Faculty of Information Technology

IN1900 -ICT Project

Automated Wire Cutting and Stripping Machine

Group No:48

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1.0 Introduction

There are so many fundamental problems that we have identified in underdeveloped small-scale industries. So nowadays lack of labor is a major problem and it is hard to find trained workers. Our focus was on the wire cutting industry. Hardware shops and electronic labs can be taken as examples in our research area. So, we have identified different difficulties when cutting and stripping different sizes of wires.

- Labors may face injuries when using sharp cutters for these processes.
- Efficiency of work would be low when considering the labor
- Accuracy of the outcome would be low on sometimes

We can overcome these difficulties with help of system automation.

The automation system solves labor problems which save cost, increases accuracy, and decrease human errors. After surveying various electrical and electronics industries we conclude that nowadays the industries have introduced automation in their systems to some extent, but they use human resources for some basic processes which are time-consuming like wire cutting, winding, etc. If we introduce automation to these basic processes, then it will be fruitful regarding the company's development and profit gain as it improves the system in many ways. Not only at the industrial level even in university labs students face some difficulties when cutting wires.

One such industry found out in which they need a solution that is very efficient, fast, and economical for cutting various lengths of wires which are required for producing requirements. So, we try to make a cost-effective Automatic Wire Cutting and Stripping Machine. This machine mainly helpful for electronic labs and hardware shops.

2.0 Literature Survey

2.1

3q Copper Wire Stripping Machine[1] has developed in China. Basically, this machine is manual, and the wire range is up to 25mm. This machine widely used in wiring harness processing, wire recycling dismantling and other large industries. By using this machine, people can strip wires in different sizes very easily.
But in this machine, there is not any automatic way to cut wires. It requires manpower to direct the stripping process by using removable hand crack. If we want to strip lengthy wires it takes much labor and time.

When compare with this machine, our Automatic Wire Cutting and Stripping Machine has both cutting and stripping parts and users can easily and automatically begin the process. We don't need any manpower and process will happen automatically. Also, user can get wire rollers as output. Only thing user has to do is entering the length and the mode of the wire. It saves time and the labor. This machine even can use in small scale industries like Hardware Shops or Electronic Labs.

Figure 1: 3q Copper Wire Stripping Machine

Figure 2: Manual Stripping Process Hand Crack

2.2

AM601 Automatic Wire Stripping Machine (Economic Type) [2] is a fully automatic wire stripping machine that widely used in the industry on process of wire such as electronic, automobile, motorcycle, lamps, dolls etc.

It adopted advanced technology from Japan and Taiwan. The length of wire to be stripped can be set arbitrarily according to customers' requirement like different thickness wire. (Cutting Length : 1~100000mm , Stripping length: Head : 0-35mm , tail: 0-15mm)

But maximum diameter of the wire is 6mm. Otherwise when we cut into long pieces of wires, we would not be able to wind the wire using this machine. These the difference between our machine and AM601 Automatic Wire cutting stripping machine.

Figure 1:AM601 Automatic Wire Stripping Machine

2.3

Wire Stripping Machine Copper Stripper BLUEROCK Tools MWS-83MD Manual Recycling [3]

This Mini Manual Wire Stripping Machine is a patented machine. Wire Range:16AWG-1/2" OD . This machine mainly focuses to strip wires. Because of that You have to use another machine to cut wires into long pieces of wires.

You would be able to see 5 Channels of cutters, but You would not be able to see any batteries. Because There are not batteries included or required. So, we have to use manpower. But in our automated wire cutting and stripping machine we use electric power. Because of that Cutting and stripping using this machine is little bit difficult more than our machine.

Nowadays Sri Lankan price of this machine is LKR87155. It's too much for small scale entrepreneurs. But the total cost of our machine is less than LKR20000. So small scale entrepreneurs such as hardware owners would be tolerating the price and cost of our machine.

