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A Study on the Accident Monitoring and Prevention System Based on IoT

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Abstract

This study proposes a monitoring system that helps today's socially disadvantaged with safe water-use activities.The number of vacationers visiting beaches and valleys has increased every summer, resulting in a series of accidents.Protecting and observing is essential when playing in the water, especially for the elderly and the disabled, as it is difficult to cope with sudden situations.The system in this paper utilizes ICT(Information and Communications Technologies) technology to monitor the real-time condition of the elderly and the weak, and to design and implement efficient reporting and first-aid activities in the event of accidents. Thus, the convenience of guardians will increase and it can have an effect of preventing human casualties.

Keywords; *Preventing accidents, Smart accident Monitoring, Vital sign, Rescue system, Arduino, Internet of things.*

I.INTRODUCTION

In the summer, the number of visitors for beaches or valleys increases, it is necessary to prepare for safety accidents. If a person falls into the sea, the position changes continuously because of the current, and failure to rescue in a short period of time will result in death from hypothermia [1].In particular, the elderly and the disabled have lesser abilities to react to sudden dangers, and therefore, should always be accompanied by their guardians and special attention should be paid on them at all times [2-3]. In order to effectively manage drowning accidents, a system that encompasses prevention and prompt early response, rescue, and first-aid when accidents occur should be equipped [4]. In addition, senior citizens living alone may be unable to call for help when an emergency situation occurs in everyday life. A monitoring system on the everyday life of the elderly is needed to prevent such incidents [5-9].

In order to construct a ubiquitous healthcare environment, it is necessary to develop a system that can identify factors that threaten health in advance and provide prompt medical aids [10-14]. It can be said that the useof ubiquitous information technologies that has recently advanced exponentially is essential [15-18]. This study designed and configured a water accident prevention and rescue system using Arduino.Therefore, this study implemented a smart accident monitoring and prevention system based on IoT(Internet of Things).

II. RELATED WORKS

A.Arduino

Arduino is a tool for making interactive objects and digital devices that can detect and control the physical world based on the microcontroller board and refers to an open source computing platform and a software development environment. Arduino can be operated in various operating systems such as

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Windows, Mac OS, Linux, etc., and the Arduino integrated development environment allows writing and editing source codes, and also allows functions for compiling and uploading codes. Arduino is a processor that executes commands sequentially [19]. The hardware is configured in a way to easily attach and detach various components. It is written through a software development environment and the uploaded codes are executed [20].

B.ICT

ICT is a compound word of information technology (IT) and communication technology (CT), and IT refers collectively to the internet and mobile phone technologies, as well as programs that operate it, etc. It also means hardware, software technologies needed to operate devices, as well as all methods for collecting, producing, processing, delivering and utilizing information using such technologies. IT is the use of computers that includes hardware and software. Regarding ODA, the household appliance, video industry, games, etc. may potentially impact domestic industries [21].

C.GPS and App Inventor

GPS is a satellite navigation system that receives signals sent from a GPS satellite to calculate the user's current location. GPS finds coordinates by calculating the distance between GPS satellites and GPS receivers [15].The App Inverter can create application programs to be executed in Android devices by dragging and dropping visual objects by users. It is a programming language that concretizes thoughts in the process of thinking to realize ideas and during the process of structuralizing [22].

III. SYSTEM DESIGN AND IMPLEMENTATION

A.System Design

The system design used in this study is shown in Fig. 1. The system was proposed to help the guardian to monitor the status and location of an elderly or disabled person by mounting a GPS module based on the UNO R3 board. If the water sensor is submerged under a certain depth or over a certain amount of time, the connected LED lights up and an alarm is set off in the guardian's application. Using a GPS module, it is linked to Google Map to find the latitude and longitude to determine the location of the elderly or disabled.It also has sensors that can measure the vital signals of the elderly or disabled to prevent dangers. In particular, falling is especially dangerous for the elderly. When the elderly falls, it can result in severe damage to him or her, and there is also a risk of death due to complications from the fall. Therefore, a system that helps guardians check the walking status of the elderly and react quickly in case of emergencies is needed for the safety of the elderly [23].

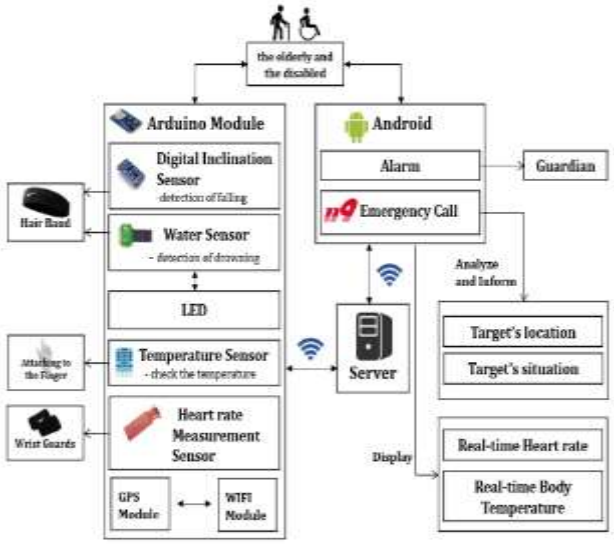

Fig. 1. System Architecture

When irregularities are detected in all vital signs measured, an alarm goes off in the application. The application is for guardians, and it has an advantage that guardians can check the state of the elderly or disabled through danger alarms without always having to look after the elderly or disabled. When they cannot check the application, an automatic reporting function can be used to report the situation and location of the elderly in danger immediately to 119.

B/System Implementation

The system proposed in this study was configured using the Windows 10 64bit operating system. The drowning prevention device was designed by connecting the water sensor and LED. Sensors to monitor the location and vital signs of the elderly or disabled were also used. Fig. 2 shows the algorithm that connects the water sensor and LED, and the algorithm uses swRTC library to measure time.

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When the water level is higher than 40 (presumed), and the water sensor is submerged for more than 20 seconds, the text "HELP!" is shown on the serial monitor, and the LED turns "on". When the user escapes the water (when the water sensor's water level drops below 40), the text "INITIALIZATION" appears and the countdown is initialized. By using the GPS module, data on the GPS base value, latitude and longitude of the geographical location, GPS system software and communication satellites, and other data can be obtained. Among them, $GPGGA contains a summary of various information such as GPS signal location, time and speed. To identify the current location, latitude and longitude date is needed; thus, the algorithm in this study only shows the GPGGA values. The output values are converted to latitude and longitude to determine the current location.

```
Algorithm WaterSensor
Void function setup()
stop ← RTC()
set Time ← (1h, 1m, 1s)
start ←RTC()
Serial begin(9600)
 //Initialize Serial communication
set OUTPUT ← LED
Void function loop()
val← Read pin (A0)
IF val>10
THEN
print ← Serial(getSeconds)
delay ←(1000)
END IF
IF getSecond() == 20
THEN
WHILE val> 40
print ← Serial("HELP")
LED ⇒ HIGH
val← Read pinA0
END WHILE
END IF
Print ←
Serial("INITIALIZATION");
LED ⇒LOW
STOP
//Initialize Time, Minutes,
Seconds
// Initialize the Day, Month, Year
```

Fig. 2. Algorithm by Linking Water Sensor with LED

C.Implementation Results

The configuration results of the system proposed in this study are shown in the below Fig. 3 to 8.Fig. 3 shows the result of connecting the water sensor and LED. Submerging under water is detected by judging the water sensor being submerged as the head being submerged, through the water sensor attached on a hairband. When it is assumed that the user gets out of the water, the text 'INITIALIZATION' appears and the time of being underwater is initialized.

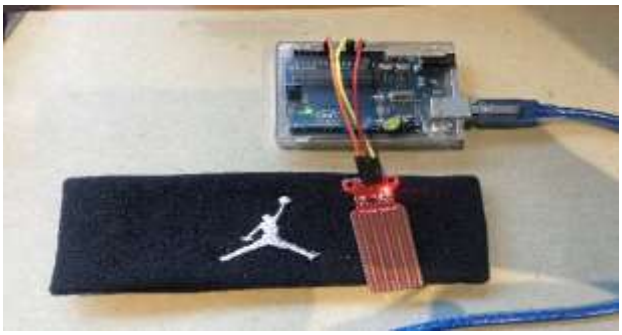

Fig. 3. System Implementation Results 1

Fig. 4 shows the location of the elderly and the weak using a GPS module. The GPS receiver module is connected to Arduino, and signals are received through coding and are converted into the current location using the map. The current location signal received by GPS can be checked through the Serial Monitor.

