POLITEKNIK BANTING SELANGOR

PICK AND PLACE ROBOTIC ARM USING IOT

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JUN 2023

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : PICK AND PLACE ROBOTIC ARM USING IOT

SESSION : II 2022 / 2023

1. We, **1. MUHAMMAD AIMAN FIRDAUS BIN MUHAMMAD SANI**
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are final year students of **Diploma in Mechanical Engineering, Politeknik Banting Selangor**, which is located at **Persiaran Ilmu, Jalan Sultan Abdul Samad, 42700 Banting, Selangor Darul Ehsan**. (Hereinafter referred to as 'the Polytechnic').

2. We represent that 'the aforesaid Project' and the intellectual property contained therein is our original work / design without taking or imitating any intellectual property from other parties.

3. We hereby agree to relinquish the ownership of the intellectual property in 'the Project' to 'the Polytechnic' to fulfil the requirements for the award of **Diploma in Mechanical Engineering** to us.

Subscribed and solemnly declared
by the above named;

a) ....……....
(NRIC No.:), MUHAMMAD AIMAN FIRDAUS BIN MUHAMMAD SANI)

b) …….....
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c) ……
(NRIC No.:) MOHAMED YOOSOOF BIN BYMUN AMIN)

Before me,
PUAN ASIAH BINTI YUNOS) ....……
as the project supervisor at the date:) ASIAH BINTI YUNOS

ACKNOWLEDGEMENT

Alhamdulillah, we are incredibly grateful to ALLAH S'W'T for being given the opportunity to complete our Final Year Project. Many thanks to my dear family my teammate who always support and pray for us to complete this project and competition. Thanks to them for giving us strength and motivation without any problem. We would like to take this opportunity to thank our supervisor, Puan Asiah Binti Yunos for guiding us to complete our project at every step and sharing knowledge with us. Thank you also to the Banting Polytechnic lecturers who always help directly and indirectly to make this project a success. Not forgetting the friends involved for helping, supporting and guiding to make this project a success and finish participating in all of this competition. Good for cooperation, kindness, willingness to share this valuable experience.

ABSTRACT

This abstract discusses the design and fabrication of a pick and place robotic arm for a final project. The project aims to create a robotic arm that can pick and place objects using an Arduino Uno microcontroller or other technologies. The paper highlights various research studies that have been conducted on the design and implementation of pick and place robotic arms. Some of the studies have focused on the simulation of pick and place robotic arms using Coppeliasim, while others have addressed the design and implementation of pick and place robotic arms for warehouse product management. The paper concludes that the project has the potential to automate material handling processes and improve efficiency in various industries.

ABSTRAK

Abstrak ini membincangkan reka bentuk dan fabrikasi lengan robot pilih dan letak untuk projek akhir. Projek ini bertujuan untuk mencipta lengan robot yang boleh memilih dan meletakkan objek menggunakan mikropengawal Arduino Uno atau teknologi lain. Kertas kerja ini mengetengahkan pelbagai kajian penyelidikan yang telah dijalankan mengenai reka bentuk dan pelaksanaan senjata robotik pilih dan letak. Beberapa kajian telah memberi tumpuan kepada simulasi memilih dan meletakkan senjata robot menggunakan Coppeliasim, manakala yang lain telah menangani reka bentuk dan pelaksanaan senjata robotik pilih dan letak untuk pengurusan produk gudang. Makalah ini menyimpulkan bahawa projek itu berpotensi untuk mengautomasikan proses pengendalian bahan dan meningkatkan kecekapan dalam pelbagai industri.

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CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

A robotic arm is a type of artificial arm that can be programmed and performs duties similar to those performed by a human arm. It can be a stand-alone robot or a component of a larger robot. Similar to an articulated robot, such a manipulator contains joints that allow for either translational (linear) or rotating mobility. The manipulator's links can be thought of as forming a kinematic chain. The manipulator's kinematic chain culminates in the end effector, which is analogous to the human hand. Nonetheless, it is often prohibited to use a robotic hand as a synonym for a robotic arm. The availability of economical robotic arms significantly grew throughout the decade. Although these robotic arms are typically sold as toys or instructional tools, applications in laboratory automation, such as their usage as autosamplers, have been suggested. A serial robot arm can be thought of as a chain of joints that are activated by motors, each of which moves a link in the chain. On the end of the chain, an end-effector, also known as a robot hand, can be connected. Robot arms are often categorised according to the number of degrees of freedom, like other robotic devices. Typically, the number of joints that move the links of the robot arm equals the number of degrees of freedom. To enable this, at least six degrees of freedom are needed.

1.2 PROBLEM STATEMENT

Pick and place robots are implemented to facilitate the separation process, the process of moving heavy materials and others. Usually, the process of transferring such heavy materials is being carried out, using human power and if the transfer process is repeated for a period of time, it can cause injury to the operator. By using a certain operator robot, it is no longer necessary to bend and lift heavy loads thus avoiding injuries and increasing work efficiency. Operators will make mistakes whether small or big at times. In an industrial world, industry cannot afford to make any mistakes. Because every mistake is expensive whether the trainee is time, money and material.

1.3 RESEARCH OBJECTIVES

- To control the displacement of the robotic arm so that the arm can be used to pick and place the elements from any source to destination.
- To build the project using 3d printing because its light and easy to handle.
- To function the robotic arm through Bluetooth connection from any device.

1.4 SCOPE OF THE RESEARCH

- By making a few minor modifications, the machine's utility can be expanded and exploited to conduct challenging and dangerous jobs for industrial applications.

- The machine will be very useful to perform repeated duties of picking and arranging small parts in an industrial production line.

- Due to its excellent increased accuracy for part placement, it can be used to execute minor assembly work successfully, which further expands the scope of our project.

1.5 SIGNIFICANCE OF THE RESEARCH

- Enhanced Productivity: Robotic arms are more efficient than human hands because they can complete jobs more quickly and precisely. Robotic arms, for instance, can operate continuously in the manufacturing industry, decreasing the need for human operators and increasing industrial productivity.

- Innovation and Advancements: Research in robotic arms can lead to new innovations and advancements in the field of robotics, including the development of new sensors, control systems, and materials. This can have a positive impact on other fields such as artificial intelligence, machine learning, and computer vision.

1.6 SUMMARY

At the end of project, Pick and Place Robotic Arm using IoT introduces the project and its objectives. The chapter provides an overview of the project, including its scope, purpose, and significance. It also discusses the background of the project, highlighting the need for automation in material handling processes. The chapter further explains the concept of IoT and its relevance to the project. It concludes by outlining the structure of the project, including the methodology, tools, and techniques that will be used to achieve the project's objectives.

CHAPTER 2

LITERATURE REVIEW

Pick And Place Robotic Arms have been widely used in various fields, including manufacturing, medical, and military. This literature review aims to provide an overview of the recent developments in the field of robotic arms. Robotic arms are manipulators that are designed to perform tasks similar to those performed by human arms. They are used in a variety of applications, such as assembly, welding, painting, packaging, and material handling.

2.1 CONCEPT/THEORY

People have long attempted to replace human labour with machine labour. Robotic machines are quicker and more efficient than humans. Practically speaking, robotics refers to the research, design, and application of robot systems in manufacturing. Robots are typically employed to carry out unpleasant, risky, excessively repetitive, and harmful activities. They do a wide range of tasks, including handling materials, assembling, arc welding, resistance welding, loading and unloading machine tools, painting, spraying, and more. The natural world serves as a source of inspiration for many robot components. The manipulator, which serves as the robot's arm, was built using human arms as a model. The robot is capable of picking and placing objects with its hands. It can run independently as well.

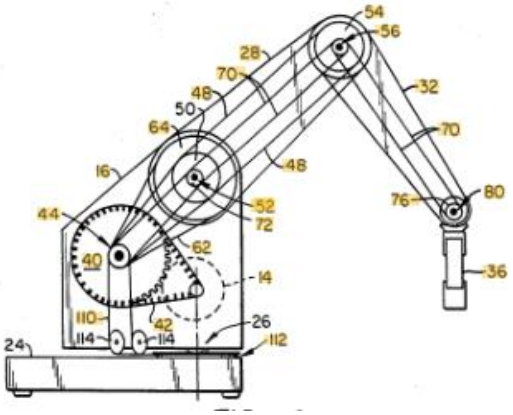
The advancement of robot system technology in the electronic industry has gotten more and more advanced. The service robot with machine vision capabilities has recently been created as one such application. Nowadays, industry adoption of pick-and-place robots and machines is on the rise, particularly in the automation and semiconductor sectors. Because it can move more quickly than a human and never gets weary, it eliminates the majority of labor-intensive tasks and boosts productivity. A manipulator and a gripper are components of a pick-and-place robot. The robot's manipulator moves and positions tools or grippers inside a predetermined work envelope. The market offers a wide variety of manipulators, including cartesian, delta, polar, articulated,

2.2 PREVIOUS STUDY ON ROBOTIC ARM

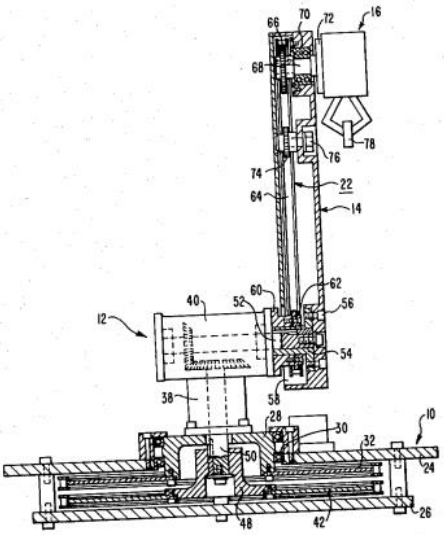
Robotic arms have previously been built and developed to serve as either expensive, intricate, heavy-duty arm for use in heavy industry or affordable, light-duty arms for use in robotic research and teaching. Closed-loop control systems are frequently used with industrial arms, and drive motors and shaft encoders are frequently positioned at each of the joints. Unimation Company and Cincinnati Milacron Corporation's robots are typical of these machines. The closed-loop design enables an arm with fine control that can be produced by using shaft encoders and motors at each joint. However, the structural elements need to be strengthened appropriately due to the additional weight at each joint. The capacity of the drive mechanisms must also be enhanced.

2.3 PREVIOUS PRODUCT PATENT DESIGN

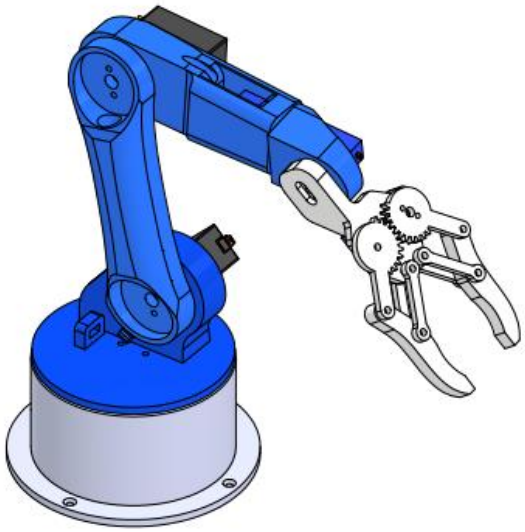
Robotic arms have previously been built and developed for use as either expensive, intricate, and heavy-duty arms for use in heavy industry, or as cheap, light-duty arms for use in robotic research and teaching. Closed-loop control systems are frequently used with industrial arms, and drive motors and shaft encoders are frequently positioned at each of the joints. Unimation Corporation and Cincinnati Milacron Corporation's robots are typical of these machines. The closed-loop design enables an arm with fine control that can be realised by using shaft encoders and motors at each joint. However, the structural elements need to be strengthened appropriately due to the additional weight at each joint. The capacity of the drive mechanisms must also be enhanced.



