# Chapter IV

## Presentation, Analysis, and Interpretation of Data

This part of the study aims to present and discuss gathered data from the laboratory experiments performed by the proponents. These data are vital for determining the reliability of each component for precise manipulation of the machine.

### 4.1 Data Analysis

The following tables are the tabulated representation of the data gathered from the tests conducted on the actuator's motors.

Table 4.1 X Motor Accuracy Test

| Test | Origin | Steps | Forward | Backward | Repetition | Difference |
|---|---|---|---|---|---|---|
| 1 | 0 | 152 | 3.2 cm | 3.2 cm | 10 | 0 |
| 2 | 0 | 304 | 6.4 cm | 6.4 cm | 10 | 0 |
| 3 | 0 | 456 | 9.6 cm | 9.6 cm | 10 | 0 |
| 4 | 0 | 609 | 12.8 cm | 12.8 cm | 10 | 0 |
| 5 | 0 | 761 | 16 cm | 16 cm | 10 | 0 |
| 6 | 0 | 913 | 19.2 cm | 19.2 cm | 10 | 0 |
| 7 | 0 | 1065 | 22.4 cm | 22.4 cm | 10 | 0 |

**Note: 1 step = 0.210 mm.**

Table 4.2 Y Motor Accuracy Test

| Test | Origin | Steps | Forward | Backward | Repetition | Difference |
|---|---|---|---|---|---|---|
| 1 | 0 | 152 | 3.2 cm | 3.2 cm | 10 | 0 |
| 2 | 0 | 304 | 6.4 cm | 6.4 cm | 10 | 0 |
| 3 | 0 | 456 | 9.6 cm | 9.6 cm | 10 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 0 | 609 | 12.8 cm | 12.8 cm | 10 | 0 |
| 5 | 0 | 761 | 16 cm | 16 cm | 10 | 0 |
| 6 | 0 | 913 | 19.2 cm | 19.2 cm | 10 | 0 |
| 7 | 0 | 1065 | 22.4 cm | 22.4 cm | 10 | 0 |

**Note: 1 step = 0.211mm**

Table 4.3 Z Motor Accuracy Test

| Test | Origin | Steps | Upward | Downward | Repetition | Difference |
|---|---|---|---|---|---|---|
| 1 | 0 | 236 | 5cm | 5cm | 10 | 0 |
| 2 | 0 | 283 | 6cm | 6cm | 10 | 0 |
| 3 | 0 | 330 | 7cm | 7cm | 10 | 0 |
| 4 | 0 | 377 | 8cm | 8cm | 10 | 0 |
| 5 | 0 | 424 | 9cm | 9cm | 10 | 0 |
| 6 | 0 | 471 | 10cm | 10cm | 10 | 0 |
| 7 | 0 | 518 | 11cm | 11cm | 10 | 0 |

**Note: 1 step = 0.212mm**

To determine how accurate the motors' steps, the difference between the forward distance and the backward distance must be at least not far to zero.

*Difference* = abs(forward distance – backward distance)

Where abs = absolute value

*forward distance* = distance from the origin to the last step

*backward distance* = distance from the last step to the origin

Solving difference on Test 1 on the X motor:

Given: forward distance= 3.2 cm

Backward distance= 3.2 cm

Difference = abs(3.2cm – 3.2cm)

Difference = 0

Zero value indicates a hundred percent accuracy on the motor's steps. This will give the actuators precise positioning of the picker in the actuators. Since all tests in all the axes yield to similar forward and backward distance, it is not necessary to present all the solutions of the findings.

On Table 4.4 are the actual specifications of the chess pieces to be use. Some of the chess pieces may vary from the tabulated values given that some of the pieces were not perfectly alike to a similar piece.

Table 4.4 Chess piece specifications

| Chess Piece | Height (cm) | Base Diameter (cm) | Weight (g) |
|---|---|---|---|
| King | 6.5 | 1.8 | 12 |
| Queen | 5.5 | 1.7 | 11.7 |
| Bishop | 4.8 | 1.8 | 11 |
| Rook | 3.6 | 1.7 | 11.5 |
| Knight | 4.6 | 1.9 | 11.2 |
| Pawn | 3.4 | 1.6 | 10.5 |

In testing the board sensors, the testing program yields no error upon completing the 1,000,000 times of reading each row of the chess set. This clearly shows the reliable detection of the sensors.