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A Mobile Smart Finder Application Using Bluetooth Location-Based Information Technology

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Abstract: With the development of smart high technology related terminals, people's life style has been gradually changed. While electronic devices become smaller and smaller, people often misplace their belongings. This can arise to seriously problems for the person in case of valuable information lost. However, most smart devices have Bluetooth capability. Bluetooth is a radio networking protocol in a short range to communicate electronic terminals wirelessly. In this study, we propose a system, smart finder to find misplaced objects based on Bluetooth technology. We reviewed Bluetooth technology and then designed hardware and software architecture for smart finder application. It has been shown the possibility and capability for many applications such as lost protector, child safety alarm or companion animal protection.

Key words: Bluetooth, smartphone application, RF communication, smart finder, lost protector

INTRODUCTION

As of 2012, research shows that 63.7% of the current population owns a smart device and that the average household has 0.64 of these devices. This dramatic increase shows that smartphones can provide effective information processing for daily activities (Lim *et al*., 2012; Korea Internet and Security Agency, 2012). The current LBS (Location Based Service) of smartphones now integrate many different kinds of services instead of role for simple location and path notification. Unlike vehicle navigation which covers area using GPS, smartphone users are indoors for the majority of their time. While the demand of tracking locations indoors increases there are still many problems to make this possible.

Most smartphones have Bluetooth capabilities that can provide easy wireless connections. Bluetooth allows wireless connection but it focuses more on lowering energy cost and integrating various UNIT. Also we should strive to develop wireless technology with many options. By only increasing the coverage range of Bluetooth there can be more losses in management and control when combined with WiBro and wireless LAN.

In the current complex society cognitive abilities and memory is becoming a major interest. Many problems can arise from the inability to remember. For example, if you lose your car keys, wallet, phone, etc., you use time to find those objects. If you lose a USB or something that contains valuable information that information can be used against you. We explored this project to prevent from accidents as mentioned above.

Background and related research: Bluetooth technology which has been extensively researched has been one of important technologies to Smart Living. It is a wireless technology developed to replace cables on devices like mobile phones and PCs. Bluetooth allows wireless devices to be able to communicate with each other within range.

Bluetooth: While there has been an increase in smartphones that have NFC (Near Field Communication), a RFID (Radio-Frequency Identification technology) where data transfer can occur within 20 cm there has not been an increase in applications that use NFC. Google enabled the use of their Google Wallet App without the use of NFC (Aziza, 2010). Unlike NFC that is limited in use of terminals, Bluetooth by Yan and Shi (2013) is supported by various terminals and is a short range, low power, low cost wireless interface. It uses 2.4 GHz, ISM (Industrial Scientific Medical) frequency band which does not require a separate license to use. Also the 1 MHz bandwidth is divided into 79 channels and uses FHSS (Frequency Hopping Spread Spectrum) to hop through the channels. The range of Bluetooth is from 10-100 m depending on the power class and the fastest transfer speed is 1 Mbp (723.2 kbps) (Bhagwat, 2001). Belows are listed some prominent features of Bluetooth:

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- Low energy cost
- From Bluetooth 3.0, transfer speed of 24 Mbp has been supported. Possibility of short distance wireless LAN connections using the advantages over massive data transfer
- From Bluetooth 4.0, it has been reported that the energy usage has been reduced upto 100 times

Lost protector: There are many applications that can use Bluetooth. Chee *et al*. (2008) used RFID to implement a wireless security system that can tag a RFID signal so that the user can know the status of the object. Kwun *et al*. (2012) developed a similar system for real time tracking. Compared to the IC chip it has the advantage of detection without limitations to the direction and it can store a lot of data. However, the implementation may be difficult as it has not been minimized to a size that can be attached to objects. Another application that can be examined is the taxi lost item system. It attaches cameras on the ceiling under the seats and in the trunk so that the customer can verify before they get off. If an object is found the taxi driver receives a signal indicating that there is a lost item. To protect the passenger identity the cameras do not show the face of the passenger. Such examples are what this paper strives for and are the first step to implement smartphones in the area of object security.

