KLE Technological University

Creating Value
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A Report on the Course Project of

Engineering Exploration course (15ECRP101)

Titled

AWSM-15

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CERTIFICATE

This is to certify that the project entitled "**AWSM-15**" is carried out by below mentioned students as part of Engineering Exploration Course (15ECRP101), KLE Technological University, Hubballi, during 2nd Semester of B.E program for the academic year 2017-18. The project report fulfils the requirements prescribed.

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Examiner 1:	Examiner 2:

DECLARATION

We hereby declare that the project work entitled "**AWSM-15**" submitted as a part of Engineering Exploration Course during 2nd semester of academic year 2017-2018 to KLE Technological University, Hubballi, is a record of an original work done by us under the guidance of Mr Sanjeev M. Kavale. Neither project work nor part of this report is plagiarized to the best of our knowledge.

Date: 27/04/2018

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Mr Vijay, Mr Udaykumar, Ms Lalithamma, Ms Kamalamma, Mr Yallappa and Mr Ramesh were always there to extend a helping hand whenever we needed it irrespective of the time was. We would like to express our sincere gratitude to the entire CEER team to constantly motivate us which gave us the confidence to complete our project. We would like to thank our batch mates like Ritushree, Raghavendra, Swastik, Sachin, Sougat, Usman, Soumya S and all our friends who helped us overcome several difficulties. We would also thank our seniors for their invaluable advice which was of great help. A sincere thanks to our parents for always being a guiding light in our lives and for their blessing. Finally, we would like to thank KLE Technological University to give us the opportunity to undertake such a project and also providing us with the necessary resources and freedom to make this project a success.

Abstract:

One of the most used consumable item in any laboratory like the tinkering lab in the KLETech campus are wires that are used to make electrical connections in any circuit or system. It is a very tedious, repetitive and time-consuming process to cut and strip the wires. Therefore to address this problem we designed and prototyped a simple portable and user-friendly wire cutting and stripping machine.

The machine basically draws wire from a wire roll, strips the wire and cuts the wire to the present standard length. After a lot of research, we designed the machine in such a way that cutting and stripping of the wire is accomplished by the use of only one cutting plier which makes the machine cost effective.

The intake of the wire is achieved by the use of rollers which feeds the wire to the cutting plier for cutting and stripping of the wire. The machine also indicates the completion of the process when the cut and the stripped wire is dispensed in the collector tray.

The project needed the use of motor, motor driver, Arduino. The knowledge of Arduino programming was required to achieve the controlled movement of motors and to couple the other electronic devices for the synchronised functioning of all the components in order to achieve the desired result.

There can be many more functions that can be added to the machine that would make the machine more versatile. A user input keypad or LCD display can be incorporated in the system which lets the user to choose not only the length of wire to be cut but also gives him/her the options to cut and strip wires with different diameters. Also the length of the wire that needs to strip can be varied.

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1. Problem Definition

1.1. Need Statement

In every semester the faculty of CEER has to make kits for Engineering Exploration class, which consists of many components including wires of different lengths. Cutting and stripping wire to required length is fatigue and consumes lot of time. There is a need to automate the process of cutting and stripping of wires

1.2. Gathering Pertinent Information

INTRODUCTION

Wire cutting and stripping is one of the most basic electrical wiring skills. It is also is an important component in making good electrical connections [1]. According to Wikipedia, The simple definition of wire stripper is that wire stripper is a tool used to strip the electrical insulation from electric wires. Wire cutting machines are automatic or semi-automatic machines that provide precise cutting of wire and cables. A wire cutting and stripping machine uses a rotating blade to follow the contour of the cable, cutting away the cable insulation to expose a portion of the cable [2].

NEED FOR AUTOMATIC WIRE STRIPPING ANDCUTTING MACHINE.

Automatic wire stripping machine is very beneficial in places such as large scale industries, workshops, labs, colleges and many more. In manufacturing plants where automobiles are manufactured on a large production basis, considerable labour is required in cutting wires of the desired length and stripping the insulation from the ends therefore Wire cutting and stripping machine plays a very important role in making various connections between the battery and generator and in the ignition and lighting systems thus decreasing the time and making the work easy [3].

HISTORICAL BENCHMARKS IN TECHNOLOGY

Wires have been in use since the early 1800's to conduct electricity and make connections in electrical and electronics system. The wires started to be insulated so as to prevent accidental contact with other conductors of electricity, thereby preventing short circuit. Insulation also prevents humans from getting electrocuted due to accidental contact with current carrying contact wires**.**

Manual wire strippers were introduced to remove the insulation of wires for making connections. A US-style simple manual wire stripper is a pair of opposing blades much like scissors or wire cutters. The addition of a center notch makes it easier to cut the insulation without cutting the wire. Because of manual wire stripper is not efficient (since the process of wire stripping and cutting becomes tedious and time consuming) therefore with the development of technology the automated wire stripper came into existence [2].

The compound automatic wire stripper was first patented in 1915 by Stuart G. Wood of Brooklyn, NY. When engaged, a compound automatic wire stripper first, simultaneously grips the wire in one side and in the other side closes its V shaped blades cutting the insulation around the conductor. After the sides have completed their strokes the two sides

of the mechanism spread apart to push the cut tube of insulation from the end of the conductor. This device allows even a novice to strip most wires very quickly.

The most recent innovation for wire stripping and cutting is the laser wire stripping and cutting machine. A laser wire stripper is a computer-controlled machine, much like a CNC router, which uses a laser to burn off the insulation of the wire. Laser wire stripping machines are used mostly for very fine gauge wires since they do not damage the conductor. A typical CO2 laser wire stripping machine should be capable of stripping the insulation from any size wire [4].

EXISTING SOLUTIONS TO THE PROBLEM

Manual wire stripping machine

- **Cutting plier**

Wire stripping in the earlier stage was done by cutting plier, the cutting plier was operated manually.

Components

The cutting plier was consisting of two blades which would look like scissors. The feature added was centre notch which made it much easier to cut the insulation around the wire. There are many wire cutting and stripping tools for a variety of automotive wiring sizes and options. The Self-Adjusting Cut and Strip Tool strips wires from 34 to 8 gauge wire without adjustment. The Heavy Duty Cable Stripping Tool strips electrical wires and cables of all insulation types. It features two interchangeable cable guides for a cable capacity of 0.18" up to 1.57". It also features three blade positions to provide circular, lengthwise or spiral cuts. Replacement blades for the heavy duty cable stripper are contained inside the tool. The Precision Stripping Tool is a 9-position tool that strips jackets of most cables up to 0.43" with insulation thickness up to .04". Regardless of size or specification, many of the wire stripping and cutting tools feature comfortable plastic covered handles that help reduce wrist fatigue [1].

Figure 1. A Cutting Plier [1]

Eco Strip 9380

The EcoStrip 9380 is a simply capable entry level machine for cut & strip applications that need to meet professional standards. It cleverly combines the latest technology with Schleuniger's industry renowned precision, making it easier than ever to process a wide range of entry level applications.

This flexible machine can be configured with rollers or a belt feeding unit. The unique 3-position design of the optional belt feeding unit can be set for normal mode, roller mode or short mode processing. The EcoStrip 9380's economical price point, along with its high level of cut & strip quality, makes it the perfect choice for both newcomers and cut & strip professionals alike.

Figure 2.EcoStrip 9380 [3]

- **CS800 Wire Cut & Strip**

Eraser's Model CS800 Wire Cut & Strip is a fully programmable, fully electric bench top wire cutter and stripper. The working principle of the automatic wire stripper is delivering the wire by feeding and discharging roller, and then cutting and stripping by the cutting structure [6].

Components

1. **Wire feeding roller**: Feeding the wire and strip the head end of wire. While stripping the short wire, it can strip the head and end of the wire (length is less than 50mm), it also could strip the middle parts of the wires.

2. **Pressure adjusting wheel for feeding roller**: adjust the pressure of the wire feeding roller, when it is pulled and rotated in clockwise direction, the pressure of feeding roller is increased; when it is pulled and rotated in counter clockwise direction, the pressure of the feeding is decreased.(The pressure is adjusted as per the strength of the wire)

3. **Adjusting wheel for the gap of the feeding roller**: adjust the gap between the wire feeding rollers, gap will be increased while rotated in the right and the gap will be decreased while rotated in the left. (The gap is adjusted as per the diameter of the wire)

4**. Wire discharging wheel**: it deliver the wire and strip the end of the wire (it doesn't work while stripping the short wire, the gap between the discharging wheels should be the max. distance)

5. **Pressure adjusting button for discharging roller**: It adjusts the pressure of the discharging roller, when it is pulled and rotated in counter clockwise direction, the pressure of discharging roller is increased; when it is pulled and rotated in clockwise direction, the pressure of the discharging is decreased. (The pressure is adjusted as per the strength of the wire)

6. **Adjusting wheel for the gap of the discharging roller**: adjust the gap between the wires discharging roller, gap will be increased while rotated in the left and the gap will be decreased while rotated in the right. (The gap is adjusted as per the diameter of the wire)

7. **Cutting frame**: wire cutting, head stripping and end stripping. When the machine is stop, the distance between up and down blades should be the max which makes the wire smoothly getting through [7].

Figure 3.CS800 Wire Cut & Strip [4]

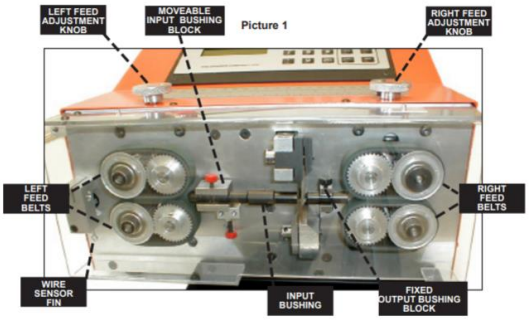


Figure 4.CS800 Wire Cut & Strip 2 [4]

SIENNA 900

SIENNA 900 is a modular laser-based magnet wire stripping units designed for complete integrated into medium to high volume production lines, new or existing, manufacturing wound components and other products using enamel insulated magnet wire.

Working principle

The laser (in the machine) delivers enough energy to effectively remove the insulating material by either photo-thermal or photo-chemical ablation process. Photo-thermal is essentially the heating and resulting evaporation of the insulator while photo-chemical ablation describes the breaking of chemical bonds in the material. Qualitatively, the two mechanisms produce very different results.

Absorption of the conductor (wire) implies the delivered laser energy to the wire results in local heating that leads to evaporation of the surrounding insulating layer. An alternate mechanism is recoil stripping, where the insulating layer is removed by the shock wave created at the wire surface by the laser pulse.

Working

It is critical to be able to strip insulation precisely from wire without damage to the conductor. Laser-based wire strippers accomplish this simply, by relying on the ability of light to selectively remove non-metallic insulating materials while leaving the metallic conductor completely untouched [8].

Benefits

The Benefits of this machine is that it has a selective, clean, non-contact process. No consumable parts like with brush or blade methods are used. No risk of product contamination due to presence of insulation debris. Conductor surface is left completely clean and also oxide-free. Optimum electrical termination can be achieved through precise control of resulting surface texture [9]

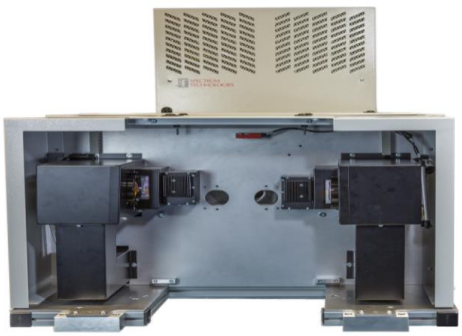


Figure 6.SIENNA 900 [5]

Figure 5.SIENNA 900 image 2 [5]

WORKING OF WIRE CUTTING AND STRIPPING MACHINE

The inputs should be processed by Arduino nano and then the command should be given to stepper motor to feed required length of wire and instruct the server to make cut of required quantity. The components required are Arduino nano, stepper motor, motor driver, servo motor, cutter, PCB terminals. For base of the machine 3mm thick white acrylic sheet can be used and all the components should be tightly mount on the sheet [11].

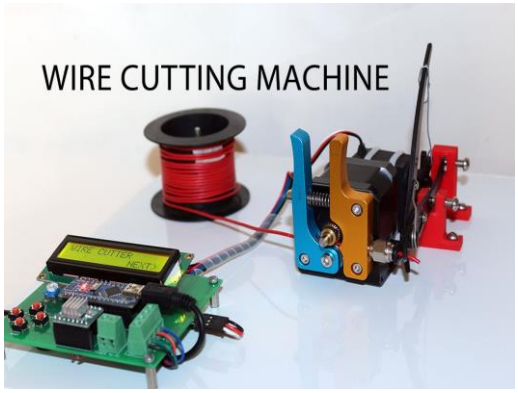


Figure 7.Wire cutting machine [7]

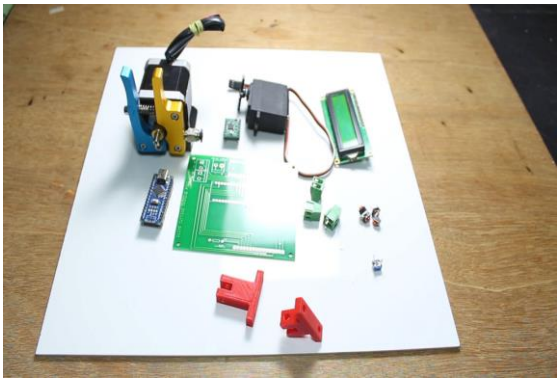


Figure 8.Components of machine [7]

The Circuit of the machine would be like

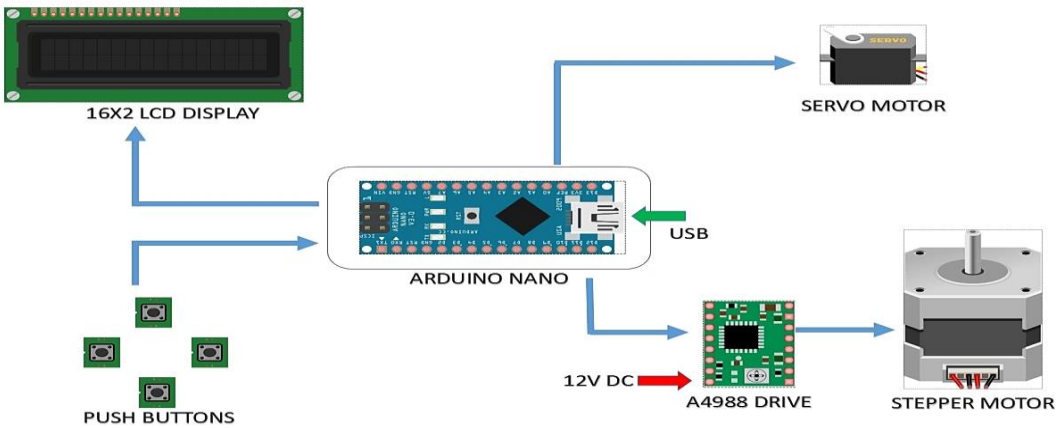


Figure 9.Circuit Diagram [7]

THE TECHNOLOGY, COMPONENTS OR MODULES THAT ARE NEEDED FOR THE DESIGN OF WIRE CUTTING AND STRIPPING MACHINE

Based on the features and components used in all the above machines there are many components or modules that are needed for the design of Wire cutting and stripping machine. Machine body structure that can house the parts in a compact state can be adopted thus enhancing the sturdiness and durability of the machine. A newly designed blade block, which activates the top and bottom blades made of ultra-fine-grain alloy simultaneously, can be employed to insure the quality and neat finish. Machine components should be designed in modular-type so that it becomes easy to assemble and disassemble in minutes. V-Blade Design can be used to ensure Cut and Strip Shape. Assembly Type of Split Blade, can be exchanged as require. Adjustable-type cylinders, machine base and tooling designs should be used so that it permits wire stripping to any wire diameter and length. Adjustable tool and clamp holders can be fixed so that operator can use the unique one-for-all tooling for stripping of either flat cables or circular wires of any diameter. Tool and clamp holders could be mutually exchanged for use in performing any specific wire-stripping task [10].

DIFFERENT EXPERTISE NEEDED FOR DESIGNING THE MACHINE

Expertise of different branches involved in the project are computer science engineer who will help us in writing the program for the electronic elements involved. Electronics engineer who will be helping in building electronic components which are required. Mechanical engineer would be needed for building up the outer frames, etc. Even guidance of course instructor and guide Sanjeev Sir, Manikanta sir, Jyoti madam, and Raghu sir is needed to design the machine.

DISCUSSING WITH THE OTHER TEAMS HAVING SAME NEED STATEMENT

When discussed about the project with other teams their idea is to make automatic wire stripper machine. The main drawback of this idea could be high cost of the machine and even making the machine would take long time and hence time management would be difficult. The positive thing about their product could be that the cutting and stripping would be done with accuracy and precision. However since it is the initial stage of our project, we are not sure about its working.

THE FACTORS IMPORTANT TO SOLVE NEED STATEMENT

Some of the factors important to solve the problem would be materials used to build the product should be eco-friendly, edges should cut in proper way so that it doesn't hurt the users in anyway, the blade should not be exposed as it may cut the user, all the components should be sealed to avoid Human contact, also the product need to be portable and even the budget of the machine would be around 3000 rupees.

1.3. Questions asked to client / users for arriving at Objectives, Functions and Constraints.

Table 1.Questions asked to client

1	Which material should be used for machine parts?
2	Should the insulation material of wire be thick or thin?
3	Should the machine be portable or not?
4	Do you suggest time limit for stripping of the insulation of each wire?
5	What should be the size of machine?
6	What should be the cost range?
7	What should be the power source of this machine?
8	What should be the length of wire to be cut & strip?
9	What should be machine able to perform?
10	Should it be automatic or semi-automatic?
11	Should it contain any display or an indicator?

1.4. Requirements Analysis

Table 2 requirement analysis

A. no	Answer	O	C	F
1	Which material should be used for machine parts?	✓		
2	Should the insulation material of wire be thick or thin?	✓		
3	Should the machine be portable or not?	✓		
4	Do you suggest time limit for stripping of the insulation of each wire?	✓		
5	What should be the size of machine?		✓	
6	What should be the cost range?		✓	
7	What should be the power source of this machine?		✓	
8	What should be the length of wire to be cut & strip?		✓	
9	What should be machine able to perform?			✓
10	Should it be automatic or semi-automatic?			✓
11	Should it contain any display or an indicator?			✓

1.5. List of Objectives

Table 3.List of objectives

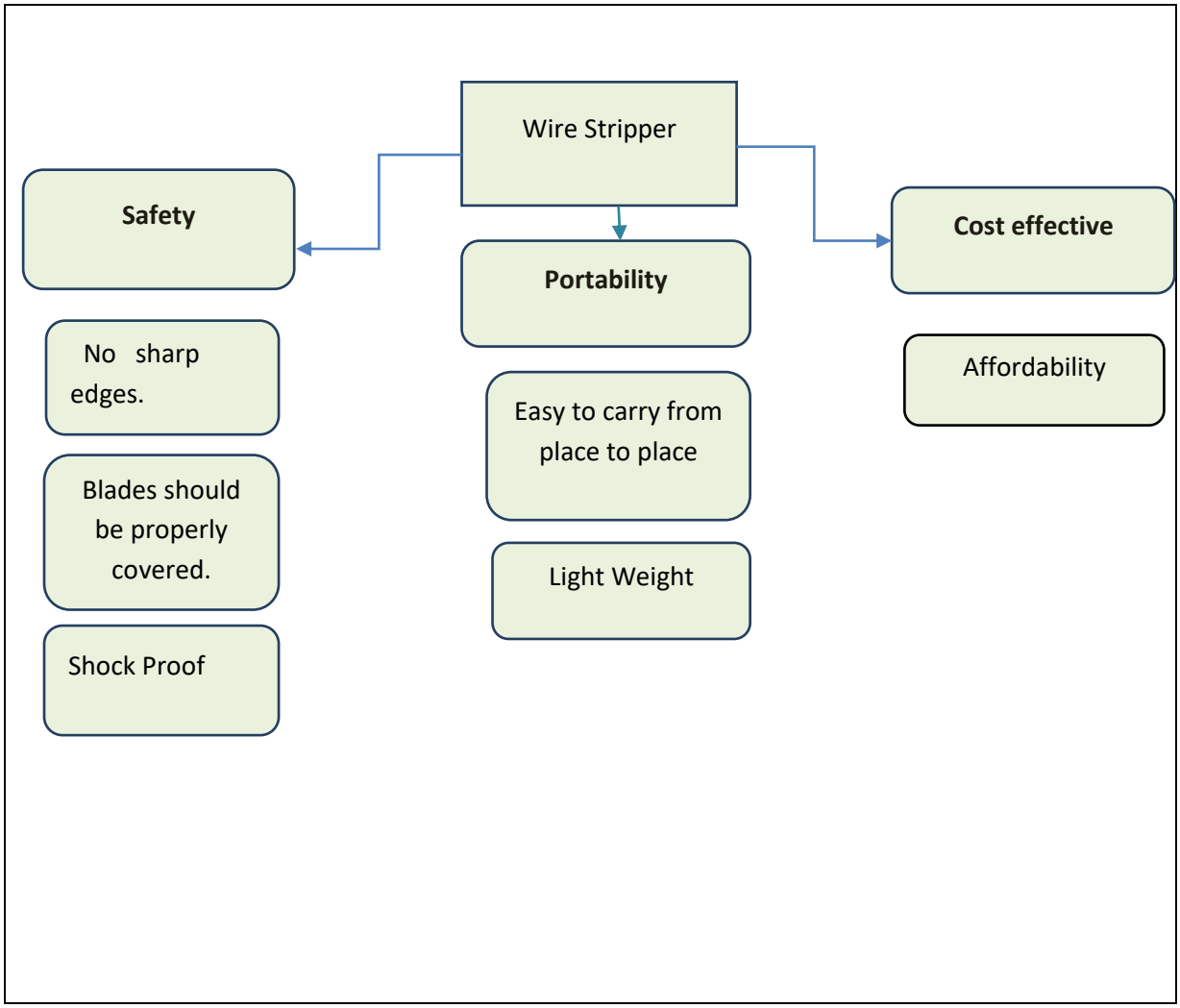
Sl. No	Objectives
1	The machine should be electric shock proof.
2	The device should be sealed properly.
3	Each wire should be stripped & cut in precise way.
4	The machine should have less maintenance cost.
5	The machine should light weight.
6	The machine should be affordable.
7	The machine should be portable
8	The machine should be stationery while cutting & stripping wire.