The following are the components of a pick and place robot structure: a fixed support structure; a rotatable turret carried by said support structure for rotation about one axis; an arm with one end portion pivotally carried by said turret for swinging movement of the arm about a second axis normal to said one axis to carry the other end portion of said arm through an arc of up to about a half circle; a working tool, such as a gripper, carried by said arm and connected to said the distance travelled by the robot's working tool from a pick site to a place position is constant between the two locations;



2.3 COMPARISON CURRENT AND PREVIOUS WORK



Figures 2.3: Project Pick and Place Robotic Arm

No.	CRITERIA	FORKLIFT	PICK AND PLACE ROBOTIC ARM
1.	Controller	Manpower	Arduino
2.	Operation	Manual	Automatic
3.	Material	Steel	3D printer and Plastic
4.	Size	Big	Small
5.	Time	50 minutes to an hour depends on human energy	30 minutes to an hour depend on the
6.	Energy	Liquid Petroleum Gas	Electric Power

Table 2.4.1.: Comparison current and previous work

2.4 THE CONCEPT OF MOVEMENT

Figures 2.41: Gripper Concept

The movement of the gripper in a pick and place robotic arm is a critical aspect of the system's design. The gripper is responsible for picking up and placing objects of different shapes and sizes, requiring it to have a flexible and precise movement. The gripper's movement can be achieved through a combination of different types of joints and actuators. For instance, a robotic arm with an articulated configuration may use rotary joints to provide rotational movement to the gripper, while linear actuators may be used to provide linear movement. To achieve precise and accurate movement, the gripper's movement can be controlled through a sophisticated control system. The control system can use sensors and feedback mechanisms to monitor the gripper's position and adjust its movement accordingly. The gripper can also have different types of end-effectors to handle different objects. For example, a gripper with a suction cup can be used to pick up flat and smooth objects, while a gripper with claws can be used to pick up irregularly shaped objects.

Figure 2.4.2: Arduino Concept

The Arduino platform can be used in the design of a pick and place robotic arm. Arduino is a popular microcontroller platform that is known for its simplicity, ease of use, and versatility. The platform consists of a range of microcontroller boards that can be programmed to control various types of electronic devices and systems, including robotic arms. In the design of a pick and place robotic arm, the Arduino platform can be used to control the movement of the arm's joints, the gripper, and the base. The microcontroller board can be programmed using Arduino's integrated development environment (IDE) to provide precise and accurate movement to the arm. One of the advantages of using the Arduino platform in a pick and place robotic arm is its compatibility with a wide range of sensors and actuators. The platform supports different types of sensors, such as ultrasonic sensors, infrared sensors, and pressure sensors, which can be used to detect objects and monitor the position of the arm.

Figures 2.4.3: Servo Motor Concept

In the design of a pick and place robotic arm, servo motors can be used to provide movement to the arm's joints and gripper. Servo motors are widely used in robotics due to their precision, accuracy, and ease of control. A servo motor consists of a DC motor, a control circuit, and a feedback mechanism. The control circuit receives signals from a microcontroller, which determines the position and speed of the motor. The feedback mechanism provides information about the motor's actual position, allowing the control circuit to adjust the motor's movement to reach the desired position. Servo motors can provide precise and accurate movement to the robotic arm, making them ideal for applications that require high accuracy, such as pick and place operations. The motor's rotation can be controlled to within a few degrees, allowing the arm to move in precise and controlled movements.

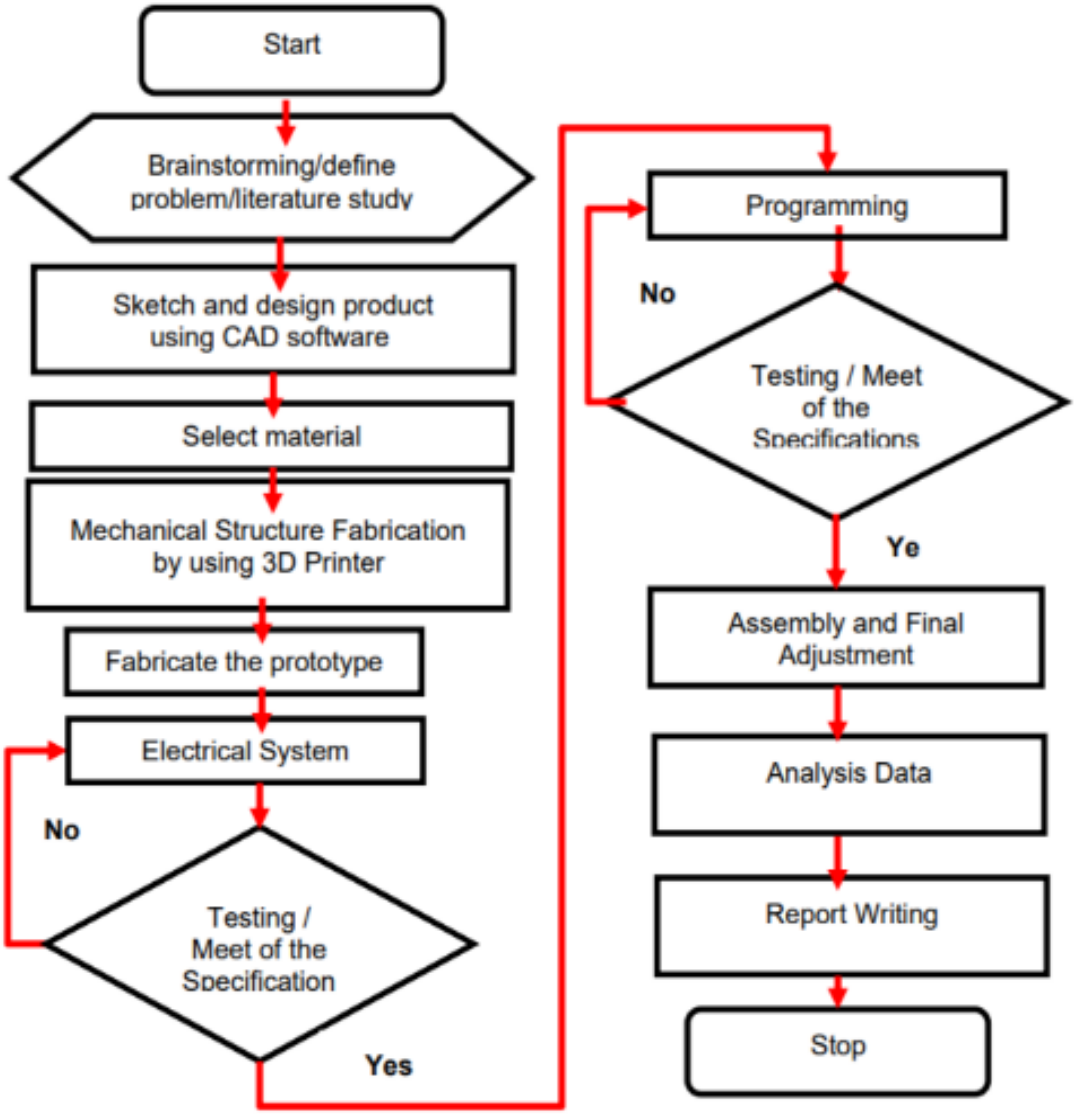
CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

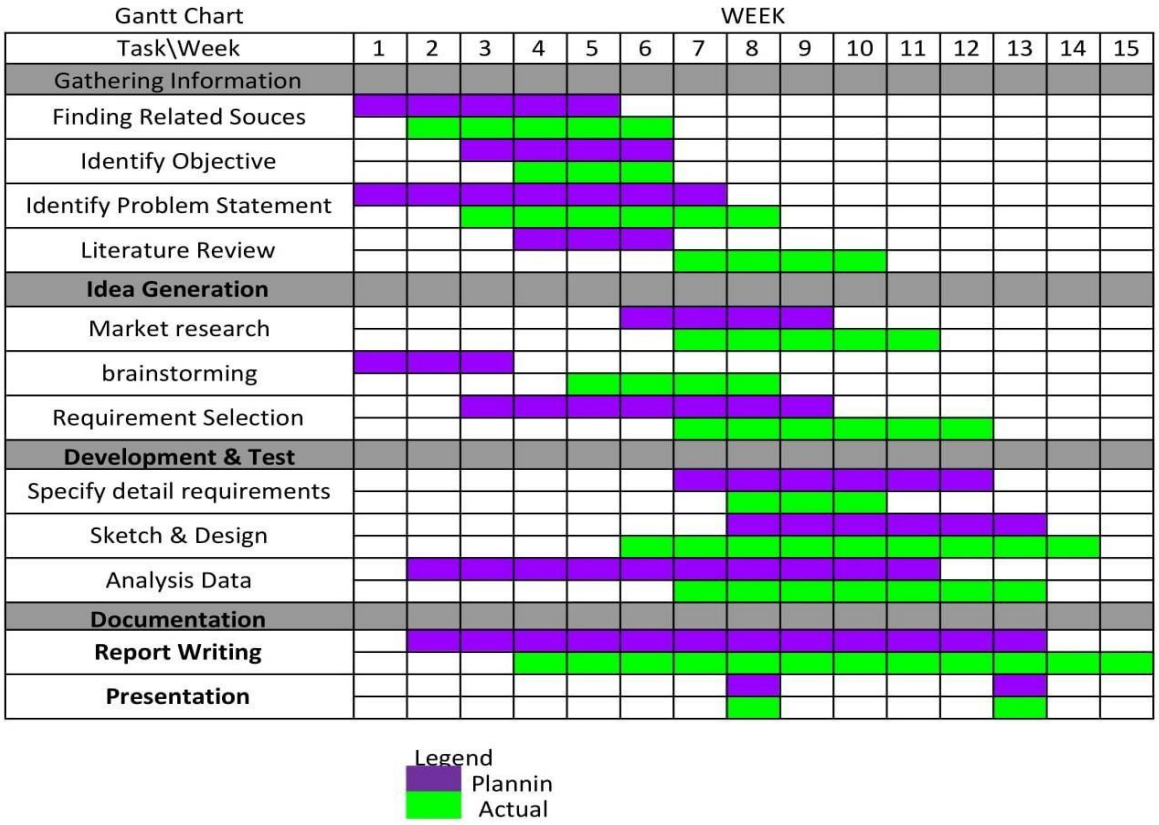
The most effective way to do research and identify the best practises for solving the research challenge is through methodology. Introduction, research design, data collecting and analysis methods, research instrument, sample strategies, and chapter summary are all included in this chapter. However, there is one subtopic in this chapter that has the greatest bearing on the kind of product that will be produced. Compared to other research, some studies may require a more in-depth examination of design and instrumentation. One of the engineering considerations that should be given careful consideration when creating a product is methodology. A method of method selection and analysis is what is meant by methodology.