Figure 1: Copper Stripper BLUEROCK Tools MWS-83MD

Figure 2: Copper Stripper BLUEROCK Tools MWS-83MD

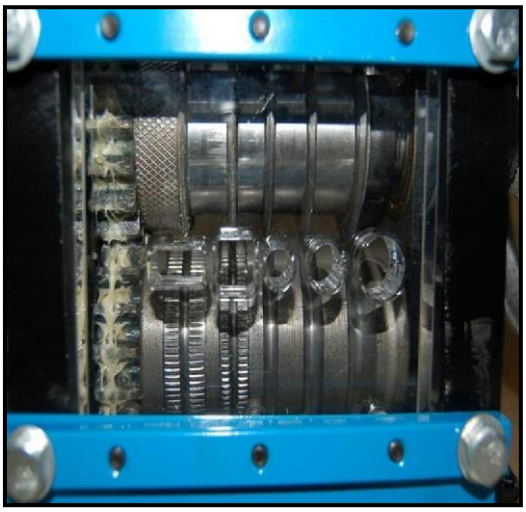


Figure 3: Inside Architecture

3.0 Problem in Brief

In day today life there are so many situations that we need to use different types of wires, and sometimes we have to use different lengths of those wires according to user requirements. Also, there are some situations that we need to strip large multicore and large gauged cables. It is difficult to strip wires manually. There is another problem when we wind lengthy wires. When customer needs wires of different sizes, they have to re-measure the length of wires every time. It leads to waste of their time. There must always be a person to do this task manually. They have to wind wires manually. The wires can be intertwined when winding manually. But there is not any automated system to fulfil these requirements, so user have to do all the things manually.

Most of these requirements emerge in hardware shops to supply customer the wires on the lengthy and stripping conditions that we required and indeed, in most of the electronic labs there are so many requirements of various lengthy and stripping of wires. Users have to face lots of difficulties when they are going to do this process manually. It is risky and very hard to cut and strip large sizes and large number of wires. When they have to strip and cut wires continuously sometimes it can occur hand injuries.

4.0. System Description

In the cutting process, there is a winded roll of wires installed in the system. The user may input the length and the number of wires that he requires using the keypad. According to the length that user entered, the stepper motor rotates the timing pulley, corresponsive number of turns to get the required length and the number of pieces of wires from the roll of wires. And the blade that we have installed nearby the timing pulley cuts the wire at an accurate length automatically.

When we discuss about the winding process, here we have installed an IR sensor for the purpose of indicating whether the wire has accessed the winding wheel; and an arm that has been supported by the servo motor to hold the wire with the rotating wheel tightly. Once the IR sensor detects that the wire has been closer to the winding roller, the arm starts the process of holding the wire with the winding wheel. At that moment the winding wheel, which is supported by the stepper motor, will start rotating and winding the wire around it.

At the stripping process, user can input the length that he requires the wire needed to be stripped. According to that input, there are two rotating wheels that are used for the purpose of pushing the wire forward accurately for the amount of required length. One of these wheels, has been installed with a moving pallet that relates to a spring that moves forward and backward inverse proportionally to the gauge of the wire. There is an ultrasonic sensor is installed behind the moving pallet. It can measure the distance between the sensor and the moving pallet, so the gauge of the wire is also measured corresponsive at the moment. According to the gauge of the wire, the cutting wheel that we use to strip the wire can be moved horizontally and vertically to the proper location for the necessary stripping process. There are 4 stepper motors that have been used in this particular process. One of them is used for the rotation of the cutting wheel, two for moving the cutting wheel vertically and horizontally, and the other one for the two wheels that are used to move the wire forward.

In addition, when we require to strip wire of less gauge, its able to be done by the cutting section itself. there we have installed a blade that is able to strip less gauged wires. So, we need to measure the height that the blade moves vertically to strip the wire related to the gauge. On that

purpose an ultrasonic sensor has been installed over the blade and it measures the height that the blade moves.

Figure 1 displayed below illustrates the high-level architecture of the proposed system.

