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Drowning Detection System

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Abstract: ***Drowning is the third leading unintentionally injury death in the world, accounting for 7% of all injury-related deaths. There are estimated 360, 000 annual drowning worldwide. Individuals with increased access to water are most at risk of drowning. In this study the researchers have come up with a wearable device that can help with the prevention of this cause. Through research and development, the Drowning Detection System can easily detect if the person is drowning by informing lost communication of the transmitter underwater. It displays the time limit status of the person in the water using Arduino Uno interfaced to and LCD screen and gives notification or monitor the status of a person in the water using a transmitting and receiving circuit using RF (radio frequency).***

Keywords: Drowning detection, wearable, RF Transmitter

I. INTRODUCTION

Safety is everyone's responsibility. Accidents such as burning, food poisoning, drowning, or car accidents can be prevented if people are responsible enough to avoid accidents. Most of the time, accidents happen because of recklessness and irresponsibility. People who do not follow safety precautions always end up in danger or worst, death. One of the highest caused of unintentionally injury death in the world is drowning. Drowning is the third leading unintentionally injury death in the world, accounting for 7% of all injury-related deaths. There are estimated 360, 000 annual drowning worldwide. Individuals with increased access to water are most at risk of drowning. A device or system is needed that will help them to prevent it.

Stages of Drowning:

1) Surprise: In this stage, a person begins to struggle at the surface but is still able to get air in their lungs. It usually lasts for around thirty seconds.

2) Involuntary Breath Holding: After the person has tired, they cannot get up for air, thus being forced to hold their breath.

3) Unconsciousness: This stage is exactly what it says. The person's lungs begin to fill with water.

4) Hypoxic Convulsion: The person has already taken in water and is unconscious. Puss begins to ooze out of their eyes, ears, nose, and mouth. Their body becomes rigid and there may be jerking motions.

5) Death: When they have reached this stage, the person is clinically dead which means that they can still be brought back, but from the moment their heart stops beating, their chance of survival drops by ten percent every minute. 2 These stages of drowning can occur all within sixty seconds. The person needs aid rendered before they pass the first stage." (Chione, 2013).

Objectives of the Study

To be able to create a drowning detection system that would help with the prevention of water-related accidents. Specifically, this study aims to achieve the following:

1. To be able to detect if the person is drowning by informing lost communication of the transmitter underwater
2. To be able to display the time limit status of the person in the water using Arduino Uno interfaced to LCD screen
3. To be able to inform or monitor the status of a person in the water using a transmitting and receiving circuit using RF (radio frequency)

II. METHODOLOGY

Research and development is a method of investigation where it is assumed new scientific knowledge is discovered due to a series of linear and sequential stages that consist of Basic Research, Applied Research and Development (Mahdjoubi, 2009). This model assumes that science has a monopoly over knowledge, technology is an outcome of science, and economic development is due to technology development. This section presents the processes that used by the researchers in developing the drowning detection system.

A. Design Phase

The use of Arduino UNO, Arduino NANO, LED, buzzer, RF Transmitter, RF Receiver, LCD Screen, and push buttons were used to assemble the hardware components and Arduino IDE for the software specification. The LCD screen is used to display the operations of the system. The push buttons will help to control the operations of the device. The researchers used LCD screen, 5V supply, push buttons, RF receiver, and ARDUINO UNO for the receiver. The RF transmitter, ARDUINO NANO, and 9V battery are for the transmitter. The figures below is the schematic diagram of the transmitter and the receiver.