3.2 FLOW CHART



3.3 GANTT CHART

Project 1

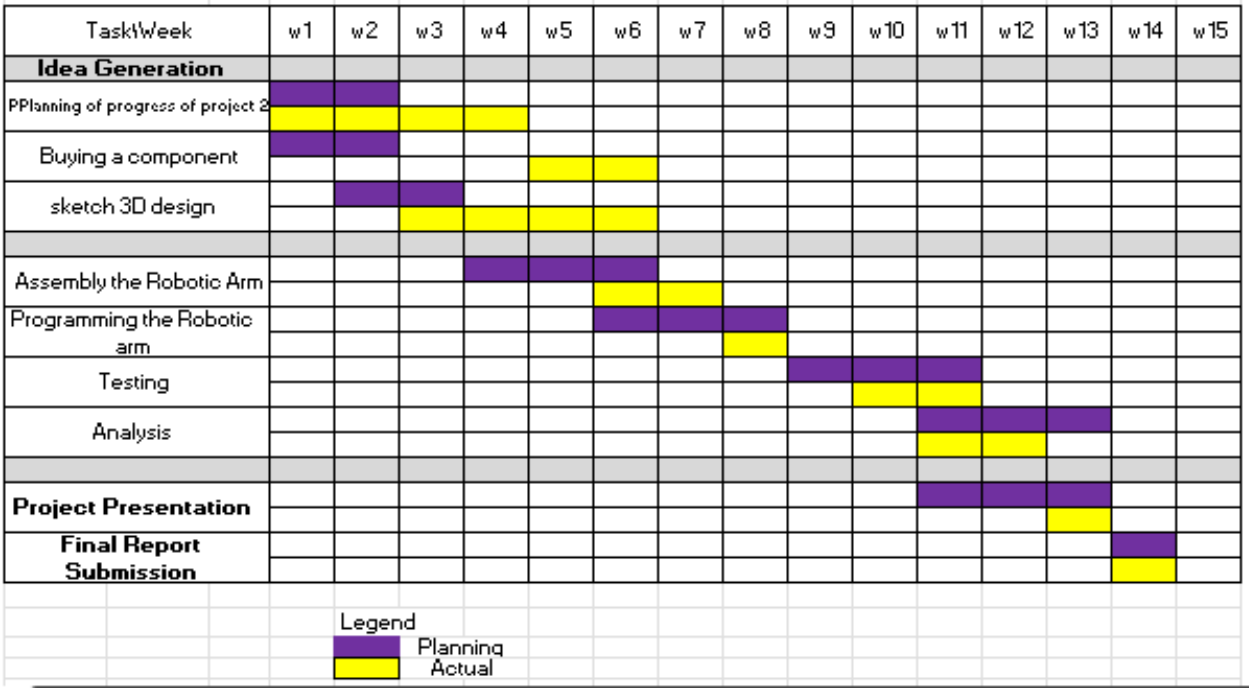


Project 2

Pick And Place Robotic Arm using Arduino

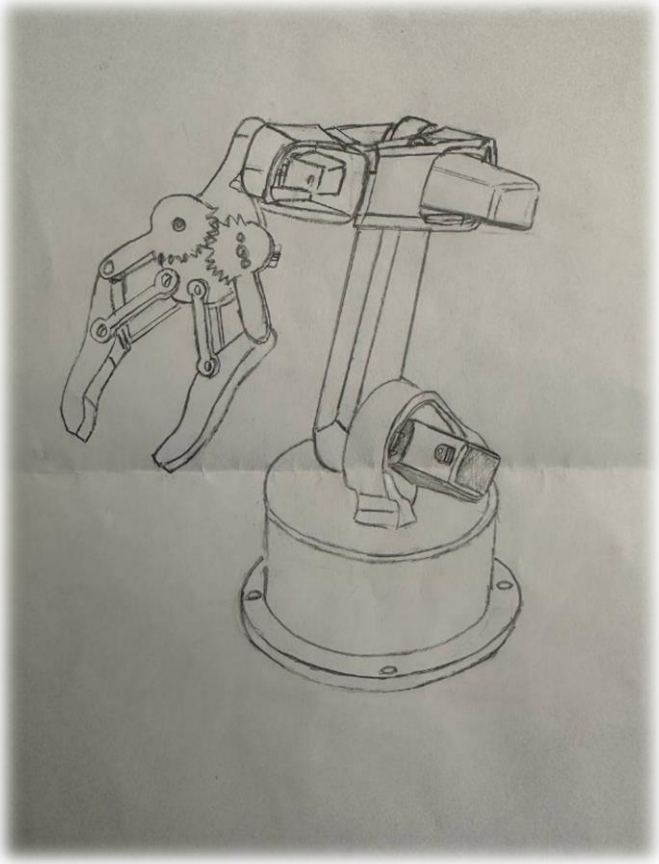
Project 2

Gantt Chart



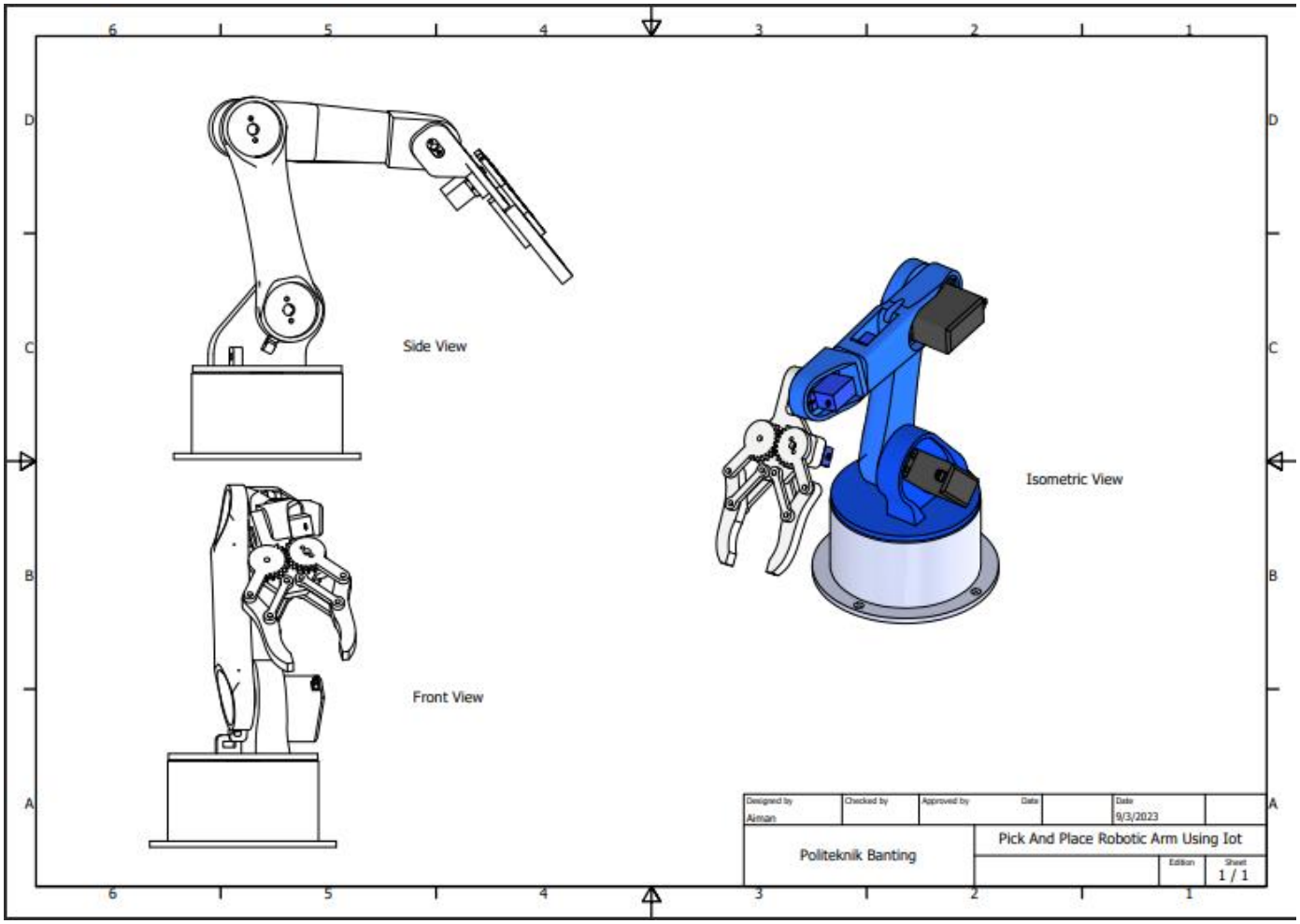
3.4 Project Final Design

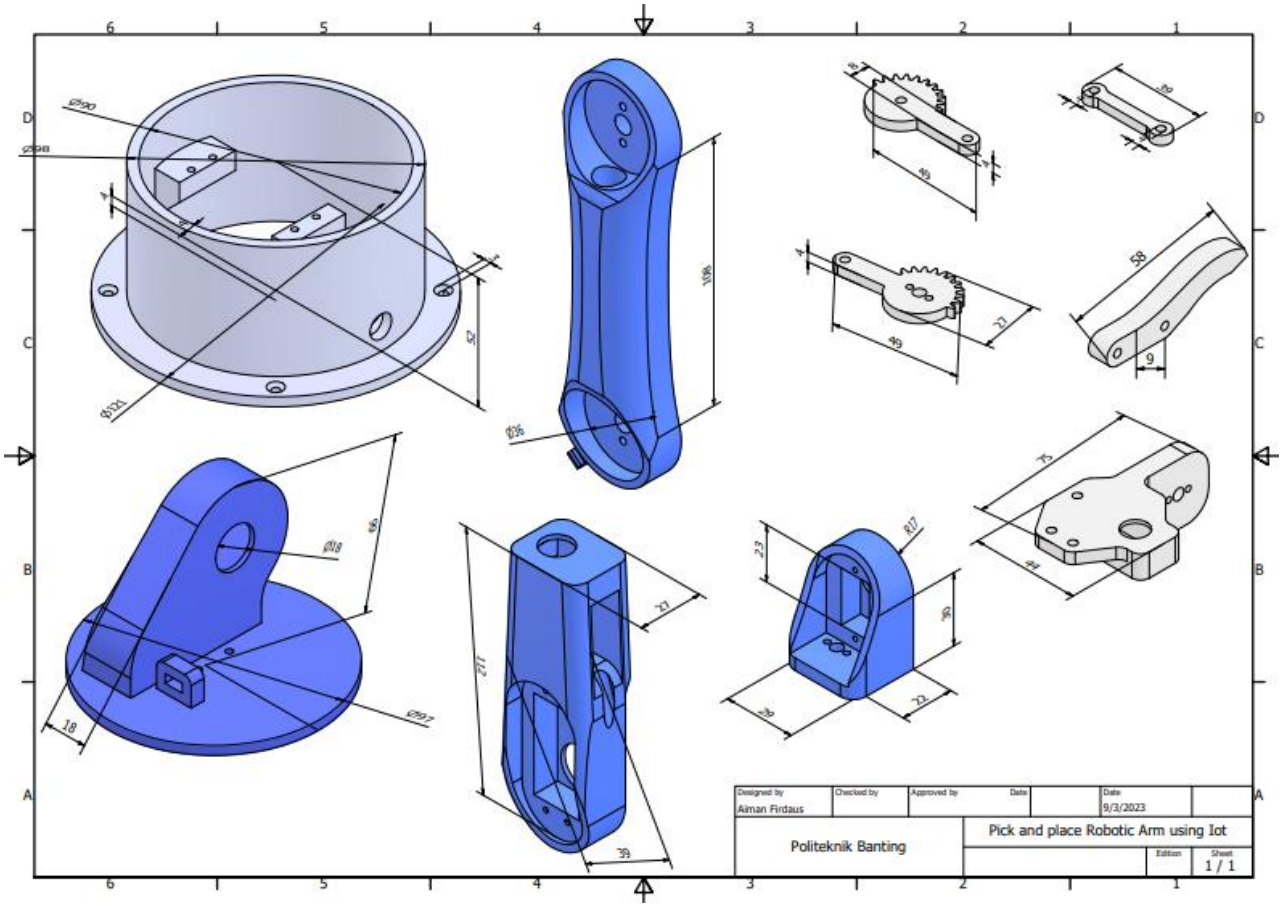
This design is intended so that before the implementation is done, it can reflect before the project is implemented even this design will provide more detailed information to build a “Pick and Place Robotic Arm Using Iot”.



