

Anti-Drowning Devices Based On Passive UHF RFID

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Abstract

The drowning is leading cause of injury-related death in children with most cases occurs in swimming pools. This experiment is designed to explore possibility of creating cost-efficient, accurate and reliable device that protect children from drowning and provided families with safety purpose. The proposed system was used passive ultra-high frequency (UHF) radio frequency identification (RFID) that has emerged as promising solution for many industrial applications. The passive UHF RFID systems did not require internal power source to activate the tags and had efficient multitasking operations. The system was started with acquisition unite which passive UHF RFID tag was place in the children hand as bracelet. The passive UHF RFID reader had received signal within specific strength. The reader signal strength was reflection of how children was closed to swimming pools. The system secondary unit was processing or controlling Arduino. The Arduino was activated warning unit through the relays. The system was worked once RFID tag in distance range up to 1 meter from the swimming pool.

Keywords: Swimming Pool; Children; Drowning; RFID; Tag

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1. Introduction

Childhood water submersion is among major public health in many developing countries with significant number of mortality and morbidity [1-3]. The ratio of drowning mortality toward survival was 1:10 and two out of three who survived were admitted to the hospital [4].

The drowning mortality is often caused by recreational activities such as swimming, watercraft and fishing [5,6]. An approximately 175,000 mortalities in year which occurs in children and adolescents aged between 0 and 19 years [3]. Drowning mortalities rates among children in low- and medium-income countries than high income countries [7]. In Saudi Arabia, 55% of cases occurs in children less than 5 years who often drown in washing containers [1].

The risk factors of drowning due to ethanol use, reckless behavior and insufficient water safety instruction

[8,9]. Personal flotation devices also save lives, also fences around swimming pools, swim 'buddies' and lifeguards. In this experiment, the researchers were noticed drowning was among mortalities causes in children. Therefore, researchers were decided to find solution to overcome this situation mainly in Saudi Arabia. The experiment aims to reduce and prevent drowning cases of children under 5 years at swimming pool.

2. Methodology

The first acquisition unit was proposed as in Figure 1 which the passive RFID tag transmitted signal to RFID reader tag in bracelet wrist. The signal from RFID reader was processed by Arduino UNO which controlled two different warning unit. The warning unit consisted speaker, buzzer and light.