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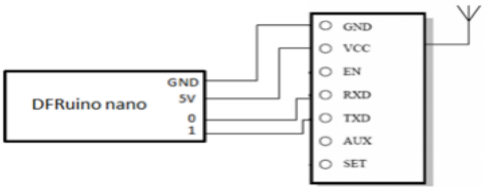

Fig. 1 Schematic Diagram of the Transmitter

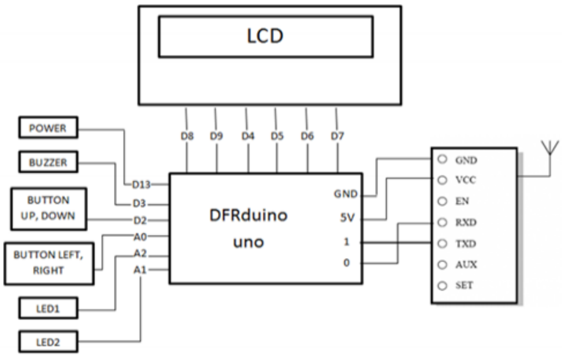

Fig. 2 Schematic Diagram of the Receiver

B. Fabrication Phase

The researchers completed the requirements as per timetable. After completing the prototype, the programmer and the researchers started doing the system of the device, and used breadboards and jumper wires to test the system. Some problems happened during the fabrication phase of the system, and fortunately, the researchers came up to a better solutions to the problems. After a month, the drowning Detection System was done and was ready for the evaluation phase.

Fig. 3 Actual Prototype of the Receiver

Fig. 4 Actual Prototype of the Transmitter

C. Project Design

The system's general objective is to save and ensure safety of the guests at a pool or beach. It can detect if a person is drowning if the device, which is the transmitter, submerged too long under the water. The system uses RF transmitter and receiver. The transmitter is in the swimmer and will monitor the status of swimmer to a family or lifeguard using the receiver. You can set the time limit of a swimmer if he or she is under the water. You can also set the time according to the capability of a person under the water. The Level 0 is for the non-swimmer, the Level 1 is for the swimmers, and the Level 3 is for the professionals.

D. Operation Flow

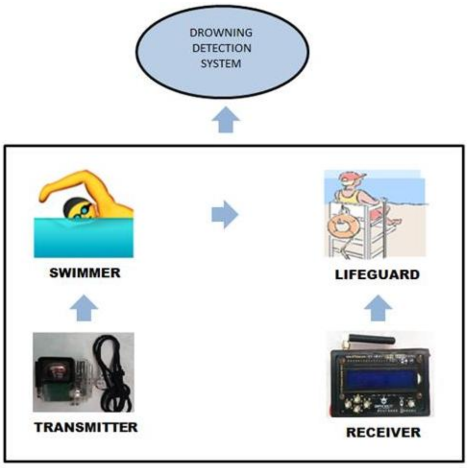

Fig. 5 Operation Flow of the System

The system used a transmitter. Transmitter has its own component, the DFRDuinonano, transceiver and a 9V battery. The battery and the APC220 transceiver are all connected to the ARDUINONANO. The receiver also has its own component that provides the needs of other component to complete the connection. It has Arduino UNO, LCD, APC220 transceiver, and a 5V supply. The LCD, APC220 transceiver, and the 5V supply were connected to the Arduino UNO.

E. Prototype Testing

The researchers conducted a self-testing method to evaluate the project of its operation and functionality. To be able to test the system, the researchers went to a pool and one of the proponents used the pool wearing the transmitter, and the other proponents used the receiver to check the functionality of the system. The proponents that used the receiver set the limit of it to fifteen seconds and the proponent that wears the transmitter started to submerged underwater. The count started after the proponent with the transmitter submerged underwater. The researchers repeated these steps twice to make sure if the project is consistent and accurate. The researchers also asked some expert to evaluate the project if it is functional and ensure its quality.

F. Evaluation Process

To be able to check the quality and consistency of the system, the researchers needed an evaluation process. This process helped the proponents of this research to determine the weaknesses of the system. Researchers prepared and distributed an evaluation sheet to assess the project system. The researchers presented first their project before the evaluation.

Evaluators of the study are as follows: (a) five (5) Lifeguards, (b) four (4) Faculty Experts in the field of Engineering, (c) twenty-five (25) Parents, (d) fourteen (14) Engineering students and (e) two (2) Industry Experts. The criteria that the respondents observed and considered during the evaluation of the system are in the Table 1.