As the number of electronic devices has increased, we looked to create an App that could prevent missing items. We used RF which is wireless to ring an alarm when the distance increases beyond the set limit between the user and object.

MATERIALS AND METHODS

For this research, we attached a reduced H/W to the missing object. The final goal of this research is to integrate the compact tag to Bluetooth communication and distribute commercially.

Experimental H/W design: The smartphone application we used in this research was developed using Eclipse development tool (Yan and Shi, 2013). H/W coding was done through AVR Studio 4.1 and the Bluetooth module and MCU parts were manufactured by Firmtech Corp's FB155BC and atmega128 (http://www.atmel.com/ images/ doc 2467.pdf), respectively. Figure 1 shows a specification of BT configuration that is one of utilities provided by Firmtech Corp. for Bluetooth module setup. By assigning the role as "slave" and the smartphone as "master", we allowed the smartphone to find missing items.

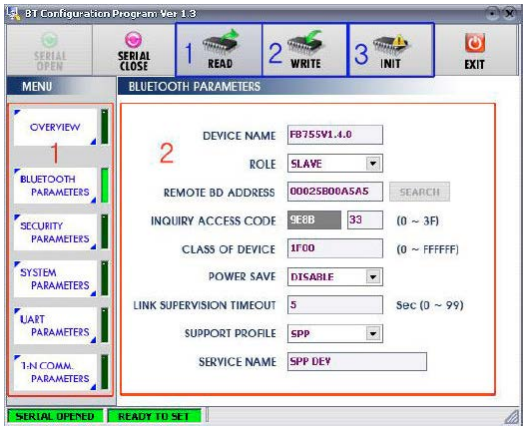

Fig. 1: Specification of BT Configuration provided by Firmtech Corp

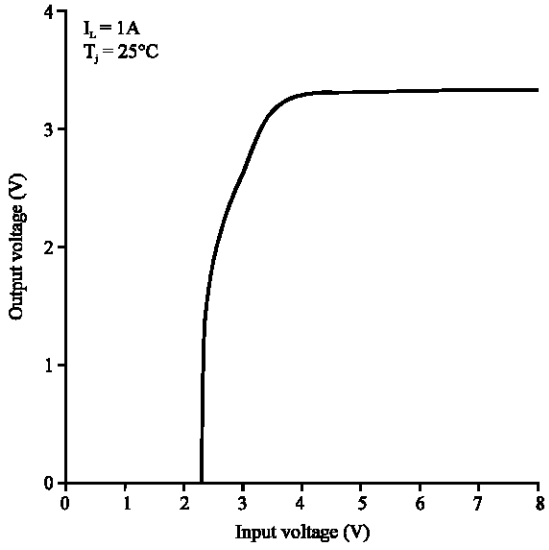

Fig. 2: Characteristics of voltage behavior (LM3940) (http://www.ti.com/lit/ds/symlink/lm3940.pdf)

As the Bluetooth module FB155BC requires 3.3 V, we need a regulator that matches it. We selected a LM3940 regulator that can lower 4.5 V from three basic AAA batteries to 3.3 V. Figure 2 shows the low voltage behavior of LM4940.

In order to find a missing item, we used GEC-33A as a buzzer for the user. Figure 3 shows how GEC-33A works. It is 80 dB/30 cm as we designed our experimental voltage as 3.3 V. We used module MAT128-100 circuit as the MCU in order to experiment using the breadboard. Figure 4 shows how the MCU works.

We first initialized UART (Universal Asynchronous Receiver/Transmitter) because the Bluetooth module and

