Using an Automatic Identification System (AIS) to Develop Wearable Safety Devices

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Abstract. The numbers of people who participate in outdoor activities are increasing; however, it has a certain risk of doing outdoor activities, such as wilderness rescue and losing the force while sailing. Therefore, people performing outdoor activities usually wear relevant safety devices. Currently, most users send emergency alarms through mobile phones; yet, the penetration rate of the fourth generation of broadband cellular network technology (4G Network) is not fully equipped in some rural areas, which causes victims failed to send emergency alarms. This study uses an Automatic Identification System (AIS) to develop a wearable safety device because the transmission range of AIS is wider than other types of systems, and it is easier to prepare essential functions in AIS wearable devices. When a victim presses the panic button, the system will send the alarm with a Global Positioning System (GPS) signal; the system will only detect the GPS location once when pressing the button to reduce power consumption, which avoids additional power consumption while repeating the detection. The research conducted practical experiments and discovered that the method is feasible in real-world applications.

Keywords: Automatic Identification System · IoT · Wearable devices

1 Introduction

Many countries promote outdoor activities and aquatic sports despite the activities have some risks. For example, the fatality rate of mountain climbing is 16%, which accounts for the highest among outdoor activities [1]. In Taiwan, there are more than 200 mountains; according to the statistics from the National Fire Agency, the wilderness rescue incidents per year are 185 cases on average [2]. Among the rescue cases, the highest ratio is missing and contact lost, which is 42%. On the other hand, there are diverse types of aquatic sports; it is critical to have relevant safety devices when there are no companies or having to wait for rescue by floating. A safety device cannot be too large to become a burden; hence, it is necessary to develop a wearable device with waterproof and user-friendly functions for carrying around. Additionally, it sometimes takes a long

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time to conduct an outdoor activity, which also needs to consider the power supply of the wearable device to lower the power consumption and avoid the situation of losing power and failing to send a signal.

Currently, many people use the Global System for Mobile Communications (GSM) systems to send emergency alarms while conducting outdoor activities [3]. Nevertheless, the equipment of GSM usually installed at the areas with a higher density of population; many mountains and sea areas do not have relevant GSM systems, which is not capable of sending a signal when encountering emergencies. Moreover, although many places have set large quantities of detectors and relay stations for people to use when doing outdoor activities [4], the transmission ranges are not able to cover fully, and it costs highly to install all of the equipment. Today, rescue teams usually utilize robots and drones to handle searching tasks [5]. With the vast zones in mountains and sea areas, victims should send a signal for the teams to locate the position; nonetheless, many wearable devices send signals via 2.4 GHz band because it is a wireless range opened for the public to use [6]. Unfortunately, 2.4 GHz band is for short-range communications, which is unfavorable for rescue teams; thus, using a wider range for communications is necessary. On the other hand, some emergency systems send signals through satellites [7]; yet, it requires many satellites for developing a complete rescue system, and there are power consumption and installation costs for considering in the meantime.

This study utilizes an Automatic Identification System (AIS) as the foundation for developing a wearable safety device. The typical range of AIS is around 20 to 30 nautical miles, which will be easier for rescue teams to search and locate victims' positions rapidly. The design of the wearable safety device in this research aims to be user-friendly with one panic button, which can reduce the information maladjustment situation for elderly people. When pressing the panic button, the system will detect the location of the victim and send the Global Positioning System (GPS) signal via the AIS communications. The experimental results of this study have proved that the method is feasible.

2 The Proposed Scheme

2.1 System Model

The research uses an AIS system to transmit signals; AIS communications are usually for avoiding collision between merchant ships. The range of AIS is around 20 to 30 nautical miles, which is suitable for receiving the signal sent from outdoor safety devices. As shown in Fig. 1, the system model demonstrates that the system will send an AIS signal regularly when a victim presses the panic button, and the rescue team can locate the position from the AIS signal. Figure 2 shows the diagram of the wearable device, which contains a straightforward panic button for users to understand and operate the device. Additionally, Fig. 3 represents the function diagram that the network layer for AIS communications and the application layer is for GPS and alarm.