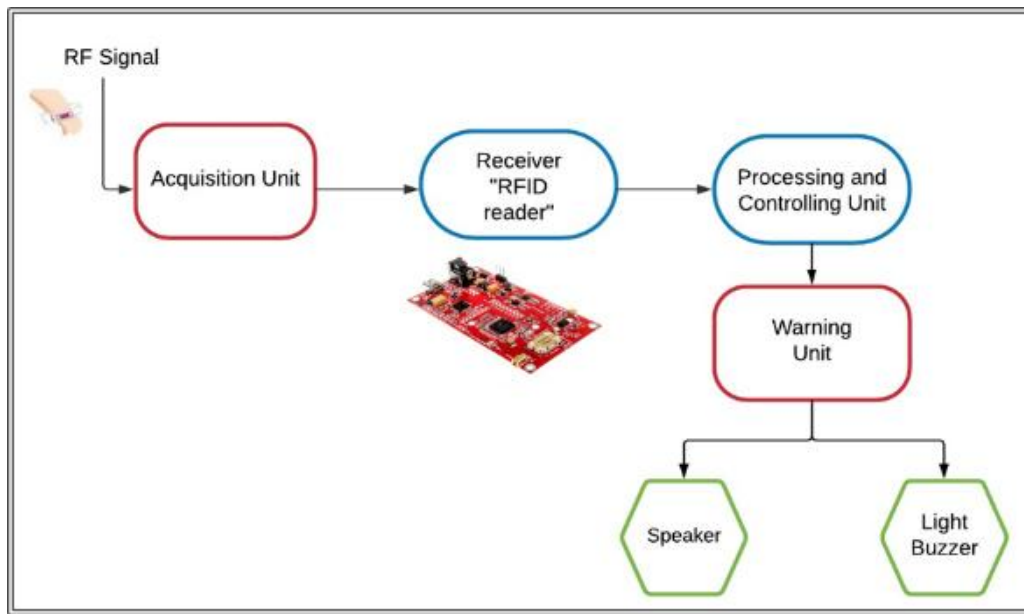


Figure 1: System block diagram

The 3D module was designed by using Autodesk Rivet with dimension between swimming pool and house, children and swimming system pool door as shown in Figure 2.

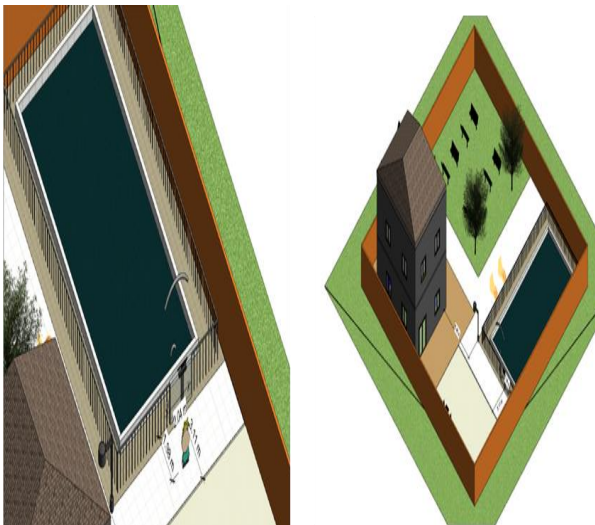


Figure 2: 3D Modelling

The prototypes consisted three parts such as acquisition unit, processing and controlling unit and warning unit. The prototype material were wood for base, glass for swimming poll wall, home, ice cream wood for hall wall, plastic grass and toys. In additions, the model dimension was 60cmx50cm, swimming pool dimension was 30cmx22.5cm and house with swimming pool dimension was 3cm.



Figure 3: Real experiment modelling



Figure 4: (a) The tag was put in children hand.
(b) whole experiment model



(a) (b)
Figure 5: Experiment model from backside
(b) speaker was inside the house model

The system functionality is described in Figure 6. Each submit was activated once the children were closed to the swimming pool.