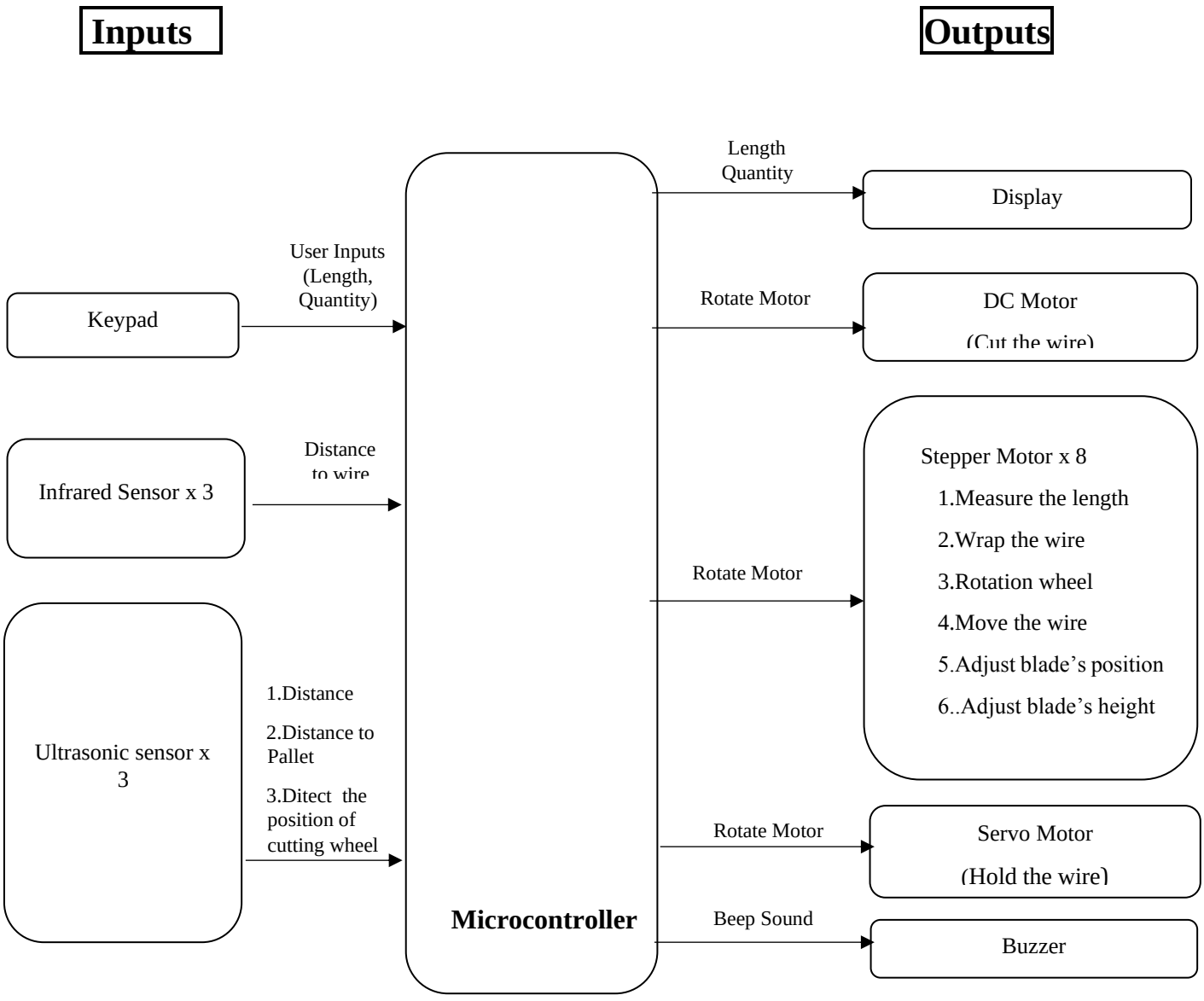


Figure 1: Block diagram of the proposed system

5.0 Aim and Objectives

5.1 Aim:

- This project aims to design and develop a Fully Automated Wire Cutting and Stripping Machine.

5.2 Objectives:

The objectives of the proposed system are as follows.

- To cut wires automatically according to the different measurements given by the user.
- To wind the wires automatically instead of using manual winding process.
- To strip wires automatically instead of using manual stripping process.
- To complete the process securely by automating manual process.
- To reduce waste of time and labor by automating the manual wire cutting process.

