Department of Electronic & Telecommunication Engineering

University of Moratuwa

Smart Spotter

Group EN 03

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ABSTRACT

Due to the ongoing economic crisis in Sri Lanka, people are facing financial difficulties and as a result, the rate of robberies has been increased. This paper focus on the development and implementation of a smart key tag to track our personal items using Atmega328P Microcontroller, HC-06 Bluetooth Wireless Module, analog components, and ICs. The goal of this project is to implement a working smart spotter with 2 key feature modes named Finder mode and Security mode.

1. INTRODUCTION

Smart spotter is a fully functional programmable smart key tag with an active piezo buzzer as sound output. Atmel Atmega328P handles storage, processing, and input/output tasks. HC-06 Bluetooth Wireless Serial Module is used for the wireless communication between the smart spotter and the user's smartphone. 2 in series Li-Po batteries are added to power the smart spotter.

2. METHODOLOGY

Here we look at the main components and how the algorithms and codes work.

2.1. Specifications

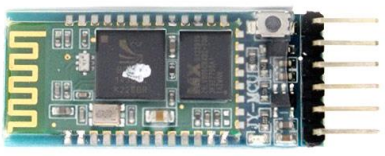
- Physical Dimensions :80x50x15mm
- Weight :50g
- Power Consumption: 0.4W
- Microcontroller: ATmega328P
- Bluetooth Module: HC-06 Bluetooth Wireless Serial Module
- DC Power Source: 2 Li-Po batteries in series
- Voltage Regulator: LM7805
- Buzzer

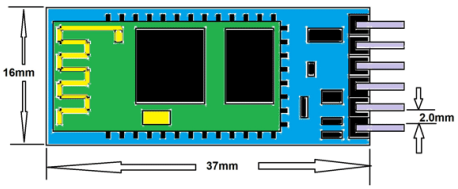
2.2. Buzzer

Active piezo buzzer is the sound output device in the smart spotter. Buzzer is used to give the user the signal when the connection between the Bluetooth module of the smart spotter and the phone is lost.

2.3. HC-06 Bluetooth Wireless Serial Module

The HC-06 is a class 2 slave Bluetooth module designed for transparent wireless serial communication. It is designed for establishing short range wireless data communication between two microcontrollers or systems. This the most affordable method which can be used for wireless data transmission. It can transmit files at speed up to 2.1Mb/s. Here we use

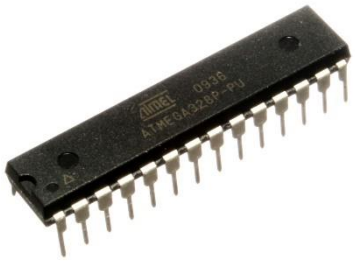




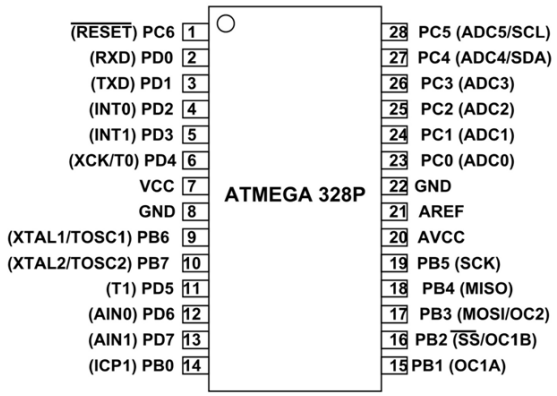
2.4. Main Circuit

2.4.1. Micro controller

The ATmega328P is high performance, low power single-chip microcontroller created by Atmel in the megaAVR family. It is an 8-bit microcontroller based on AVR RISC architecture.



Atmega328P Microcontroller



Atmega328P Microcontroller Pinout configuration

Features

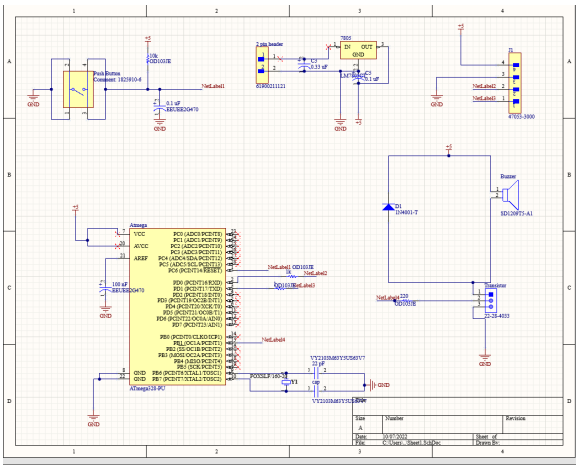
Max CPU speed	20MHz
Performance	20 MIPS at 20 MHz
Flash memory	32KB
SRAM	2KB
EEPROM	1KB
Package pin count	28 or 32
Maximum I/O pins	23
External interrupts	2
USB interface	No