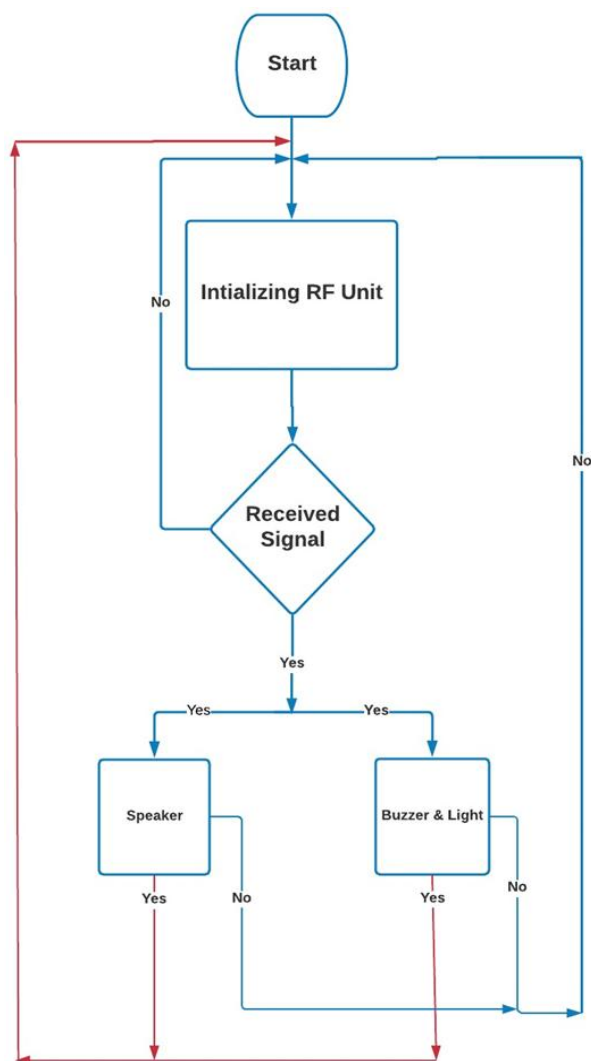


Figure 6: Flowchart

3. Hardware Implementation

In this experiment, the acquisition unit consists passive UHF RFID tag, antenna and reader communication. The passive UHF RFID was working with frequency between 860MHz and 960MHz and read up to 1 meter with lightweight.

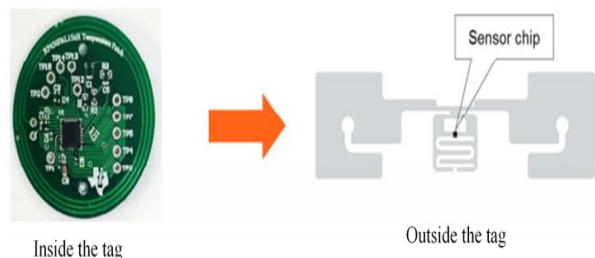


Figure 7: Passive UHF RFID tag

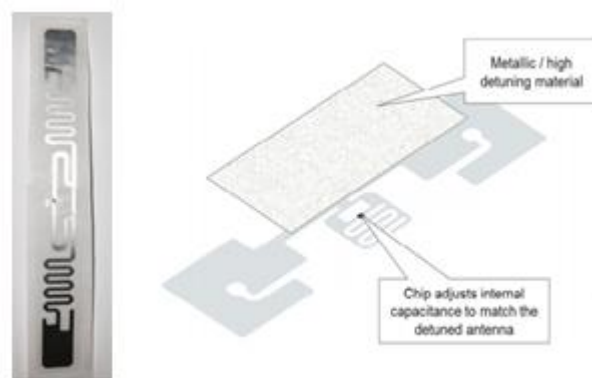


Figure 8: Sensor chip capabilities

An UHF RFID Antenna was used to generate and allowed the reader to transmit and receives signal from RFID tag. In Figure 9, passive UHF RFID tag and reader operation represented the communication protocol between UHF RFID reader and tag.

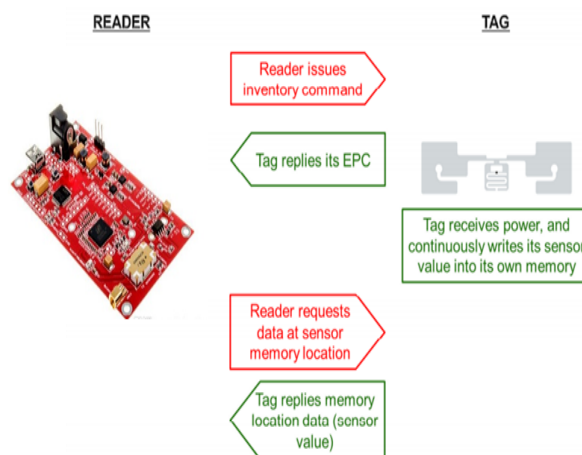


Figure 9: Passive UHF RFID tag and reader operation

The signal was processed by Arduino UNO which programmed through Arduino software IDE. Afterward, the signal was sent to the warning unit. The warning unit contained JBL clip with speaker, SD card module, bicycle electric horn device and electromagnetic switch relay.

The JBL clip with speaker was used to send out to alert that children was closed to the swimming pool. These devices had auxiliary port 9AUX) that received from peripheral resources as MP3 or CD player.