2.2 The Proposed Scheme

This research utilizes AIS communications for the wearable device to initiate the GPS and detect the position when victims press the panic button. Further, the system will

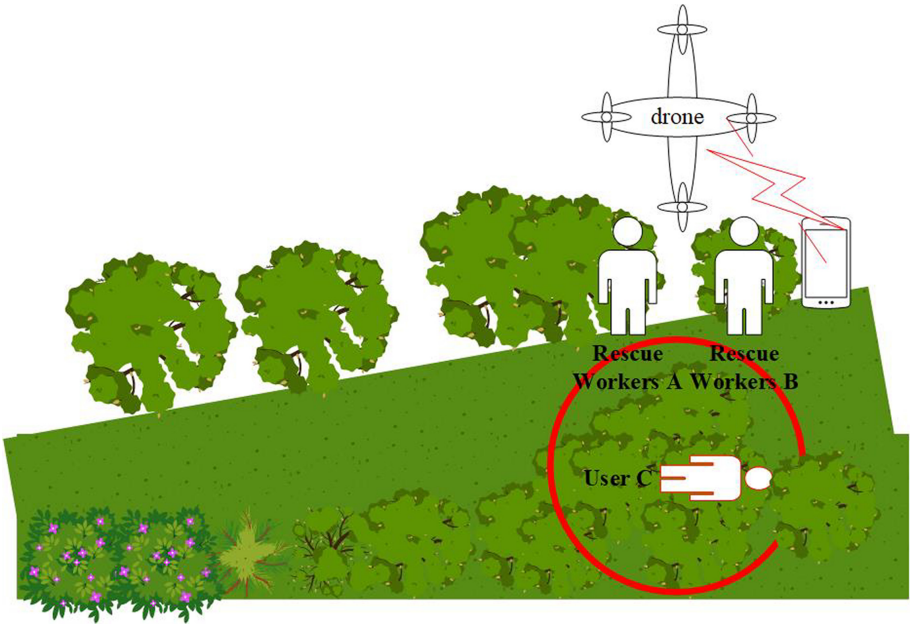

Fig. 1. System model.

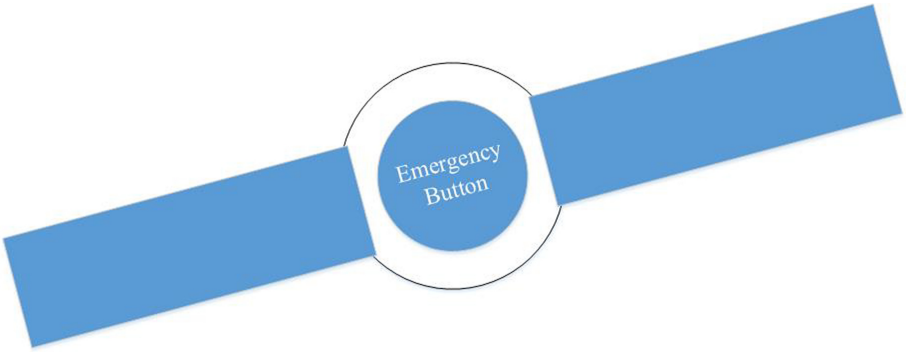

Fig. 2. The designed panic button of the proposed system.

deliver the GPS position with the AIS signal every ten minutes. Considering the overall power consumption, sending out a signal every ten minutes can effectively reduce the energy workload for the wearable device, and the rescue team can receive the signal constantly. The algorithm design is as shown below:

IF pressing the panic button
Sending an emergency alarm every ten minutes
ELSE
Terminate the wearable device
END

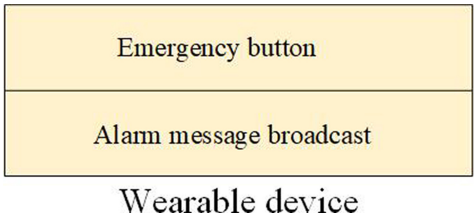

Fig. 3. The function diagram of the proposed system.

In the design, the system will only detect GPS position once when pressing the panic button; afterwards, the system will terminate the detector to avoid large power consumption. Meanwhile, it will also start the buzzer inside the device to make alarm sounds regularly for the rescue team to find the victim rapidly.

3 Performance

The hardware equipment used in the suggested system of this study is as listed in Table 1, which demonstrates the marine AIS processor IC that has the transmission capacity to 20 to 30 nautical miles and uses a GPS detector to check the position. The article applies a portable battery to simulate the experiment, which presents the details in Figs. 4 and 5. Using an Internet of Things (IoT) development board for the software application, confirming through the experiments, the suggested method of this study is feasible.

Table 1. The software and hardware of the proposed system.

Hardware	Software
ASUS X556UR Notebook	Operating System: Windows 10
Drone	Program Language: C Program Development Tools: APP Inventor
Automatic Identification System Chip	

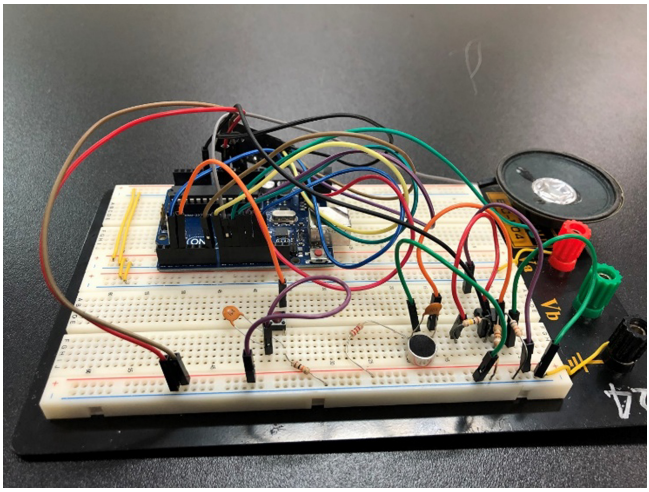

Fig. 4. Experimental trials.

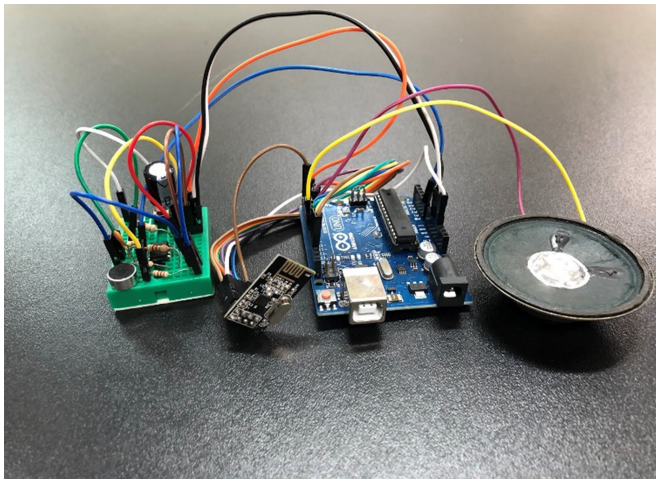

Fig. 5. Portable trials.

4 Conclusions

Today, many countries pay more attention to promote outdoor activities despite there is a certain level of risks for conducting such activities; therefore, wearing suitable safety devices becomes a critical issue. However, some safety devices have smaller transmission ranges that make it fail to send effective signals to rescue teams. This study applies AIS communications that enlarge the transmission ranges and employs a user-friendly operation method for elderly adults. A GPS detector in the system helps the rescue team to confirm the position quickly; moreover, a buzzer makes alarm sounds

regularly enables the rescue team to find the victim sooner. The experiment results have proved that the suggested method in this article is capable of enhancing the safety level for people to do outdoor activities.

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