DEVELOPMENT OF PROTOTYPE OF WIRELESS FOOTWORK ANALYSIS FOR BADMINTON PLAYER

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ABSTRAK

Thesis ini membentangkan penyelidikan latihan ketangkasan dalam sukan badminton sangat penting. Kumpulan kami merancang peranti dan program yang dapat membantu pemain badminton berlatih untuk menjadi lebih tangkas. Kami akan menggunakan bahagian elektronik untuk membantu peranti dan pengekodan untuk mengembangkan system yang dapat memantau prestasi permain. Hasilnya dapat ditunjukkan selepas latihan sehingga pemain dapat meningkat kemudian.Terdapat grafik dan data sehingga permain dapat menganalisisnya.

ABSTRACT

This research examines the agility training in badminton is very important. Our group design a device and program that can help badminton player train to be more agile. We will use electronic part to create a device and coding to develop a system that can monitor the performance of the player. The result can be shown after training so player can be improving later. There is graph and data so player can analyses it.

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LIST OF ABBREVIATIONS

IDE	Integrated Development Environment
V	Voltage
GUI	Graphical user interface
LED	Light emitting diode
CT	Capacitor touch
Li-on	Lithium ion
IC	Integrated circuit
Li	Lithium
NTC	Negative Temperature Coefficient
DC	Direct Current
AC	Alternating current
A/AMP	Ampere Electrical Current
BT	Bluetooth antenna
USB	Universal serial bus
UART	Universal asynchronous receiver-transmitter
TTL	Time-to-live
W	Watt
mm	millimetre
dBm	Decibel milliwatts
PC	Personal Computer
RX	Receive
TX	Transmit
Hz	Frequency per unit
PCB	Printed circuit board
A-PET	Amorphous polyethylene terephthalate

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Badminton has been one of the most famous sports in the world lately. Among badminton players, there are two distinct ambitions, whether they play as a hobby to fill their spare time or play to become a professional badminton player. In order to become a professional player, a lot of preparation is required. There are many challenges between players and coaches during the training session based on the research that has been done, particularly to improve pace, endurance, and stamina among players. In addition, coaches still have issues with how to track and control the progress of athletes.

Agility has historically been referred to as physical rapidity, including the ability to produce explosive energy and the ability to quickly change direction. A detailed concept of agility, however, indicates that the visual rapidity correlated with cognitive and decision-making abilities is another key aspect of agility and should be included in the creation and preparation of sport-specific agility measures. The cognitive aspect of the agility test has been found vulnerable to distinguishing between high-level and low-level competitors in invasion sports where adversaries aim to penetrate each other's territories to achieve advantages. Badminton is a net/wall game with an environment for net diving matches. While players constantly use lateral shots to outscore rivals, by moving quickly and frequently on court to shift course to catch the shuttlecock, they must still return the opponent's shots. The player usually has less than one second to respond and run to finish the interception, considering the limited shuttlecock flight period in a rally. Nevertheless, badminton involves on-court agility requiring both physical and perceptual pace, and possessing the potential to predict the shot can significantly ease the difficulty of enhancing on-court agility.

Therefore, we built an application for badminton matches, Wireless Footwork Tracking, which can conduct analysis to track and control the progress of athletes and can also help enhance athletes' speed, agility, fitness, and conditioning. In addition, reaction, answer time and inspiring athletes to become a stronger player may be strengthened. To guarantee that the players have a successful training session in order to enhance their results, this can be good for the coaches.

Wireless Footwork Analysis applies to a program that during the training session will provide the athlete with guidance. At the same time, it measures all the data and then uses the Arduino Serial Converter Module Package to pass it to the monitor. The outcome is shown in the Graphical User Interface (GUI). The coach will then assess the success of the player based on the outcome seen.

1.2 Problem Statement

An ineffective training system will influence the performance of athletes and lead to a real game, as well as stifling the development of national sports, especially in badminton. It will help to improve the performance of players by having an effective training session by applying this Wireless Footwork Analysis at each National Badminton Training Centre. At the same time, for each player, coaches can monitor the level of fitness. As a result, this will help promote the development of national sports development.

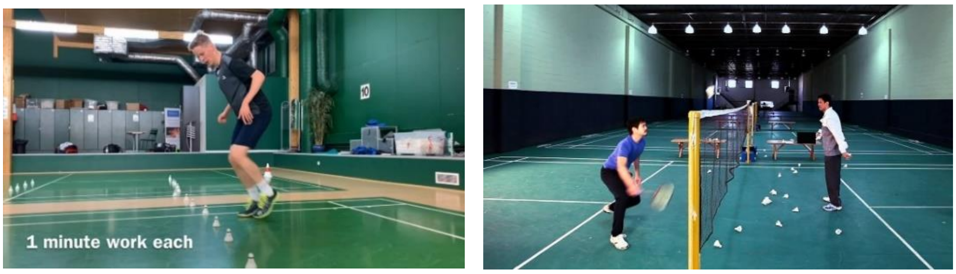


Figure 1.1: Example of Training badminton footwork

1.3 Objectives

The key goal of this project is to establish an efficient training method for athletes in the field of badminton. To do this, the goals below must be accomplished.

- To design and fabricate a simple and low-cost Wireless Footwork Analysis for badminton player that can be monitored by coaches during training session and provided with light and sound in order to give instructions to the players.
- To detect player's hand by implementing an Arduino monitoring system by utilizing sensors and buzzers and send all the data to the computer.
- To train player's agility by following all the instructions given by the system.

1.4 Project Scope

In this project, the aim of the design is based on two design, which is software design and electronics design. There also limitation in this project.

Software design

- The Arduino Integrated Development Environment (IDE) software is used to program, code-editor, identify the commands and perform the appropriate action.
- Visual Basic software is used to integrate computation, visualization, and program the database in C language.

Electronic design

- Arduino is used to read inputs and turn it into an output.
- LED and buzzer are used to emit light and to make a sound.
- HC-12 is a module is use as communication between Arduino node

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter presents about a review of literature that are related with our project. It explains more details about subtopic from the background of this project and valuable information and idea are essential to decide the best application for the design and development for the footwork analysis device.

2.2 Background

There are different types of badminton footwork research on the market with not only safety security purpose, but also with certain clever features that can manipulate time and speed of training as the advancement of technology in the 20th century. The following summary reveals some of the specifics of the currently available footwork research products that will allow the player to take care of their fitness

2.2.1 Reaction Time Test

Time for response is the potential to react to a stimulus rapidly. It is significant in many day-to-day activities and sports, but it is not always measured. The time taken between a stimulus and motion, e.g., sprint start, is basic reaction time. See a list of tests on response rate.

Such simple response speed depends on the nerve contacts and signal paths, is 'hard wired' in the composition of the body and cannot be changed. Another reaction time type, reaction time of choice, is the period taken between stimuli and response that involves a choice. Training and preparation will boost the selected response rate.

Performers receive stimulation from the eyes (position of other teams, ball, etc.), the ears (call from players, referee, also spectators), and kinaesthetic learning awareness (position of the actor, their choices, etc.). Skilled players minimize response time by choosing the most relevant details, and easily predicting other players' behaviours and the ball's direction (Wood, R.J,2010). Reaction time depends on;

- Perception: (Seeing, Hearing, Feeling).
- Processing: Have a good reaction time come from focused and understand the information well.
- Response: When perceived and correctly process the signal, then the body moving to target.

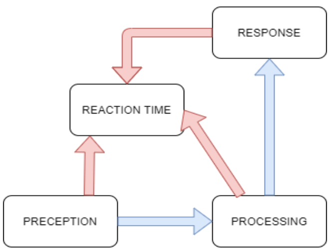


Figure 2.1 Example of Reaction time

2.2.2 Onigoe

This brand, named onigoe, is from Japan. This product is designed to test the pace of a badminton player. This is used by Japanese national team players to prepare while playing in the championship. There are two kinds of onigoe, the one is onigoe 6 it's bigger and the onigoe mini it's simpler to hold. To complete the sequence, the player must press the button so that it can measure the pace after that. You must shop from the onigoe website in order to buy these items. It'll be posted to the rest of the world in Japan. This piece is one of the greatest since it is from Japan.

Figure 2.2:Onigoe

Figure 2.3: Onigoe Mini 1.4

Features of Onigoe 6 And Mini 1.4

- Sports Specific Training Sports Specific Training
- Enhanced Reaction & Response Time
- Improved speed, agility, stamina, conditioning
- Performance analysis to track and monitor athlete's development
- Real-Time Measurements
- Create a variety of training
- Motivate athletes

2.3 Shadow Trainer

The Shadow Trainer is an extremely powerful way for all levels to strengthen footwork, acceleration, reflexes, and fitness for badminton. It takes seconds to install and is stored just as easily. Simply drop the Shadow Trainer's feet, position the 2 hooks above the net and start by pressing the power button.

It is particularly useful for singles, but for training specific to doubles, it can be used by inexperienced doubles teams. The Shadow Trainer uses random lights on a court outline to guide players to move to the corresponding points on the actual court, swinging as if hitting a shuttlecock, and then returning for the next light signal to their base location.

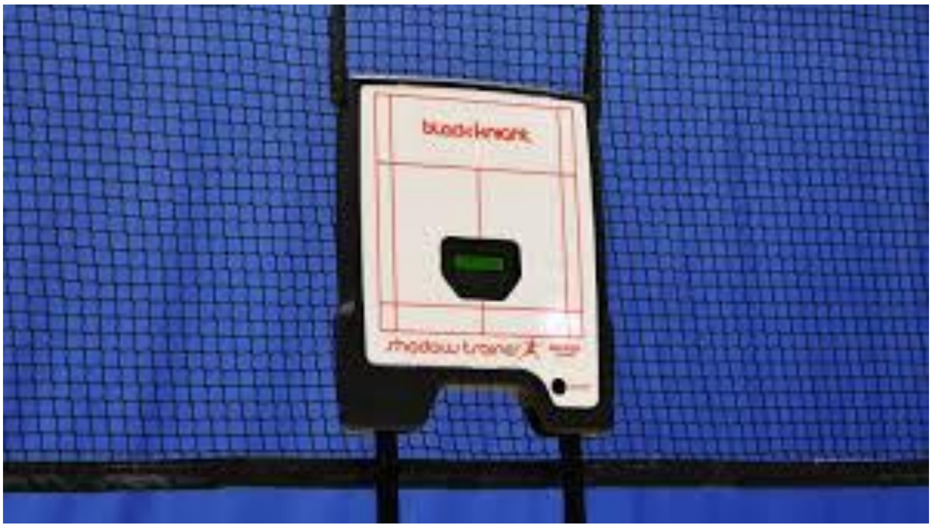


Figure 2.4: Shadow Trainer Black Knight

2.3.1 Transceiver Wireless Connection Module

Much of the agility training equipment uses wire to connect between nodes from the previous system. HC-12 and NRF24L01 would be a module capable of eliminating the wire and becoming wireless.

Figure 2.5: HC-12 Module

Figure 2.6: NRF24L01 Module

2.3.2 Type Touch Sensor for Player Response

Touch Sensors are the electronic sensors to detect touch, used for measuring the time for the user reaction and reposted there several types of touch sensors can utilize this project Touch Sensors. When touched, they act like a switch. An intuitive user interface is offered through touch sensors. These are easy to build, low cost and large-scale manufacturing.