2.4.2.PCB

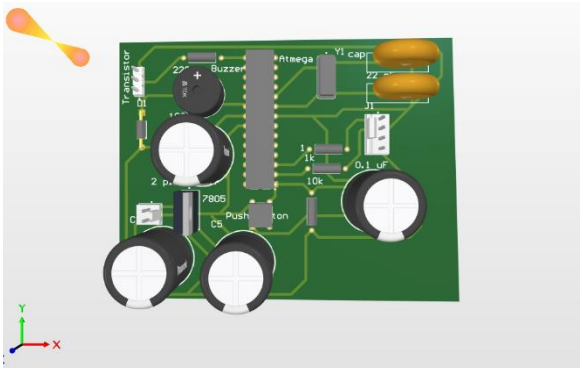
The following components are mounted on PCB.

- LM7805 Voltage Regulator
- Capacitors
  - Three 0.1 µF
  - Two 22 pF
  - One 0.33 µF
- Resistors
  - 220 Ohms
  - 1 k Ohms
  - 10 k Ohms
- Push Button
- Crystal Oscillator 16MHz
- BC547 transistor
- IN4007 Diode
- Active Buzzer
- A 2-pin header

Designing the PCB is a very important step, because all the factors depend on the reliability of the PCB.



Schematic Design



PCB Design

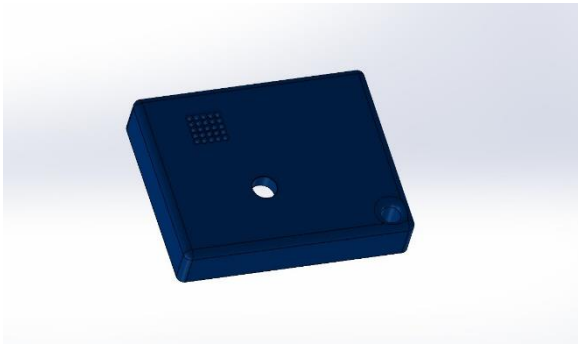
2.5. Battery

Two thin 3.7V lithium polymer batteries are the best solution. Because it wasn't available in Sri Lankan market, we used a 9V Lithium-ion rechargeable battery.

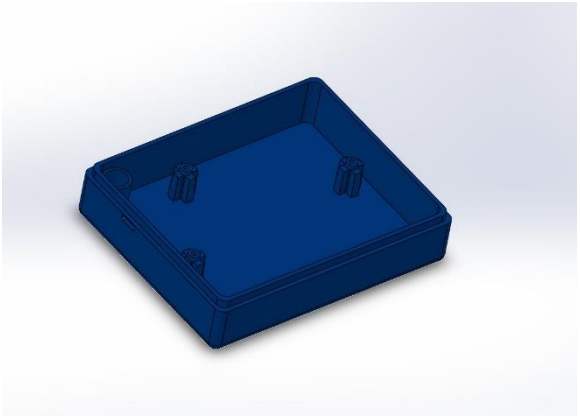
2.6. Enclosure Design

Enclosure is designed with a glossy finish to get a futuristic appearance.

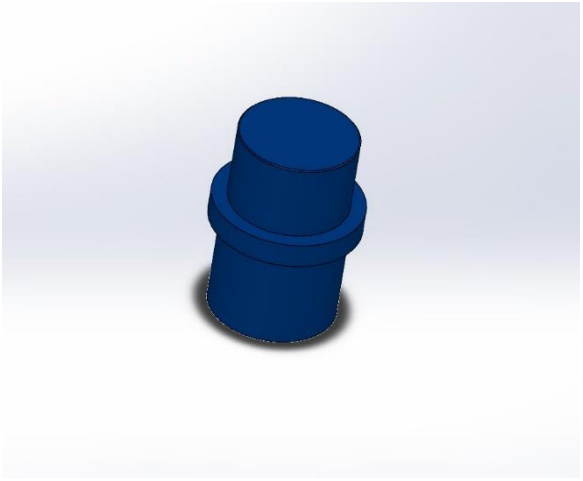
Material: Polylactic Acid (PLA+)



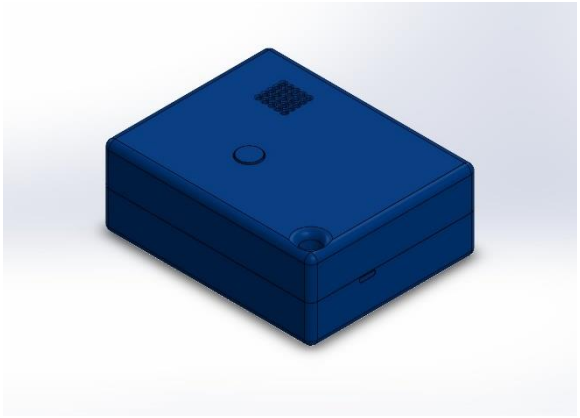
Top part of the enclosure



Bottom part of the enclosure



Button



Full Assembly

2.7. UI Design of the Mobile App

The interface of the mobile app is made user friendly to satisfies the user requirements. It is made using MIT app inventor. This app has 2 modes.

1. Finder mode

To find the misplaced items like keys attached to the smart spotter when user taps on the 'connect' button, the buzzer starts to beep via the Bluetooth communication between smartphone and the smart spotter. Then, user can easily find the lost item through the sound.

2. Security mode

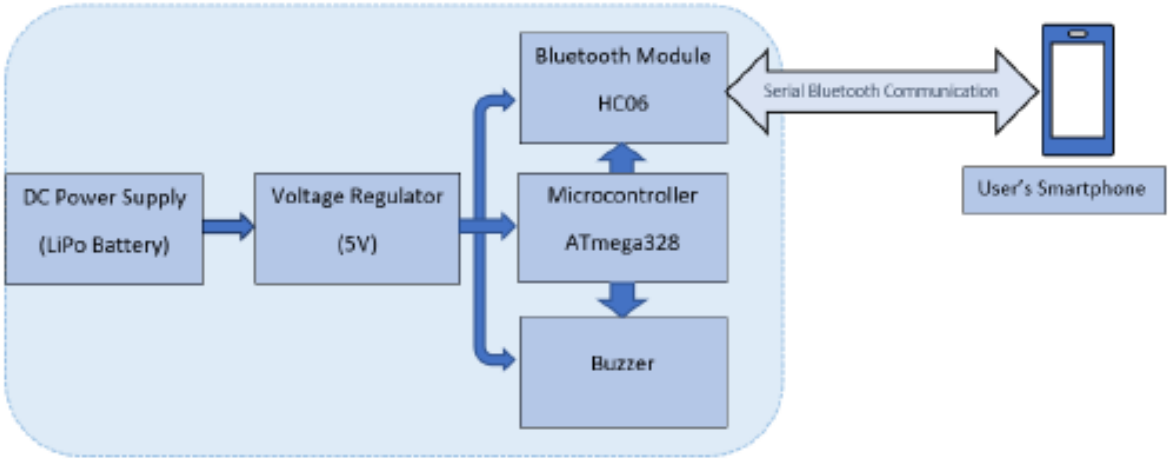
To ensure the safety of the items such as wallets and bags that contain the smart spotter. When user taps on the 'connect' button. As long as the item containing smart spotter is in the vicinity of the user (radical distance is about 10m), the Bluetooth connection between the smartphone and the smart spotter is maintained and user is notified about the connection by the app. At the moment when the connection is lost, the user receives the warning alert notification and the buzzer in the smart spotter starts to beep.

2.8. Product Architecture

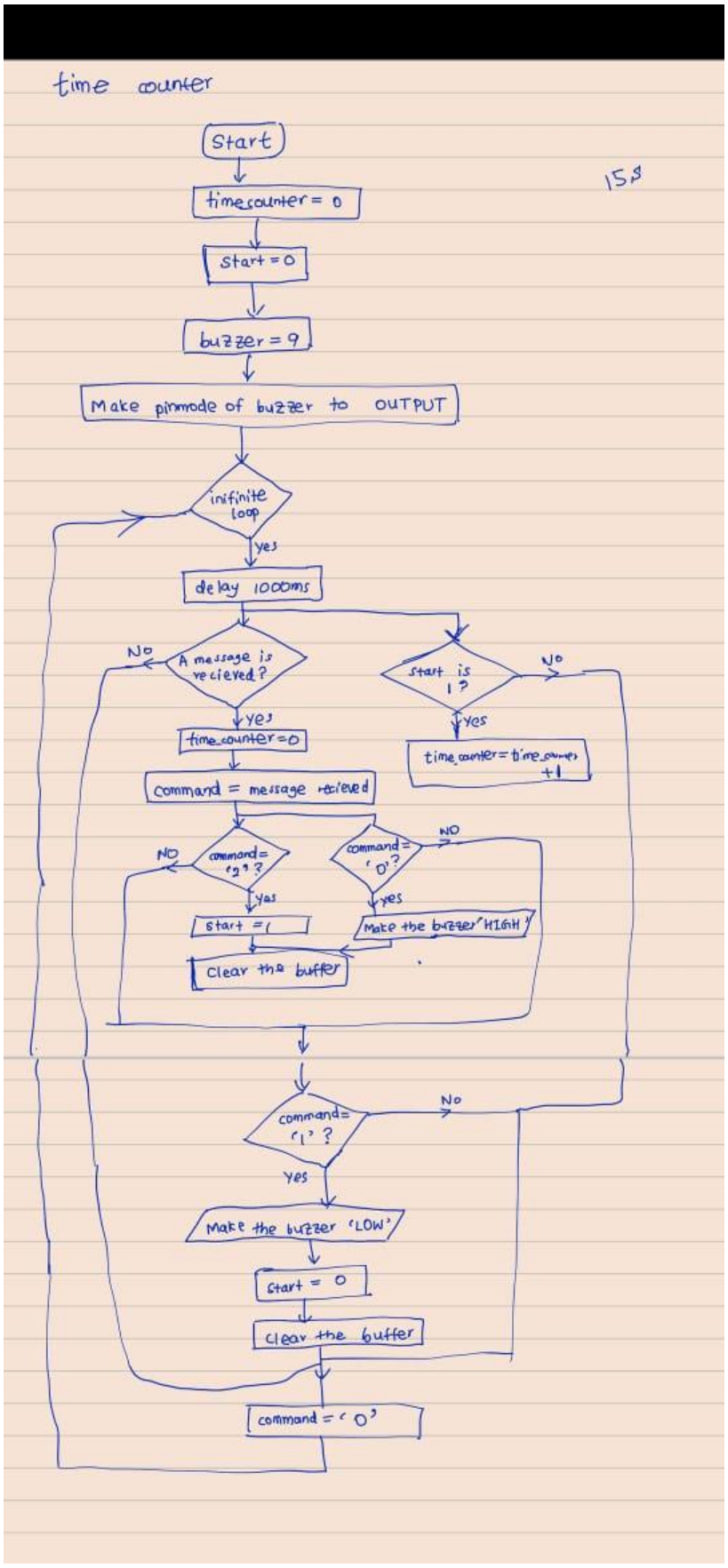
2.8.1. List of Components

ATmega328P	1
HC-06 Bluetooth module	1
LM7805 Voltage Regulator	1
IN4007 Diode	1
BC547 Transistor	1
16MHz Crystal Oscillator	1
Push Button	1
10 kΩ Resistor	1
1 kΩ Resistor	1
220 Ω Resistor	1
0.1 µF Capacitor	3
0.33 µF Capacitor	1
22 pF Capacitor	2
Piezo Active Buzzer	1
2-pin header	1

2.8.2. Block Diagram

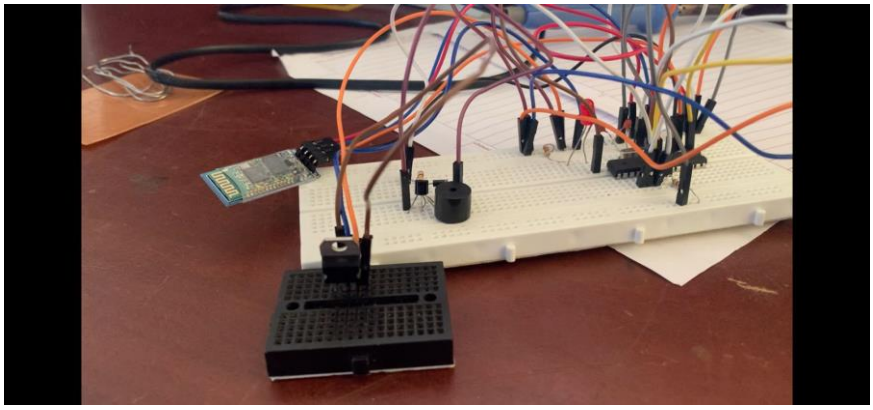


3. ALGORITHM


time counter
Start
timecounter = 0
Start = 0
buzzer = 9
Make pinmode of buzzer to OUTPUT
inifinite loop
yes
delay 1000ms
A message is recieved?
No
yes
time_counter=0
command = message recieved
command = '2'?
NO
yas
start = 1
command = '0'?
NO
yes
Make the buzzer 'HIGH'
Clear the buffer
start is 1?
No
Yes
time_counter = time_counter +1
command = '1'?
No
yes
Make the buzzer 'LOW'
start = 0
clear the buffer
command = '0'

4. TESTING

Test Case



The prototype worked properly without any failure. The app paired perfectly with the Bluetooth module. When we turned on the finder mode the buzzer went off and turned off when we disconnected it. Finder Mode

After we turned on the security mode and when the distance between the smart spotter and the phone increased more than 10m, the connection got lost and the buzzer went off. Security Mode Activated Security Mode Alert

5. DISCUSSION

When we were designing and implementing the device there were some problems that we came across.

01. As we wanted design to be small as possible, we were going to use an esp32 module. But due to lack of it in Sri Lankan market these days we decided to use the ATmega328P module.
02. We were going to use 2 in series 3.7V Li-Po batteries. Since it wasn't available in the market, we used a 9V battery. Because the power dissipation is significantly larger, we connected a power regulator with a heat sink.

6. MARKETING AND SALES

6.1.Marketing Plan

- Our main platform for marketing is social media. We will mostly focus on WhatsApp, Facebook, YouTube, and Instagram.
- We will create separate official accounts on YouTube, Facebook, and Instagram and use advertisements and followers to reach the target audience.
- Eye-catching flyers, posts and videos about the smart spotter will be shared through social media platforms.
- Introductory videos comparing our product with the similar products in the market will be created and shared.
- In addition, we can collaborate with online websites to post advertisements for the smart spotter.

6.2.Sales

- We intend to sell our product in local shops such as mobile phones and accessories shops, tech shops. In this way, we can reach the target audience easily.
- In addition, we plan to sell our product through online platforms like eBay, Amazon, Daraz, and Instagram

6.3.Packaging

- The product will be packed as a single unit
- A cardboard box will be used, and the product will be wrapped in bubble wrap
- Product's name, logo, price, manufactured date, serial number, special features and contact information will be printed on the box.

6.4.Maintenance

- There is no major maintenance related to the smart spotter
- 1 year warranty is provided
- After one year, the battery replacements may need to be done. Therefore, users will be notified about how to replace the battery
- In case of the mobile app, users will be notified of the future app updates.

6.5.Disposal

- Since we are using eco-friendly plastic for the enclosure it can be disposed easily.
- For the metal and electronics parts, we'll attach a card describing how to safely dispose them

7. PROJECT BUDGET

Module/Component	Number of units	Cost per unit (Rs)	Total cost (Rs)
ATmega 328P Microcontroller	1	1750	1750
Voltage Regulator IC LM7805	2	60	120
3.7V, 350mAh Li-po Battery	2	450	900
HC-06 Bluetooth Wireless Module	1	800	800
330Ω Resistor	1	10	10
1 kΩ Resistor	1	10	10
0.74 µF Capacitor	2	2.50	5
PCB	1	500	500
Enclosure	1	250	250
Total Cost			Rs. 4345.00
Estimated Selling price			Rs 4750.00

8. ACKNOWLEDGEMENTS

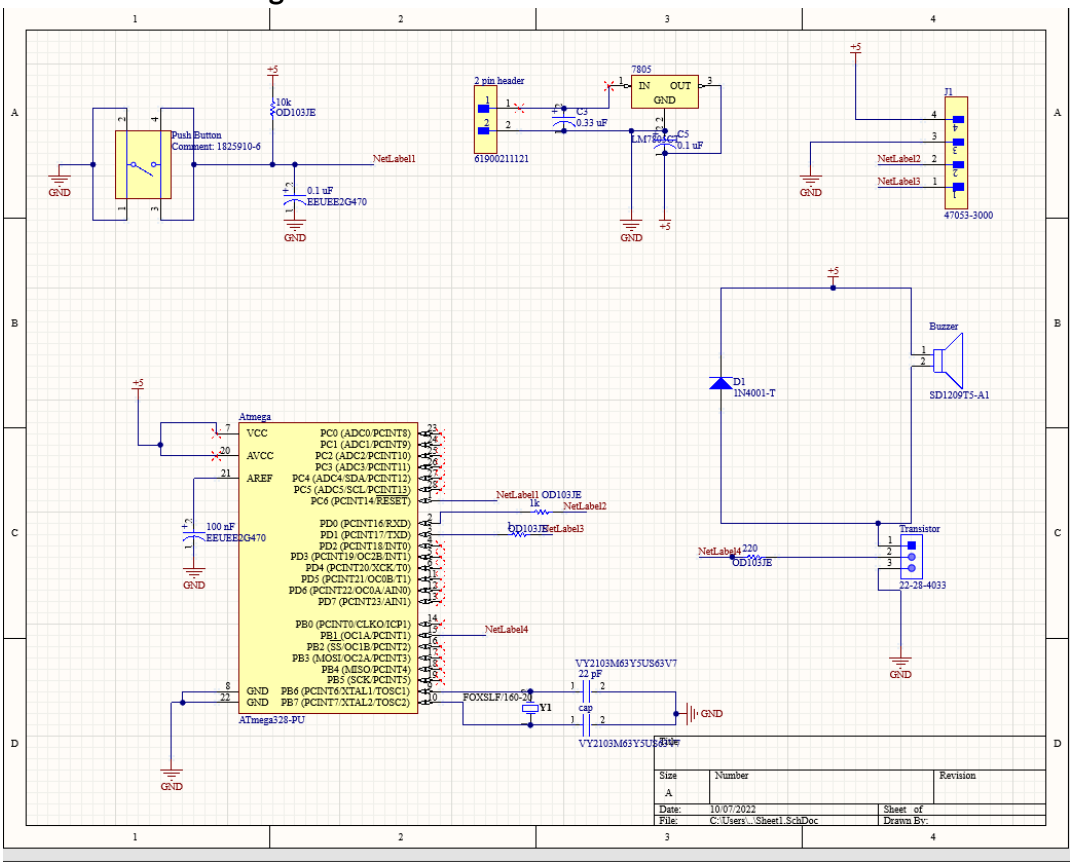
We would like to thank each and every person who helped us even in the smallest way possible. We were able to obtain good results thanks to them. We'd like to express our sincere gratitude to Dr. Ajith Pasqual for giving us the technical knowledge and the design strategies we need. Also, we'd like to remember the technical personnel for helping us test the product in labs.

9. REFERENCES

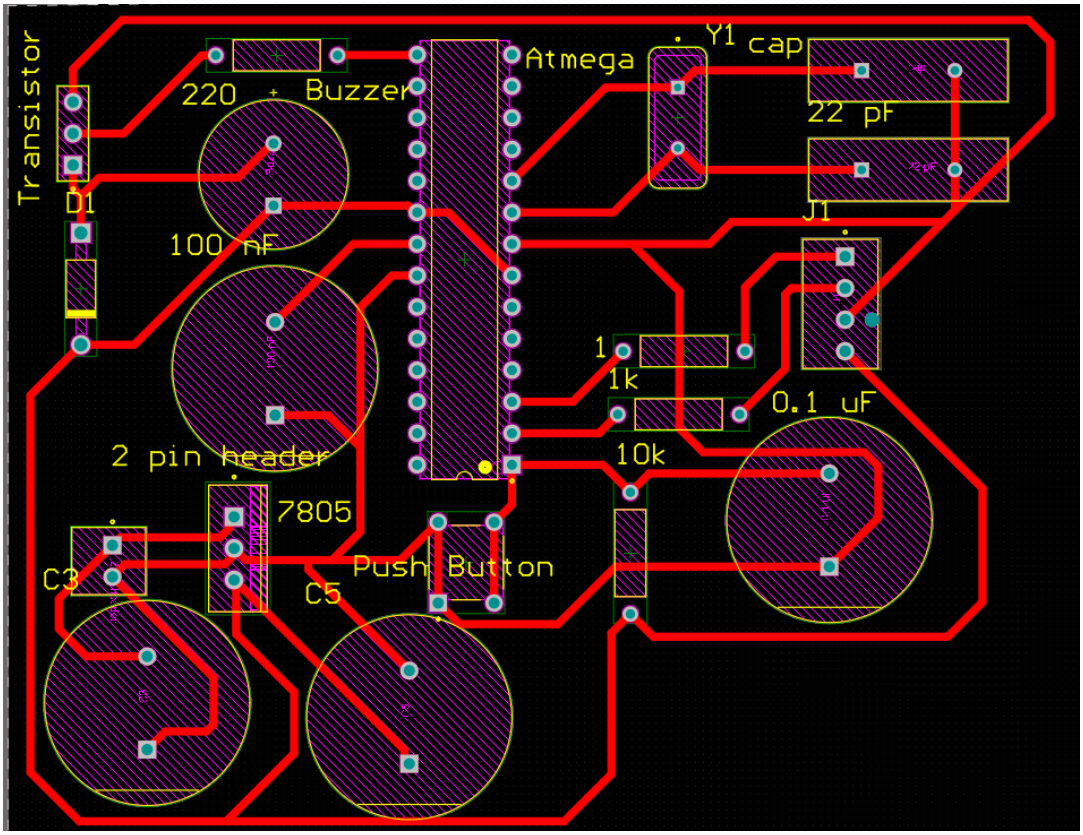
Microchip ATmega328P
MIT App Inventor
HC06 Module datasheet