FIGURES 3.4: Idea Project Design

Isometric View, Top View, Front View, Side View

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Aiman Firdaus
Checked by
Approved by
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3.5 Material Selection.

The choice of materials is meant to make the project's execution process easier. Furthermore, it can also prevent production cost wastage because the proper materials were chosen before the project even began to ensure its success.

1. 3D Printer

Figures 3.5: 3D Printer

The robot's body is one of its most valuable assets. The robot needed to move and install electrical components, as well as communicate with them. The robotic arm was built using a 3D printer. Additive manufacturing, also known as 3D printing, is the process of creating a three-dimensional object from a CAD model or digital 3D model. It can be done using a variety of procedures in which material is brought together, frequently layer by layer, and then computer-controlled deposition, joining, or solidification occurs. The filament material had to be melted in the 3D printer before the printing process could begin. The first phase in the 3D printing process is product design. This can be accomplished with Inventor CAM or equivalent CADCAM software. When the design was completed, the.ipt file was converted to.stl since 3D printing software can construct 3D models from.stl files and begin the 3D printing process. The filaments were placed into the 3D printer to be melted and used to build the robotic arm.

2. 5V Power Supply

Figures 3.51

The 5V power supply (sometimes known as the 5VDC power supply) is one of the most often utilised power sources today. To convert a 50VAC or 240VAC input to a 5VDC output, transformators, diodes, and transistors are often used in conjunction. 5V power supplies are classified into two types: regulated 5V power supplies and unregulated 5V power supplies. The three forms of 5V regulated power supplies are switching regulated AC to DC, linear regulated AC to DC, and switching regulated DC to DC.

3. Arduino Uno

Figures 3.5.2

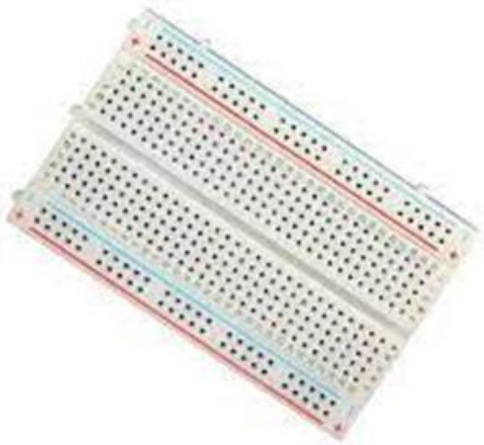
An open-source microcontroller board called the Arduino Uno was developed by Arduino.cc and originally made accessible in 2010. It is built around the ATmega328P microprocessor from Microchip.The board's sets of digital and analogue input/output (I/O) pins can be used to interface with a variety of expansion boards (shields) and other circuits. Six of the board's 14 digital I/O pins, six of its six digital I/O pins, and six of its six analogue I/O pins can be used to produce PWM. With a type B USB port, it may be programmed using the Arduino IDE (Integrated Development Environment). You may power it with a USB cable or a barrel connector that can manage voltages between 7 and 20 volts, like a square 9-volt battery.

4. Servo Motor

Figures 3.5.3

A servo motor is a type of motor with exceptionally accurate rotational capabilities. This sort of motor often incorporates a control circuit that provides feedback on the current location of the motor shaft. This feedback allows the servo motors to rotate with extreme precision. A servo motor is a motor that rotates an object at specific angles or distances. It consists solely of a simple motor that drives a servo mechanism. If a motor is powered by a DC power source, it is referred to as a DC servo motor; otherwise, it is referred to as an AC servo motor. In this session, we will only discuss the operation of the DC servo motor. There are several types of servo motors based on their application.

5. BREADBOARD



Figures 3.5.4

A breadboard (sometimes known as a plug block) is used to create temporary circuits. Because of its utility, designers may quickly remove and replace components. It is useful for someone who wants to build a circuit to demonstrate how it works before reusing the components in another circuit.

6. BLUETOOTH MODULE

Figures 3.5.5

The short-range 2.4G wireless communication module known as a Bluetooth module is the basic circuit set of the chip with an incorporated Bluetooth function. The Bluetooth module is a semi-finished good for the consumer.

3.5 Analysis Costing

Component	Cost per unit (RM)	NO Unit	Total Cost (RM)
Servo Motor	30	6	180.00
5V Power Supply	20.80	1	20.80
Arduino Uno	61.00	1	61.00
Breadboard	13.00	1	13.00
Bluetooth Module	31.20	1	31.20
3D Printing			500.00
Total			**806.00**

3.6 Manufacturing process

Firstly, the body of the Pick & Place Robotic Arm is designed using the Auto Cad Software and the dimensions are taken in order to step into the next process. Secondly, the design is then moved into a 3D printer to print the 3D Printing. The base, gripper, waist, gear and more are printed using 3D printing.

Figures 3.6 : Process

3.7 SUMMARY

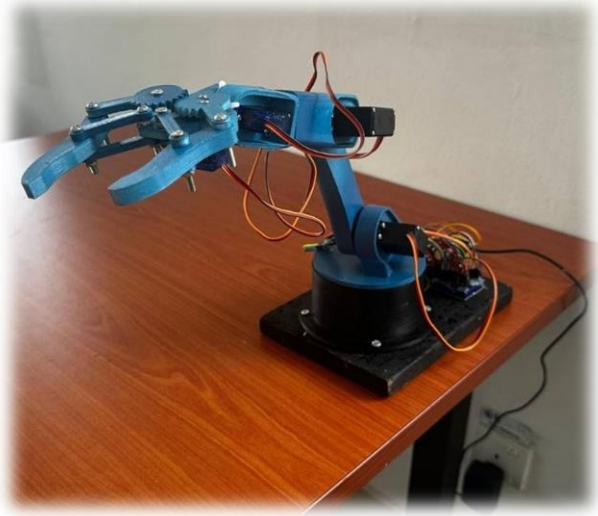
Study methodology and design indicated the overall process of research flow for a particular study. Data sources and data collection methods were used. This research process, which includes all parameters from problem formulation to problem validation, provides an overall research strategy and framework. We laid some groundwork and explained how research methodologies are developed and designed for researchers. In other words, it helps researchers see it as a pattern or model of research data collection, working from the beginning of problem definition to research results. In particular, this research flow helps new researchers to learn specifically about the research environment and methodology.

CHAPTER 4

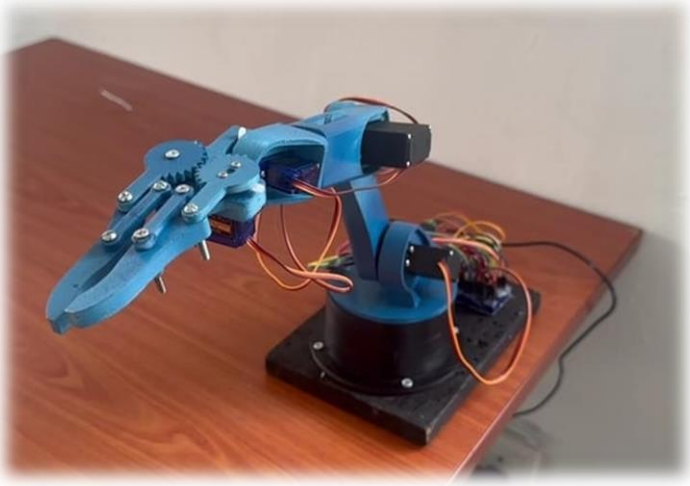
RESULT AND DISCUSSION

4.1 Result of Project

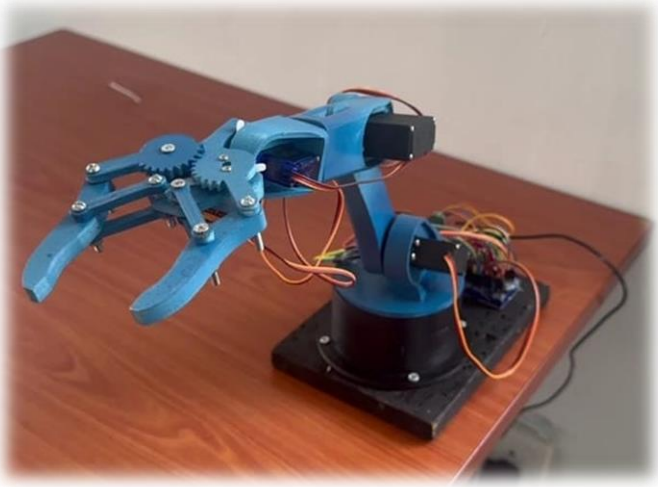
The following figures are the snapshots of results or output of the prototype while picking and placing the objects.



