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DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY

A Report on the Course Project of

Engineering Exploration (15ECRP101)

Titled

"BOT-FOLDAWAY"

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DECLARATION

We hereby declare that the project work entitled "BOT FOLD AWAY" submitted as a part of Engineering Exploration Course during 2nd semester of academic year 2021-2022, is a record of an original work done by us under the guidance of Dr Prajaka K. The project work and part of this report is not plagiarized to the best of our knowledge.

Date:06/10/22

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Last but not the least we thank our parents for their constant support and intellect opinions that kept us motivated and dedicated towards the project.

Abstract:

In cloth industry or in common household, folding clothes is time consuming and a tedious task which needs human intervention. We have come up with a model which will help out people in their daily lives to fold their clothes. These models will come in handy to people of all ages and will make their lives easier by folding their clothes for them. These designs will reduce the work for people with larger families and save them a lot of time. These can also come in handy in clothing stores.. Our model “BOT FOLD AWAY” is a robotic arm. With the help of robotic arm controlled by a mobile app, the cloth will be picked from desired points and folded. The weight of these models is less than 4kg. The machine require less maintenance and are affordable.

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1.Problem Definition

1.1Need Statement of our project

A Cloth Machine Industry needs a machine which folds clothes automatically and which can be used in Houses.

1.2 Gathering Pertinent Information

Be it a cloth industry or in common household, folding clothes is time consuming and a tedious task which needs human intervention. Every engineer looks forward to design a machine which makes the work easy and complete the work efficiently. We discussed with other team members who were given the same problem statement and came up with some designs which would solve our the given problem. As the design developed by other teams were not efficient we came up with an idea of making a robotic arm which fold the cloth and even would perform a pick & place operation when given instructions.

As a wise man said future will be replaced by robots we came up with this idea. As per the market survey in the industrial sector every industry is looking for robots instead of human hands. The other matters that we considered while choosing this idea are hygiene, user friendly, cost, aesthetics, easily portable, the type of material used for it etc.

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

Sl. No.	Questions	Answers	O	C	F
1	What type of product do you want to us make?	Cloth Folding Machine	●		
2	What is your budget?	3000 Rs		●	
3	What should be the size of the model?	Portable	●		
4	Should the model be semi automatic?	Yes			●
5	Should the model be controlled from mobile	Yes	●		
6	Should the model fold tshirts and shirts?	Only tshirts	●		
7	Should the model fold pants?	No		●	
8	should the model keep the folded tshirts there itself?	Yes			●
9	Should the model have a conveyer belt to keep the folded tshirt?	No		●	
10	Should the model fold tshirt vertically or horizontaly?	Horizontaly			●
11	Should the model have a LED display?	if in budget then ye			●
12	Should the model be user friendly	Yes			●
13	How many tshirts must be folded at once	1			●
14	What should be the maximum weight of the machine	Less than 5kg			●

15	What more features do you expect	It should have LED lighting to show start and completion of the proces			●
16	Should the machine work on a regulated power supply	Yes			●
17	Should the machine have a backup	No	●		

1.4. Objectives

Sl. No	Objectives
1	Portable
2	Fold tshirts
3	User friendly

Problem definition 1.1

Updated Problem Statement according to the clients objectives

Design a portable user friendly cloth folding machine which folds kids tshirts and which runs on a regulated power supply.

1.5. Constraints

Sl. No	Constraints
1	3000 Rs
2	no conveyer belt
3	1 tshirt at a time
4	size 2x2x2(feet)
5	No conveyer belt

Problem definition 1.2

Updated Problem Statement according to the clients objectives,constrains.

Design a portable user friendly cloth folding machine which folds kids tshirts once at a time and which runs on a regulated power supply.The weight and the size should be 4kg & 2x2x2 and the cost of the product should not be more than 3000.

1.6. Functions

Sl. No	Functions
1	Semi Automatic
2	Keep folded tshirt
3	Horizontally folding
4	Hygienic
5	Regulated power supply
6	Backup for 3 hours
7	

Problem Definition 1.3

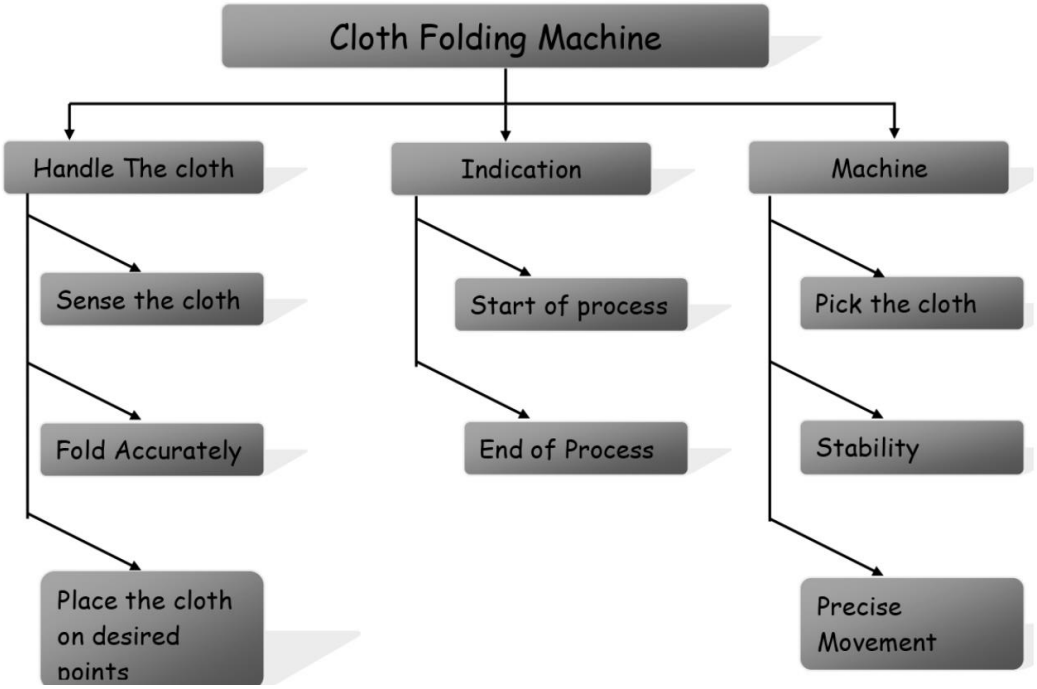
Design a user friendly Semi automatic portable cloth folding machine which can fold t-shirts once at a time and should maintain the standards of hygiene. The size of the machine should be 2x2x2 (in feet) The machine should display the start and end of the process. The machine should run on a continuous power supply.The whole cost of the machine should not exceed than 3000 rupees

2.Conceptual Design

2.1. Establishing Functions

Sl. No	Functions from user perspective	Functions from the designer perspective
1	Semi automatic machine	Using a device to control
2	Keeps folded tshirt	Keep it on the table
3	Horizontal folding of tshirt	Horizontal Movements
4	Hygienic process	Non involvement of hands
5	Folds kids tshirt	Specifically Kids Tshirt

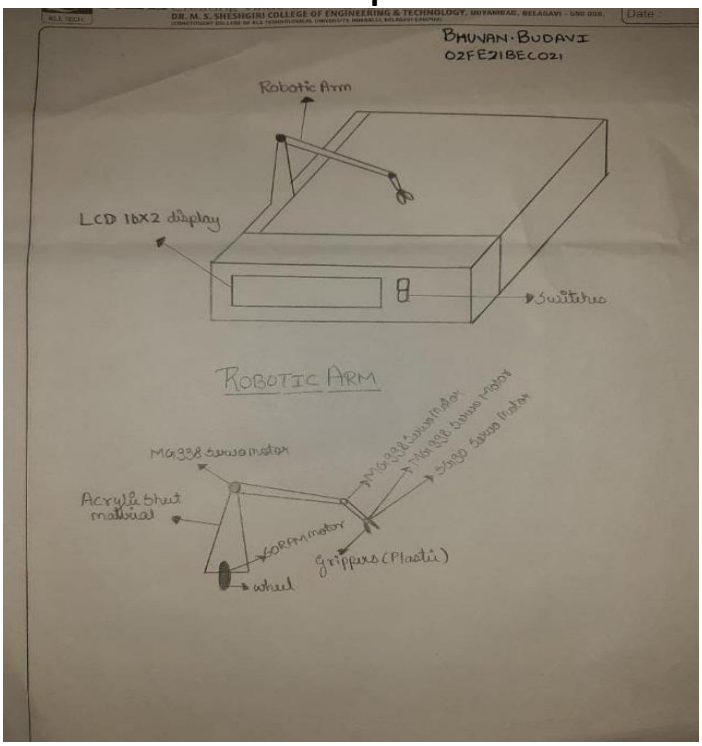
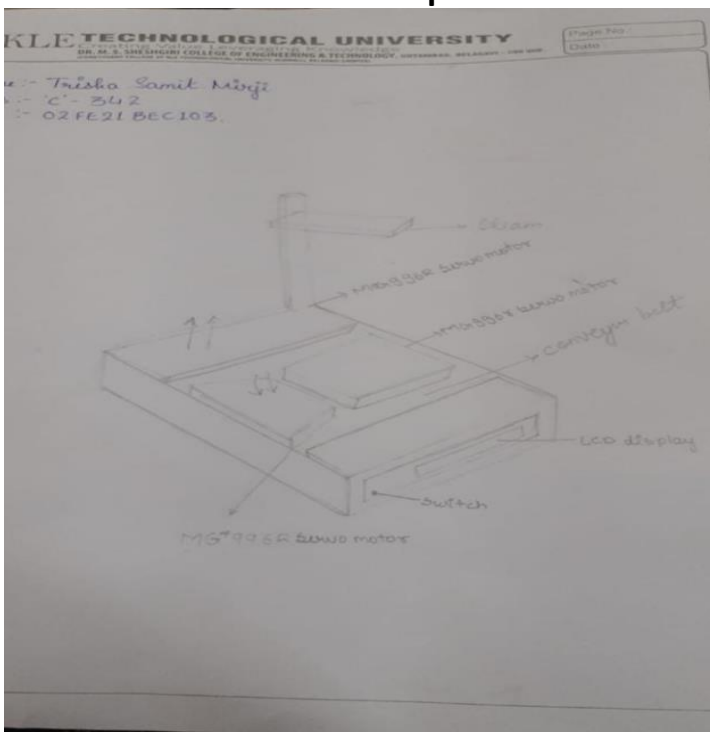
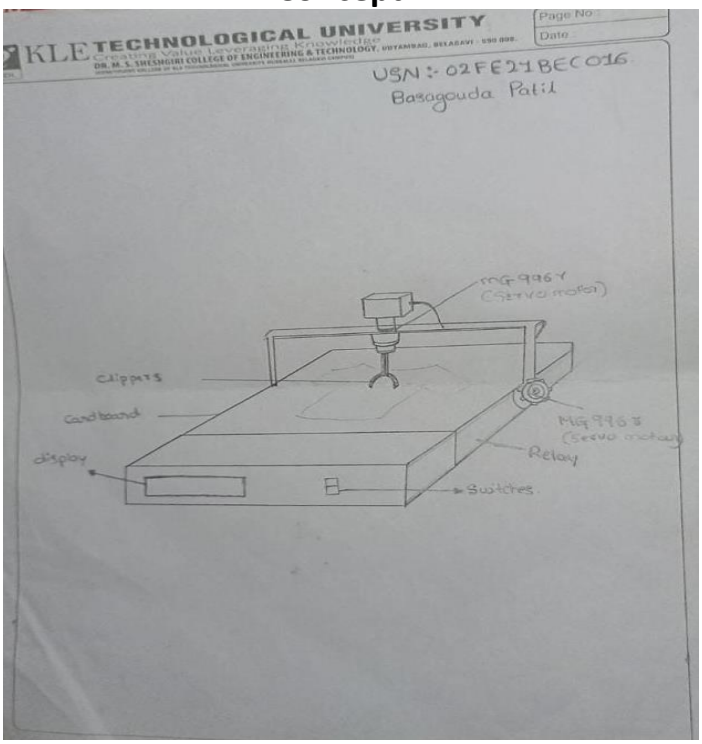
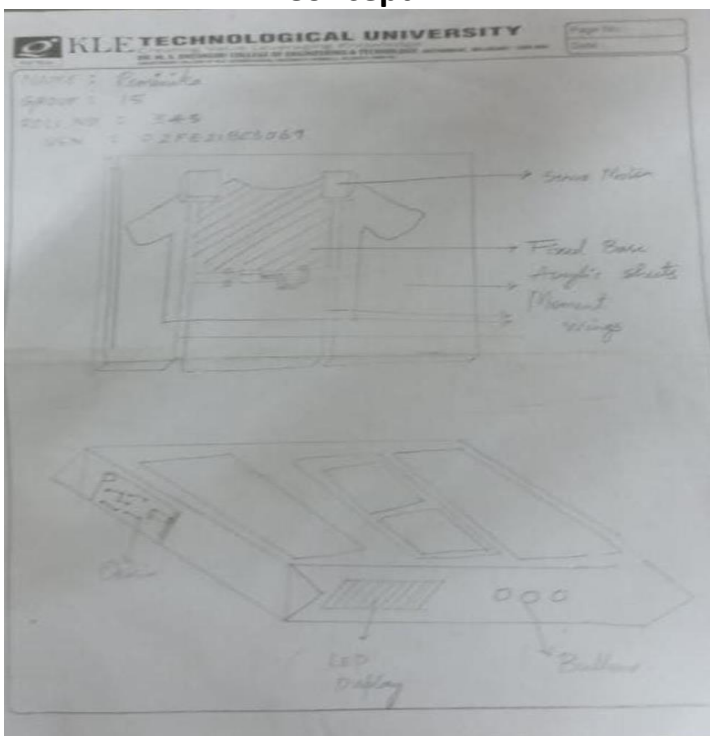
2.2. Functions Tree



2.3. Morphological Chart

Serial no	Sub Functions	Means1	Means2	Means3	Means4
1	Process Start and completion indicator	LCD(16x2) 	LED Board 	LED Bulbs 	NULL
2	Robotic Arm body	Acrylic Sheet 	Cardboard 	NULL	NULL
3	Communication	HC-05 	HC-06 	JYMCU 	NULL
4	Movement	SG90 Servo Motor 	MG996r Servo Motor 	NULL	NULL
5	IC	Ardiuno UNO 	Ardiuno MEGA 2560 	Ardiuno NANO 	Raspberry PI 
6	Sensors	IR Sensor 	Ultrasonic Sensor 	Proximity Sensor 	NULL

2.4. Generated Concepts

Concept 1	Concept 3
	
Concept 2	**Concept 4**
	

3.Conceptual Evaluation and Product Architecture

3.1. Pugh Chart

SI.NO	Design Objectives	Weights	Design 1	Design 2	Design 3	Design 4
1.	Safety	5	+	Datum	+	++
2.	Ease of use	8	++	Datum	++	-
3.	Portability	7	+	Datum	-	+
4.	Use of standard parts	8	++	Datum	+	+
5.	Cost	5	--	Datum	--	-
6.	Aesthetics	6	+	Datum	+	-
7.	Positive score		50	0	35	25
8.	Negative score		10	0	17	19
9.	Total		40	0	18	6

3.2. Justification for the Scores

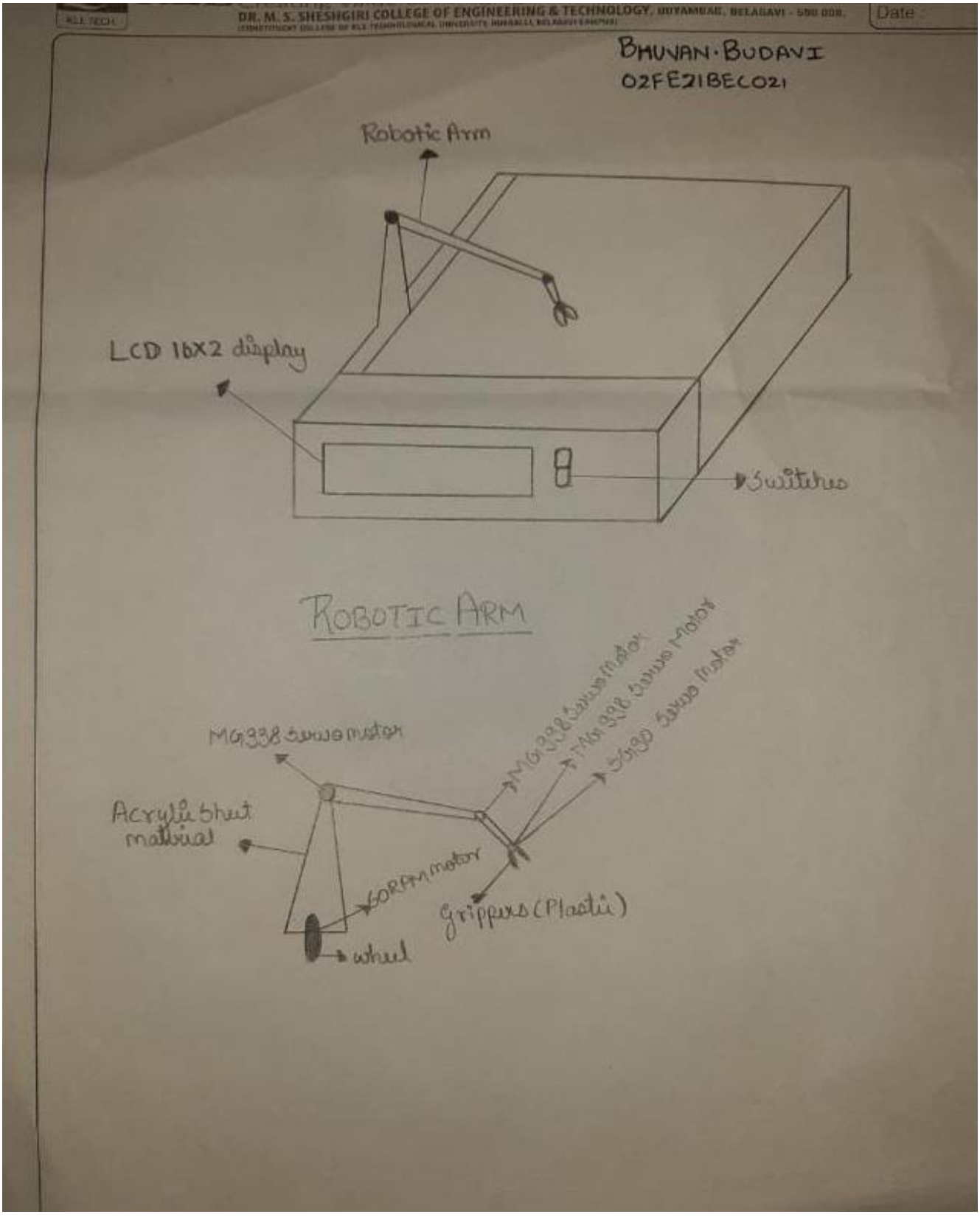
4.3 Justification

Design no	Objective	Score Allocated	Justification for the score
1.	Safety	+	Safely folds the cloth

Design no	Objective	Score Allocated	Justification for the score
	Ease of use	++	Very easy to use and reprogrammable
	Portability	+	Easily portable
	Use of standard parts	++	Standard parts are used
	Cost	--	Expensive
	Aesthetics	+	Due to 3d printing aesthetics are good
2.	Safety	0	datum
	Ease of use	0	datum
	Portability	0	datum
	Use of standard parts	0	datum
	Cost	0	datum
	Aesthetics	0	datum
3.	Safety	+	Local part is used

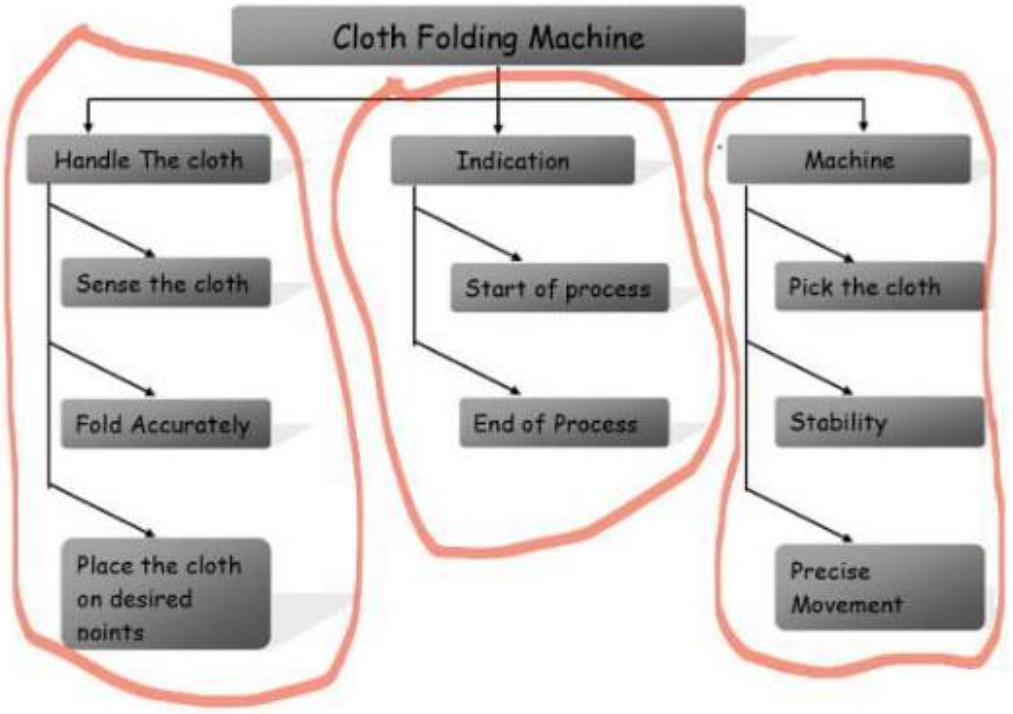
Design no	Objective	Score Allocated	Justification for the score
	Ease of use	++	Easy to use
	Portability	-	Heavy weight
	Use of standard parts	+	Standard Parts are used
	Cost	--	Due to use of local parts it is inexpensive
	Aesthetics	+	Aesthetically good
4.	Safety	++	Safe folding of clothes
	Ease of use	-	Complex to use
	Portability	+	Portable
	Use of standard parts	+	Stand parts are used
	Cost	-	Inexpensive
	Aesthetics	-	Aesthetically poor-

3.3 Selected Design



3.4 Product Architecture

3.4.1 Function Clustering



3.4.2 Interaction between subsystems

		Indication	Machine
Handle the cloth	Material Interaction	✓	✓
	Data Interaction	X	X
	Spatial Interaction	X	✓
Details: Cloth interacts with indication process and the machine as it will indicate if the cloth is dropped while folding. As it requires space that it will interact with the machine			

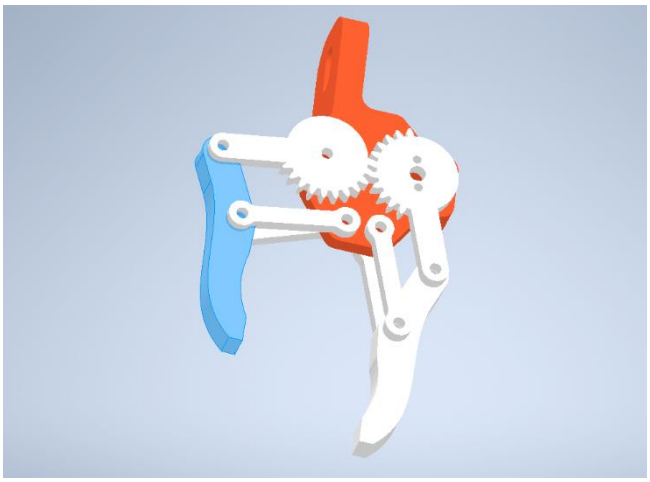
		Handle the cloth	Machine
Indicaton	Material Interaction	✓	✓
	Data Interaction	X	✓
	Spatial Interaction	X	X
Details: Indication interacts with the cloth and the machine as it informs the user about the incomplete or completion of the process, as it gets data from the machine.			

		Indication	Handle the cloth
Machine	Material Interaction	✓	✓
	Data Interaction	✓	X
	Spatial Interaction	X	✓
Details: Machine interacts with cloth and indicates the completion of the process, it is connected with indication as it indicates data to the user and has spatial connection with the cloth			

4.Implementation

4.1.Sprint 1 Implementation

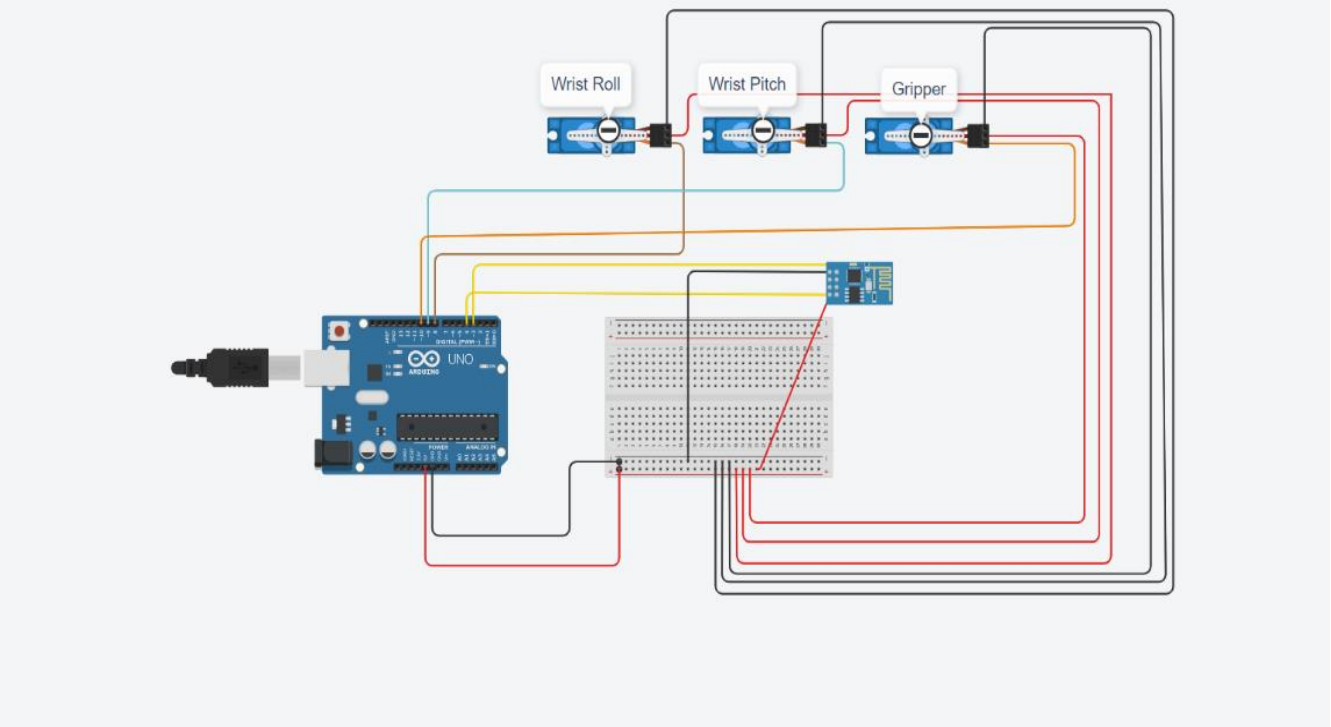
4.1.1. 3D model of the sprint 1 subsystem



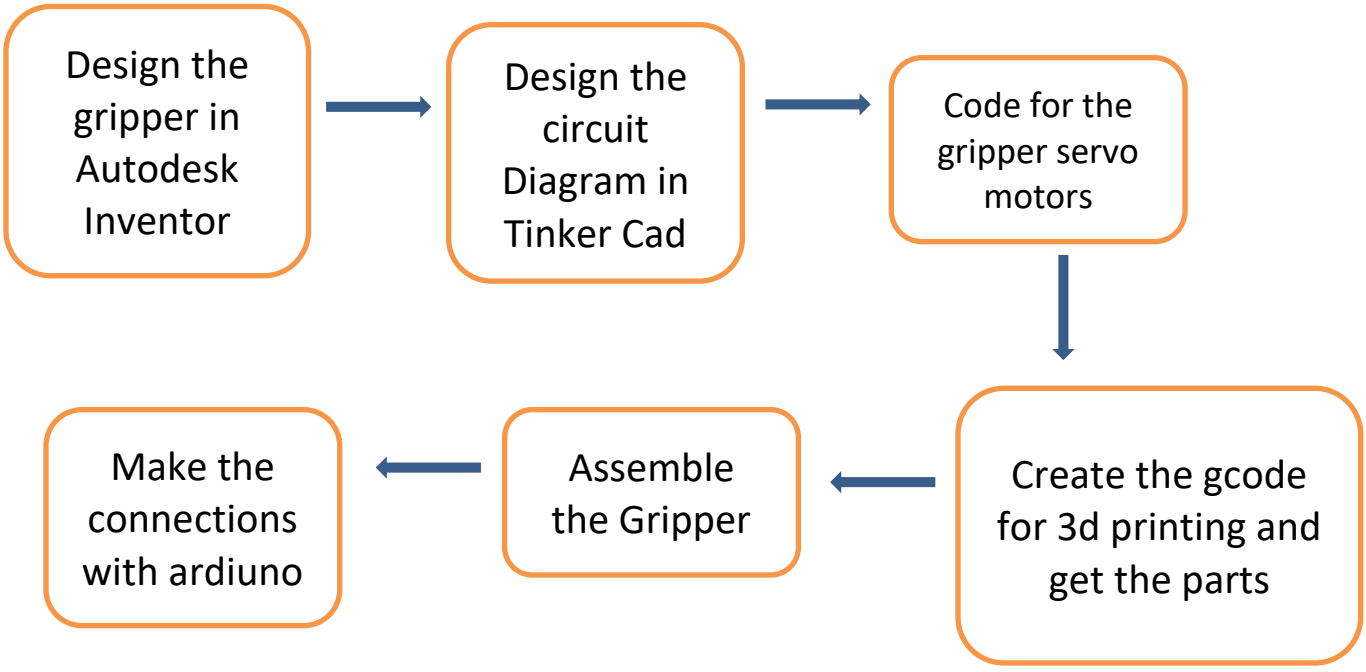
4.1.2. Bill of Materials(BOM) of the sprint 1

Sl. No	Item with description	Quantity	Price in Rs.
1	Servo Motors	3	360
2	Jumpers(Male to Male)	1 set	60
3	Jumpers(Male o Female)	1 set	60
4	Arduino	1	920
5	Breadboard	1	40

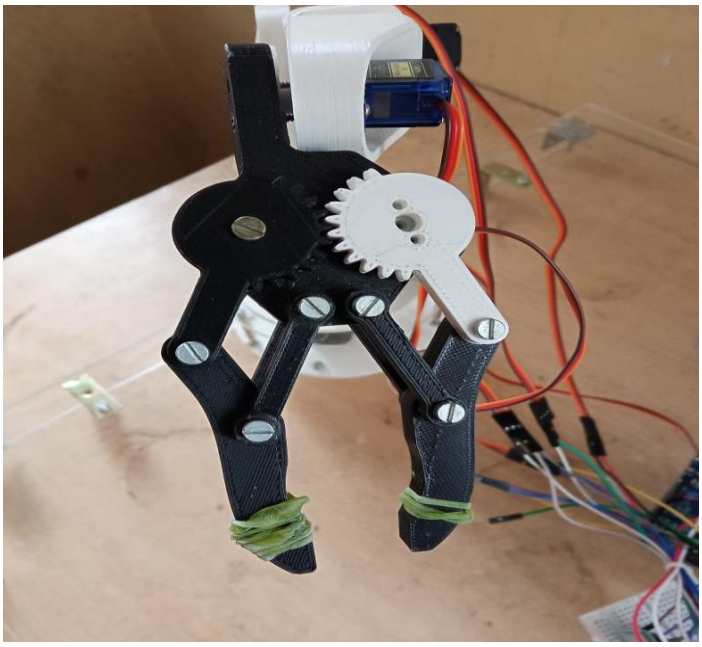
4.1.3. Circuit diagram of the sprint 1



4.1.4. Flow chart of the sprint 1



4.1.5. Physical implementation image of the sprint 1



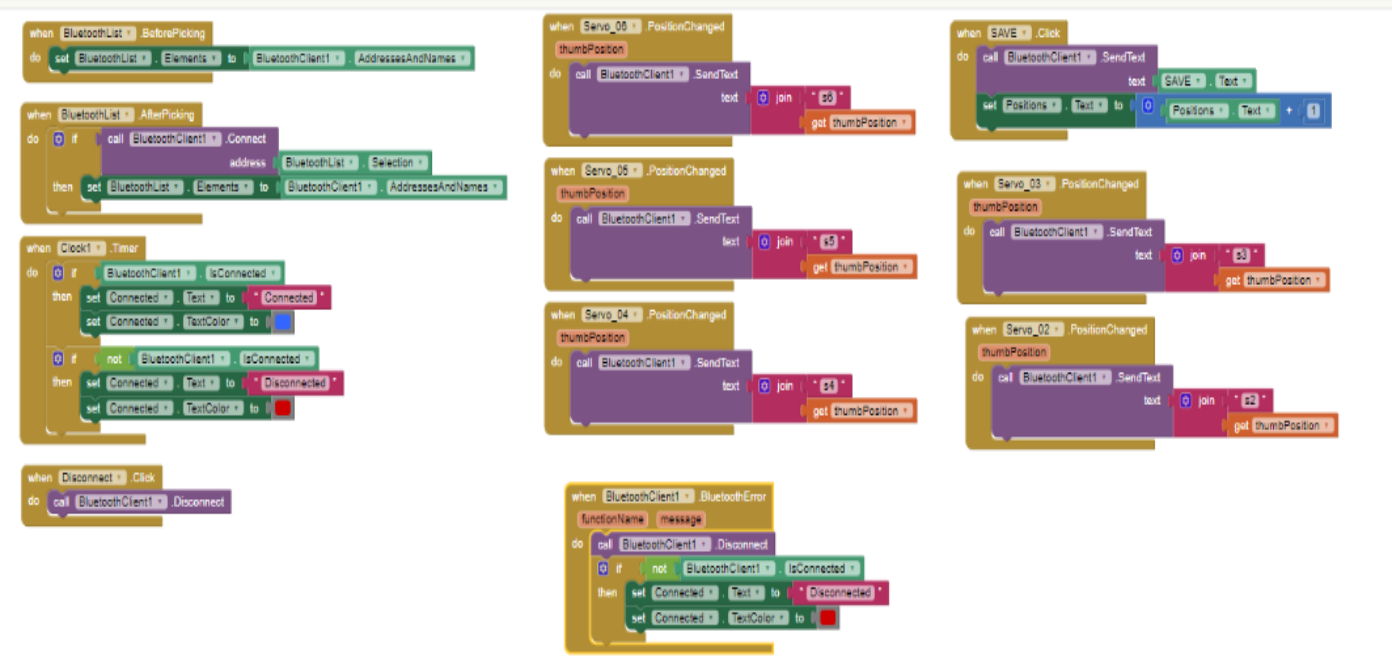
4.2.Sprint 2 Implementation

4.2.1. 3D model of the sprint 2

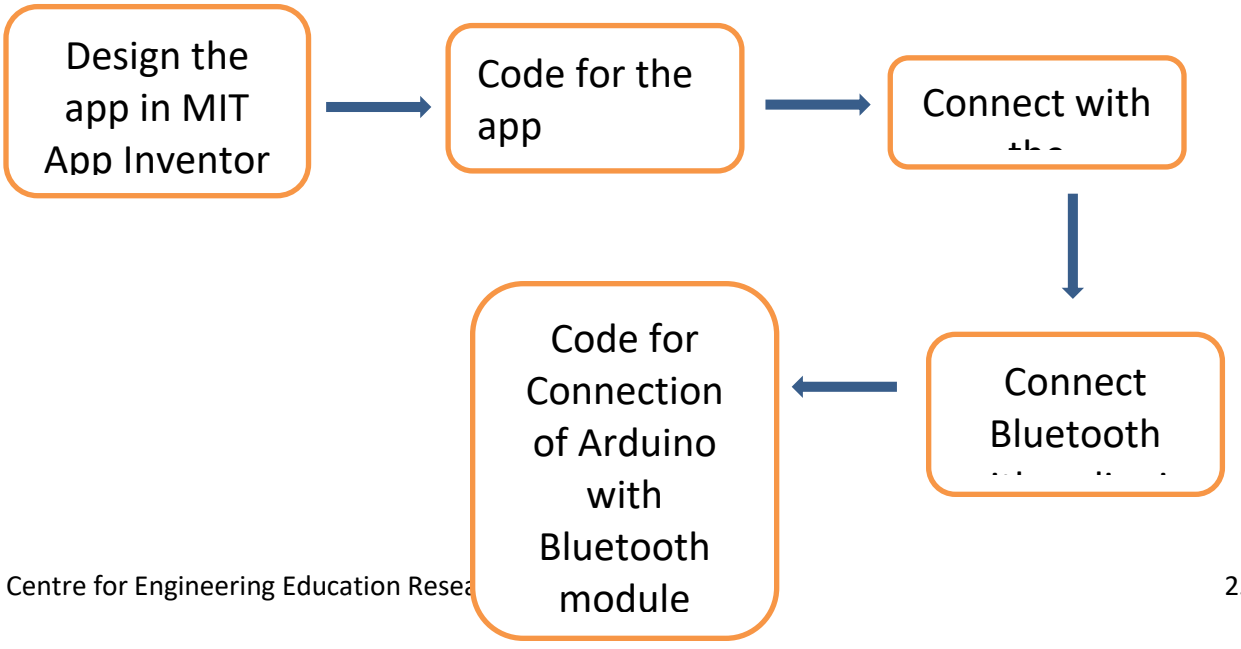
4.2.2. Bill of Materials (BOM) of the sprint 2

Sl. No	Item with description	Quantity	Price in Rs.
1	Bluetooth Module	1	480

4.2.3. Circuit diagram of the sprint 2



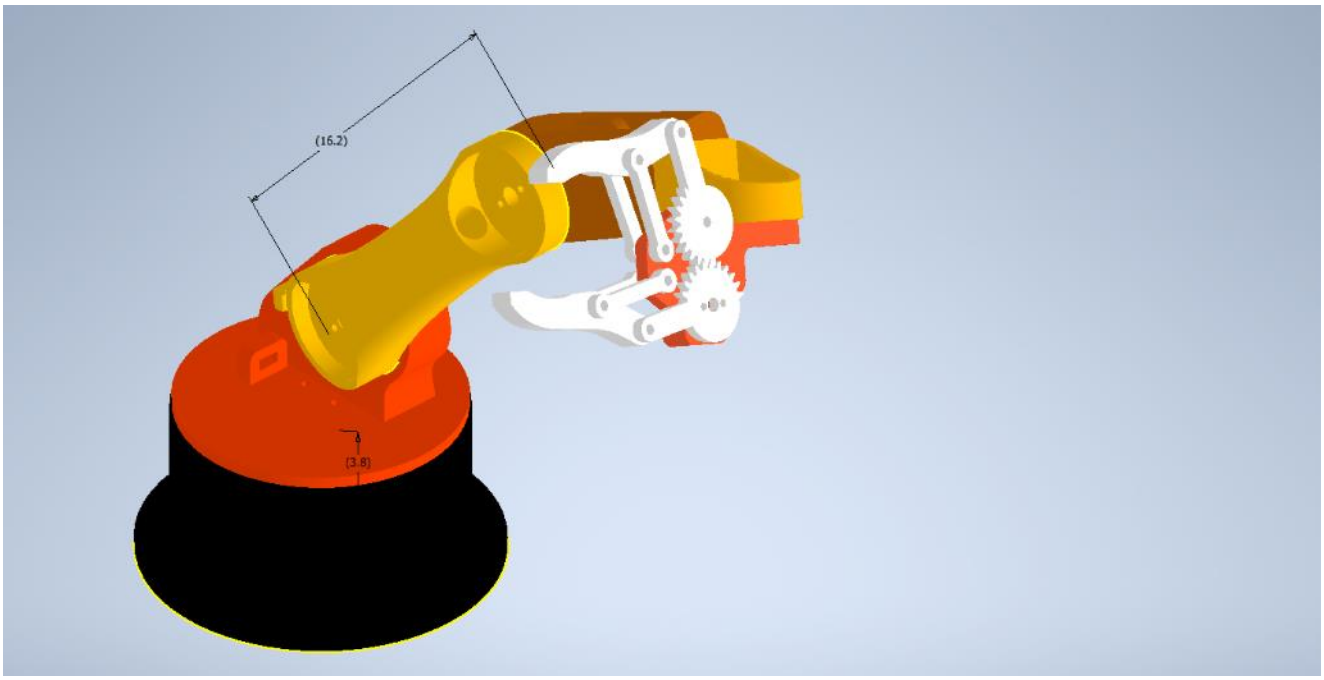
4.2.4. Flow chart of the sprint 2

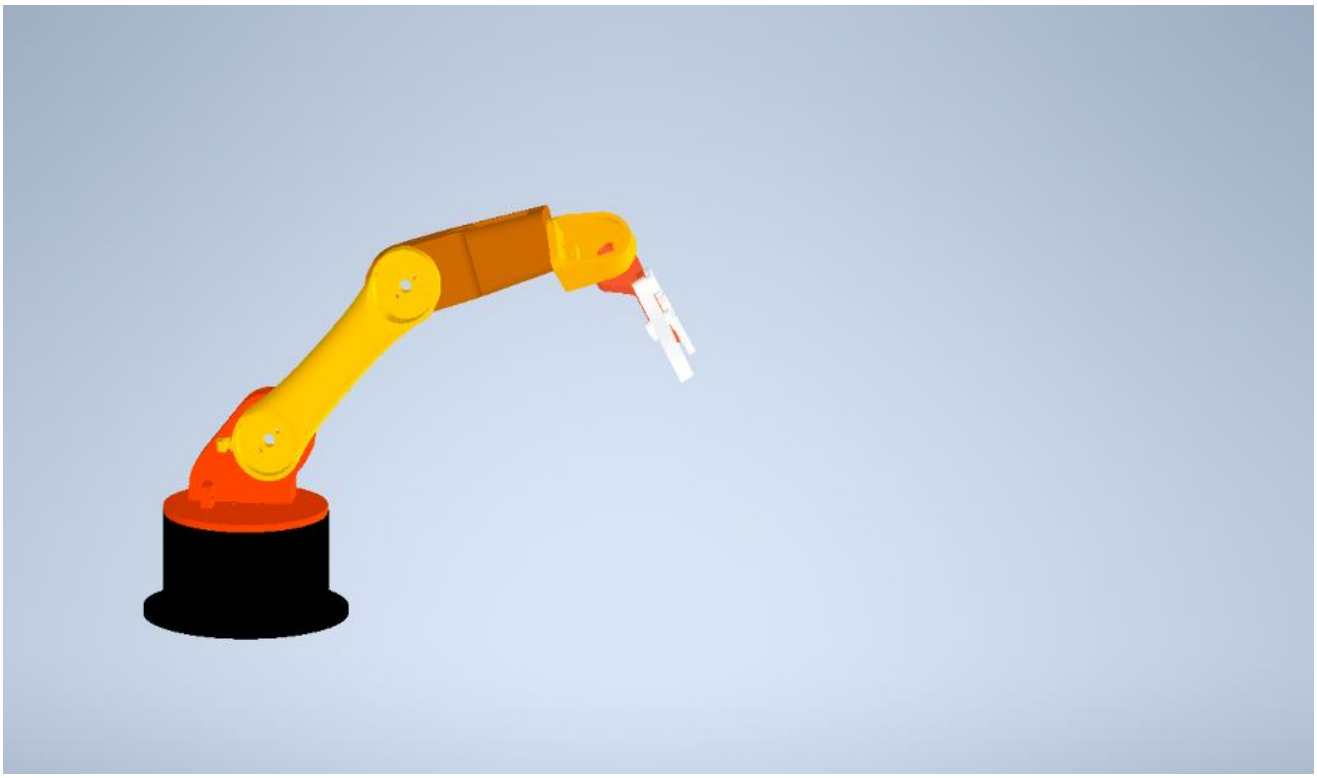


4.2.5. Physical implementation image of the sprint 2

4.3.Sprint 3 Implementation

4.3.1. 3D model of the sprint 3 subsystem

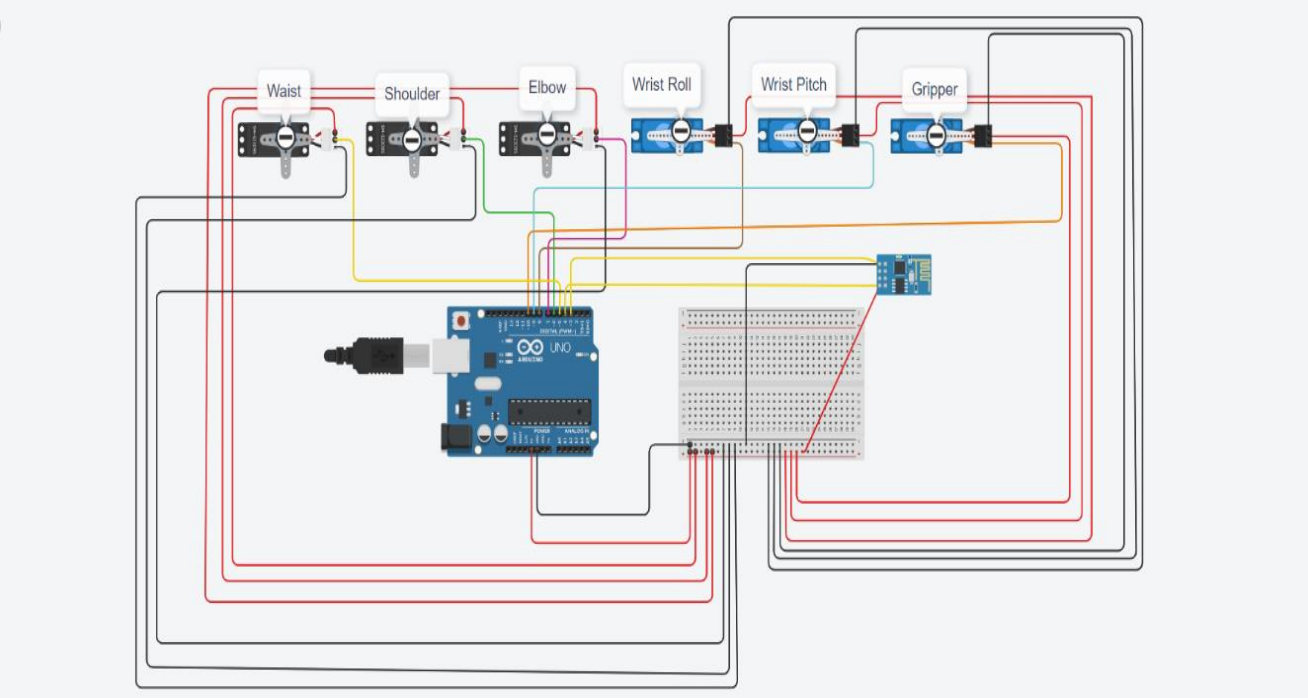




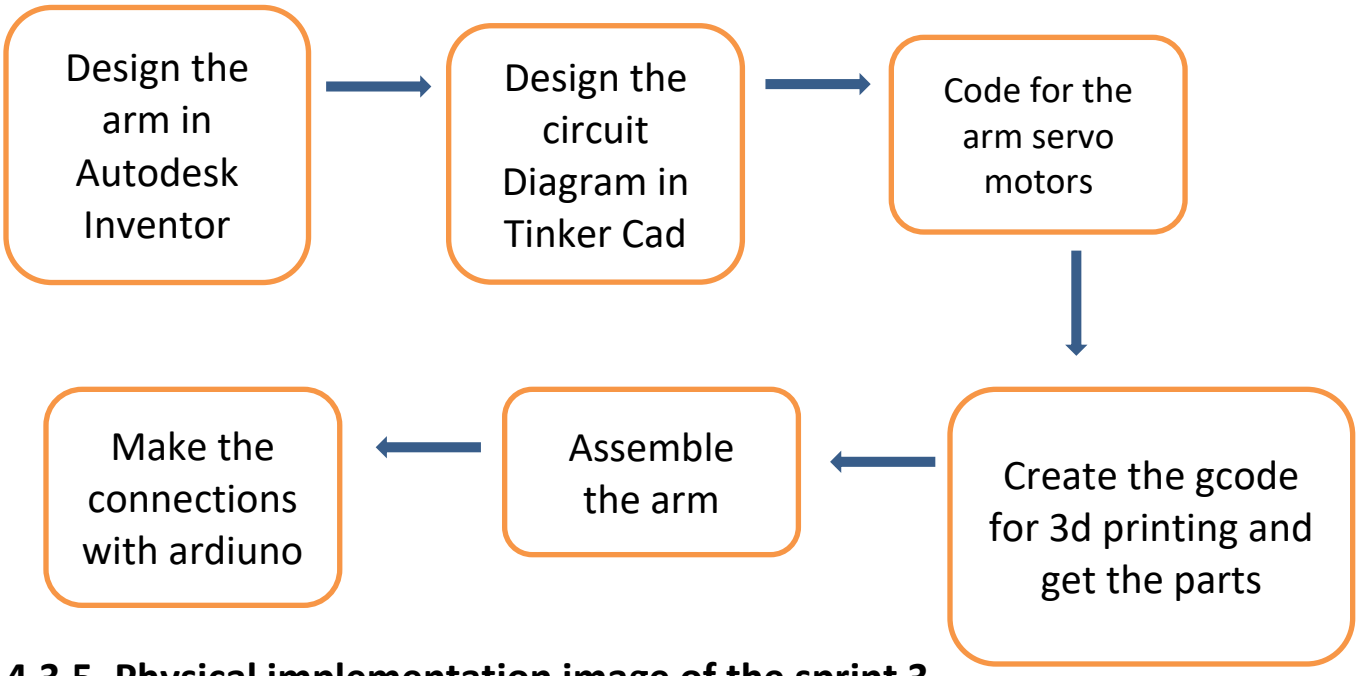
4.3.2. Bill of Materials (BOM) of the sprint 3

Sl. No	Item with description	Quantity	Price in Rs.
1	Servo Motor(MG996r)	3	480
2	Adapter(5V,2A)	1	300
3	Female Jack	1	20

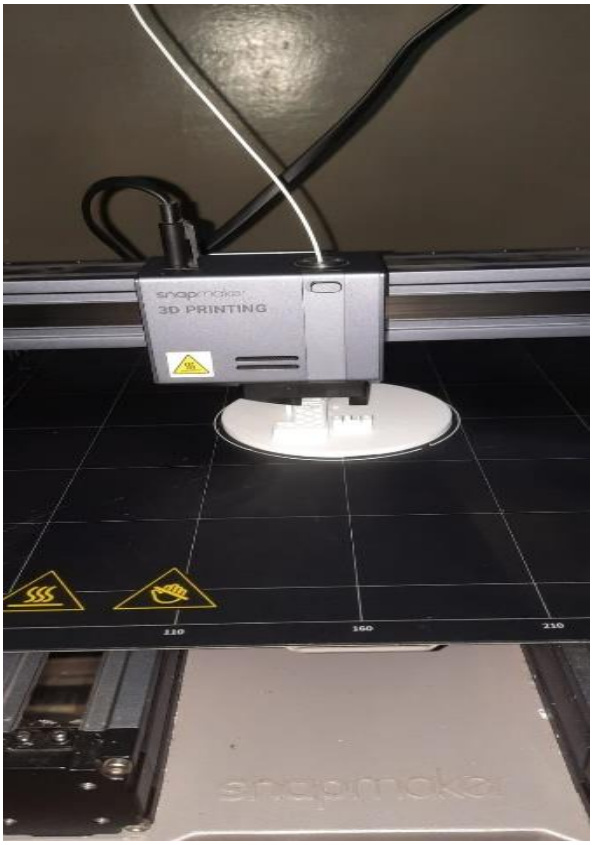
4.3.3. Circuit diagram of the sprint 3

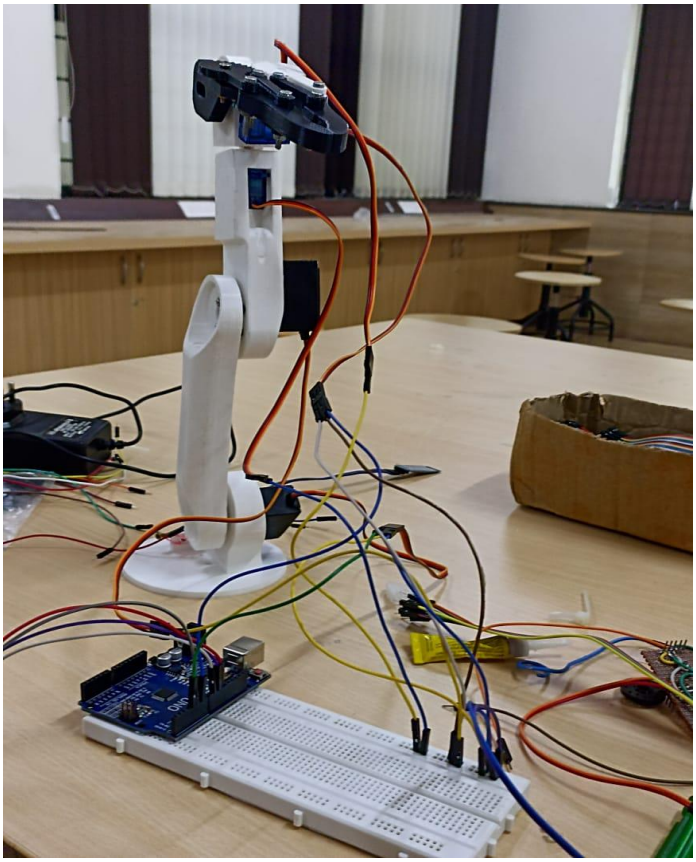


4.3.4. Flow chart of the sprint 3



4.3.5. Physical implementation image of the sprint 3





4.4 Motor and Resource Specification

3D Print Material

- Material Name-Polylactic Acid
- Co efficent of Friction=0.48
- Density=1.27 per cm^-3

Servo 1

- Length=49.7cm
- Breadth=4cm
- Thickness=2.5cm
- Factor of safety=1.4
- Density=1.27
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(49.7 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =363.5g
- Torque=Force x distance =(363.5 x 49.7) / 1000 =18.06 kgcm

For servo 1 MG996r servo motor is used

Servo 2

- Length=45.7cm
- Breadth=4cm
- Thickness=3cm
- Factor of safety=1.4
- Density=1.27
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(45.7 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =334.5g
- Torque=Force x distance =(334.5 x 45.7) / 1000 =15.28 kgcm

For Servo 2 MG996r servo motor is used

Servo 3

- Length=33.5cm
- Breadth=4cm
- Thickness=2.5cm
- Factor of safety=1.4
- Density =1.27
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(33.5 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =245g
- Torque=Force x distance =(245 x 33.5) / 1000 = 8.20 kgcm

For Servo 3 MG996r servo motor is used

Servo 4

- Length=21.6cm
- Breadth=4cm
- Thickness=2.5cm
- Density=1.27cm
- Factor safety=1.2
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(21.6 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =158g
- Torque=Force x distance =(158 x 21.6) / 1000 =3.41 kgcm
- **For Servo 4 SG90 servo motor is used**

Servo 5

- Length=17cm
- Breadth=4cm

- Thickness=2.5cm
- