the transmitter section.

The Temperature sensor detects the body temperature of a swimmer. Here, the range is fixed from 35°C to 40°C. The Respiratory sensor detects the abdominal contraction of a swimmer. Here, the range is fixed from 12 to 16 breaths per minute. The Heart-beat sensor detects the heart-beat of a swimmer. The range is fixed between 60 to 100 beats per minute. The LCD display is used to display the output values of sensors such as temperature, respiratory rate, and heart rate. The Buzzer is an audio signaling device used to generate an alarm-based sound when the sensor's value crosses the fixed range, which is used to alert the lifeguard rescuer.

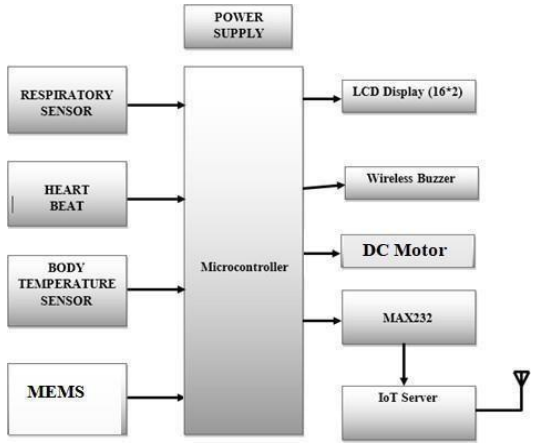

Figure 2-Block diagram of transmitter section

The ATMEGA 328 is a single-chip microcontroller will receive sensor input, process and display the output on the LCD display. The Accelerometer used here is MEMS (Micro Electro-Mechanical System) is to measure the movement of swimmer while swimming. The Arduino Serial Plotter is one of the features of the Arduino IDE that enables native real-time serial data graphing from the Arduino to the computer's monitor. A serial plotter is a tool that may be used offline to visualize data and debug computer code without using any third-party resources like processing. In order to visualize the data from the sensor or from the project, the serial plotter doesn't need to be connected to the Internet. The Serial plotter is therefore excellent at displaying data. A Node, MCU

The ESP 8266 Wi-Fi module has the ability to connect with various other devices using either a physical or wireless setup. The driving instructions are stored in this node. The module is powered by the supplied voltage from the battery connected to it.

The general variables are Height, Body Mass, RR intervals and ECG. The Height of the volunteers was measured using an anthropometer (level of resolution: 1mm) in centimeters. Body mass was measured using a digital weighing machine (level of resolution: 100 g) to the nearest kilogram. RR Intervals are the reciprocals of the heart- beat. They are recorded under the basal state. Electrocardiogram (ECG) are mostly used to capture the electrical signal from the heart to check for different heart conditions.

HRV-Heart Rate Variability. The RMSSD time-domain method is the most often used method for HRV analysis as shown in Fig. 3.

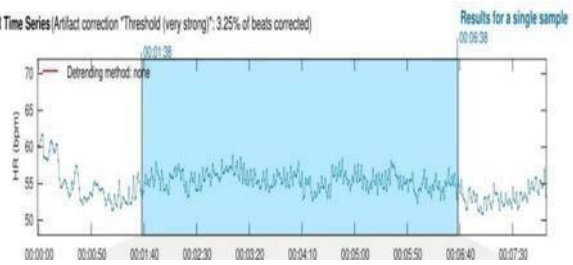

Figure 3-Time domainanalysis

Towards the design of an IoT-based anti- drowning device, the methodology adopted was the Agile system. Its core value includes:

- Team and individual discussions about procedures and resources;
- Using software over comprehensive records;
- Instead of contract negotiations, encourage consumer cooperation and
- Response to modifications in line withthe system's initial design strategy.

In the receiver section the IOT server used to display live values and stores them in cloud as shown in Fig. 4.

RECEIVER SECTION ---------IOT WEB SITE

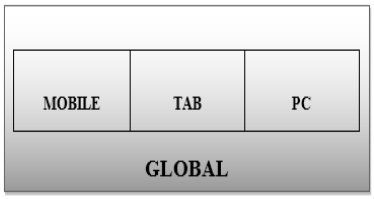

Figure 4-Block representation of IOT server

The Proteus circuit simulator was used to simulate the system's component connections and performance. The driving codes required were written and burned into the microcontroller. The Proteus software, on the other hand, is limited in that it lacks package or schematic support for the Node MCU that was originally utilized in the project implementation.

As a result, an Arduino UNO was used instead during the project simulation phase. The Arduino IDE displays key characteristicsof the embedded software. The packages and libraries required for simulating and sketching the schematic circuit were imported.

Fig.5 shows the schematic diagram of proposed system that illustrates the anti- drowning IoT device works on the differential heart rate pressure principle. The transmitter device, which is a watch-like wristband containing the pressure sensor for heart rate, is the first of the two key system elements. The second module, which includes an alarm and the display, delivers signals to the on-duty lifeguard during crises. Users in swimming pools are urged to use wristband watches. Individuals usually begin to panic before drowning, which causes changes in cardiac rate.

As a result, the individual's pulse rate increases. Before donning the bracelet, an individual swimmer's typical pulses are obtained and recorded. The band is programmed with low and high thresholds to detect a difference between outmatched heartbeat threshold values, suggesting dangerto a swimmer. The chip (Atmega328) on the Lily Pad Arduino microcontroller translates analogue pulse signals to discrete signals, anda 433 MHZ transmitter delivers the signal to a 433 MHZ receiver. The Arduino Uno microcontroller detects the signal, activates a buzzer, and displays an SOS message warningthat a swimmer is in danger and requires assistance from lifeguards.

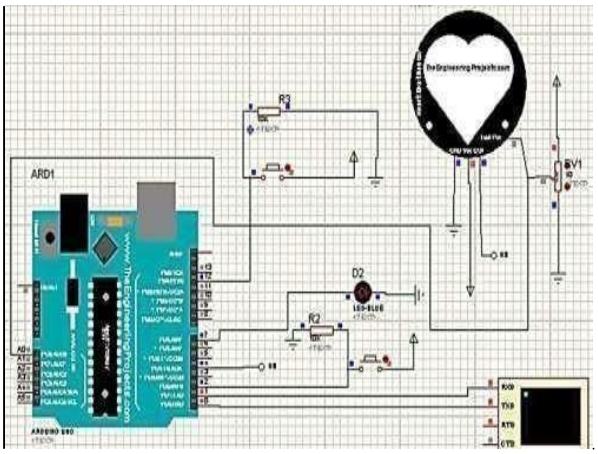

Figure 5-Schematic Diagram ofproposed system

III. RESULTS AND DISCUSSION

The hardware model of the proposed system consists of ATMEGA 328 microcontroller to control the sensors, buzzer, accelerometer, and IOT board as shown in Fig. 6. The heart- rate sensor consists of a transmitter and a receiver; a finger has to be placed between them for a few seconds. Now, a led light will start blinking, which indicates that an input value is passed to the microcontroller. The values will be displayed on the LCD display after one minute since they will be calculated in beats perminute. The beats per minute value should be from 60 to100.

Number of Persons	Number of Iteration	Temperature value	Heart Rate value	SPO2 value
Person 1	20	37.4	78	12
Person 2	20	35.1	86	15
Person 3	20	39.2	67	12
Person 4	20	35.5	72	11

Person 5	20	36.3	90	13
Average	**20**	**36.7**	**78.6**	**12.6**

Table 1-Threshold range of sensors

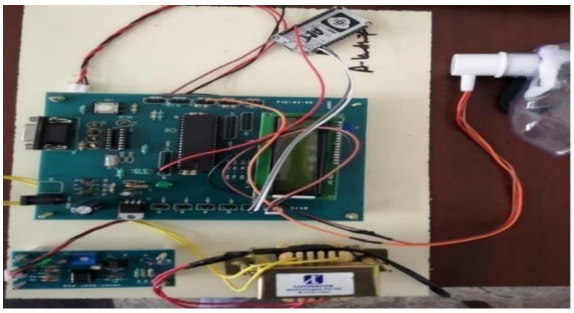

Figure-6 Proposed Hardware model

A buzzer is used to alert the lifeguard rescue team by producing an alarm sound if any of the sensors cross the given range. The respiratory sensor will measure the breathing rate by counting the number of times the abdomen rises in one minute. The respiratory rate will be measured in breaths per minute, and its value should lie between 12 and 16. An accelerometer (MEMS) is used to monitor the movements of a swimmer while swimming and displays the swimmer's action in a graph format using x, y, and z axes. The IOT server will display the heart rate, temperature, and respiratory rate values and also display the graph of the swimmer's movement.

S.no	Sensors	Threshold range
1.	Temperature	35 to 40 °C
2.	Respiratory rate	12 to 16 breaths per minute
3.	Heart rate	60 to 100 beats per minute

Table 2-Test analysis of mandatory values

When the value of this sensor records lesser than 60 beats per minute or greater than 16 beats per minute, it will produce an alert sound to the lifeguard rescue. The temperature sensor consists of three connecting wires, of which two are used to sense the body temperature and the other to display the input on the LCD display. The result analysis for drowning detection and security in swimming pools with an IoT server will depend on how well the system performs in these and other key metrics. By providing an accurate and timely response to potential drowning incidents, this technology has the potential to significantly enhance the safety of swimmers in pools and other aquatic facilities. The temperature value will be calculated in Celsius and its value should lie between 35 and 40. When the value of this sensor records lesser than 35°C or greater than 40 breaths per minute, it will produce an alert sound to the lifeguard rescue. If the reading of this sensor shows fewer than 12 breaths per minute or more than 16 breaths per minute., it will produce an alert sound to the lifeguard rescue as mentioned in Table 1.

IV. CONCLUSION

The implementation of an automated drowning detection in swimming pool offers several safety measures for the swimmers. This study concludes that the swimmer's basal HR is quite low when compared to the overall population. Swimmers' HRV (heart rate variability) scores differ from those of the general population. Although RR intervals are person-specific, there was a similar pattern (small quartile range) in the RR intervals of the swimmers in this experiment. Swimmers' HRV (heart rate variability) scores differ from those of the general population. The temperature can also vary the normal range, which may also lead to abnormal condition. A buzzer is used for producing an alert sound, if the swimmer body conditions cross any of the fixed sensor ranges which indicates that the swimmer is drowning. Thus, the lifeguard rescue will save the swimmer, And, the swimmers body conditions will be stored using IOT server by connecting the server with

an internet or wi- fi. An accelerometer is used to monitor the movements of the swimmer in a graph format by using the x-axis, y-axis and z-axis. Although RR intervals are person- specific, there was a similar pattern (small quartile range) in the RR intervals of the swimmers in this experiment. From this vantage point, the RR intervals of various sports groups may be delineated, which may be useful for future research. HR and HRV ratings provide a clear picture of aerobic capacity and cardiovascular efficiency, both of which are crucial in athletics. HRV and basal HR are valid indicators of health- related fitness components. More intensive study is required to understand the physical implication of HR and HRV in terms of physiological performance in swimming.

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