Robotic arm Prototype



Closing Action

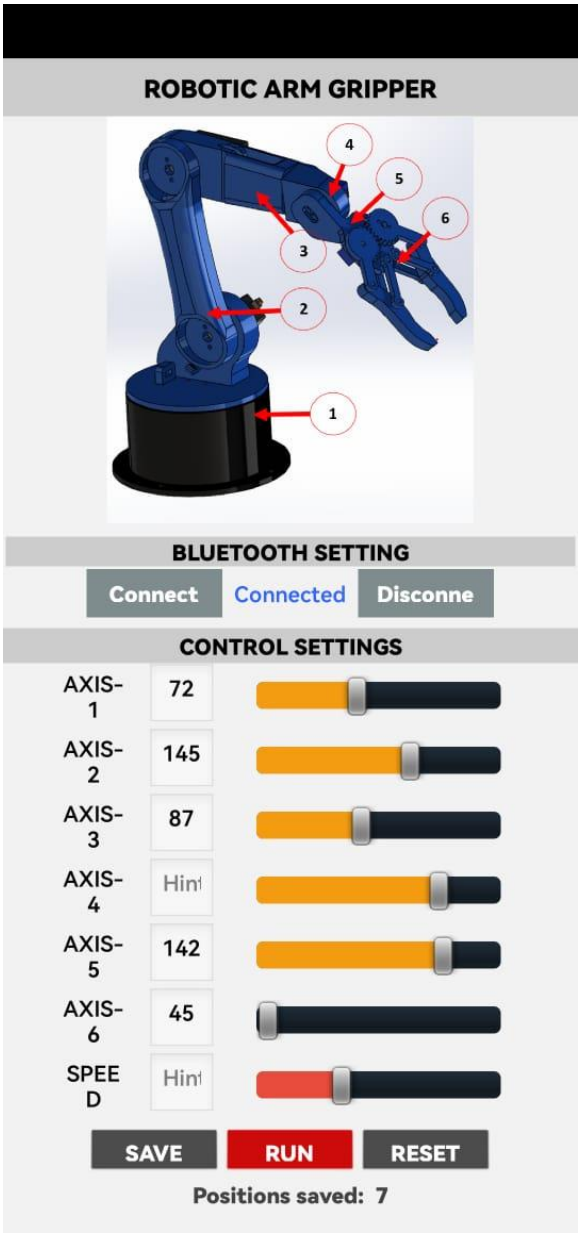


Opening Action

Picking and Placing Object Action

Application for control

Robotic Arm through Bluetooth Connection.

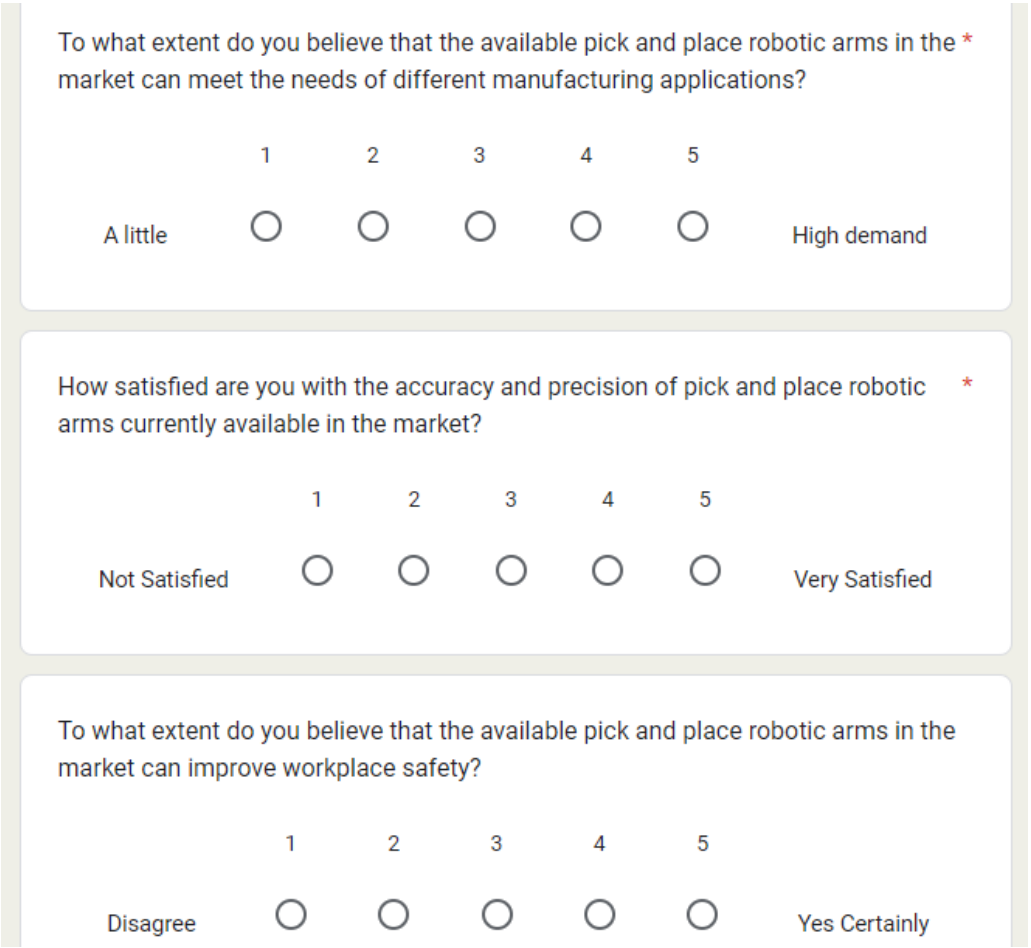


Figures 4.1.5: Application to Control

4.2 Data Collection Method

Respondents were sent a questionnaire via social media. Data was gathered over a short period of time, from March till April 2023. The scale that has been created and carefully validated serves as the foundation for the study tool. To develop a robotics industry benefit and implement IR 4.0 technology in our daily lives. A questionnaire has just one portion with five questions and uses the Likert 5 Scale format (1 = strongly disagree to 5 = strongly agree) and just only have 1 part with 5 Questions.

A questionnaire for respondent to gives their feedback:



How satisfied are you with the ease of use and programming capabilities of pick and place robotic arms currently available in the market?

	1	2	3	4	5	
Not Satisfied	○	○	○	○	○	Very Satisfied

To what extent do you believe that the available pick and place robotic arms in the market can reduce labor costs in manufacturing processes?

	1	2	3	4	5	
Disagree	○	○	○	○	○	Yes Certainly

How satisfied are you with the reliability and uptime of pick and place robotic arms currently available in the market?

	1	2	3	4	5	
Not Satisfied	○	○	○	○	○	Very Satisfied

To what extent do you believe that the available pick and place robotic arms in the market can improve product quality and consistency?

	1	2	3	4	5	
Disagree	○	○	○	○	○	Yes Certainly

How satisfied are you with the flexibility and adaptability of pick and place robotic arms currently available in the market?

	1	2	3	4	5	
Not Satisfied	○	○	○	○	○	Very Satisfied

To what extent do you believe that the available pick and place robotic arms in the market can integrate well with other automation technologies?

	1	2	3	4	5	
Disagree	○	○	○	○	○	Yes Certainly

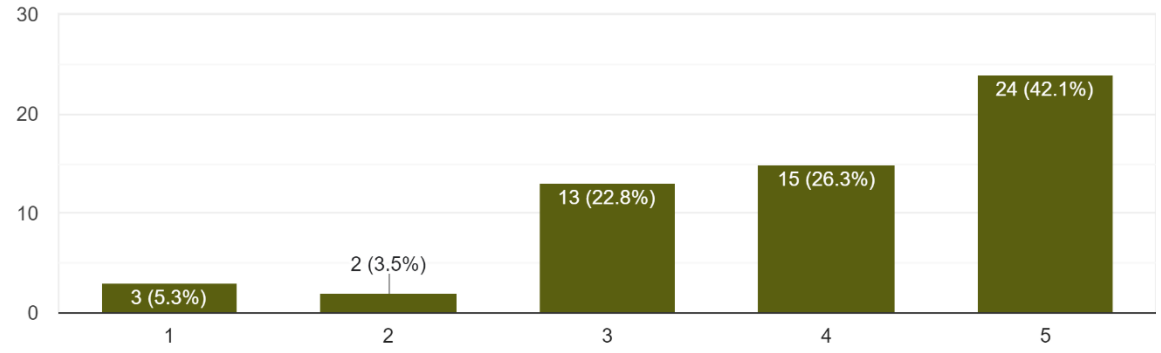
How satisfied are you with the overall value and cost-effectiveness of pick and place robotic arms currently available in the market?

	1	2	3	4	5	
Not Satisfied	○	○	○	○	○	Very Satisfied

Bar Chart for Respondence

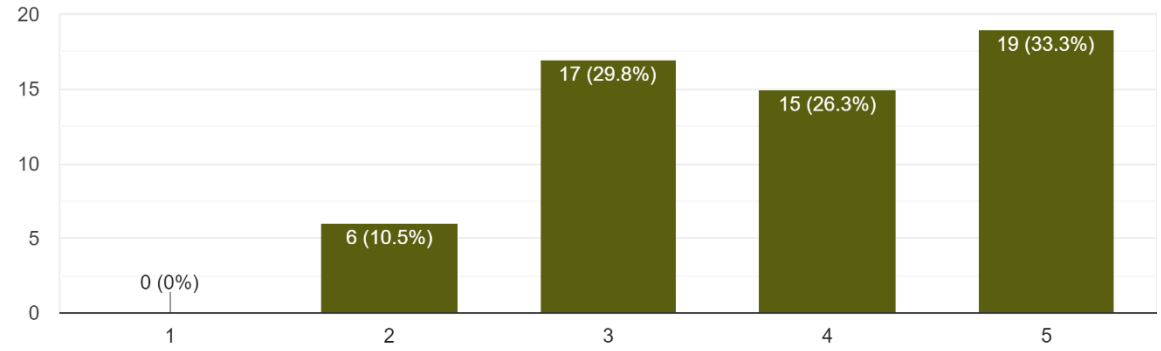
To what extent do you believe that the available pick and place robotic arms in the market can meet the needs of different manufacturing applications?

57 responses



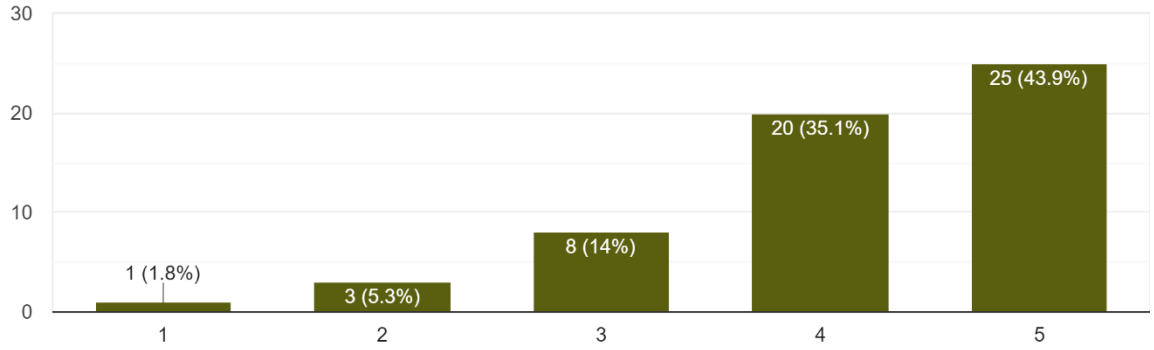
How satisfied are you with the accuracy and precision of pick and place robotic arms currently available in the market?