Figure 2.7: TTP223 Capacitive Touch Sensor

Figure 2.8: Infrared Sensor

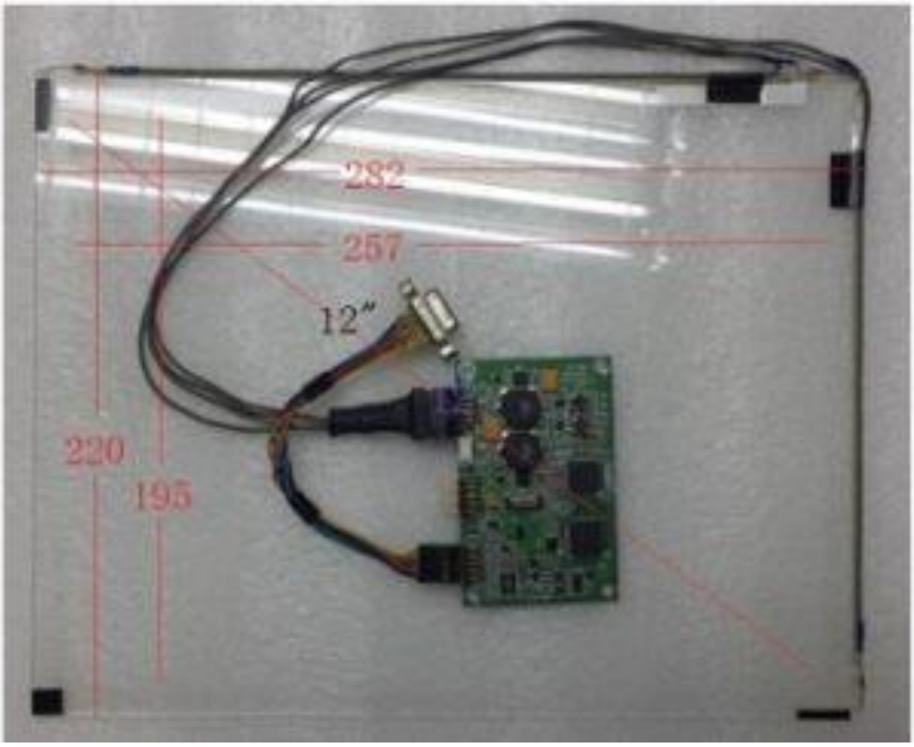


Figure 2.9: Surface Acoustic Wave Sensor

Figure 2.10:Resistive Touch Sensor

2.3.3 Type Rechargeable Battery for Portable

From previous projects, the component node for light and sensor is used wired to supply. The rechargeable battery is composed of one or more electrochemical cells and is a form of electric battery. Rechargeable load-levelling batteries are used for grid energy storage applications. We use rechargeable battery form to provide power to each node component device in order to make it portable.

Figure 2.11: Lithium-ion Rechargeable battery

Figure 2.12: Lithium Polymer Rechargeable battery

2.3.4 Software Arduino (IDE)

The Arduino Integrated Programming Environment or Arduino Software (IDE) - includes a code writing text editor, a message box, a text console, a typical function button toolbar, and a set of menus. To upload programs and communicate with them, it communicates with the Arduino and Genuino hardware. It is useful to integrate third party hardware support to the hardware directory of your sketchbook directory. Board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions can be part of the platforms built there.

Figure 2.13: Arduino IDE

CHAPTER 3

METHODOLOGY

3.1 Introduction

Designing and improving the wireless footwork analysis system is the main objective of this project. This project is targeted purposefully at a portability device that is widely used primarily for an adopting new of sport. In order to accomplish the main purpose, this part will present the technique design and creation of wireless footwork system also will be explained in details.

For a developer, methodology is a guideline for organizing the process of structure and control development. In this section, the process for design and production will continue to be explained. This chapter discusses the development of hardware, programming, and software such as equipment, procedures, sensors, and electronic design of methods for wireless footwork analysis devices. The relevant information is gathered from the previous chapter through the literature review. This chapter will also cover part-by-part circuits, sensor coding, and each component will be planned step by step according to its priority.

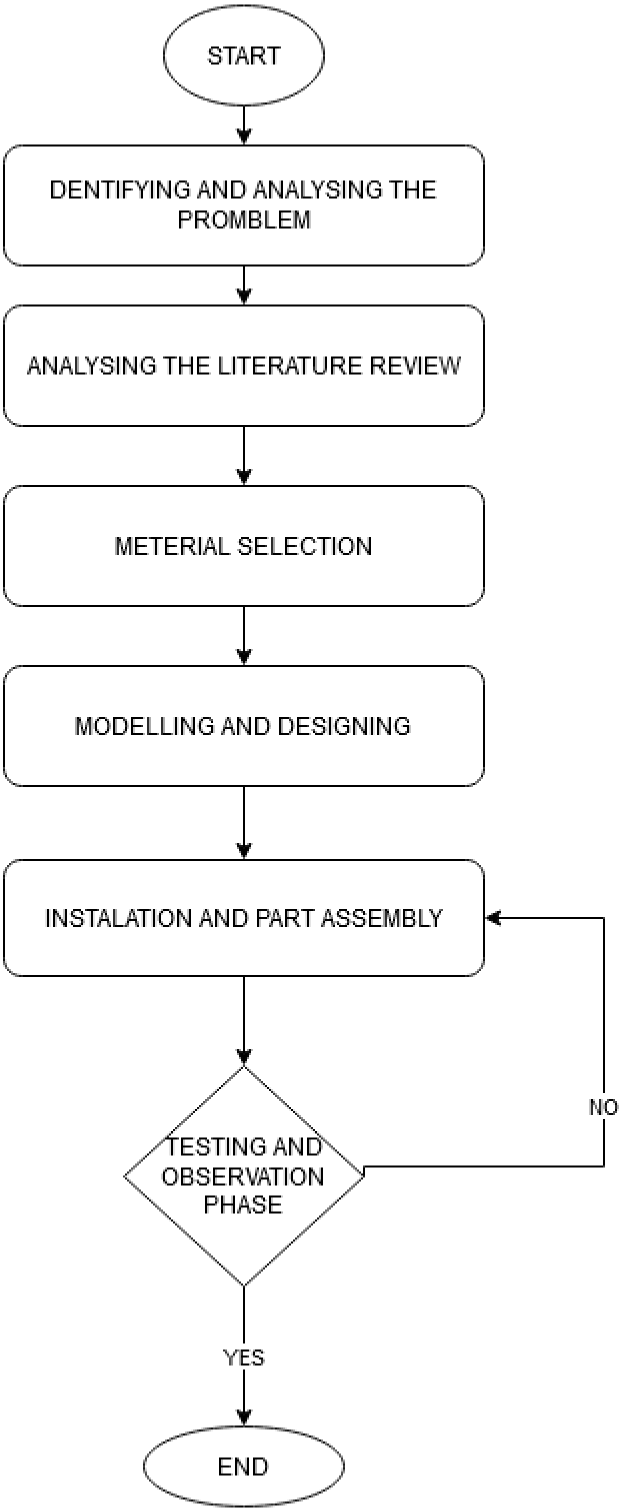


Figure 3.1: Flowchart of Methodology

3.2 Identify Problem

In this phase, two problems had been identified as below:

- Most of the players are having problems regarding of the less effective training system. This causes, players cannot perform very well during real game.
- With the existing system, there is a limitation, which is coaches can only assess the fitness of the players only through observation during the training session.

In order to overcome this problem, a Wireless Footwork Analysis for badminton player will design to allow the coaches to be able to access an account to monitor the player fitness/performance during the training session. At the same time, it will help the player to get a more effective training system.

3.3 Material Selection

3.3.1 TTP223 Capacitive Touch Switch/Sensor Module

In this project, the Capacitive Touch Sensor is used to measure how long the user can detect touch in response that can be used for human hands. The electrode represents one of the plates of the capacitor in the capacitive touch sensors. The second plate is represented by two objects: one is the sensor electrode environment that forms the parasitic capacitor, and the other is a human finger-like conductive object that forms the touch capacitor CT.

The sensor electrode is connected to a measurement circuit and periodically the capacitance is measured. When a conductive object touches the sensor electrode or approaches it, the output capacitance will increase. The measurement circuit will detect and transform the change in the capacitance into a trigger signal (Administrator, June 24,2019). The working of a capacitive touch sensor is shown in below figure 3.1.

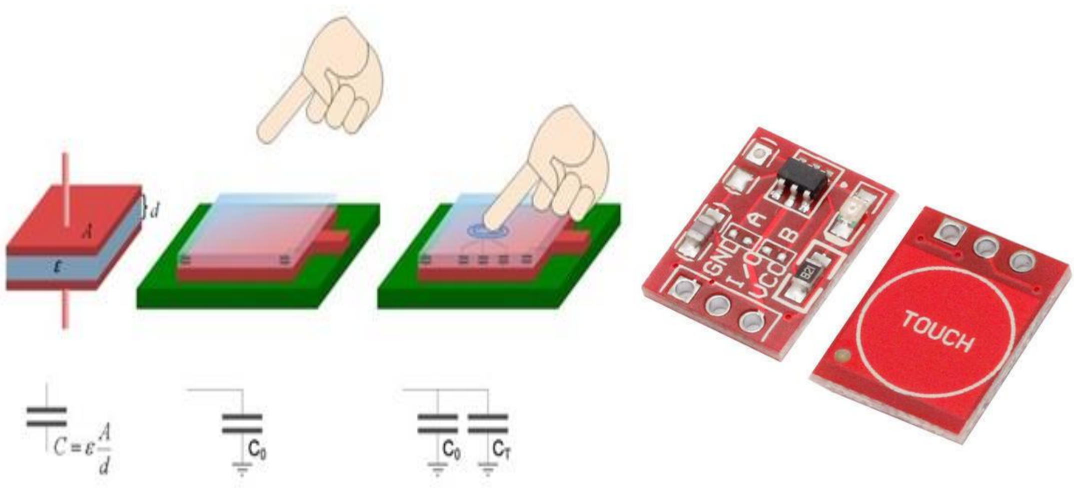


Figure 3.2: Example of working Capacitive touch sensor

3.3.2 Rechargeable 18650 Li Ion3.7v Battery (3000mah)

In this project, the Arduino and other device 18650 Li-ion 3.7v battery is used for power supply, it has greater capacity and low maintenance than the price cheaper than li polymer battery. A lithium-ion battery is a family of rechargeable battery types in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Chemistry, performance, cost, and safety characteristics vary across lithium-ion battery types. Unlike lithium primary batteries (which are disposable), lithium-ion batteries use an intercalated lithium compound as the electrode material instead of metallic lithium.

Lithium-ion batteries are common in consumer electronics. They are one of the most popular types of rechargeable battery for portable electronics, with one of the best energy-to-weight ratios, high open circuit voltage, low self-discharge rate, no memory effect, and a slow loss of charge when not in use. Beyond consumer electronics, lithium-ion batteries are growing in popularity for military, electric vehicle, and aerospace applications due to their high energy density (H. Qiao, Q. Wei,2012).

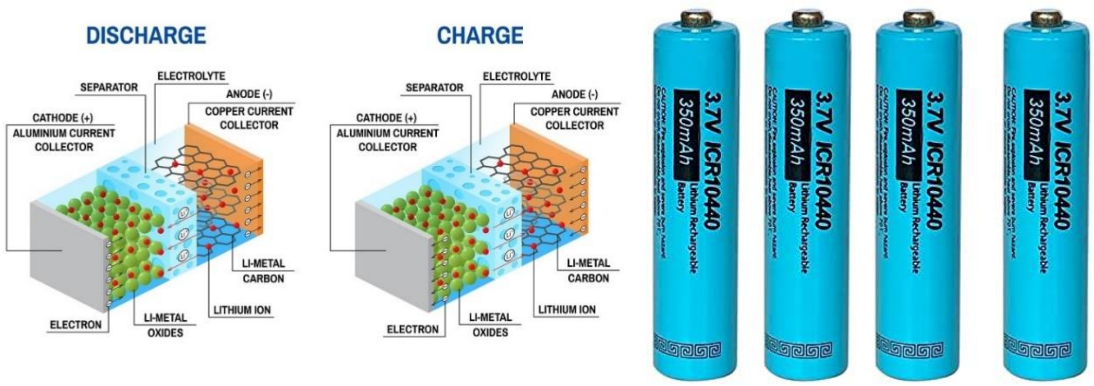
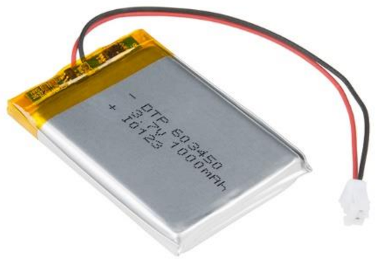


Figure 3.3: Example of working Rechargeable 18650 Li Ion 3.7v Battery

Table 1: Comparison Battery

	Lithium-ion	Lithium-Polymer
		
Energy Density (Amount of energy stored in a power bank)	Higher energy density	Lower energy density
Aging	Loses its actual charging capacity over time	Does not lose its charging capacity as much as Lithium-ion
Price	Cheaper	Expensive
Conversion rate (The capacity to convert battery into actual power)	85%-95%	75%-90%

3.3.3 HC-12 Transceiver

HC-12 Transceiver used in wireless communication in this project. The HC-12 is a capable transceiver with an impressive range (up to 1 km). It is satisfactory for most hobby and even some industrial applications. It is an important alternative to the very inexpensive, low-power, but short-range NRF24L01. Though a bit more expensive than the NRF24L01, its range and simplicity of use make the HC-12 an excellent choice for projects involving tracking (M.H, March 5,2018).