1.6. Segregated Objectives

Table 4.Segregated Objects

Category1: Safety	**Category2**: Portability	**Category3:** Cost Effective
No sharp edges	Easy to Carry from place to place	Affordability
Blades should be properly covered	Light weight	
Electric Shock proof		

1.7. Objective tree



1.8. Pair-wise Comparison Chart (PCC)

Table 5 PCC chart

Goals	Safety	Portability	Cost effective	Total score
Safety	*	1	1	2
Portability	0	*	1	1
Cost effective	0	0	*	0

1.9. Prioritized Objective List

Table 6 Prioritized object list

Sl. No	Objective
1	Safety
2	Portability
3	Cost effective

1.10. List of constraints

Table 7 List of constraints

Sl. No	Constraints
1	The length of the wire to be cut should be 15cm.
2	The machine should strip 1 cm of the wire from both the ends.
3	The size of the machine should not exceed 14*14*14 inches

1.11. List of functions

Table 8 List of functions

Sl. No	Functions
1	The machine should cut and strip one wire at a time.
2	The machine should be semi-automatic i.e. the machine should sense the input
3	The machine should indicate the completion of the process

1.12. Problem Statement

Design a wire stripping and cutting machine which should be safe to use and should be properly insulated. The machine should be light weight, compact and portable. The machine should cut 15cm of the insulated wire of diameter 1.25mm (diameter of inner conductor is 0.35mm) and it should strip 1cm from both the ends. The size of the machine should not exceed 14*14*14 inches. The cost of the machine should not exceed Rs.3000. The machine should be able to cut and strip one wire at a time and should be able to sense the user input and dispense the trimmed wire in the collecting tray. The machine should also indicate the completion of the process.

2. Project Schedule

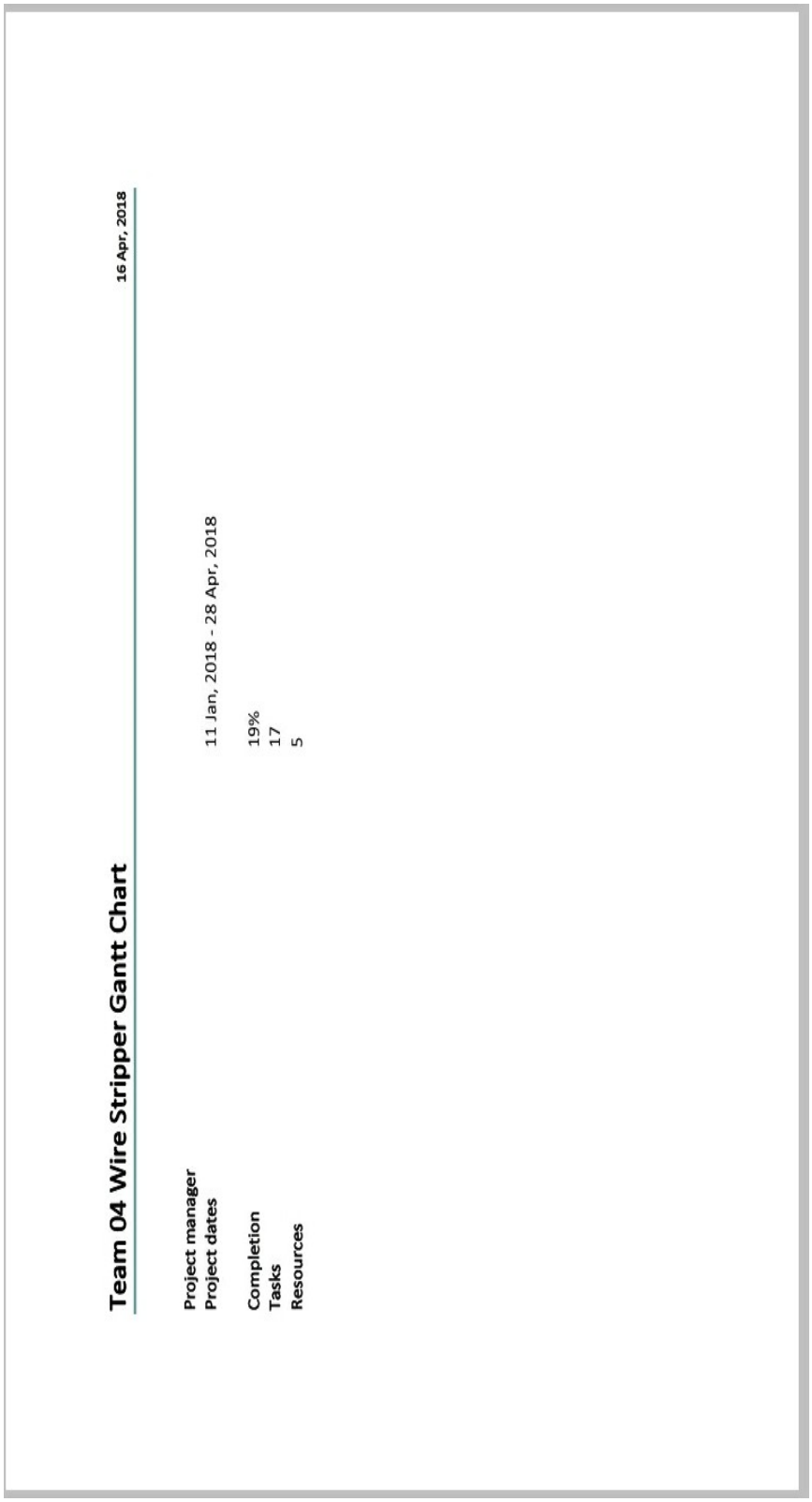
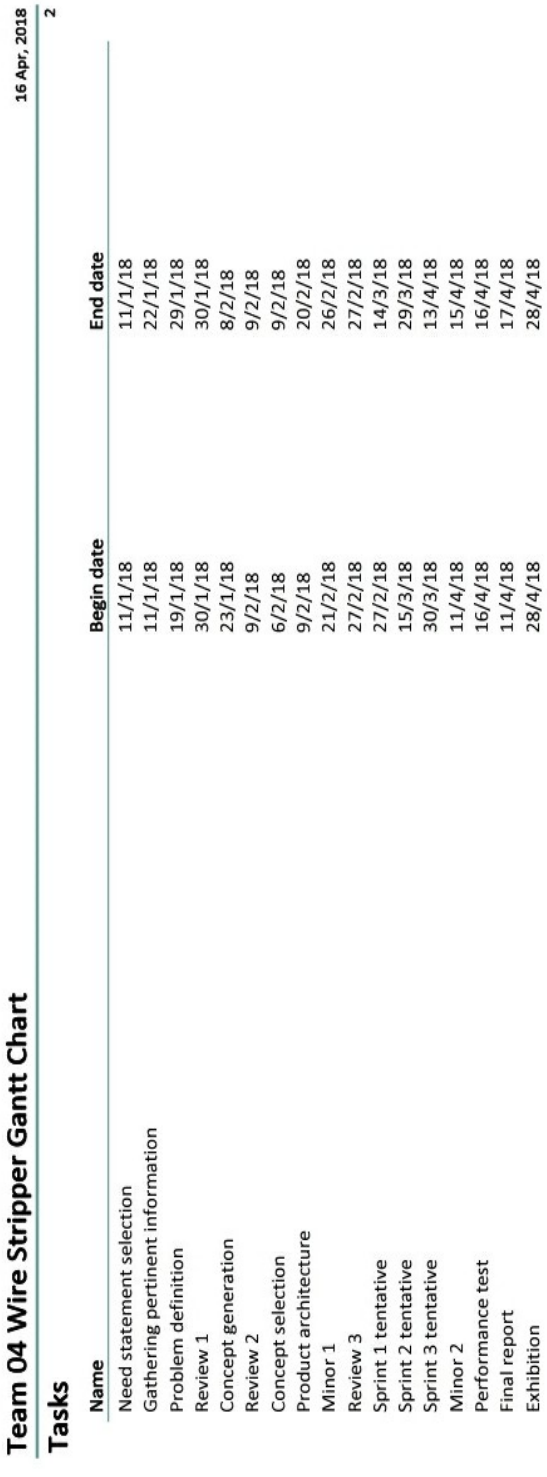


Figure 10 Page 1 Gantt chart



16 Apr, 2018 2

Team 04 Wire Stripper Gantt Chart

Tasks

Name	Begin date	End date
Need statement selection	11/1/18	11/1/18
Gathering pertinent information	11/1/18	22/1/18
Problem definition	19/1/18	29/1/18
Review 1	30/1/18	30/1/18
Concept generation	23/1/18	8/2/18
Review 2	9/2/18	9/2/18
Concept selection	6/2/18	9/2/18
Product architecture	9/2/18	20/2/18
Minor 1	21/2/18	26/2/18
Review 3	27/2/18	27/2/18
Sprint 1 tentative	27/2/18	14/3/18
Sprint 2 tentative	15/3/18	29/3/18
Sprint 3 tentative	30/3/18	13/4/18
Minor 2	11/4/18	15/4/18
Performance test	16/4/18	16/4/18
Final report	11/4/18	17/4/18
Exhibition	28/4/18	28/4/18

Figure 11 Page 2 of Gantt chart

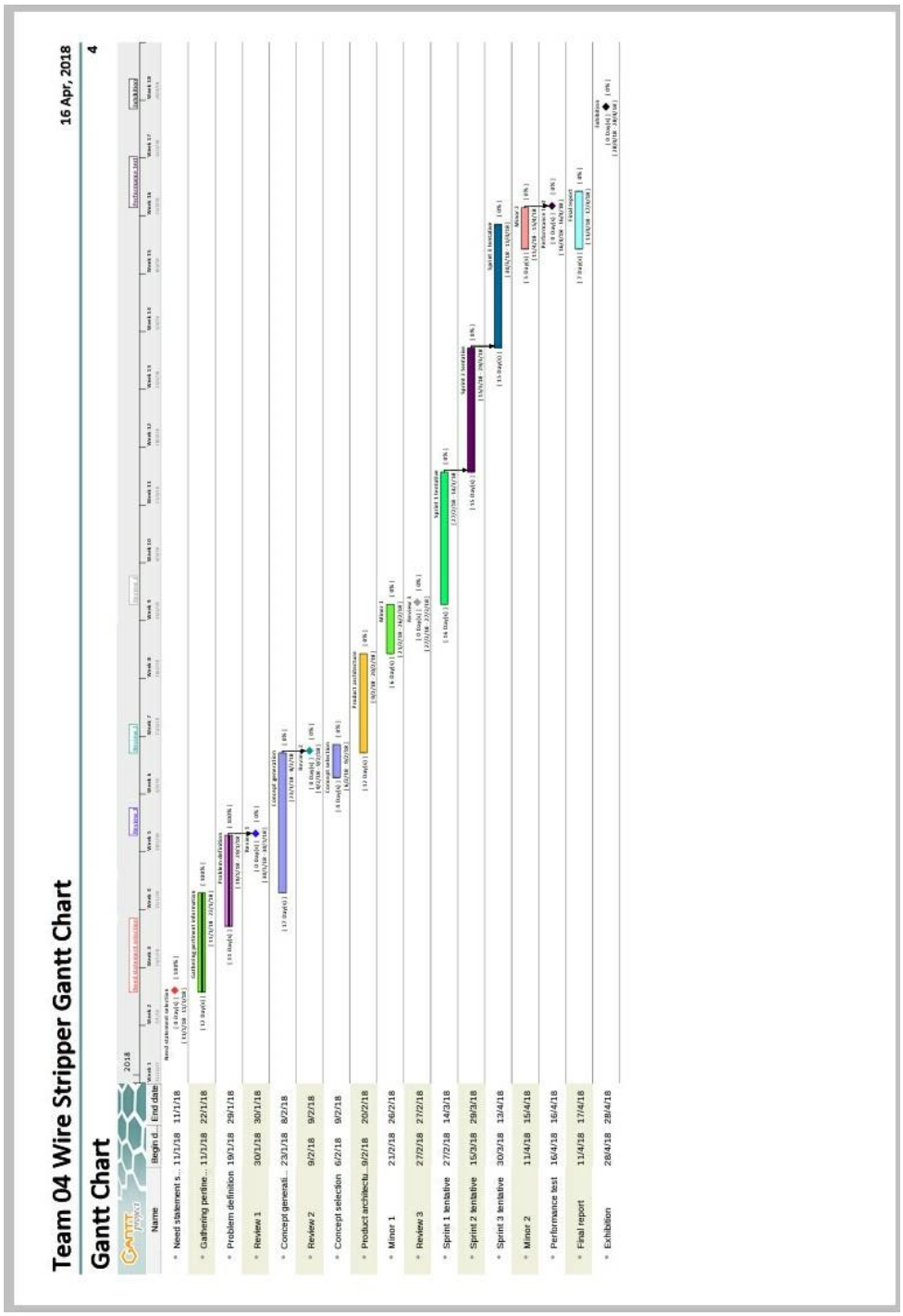
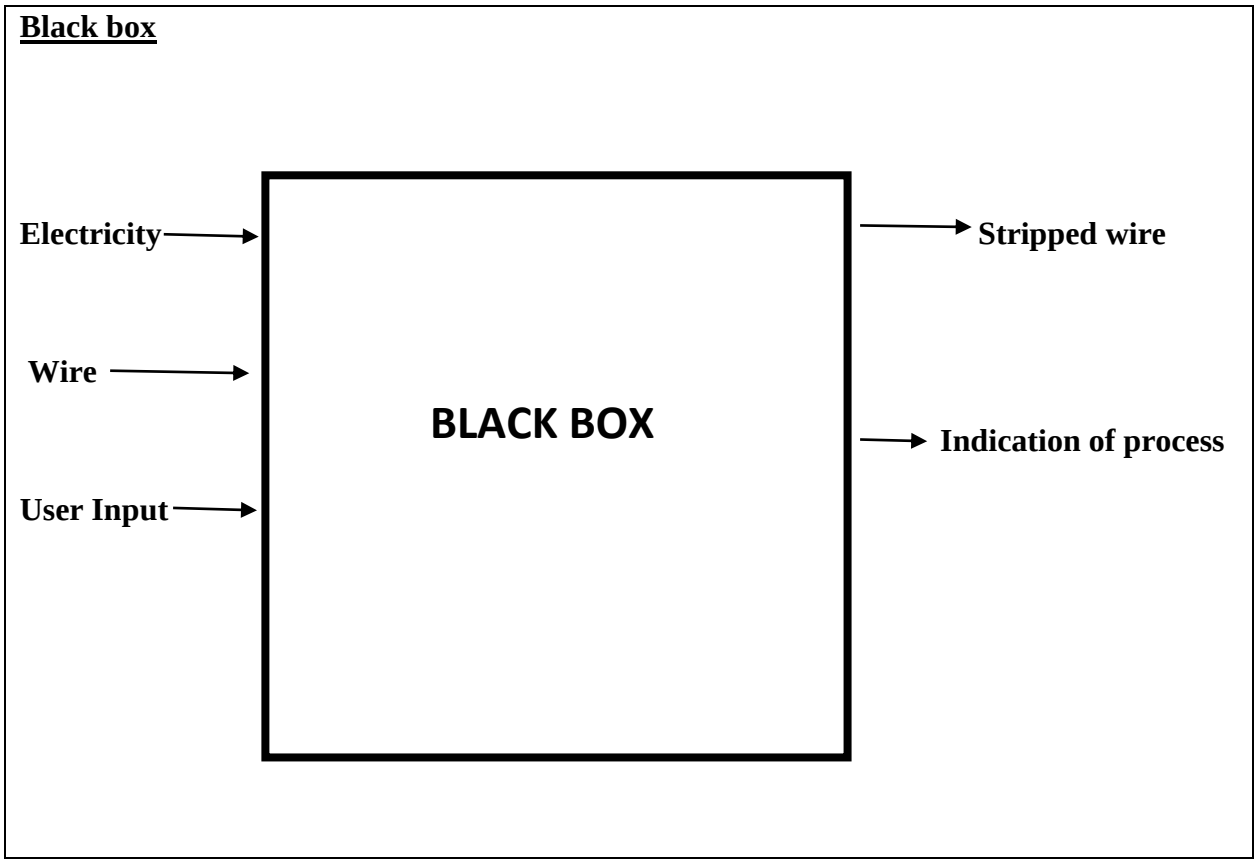


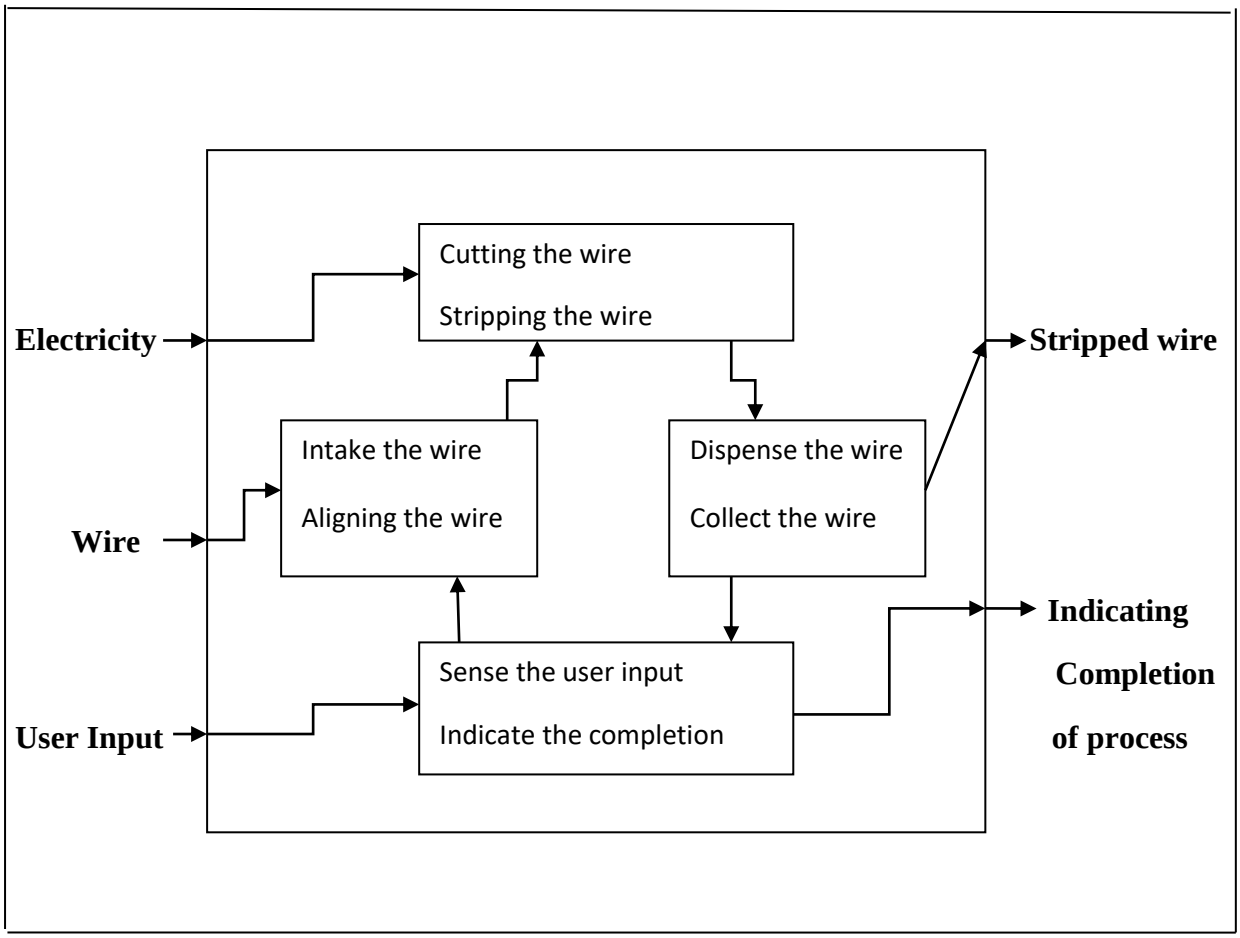
Figure 12 Page 3 Gantt chart

3. Conceptual Design

3.1. Black Box Representation

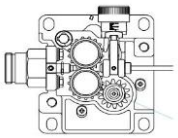


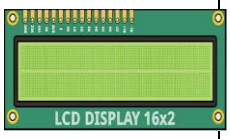
3.2. Glass Box Representation



3.3. Morphological Chart

Table 9. Morphological Chart

Functions	Mean1	Mean2	Mean3	Mean4
Function 1 Intake of wire	Roller feed mechanism 	Movable wire holder 	Robotic arm 	Extruder Mechanism
Function 2 Aligning of wire	Multiple roller 	Robotic arm 	Wire holder 	Alignment tubes 
Function 3 Cutting	V Shaped Blade 	Cutting plier 	Circular blade 	Two Sharpener Blades aligned at 45 degrees
Function 4 Stripping	Blade with a notch 	Cutting Plier 	V shaped blade 	Two Sharpener Blades aligned at 45 degrees
Function 5 Movement of blades	Cam mechanism	Using Servo motor	Wedge Screw Mechanism	Reciprocating Mechanism

Function 6 **Movement of stripping equipment**	**Rack and pinion**	**Using servo Motor**	**Toggle clamp**	**Four link level screw mechanism**
Function 7 **User input**	**Switch** 	**Keypad** 	**Bluetooth** 	**Remote** 
Function 8 **Dispense**	**Tray** 	**Guiding tubes** 	**Incline plane made with acrylic sheet** 	
Function 9 **Indicate**	**Buzzer** 	**LCD display** 	**LED light** 	

3.4. Concept Generations Using Morphological Chart

3.4.1. Concept 1:

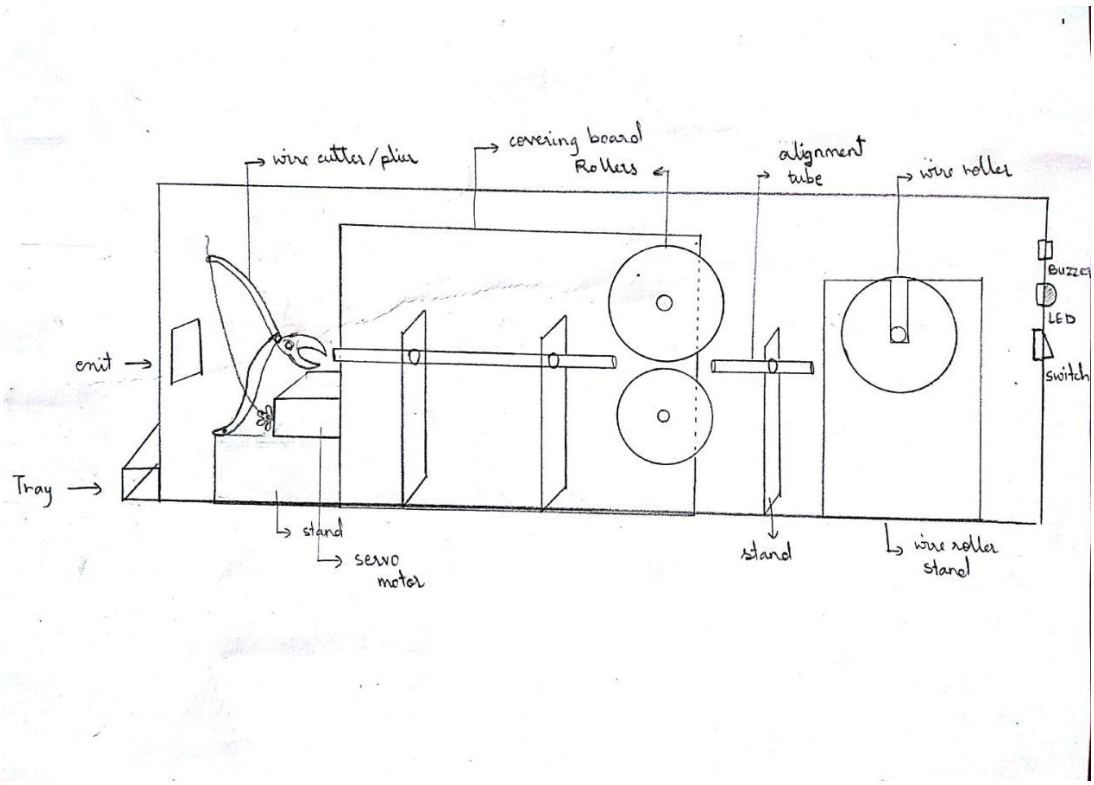


Figure 13 Concept 1 design

Table 10.Concept 1 function chart

Function	Means Selected
Cutting	Cutting plier
Stripping	Cutting plier
Alignment	Alignment tubes
Movement	Roller

3.4.2. Concept 2:

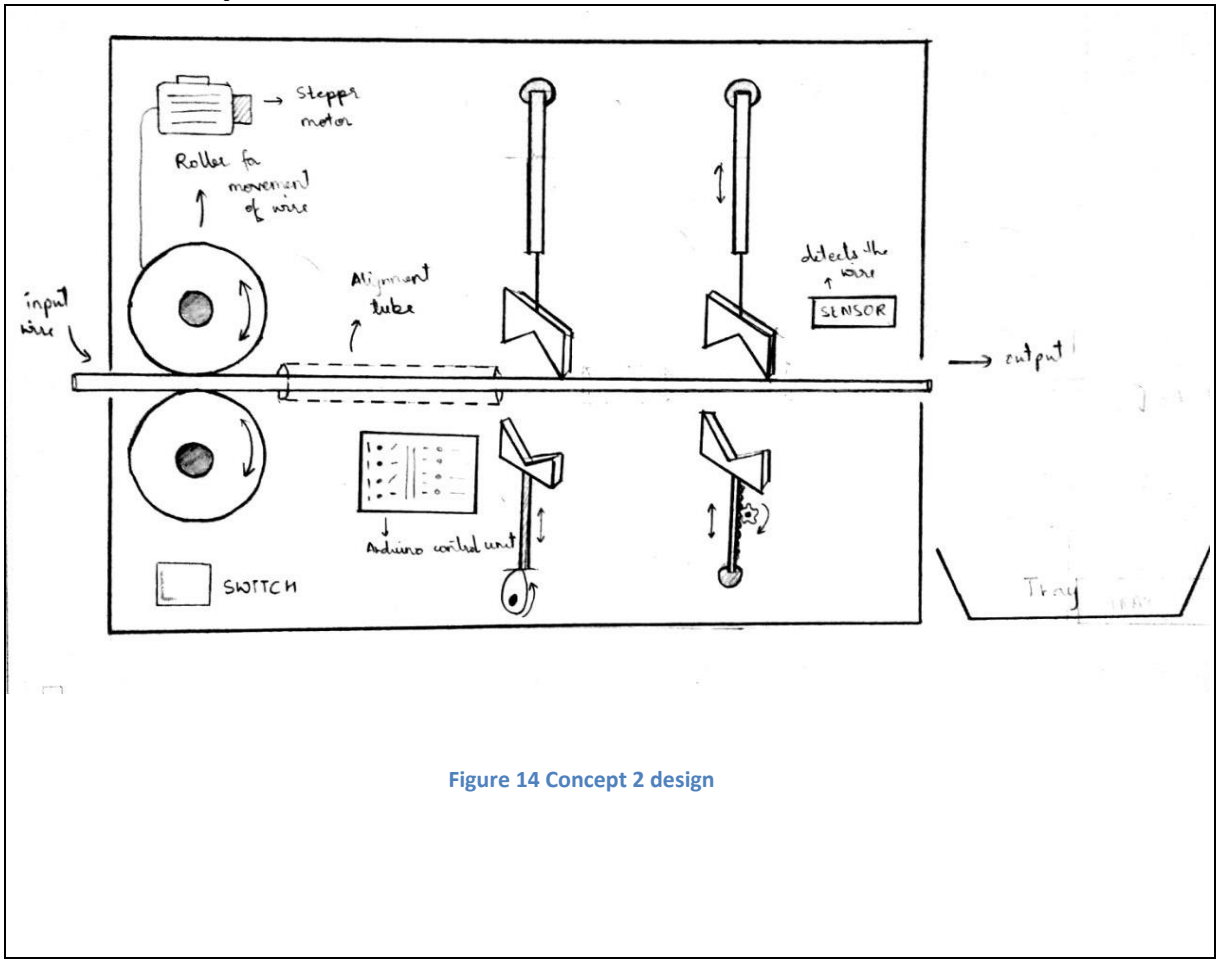


Figure 14 Concept 2 design

Table 11.Concept 2 function chart

Function	Means Selected
Cutting	V shaped blades
Stripping	V shaped blades
Alignment	Alignment tubes
Movement	Roller

3.4.3. Concept 3:

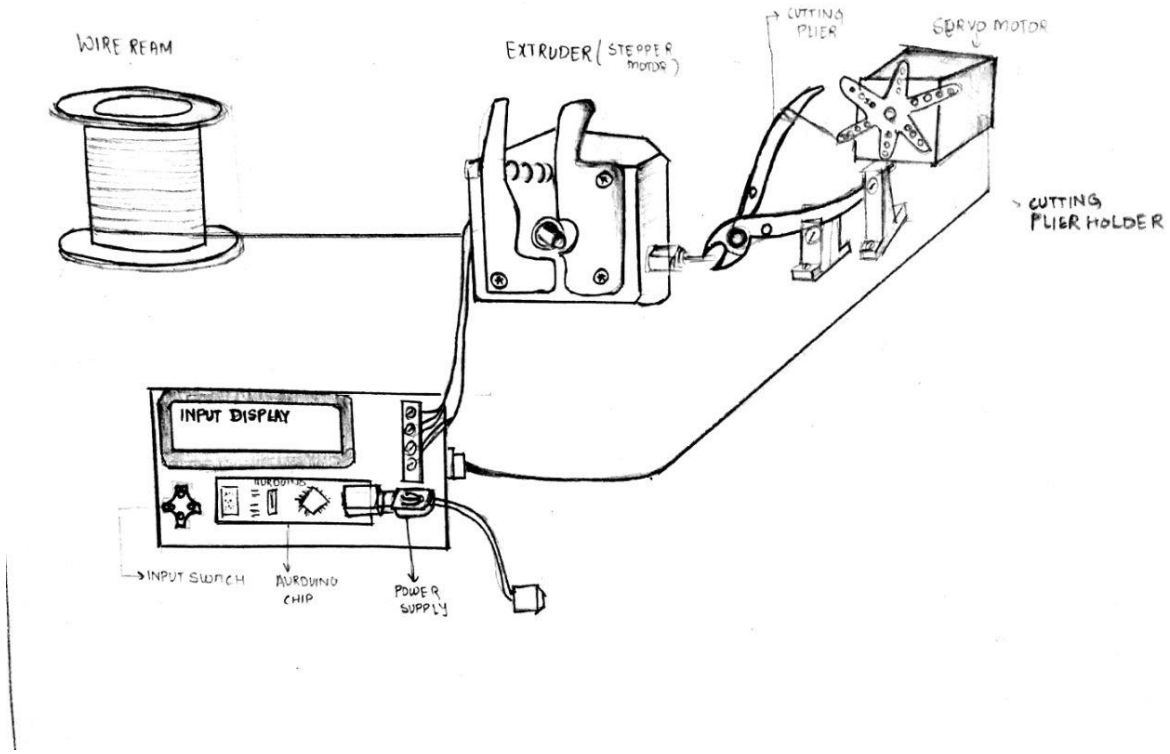


Figure 15 Concept 3 design

Table 12.Concept 3 function chart

Function	Means Selected
Cutting	Blades
Stripping	Blades
Alignment	Alignment tubes
Movement	Robotic arm

3.4.4. Concept 4:

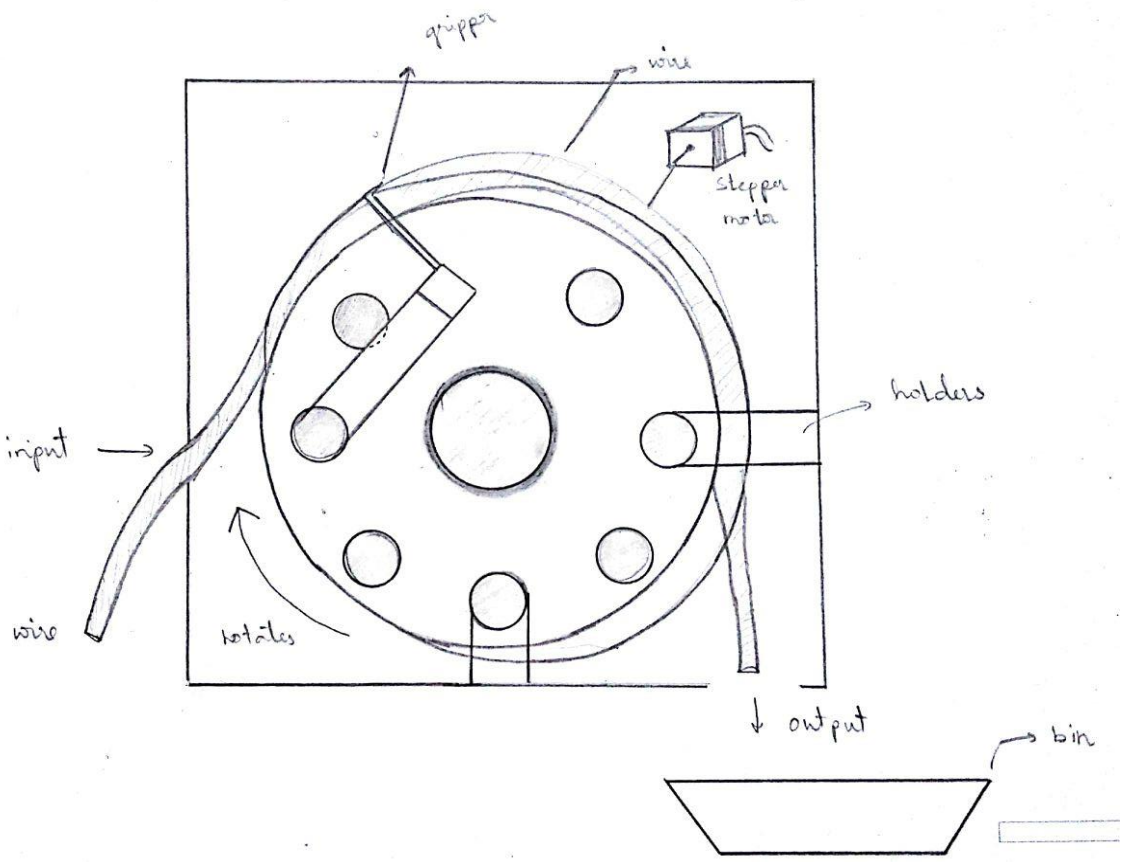


Figure 16 Concept 4 design

Table 13. Concept 4 function chart

Function	Means Selected
Cutting	Blades
Stripping	Blades
Alignment	Wire gripper (holder)
Movement	Robotic Arm

3.5. Assigning the Weightage to the Objectives:

Table 14 Weightage to objectives

Objectives	Weight
1.Safety	8
Justification: Since the machine uses sharp blades to cut and strip if it is unsafe to use as it could severely injure the user if proper care of safety is not taken.	
2. User Friendly	7
Justification: The machine should be user friendly so that the user easily understands the functioning and can operate the machine with ease.	
Objectives	Weight
3.Electrical shock proof	6
Justification: The user should be not be exposed to electrical shock during the operation as it could lead to serious injury and may also lead to hospitalization. Therefore special care should be taken while designing the machine.	
4. Portability	7
Justification: A wire cutting and stripping machine needs to portable since the user/client will require to take it from one location to another to complete the required tasks.	
5. Cost Effective	3
Justification: The machine may be reasonable priced since target groups are institutions and laboratories.	

3.6. PUGH Chart:

Table 15 PUGH chart

Objectives	Weightage	Concept 1	Concept 2	Concept 3	Concept $
Safety	8	++	Datum	0	+
User-friendly	7	+	Datum	++	+
Electrical Shock proof	6	0	Datum	-	0
Portability	7	-	Datum	-	-
Cost Effective	3	0	Datum	0	0
+ Score		24	0	14	15
- Score		5	0	13	7
Total		18	0	1	8

3.7 Selected Concept

CONCEPT 1

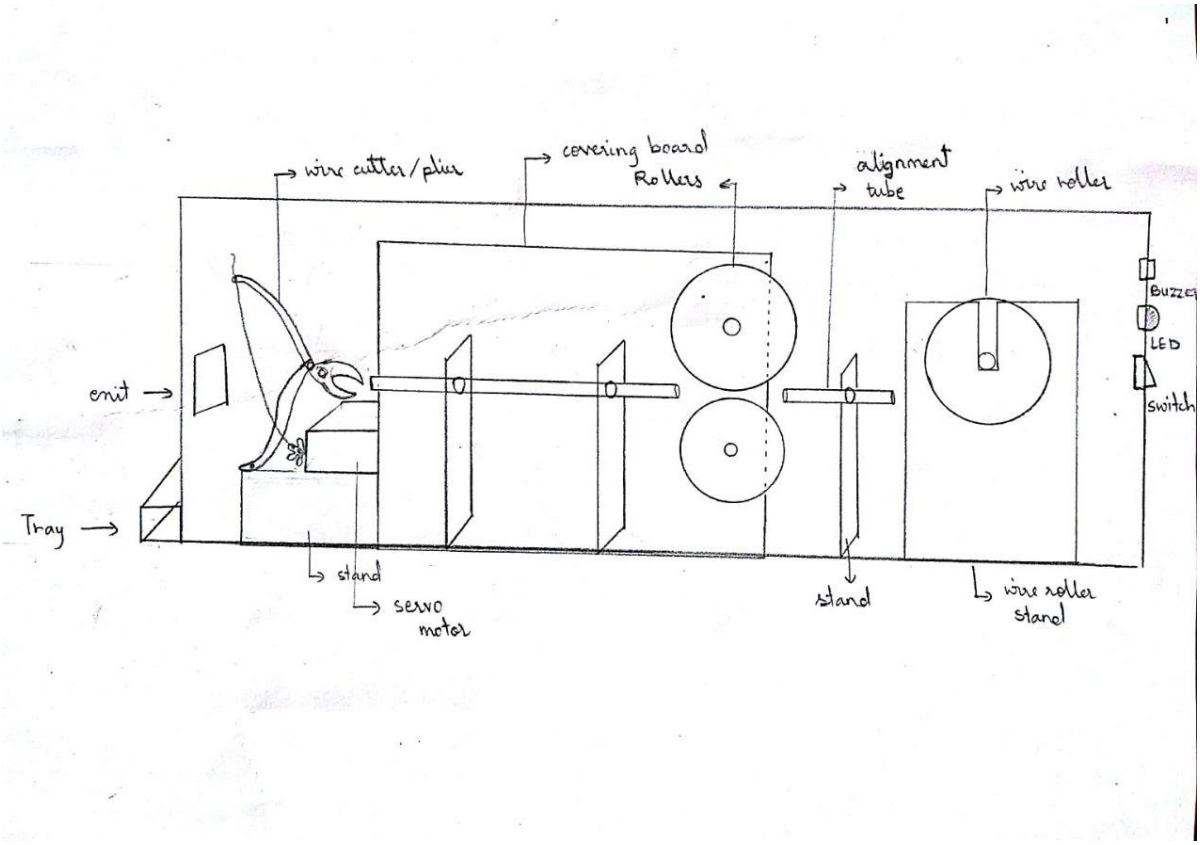
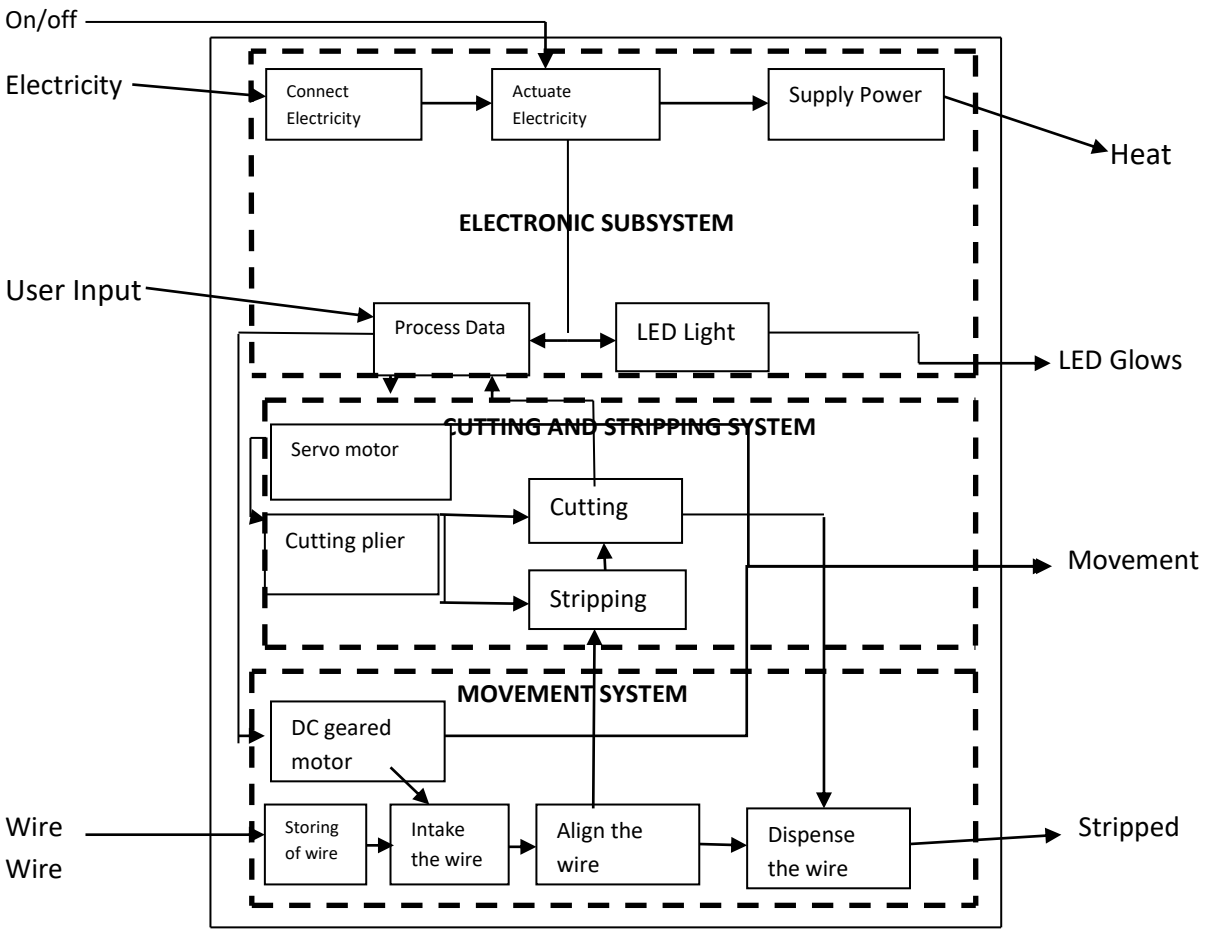


Figure 17 Selected concept design

4. Product Architecture

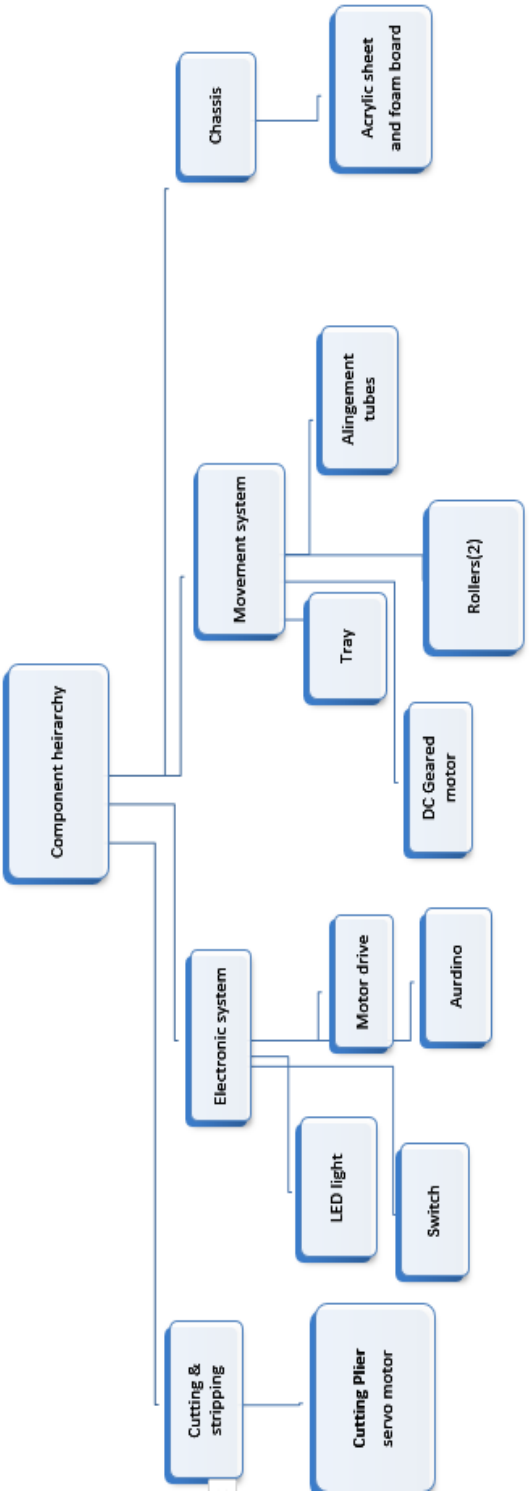
4.1. Glass box with clustering



4.2 Subsystems Identified

1. Cutting and Stripping system
2. Movement system
3. Electronic System

4.3. Component Hierarchy



4.4 Interaction Details

Table 16 interaction details

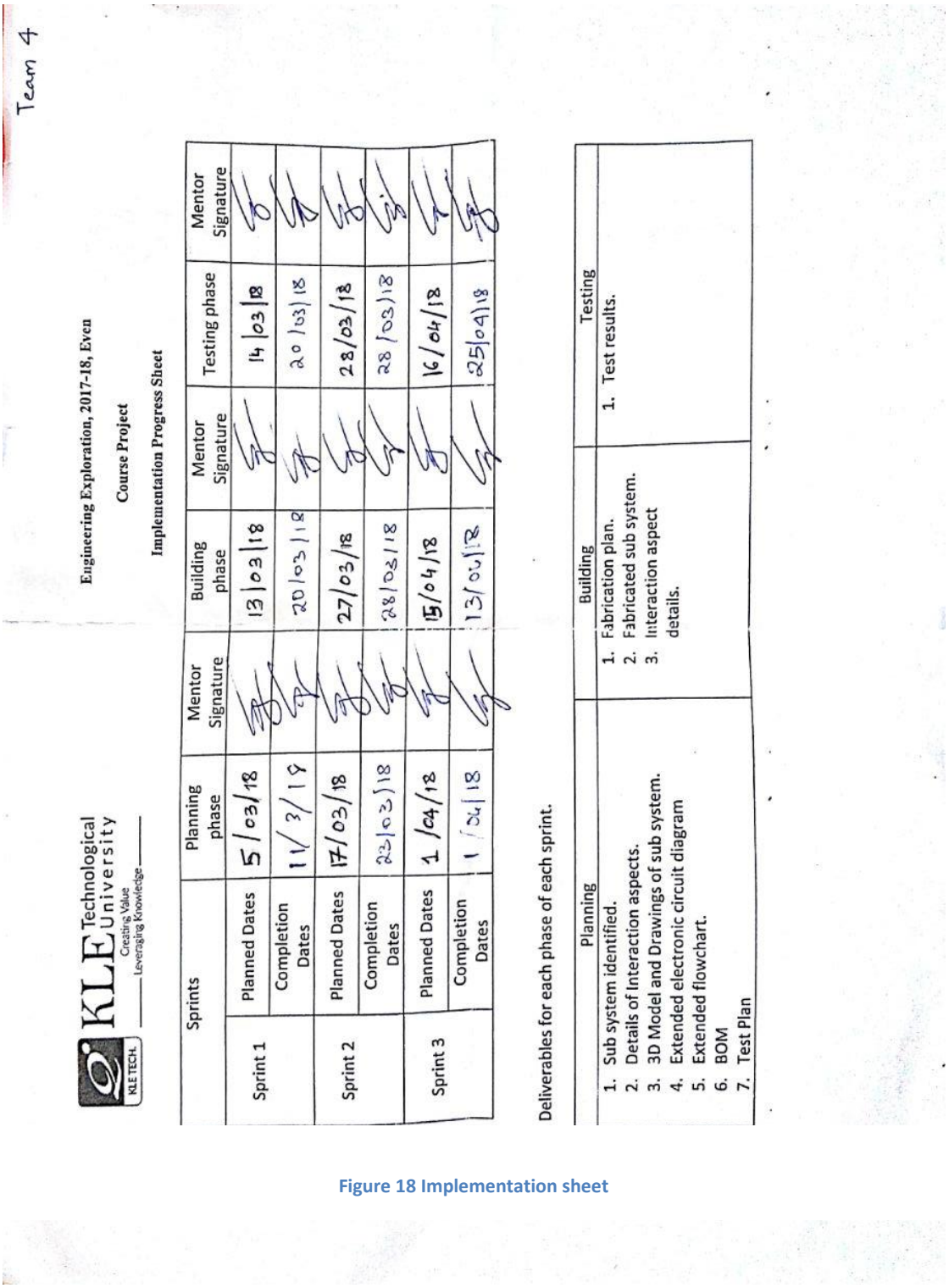
		Movement subsystem	Electronic subsystem
Cutting and stripping subsystem	Material Interaction	✓	X
	Data Interaction	X	✓
	Energy Interaction	X	X
	Spatial Interaction	X	X
Interactions There is material interaction between alignment subsystem and cutting and stripping subsystem when wire moves from rollers into the plier. The electronic subsystem(arduino) gives command to the servo motor when to strip and cut the wire			

		Cutting and stripping subsystem	Electronic subsystem
Movement subsystem	Material Interaction	✓	X
	Data Interaction	X	✓
	Energy Interaction	X	X
	Spatial Interaction	X	X
The wire moves from alignment subsystem and cutting and stripping subsystem therefore there is material interaction. The Electronic system controls the motion of the rollers so that the wire can be fed with precision. Therefore there is data interaction between the movement subsystem and the alignment subsystem.			

		Cutting and stripping subsystem	Movement subsystem
Electronic subsystem	Material Interaction	X	X
	Data Interaction	✓	✓
	Energy Interaction	X	X
	Spatial Interaction	X	X
There is data interaction between the cutting and stripping subsystem for the movement of the cutting plier. The data regarding completion of process received by the electronic system and the indication when the bulb glows			

5. Implementation

5.1. Implementation Progress Sheet



Team 4

KLE Technological University
Creating Value
Leveraging Knowledge

Engineering Exploration, 2017-18, Even

Course Project

Implementation Progress Sheet

Sprints		Planning phase	Mentor Signature	Building phase	Mentor Signature	Testing phase	Mentor Signature
Sprint 1	Planned Dates	5/03/18		13/03/18		14/03/18	
	Completion Dates	11/3/18		20/03/18		20/03/18	
Sprint 2	Planned Dates	17/03/18		27/03/18		28/03/18	
	Completion Dates	23/03/18		28/03/18		28/03/18	
Sprint 3	Planned Dates	1/04/18		15/04/18		16/04/18	
	Completion Dates	1/04/18		13/04/18		25/04/18	

Deliverables for each phase of each sprint.

Planning	Building	Testing
1. Sub system identified. 2. Details of Interaction aspects. 3. 3D Model and Drawings of sub system. 4. Extended electronic circuit diagram 5. Extended flowchart. 6. BOM 7. Test Plan	1. Fabrication plan. 2. Fabricated sub system. 3. Interaction aspect details.	1. Test results.

Figure 18 Implementation sheet

5.2 Sprint 1

5.2.1 3D model and Drawings of the Sub System 1

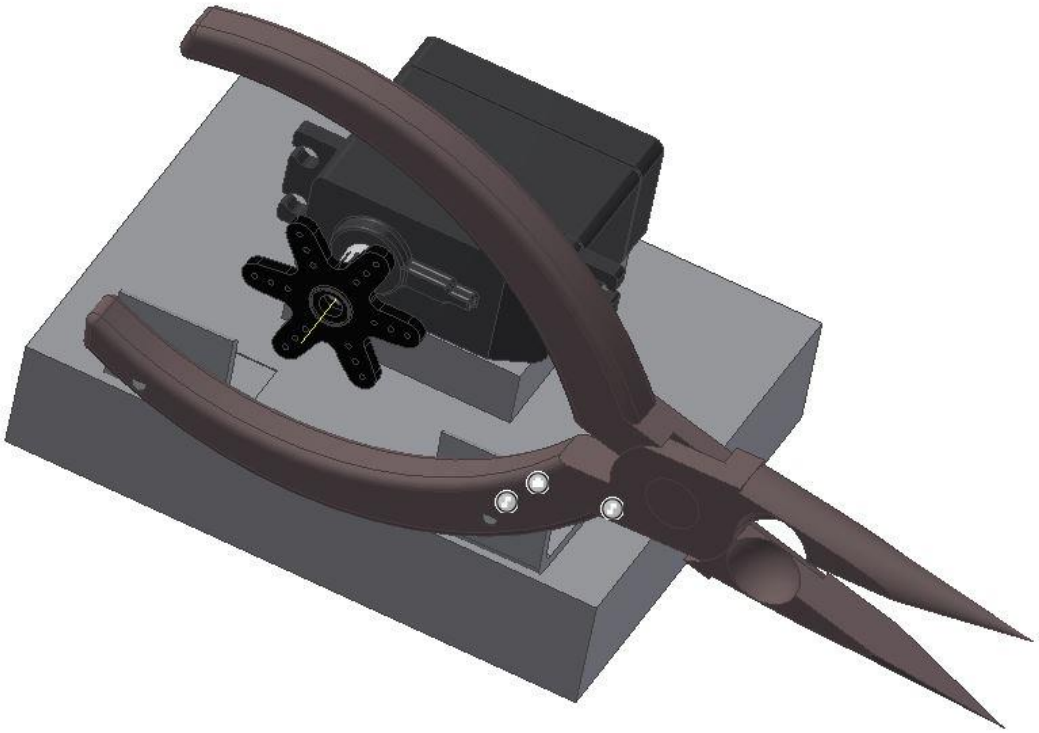


Figure 19 3D model of sprint 1

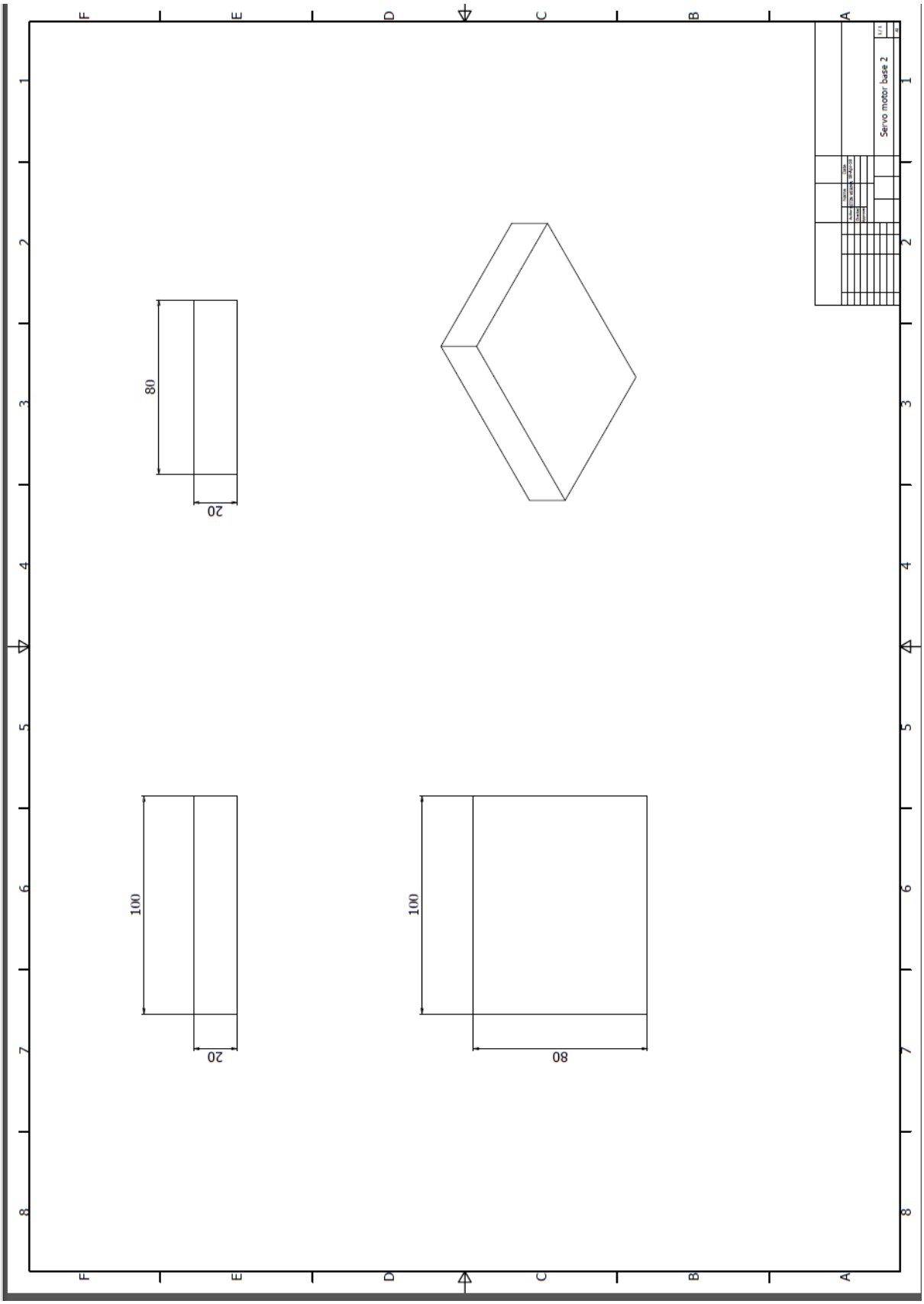


Figure 20 Base for the cutting plier

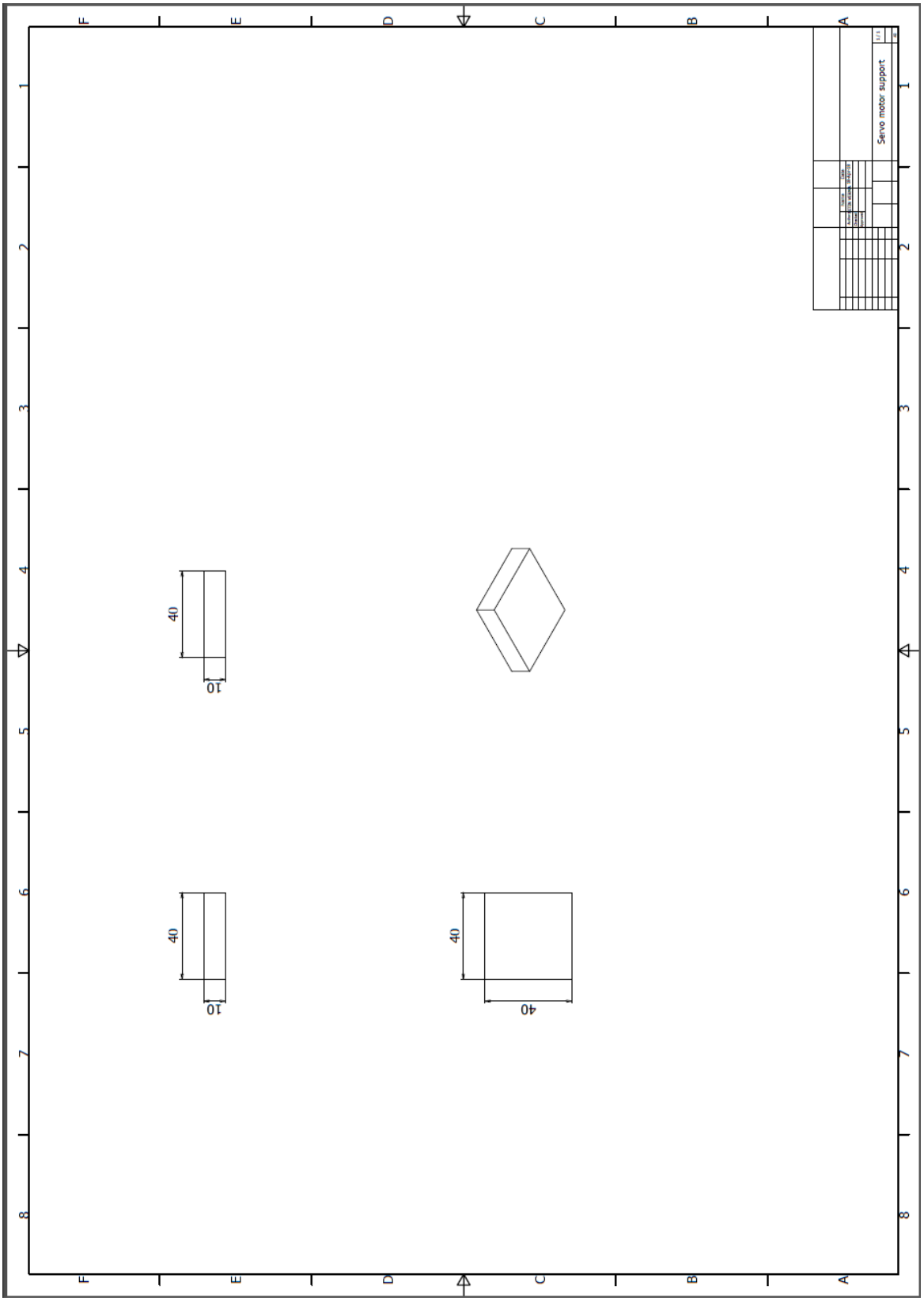


Figure 21 Small component to increase height of motor

5.2.2. Bill of Materials

Table 17 Sprint 1 BOM

Sl.no	PART NAME	MATERIAL WITH WHICH THE PART IS MADE OF	DESCRIPTION ABOUT PART	QUANTITY	FABRICATION PROCESS REQUIRED
1	Stand of servo motor	Foam board	1.2cm thick,5cm long,7cm width	1	Hex blade
3	Stand of subsystem	Foam board	10cm length 20cm height 3mm thick	1	Hex blade
2	U shape clamp	___	3'' size	1	----
4	Cutting plier	__	Standard sized	1	---
4	Servo motor	___	4.8V- 6V	1	_____
5	Micro controller	___	Arduino mega 2560	1	_____
6	Nuts	--	16 -6mm length and 3mm diameter	2	---
7	Bolts	--	2 -25mm length and 3mm diameter	2	---
8	Jumper cables	--	male to male, male to female	5	__
9	Nylon thread	--	8cm length	1	__

5.2.3. Electrical/Electronic Circuit Diagram

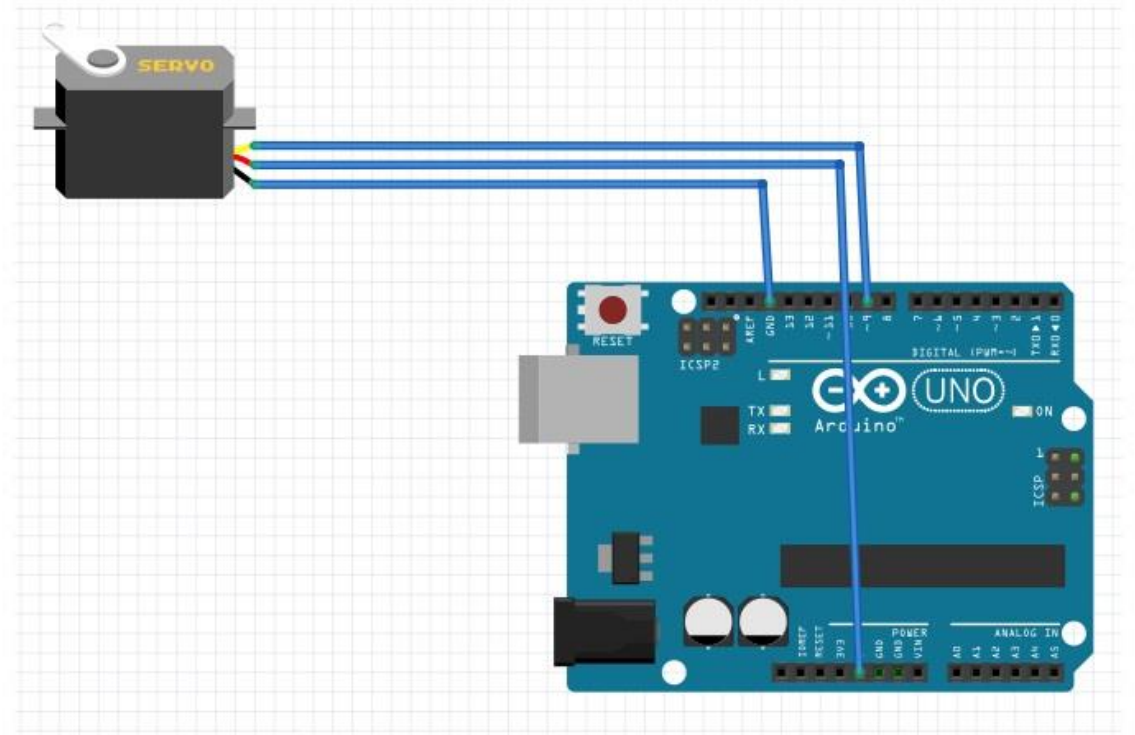


Figure 22 Sprint 1 electronic circuit

5.2.4. Flowchart

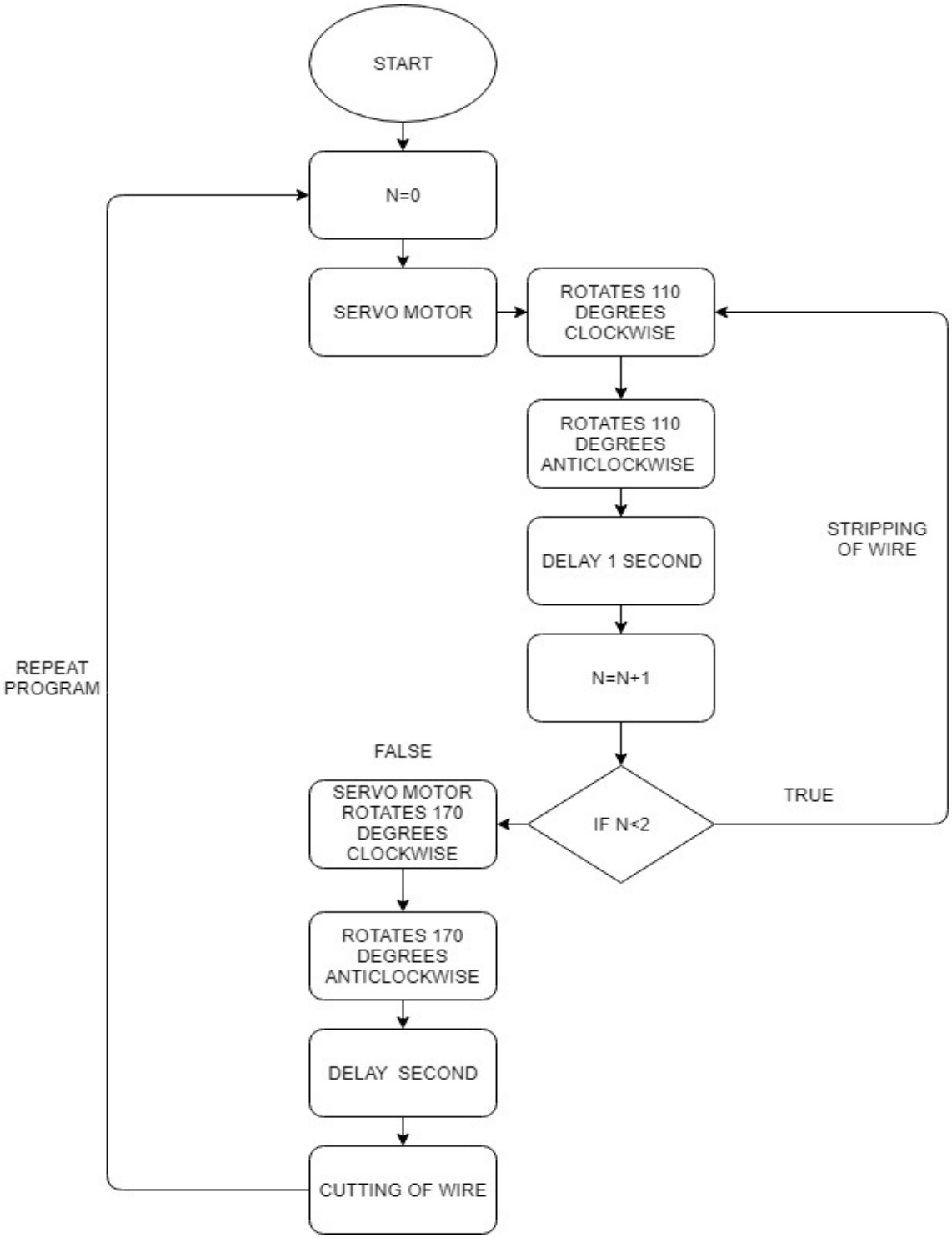


Figure 23 Sprint 1 flowchart

5.2.5. Test Plan

When the switch is turned on, the servo motor receives the signal from arduino which specifies the rotation angle as 110 degrees, hence stripping the wire. Within a delay of 1 second, the plier again stripes the wire again at certain length. For cutting of the wire, the servo is rotated at 170 degrees by the micro controller. This whole process is repeated once the cutting of wire is done. The output of this result is a wire cut of specific length and stripped at its both ends.

5.2.6. Fabricated Sub System:

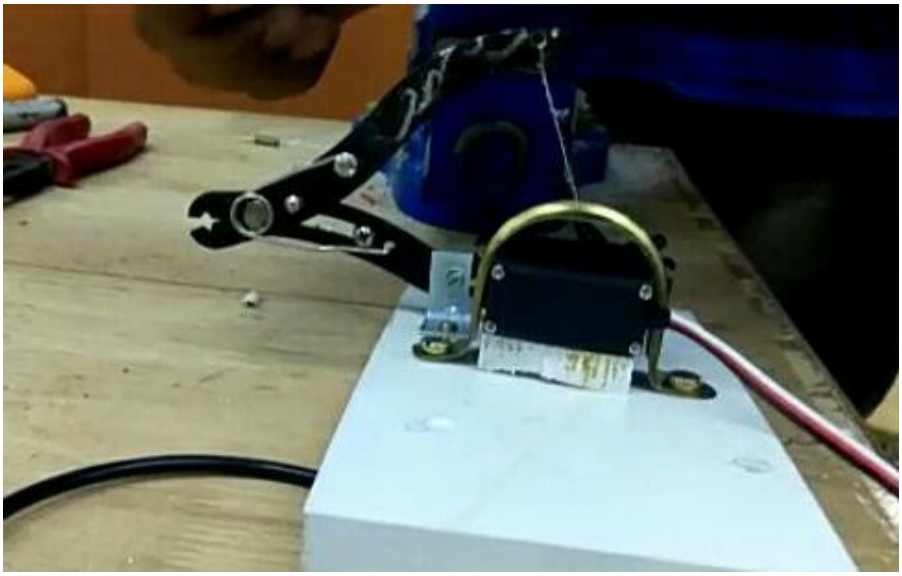


Figure 24 Fabricated sprint1 image

5.2.7. Test Results

A 12V adapter is used to test the working of sub system, the testing is achieved by connecting the adapter to the motor and feeding a proper program to the arduino. The test result delivered a cut and stripped wire of required length.