57 responses



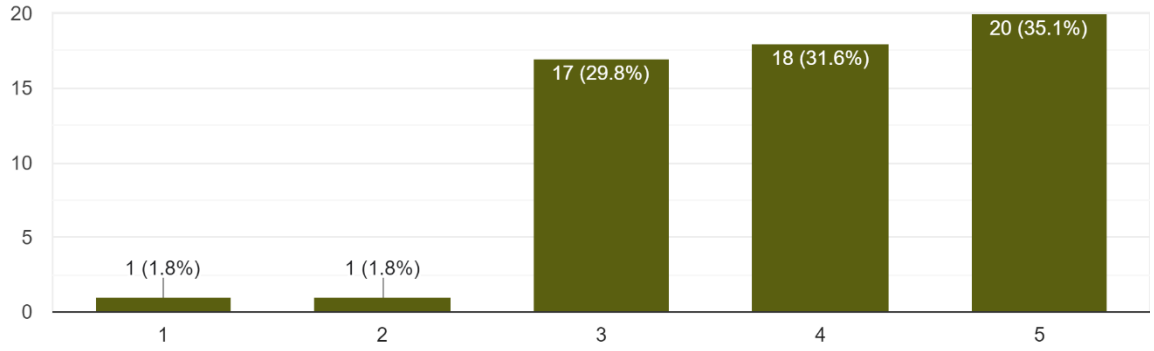
To what extent do you believe that the available pick and place robotic arms in the market can improve workplace safety?

57 responses



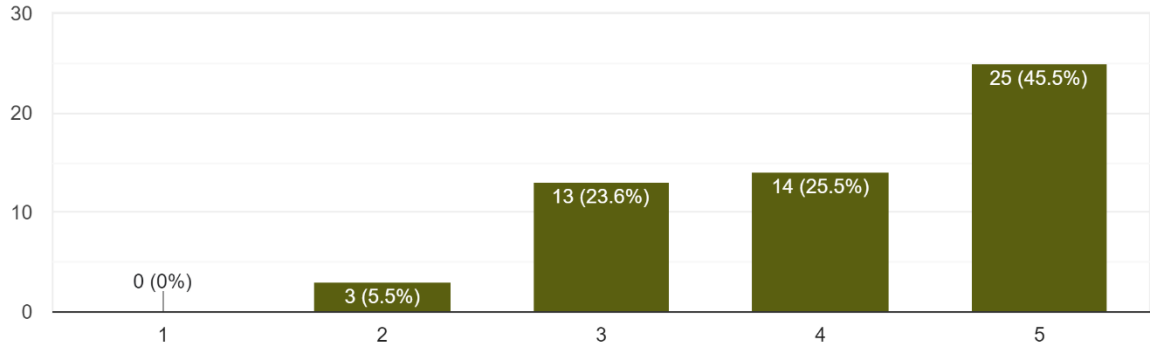
How satisfied are you with the ease of use and programming capabilities of pick and place robotic arms currently available in the market?

57 responses



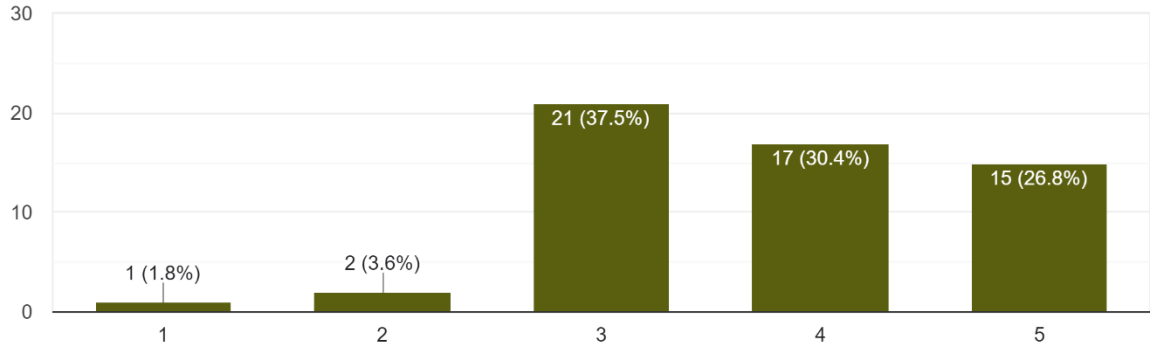
To what extent do you believe that the available pick and place robotic arms in the market can reduce labor costs in manufacturing processes?

55 responses



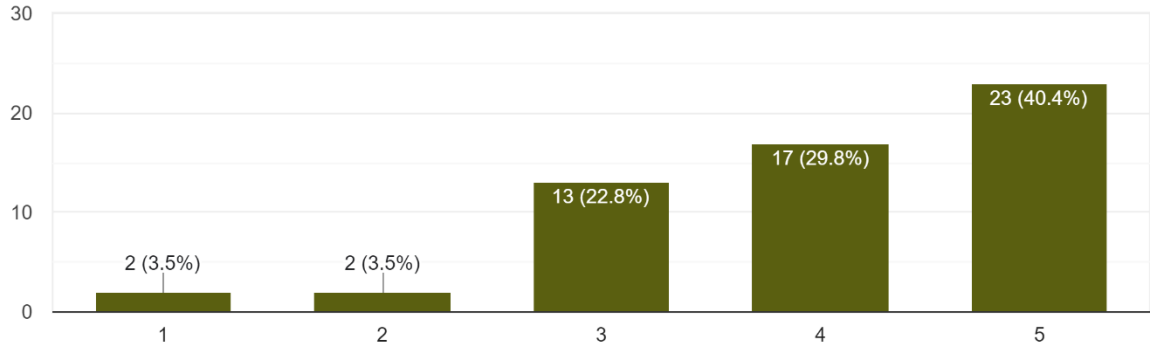
How satisfied are you with the reliability and uptime of pick and place robotic arms currently available in the market?

56 responses



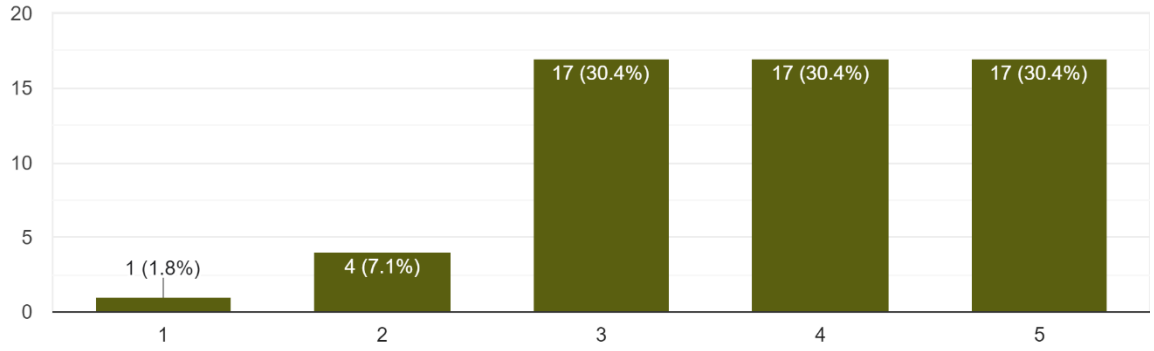
To what extent do you believe that the available pick and place robotic arms in the market can improve product quality and consistency?

57 responses



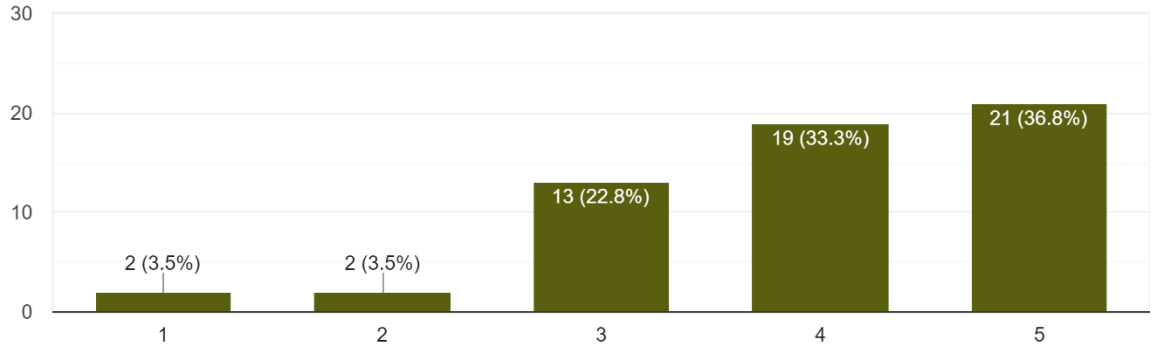
How satisfied are you with the flexibility and adaptability of pick and place robotic arms currently available in the market?

56 responses



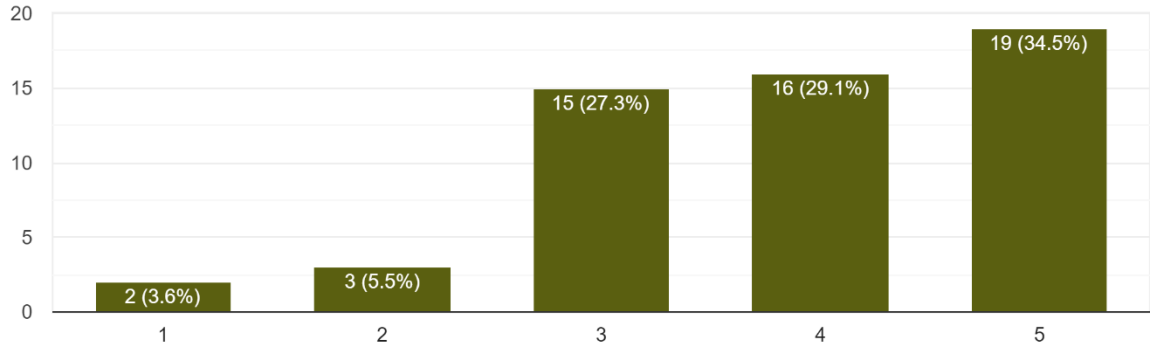
To what extent do you believe that the available pick and place robotic arms in the market can integrate well with other automation technologies?

57 responses



How satisfied are you with the overall value and cost-effectiveness of pick and place robotic arms currently available in the market?

55 responses



4.3 IMPACT OF APPLICATION IN PROJECT

The application of pick and place robotic arms has had a significant impact in various industries, including manufacturing, packaging, and logistics. Here are some of the impacts:

1. **Improved Efficiency**: The use of pick and place robotic arms has significantly improved efficiency in various industrial processes. With the ability to work non-stop, these robots can perform repetitive tasks much faster and with greater precision than human workers. As a result, companies have been able to increase production rates and reduce costs associated with labour.

2. **Increased Safety**: Pick and place robotic arms have also improved safety in industrial processes. They can be designed to perform dangerous and hazardous tasks that may pose a threat to human workers. This reduces the risk of accidents and injuries in the workplace, making it a safer environment for all.