Figure 3.4: HC-12 Transceiver Module

3.3.4 Arduino Nano V3.0

The Arduino Nano we used in this project's main microcontroller is a light, full and breadboard-friendly board based on the Arduino Nano with its Atmega328 microcontroller specs based on the ATmega3288.

Figure 3.5: Arduino Nano

3.3.5 TP4056 Micro USB 5v Lithium Battery 18650 Charger

The TP4056 module for the project is a complete, linear charger of current and voltage constant with USB. The 3.7V single li cell ion or lithium-ion cell charge module is an efficiently powered TP4056. Not just 18650 cells, but a wide range of different 3.7V li ion batteries and sizes can be charged. The core of the module is a TP4056 IC, an advanced IC lithium battery charging device. The IC is designed and configured internally to efficiently charge an ion cell, thereby increasing cell backup and cell life.

The IC has a temperature input pin that can be attached to a type of NTC sensor. To detect the battery temperature while charging, the battery body must be connected to the temperature sensor. The IC is also configured to disconnect the charging when the battery temperature within the IC software reaches the limit. The module also has two LED indicators in the pinout & information above. When the battery is fully charged, one LED is switched off automatically while the other LED is activated to show that the battery is fully charged.

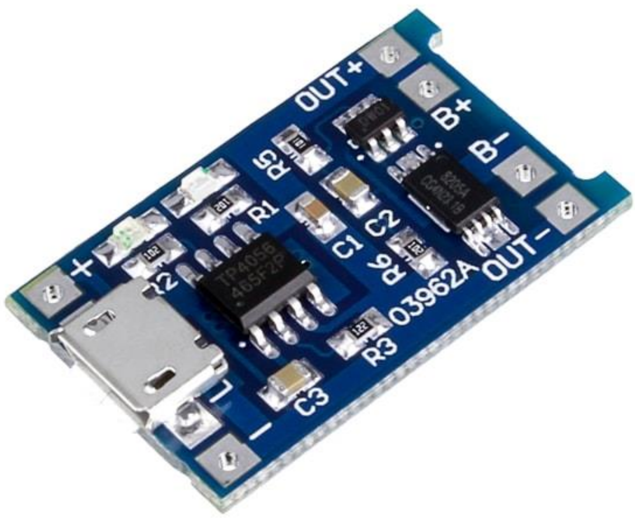


Figure 3.6: **TP4056 Micro USB Charge**

3.3.6 Super Bright White Piranha LED

The LED light can show the player which node to be on and the player must react to an LED light. LED Piranha are small and have the brightest LED of its size. Each has a large lens that generates a wide-angle beam. This is excellent for custom installations that require an extremely bright and wide-angle light. The Piranha LED gives you excellent results and a unique approach to lighting.

Figure 3.7: LED Piranha

3.3.7 Buzzer

Sound need to this project for player can hearing the sound so player can tell which node that on if it from behind player. A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke (Wikipedia contributor, January 1,2021).

Figure 3.8: Buzzer

3.3.8 Single Channel 5V Relay Module

1-channel 5v relay is used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A.It has a standard interface that can be controlled directly by Arduino nano. The wire coil wrapped around a soft iron core, or solenoid, consists of a basic relay. It has a low magnetic flux reluctance path, mobile iron armature, and one or more contacts. When switched off, the armature is forcibly returned to its relaxed position. Usually a spring provides this force, but gravity can also be used in some applications. The armature leaves a magnetic circuit gap when the relay is de-energized. Figure 3.4 shows an example of a channel 5V relay that is available in the market.

Figure 3.9: Single channel 5v relay

3.3.9 Xl6009 4A Step Up Module

Electronic Project need power supply and in some cases, you might need to step-up or boost the voltage. Example from 4xAA battery, step up voltage to 12V and power the Arduino via DC jack input.

Well, this XL6009 adjustable boost convert will helps you. It is the most basic and compact module that allow you to boost up the Vin to 35V (maximum). The module comes without terminal block or component to display the Vin or Vout, so you do need an additional multimeter to measure the input or output voltage before connecting it to the load. Nonetheless, it comes with multiturn potentiometer/variable resistor/adjustable resistor that provides high resolution voltage adjustment with a flat screw driver.

Figure 3.10: Xl6009 dc step up module

3.4 Specification

The specification of each of the component used in this project are;

3.4.1 TTP223 Capacitive Touch Switch/Sensor Module

The module is a capacitive touch-switch module integrated with the touch detection IC (TTP223). The default operating mode for this sensor is low power mode. The module will output a low-level voltage without any capacitive touch; when the corresponding

Specification

- Size:15*11mm
- Power:2.5V - 5.5V

Features

- Capacitor switch
- Self-locking
- Package includes
- 10* TTP223 capacitive touch switch button self-lock module

3.4.2 Rechargeable 18650 Li Ion3.7V Battery (3000mah)

The 18650 battery is a lithium-ion cell classified by its 18mm x 65mm size, which is slightly larger than an A+443A battery. They're often used in flashlights, laptops, and high-drain devices due to their superior capacity and discharge rates.

Specification

- Model li-ion 18650 battery 3000mAH
- Standard voltage 3.7V
- Rechargeable battery • Rated capacity:1200mAH
- 20-30 Resistance charge retention capability
- High frequency discharge performance
- Use small appliances, digital camera, electronic toys, 4wd

3.4.3 HC-12 Transceiver

433Mhz SI4463 Wireless Serial Port Module 1000M HC-12 Replacement for BT Antenna

Specification

- Working frequency: 433.4MHz to 473.0MHz
- Supply voltage: 3.2V to 5.5VDC
- Communication distance: 1,000m in the open space
- Serial baud rate: 1.2Kbps to 115.2Kbps (default 9.6Kbps)
- Receiving sensitivity: -117dBm to -100dBm
- Transmit power: -1dBm to 20dBm
- Interface protocol: UART/TTL, Half Duplex
- Operating temperature: -40℃ to +85℃
- Dimensions: 27.8 x 14.4 x 4 mm

3.4.4 Arduino Nano V3.0

The Arduino Nano is a small, complete, and breadboard-friendly board based on the Atmega328. It has the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

Specification

- Microcontroller: Atmel ATmega328
- Operating voltage (logic level): 5V
- Input voltage: 7 - 12V
- Input voltage (limit): 6 - 20V
- Digital I/O pins: 14 (6 PWM)
- Analog input pins: 8
- DC current per I/O pin: 40mA
- Flash memory by bootloader: 32 KB (ATmega328) of which 2 KB used
- SRAM: 2 KB (ATmega328)
- Clock speed: 16MHz
- Dimensions: 0.73" x 1.70"
- Length: 45mm
- Width: 18mm

3.4.5 TP4056 Micro USB 5V Lithium Battery 18650 Charger

This tiny module is perfect for charging single cell 3.7V 1 Ah or higher Li-ion cells

Specification

- This module can charge and discharge Lithium batteries safely
- Suitable for 18650 cells and other 3.7V batteries
- Charging current – 1A
- Input Voltage: 4.5V to 5.5V
- Full charge voltage 4.2V
- Protects battery from over charging and over discharging

3.4.6 Super Bright White Piranha LED

5mm high brightness piranha 12 LEDs long lifetime, low consumption, very convenient to use light board four corners with a fixed screw hole, easy fixed.

Specification

- LED number: 4 x 3 12 LEDs
- Light colour: white
- Material: Plastic
- Voltage: DC 3-5V
- Board size: 45 x 28mm
- Operating current: over 200MA.
- Power: over 1.0W.
- Weight: 10g

3.4.7 Buzzer

Piezo Electronic Buzzer Alarm

Specification

- Colour : Black
- Buzzer Type : Piezoelectric
- Sound Level : 95 dB
- Rate Voltage : 12V DC
- Operating Voltage : 3 - 24V
- Max Current Rating: 10mA
- Frequency : 3900±500Hz

3.4.8 Single Channel 5V Relay Module

The Single Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps, and AC load. It is designed to interface with microcontroller such as Arduino, PIC etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.

Specification

- -Digital output controllable
- -Compatible with any 5V microcontroller such as Arduino.
- -Rated through-current: 10A (NO) 5A (NC)
- -Max. switching voltage 250VAC/30VDC
- -Max. switching current 10A
- -Size: 43mm x 17mm x 17m

3.4.9 XL6009 4A Step Up Module

4A Switching Power High-Performance Boost Module

Specification

- Input range: 3V to 32V
- Output range: 5V to 35V
- Maximum output current: 4A
- Output Ripple: 50mV
- Conversion efficiency: <94% (Lower efficiency when higher pressure difference occurs)
- Switching Frequency: 400KHz
- Load Regulation: +/- 0.5%
- Voltage Regulation: +/- 0.5%
- Operating Temperature: -45℃ to 85℃
- Dimension: 60mm * 35mm * 13.5mm
- Weight: 24g

3.5 Flowchart System

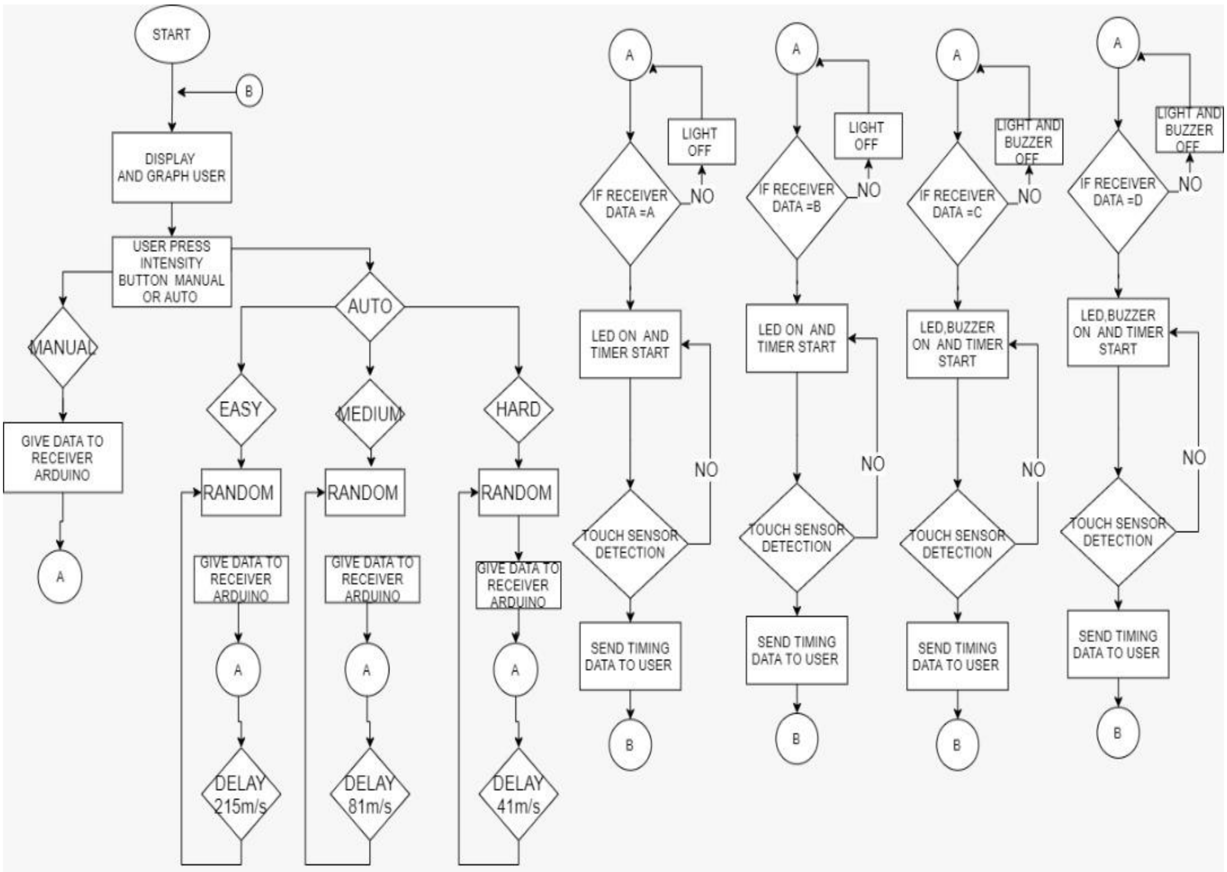


Figure 3.11: Flowchart of The System Run

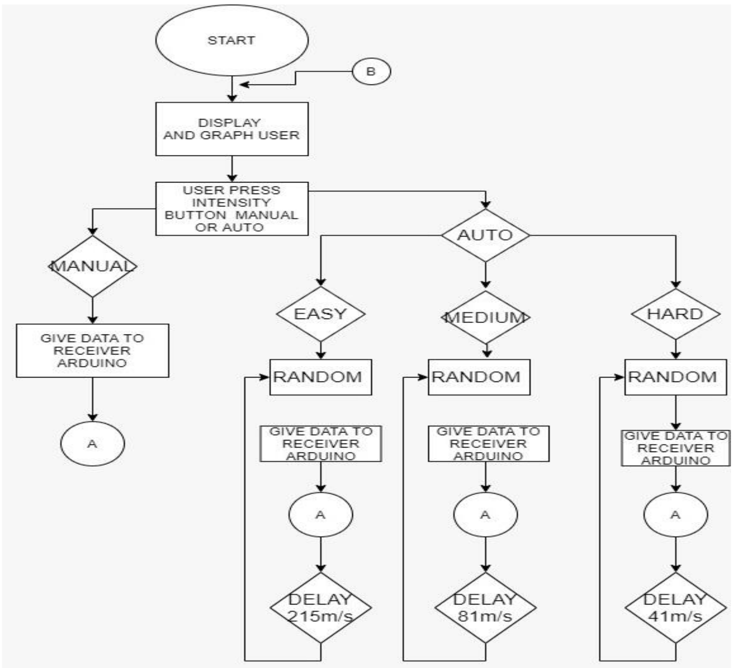


Figure 3.12: Flowchart of main arduino

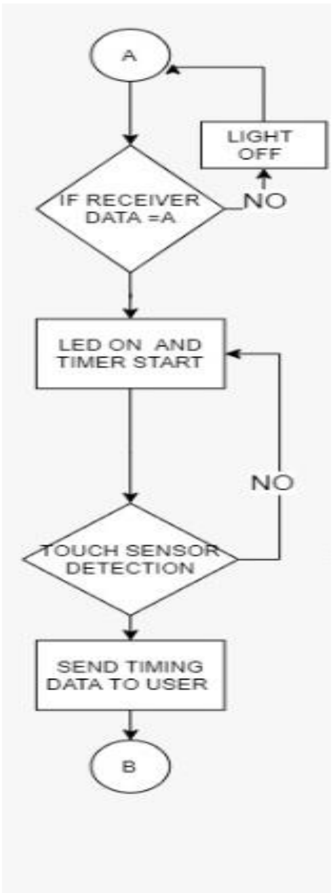


Figure 3.13: Flowchart of Part A, B, C, D Node for Reaction player

3.6 Coding Arduino

An Arduino nano was used as the basic tester to try out codes and the equipment to make sure all the component, such as relay and sensor were working well before compiling all the codes also to make sure the that Arduino with HC-12 can communication with other Arduino in serial monitor.

Figure 3.14: Coding for main Arduino


```
#include <SoftwareSerial.h>
SoftwareSerial HC12(2, 3); // HC-12 TX Pin, HC-12 RX Pin
int hantar = 0;
int light;
char commado;
unsigned long  Totaltime = 0;
unsigned long  Starttime = 0;
#define rly 6
#define touchpin 7
void setup() {
  Serial.begin(9600);             // Serial port to computer
  HC12.begin(9600);               // Serial port to HC12
  Serial.println("no 1 Arduino A");
  pinMode(touchpin, INPUT);
  pinMode(rly, OUTPUT);
  millis();
}
void loop() {
  int valu = digitalRead(touchpin); //reads the touch sensor signal
  while (HC12.available())          // If HC-12 has data
  {
    commado = HC12.read();
    Serial.println(commado);
    Starttime = millis();              //Start TIME

  }

  if (commado == 'A')
  { hantar = 0;
    if (valu == 0)          // IF this Arduino have been select and Not touch then Relay will ON
    {
      digitalWrite(rly, LOW);
      light = 1;
    }
  } else if (commado == 'B')   // If Not relay OFF
  {
    digitalWrite(rly, HIGH);
  }
  else if (commado == 'C')
  {
    digitalWrite(rly, HIGH);
  } else if (commado == 'D')
  {
    digitalWrite(rly, HIGH);
  }
  if (valu == 1 && light == 1 )      //  IF touch Send Data to Serial Monitor
  {
    digitalWrite(rly, HIGH);          //Relay OFF
    light = 0;
    Totaltime =  millis() - Starttime;

    if (hantar == 0) {
      HC12.print(Totaltime);
      Serial.print(Totaltime);     //send DATA TIME
      hantar = 1;

    }

  }


}
```

Figure 3.15: Coding for part A Arduino node with sensor and relay

This coding uses part A to receive the data from main Arduino to activate the light LED and touch sensor to give the user the signal to notice that part A is on, at the same time when the LED is also active, then it stops where the user touches the sensor, giving the data to main Arduino to make a graph.

```
#include <SoftwareSerial.h>
SoftwareSerial HC12(2, 3); // HC-12 TX Pin, HC-12 RX Pin
int hantar = 0;
int light;
char commado;
unsigned long  Totaltime = 0;
unsigned long  Starttime = 0;
#define rly 6
#define touchpin 7
void setup() {
  Serial.begin(9600);             // Serial port to computer
  HC12.begin(9600);               // Serial port to HC12
  Serial.println("no 2 Arduino B");
  pinMode(touchpin, INPUT);
  pinMode(rly, OUTPUT);
  millis();
}
void loop() {
  int valu = digitalRead(touchpin); //reads the touch sensor signal
  while (HC12.available())          // If HC-12 has data
  {
    commado = HC12.read();
    Serial.println(commado);
    Starttime = millis();              //Start TIME

  }

  if (commado == 'B')
  { hantar = 0;
    if (valu == 0)          // IF this Arduino have been select and Not touch then Relay will ON
    {
      digitalWrite(rly, LOW);
      light = 1;
    }
  } else if (commado == 'A')   // If Not relay OFF
  {
    digitalWrite(rly, HIGH);
  }
  else if (commado == 'C')
  {
    digitalWrite(rly, HIGH);
  } else if (commado == 'D')
  {
    digitalWrite(rly, HIGH);
  }
  if (valu == 1 && light == 1 )      //  IF touch Send Data to Serial Monitor
  {
    digitalWrite(rly, HIGH);          //Relay OFF
    light = 0;
    Totaltime =  millis() - Starttime;

    if (hantar == 0) {
      HC12.print(Totaltime);
      Serial.print(Totaltime);     //send DATA TIME
      hantar = 1;

    }

  }


}
```

Figure 3.16: Coding for part B Arduino node with sensor and relay.

It is the same with the coding of part A Arduino, only it will receive various data, then part A Arduino, if the data receiver B will deactivate part A Arduino.

NO3

```
#include <SoftwareSerial.h>
SoftwareSerial HC12(2, 3); // HC-12 TX Pin, HC-12 RX Pin
int hantar = 0;
int light;
char commado;
unsigned long  Totaltime = 0;
unsigned long  Starttime = 0;
#define rly 6
#define touchpin 7
void setup() {
  Serial.begin(9600);             // Serial port to computer
  HC12.begin(9600);               // Serial port to HC12
  Serial.println("no 3 Arduino C");
  pinMode(touchpin, INPUT);
  pinMode(rly, OUTPUT);
  millis();
}
void loop() {
  int valu = digitalRead(touchpin); //reads the touch sensor signal
  while (HC12.available())          // If HC-12 has data
  {
    commado = HC12.read();
    Serial.println(commado);
    Starttime = millis();              //Start TIME

  }

  if (commado == 'C')
  { hantar = 0;
    if (valu == 0)          // IF this Arduino have been select and Not touch then Relay will ON
    {
      digitalWrite(rly, LOW);
      light = 1;
    }
  } else if (commado == 'A')   // If Not relay OFF
  {
    digitalWrite(rly, HIGH);
  }
  else if (commado == 'B')
  {
    digitalWrite(rly, HIGH);
  } else if (commado == 'D')
  {
    digitalWrite(rly, HIGH);
  }
  if (valu == 1 && light == 1 )      //  IF touch Send Data to Serial Monitor
  {
    digitalWrite(rly, HIGH);          //Relay OFF
    light = 0;
    Totaltime =  millis() - Starttime;

    if (hantar == 0) {
      HC12.print(Totaltime);
      Serial.print(Totaltime);      //send DATA TIME
      hantar = 1;

    }

  }


}
```

Done compiling.