5.3. Sprint 2

5.3.1 3D model and Drawings of the Sub System 1 and 2

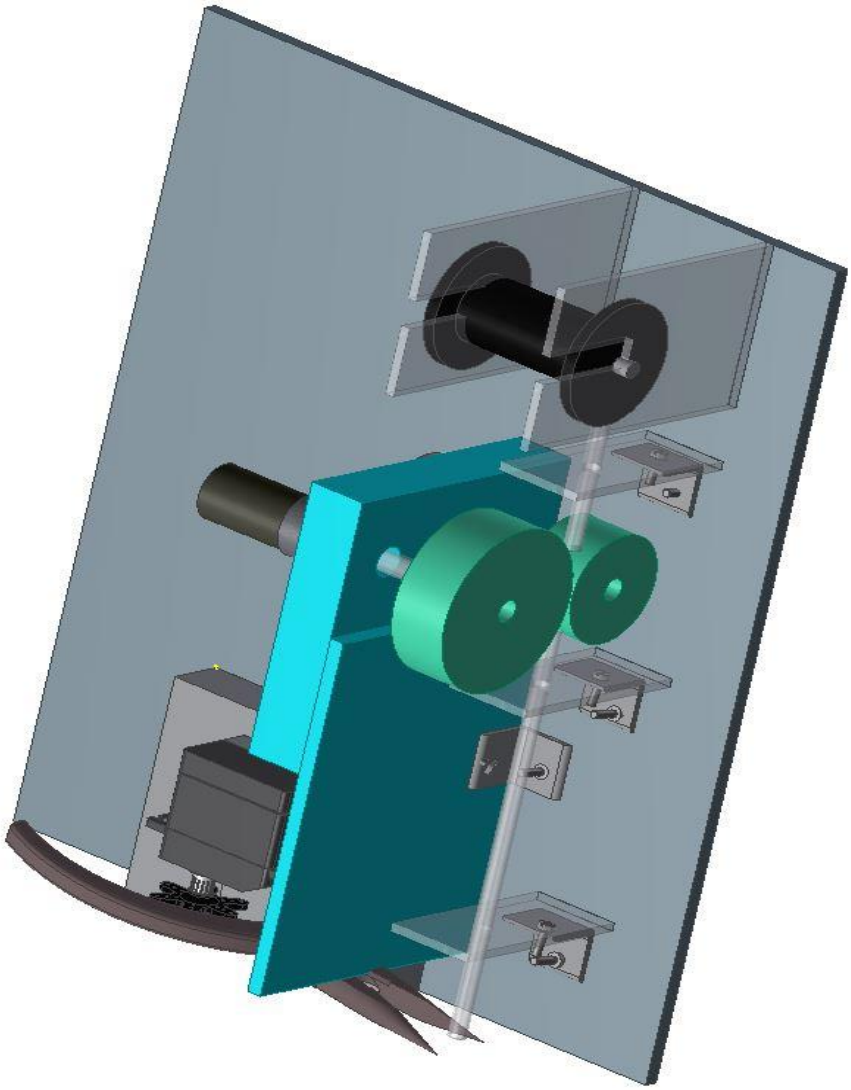


Figure 25 3D model of sprint 2

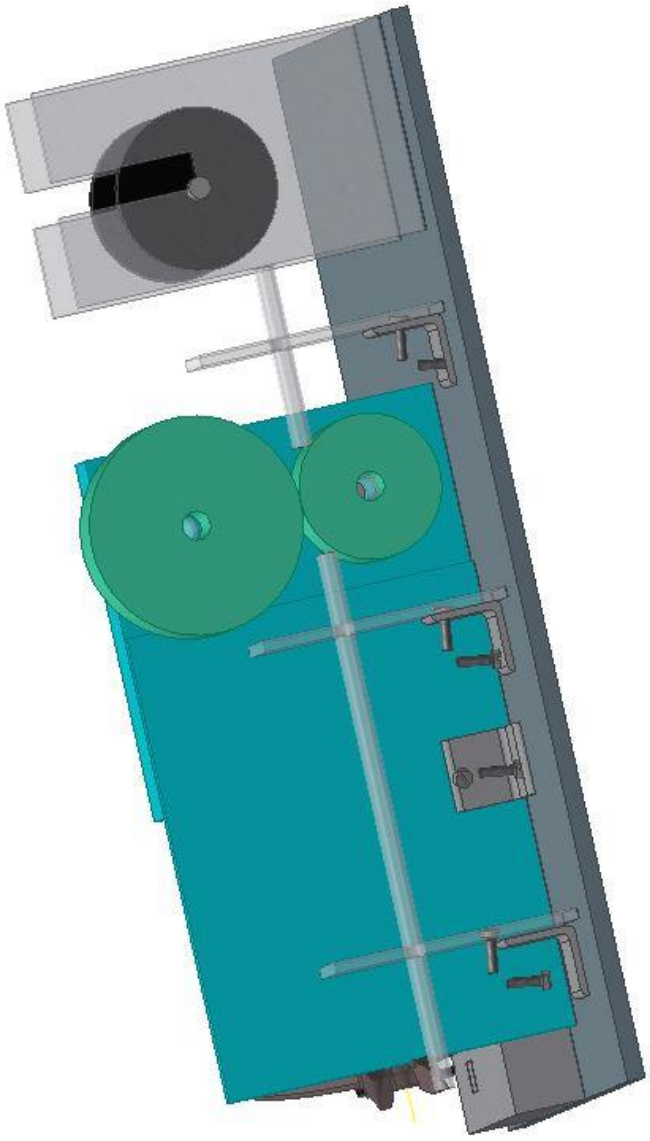


Figure 26 3D model of sprint 2 image 2

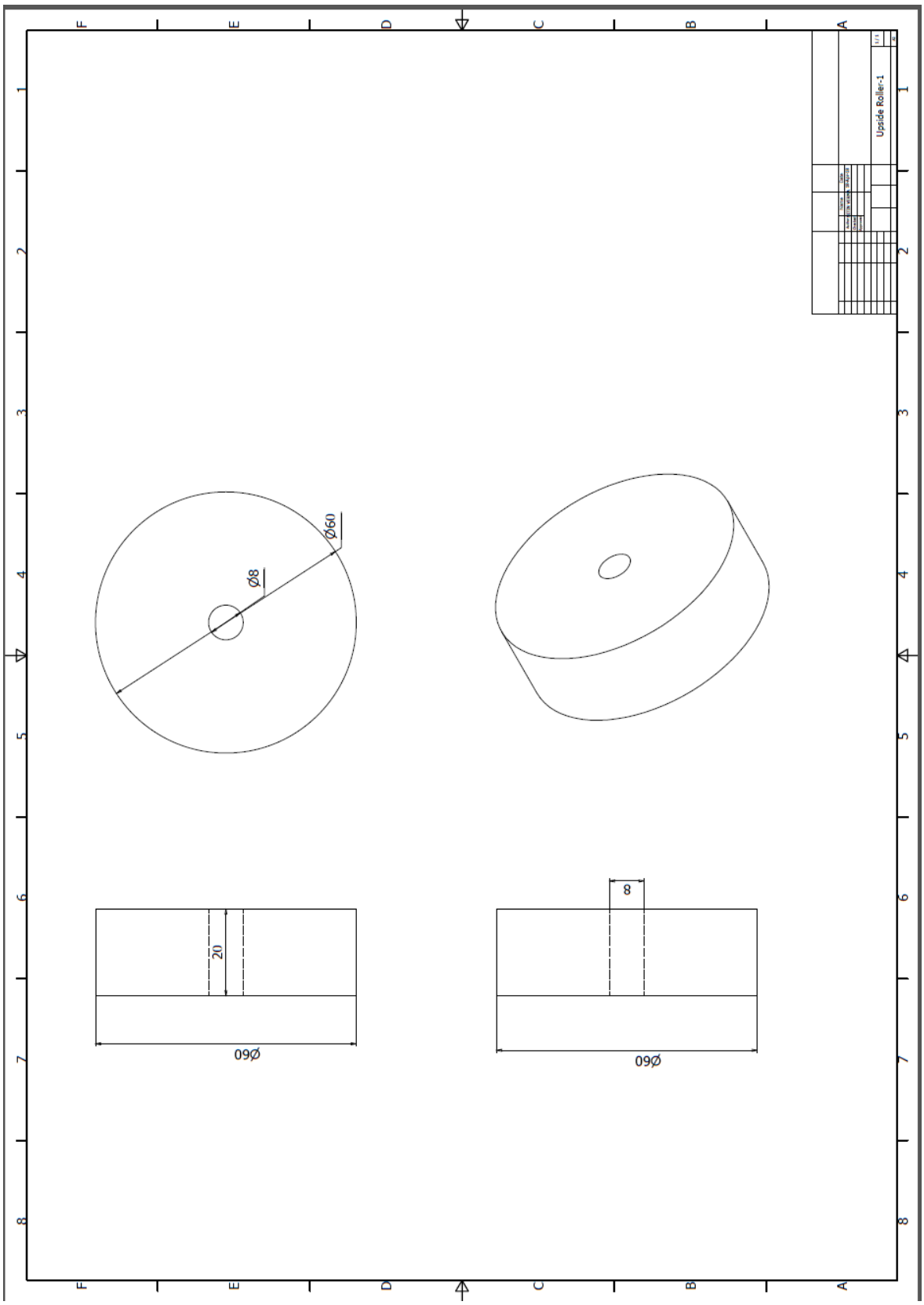


Figure 27 60mm diameter roller

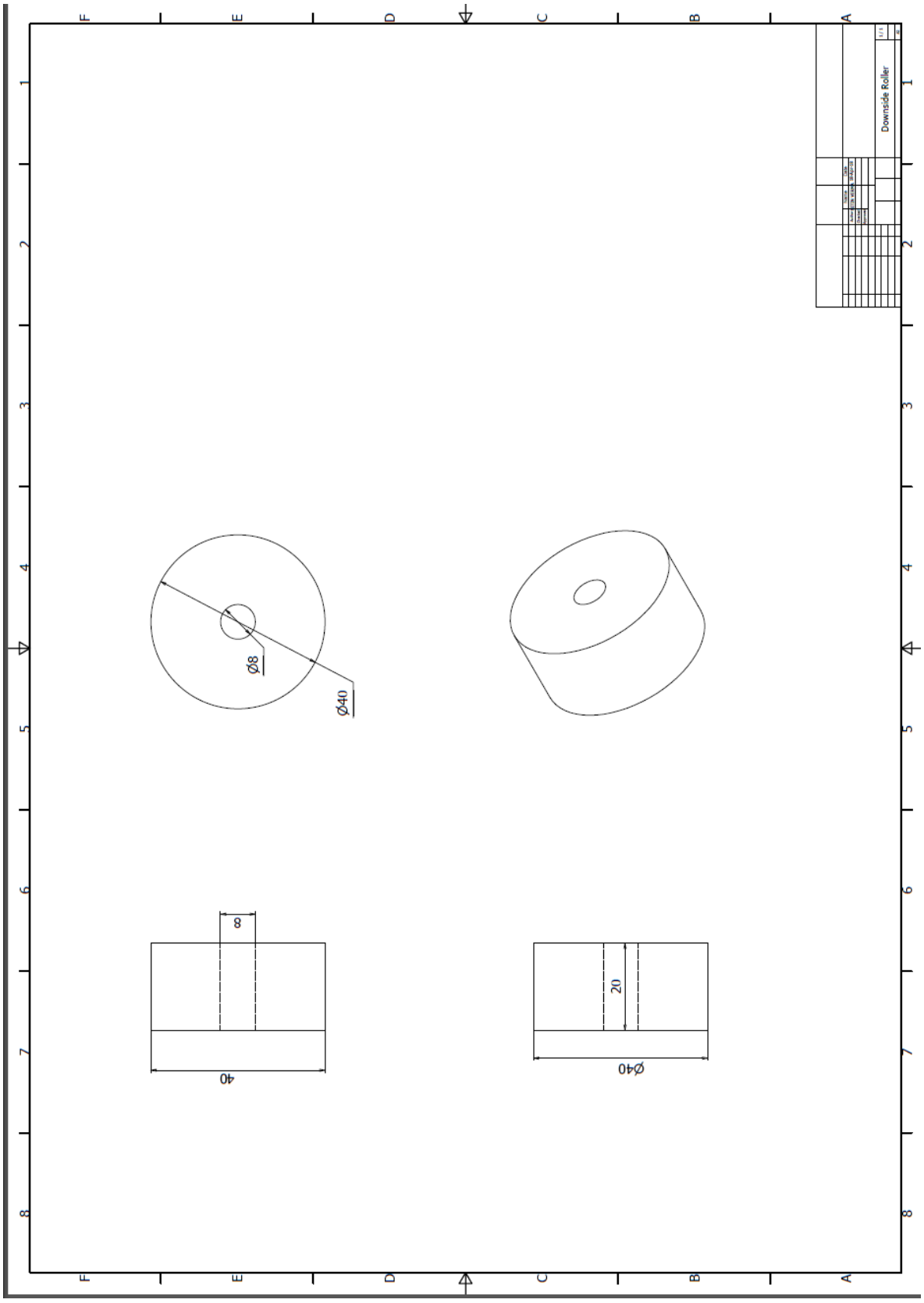


Figure 28 40mm diameter roller

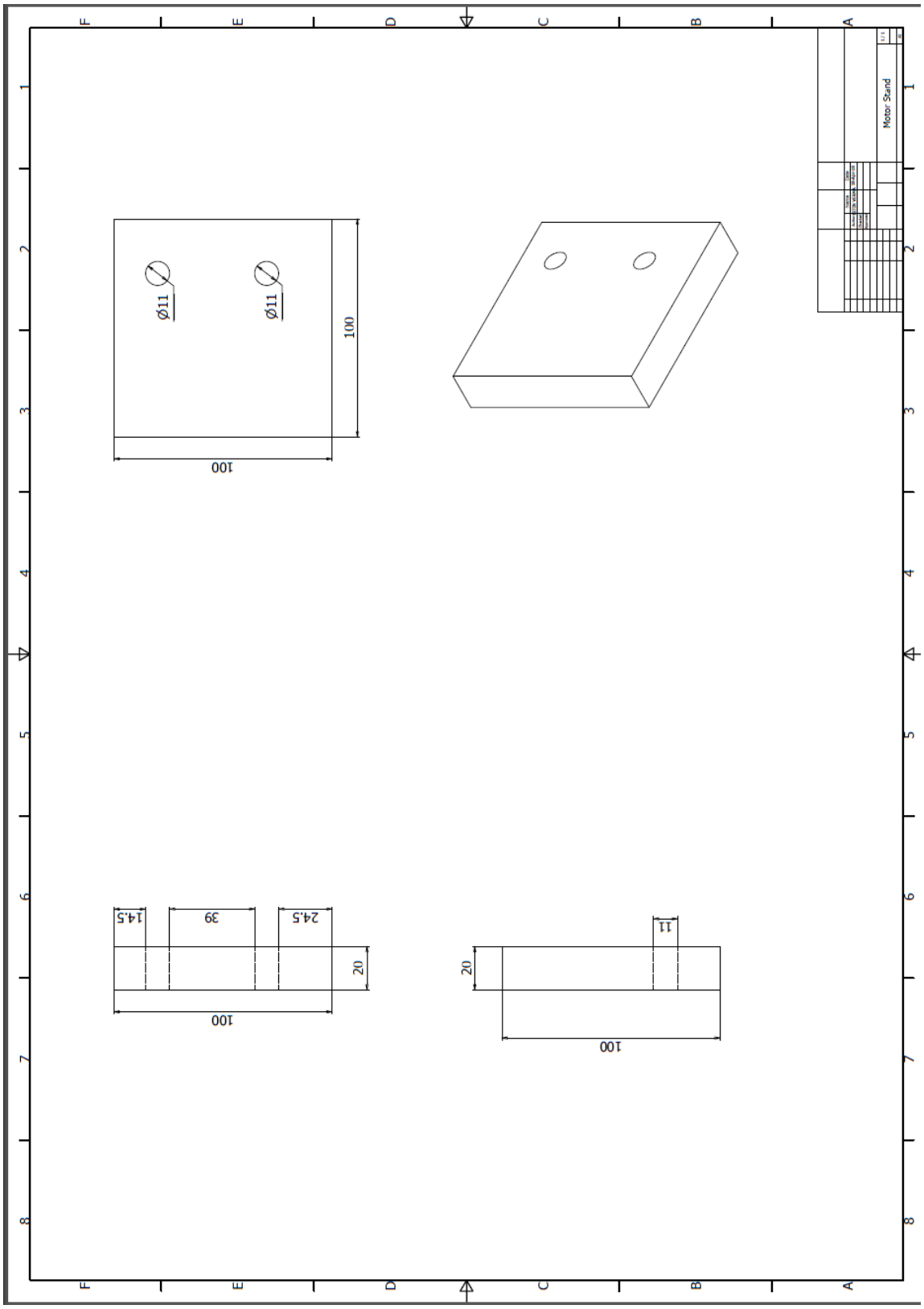


Figure 29 A stand for rollers

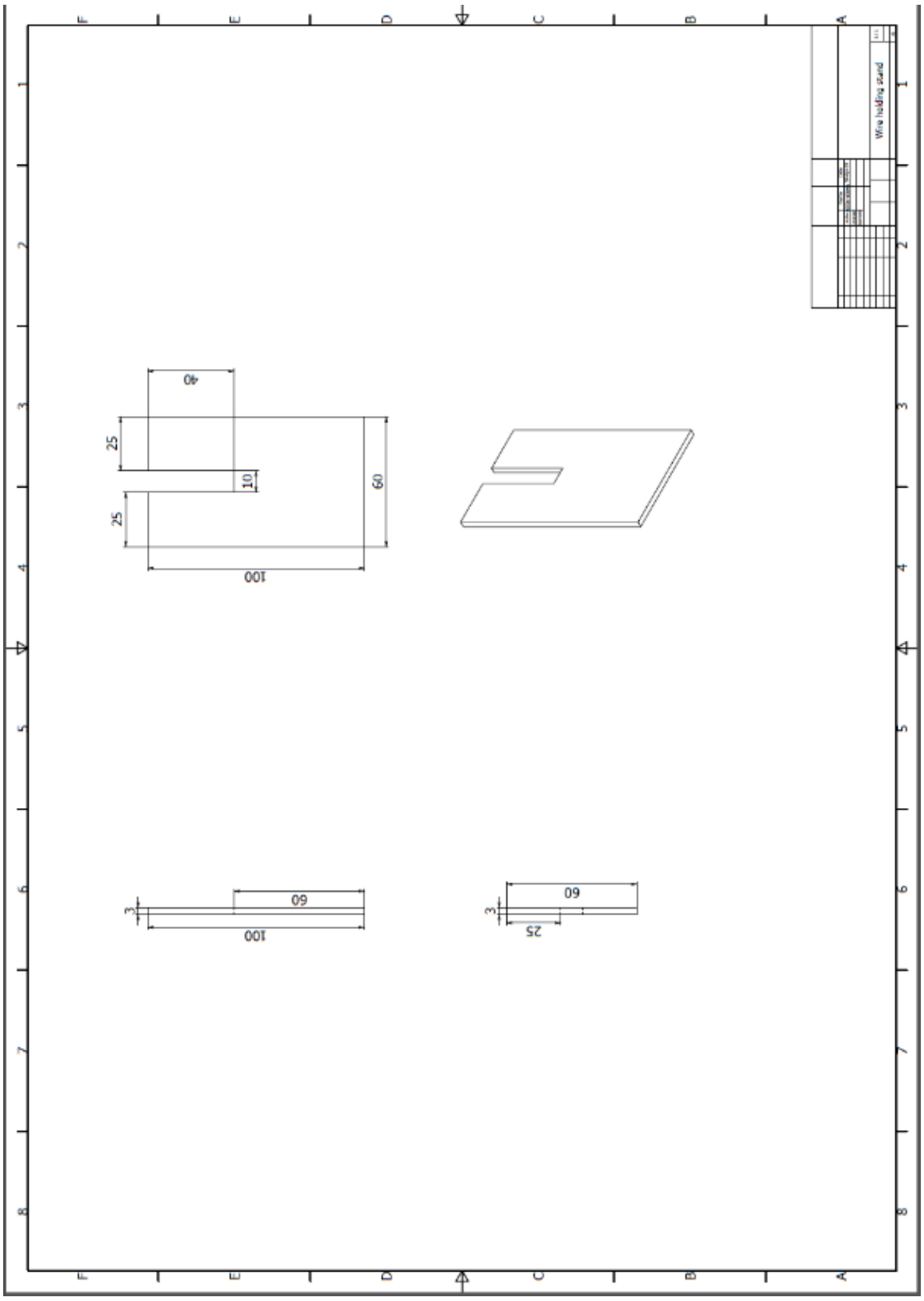


Figure 30 A stand for wire rollers

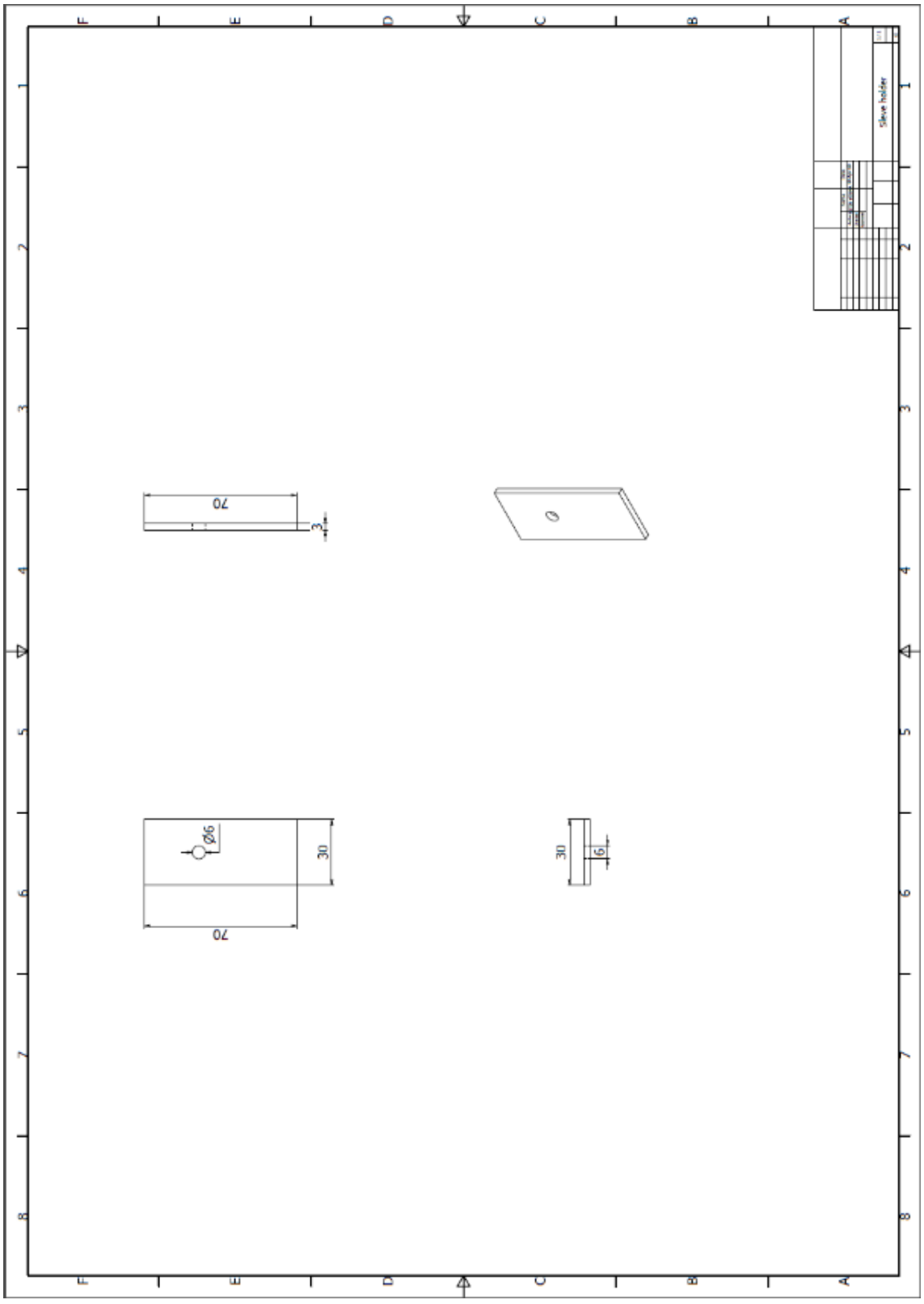


Figure 31 Alignment tube holder

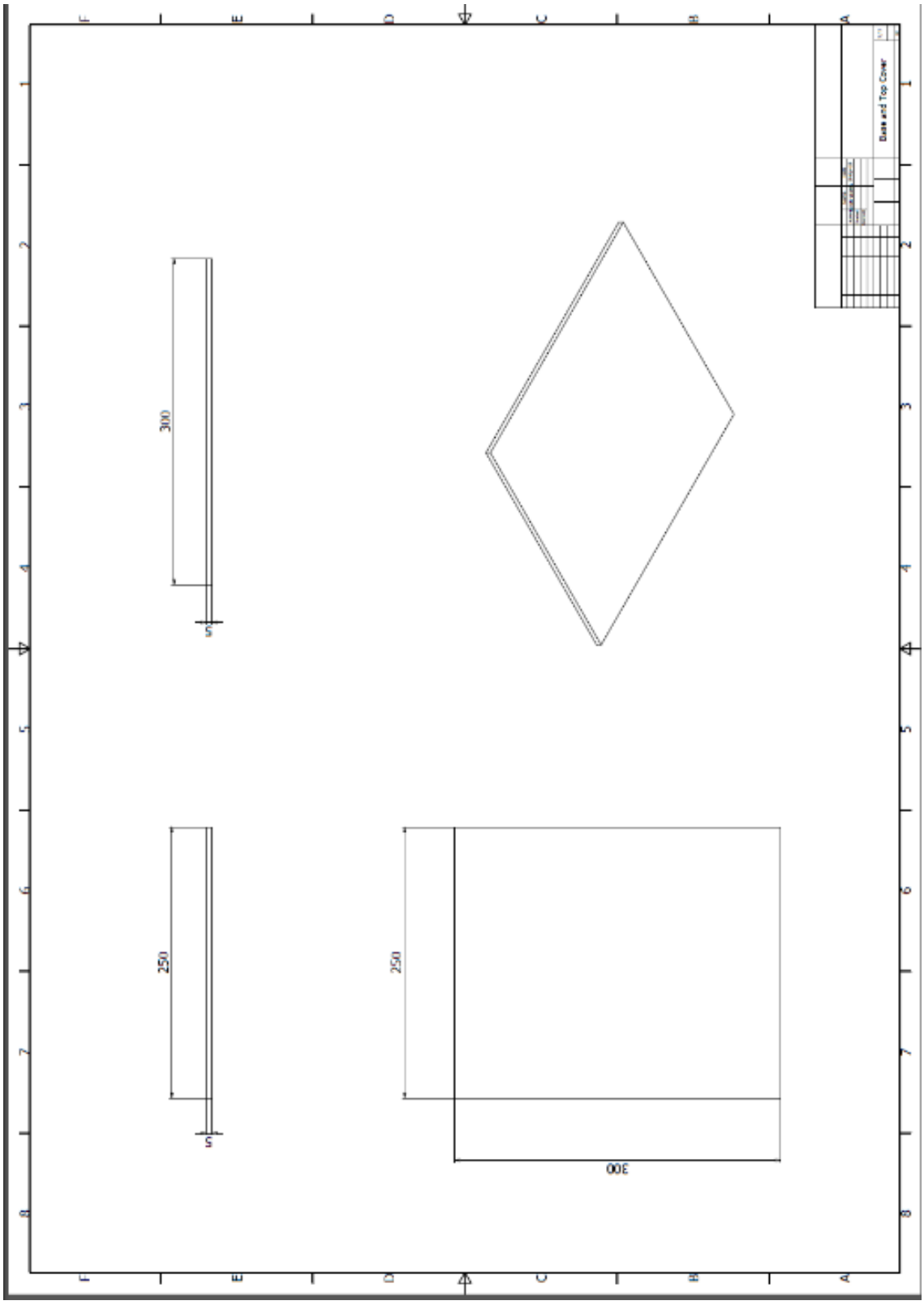


Figure 32 Base of the machine

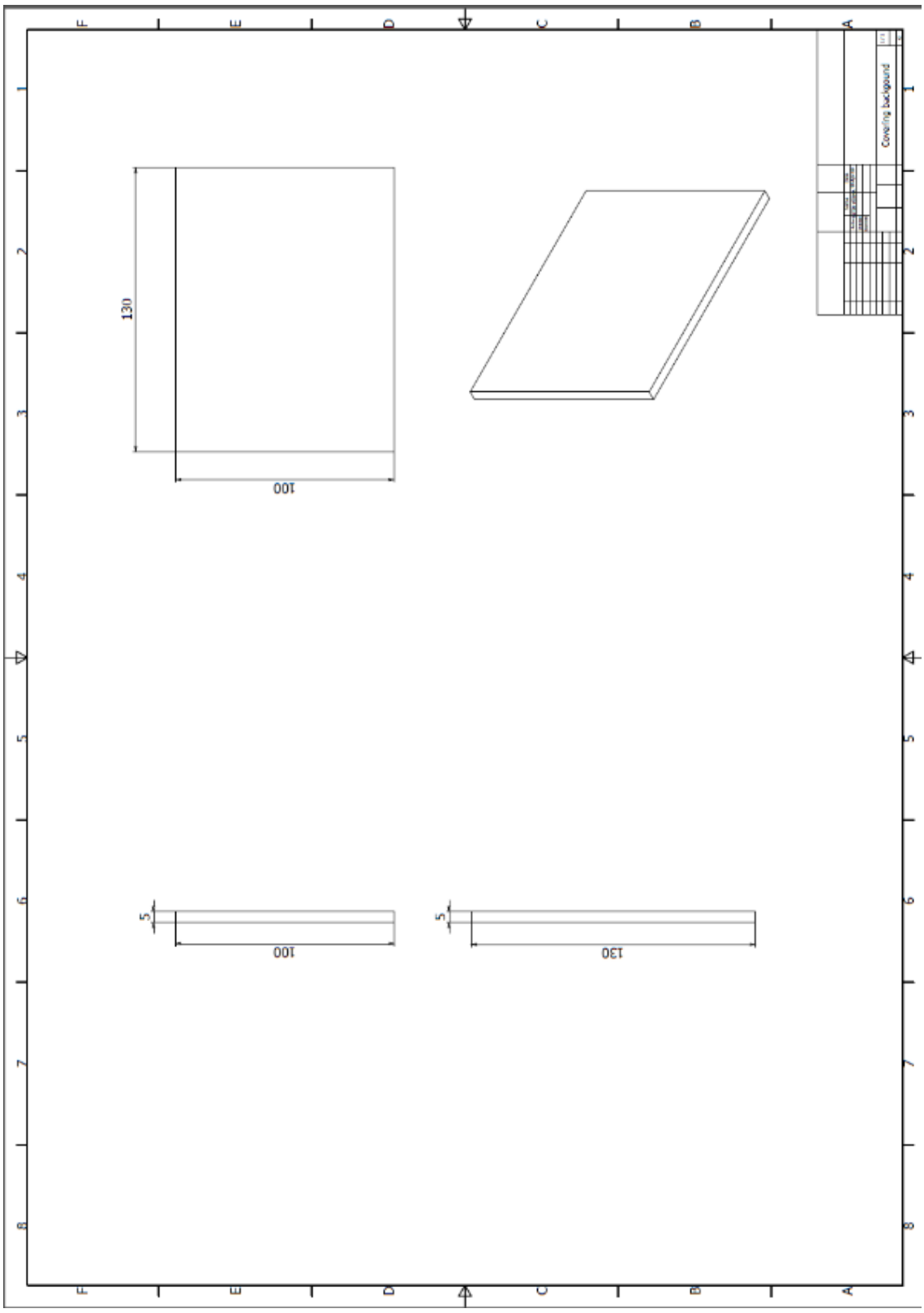


Figure 33 A covering board for the motor

5.2.2. Bill of Materials

Table 18 Sprint 2 BOM

Sl.no	PART NAME	MATERIAL WITH WHICH THE PART IS MADE OF	DESCRIPTION ABOUT PART	QUANTITY	FABRICATION PROCESS REQUIRED
1	Stand of servo motor	Foam board	1.2cm thick,5cm long,7cm width	1	Hex blade
3	Stand of subsystem	Foam board	10cm length 20cm height 3mm thick	1	Hex blade
2	U shape clamp	___	3'' size	1	----
4	Cutting plier	__	Standard sized	1	---
4	Servo motor	___	4.8V- 6V	1	_____
5	Micro controller	___	Arduino mega 2560	1	_____
6	Nuts	--	16 -6mm length and 3mm diameter	2	---
7	Bolts	--	2 -25mm length and 3mm diameter	2	---
8	Jumper cables	--	male to male, male to female	5	__
9	Nylon thread	--	8cm length	1	__

10	Rollers	Foam board	4cm diameter,2cm thickness	2	Cutting tool
11	DC geared motor	---	300 rpm	1	__
12	Rubber belt	__	12cm length,2cm width	2	__
13	Alignment tube	Nylon fiber	0.9cm diameter,25cm length	1	__
14	Stand for alignment tube	Acrylic sheet	5cm length,3cm width,4mm thickness	2	Laser cutting
15	Wire roller	__	5cm long	1	__
16	Stand for wire roller	Acrylic sheet	10cm long, 5cm width.	2	Laser cutting
17	Spacer	Nylon fiber	0.6cm diameter	2	__

5.3.3. Electrical/Electronic Circuit Diagram

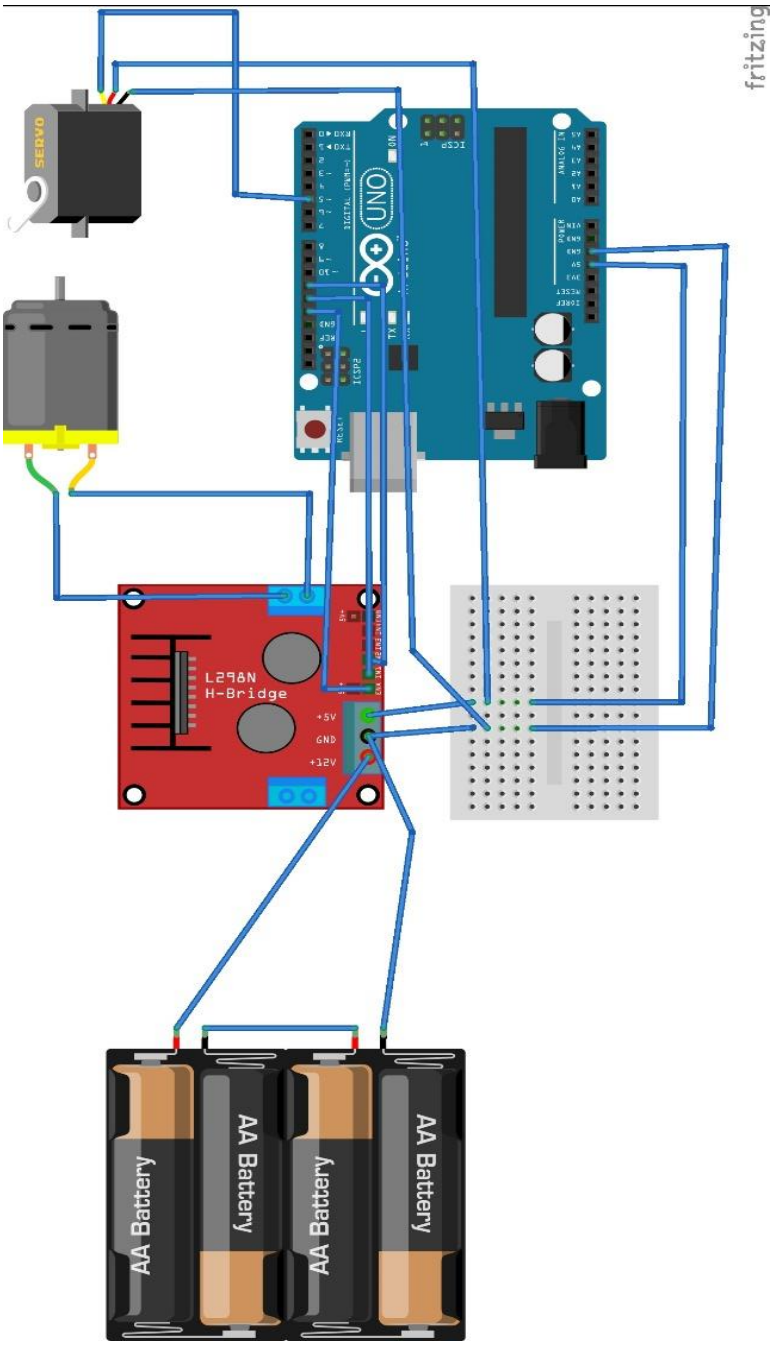


Figure 34 Circuit diagram of sprint 2

5.3.4. Flowchart

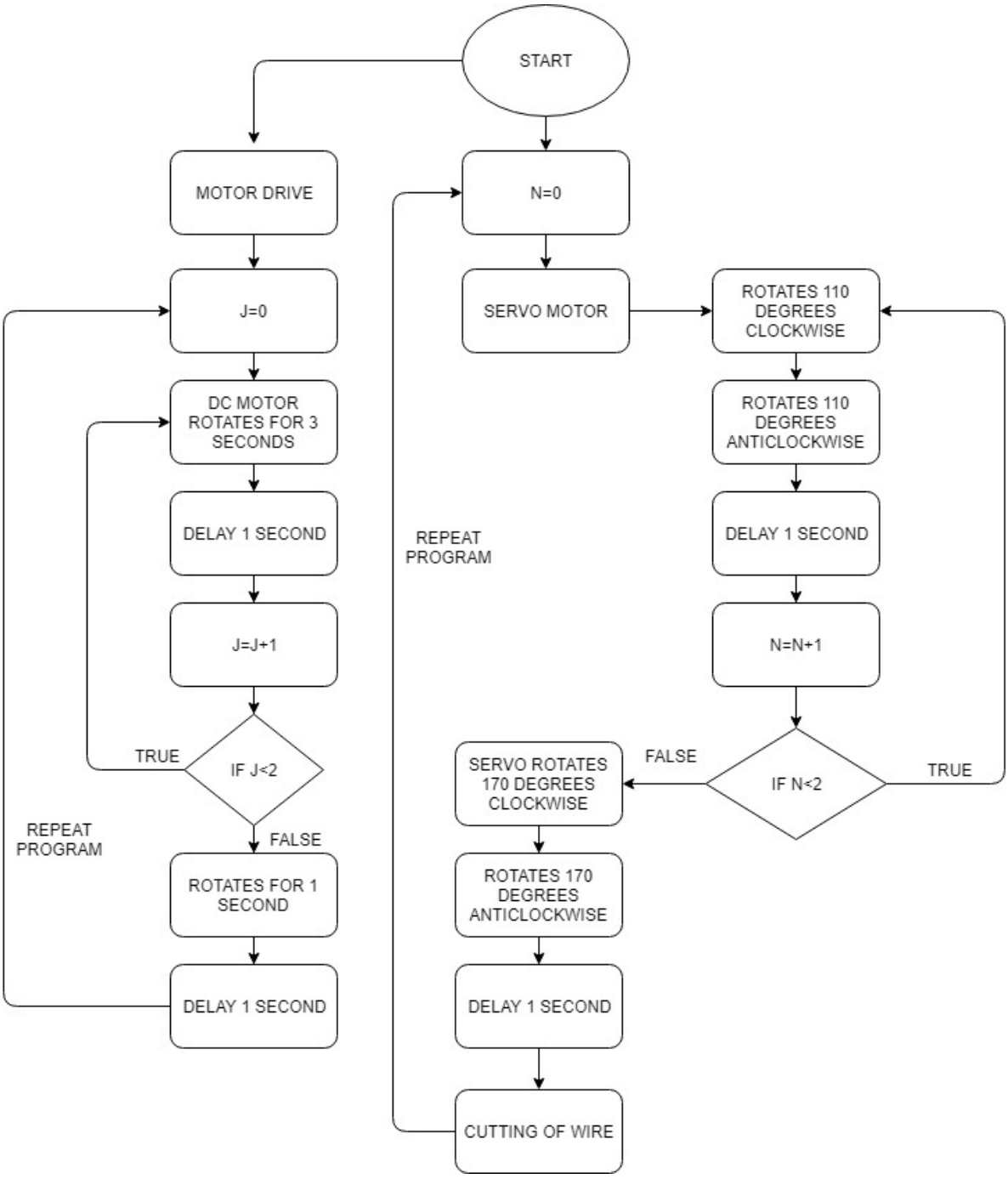


Figure 35 Flowchart of sprint 2

5.3.5. Test Plan

When the switch is turned on, the DC motors rotates the rollers which feeds in the wire, the arduino is programmed in such a way that the rollers stop just as the wire reaches the plier. The plier stripes and cuts the wire under the control of arduino.

5.3.6. Fabricated Sub System:

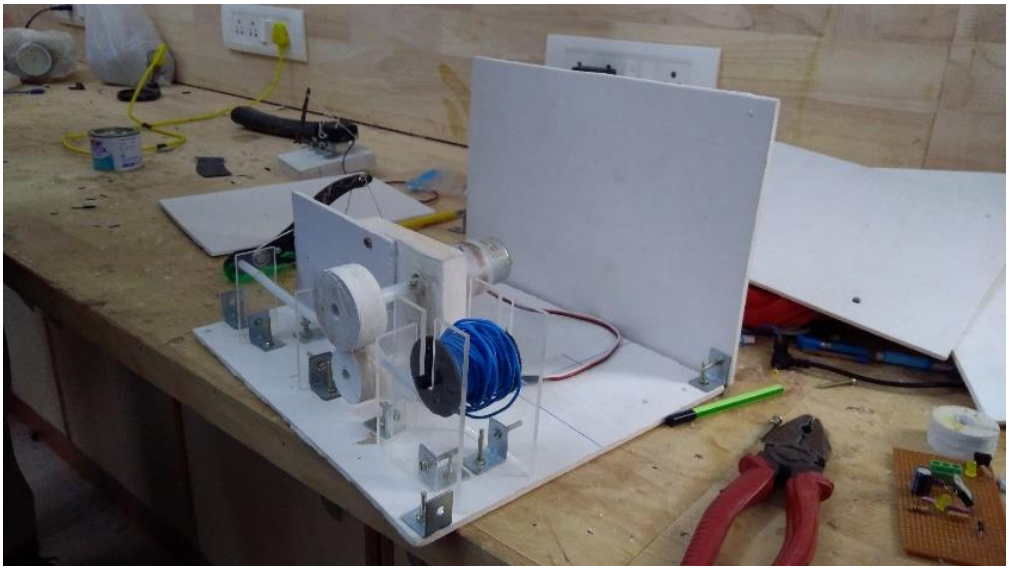


Figure 36 Sprint 2 model

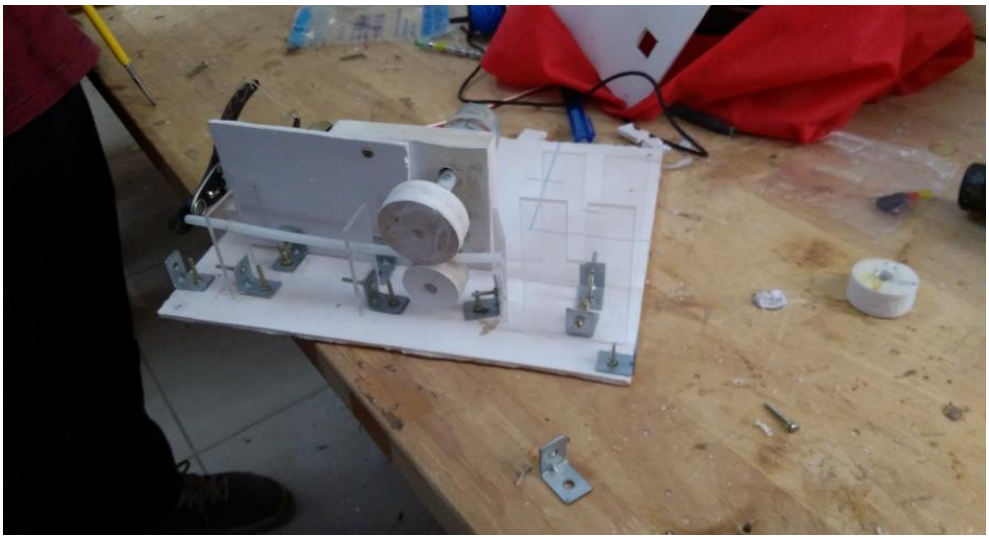


Figure 37 Sprint 2 subsystems

5.3.7. Test Results

The unit testing is done by connecting the 12V adapter to the arduino, the roller connected to the DC motor rotates which in turn turns the rollers. Due to the circular motion, the rollers feed in the wire. And when the system is integrated with the cutting plier, it is stripped and cut according the program fed. The end result is a cut and stripped wire fed through rollers.

5.4. Sprint 3

5.4.1 3D model and Drawings of entire System

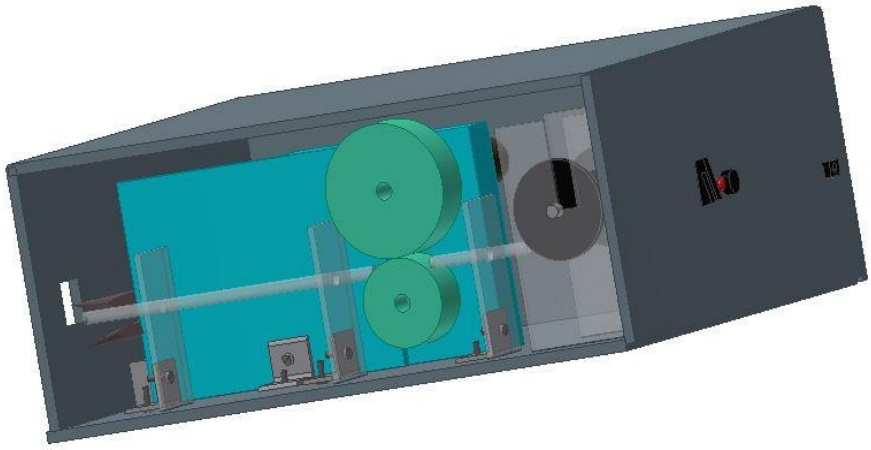


Figure 38 3D model of sprint 3

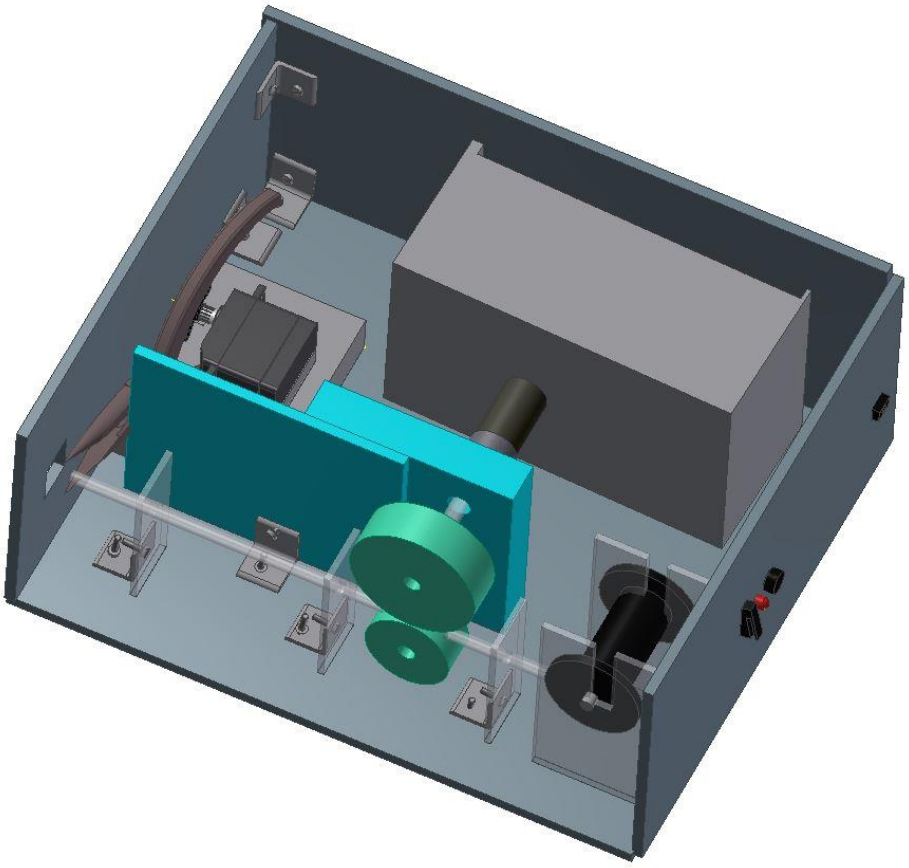


Figure 39 3D model sprint 3 [1]

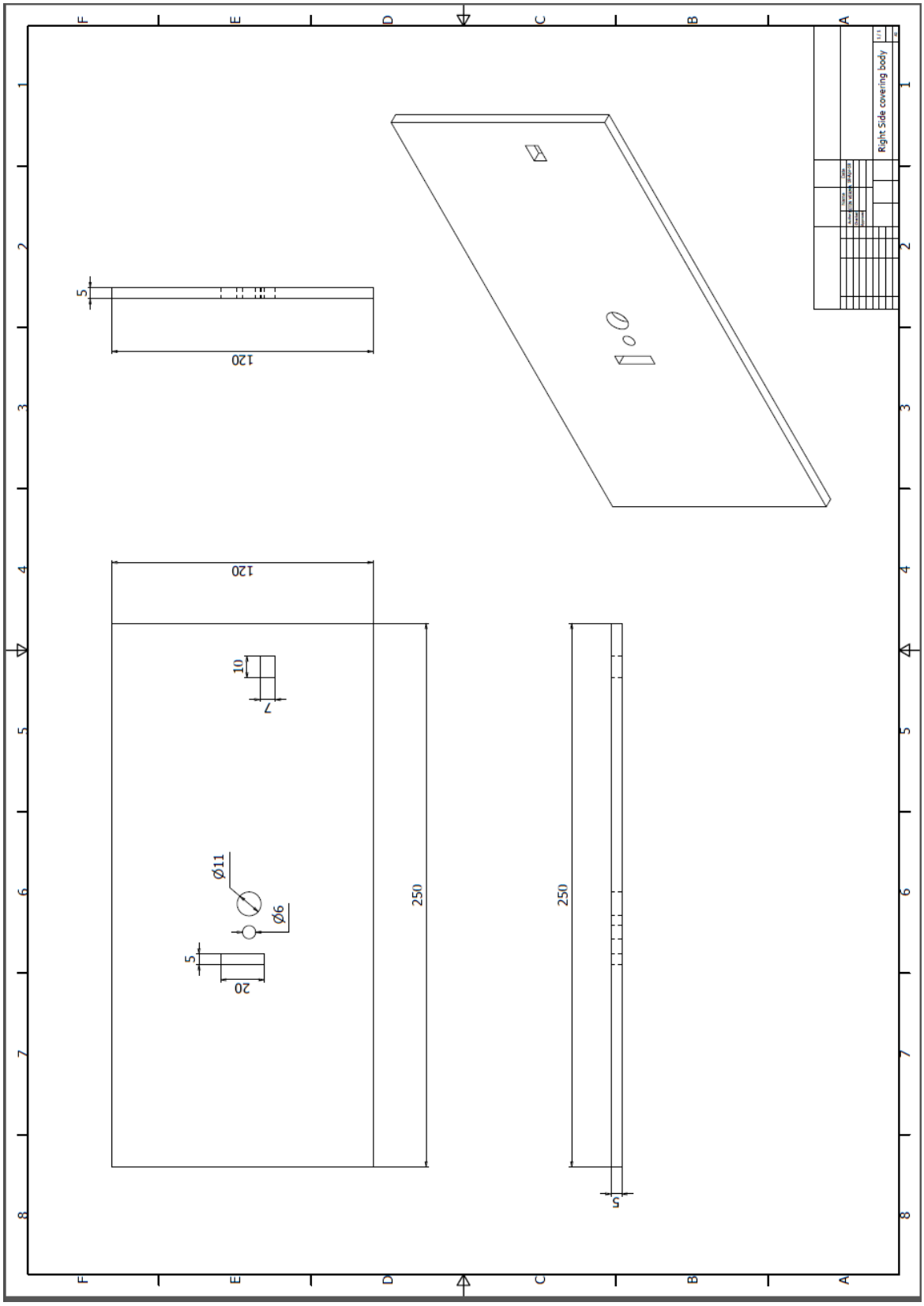


Figure 40 Entry slab

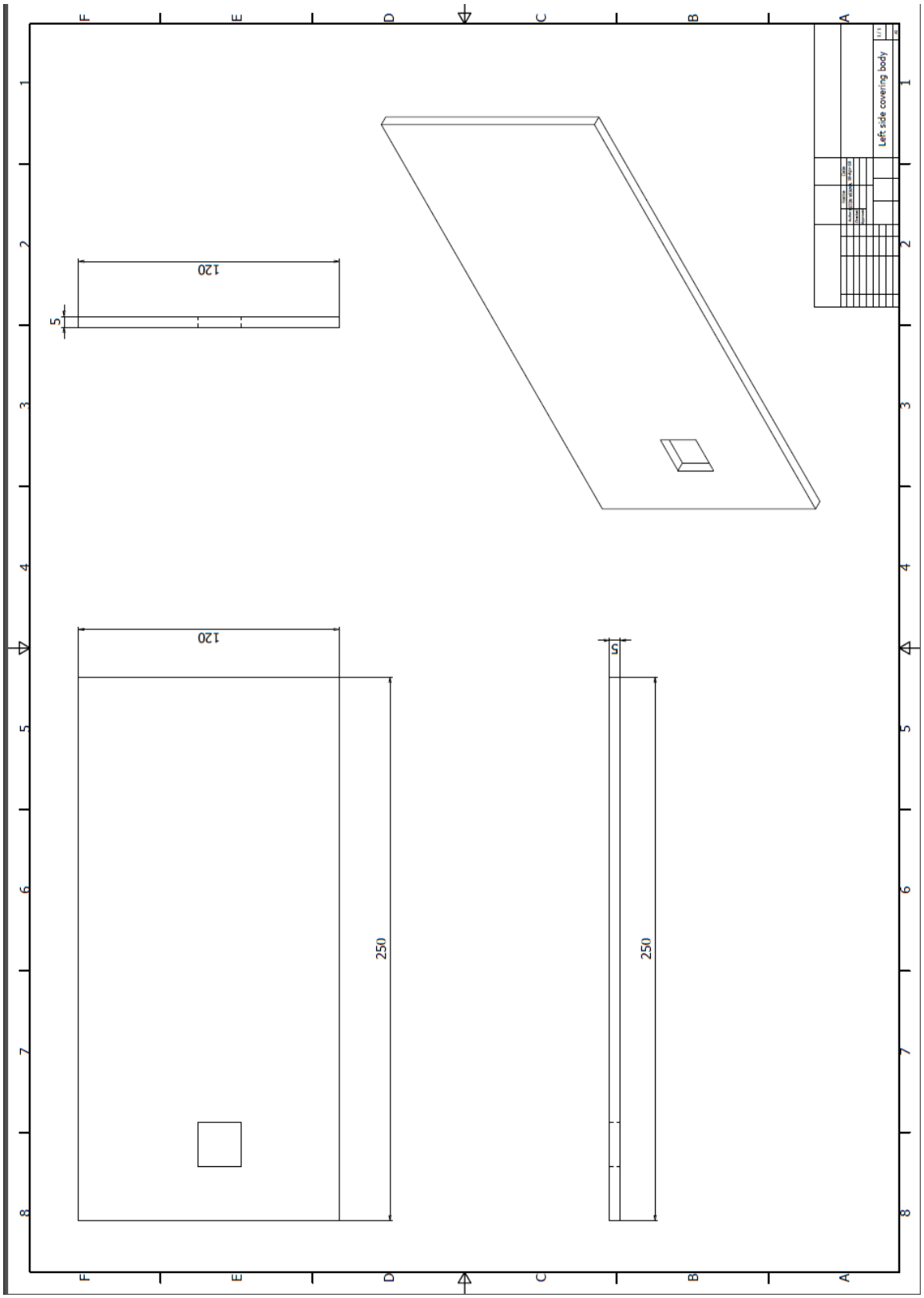


Figure 41 Exit board

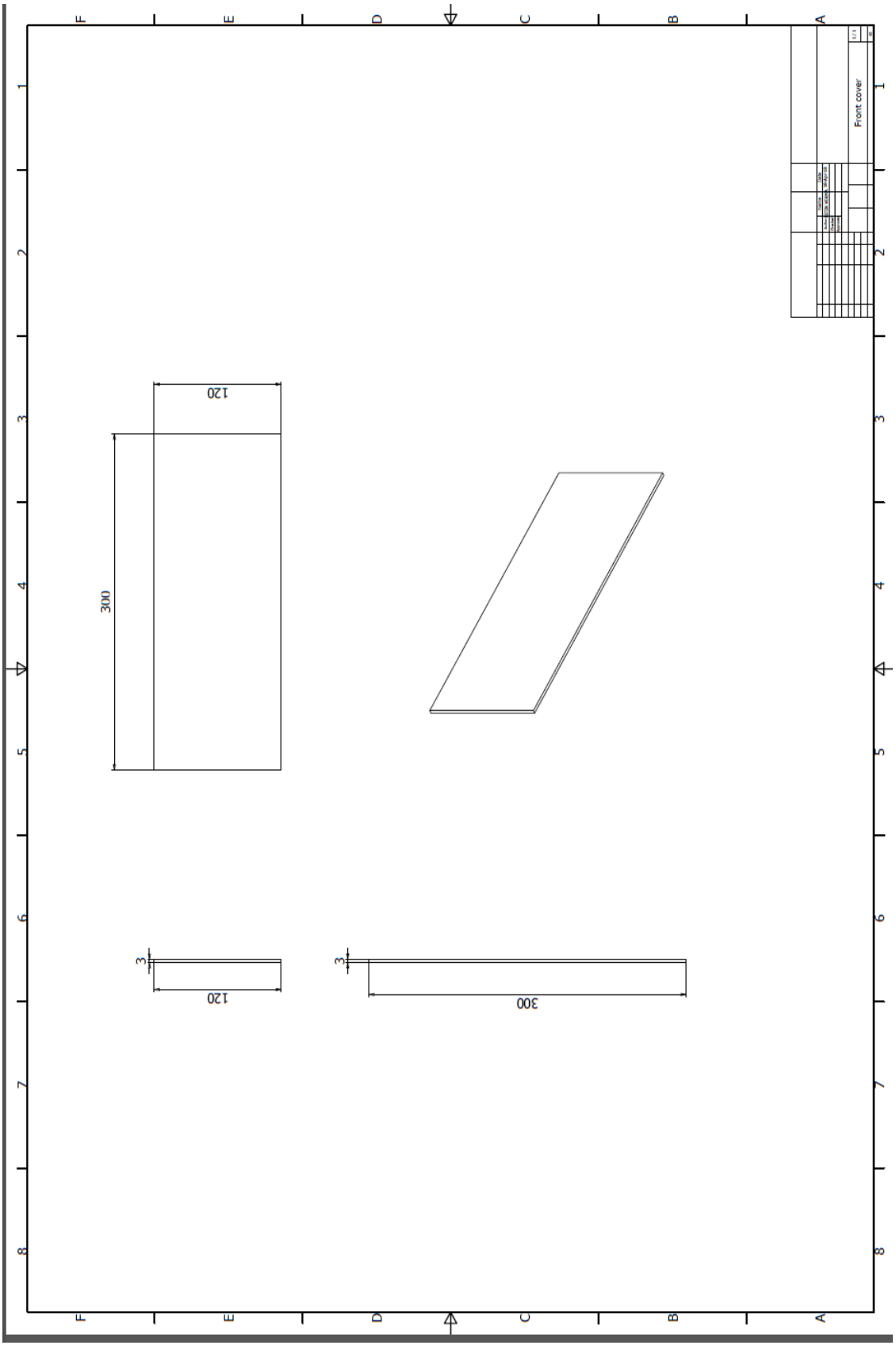


Figure 42 Front system enclosing slab

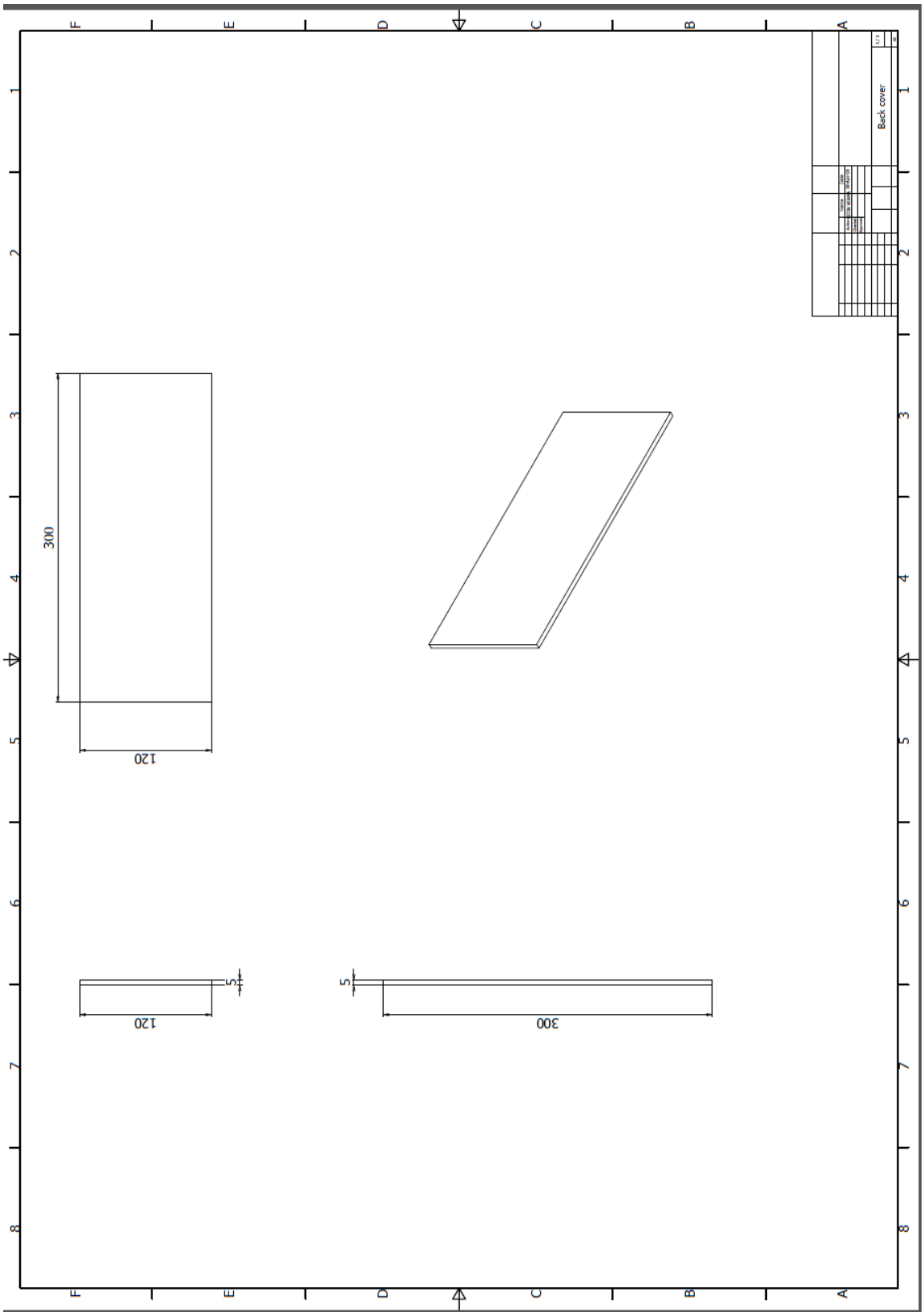


Figure 43 Back system enclosing slab

5.4.2. Bill of Materials

Table 19 Sprint 3 BOM

Sl.no	PART NAME	MATERIAL WITH WHICH THE PART IS MADE OF	DESCRIPTION ABOUT PART	QUANTITY	FABRICATION PROCESS REQUIRED
1	Stand of servo motor	Foam board	1.2cm thick,5cm long,7cm width	1	Hex blade
3	Stand of subsystem	Foam board	10cm length 20cm height 3mm thick	1	Hex blade
2	U shape clamp	___	3'' size	1	----
4	Cutting plier	__	Standard sized	1	---
4	Servo motor	___	4.8V- 6V	1	_____
5	Micro controller	___	Arduino mega 2560	1	_____
6	Nuts	--	16 -6mm length and 3mm diameter	2	---
7	Bolts	--	2 -25mm length and 3mm diameter	2	---
8	Jumper cables	--	male to male, male to female	5	__
9	Nylon thread	--	8cm length	1	__
10	Rollers	Foam board	4cm diameter,2cm thickness	2	Cutting tool
11	DC geared motor	---	300 rpm	1	__
12	Rubber belt	__	12cm length,2cmwidth	2	__

13	Alignment tube	Nylon fiber	0.9cm diameter,25cm length	1	__
14	Stand for alignment tube	Acrylic sheet	5cm length,3cm width,4mm thickness	2	Laser cutting
15	Wire roller	__	5cm long	1	__
16	Stand for wire roller	Acrylic sheet	10cm long, 5cm width.	2	Laser cutting
17	Spacer	Nylon fiber	0.6cm diameter	2	__
18	Buzzer	__	__	1	__
19	Switch	__		1	__
20	PCB board	__		1	__
21	Outer casing	Foam board		4	Hex blade
22	L clamps	__	1'' size	20	__
23	Front casing	Acrylic sheet		1	Laser cutting
24	Hinges	__	Small size	6	__
25	Nuts and bolts	__	M3 size	40	__
26	Washers	__	M3 size	40	__

5.4.3. Electrical/Electronic Circuit Diagram

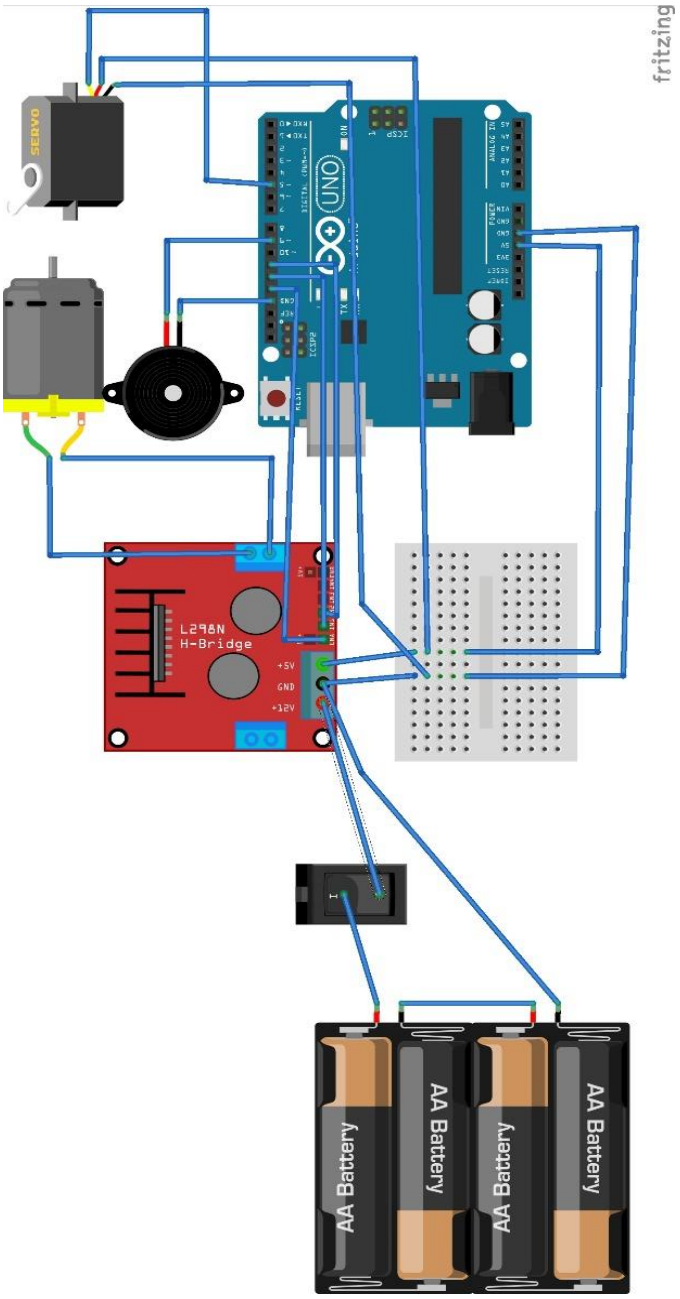


Figure 44 Sprint 3 electronic diagram

5.4.4. Flowchart

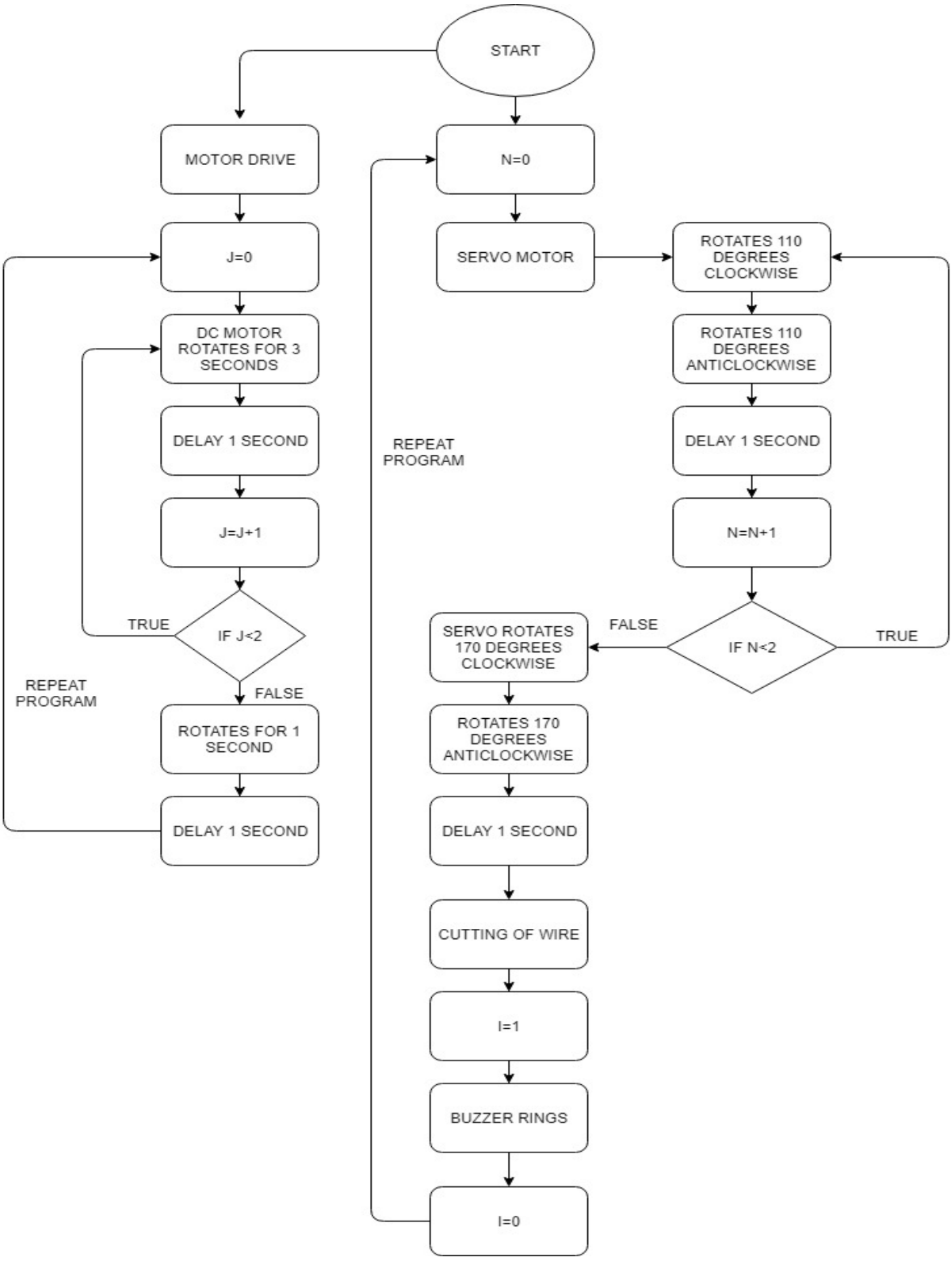


Figure 45 Sprint 3 flowchart

5.4.5. Test Plan

The 12V adapter is connected to the micro controller, as the switch is turned on, the rollers feed in the wires till a certain length and the plier stripes and cuts the wire, the arduino is programmed in such a way that as the wire is cut, the buzzer receives a input signal from the arduino and buzzes for a short time indicating the user completion of the process..

5.4.6. Fabricated System:

Figure 46 Fabricated image of sprint 3

5.4.7. Test Results

The unit testing is done by connecting a 12V adapter to the arduino. As the switch is turned on, the buzzer takes in the signal from arduino and gives the output as a buzzing sound. The buzzing sounds indicates the completion of process. So this results the completion of unit testing. The integration of this system with the rollers and the cutting plier is tested, the end result is a wire passed through the rollers, stripped and cut of required length, giving out a buzzing sound when the wire is cut. The performance test was also conducted successfully for a duration of three hours, yielding cut and stripped wires of same length

5.5. Statement of Expenditure

Table 20 Statement of expenditure

Sl. No	Item with description	Quantity	Price in Rs.
1	Servo motor of 6V	1	400
2	DC geared motor	1	150
3	Foam board 3mm thick	1	180
4	12mm thick foam board	1	--
5	Nuts, bolts, screws	30	--
6	Cutting plier	1	80
7	12V adapter	1	200
8	L clamps, U clamps	20	--
9	Arduino Mega	1	800
10	Wire roller	1	--
12	Limit switch	1	18
13	Buzzer	1	20
14	Rubber belt	1	--
15	Jumper cables	10	--
16	PCB Board	1	--
17	Arduino cable	1	--
18	L298n motor drive	1	160
		Total	2008

5. Limitations of Present work and Future Scope

LIMITATIONS

1. A wire of only one specific length can be cut and stripped.
2. The wire is both stripped and cut, either of the function cannot be achieved singularly.
3. The machine cannot give an indication if the wire stored in is emptied. The user will have to check the amount of wire remaining manually.
4. The rollers made of foam board may wear and tear or become smooth hindering the feeding of wires with time.
5. The outer casing of the machine done with 3mm thick foam board can only serve as temporary protection purpose. It may wear off with time.
6. The indication of the process is though a buzzer which beeps a sound when wire is cut and stripped, it may not be feasible in all cases. (Like in noisy places, for a deaf user).

FUTURE SCOPE

1. A LCD display and a keypad can be integrated, and the program can be modified so that the user can enter the desired length of the wire to be cut and stripped.
2. The outer casing done by foam board can be replaced by any hard and durable material like wood, metal, plastic.
3. A sensor can be added to the wire roller, so that it indicates the user whenever the wire roll is empty.
4. The buzzer can be replaced by an android signal which sends a message to the user when process is completed.

References:

Sl. No.	Website URL
1	https://www.waytekwire.com/products/1445/Cutters-Strippers/
2	https://en.m.wikipedia.org/wiki/Wire_stripper
3	http://www.schleuniger.com/products/p/ecostrip-9380/
4	http://www.wire-processor.com/news/Automatic-wire-stripping-machine-working-principle_1466.html
5	http://www.spectrumtech.com/about-us/technology/laser-wire-stripping/
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