9. APPENDICES

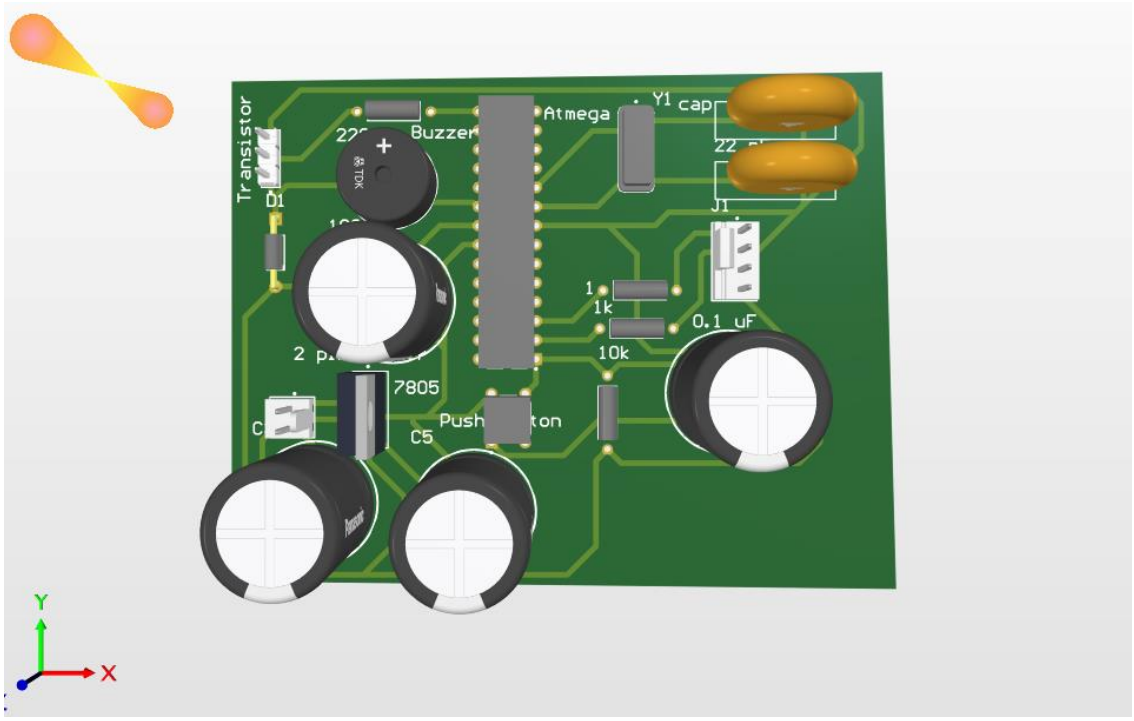
9.1. PCB Schematic Design



9.2. PCB Design



9.3. 3D View of the PCB



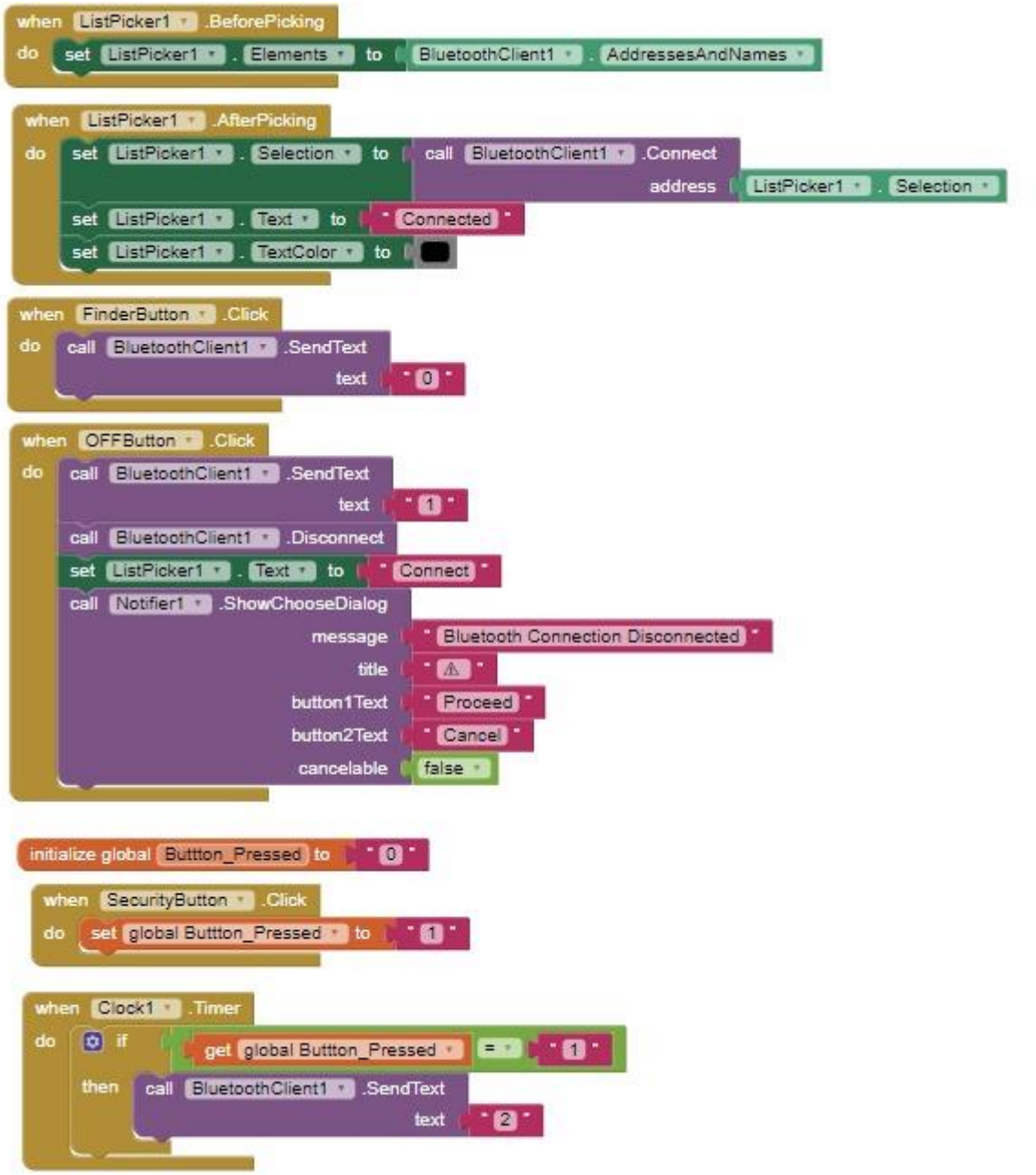
9.4. Code

9.4.1. Main

Smart_spotter §

```
char command;                 //store the bluetooth command which is sent
int  time_counter=0 ;         //count the time past without an signal
int buzzer=9;                 //buzzer pin number
int start=0;
void setup() {
 pinMode(buzzer,OUTPUT);      //make the buzzer as the output pin
 Serial.begin(9600);
}

void loop() {
    Serial.println(time_counter);

    delay(1000);
    if (time_counter>30){        //if the system didn't receive a signal until 30 second after connected buzzer set to on
      digitalWrite(buzzer,HIGH);
    }

    if (Serial.available() > 0) {
       time_counter=0;
       start=1;
       command = Serial.read();  //if a signal is received read and store it
       Serial.println(command);
    }
    if (start==1){
      time_counter=time_counter+1;
    }
    if(command=='0'){                   // set the buzzer on manually by a signal
      digitalWrite(buzzer,HIGH);

      Serial.flush();
    }
    else if(command=='1'){              //Reset the buzzer
      digitalWrite(buzzer,LOW);
      start=0;
      Serial.flush();

    }
    command =0;

}
```

9.4.2. Application



9.5. Enclosure