Figure 3.17: Coding for part C Arduino node with sensor and relay

The Arduino Part C coding above them is the same with Arduino Part A/Arduino Part B but slightly different. The LED and Buzzer are used by Part C to notify the user behind them because the LED will not see if it is behind the user. It also used for Part D Arduino different receiver at Figure Below.

```
#include <SoftwareSerial.h>
SoftwareSerial HC12(2, 3); // HC-12 TX Pin, HC-12 RX Pin
int hantar = 0;
int light;
char commado;
unsigned long  Totaltime = 0;
unsigned long  Starttime = 0;
#define rly 6
#define touchpin 7
void setup() {
  Serial.begin(9600);             // Serial port to computer
  HC12.begin(9600);               // Serial port to HC12
  Serial.println("no 4 Arduino D");
  pinMode(touchpin, INPUT);
  pinMode(rly, OUTPUT);
  millis();
}
void loop() {
  int valu = digitalRead(touchpin); //reads the touch sensor signal
  while (HC12.available())          // If HC-12 has data
  {
    commado = HC12.read();
    Serial.println(commado);
    Starttime = millis();              //Start TIME

  }

  if (commado == 'D')
  { hantar = 0;
    if (valu == 0)          // IF this Arduino have been select and Not touch then Relay will ON
    {
      digitalWrite(rly, LOW);
      light = 1;
    }
  } else if (commado == 'A')   // If Not relay OFF
  {
    digitalWrite(rly, HIGH);
  }
  else if (commado == 'B')
  {
    digitalWrite(rly, HIGH);
  } else if (commado == 'C')
  {
    digitalWrite(rly, HIGH);
  }
  if (valu == 1 && light == 1 )      //  IF touch Send Data to Serial Monitor
  {
    digitalWrite(rly, HIGH);          //Relay OFF
    light = 0;
    Totaltime =  millis() - Starttime;

    if (hantar == 0) {
      HC12.print(Totaltime);
      Serial.print(Totaltime);     //send DATA TIME
      hantar = 1;

    }

  }


}
```

Figure 3.18: Coding for part D Arduino node with sensor and relay

#include <SoftwareSerial.h> is the serial communication library on HC-12 that allows serial communication on another Arduino digital pin, based on the above coding. Char [] is the token that sends the data to another serial monitor via a serial monitor. (HC12.available) it sends the HC-12 data to the Arduino node at the serial monitor 9600bps, the same as (Serial.available) that it uses for the Arduino node part A, B, C and D data receiver time. SoftwareSerial HC12(2, 3); it sends data continuously to the pin using Tx (Transmit) and Rx (Receive) for HC-12, int hantar=0 to stop the Arduino loop. Int light for knowing whether the LED light is on or off. Char Commado is used to read data from the HC-12 receiver. For player reaction timer that will use coding Millis () for the Arduino node that starts, then if the Arduino node that has been selected and receives data it will run the start time of coding = Millis (), there will be old Millis-start time=total time for player real data timer calculation for player data timer of react

3.7 Flow Diagram

There are five HC-12 and Arduino Flow diagrams for this project. For the four Arduino nodes, the touch sensor, buzzer, and LED Piranha are included. Main Arduino will be instructed by the GUI interface user from pc, the main Arduino will provide data and collect data from four Arduino nodes that have sensor and the PC/GUI interface will also get the data from main Arduino to display graph user data

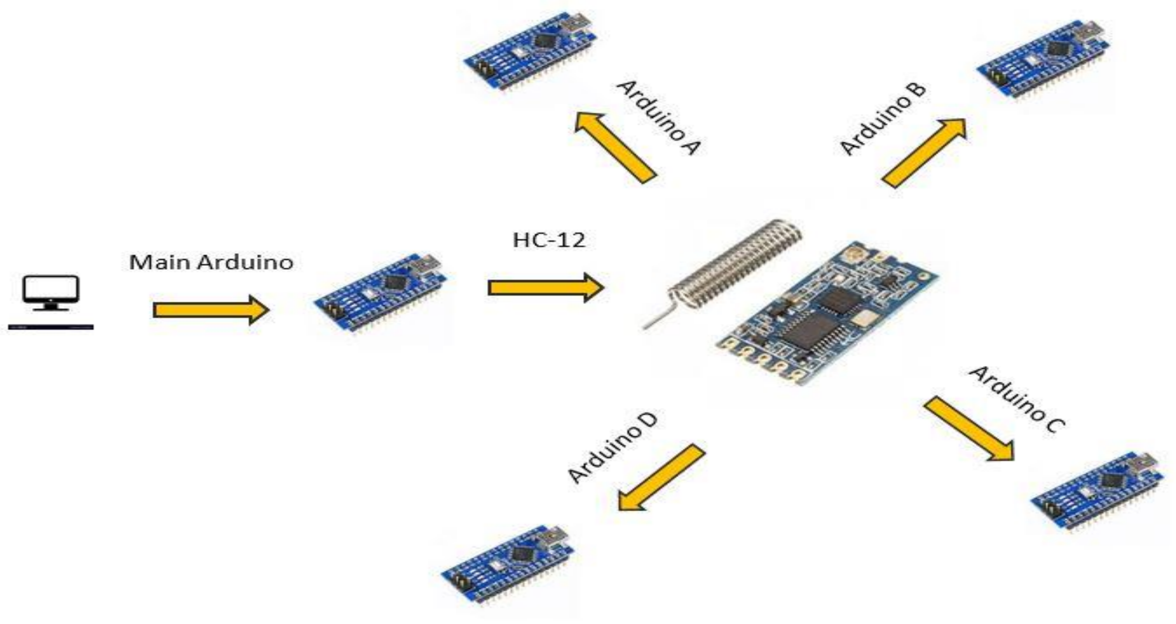


Figure 3.19: The flow diagram HC-12 communication

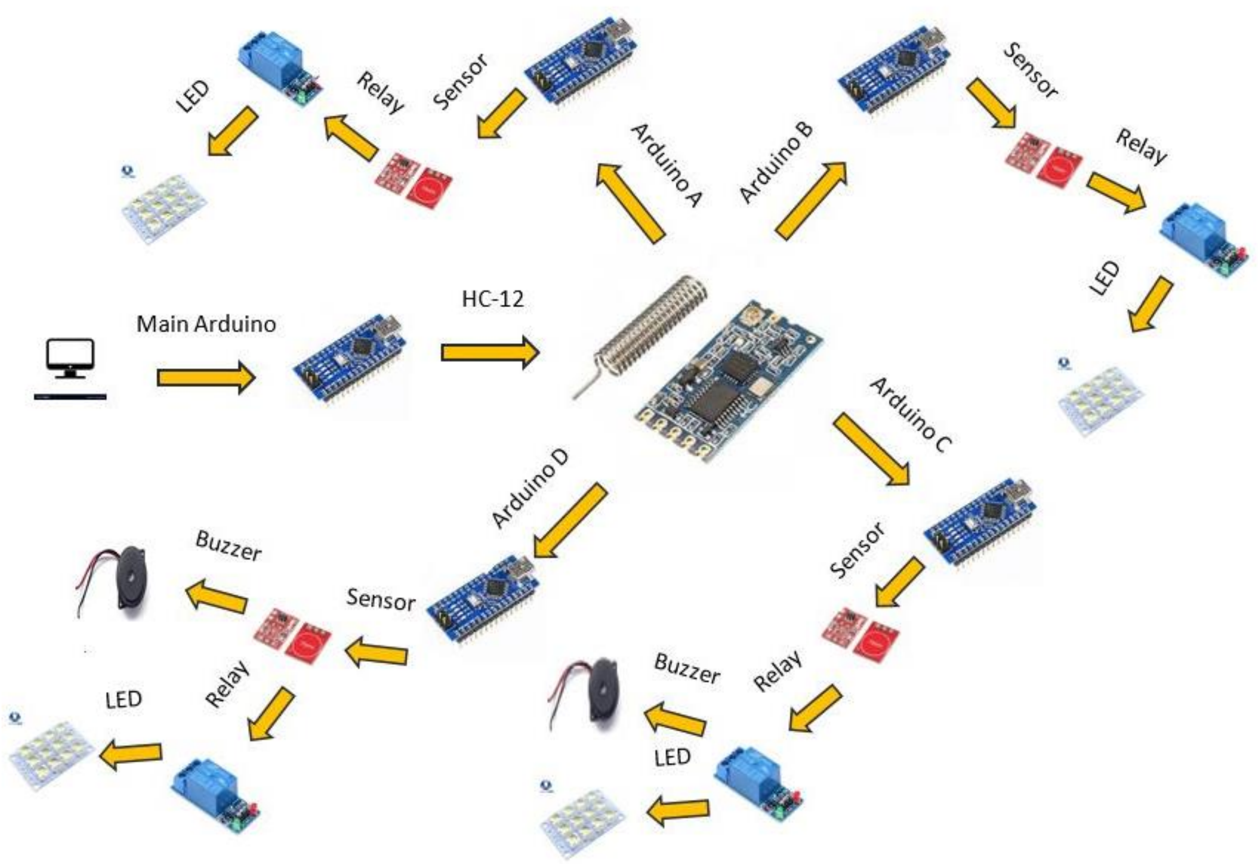


Figure 3.20: Flow diagram of project

3.8 Circuit Design

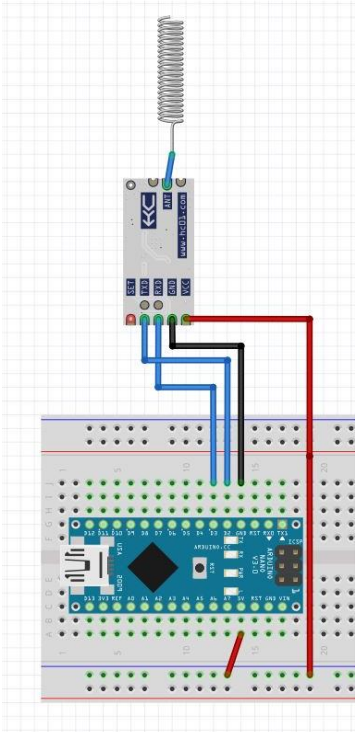


Figure 3.21: Circuit for main Arduino

The main Arduino that attaches to the PC consists of this circuit. The PC and Arduino interact with the serial display. The HC-12 from the Arduino will obtain 5V. The RX, TX would be linked to D2, D3, and so on. The solder of the antenna at the top to send and receive data.

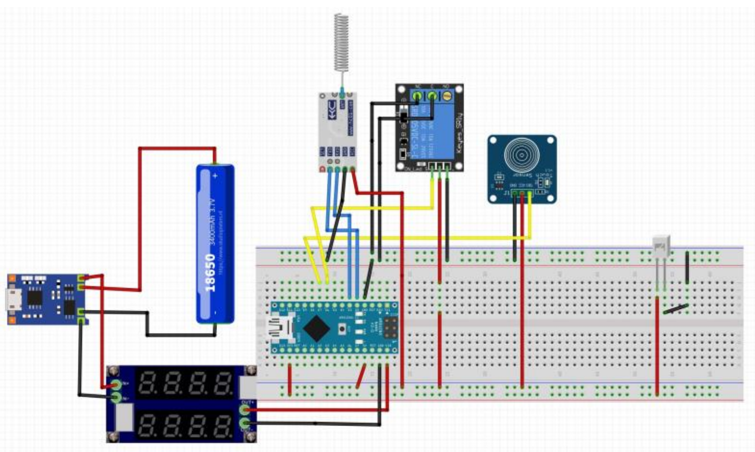


Figure 3.22: Circuit for Arduino node Part A and B

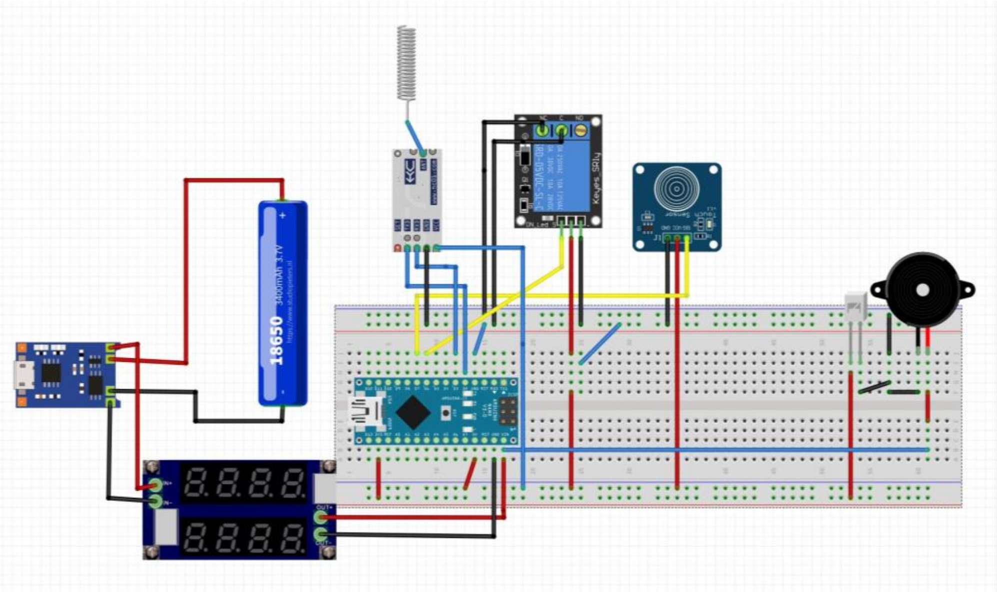


Figure 3.23: Circuit for Arduino node Part C and D

the Arduino derives power from the DC-DC step-up voltage of the XL6009. The voltage provided by the Arduino is 12.5V. The 18650 Li-Ion 3.7v battery is rechargeable (3000mah). It is possible to charge the battery using the TP4056 Micro USB module. For this module, the performance is 5V.

