Anti-lost/theft Alarming System for Personal Belongings

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Introduction

• **Inspiration:** High loss rate of personal belongings from TechCrunch report

• **Goal:** Design an effective anti-lost alarming system for personal belongings by using advanced communication device
Features

- Multiple item-tracking function
- LCD screen displaying losing item
- Traceable alarming system
- Manual switch for LCD display
- Flash LED indication
Technology Choice

- Radio Frequency Identification (RFID)
  - Multiple tags reading function
  - One-way signal transmitting
  - Small size tags
  - Large size readers
  - Large power consumption
Technology Choice

- Bluetooth 4.0
  - Programmable function
  - Two-way signal transmitting
  - Small size and light weight
  - Low energy consumption
Hardware Overview

Portable Base Block Diagram

Tag Block Diagram
System Flow

1. System Boot
2. Tag Scan Portable Base's RSSI
3. RSSI < Threshold?
   - Yes: Tag Establish Connection with Portable Base
   - No: Portable Base Start Advertise
4. Portable Base Decode ID Information
   - Yes: 1. Display item information, 2. Light Alarm LED
   - No: Tag Disconnect from Portable Base
5. Measure Connection RSSI
6. RSSI < Threshold?
   - Yes: END
   - No: Tag Disconnect from Portable Base
Portable Base (master-end)

- **Microcontroller Module**
  - Arduino UNO
  - Receive signal from bluetooth
  - Send signal to LCD screen and LED

- **Communication Module**
  - Bluegiga BLE112 chip
  - Communicate with tags
Portable Base (master-end)

- **Power Supply Module**
  - 9V Battery with Dc-Dc converter
  - CR2032 Coin Cell Battery

- **Display Module**
  - ACM1602A SERIES LCD screen
  - Display losing item name

- **LED and Push button**
  - Cancel alarm notification
Master-End Device
Design Change

- Keypad to Push Button
  - Size issue
Portable Base Requirement

• Portable Base is visible to each tag
• Be able to identify the signal transmitted by the tag
• Display the identity of the item is under the risk of losing
Slave-End Device
Tag (slave-end)

- **Communication Module**
  - Bluegiga BLE112 chip

- **Power Supply Module**
  - CR2032 Coin cell battery
  - Buck power converter

- **Alarm Module**
  - FY14. 3-18Vdc mini-piezo buzzer

- **Capacitors**
Design Change

- Not using the MOSET to Control the buzzer
  - $V_{ds} > 2.5$ V
Tag Schematic
Tag Requirement

• Get the RSSI of the Portable Base
• Compare the RSSI to the setup reference value
• When RSSI < Reference
  • Trigger the alarm
  • Send ID information to the Portable Base
RSSI Test

Figure 1: Raw RSSI Value at 0.5m

Figure 2: Raw RSSI Value at 1.5m
Filtered RSSI Plot

Figure 3: Filtered RSSI Value at 0.5m

Figure 4: Filtered RSSI Value at 1.5m
Real RSSI Data Plot

Figure 5: Sample Raw and Filtered RSSI data
Alarm Response Time

Response Time ≈ 1 us

Figure 6: Alarm Response Time
Power Consumption

Voltage constant at 2.8 V (Vary with coin cell battery)

Current Profile:

Figure 7: Current Profile when Advertising and Scan

Figure 8: Current Profile During Data Transfer
Battery Lifetime

- Scan Rate: 20/min (every 3 sec)
- Scan Interval: 125 ms
- Power Consumption:
  \[36 \text{mA} \times (20 \times 125 \text{ms}) \times 60/3600 = 1.5 \text{ mAh/hr}\]
- CR2032 Coin Cell Battery Capacity: 230 mAh

- **System Battery Lifetime**: \[230/1.5 = 153 \text{ hr}\]
Difficulties

- Solder the Power Converter
Future Work

• Change the user interface to touch screen

• Integrate the whole system

• Improve power efficiency
Question ?
Credits

- Professor Scott Carney
- TA: Igor Fedorov
- Staff at ECE Part Shop
- Bluegiga Tech Support: Jeff Rowberg
Thank you!