6.0 Resource Requirements

6.1 Software:

- Atmel Studio 7
- Blender
- SimulIDE

6.2 Hardware:

- Sensors: Infrared Sensor x 3
  Ultrasonic Sensor x 3
- Microcontroller: Atmega32 x2
- Servo Motor x 1
- DC Motor x 1
- Stepper Motor x 8
- Display x 1
- Buzzer x 1
- Keypad x 1
- Stepper Motor Drivers x 8
- DC Motor Driver(l293) x 1

7.0 Cost Estimation

Component	Quantity	Unit Price (Rs.)	Price (Rs.)
Keypad	1	180.00	180.00
Ultrasonic Sensor	3	200.00	600.00
Infrared Sensor	3	120.00	360.00
Servo Motor	1	750.00	750.00
Stepper Motor	8	350.00	2800.00
Stepper Motor Driver (ULN2803)	8	40.00	320.00
DC Motor Driver(L293)	1	280.00	280.00
Atmega32 Microcontroller	2	550.00	1100.00
LED Display	1	850.00	850.00
Buzzer	1	130.00	130.00
DC Motor	1	400.00	400.00
Power Supply Unit	1	2000.00	2000.00
Others			5000.00
		Total:	14770.00

Table 1:Cost Estimation for Proposed System[10]

8.0 Testing and Implementation

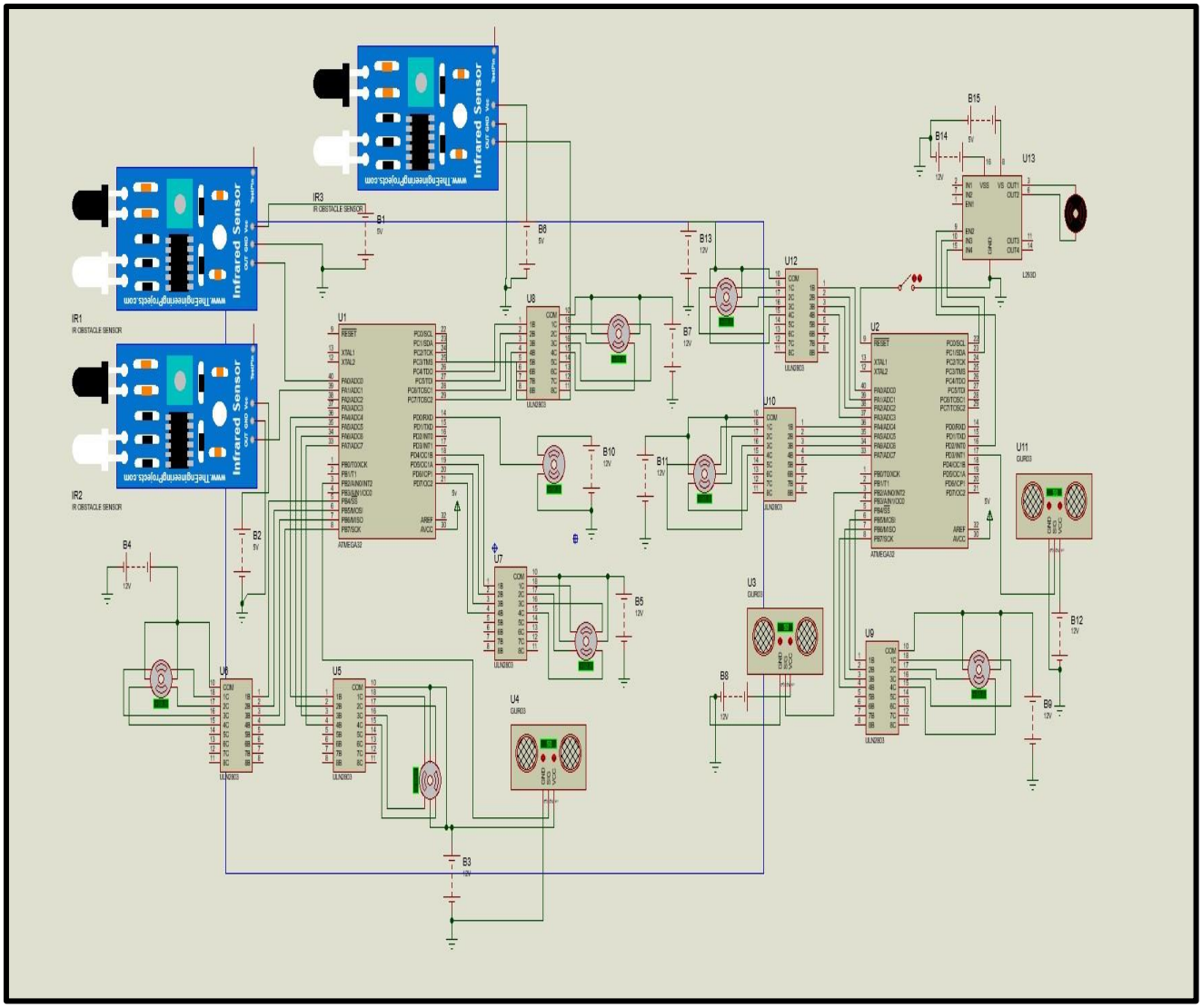
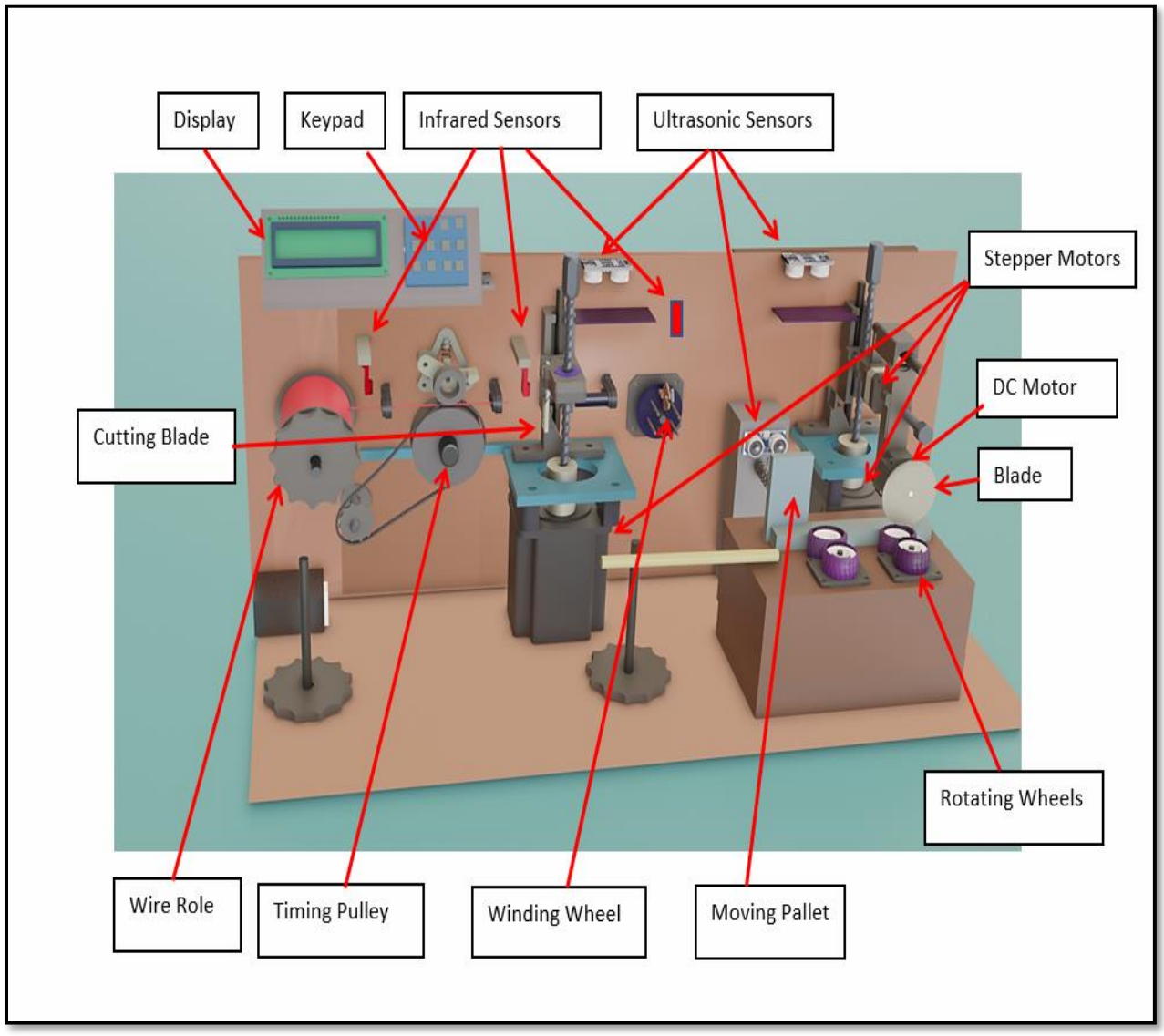


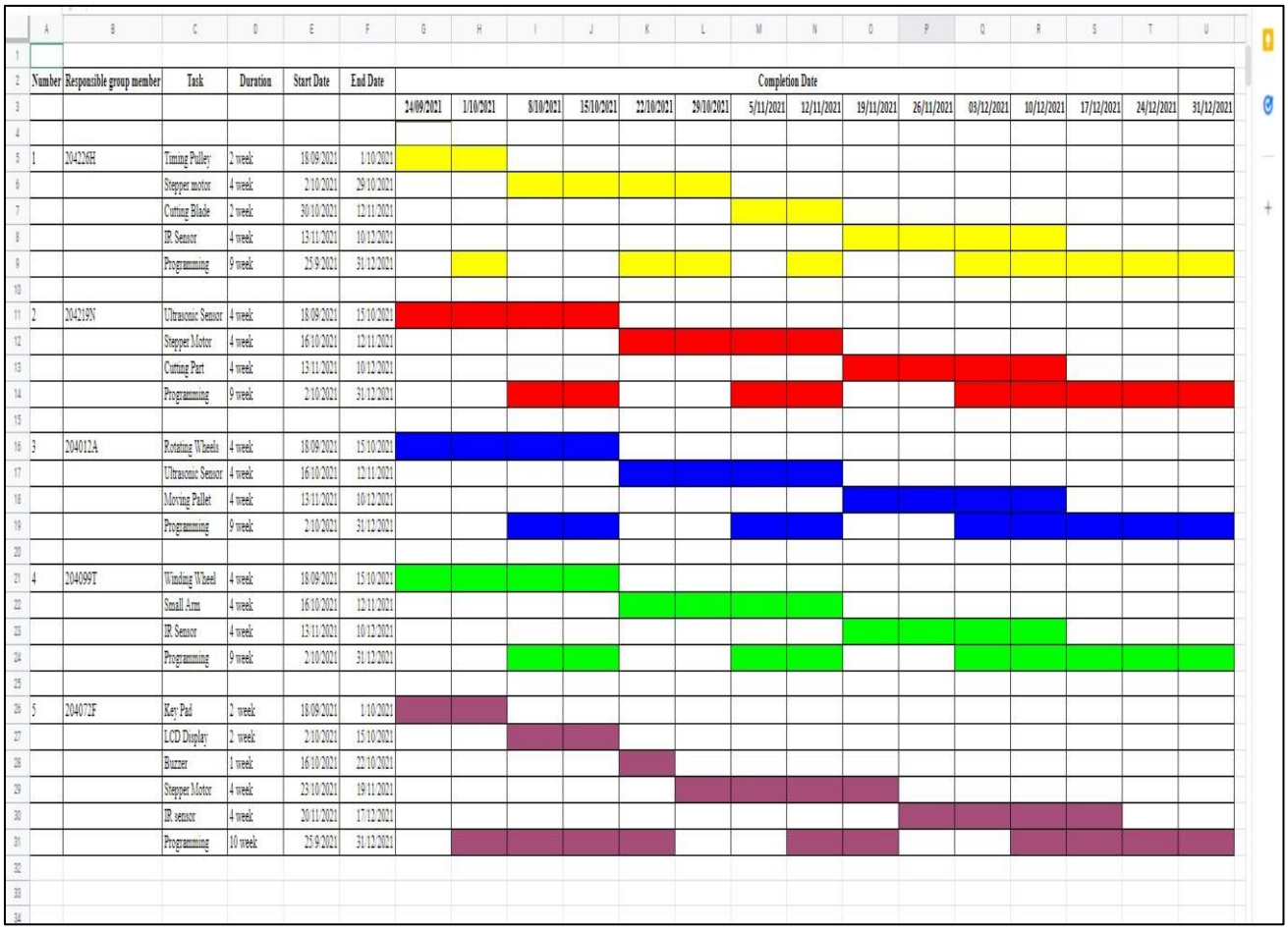
Figure 1: :System Diagram



Google Document for Labeled 3D Diagram:

https://drive.google.com/drive/folders/17hJWQLESjQFpUusO3k_iePdAxYnMa1rJ?usp=sharing

9.0 Action Plan for Remaining Work



Number	Responsible group member	Task	Duration	Start Date	End Date	Completion Date														
						24/09/2021	1/10/2021	8/10/2021	15/10/2021	22/10/2021	29/10/2021	5/11/2021	12/11/2021	19/11/2021	26/11/2021	03/12/2021	10/12/2021	17/12/2021	24/12/2021	31/12/2021
1	204226H	Timing Pulley	2 week	18/09/2021	1/10/2021															
		Stepper motor	4 week	2/10/2021	29/10/2021															
		Cutting Blade	2 week	30/10/2021	12/11/2021															
		IR Sensor	4 week	13/11/2021	10/12/2021															
		Programming	9 week	25/9/2021	31/12/2021															
2	204219N	Ultrasonic Sensor	4 week	18/09/2021	15/10/2021															
		Stepper Motor	4 week	16/10/2021	12/11/2021															
		Cutting Part	4 week	13/11/2021	10/12/2021															
		Programming	9 week	2/10/2021	31/12/2021															
3	204012A	Rotating Wheels	4 week	18/09/2021	15/10/2021															
		Ultrasonic Sensor	4 week	16/10/2021	12/11/2021															
		Moving Pallet	4 week	13/11/2021	10/12/2021															
		Programming	9 week	2/10/2021	31/12/2021															
4	204099T	Winding Wheel	4 week	18/09/2021	15/10/2021															
		Small Arm	4 week	16/10/2021	12/11/2021															
		IR Sensor	4 week	13/11/2021	10/12/2021															
		Programming	9 week	2/10/2021	31/12/2021															
5	204072F	Key Pad	2 week	18/09/2021	1/10/2021															
		LCD Display	2 week	2/10/2021	15/10/2021															
		Buzzer	1 week	16/10/2021	22/10/2021															
		Stepper Motor	4 week	23/10/2021	19/11/2021															
		IR sensor	4 week	20/11/2021	17/12/2021															
		Programming	10 week	25/9/2021	31/12/2021															

Figure 1: Action Plan Diagram

Action Plan Google Document:

https://docs.google.com/spreadsheets/d/1FQ_Ta13aoDU6rwvpCmZdLBbd83FU78iz4PRh_ykgN6k/edit#gid=0

10.0 Appendix

Appendix A

10.1 Individuals Contribution to the Project

Name of the student: Wanni Arachchi H.N (204226H)

1. Designing and Programming a Stepper Motor to rotate the Timing pulley.
2. Designing and Programming a Stepper Motor to move the cutting blades.
3. Designing and programming an IR sensor.

I had to do the work related to the above components (two stepper motors and an IR sensor). In the beginning I referred the Atmega 32 microcontroller data sheet and clearly learn about pin diagram. First, I tried to implement simple circuits using the Atmega 32 microcontroller. Then I learnt about other components using online resources. There I found the basic concepts about these components such as, how can we detect an object using an IR sensor and the theoretical part behind the stepper motor. In the stepper motor part, I also had to learn about motor divers.
Then I tried to learn about how to do coding part using Microchip Studio. Here also I referred some online resources like Electronwings[8] and AVR Freaks[7] websites. Here I used c language for the coding. With that I was able to write and build the programs. After I tried to build circuit and simulated using SimulIDE software.

Codes and Circuit diagrams for completed work:
https://drive.google.com/drive/folders/1ydJEv1NTKH-QSatE9Q6uVB92MRPjdS3l?usp=sharing

Name of the student: Thiunuwan G.V.R (204219N)

1. Designing and programming Stepper Motor
2. Designing and programming DC motor
3. Designing and programming an Ultrasonic Sensor

I had to do the work related to the above components (DC motor, Stepper motor, Ultrasonic sensor).

In the beginning, I studied how to connect these components to the Atemga32 microcontroller. Then I use datasheets and other online resources to gather more information about them. There I found the basic concepts about these components such as, how we can measure the distance to an object using an Ultrasonic sensor and the theoretical part behind the stepper motor and DC motor. Then I tried to learn how to do the coding part. Here also, I get some help from online resources like Electronicwings[8] and AVR Freaks[7] websites. With that help, I was able to write and compile(build) the program. I used Microchip Studios software and C language for that purpose. Then I used SimulIDE software to draw the circuit diagram and simulate it. (For some simulations, I connect some other components to make sure that some sensors are working) e.g.: Simulation of Ultrasonic sensor

Codes and Circuit diagrams for completed work:
https://drive.google.com/drive/folders/1t9jyPQiOEA3Dm-fpqZ2X1voTsPtYRnL4?usp=sharing

Name of the Student - Kavindi G.V.M (204099T)

1. Winding wheel
2. IR sensor
3. Small Arm
4. Programming

First, I studied about Winding wheel, IR sensor and small arm and got some idea about those components. Then I made the circuits separately on the SimulIDE and helped to implement and test.

First, I decided to make the circuit for winding wheel. I used a servo motor, Atmega32 chip, power supply, a resistor and two switches. I used Microchip Studio for cording and compilation process. Here I read some articles and watched about servo meter.

After that I tried to make the circuit for IR sensor. But I could not simulate it because there is not an IR sensor on SimulIDE. But I read some articles, watched YouTube videos and got some Idea about IR sensor. Then I draw the circuit in a paper and tried to code using Microchip Studio. Finally, I decided to make the circuit for small arm. I used a stepper motor, Atmega32 chip, ULN2803 key, power supply, a resistor and a switch to simulate the circuit in SimulIDE and used microchip Studio for cording and compilation process. Here I read some articles and watched about stepper motor.[4][8]

Codes and Circuit diagrams for completed work:

https://drive.google.com/drive/folders/1_9g_1zGNmRBepWDVMDsUkWJBB960Z3BJ?usp=sharing

Name of the Student - Avishka W.D (204012A)

1. Designing and Programming a Stepper Motor to rotate the rotating wheels.
2. Designing and Programming an ultrasonic sensor.

First, I have learned about how stepper motor and ultrasonic sensor working. Then I studied how to apply them in our project.
Next, I studied about Atmega 32 microcontroller and how to connect components to it.
Then I made a circuit diagram using simul ide to rotate a stepper motor. To do that task I used ULN2803 driver to power up the stepper motor. I have to write code to rotate motors according to the given length by the user.
Then I made a circuit diagram to get input to microcontroller from an ultrasonic sensor.
Basically, I have done above mentioned parts for the moment. I used Electronicwings.com[8] and Atmega32-avr.com[9] websites to learn about mentioned things.

Codes and Circuit diagrams for completed work:
https://drive.google.com/drive/folders/1uVxWmVse6J80fBSBdCA9mSpJZfc_isdE?usp=sharing

Name of the Student-H.A.T.N.Hemarathna(204072F)

1. Designing LCD Display and programming part.
2. Designing Keypad and programming part.
3. Buzzer with programming part.
4. Programming a Stepper Motor to rotate the Wire Role.
5. Programming an IR sensor.

First, I have studied basic theories of these components including the Microcontroller.
Then I made a circuit diagram to see the process of LCD Display using SimulIDE. By that I learned about the pin diagram of LCD and learn to connect it properly. Then I wrote the C code using Microchip Studio to run the circuit diagram and I confirmed that the LCD work properly. Then I modified above circuit diagram by adding the 4 x 4 Keypad to that. When I am connecting the keypad all the column of the keypad defined as outputs and rows defined as inputs. Then I wrote a code to display a string with numbers that we gave from a keypad. After some efforts I could run the circuit diagram properly. Likewise, I completed the LCD and Keypad part. But I must connect all the components according to our machine.
Then I moved to learn about Buzzer, and I drew the circuit design by hand because there is not any buzzer to check the circuit properly in SimulIDE. After the coding part I designed a circuit diagram to rotate a stepper motor. To do that I used ULN2803 Driver to give more power to the stepper motor. I must write the program to rotate it according to the length given by a user and have to design the circuit diagram for IR Sensor.
Basically, I have completed above mentioned parts for now. For above mentioned works I referred Electronicwings web site[8], Data Sheet of LCD[5], Stepper Motor[6] and some YouTube videos.

Codes and Circuit diagrams for completed work:
https://drive.google.com/drive/folders/1sz7ZrSYU-FK8p80SR8sLf1I6YE-MznHi?usp=sharing

Appendix B

10.2 References

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