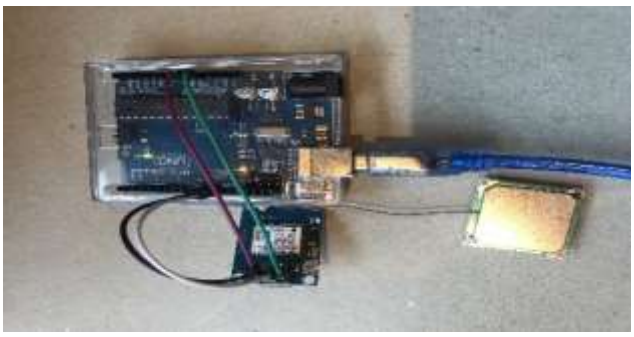

Fig. 4. System Implementation Results 2

Fig. 5 measures falls of the elderly or disabled using a slope sensor. The slope sensor is attached to a hairband; when a person falls over for over a certain period of time, an alarm is sent to the application. If

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the person has not fallen, he or she can respond to the alarm such as turning off it by himself or herself.

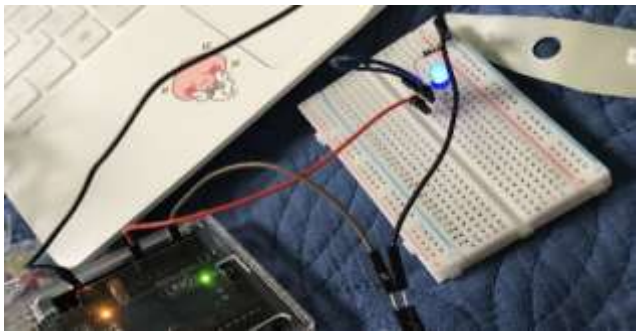

Fig. 5. System Implementation Results 3

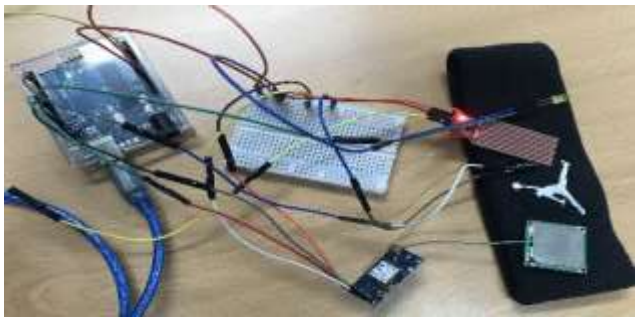

Fig. 6. Hair Band Model

Fig. 6 presents the hairband that attached the water sensor, LED, GPS and the slope sensor. If the water sensor is under water for over a certain period of time or if the elderly or disabled fell and could not get up, a light turns on in the LED to notify nearby people.

If there is nobody in the area and he or she cannot be rescued, an alarm goes off in the guardian's application first. If the guardian does not respond, a secondary rescue request is made using the 119 automatic reporting function.Fig. 7 shows a finger band designed to measure the heart rate and body temperature using a heart rate sensor and a temperature sensor attached. This finger band consisting of small sensors was made to be easily worn on the finger.

Fig. 7. Finger Band Model

Fig. 8 presents the application for guardians and was designed to monitor the vital signs of the elderly or disabled such as Submerged, Fell Down, Heart Rate, etc. It was designed to monitor the biometric data such as heart rate, etc. of the elderly or disabled person.When the data has been checked by the guardian, the CONFIRM box can be marked. If there is no response, it can automatically report to 119.

Fig. 8. Protector Application

IV.PERFORMANCE EVALUATION

The accuracy of water level and the performance on the precision of GPS obtained from the water sensor was assessed using Arduino. Fig. 9 shows the accuracy of the water level. The blue line in the graph shows the result of measuring the water level using a water sensor fixed inside a tumbler, and the result did not show almost no difference from the real value. Theoretically, the output of the water sensor is 0 to 023. The sensor is about 6cm in size, so each measurement value was predicted by dividing it into 1cm increments. Upon conducting a total of six tests, the error between the theoretical value and the test results of the fixed water was less than 50. The green line on the graph represents the value of measuring the water level in flowing water, and the measurement was performed by assuming underwater situations where the water moves such

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as in oceans, swimming pools and valleys. The range of error with the theoretical value can be said to be high.

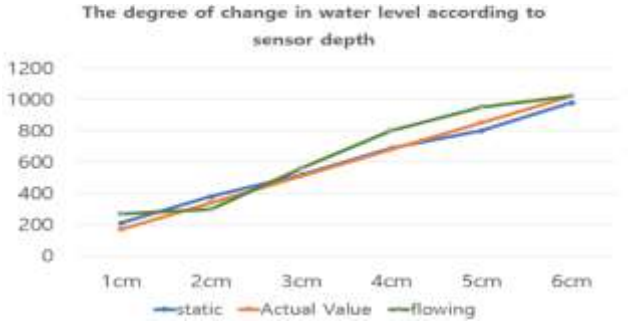

Fig. 9. Performance Evaluation 1

Table 1 shows the detailed measurements of Fig. 9. When compared with the theoretical value, the maximum error for static water value was less than 50, thus indicating that there was almost no difference. On the other hand, the maximum value of the flowing water value was 120, thus being relatively high compared to static water.

Table 1.Measurement Comparison

Stage / Depth	Static Water	Flowing Water	Theoretical Value
1cm	210	250	170
2cm	380	330	340
3cm	520	560	510
4cm	690	800	680
5cm	800	950	850
6cm	980	1023	1023

Fig. 10 shows the result of measuring the location using a GPS module outdoors. Upon testing a total of 10 times, the measurement of location (error being less than 10m) was accurate nine times.

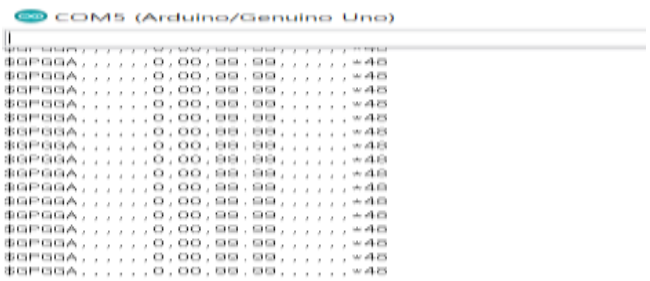

Fig.10. Performance Evaluation 2

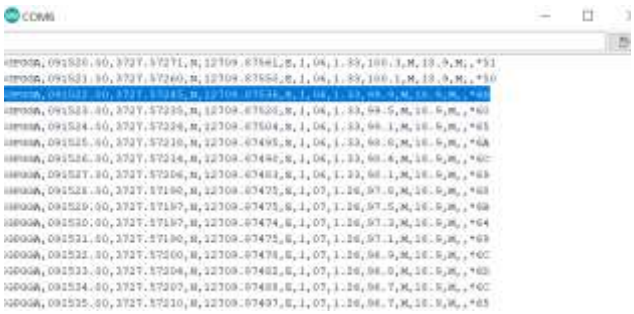

Fig. 11. Performance Evaluation 3

Fig. 11 presents the result of testing location measurement indoors. Out of 10 tests, the measurement of location (error being less than 10m) was accurate five times. Therefore, there were limitations when measuring indoor location using the GPS module.

V.CONCLUSIONS

In this paper, the system of preventing and monitoring old and weak drowning was proposed using Arduino and Android applications. Information is transmitted to the guardian through the application by measuring whether the old and the weak are submerged, whether they are falling and the number of heart rate and body temperature. This system will make it easier to predict and prevent accidents and increase the convenience of guardians. In addition, secondary arrangements are made for automatic reporting to 119 immediately in the event of no response from the guardian to prevent damage. Therefore, this study designed and implemented a smart accident monitoring and prevention system based on IoT(Internet of Things). Performance evaluations have resulted in the need to improve the accuracy of water levels measured by water sensors in flowing water and to reduce errors in indoor GPS. If the system is improved in the future, including a variety of other biometric information for the elderly and the weak, it will further reduce the burden on carers and increase the convenience of hospital staff.

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