Table I Criteria for Prototype Evaluation

Criteria	Indicator
Functionality	• The proposed system works properly and all expected outcomes are delivered. • The system is user-friendly and has met the work requirements of the users.
Reliability	• The proposed system can be used in any time and place with minimal or without consequences in its functionality • The system performs with minimal or without errors during its operations
Maintainability	• The proposed system requires only minimal maintenance after its operation. • The integrated devices are carefully placed inside the enclosure and the system is rugged in construction.
Extensibility	• The system supports adaptability, coping with the needs of the end-users. • The system can still be integrated with other devices in the future.
Economic Feasibility	• The proposed system offers long-term usage and can be considered as a good investment. • The total cost of the system is practically worth of its performance.

Analysis of Data Gathering Methodology

After the evaluation of the responders in the evaluation process, the researchers tallied the data that they gathered to them using the Likert Scale as seen in the Table 2. A Likert item is simply a statement that the respondent is asked to evaluate according to any kind of subjective or objective criteria, generally, the level of agreement or disagreement is measured. This can help the researchers to determine the capability of their system. The data has to be thoroughly checked to fulfill the strict formal axioms of the project.

Table II Likert Scale Used

Rating	Scale	Range
5	Outstanding	4.51 – 5.00
4	Above Satisfactory	3.51 – 4.50
3	Satisfactory	2.51 – 3.50
2	Below Satisfactory	1.51 – 2.50
1	Needs Improvement	1.00 – 1.50

Table III Overall Evaluation Summary

Criteria	Mean	Descriptive Rating
Functionality	4.51	Outstanding
Reliability	4.31	Above Satisfactory
Maintainability	4.37	Above Satisfactory
Extensibility	4.34	Above Satisfactory
Economic Feasibility	4.50	Above Satisfactory
Grand Mean	**4.41**	**Above Satisfactory**

G. Summary Of Findings

The researchers undergone to the stages that the researchers need to do to accomplish the project's objectives. The project was developed after the phases that the researchers undergone. The first project that the researchers proposed was also a Drowning Detection System that uses a heart rate sensor to detect the pulse of a swimmer underwater but unfortunately, they found out that it is impossible because of the fact that radio frequency signal will cut if it is underwater. The researchers came up the idea of using the lost signal to determine if the person in the water is drowning by setting a time limit depending to the capability of a person to hold his or her breath underwater.

The general objective of the project is to create a drowning detection system that will help to lessen the cases of drowning incidents in the world. The researchers undergone to the design phase which they identified the components that needed in creating the system. They used Arduino IDE for the software. The main components of the hardware are the DFRduino Uno and nano, APC220 Transceiver, LCD, and the buzzer. After the design phase, they undergone to the fabrication phase. When the components were completed, the researchers were ready to create the prototype. After a month, the drowning Detection System was subjected to the evaluation phase. They conducted expert's evaluation after the proponents self-tested the device. The respondents have evaluated the system for its functionality, reliability, maintainability, extensibility, and economic feasibility. The researchers got an above satisfactory for this project.

III. CONCLUSION

After conducted some research and evaluation of the system, the researchers found out that the system is above satisfactory as evidenced with a 4.41 rating. The system works properly and that all expected outcomes has been delivered. That this project is reliable in terms of its operation and that it is low maintenance on its parts. That this project can be integrated to other system for it supports adaptability with the needs of the end-users. In terms of economic feasibility, the project offers a long-term usage and can be considered as a good investment.

It is therefore concluded that the Drowning Detection System can be of help on the prevention of water-related accidents, particularly, drowning.

IV. RECOMMENDATIONS

Based on the evaluation and conclusions, the following are recommended: (1) Additional features such as emergency button, location of the user, application that will send SMS to the guardian of the user when the limit was reached, one receiver for many transmitter. (2) Adding switch to the transmitter so that the battery will not easily drained. (3) Make the receiver wearable and transmitter more portable to be more convenient to use. (4) Improve physical features.

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