**AntiaTech**

Test Documentation

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Table of Contents

[AntiaTech Test Documentation 3](#_Toc122268957)

[Introduction 3](#_Toc122268958)

[Definitions 3](#_Toc122268959)

[Unit Test 3](#_Toc122268960)

[Feature Test 3](#_Toc122268961)

[Integration Test 3](#_Toc122268962)

[User Acceptance Test 3](#_Toc122268963)

[Unit Tests 4](#_Toc122268964)

[Check if DC Motors Work Continuously with Rated Current 4](#_Toc122268965)

[Check If Maximum Power Consumption of All Motor Units is In Proper Limits 5](#_Toc122268966)

[Check If Mechanical Components Fits Our Purpose After Printing Them 6](#_Toc122268967)

[Check if Servo Motor of Ball Thrower Can Work as Expected 7](#_Toc122268968)

[Check if Step Motor of Ball Thrower Can Work as Expected 8](#_Toc122268969)

[Check if Microphones Work Properly 9](#_Toc122268970)

[Check if System Ball Tracking Can Work Continuously 10](#_Toc122268971)

[Check if the Vibration Sensor Can Work Properly 11](#_Toc122268972)

[Feature Tests 12](#_Toc122268973)

[Check if ball-thrower can throw ball with manually entered input speeds 12](#_Toc122268974)

[Check if balls are sent to barrel with manually entered input speeds 13](#_Toc122268975)

[Check if Barrel and Motors Are Connected Properly 14](#_Toc122268976)

[Check if Ball Thrower Changes Horizontal Angles Correctly 15](#_Toc122268977)

[Check if Ball Thrower Changes Vertical Angles Correctly 16](#_Toc122268978)

[Check if System Can Detect the Ball Accurately 17](#_Toc122268979)

[Check if System Can Track Ball Accurately 18](#_Toc122268980)

[Check if Raspberry Pi Understands the Verbal Commands 19](#_Toc122268981)

[Integration Test 20](#_Toc122268982)

[Check if ball-thrower mechanism with all components can work properly. 20](#_Toc122268983)

[Check if immediate photo capture is possible by signaling 21](#_Toc122268984)

# AntiaTech Test Documentation

## Introduction

This document provides possible test scenarios of the product. There are 4 different test scenario are defined; unit, feature, integration and user acceptance tests.

This demo document contains only the first three. Since the final product has not been completed, we don’t have an acceptance test yet.



## Definitions

### Unit Test

By doing the unit test, we aim to test all minor elements of the system. These tests are not very comprehensive but very critical for our processes because any fault in a minor component in the system may have an important effect on other subsystems.

### Feature Test

Feature test aims to test the combination of sub-system elements. These tests are executed for all different sub-systems, and the test inputs don’t depend on the other sub-systems.

These tests are important in order to prevent any fault while integrating the sub-systems.

### Integration Test

Integration test aims to test the behavior of a combination of all sub-systems. By doing these tests, we would like to ensure that our sub-systems are properly integrated and can work together.

### User Acceptance Test

User Acceptance test aims to test if the final product meets the specifications of the project definition. This test will probably be executed at the end of the development progress.

# Unit Tests

### Check if DC Motors Work Continuously with Rated Current

#### Summary

##### Location & Date

##### Description & Aim

DC motors will probably work continuously during the game. Thus, we need to check if they can properly work continuously without interruption or hazard. In this test, we aims to assure that dc motors can work at least 10 minutes without interruption with rated current.

##### Participants

#### Preconditions & Environment Requirements

1. DC Motors which are connected with wheels
2. DC Supply
3. Digital Multimeter (Ground Truth: If multimeter & dc supply shows the same values)

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect 1 of the dc motors to the supply | - | - |  |  |
| Then, activate power supply with zero voltage & current | 0V,0A | No motion observed |  |  |
| Then, increase voltage limit | 9V | No motion observed because supply is at CC mode |  |  |
| Then, starts to increase current | 0.10A | Motor starts to run with low speed |  |  |
| Then, set current value to the rated current of dc motor | 0.5A | Motor speed increases,  Motor temperature increases |  |  |
| Then, wait 10 minutes to observe if motor has been damaged or not | 10 minutes | Motor should run continuously without interruption  Motor temperature should not be high |  |  |

### Check If Maximum Power Consumption of All Motor Units is In Proper Limits

#### Summary

##### Location & Date

##### Description & Aim

In the project, we are going to use batteries to power up all motor components. Since the batteries has some current limits, we need to check our maximum power ratings to run our system in proper limits.

In this test, all motors are run at their rated currents and maximum current rate will be observed. Then, it is optimized according to batteries capability.

##### Participants

#### Preconditions & Environment Requirements

1. DC Supply
2. Battery
3. Digital Multimeter \*2 (Ground Truth: If multimeter & dc supply shows the same values)
4. DC Motors

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect all dc motors at the same dc supply | - | - |  |  |
| Then, activate power supply with zero voltage & current | 0V,0A | No motion observed |  |  |
| Then, increase voltage limit | 9V | No motion observed because supply is at CC mode |  |  |
| Then, starts to increase current | 0.3A | Motors start to run with low speed |  |  |
| Then, increate the current up to DC supply enters VC mode | - | Motors reach top speed.  At 9V case, maximum current is observed.  Check the 1 series 9V battery capability to run all motors at the same time. |  |  |

### 

### Check If Mechanical Components Fits Our Purpose After Printing Them

#### Summary

##### Location & Date

##### Description & Aim

Some mechanical components are printed in 3D printer. Since they are all plastic, their mechanical strength should be checked. Note that this test doesn’t aim to broke printed material. This test only aims to be assure that if printed component is suitable for us or not.

##### Participants

#### Preconditions & Environment Requirements

1. Printed Barrel
2. Printed Wheels
3. Printed Floor
4. Printed Motor Bed
5. Printed Screw Bed
6. Other Printed Components
7. No ground truth for these tests

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Check Barrel | Ball can pass inside it |  |  |  |
| Check DC Motor Bed | Motor Fit In Bed |  |  |  |
| Check Screw Bed is Capable to Carry all Balls etc. |  |  |  |  |
| Check Wheels fit into Barrel and DC Motor Mill |  |  |  |  |
| Check if Floor is capable to carry weight | Floor can carry all balls. | Up to 1.5KG |  |  |
|  |  |  |  |  |

### Check if Servo Motor of Ball Thrower Can Work as Expected

#### Summary

##### Location & Date

##### 

##### Description & Aim

In the project, a servo motor is placed next to the ball thrower’s barrel, and it supplies horizontal angle changes for the ball thrower. Aim of this test is to check if the servo motor is working properly in desired limits. Ground truth is protractor with right angle measurements.

##### Participants

#### 

#### Preconditions & Environment Requirements

* Arduino
* Servo Motor
* Protractor

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect Servo Motor Directly to the Arduino | - | - | - |  |
| Write a Code with 10° Angle Changes every time step in Arduino | - | - | - |  |
| Compile and Upload the Code to Arduino | - | RX TX leds of the Arduino blinks | - |  |
| Time Step 1 | 10° | Protractor angle shows 10° |  |  |
| Repeat Previous Step 1 for 10 times | 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100° | Protractor angle shows 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100° |  |  |
| Write and Upload a Code with 5° Angle Changes every time step in Arduino |  |  |  |  |
| Time Step 1 | 5° | Protractor angle shows 5° |  |  |
| Repeat Previous Step 1 for 10 times | 10°, 15°, 20°, 25°, 30°, 35°, 40°, 45°, 50° | Protractor angle shows 10°, 15°, 20°, 25°, 30°, 35°, 40°, 45°, 50° |  |  |
| Write a Code with 100° Angle Changes in Total in Arduino |  |  |  |  |
| Uploaded Code runs and changes the servo motor angle | 100° | Protractor angle shows 100° |  |  |

### Check if Step Motor of Ball Thrower Can Work as Expected

#### Summary

##### Location & Date

##### Description & Aim

In the project, a step motor is placed next to the ball thrower’s tank, and it supplies vertical angle changes fort he ball thrower. Aim of this test is to check if the step motor is working properly in desired limits. Ground truth is protactor with right angle measurements.

##### Participants

#### Preconditions & Environment Requirements

·        Power Supply and Motor Driver

·        Step Motor

·        Protractor

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect Step Motor to Power Supply and Motor Driver | - | - | - |  |
| Write a Code with 10° Angle Changes every time step in Arduino | - | - | - |  |
| Give High to First Input of Motor Driver to Change Step Motor Angle |  | Protactor angle should show 0° |  |  |
| Repeat Previous Step 3 times | 45°, 90°, 135° | Protactor angle should show 45°, 90°, 135° |  |  |
| Place the motor next to the system | - | Motor torque is high enough to turn the tank |  |  |

### Check if Microphones Work Properly

#### Summary

##### Location & Date

##### Description & Aim

Three microphones are planned to be used in this project, two for recording the sound of the balls hitting the table and one for acquiring the player's commands. Since the performance expected from the microphones is not high, this standard unit test is designed to be applied to all microphones.

##### Participants

#### Preconditions & Environment Requirements

* A quiet place
* A person (two if possible, a male & a female) who will speak the commands (Ground truth: the command(s) the microphone should record is known)
* USB microphone
* Distance measurement tool (e.g., a tape measure)

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect microphone to start recording sound | - | - | - | - |
| Arrange the distance from microphone to person who will speak the commands | 40 cm | - | - | - |
| Record the command(s) the person speaks | 10 times | all records include the command(s) in a clearly understandable way |  |  |
| Repeat the second step | 70 cm | - | - | - |
| Repeat the third step | 10 times | at least 8 records include the command(s) in a clearly understandable way |  |  |
| Repeat the second step | 110 cm | - | - | - |
| Repeat the third step | 10 times | at least 7 records include the command(s) in an understandable way |  |  |

### Check if System Ball Tracking Can Work Continuously

#### Summary

##### Location & Date

##### Description & Aim

We have designed our system to be simple and user-friendly. So, we expect the system to be up and running at the moment it is powered. Camera will continuously monitor the table as the practices goes on. We need to see if the image processing module of our product works for long periods of time without any overheating or program crashing.

##### Participants

#### Preconditions & Environment Requirements

* Raspberry Pi
* An image sensor (a webcam, piCamera etc.)
* A table tennis set-up

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect image sensor to the Raspberry Pi | - | - | - |  |
| Connect power supply to Raspberry Pi | - | Image processing program starts running automatically | - |  |
| Let the system run for a while | 2 hours(runtime) | -40°<Tmeasured °<85° |  |  |
| Let the system run for a while | 2 hours(runtime) | No crashing |  |  |

### Check if the Vibration Sensor Can Work Properly

#### Summary

##### Location & Date

##### Description & Aim

The two vibration sensors at the left and right edges of the table-tennis table are to sense the vibration when a ball hits the table. If they do not hit the right part of the table, sensors don’t detect the vibration. Ground truth is ten certain ball hits on the table.

##### Participants

#### Preconditions & Environment Requirements

* Vibration sensor
* An Arduino with power supply
* A table tennis set-up and balls

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect vibration sensor to Arduino | - | - | - |  |
| Upload the code to Arduino for detecting vibration | - | - | - |  |
| Place the vibration sensor and Arduino next to tennis table | - | - | - |  |
| Power the Arduino and throw a ball to the table at 25 cm distance to set-up | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |
| Throw a ball to the table at 50 cm distance to set-up cm distance to set-up | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |
| Throw a ball to the table at 80 cm distance to set-up cm distance to set-up | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | Serial monitor shows non-zero data between 0-10000 Hz |  |  |

# Feature Tests

### Check if ball-thrower can throw ball with manually entered input speeds

#### Summary

##### Location & Date

##### Description & Aim

After combining minor components, we need to check if ball-thrower can throw balls with desired speed and desired direction.

##### Participants

#### 

#### Preconditions & Environment Requirements

* Power Supply
* Ball
* Ball-Thrower Body with controller elements

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Check if all motor components are connected to input terminal | - | All motors should be connected to the related port of motor driver |  |  |
| Then, power up controller but not dc motors | 5V | Arduino and Controller Circuit leds should be activated |  |  |
| Then, set PWM of motor controller inputA | 20% | Only motors 1 should starts to run |  |  |
| Then, push a ball to the barrel and check if it is thrown by whell |  | Ball, should be thrown with low speed |  |  |
| Then, change the PWM of motor controller inputA | 70% | * Motor should accelerate * Possible “zzz” noise can be occurred * Motor should run continously |  |  |
| Then, change the PWM of motor controller inputA | 0% | Motor 1 should decelerate and stop. |  |  |
| Then, repeat the steps above for the motor 2 |  |  |  |  |

### 

### Check if balls are sent to barrel with manually entered input speeds

#### Summary

##### Location & Date

##### Description & Aim

Balls should be pushed to the barrel in order to throw them. Thus, we build a push mechanism that contains a turning platform and 1 dc motor.

##### Participants

#### Preconditions & Environment Requirements

* Balls
* Box Mechanism which contains all dc motors, turning platform(floor) and controller

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Check the motor is connected to the input terminal. |  | Motor terminals should be connected the terminals properly. |  |  |
| Then, give power to the controller but not motors. |  | Arduino and Controller Circuit LEDs should be activated |  |  |
| Then, set PWM of motor controller | 30% | Balls should be pushed to the barrel slowly (1ball/1 sec) |  |  |
| Then, change the PWM of motor controller | 80% | Balls should be pushed to the barrel fastly (2 balls /3sec) |  |  |

### 

### Check if Barrel and Motors Are Connected Properly

#### Summary

##### Location & Date

##### Description & Aim

DC motors of ball thrower should be integrated to the barrel in order to proper throw mechanism. Thus, we need to do test this part carefully because in case of any error or mistake, the balls can’t be accelerated properly.

##### Participants

#### Preconditions & Environment Requirements

1. Printed Barrel
2. Printed Motor Bed
3. DC Motor connected with a Wheel
4. DC Supply
5. Ball

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Check if Motor Bed and Barrel is well connected |  | When someone tries to separate bed from barrel, it should not be separated |  |  |
| Then, check if DC motor can fit into motor bed |  | DC motor should fit into the bed and there should not be any space. |  |  |
| Then, put DC motor into the bed and connect its terminal to dc supply directly |  | Motor is ready to be run |  |  |
| Then, activate dc supply and set the voltage | V = 9V | Motor should start to accelerate, and motor should be stationary inside the bed |  |  |

### Check if Ball Thrower Changes Horizontal Angles Correctly

#### Summary

##### Location & Date

##### Description & Aim

After combining the servo motor with the rest of the ball thrower mechanism, horizontal angle changes of the overall system with the proper time limits will be checked. The ground truth is protractor measuring the angle differences, and chronometer measuring the time change.

##### Participants

#### Preconditions & Environment Requirements

* Tennis Table
* Balls
* DC Power Supply
* Ball Thrower
* Protractor
* Chronometer

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Activate ball thrower | - | - | - |  |
| Activate the mode with 10° angle changes for every time step, and minimize the mass of the ball thrower | - | - |  |  |
| Time Step 1 - Ball thrower with minimum mass rotates horizontal 10° | 10° | Protractor angle shows 10° |  |  |
| Repeat the previous step 6 times | 20°, 30°, 40°, 50°, 60° | Protractor angle shows 20°, 30°, 40°, 50°, 60° |  |  |
| Activate the mode with 10° angle changes for every time step, and maximize the mass of the ball thrower |  |  |  |  |
| Time Step 1 - Ball thrower with maximum mass rotates horizontal 10° | 10° | Protractor angle shows 10° |  |  |
| Repeat the previous step 6 times | 20°, 30°, 40°, 50°, 60° | Protractor angle shows 20°, 30°, 40°, 50°, 60° |  |  |
| Activate the mode with 10° angle changes for every 3 secs |  |  |  |  |
| Ball thrower rotates horizontal 10° every 3 seconds | 10°, 20°, 30°, 40°, 50°, 60° | Protractor angle changes every 3 seconds and show 10°, 20°, 30°, 40°, 50°, 60° in total 18 seconds |  |  |

### Check if Ball Thrower Changes Vertical Angles Correctly

#### Summary

##### Location & Date

##### Description & Aim

After combining the step motor with the rest of the ball thrower mechanism, vertical angle changes of the overall system with the proper time limits will be checked. The ground truth is protractor measuring the angle differences, and chronometer measuring the time change.

##### Participants

#### Preconditions & Environment Requirements

1. Tennis Table
2. Balls
3. DC Power Supply
4. Ball Thrower
5. Protractor
6. Chronometer

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Activate ball thrower | - | - | - |  |
| Activate the mode with 10° angle changes for every time step, and minimize the mass of the ball thrower | - | - |  |  |
| Time Step 1 - Ball thrower with minimum mass rotates vertical 10° | 10° | Protractor angle shows 10° |  |  |
| Repeat the previous step 6 times | 20°, 30°, 40°, 50°, 60° | Protractor angle shows 20°, 30°, 40°, 50°, 60° |  |  |
| Activate the mode with 10° angle changes for every time step, and maximize the mass of the ball thrower |  |  |  |  |
| Time Step 1 - Ball thrower with maximum mass rotates vertical 10° | 10° | Protractor angle shows 10° |  |  |
| Repeat the previous step 6 times | 20°, 30°, 40°, 50°, 60° | Protractor angle shows 20°, 30°, 40°, 50°, 60° |  |  |
| Activate the mode with 10° angle changes for every 3 secs |  |  |  |  |
| Ball thrower rotates vertical 10° every 3 seconds | 10°, 20°, 30°, 40°, 50°, 60° | Protractor angle changes every 3 seconds and show 10°, 20°, 30°, 40°, 50°, 60° in total 18 seconds |  |  |

### Check if System Can Detect the Ball Accurately

#### Summary

##### Location & Date

##### Description & Aim

The detection of the ball hitting the tennis table is done by vibration sensors and microphone. Ground truth is ten certain ball hits on the table for each unit, for each side and outside of the table (ball thrower side - user side - floor).

##### Participants

#### Preconditions & Environment Requirements

* Ball thrower
* A table tennis set-up

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Activate ball thrower | - | - | - |  |
| Throw a ball to the ball thrower side of table | 0-10000 Hz | Ball thrower detects the throw |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | * Ball thrower detects the throw 9 times * Vibration sensors detect the throw 9 times * Microphone set-up detects the throw 9 times |  |  |
| Throw a ball to the user side of table | 0-10000 Hz | Ball thrower does not detect the throw |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | * Ball thrower does not detect any throw * Vibration sensors detect the throw 9 times * Microphone set-up detects the throw 9 times |  |  |
| Throw a ball to the outside of table | 0-10000 Hz | Ball thrower does not detect the throw |  |  |
| Repeat the previous step 9 times | 0-10000 Hz | * Ball thrower does not detect any throw * Vibration sensors detect the throw 9 times * Microphone set-up detects the throw 9 times |  |  |

### Check if System Can Track Ball Accurately

#### Summary

##### Location & Date

##### Description & Aim

Camera will continuously monitor the table as the practices goes on. We need to see if the image processing module of our product works.

##### Participants

#### Preconditions & Environment Requirements

* Raspberry Pi
* An image sensor (a webcam, piCamera etc.)
* A table tennis set-up

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect power supply to Raspberry Pi | - | - | - |  |
| Connect image sensor to the Raspberry Pi | - | - | - |  |
| Execute the ball tracking software | - | Program runs successfully |  |  |
| Place the balls in predestined locations where we know the x and y locations (ground truth). | x and y coordinates of the pre-decided locations (in cm) |  |  |  |
| See if the algorithm responses | - | Program prints any (x, y) location to the console |  |  |
| Compare the generated results and ground truth. | x and y coordinates of the pre-decided locations (in cm) | exact (x±1, y±1) locations of the balls |  |  |

### 

### Check if Raspberry Pi Understands the Verbal Commands

#### Summary

##### Location & Date

##### Description & Aim

To check how successfully Raspberry Pi understands the verbal commands recorded via a USB microphone.

##### Participants

#### Preconditions & Environment Requirements

* A quiet place
* USB microphone
* Raspberry Pi 4 (4GB) (running speech recognition software)
* A person (two if possible, a male & a female) who will speak the commands (Ground truth: the command(s) Pi should understand is known)
* Distance measurement tool (e.g., a tape measure)

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect USB microphone | - | - | - | - |
| Get Pi running the code | - | - | - | - |
| Arrange the distance from microphone to person who will speak the command | 40 cm | - | - | - |
| Check whether Pi understands the command after the person speaks it | 10 times | At least 9 times Raspberry Pi understood the command |  |  |
| Repeat the previous two steps | 70 cm  10 times | At least 8 times Raspberry Pi understood the command |  |  |
| Repeat the previous two steps | 110 cm  10 times | At least 7 times Raspberry Pi understood the command |  |  |
| Repeat the previous four steps for different commands | - | - | - | - |

# Integration Test

### Check if ball-thrower mechanism with all components can work properly.

#### Summary

##### Location & Date

##### Description & Aim

After constucting all mechanical components of the project, we need to assure that ball-thrower can take ball from box and throw them with desired speed and to desired direction.

##### Participants

#### Preconditions & Environment Requirements

1. All mechanical part is done (Barrel, box, other dc motor components etc.)
2. Balls

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Check if all necessary components are connected to the power supply. |  | All required components are ready to power up. |  |  |
| Then, activate one of the barrel motors | Speed of motor will be determined by a pot or Raspberry command | Motor 1 starts and accelerate |  |  |
| Then, activate the ball pusher motor | Speed of motor will be determined by a pot or Raspberry command | Balls are started to be pushed to barrel and they should be thrown |  |  |
| Then, activate the servo motors that change the motor direction horizontally | Direction of motor will be determined by a pot or Raspberry command | Barrel starts to turn through desired direction while they are currently throwing balls |  |  |
| Then, stop the servo motor of horizontal motion and change the angle of barrel for vertical direction | Direction of motor will be determined by a pot or Raspberry command | Barrel angle changes according to user decision |  |  |

### Check if immediate photo capture is possible by signaling

#### Summary

##### Location & Date

##### Description & Aim

We would like to capture exactly where the ball has landed on the table. To achieve this, we plan to sense when the ball has hit the table, be it vibration sensor or audio sensor, and capture the place of the ball with our image sensor. This test is to see if we can capture the exact place of the ball with little error when a correct signal is emitted.

##### Participants

#### Preconditions & Environment Requirements

* Raspberry Pi
* An image sensor (a webcam, piCamera etc.)
* A table tennis set-up
* A signal emitter with the correct timing
* Ball launcher shooting at the exact place at an interval (ground truth)

#### Scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Data** | **Expected Result** | **Actual Result** | **Error** |
| Connect power supply to Raspberry Pi | - | - | - |  |
| Connect image sensor to the Raspberry Pi | - | - | - |  |
| Execute the ball tracking software | - | Program runs successfully |  |  |
| Start the ball launcher | - | - | - |  |
| Compare the generated results and ground truth. | (x, y) coordinates (in cm) of the place where the balls repeatedly lands | (x±2cm, y±2cm) |  |  |