Figure 10: JBL clip with speaker

The bicycle electric horn device also used in warning unit. This device was activated if the children was in distance range of passive UHF RFID reader.



Figure 11: Bicycle electric horn device

4. Verification and Validation

The passive UHF RFID was tested with Arduino UNO and speaker with light by Arduino UNO. The whole hardware tools was connected as shown in Figure 12.

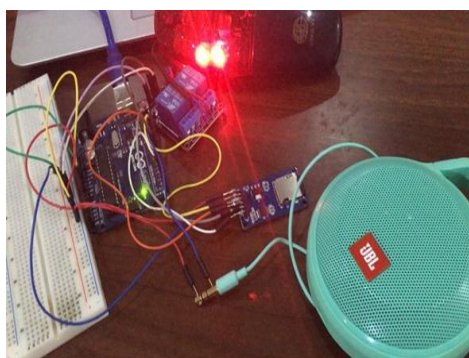


Figure 12: The whole model system

The passive UHF RFID reader interfacing with Arduino Uno as in Figure 13. The result of the interfacing in (serial monitor) of Arduino was represented in Figure 14.

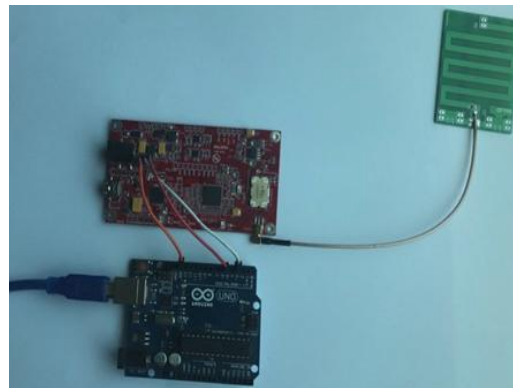


Figure 13: Passive UHF RFID reader interfacing with Arduino UNO

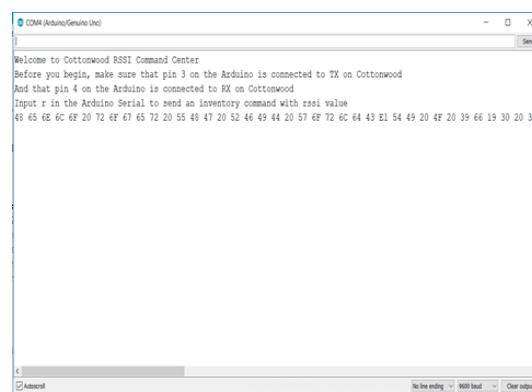


Figure 14: Result of passive UHF RFID reader with tag

In Figure 15, JBL clip with speaker was interfacing with Arduino UNO and SD card by AUX cable.



Figure 15: JBL clip+ speaker is interfacing with Arduino

The bicycle electric horn device was controlled by Arduino with relay was set on NO mode.

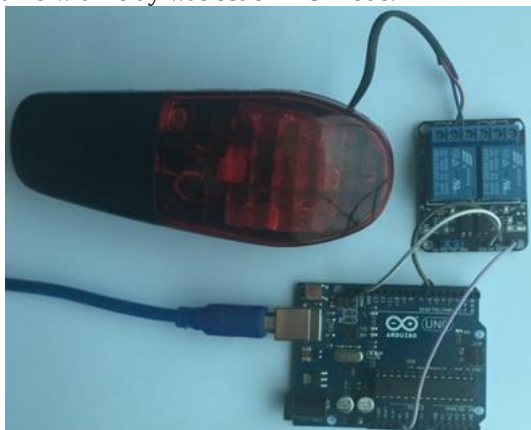


Figure 16: Electric horn device interfacing with Arduino Uno

5. Conclusion

In conclusions, this experiment was proved a solution for protecting the children from drowning by utilization wearable RFID system. This system was contributed in solving social issue by reducing children drowning rate. In future, the wireless speaker and magnetic locks door will be implanting to improve the result accuracy.

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