The TTP223 capacitive touch sensor is the input for this project. Cantered on the dedicated TTP223 touch sensor IC, a capacitive touch sensor module. A single integrated contact sensing region of 11 x 10.5mm with a sensor range of ~5mm is given by the module. A visual indicator of when the sensor is activated is provided by an on-board LED. The performance of the modules will change from its low idle state to high when activated (default operation). Solder jumpers cause the active low output or toggle output to reconfigure its mode of service.

The output for this circuit is the LED Circuit Board 12V Ultra Bright White Piranha. This LED is chosen because of the high brightness it can bring. Next is the 3V - 12V DC Electronic Piezo Buzzer. A 5V relay module is used to activate the output. Finally, in the 433.4-473.0 MHz range, HC-12 is a half-duplex wireless serial connectivity module with 100 channels that can transmit up to 1 km.

3.9 Design

For the wireless footwork analysis in this project, where design based on solid drawing is factor size and dimensions, the project should be designed. There's a PCB board, on/off switch, LED, buzzer, charger slot. We used visual basic studio for the user interface to easily control the user from there.

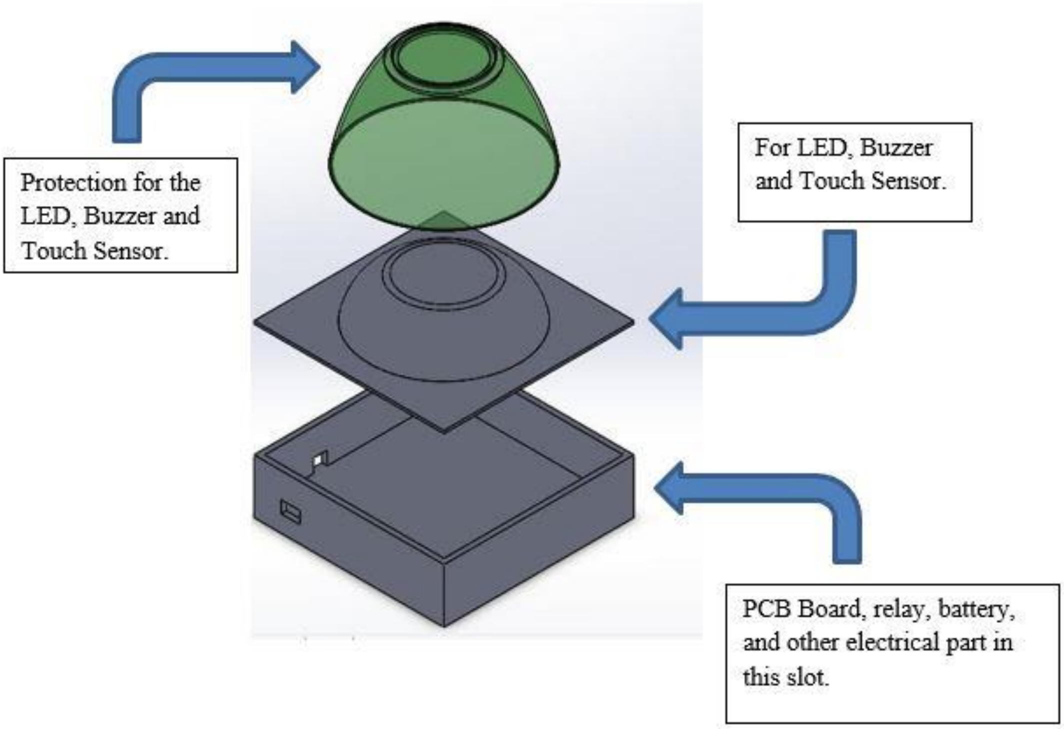


Figure 3.24: Design for Arduino node Part

3.10 Installation and Assembly

One of the critical parts of any project is wiring and interfaces. The details of the connection of various devices such as the TTP223 touch sensor, single channel relay module, LED Piranha, 5V buzzer, battery holder, HC-12 module and Arduino are based on detail have been explained on the material selection above. Also, we need to know the functionality of each Arduino Nano pin. In our project, first we make a connection on the breadboard. Then we do the LED piranha, buzzer, HC-12 Module and Arduino nano TTP223 touch sensor interfacing. After successfully testing work, using Arduino IDE Serial Monitor communication, we test wireless communication with other Arduino nano, then we continue to interface Arduino nano with Xl6009 DC step up module, battery holder, TP4056 micro-USB charger module and switch. Lastly, we solder all of them onto the stripboard after testing no issue and put it all into the body.

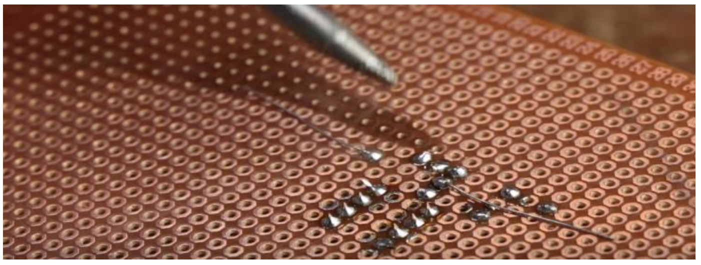


Figure 3.25: Soldering

Based on Figure 3.24, the electrical components are neatly assembled and welded well on the PCB board using soldering iron. Because the temperature of the soldering iron is too high and could melt the electrical components, we must be careful when doing soldering activity to prevent the components from burning. We need to use the sucker to clean it to avoid short circuits when we do the wrong soldering. There is a welding technique. On each minor part of soldering, we can do it one by one, when one minor part is completed, test it first then proceed to the next part. We can minimize the area that could cause short circuit by using this technique and correct it within a second. When short circuit appears, it would be more difficult to find out the problem that causes it, not like doing checking after all the soldering is do

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter a step-by-step explanation on how to implement the project of wireless footwork analysis for badminton player. Wiring and interfacing, Coding for sensor battery connection, user interface and body of this project. After the procedure from the previous chapter is done.

4.2 Calibration and Coding

Before testing the project, we need insert the coding that can work with by using Arduino library to make HC-12 working. Then testing to make sure can communicate with another Arduino using Serial monitor Arduino IDE.

```
#include <SoftwareSerial.h>
SoftwareSerial HC12(10, 11); // HC-12 TX Pin, HC-12 RX Pin
void setup() {
  Serial.begin(9600); // Serial port to computer
  HC12.begin(9600); // Serial port to HC12
}
void loop() {
  while (HC12.available()) { // If HC-12 has data
    Serial.write(HC12.read()); // Send the data to Serial monitor
  }
  while (Serial.available()) { // If Serial monitor has data
    HC12.write(Serial.read()); // Send that data to HC-12
  }
}
```

Figure 4.1: Example of coding testing HC-12

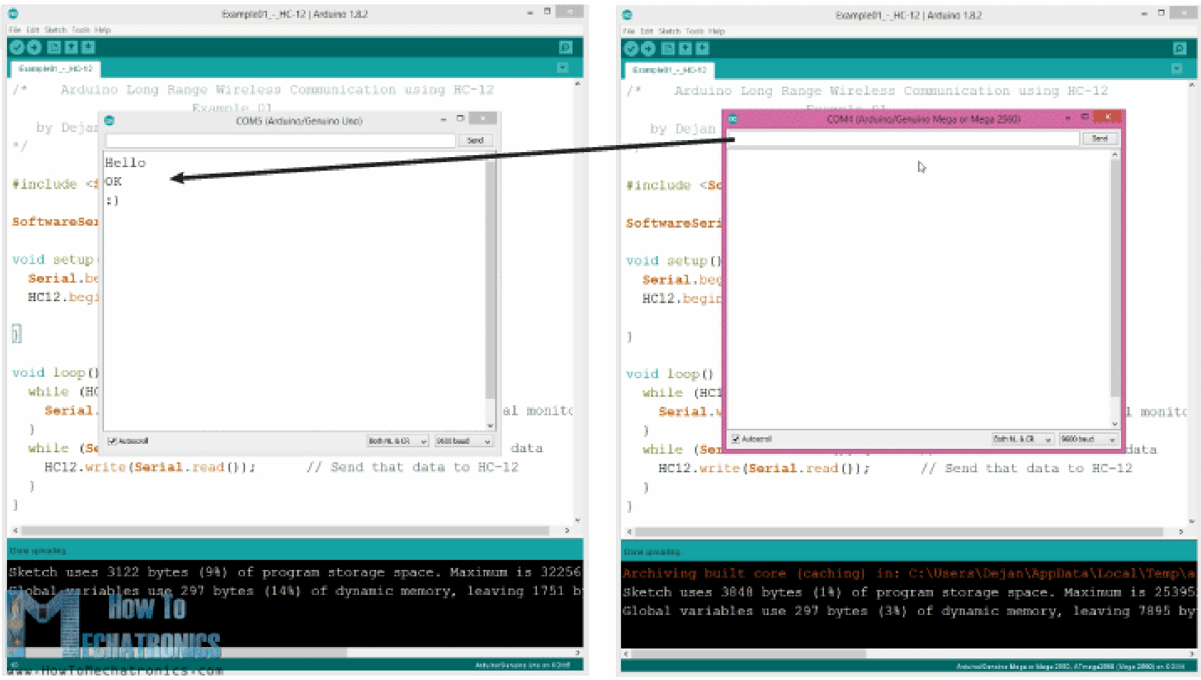


Figure 4.2: Example of HC-12 communication to other HC-12

We can see testing it done based on figure 4.2, then we can follow the coding we make in the previous chapter, so that the coding can work or not to communication other HC-12 with working other electrical part like LED, buzzer, and touch sensor.

4.3 Wiring and Soldering

We need to design the circuit diagram first for the circuit to control the Arduino node and Arduino main, before we start wiring the components. To avoid the wrong connection between the component so that it will function properly, we need to link all the components together, it is important to carefully design the system so that the touch sensor can detect the user hand as well as LED and buzzer functioning well and this was accomplished by the circuit, we designed from the previous chapter.

We start to connect to all the electrical components in the breadboard according to the design based on the wiring diagram we design on proteus. One of the reasons why we use breadboard at the first stage is that we want to make sure that the circuit can work and that it is easy for us to solve problems if any problems occur or output does not work according to what we expected. We're just connecting the entire Arduino cable component to the breadboard in appendix C and D.

There is no problem with our circuit after testing. We continue soldering on the PCB board in appendix F. At this stage, all the electrical components connected to the wire must be soldered carefully to avoid any connection errors. Then, the electrical part is connected to the Arduino nano, HC-12, relay module, LED, buzzer, and touch sensor. We make sure that there is no loose wire that can cause a faulty circuit.

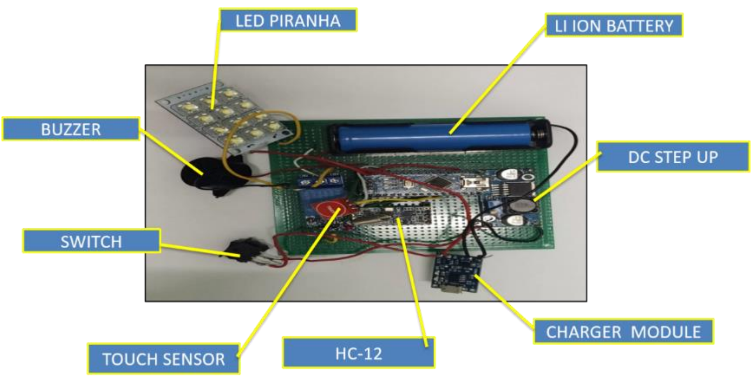


Figure 4.3: Assembly of electric components

4.4 Battery connection

Battery is main source to operate Arduino, the LED, buzzer, relay, and touch sensor. In this case we are using 3000mah rechargeable lithium-ion battery to make the project portable. After that we connect the charger for the battery to see how long to take charge full battery based on the table 2 and figure 4.3.

Table 2: Typical charge characteristics of lithium-ion

Capacity at cut-off voltage	Capacity with full saturation	Charge time	3.7V battery (V)
40%	60%	120min	3.80
60%	70%	135min	3.90
70%	80%	150min	4.00
80%	90%	165min	4.10
85%	10%	180min	4.20

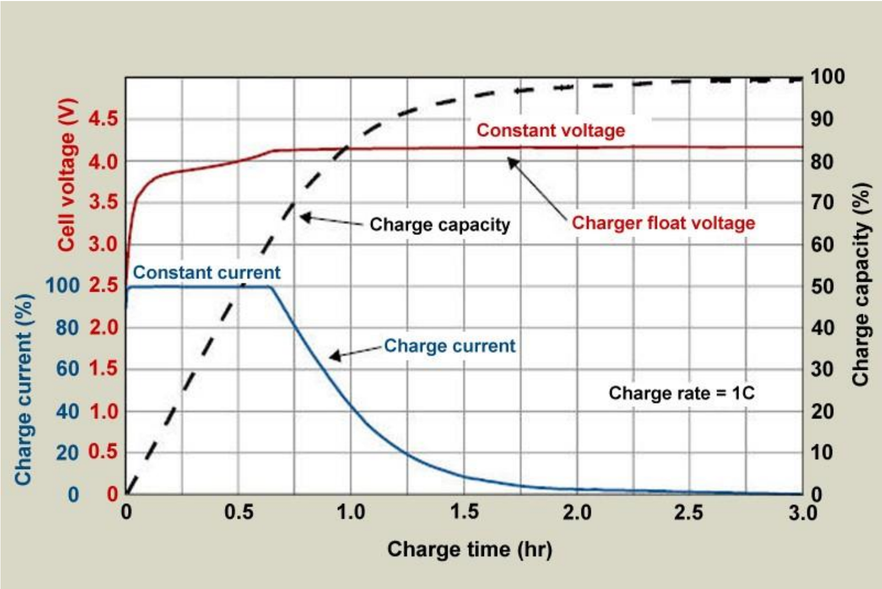


Figure 4.4: Volts/capacity vs. time when charging lithium-ion

4.5 User Interface

The user interface must be created from the visual studio program in order to monitor the Arduino Nano input and output. Based on the need, it can build any GUI, software, and design. This app also has several features and shapes that can be configured by each button and boxes that are generated. The graphical user interface (GUI) of this agility unit is seen in the figure below.

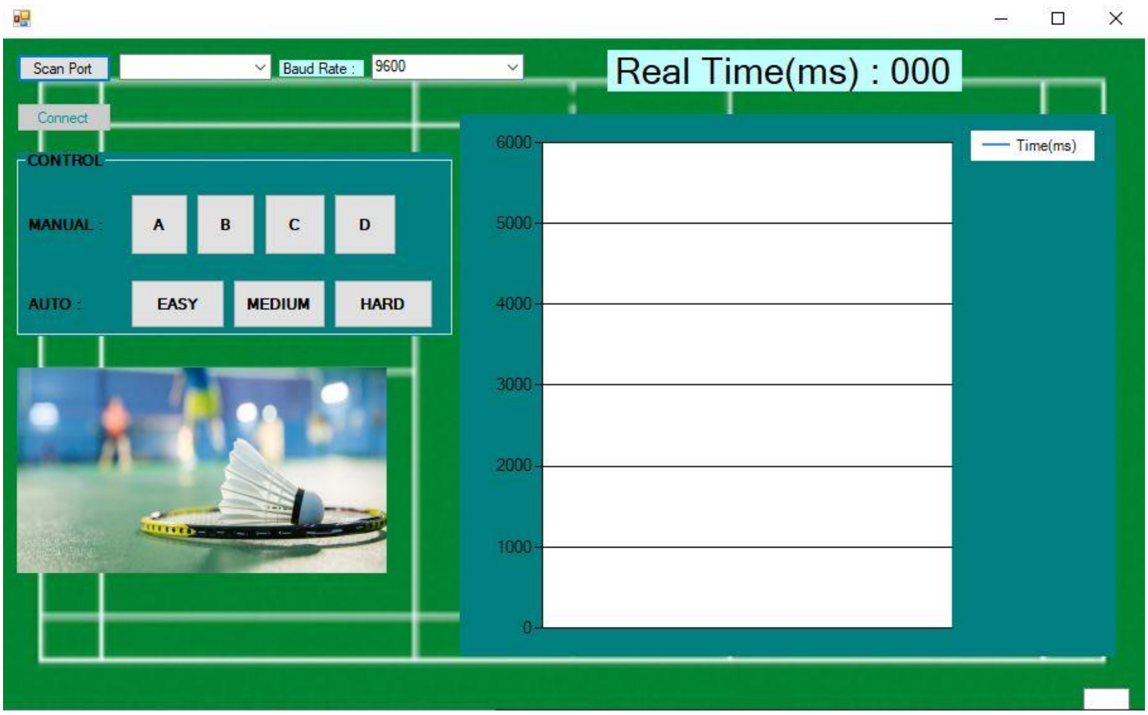


Figure 4.5: User Interface Gui using Visual basic

Among many systems with a graphical user interface, this device consists of a scan port to pick which com and which baud rate can be chosen. When Arduino Nano binds to the device, the Interface can detect com. The control component consists of an automatic and manual mode. The manual mode will provide guidance on an individual basis. If the user presses A, the Lead in node A will click on and the other alphabet button will switch on. For auto mode, a serial monitor such as A, B, C, D should be given a random alphabet at a certain delay. Compared to other modes that are medium and heavy, the simple mode would have more delay. In the table, the output will be seen. Time vs distance would be the graph. At the top of the graph, the real-time answer will be seen.

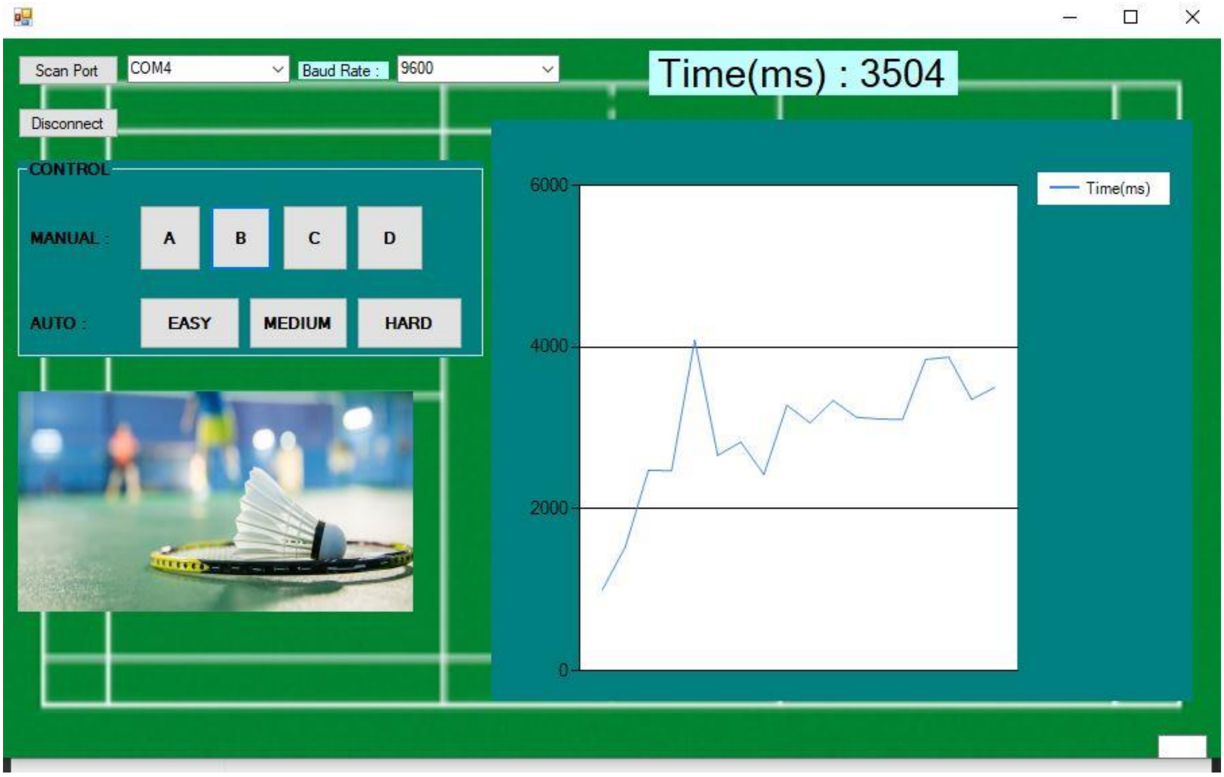


Figure 4.6: Example the project been used and show the result in the gui/user interface.

4.6 Project body

In this project we used acrylic glass and plastic (A-PET) amorphous polyethylene terephthalate for the body wireless footwork analysis for badminton.

Figure 4.7: Body of Arduino node Part A, B, C, D

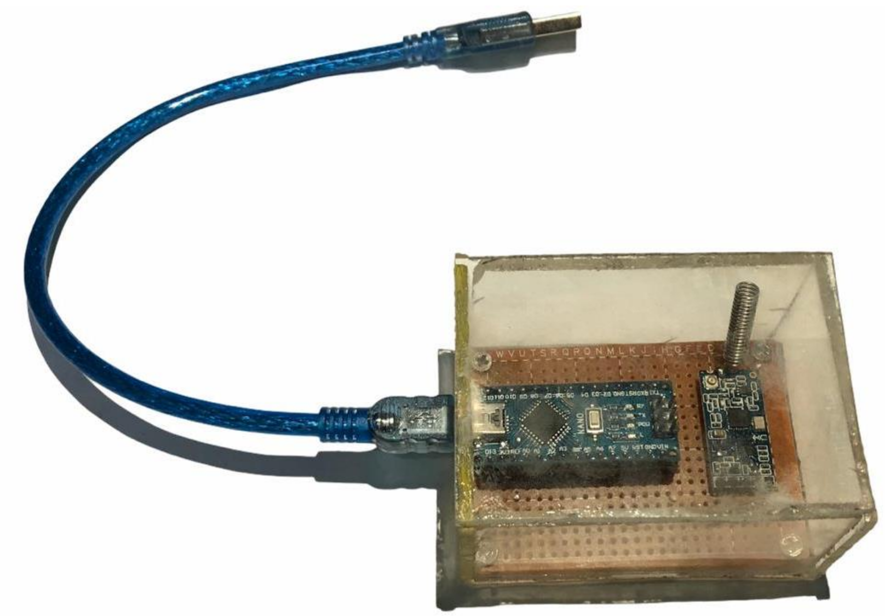


Figure 4.8: Body of main Arduino

Figure 4.9: All part of this project body

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter ended with the useful content of the report. The research result gave an overall overview of this study case. Along with the guidelines for future research purposes, the shortcomings or issues found during the conduct of this analysis have also been mentioned.

5.2 Conclusion

In conclusion, this project is to explain the idea and method of creating a system and software to measure the footwork of badminton players. It can therefore be assumed that this system is very effective as an efficient means of evaluating the footwork of the badminton player. Other than that, compared with other technology, the cost of developing this project is cheap. When designing a wireless footwork study, the most critical components that need to be addressed are the connectivity between nodes so that everything can work wirelessly smoothly. In addition, this project can evaluate the performance graph based on how quickly the player can react. With the support of the graphical user interface we are creating, the player is helped to analyse their footwork performance based on this project.

However, this project has been a success as far as learning and practical implementation of electronics engineering concepts is concerned. The basic idea proposed in this project work well and can be implemented on large scale industry like sport.

5.3 Recommendation

This project will be further strengthened by the appropriate construction of the prototype as a suggestion. Need decreasing the size of the configuration would allow the user more portability to bring in the backpack. In addition, the battery can be much smaller to allow other electronic circuits more space. It is proposed to build Interface in other devices such as smartphones to be able to link to the internet for enhancement.

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APPENDICES

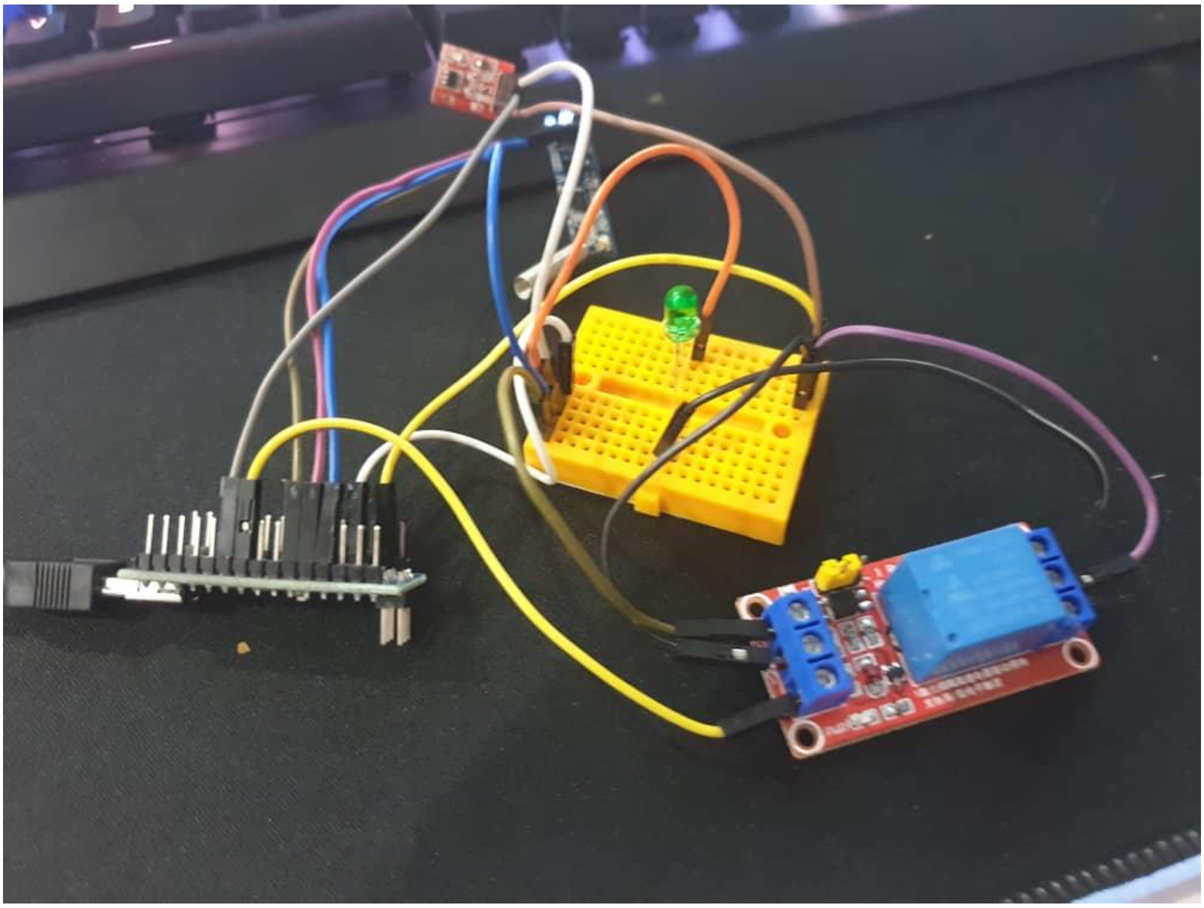
APPENDIX A:COST PROJECT ITEM

NO	Component	Quantity	Price
1	Arduino Nano V3.0	5	RM85.00
2	Rechargeable 18650 Li Ion 3.7v Battery (3000mah)	4	RM 31.20
3	TTP223 Capacitive touch switch/sensor module	4	RM12.00
4	5V single channel Relay	4	RM22.00
5	TP4056 Micro USB 5V 1A Lithium Battery 18650 Charger	4	RM13.00
6	HC-12 433MHz RF (UART) Transceiver Module 1km	5	RM131.65
7	Large Active Buzzer 3V - 24V DC	2	RM13.00
8	18650 3.7V Lithium Battery Holder	4	RM12.40
9	New DC 3V 5V 12 Super Bright White Piranha LED Circuit Board LE DRM	4	RM22.20
10	Arduino XL6009 DC-DC Adjustable Step-up Voltage Booster Module	4	RM25.20
11	PCB Board and Header Male/Female	5	RM22.50
Total			RM377.15

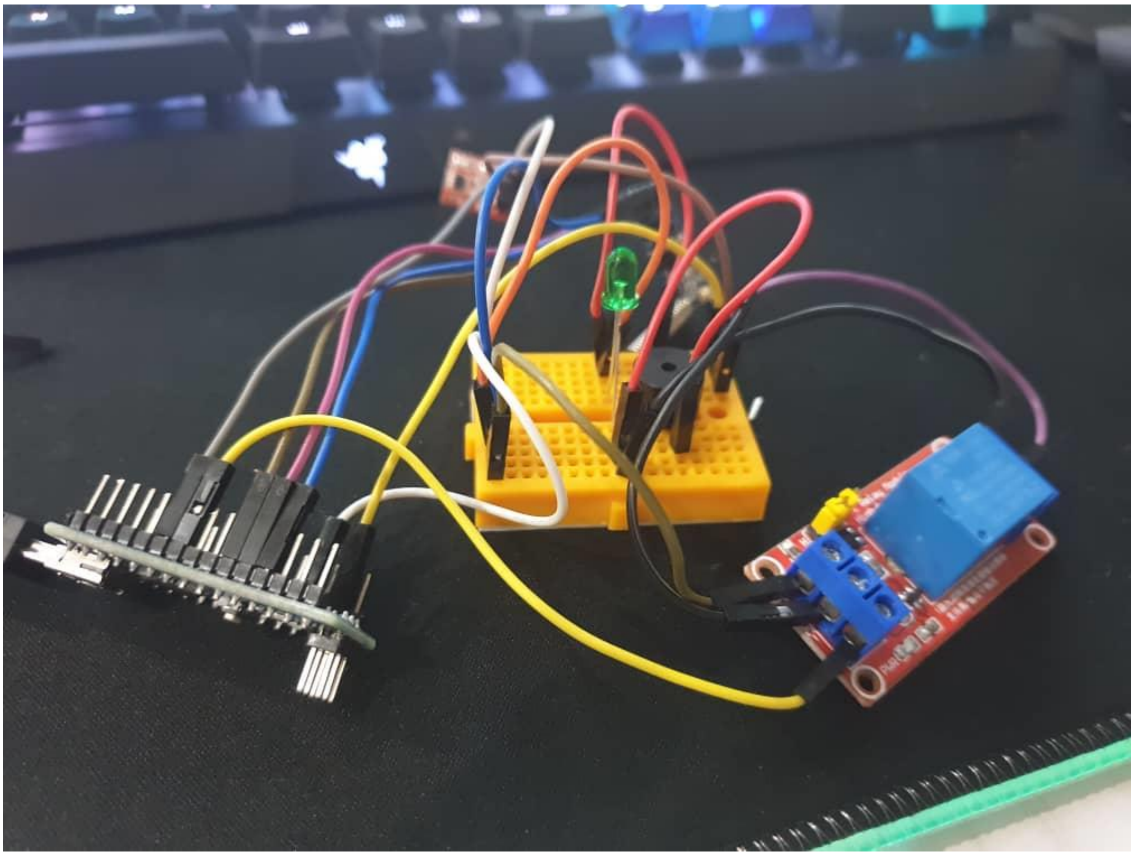
APPENDIX B:Gantt Chart project planning for SDP2

MONTHS	**SDP 1**				**SDP 2**			
ACTIVITIES	FEB	MAY	JUN	JULY	OCT	NOV	DEC	JAN
TOPIC UNDERSTANDING								
BASIC DESIGN								
DETAIL DESIGN								
MATERIAL SELECTION								
DRAFT PROJECT PROPOSAL								
PRESENTATION								
SDP2 BRIEFING								
SUMULATION								
PURCHASE METERIAL								
BUILD PROTOYPE								
CREATE A CODING								
IMPLEMENTATION FINAL PROJECT								
REPORT								
PRESENTATION								
FULL REPORT PROJECT								

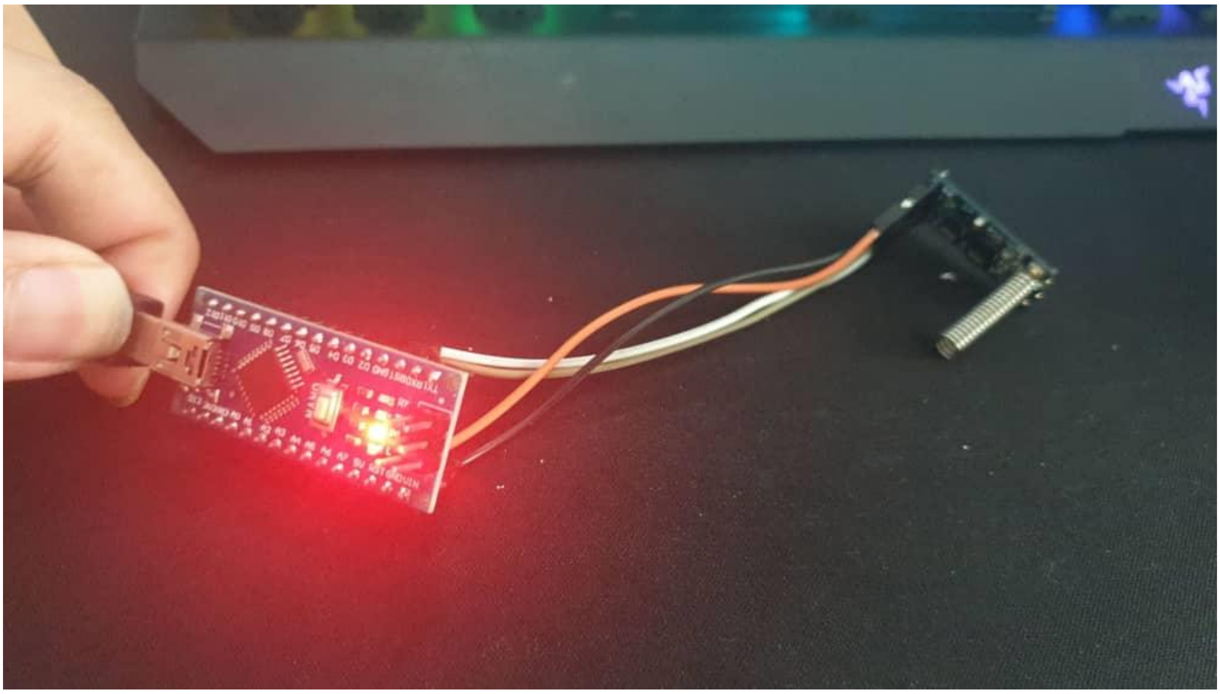
APPENDIX C :Arduino node Part A and B breadboard Testing



APPENDIX D : Arduino node Part C and D breadboard Testing



APPENDIX E : Arduino Main Testing Breadboard



APPENDIX F :Soldering All Part