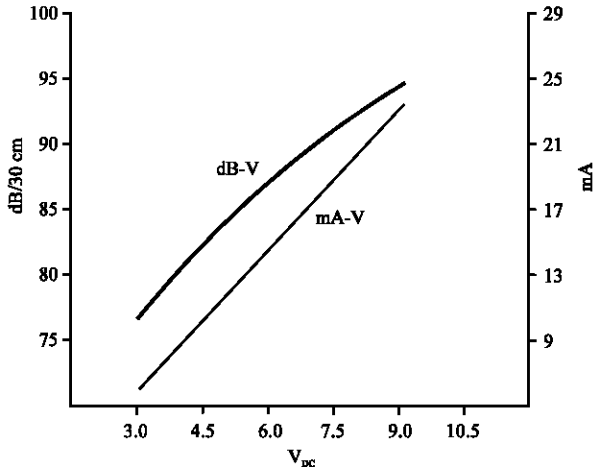

Fig. 3: Frequency range for buzzer-GEC-33A

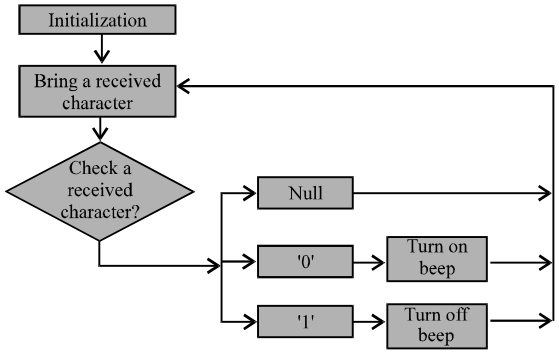

Fig. 4: Design diagram for MCU operation function

the MCU communicate using the UART by Osborne (1980). After initialization it operates in an infinite loop according to the transmitted character. If the value is null, it means that no character was transmitted thus the loop runs again until '0' or '1' is returned. Depending on the value the GPIO of Atmega 128 turns the buzzer on or off.

RESULTS AND DISCUSSION

Application design: By assigning the roles, the smartphone and Bluetooth of H/W can communicate through the Bluetooth socket. By assigning the UUID as "00001101-0000-1000-8000-00805F9B34FB" it can communicate with H/W through serial communication. The GUI of the smartphone application is shown in Fig. 5a.

The add button prints out the Bluetooth enable devices nearby. The list has both paired devices and unpaired devices and by clicking on a device the phone can start communicating with the selected device. If it is successful H/W receives a value of '1' and in the status

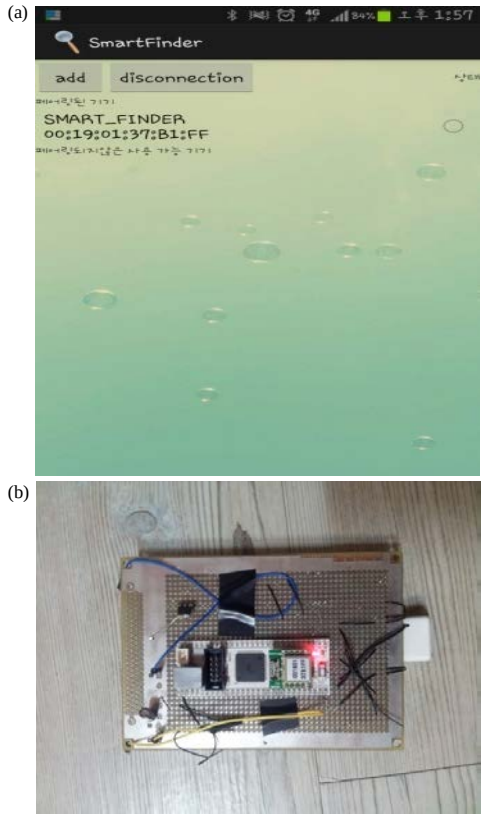

Fig. 5: Initial experimental prototypes for smart finder application; a) Graphic user interface and b) H/W configuration

is changed to "connected". If the communication is unsuccessful then a error message is shown. By communicating the H/W sounds the buzzer and the person finds their missing object they can disconnect Bluetooth. By disconnecting it the buzzer from H/W is turned off. Figure 5b shows a completed initial design.

CONCLUSION

This study implemented a smart finder application based on Bluetooth technology. Though it was a simple design for the experiment, we think it can be useful for many applications including lost protector. Also, there needs to be competition between the final product size and price. If we consider that the Bluetooth range is 10 m, it may be difficult to find the object in a large room. Although, we used Bluetooth for the experiment we advise for future works to use a different wireless communication method to increase the search range, number of connections as well as low power

consumption. In this experiment, we relied on the user to find the object using sound but as sound decreases over longer distances some modifications will be needed for commercial use.

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