3. **Cost Savings**: Although the initial investment in a pick and place robotic arm may be high, the long-term cost savings can be significant. By reducing labour costs, improving efficiency, and increasing production rates, companies can realize significant cost savings over time.

4.4 PRODUCT FEATURES.

1. **High-precision positioning**: The robotic arm should be capable of precise and accurate positioning to ensure reliable picking and placing of objects.

2. **Adjustable arm length**: The ability to adjust the arm length or extendable segments allows for handling objects at different distances or sizes.

3. **User-friendly interface**: A user-friendly interface, such as a graphical user interface (GUI) or a control panel, allows users to easily program and control the arm's movements, set parameters, and define pick and place sequences.

4. **Programmability and customization**: The robotic arm should be programmable, allowing users to define complex motion sequences and easily adapt it to different tasks or environments.

4.5 DISCUSSION

Firstly, it's important to understand the scope of the project and the available resources. Developing a pick and place robotic arm involves several stages such as designing the arm, selecting the right components, programming the controller, and testing the system. It's essential to break the project down into manageable parts and create a timeline to ensure that the project is completed on time. One of the key aspects of designing a robotic arm is to determine the size and weight requirements based on the application. A robotic arm for a pick and place operation may require a specific reach, payload capacity, and degree of freedom. These factors will influence the design and choice of components such as motors, gears, and sensors. Once the design is finalized, selecting the right components is essential to ensure the arm functions optimally. There are different types of motors such as DC motors, steppers, and servos, each with their own advantages and disadvantages.

Controller programming is another important step in developing a pick and place robotic arm. The controller may be a microcontroller or a single board computer, and the code may be written in a programming language such as C or Python. It is important to test the code carefully to ensure that the arm moves accurately and safely. Testing the system is the final stage of developing a pick and place robotic arm. Arms can be tested in a controlled environment such as a laboratory or workshop, or in a real application environment. The testing process should involve a comprehensive evaluation of arm performance, including accuracy, repeatability, and speed.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter discusses the discussions that have arisen during this project construction to ask project-related questions. This is to ensure that all work techniques can be used, as stated in the logbook, and that the project is fully operational. To ensure that all results are achieved, these discussions are often held. Without enough preparation, most likely the work will be mediocre. We developed a pick and place robotic arm project with our research and brainstorming collection. The design of the robotic arm has gone through a comprehensive procedure that has several stages. Following the research and analysis of this robotic arm created. There are various steps in the basic process of designing robotic arm. It is important to discuss several points and concerns, including the need for investment to purchase materials and equipment, quality project, how it will be used, and how to do it efficiently. To guarantee project production runs smoothly, daily tasks are also organized every week in our Gantt Chart.

5.2 CONCLUSION

In conclusion, the pick and place robotic arm system developed for this final project is a successful solution for improving material handling processes in an industrial setting. The system was designed to meet specific requirements for picking up and placing objects of various shapes and sizes, adhering to all safety regulations, and ensuring minimal downtime.

The implementation of the pick and place robotic arm system resulted in a significant increase in efficiency, accuracy, and productivity in material handling processes. The system reduced the workload of human operators and minimized the risk of injuries, which can have a significant impact on the overall health and safety of an industrial setting.

The system developed for this project was also scalable to accommodate future expansion needs of the industry, making it a valuable investment in the long term. Moreover, the system was designed to integrate seamlessly with existing industrial systems, making it easy to operate and maintain. Overall, the pick and place robotic arm system developed for this final project has demonstrated its potential as an effective solution for improving material handling processes in an industrial setting. It is a valuable investment that can help industries gain a competitive edge and ensure the safety of their workforce.

5.3 RECOMMENDATION

Based on the successful development and implementation of the pick and place robotic arm system in this final project, it is recommended that industries with material handling processes consider investing in this technology. The system has shown to improve efficiency, accuracy, and productivity, while minimizing the risk of injuries and downtime associated with manual labour.

The scalability of the system to accommodate future expansion needs, and its ability to integrate with existing industrial systems, make it a valuable investment in the long term. The system can be tailored to meet specific requirements for picking up and placing objects of various shapes and sizes, which makes it versatile and applicable to a wide range of industries.

Moreover, the pick and place robotic arm system can provide a competitive edge for industries by reducing labour costs, improving throughput, and ensuring consistent quality of materials handling. It can also free up human operators to focus on other critical tasks, improving overall productivity and efficiency.

In summary, based on the successful development and implementation of the pick and place robotic arm system in this final project, it is recommended that industries consider investing in this technology to improve their material handling processes, gain a competitive edge, and ensure the safety of their workforce.

REFERENCE

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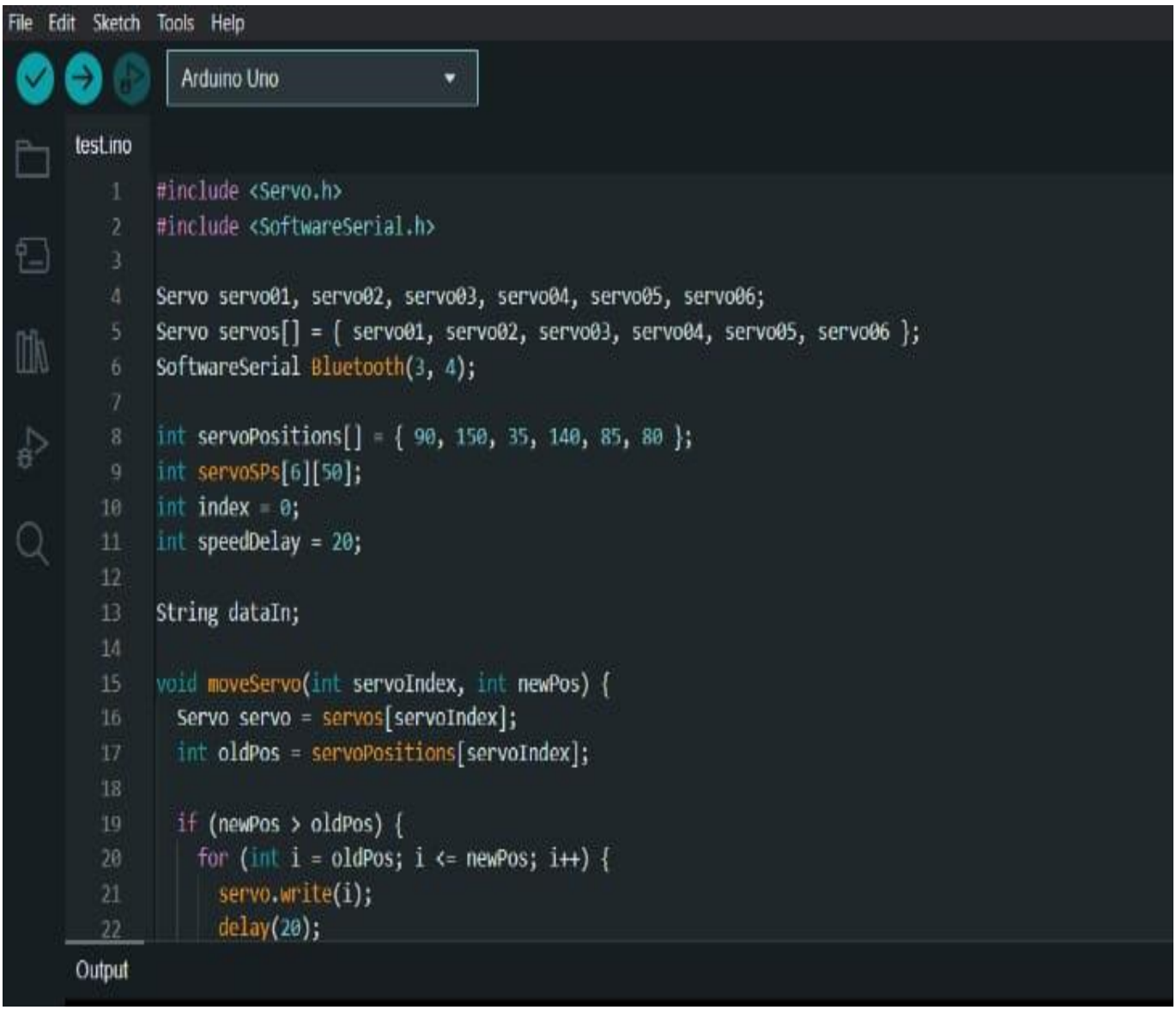
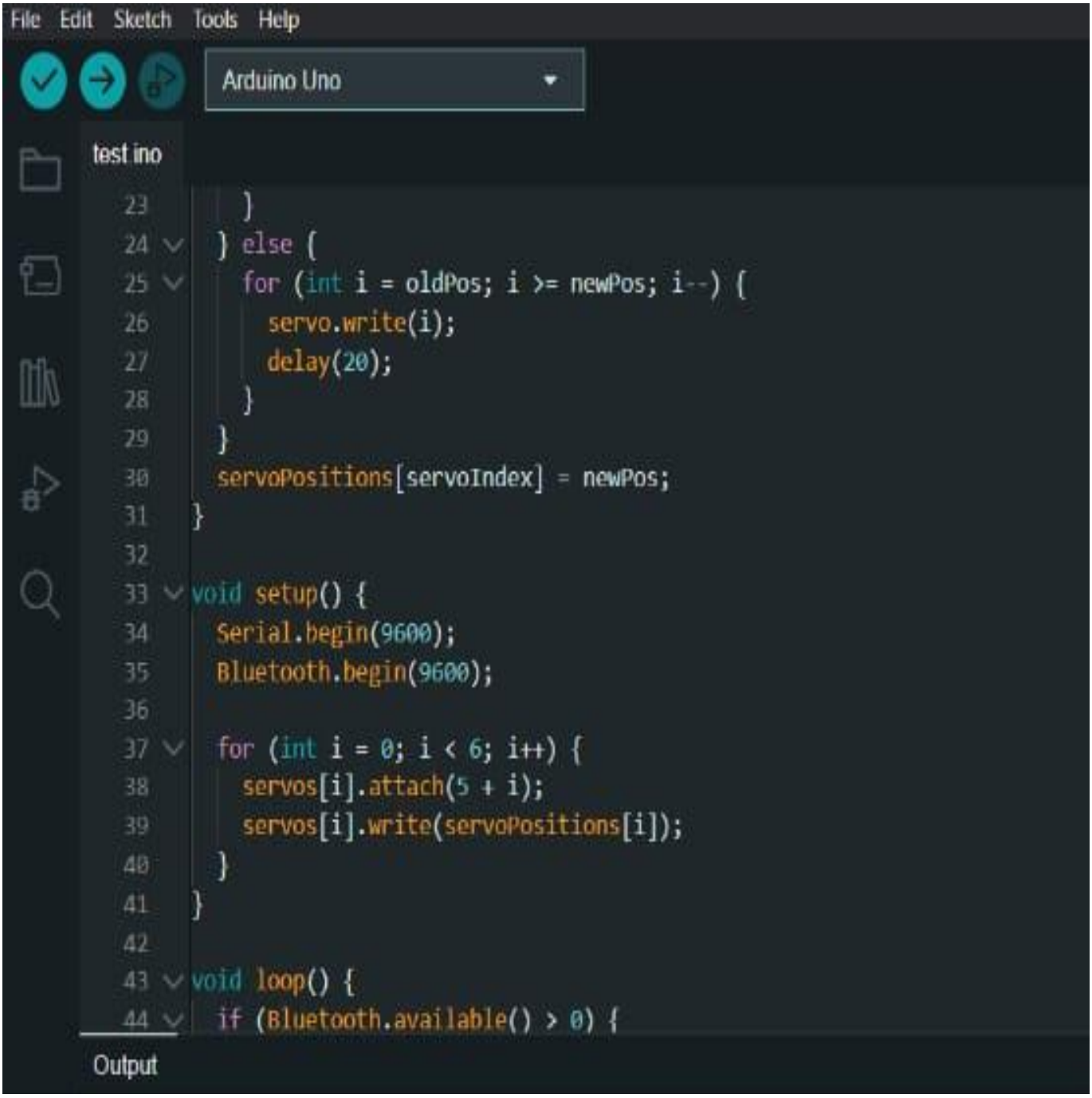
8. **https://mrsd.ri.cmu.edu/wp-content/uploads/2017/07/Team10Report.pdf**

APPENDICES


File Edit Sketch Tools Help
Arduino Uno
test.ino
#include <Servo.h>
#include <SoftwareSerial.h>
Servo servo01, servo02, servo03, servo04, servo05, servo06;
Servo servos[] = { servo01, servo02, servo03, servo04, servo05, servo06 };
SoftwareSerial Bluetooth(3, 4);
int servoPositions[] = { 90, 150, 35, 140, 85, 80 };
int servoSPs[6][50];
int index = 0;
int speedDelay = 20;
String dataIn;
void moveServo(int servoIndex, int newPos) {
Servo servo = servos[servoIndex];
int oldPos = servoPositions[servoIndex];
if (newPos > oldPos) {
for (int i = oldPos; i <= newPos; i++) {
servo.write(i);
delay(20);
Output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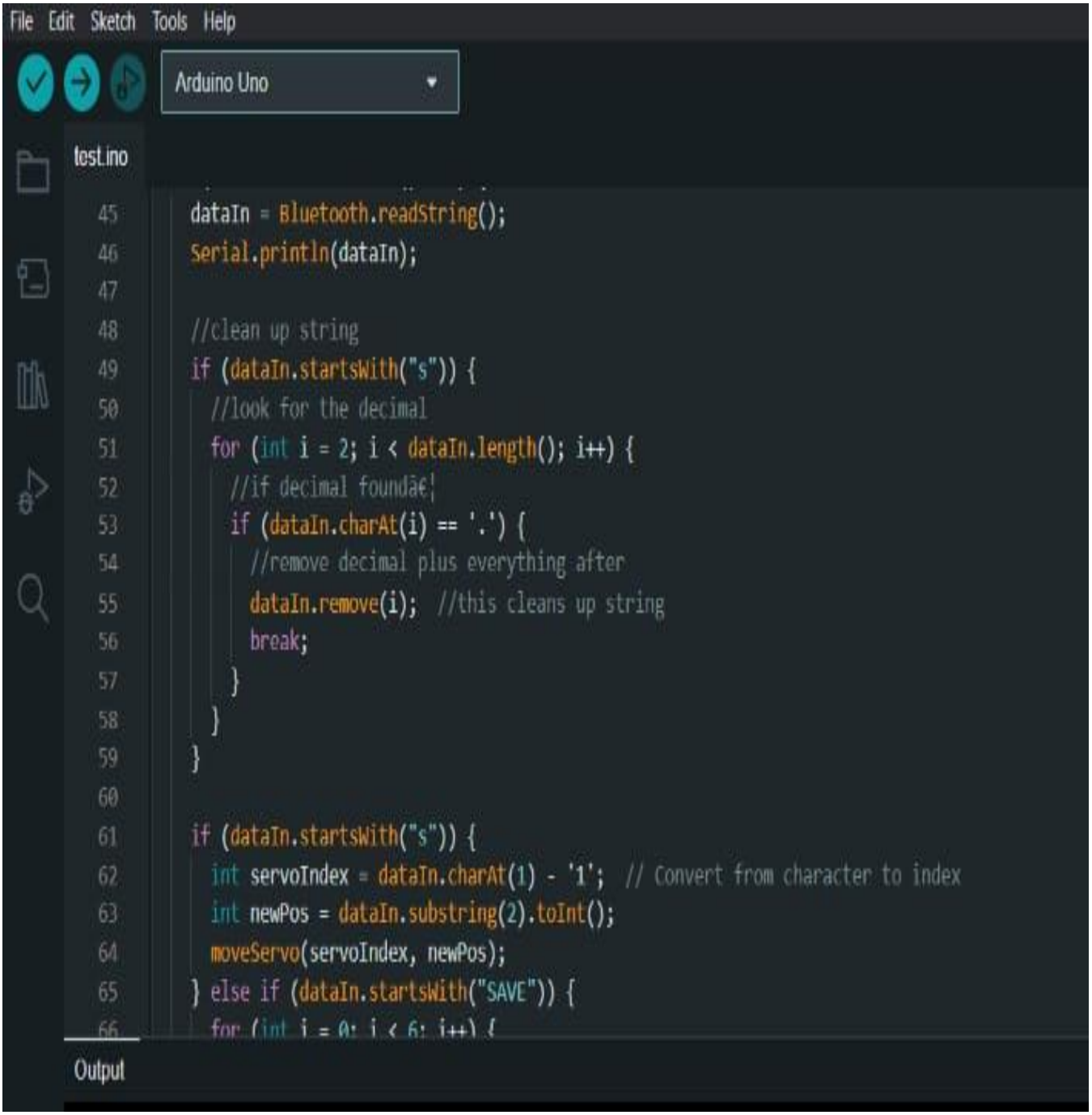
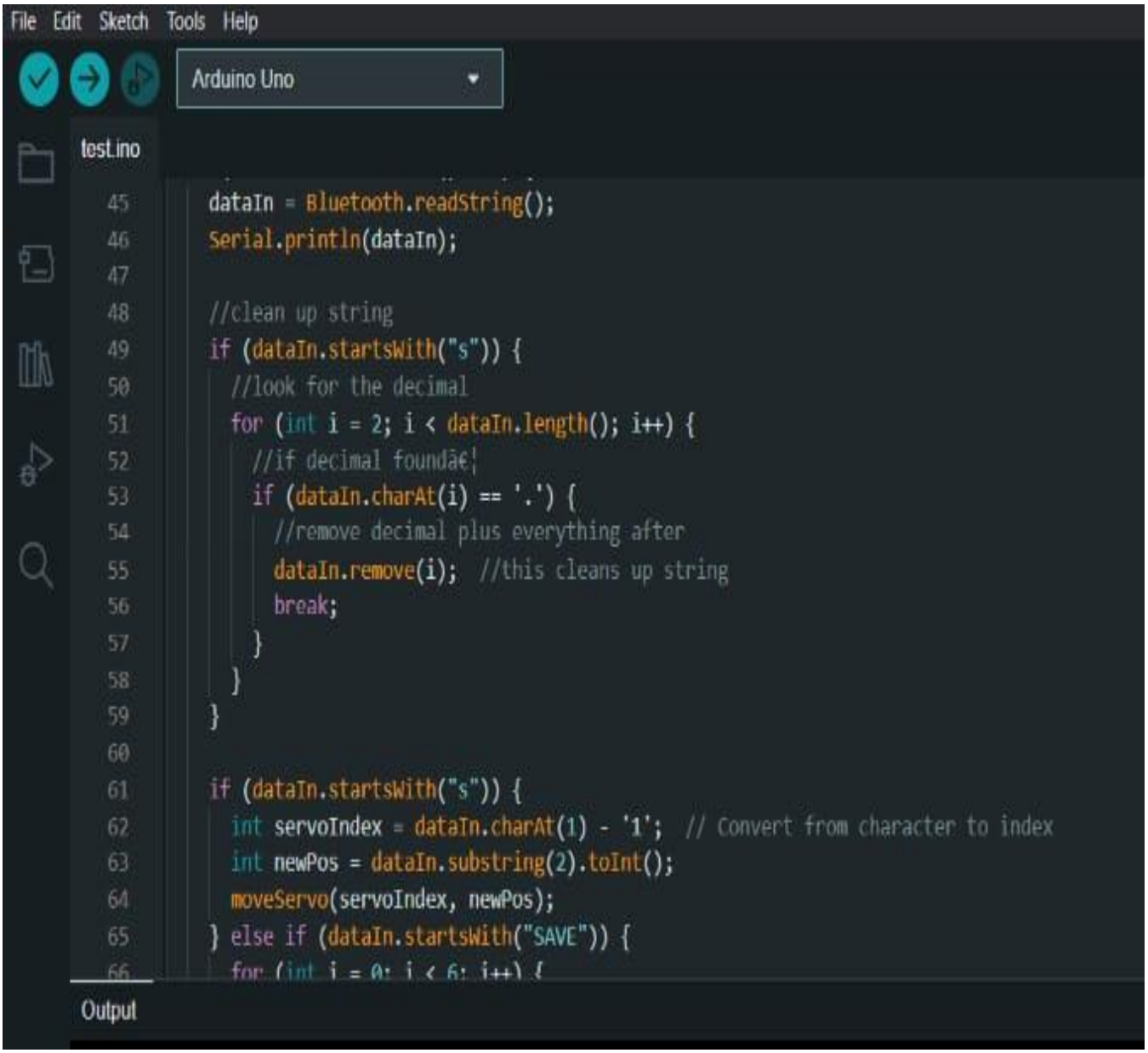
Arduino Uno
test ino
}
} else {
for (int i = oldPos; i >= newPos; i--) {
servo.write(i);
delay(20);
}
}
servoPositions[servoIndex] = newPos;
}
void setup() {
Serial.begin(9600);
Bluetooth.begin(9600);
for (int i = 0; i < 6; i++) {
servos[i].attach(5 + i);
servos[i].write(servoPositions[i]);
}
}
void loop() {
if (Bluetooth.available() > 0) {
Output


File Edit Sketch Tools Help
Arduino Uno
testLino
dataIn = Bluetooth.readString();
Serial.println(dataIn);
//clean up string
if (dataIn.startsWith("s")) {
//look for the decimal
for (int i = 2; i < dataIn.length(); i++) {
//if decimal foundâ€¦
if (dataIn.charAt(i) == '.') {
//remove decimal plus everything after
dataIn.remove(i); //this cleans up string
break;
}
}
}
if (dataIn.startsWith("s")) {
int servoIndex = dataIn.charAt(1) - '1'; // Convert from character to index
int newPos = dataIn.substring(2).toInt();
moveServo(servoIndex, newPos);
} else if (dataIn.startsWith("SAVE")) {
Output


File Edit Sketch Tools Help
Arduino Uno
test.ino
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//look for the decimal
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//if decimal foundâ€¦
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//remove decimal plus everything after
dataIn.remove(i); //this cleans up string
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