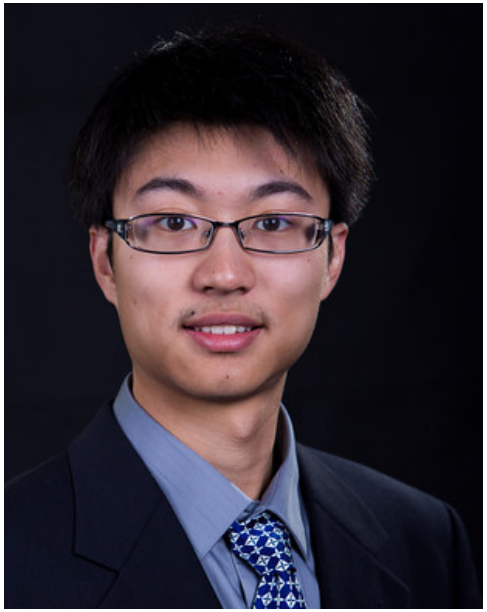
Anti-lost/theft Alarming System for Personal Belongings

Group 24
Wenhao Li, Yunchi Sun, Xiying Wang
TA: Igor Fedorov

April 30, 2013

Yunchi Sun **Xiying Wang** **Wenhao Li**



Introduction

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

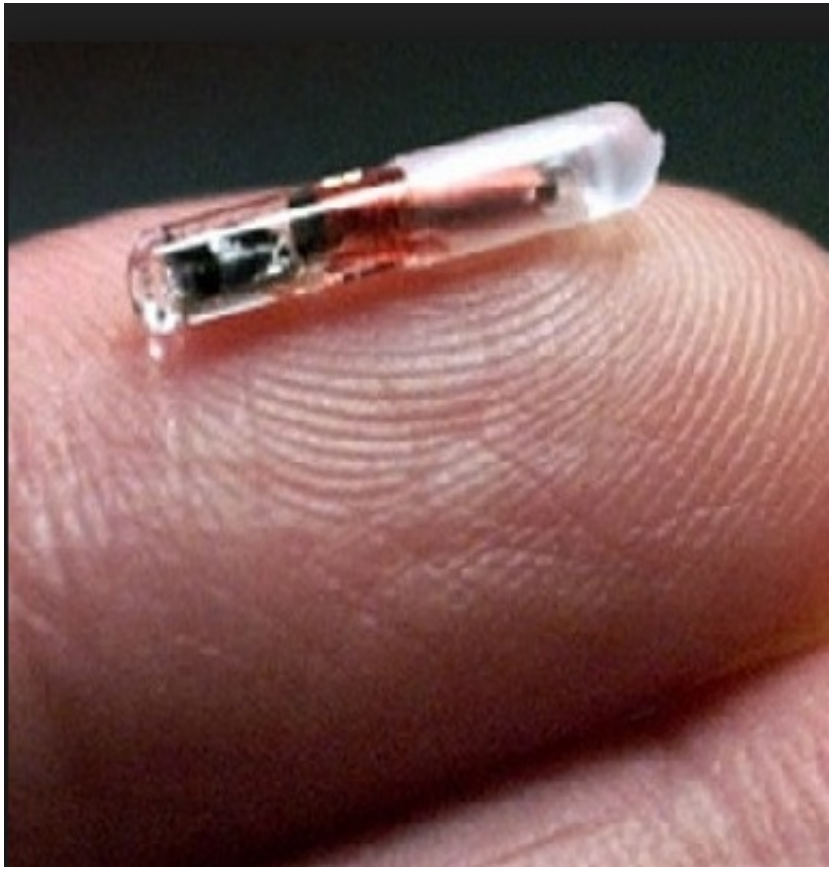
- **Goal:** Design an effective anti-lost alarming system for personal belongings by using advanced communication device

Features

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

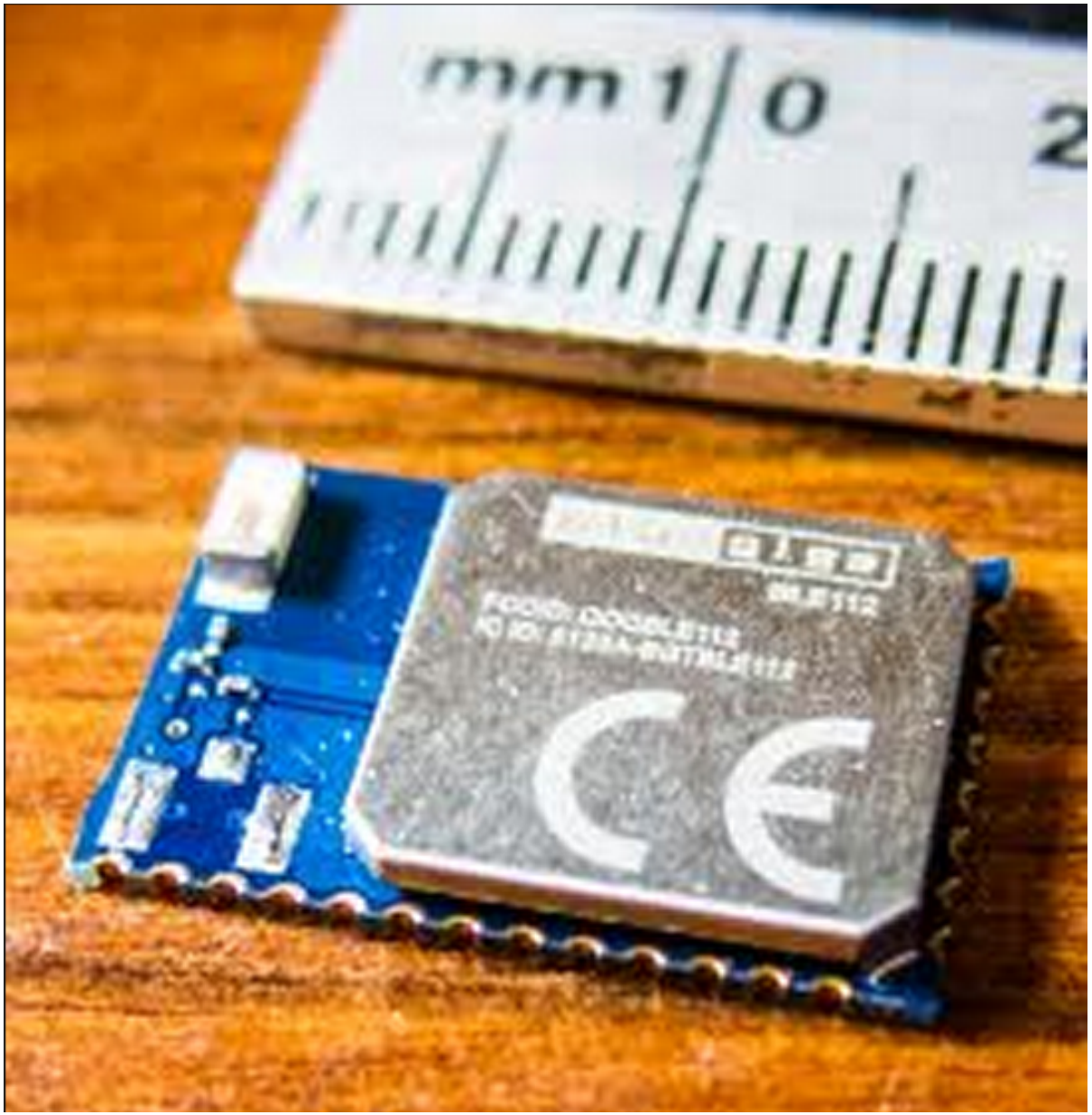
Technology Choice

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



Technology Choice

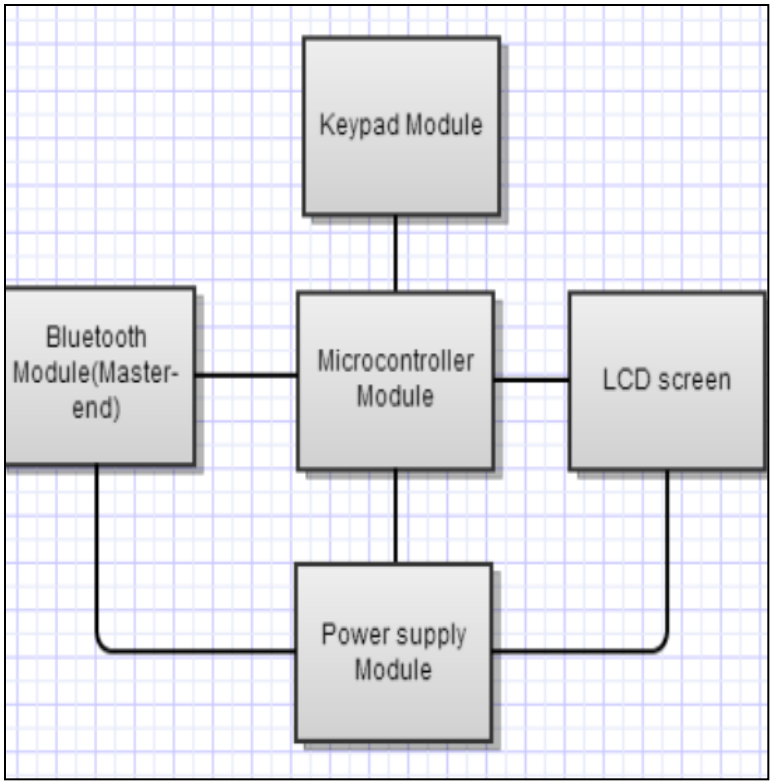
- Bluetooth 4.0
  - Programmable function
  - two-way signal transmitting
  - Small size and light weight
  - Low energy consumption



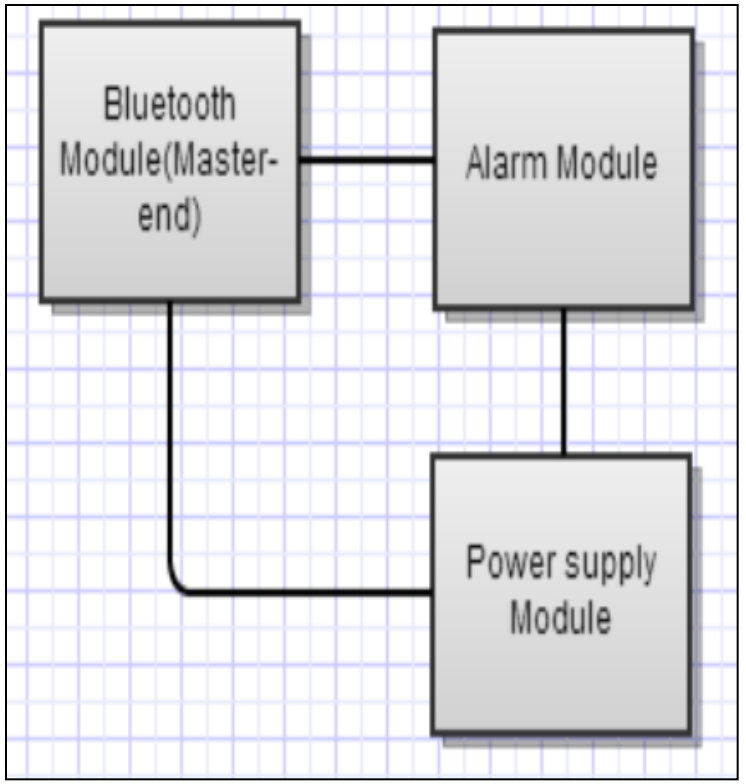
BLE112

Hardware Overview

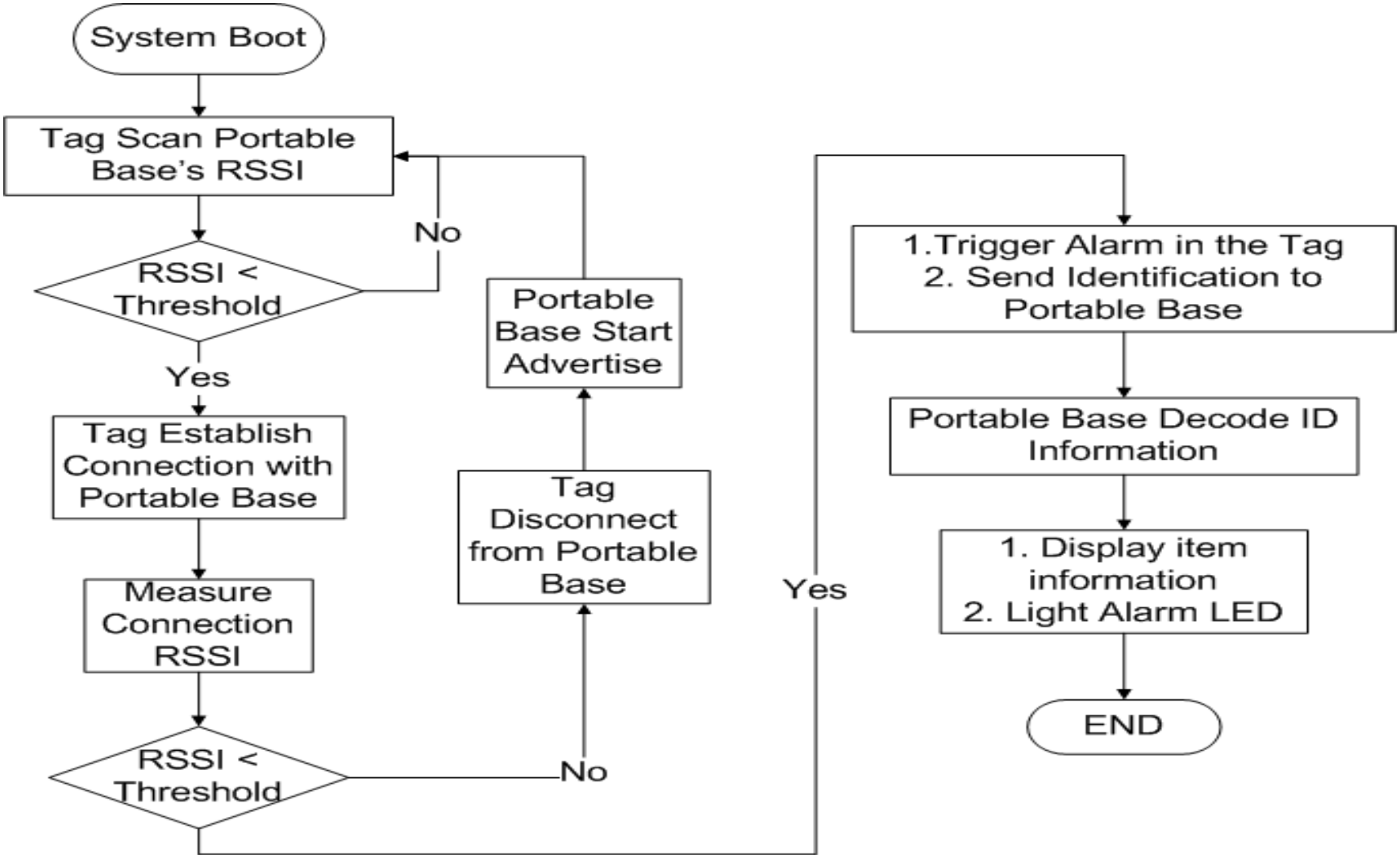
Portable Base Block Diagram



Tag Block Diagram



System Flow


System Boot
Tag Scan Portable Base's RSSI
No
RSSI < Threshold
Yes
Tag Establish Connection with Portable Base
Measure Connection RSSI
RSSI < Threshold
No
Tag Disconnect from Portable Base
Portable Base Start Advertise
Yes
1.Trigger Alarm in the Tag
2. Send Identification to Portable Base
Portable Base Decode ID Information
1. Display item information
2. Light Alarm LED
END

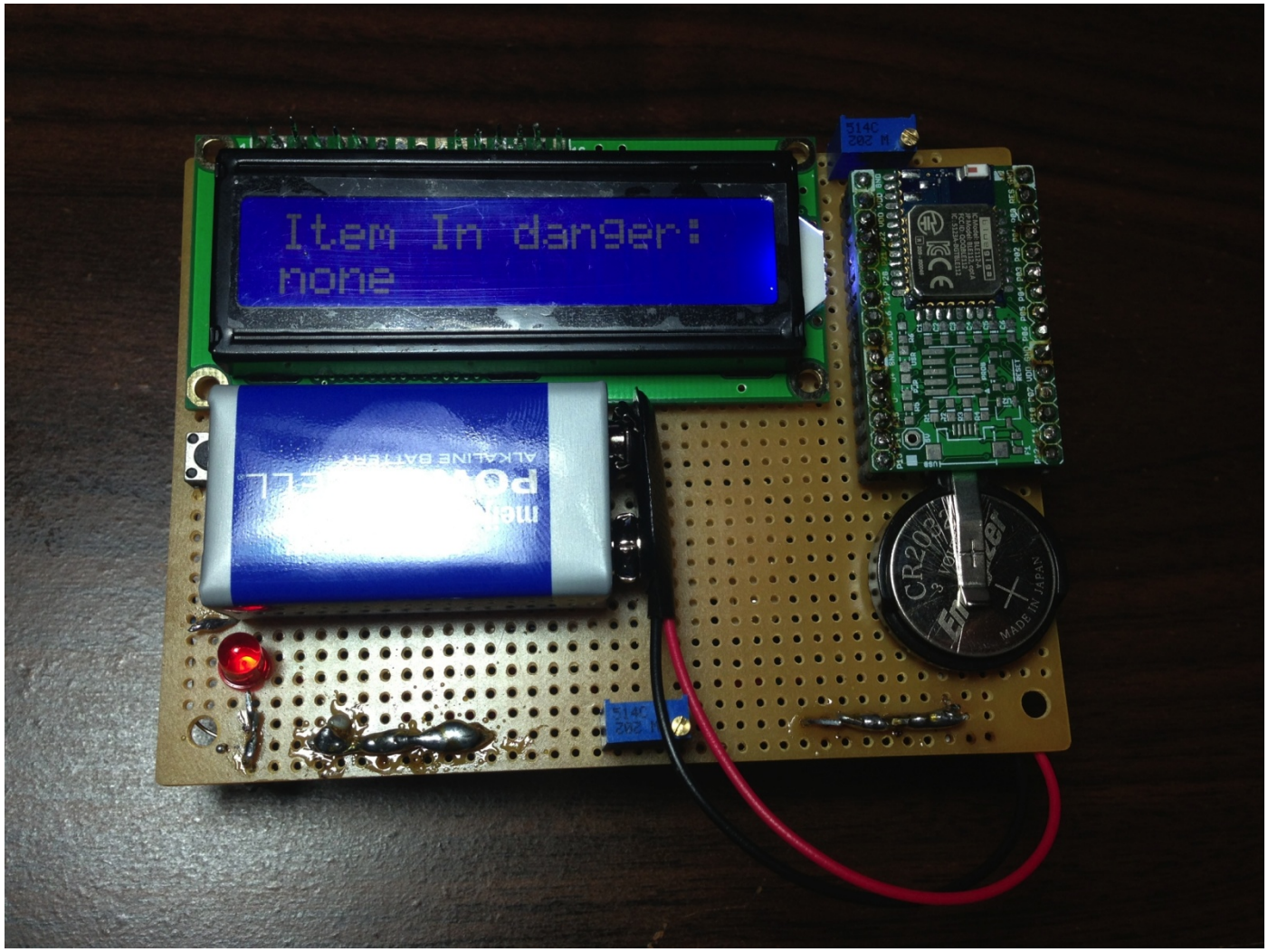
Portable Base (master-end)

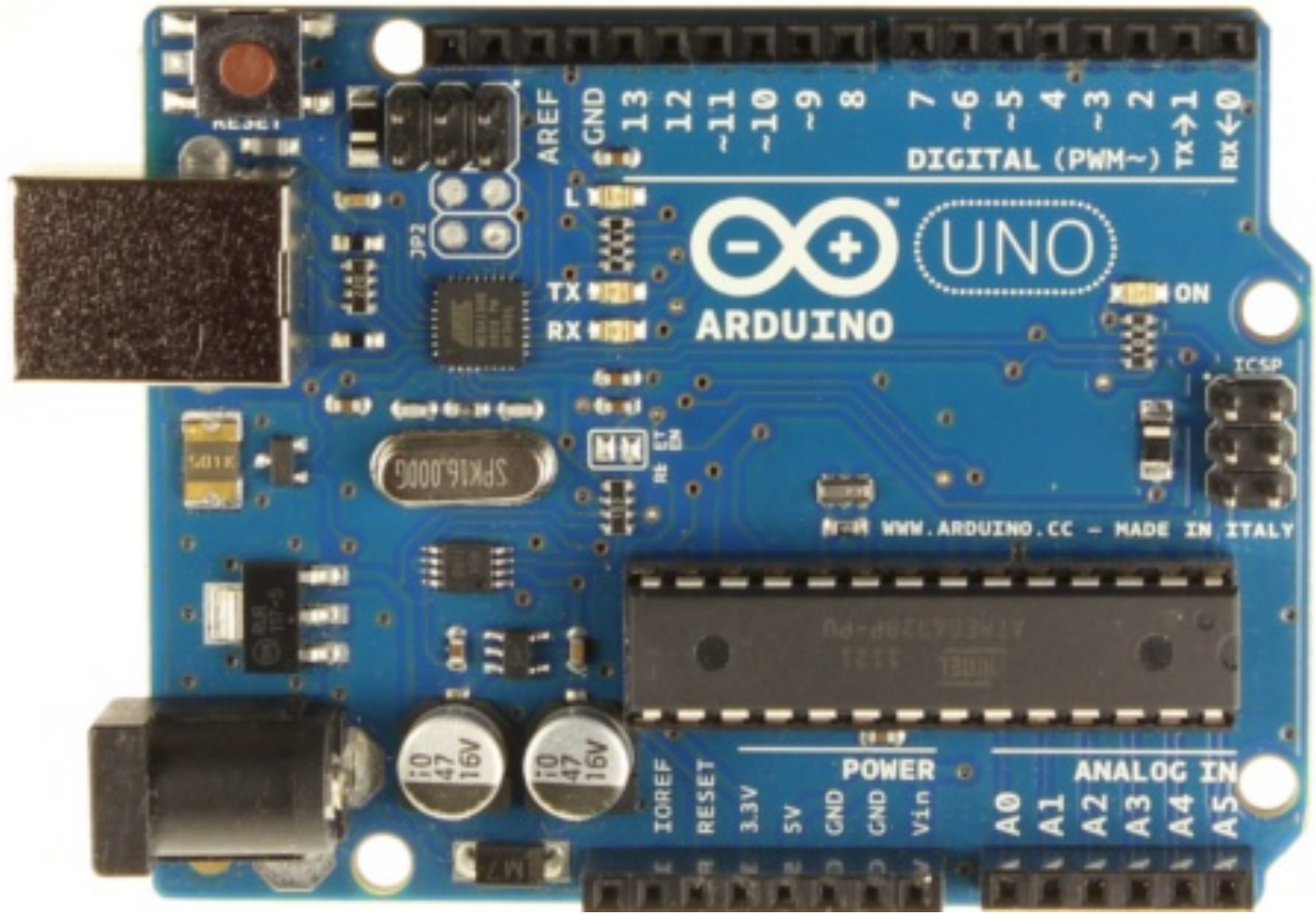
- Microcontroller Module
  - Arduino UNO
  - Receive signal from bluetooth
  - Send signal to LCD screen and LED
- Communication Module
  - Bluegiga BLE112 chip
  - Communicate with tags

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

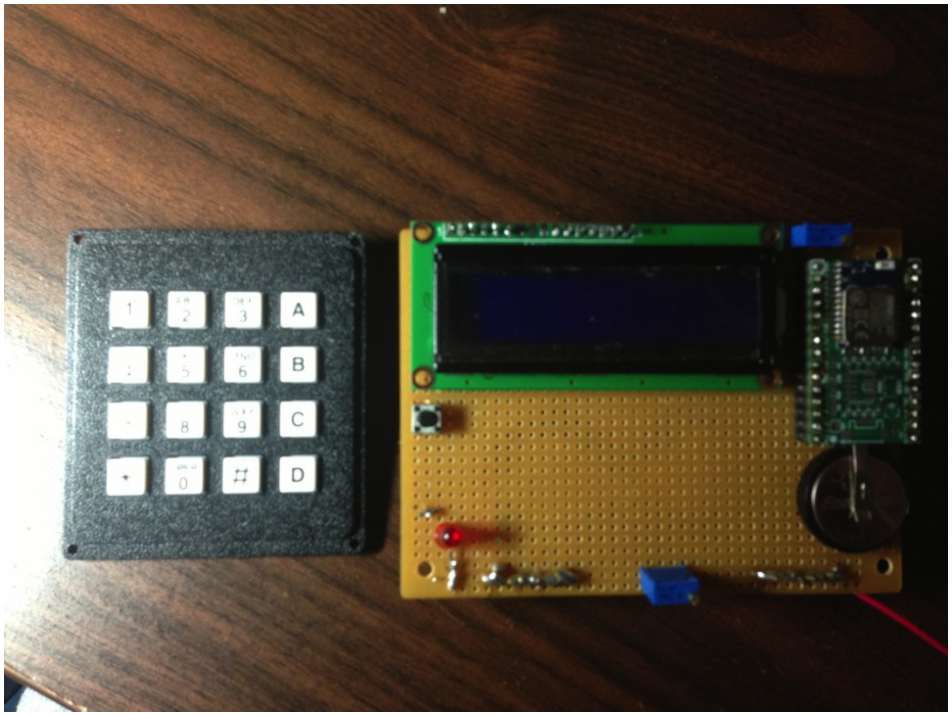
Master-End Device




AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
ICSP
WWW.ARDUINO.CC – MADE IN ITALY
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5

Design Change

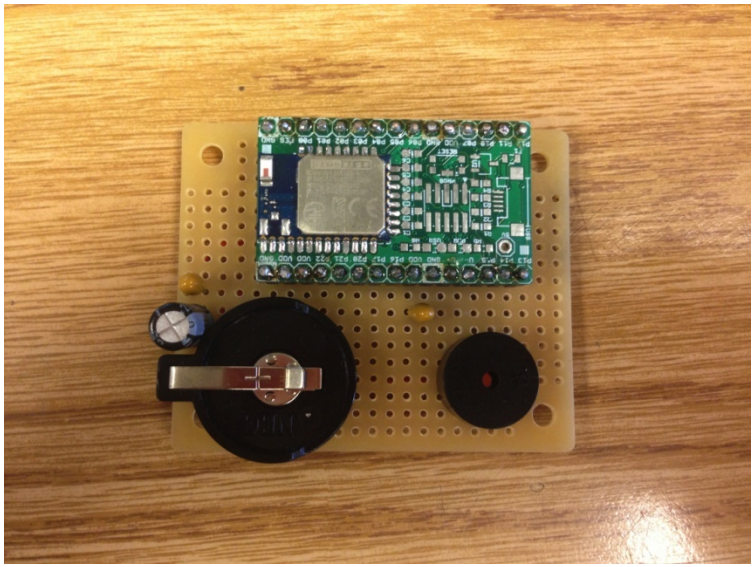
- Keypad to Push Button
  - Size issue

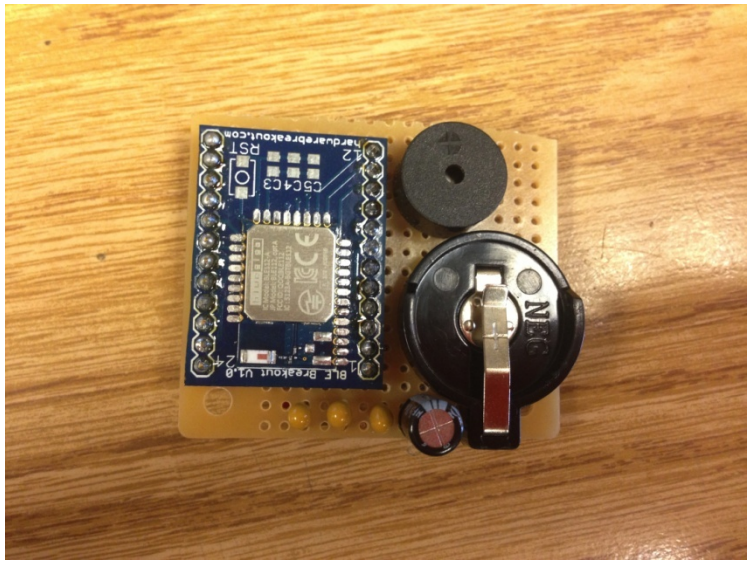


Portable Base Requirement

- 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





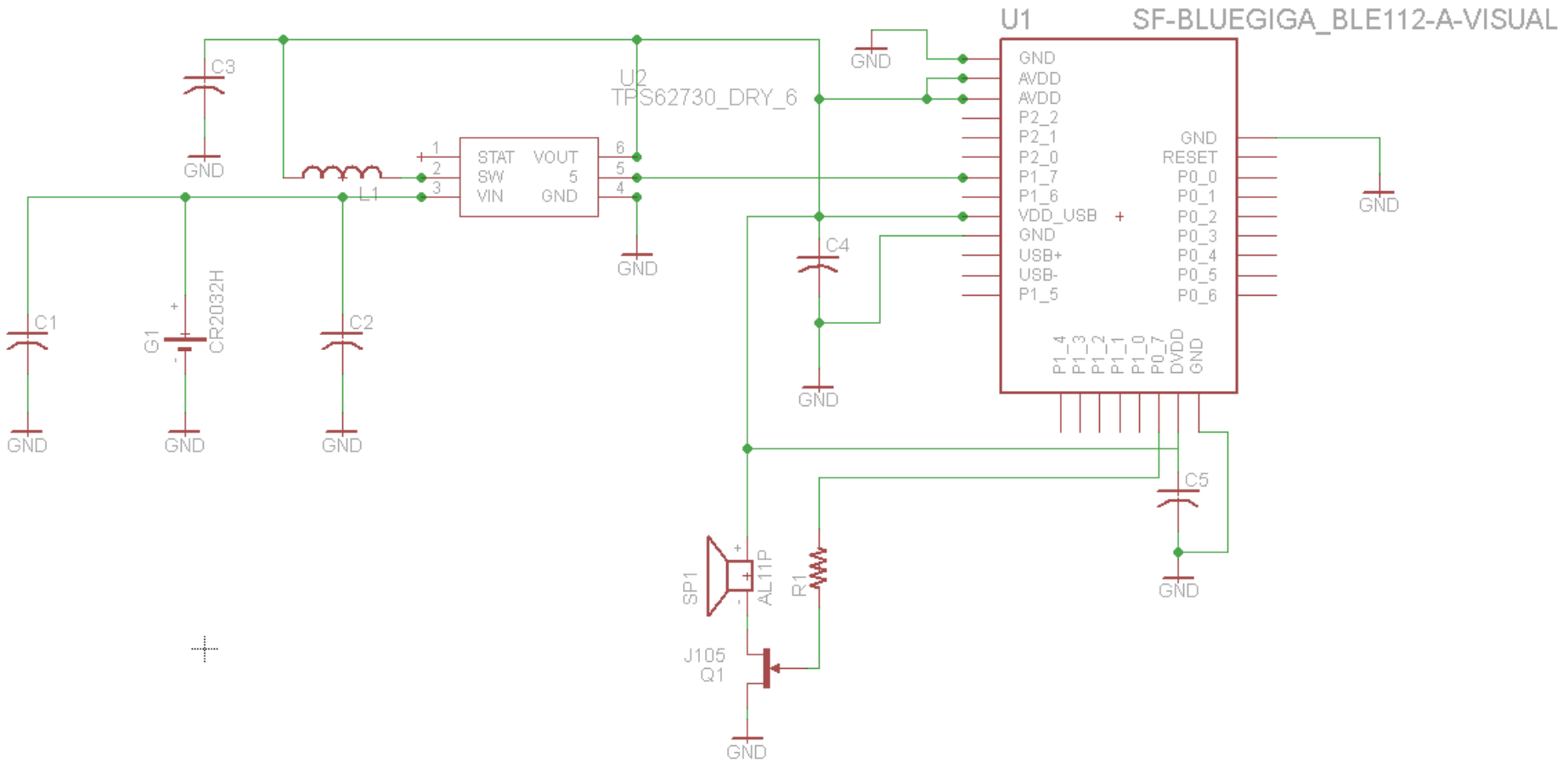
Tag (slave-end)

- 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

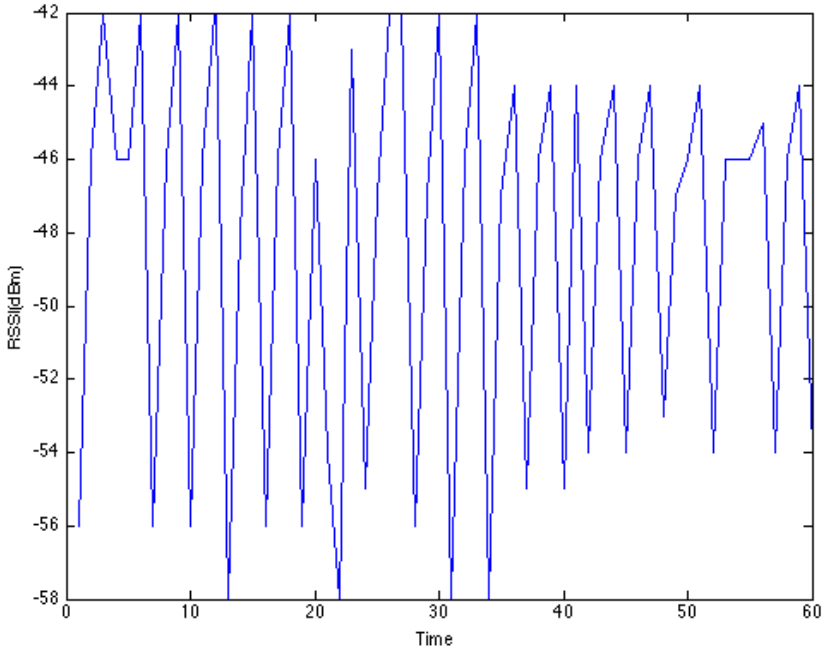


Figure 1: Raw RSSI Value at 0.5m

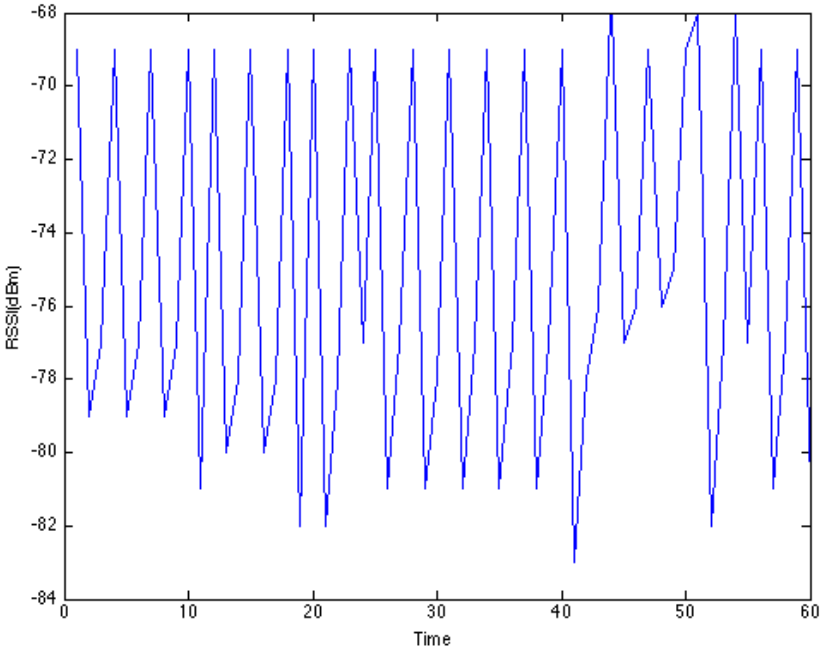


Figure 2: Raw RSSI Value at 1.5m

Filtered RSSI Plot

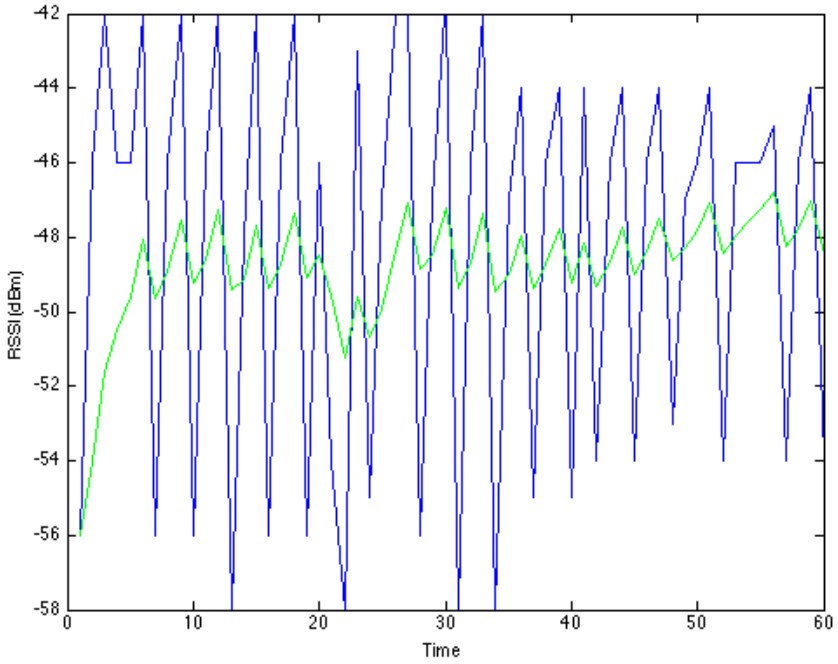


Figure 3: Filtered RSSI Value at 0.5m

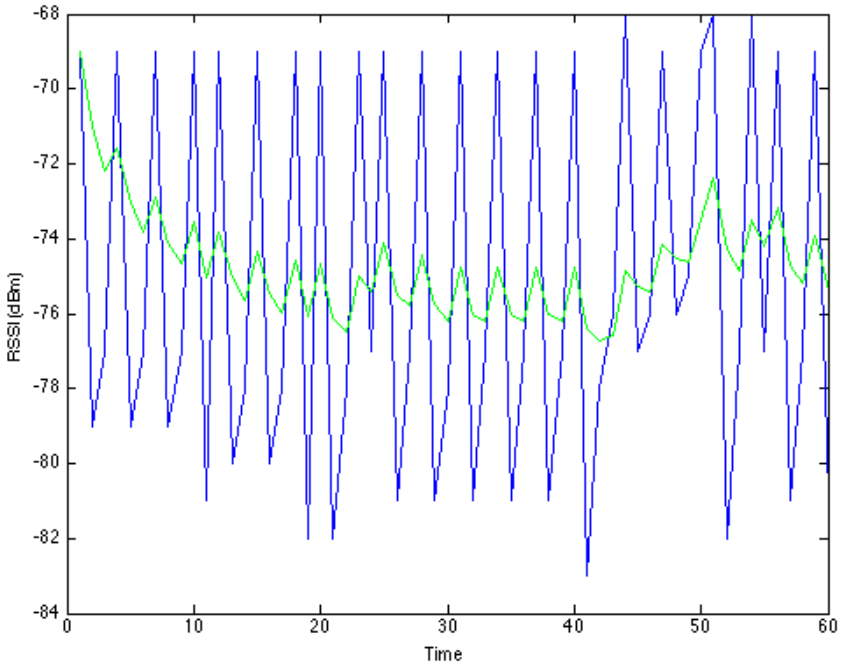


Figure 4: Filtered RSSI Value at 1.5m

Real RSSI Data Plot

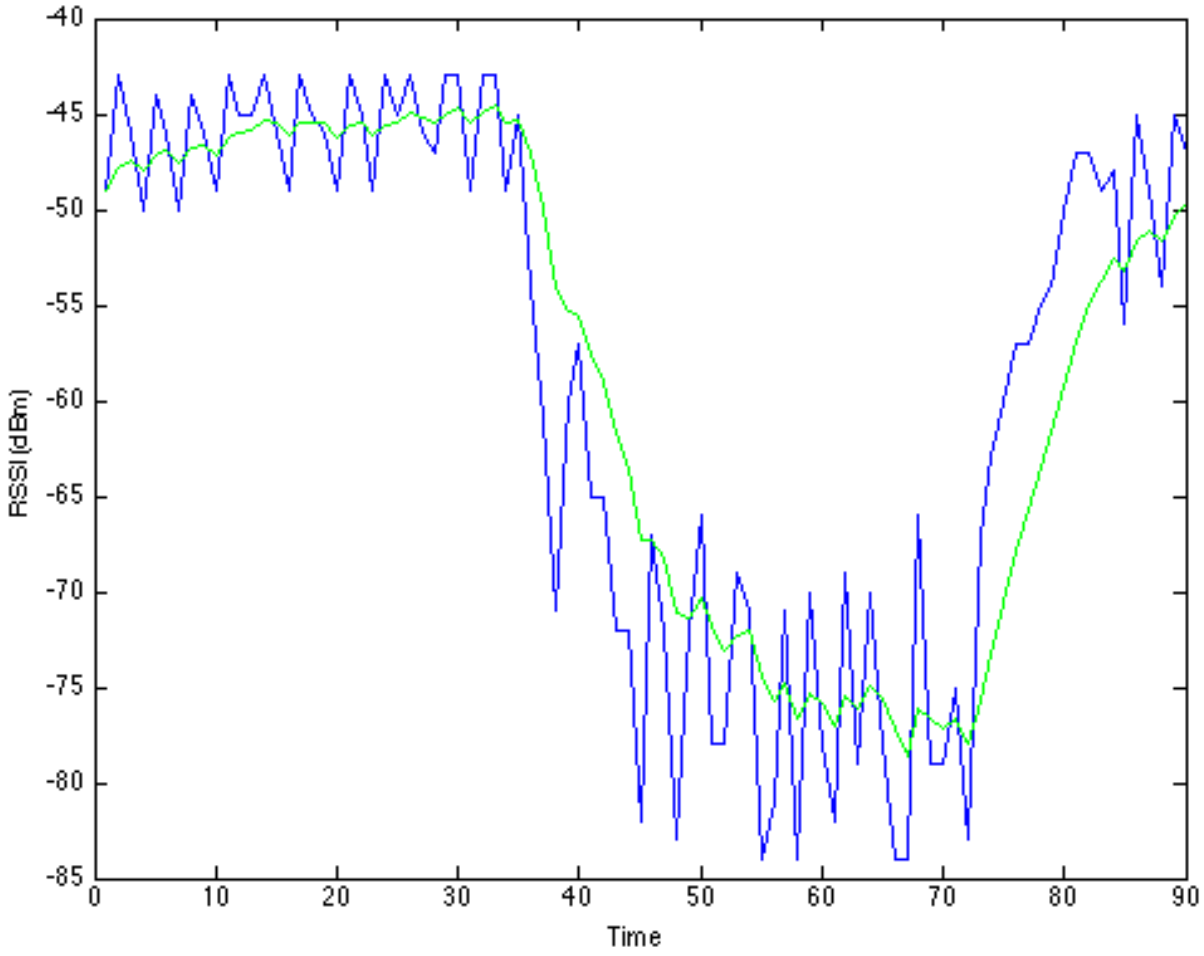


Figure 5: Sample Raw and Filtered RSSI data

Alarm Response Time

Response Time ≈ 1 us

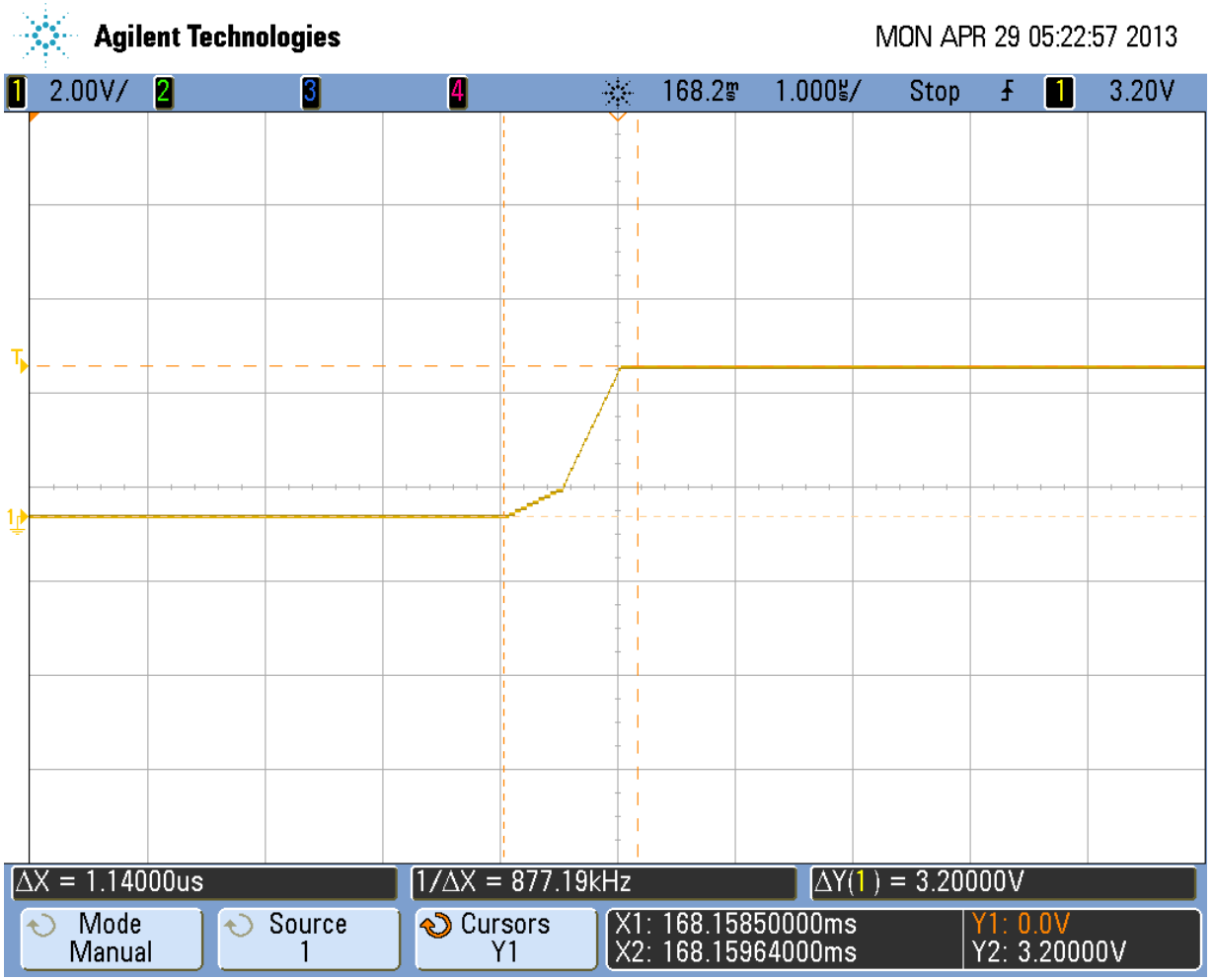


Figure 6: Alarm Response Time

Power Consumption

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

Current Profile:

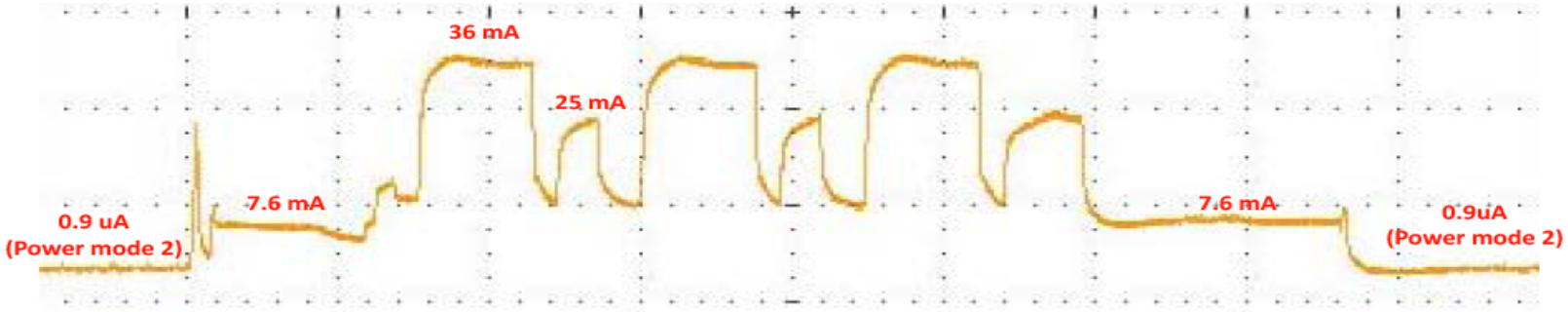


Figure 7: Current Profile when Advertising and Scan

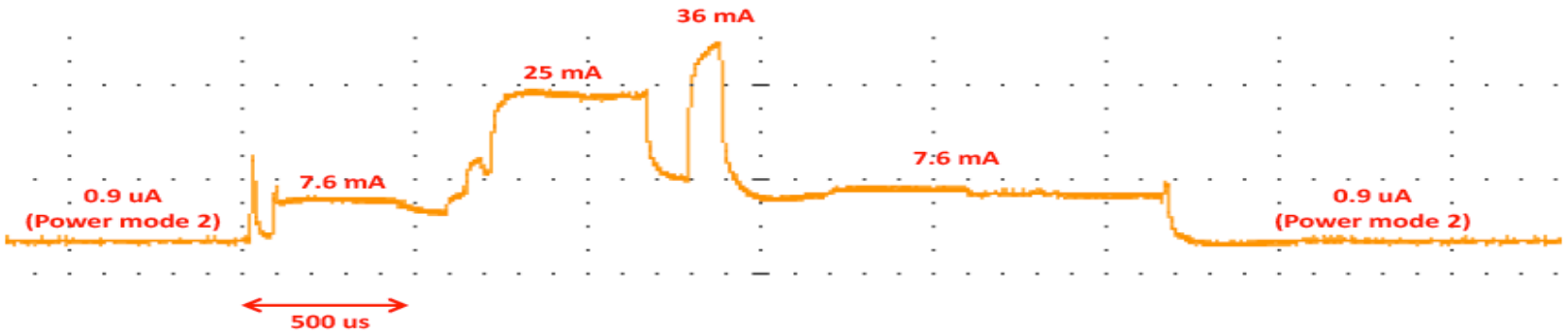


Figure 8: Current Profile During Data Transfer

Battery Lifetime

- Scan Rate: 20/min (every 3 sec)
- Scan Interval: 125 ms
- Power Consumption:
  36mA*((20*125ms)*60/3600)=1.5 mAh/hr
- CR2032 Coin Cell Battery Capacity: 230 mAh

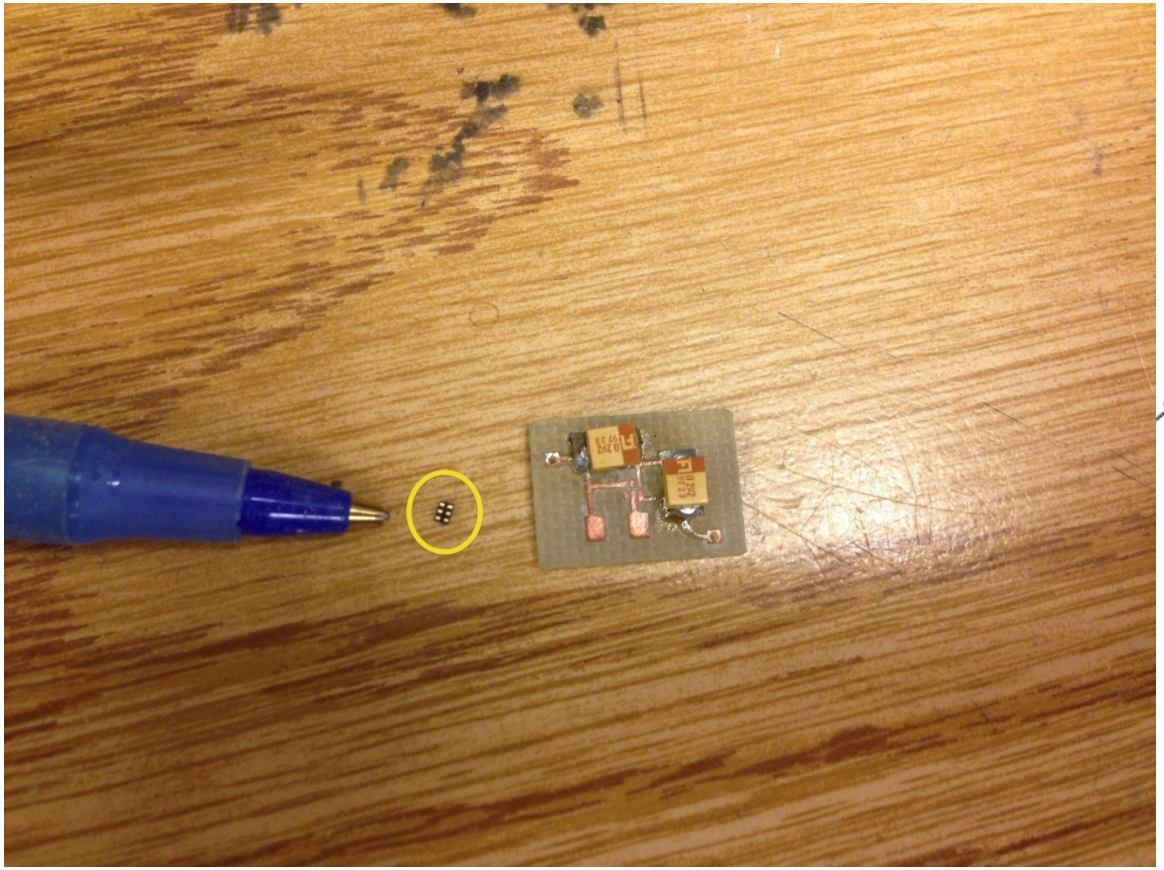
- **System Battery Lifetime**: 230/1.5=153 hr

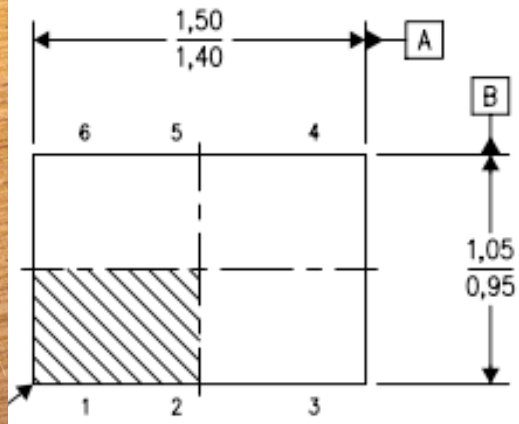

maxell
3 V
CR2450
Hitachi Maxell, Ltd.
Japans


RPM
FLUKE 45 DUAL DISPLAY MULTIMETER
M
AUTO
3.220
V DC
FREQ
AUTO

Difficulties

- Solder the Power Converter





Unit: mm

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 !