Tracking System using RFID for Hiking Activity with IoT Technology

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Abstract. Hiking is popular in Malaysia because of the geographical factors that have a lot of mountains. Since this is an extreme activity, it gives a lot of risk for the hikers. There were 134 incidents in the mountains reported during 1996 until 2014 where 52 cases are about missing people. When encounter with missing people cases, it is difficult to pinpoint the last location of victim. Therefore, this project aimed to help the rescuer by providing them information of the victim’s last location by creating a tracking system using RFID in order to store data on each checkpoint along the hiking trails in memory card. This system also equipped with wifi which allowed the system send notification using Telegram Apps. The rescuers can extract the data from the memory card from each checkpoint to trace the last location of the victim before reported missing. By having this information, the rescuers will save a lot of time because they can estimate from which area they should start the search and rescue operation.

1. Introduction

Hiking is an extreme activity that are beneficial for healthy lifestyle and very popular in Malaysia because of geographical factors that have a lot of mountains. Based on the past research, there were 134 incidents in the mountains during 1996 until 2014, 52 of the incidents are about missing people [1]. When there is a missing people reported, the rescuers will take immediate action to start search and rescue operation. It will take a lot of time for the rescuers to find the victim if they cannot pinpoint the last location before the victim start to lost. This can be dangerous for the victim life. Radio Frequency Identification (RFID) technology is an automatic identification system. This technology use two main components which is an RFID tag and reader and has been utilized widely for many applications such as automatic identification of inventory, tracking of vehicle, animals, library books, merchandise, pharmaceuticals and supply chains.

By creating this tracking system using RFID technology for hiking activity, the information that provided from this system is crucial for the search and rescue operation. Each hiker will be provided with an RFID tag before begin to hike. The hiker will use the RFID tag to check in at every checkpoint that has been passed. Every time a hiker tap their RFID tag at the checkpoint, it will store the data into a memory card. When there is a search and rescue operation, the rescuers can extract data from each checkpoint. With that information, the rescuers can trace the last checkpoint passed by the victim and make the search area become smaller.
2. Related Work
A study of an automation of attendance system implemented using RFID, Biometric, and GSM Modem has been conducted [2]. The study shows a successful development and prototyping of a low-cost event attendance and tracking management system. The system use the RFID technology combined with wireless communications and data analytics delivered by the system server [2]. A vehicle tracking system is proposed by Jayalakshmi to lift the burden of police that manually check each vehicle on the road by changing it to automatically using RFID technology. When a vehicle go through the scanning area, the reader will read the RFID tag at the vehicle. When there is an invalid information about the vehicle, the system will automatically send an alert message to the police by email [3]. An indoor location tracking system using RFID technology has also been proposed. The system use RFID technology combined with ZigBee to track student or staff inside a building by providing to everyone with a RFID tag [4]. Lastly, a system to track hiker by using RFID technology but with a different method has been proposed. The system use RFID tag to be embedded in the trees, the user will be provided with an RFID reader. Every time the user scan the RFID tag at the trees their sequence number will increase that will create a virtual trail that enable the user to backtrack their route. When the user leave the forest, their sequence number will decrease at each checkpoint [5].

3. Methodology
This system use Arduino UNO (Atmega328P) as the microcontroller to control all of the component and modules that being used. It is programmed using with the Arduino IDE. At idle state, the LCD will display the current time. When there is an RFID tag detected at the reader, it will read the value of radio frequency of the tag and transmit the data to the microcontroller. The data will be stored into a memory card in a text formatted file (.txt) which is accessible by using any text file reader or editor through a smartphone or a laptop. The LCD will display a message to tell the user that the data is successfully stored into the memory card. Only for the first checkpoint, there is an additional feature for the system. When someone tap their RFID tag at the checkpoint it will send a notification message through Telegram by providing the same details as to be saved into the memory card. This is possible by using the ESP32 to connect to the internet. By instantly sending notification through the Telegram to the base, the number of people that go hiking everyday can be counted at real time. At end of the day, the number of people that went hiking can be compared to the number of people that comeback from hiking.

![Figure 1. Block diagram of the system](image-url)
In order to send the notification message using Telegram as the platform, the person who are involved need to install Telegram in their smartphone or computer. The ESP32 can be programmed to send the message directly to a certain user or to a group by using the UniversalTelegramBot library [6]. The library was created to work with ESP8266, but it is also compatible with ESP32. First, create the bot for ESP32 by searching the BotFather in the Telegram to get a token. The token will be programmed into the ESP32. To send to a specific user, the user need to get their specific ID by searching the IDbot in the Telegram and send a “/getid” command to get their specific ID. With that ID, it can be programmed into ESP32 to send the message directly to the user. The same principle works for group. The group need to add the IDbot into the group then use the command “/getgroupid@myidbot” inside the group chat to get the id for that group. Then, the bot will provide the specific ID for that group [7].

![Flowchart of the system](attachment:image.png)

**Figure 2.** Flowchart of the system
4. Result and discussion
At normal state, the LCD will display the date and the time. Both data is provided by the Real Time Clock Module that used an internal battery to always keep track of time even when the system in not running.

![Figure 3. Picture of the hardware](image)

![Figure 4. Display of the LCD when an RFID tag is checked](image)

The data that has been saved into the memory card can be extracted by inserting the memory card into a smartphone or a computer. The data is written in order of date, time and user id. Figure 5 shows the sample of data taken from memory card.

```
540 03.12.2018--11:55:30--89 56 46 73
541 03.12.2018--11:55:33--53 76 5C 2E
542 03.12.2018--11:55:37--43 EB FD 2E
543 03.12.2018--12:44:45--96 06 59 A3
544 03.12.2018--12:44:48--89 56 46 73
545 03.12.2018--12:44:52--43 EB FD 2E
546 03.12.2018--12:44:56--53 76 5C 2E
547 03.12.2018--13:18:22--53 76 5C 2E
548 03.12.2018--13:18:25--43 EB FD 2E
549 03.12.2018--13:18:27--96 06 59 A3
550 03.12.2018--13:18:30--89 56 46 73
551 03.12.2018--14:00:04--96 06 59 A3
552 03.12.2018--14:00:07--89 56 46 73
553 03.12.2018--14:46:48--89 56 46 73
554 03.12.2018--14:46:51--96 06 59 A3
```
Figure 5. The view of text file from the memory card using smartphone

For the checkpoint which has an internet connection, when an RFID tag is tapped the system will send a notification message through Telegram into the group that has been setup beforehand. The message will tell the exact time when a hiker tapped their RFID tag. The Telegram group should be managed by authority that in charge the hiking trail.

Figure 6. Notification message in Telegram

For the analysis, a power consumption test done by using a 20000 mAh capacity power bank to run the system for 120 hours non-stop which equal to 5 days. The power consumption of the system become higher each day. By looking at the trend of the graph shows in Figure 7, it can be estimated that the system could last for a week without changing or recharging the power supply.

Figure 7. Power consumption of the system

5. Conclusion
This project is to provide a way of tracking a hiker using RFID technology. Every hiker will be provided with an RFID tag before passing through the first checkpoint. The hiker need to tap the RFID tag at each checkpoint along the hiking trails. If there is a case of missing person, the rescuer can
check the data from each checkpoint to trace the last checkpoint before the victim start to lost. With that information, the area for search and rescue operation will be reduced significantly.

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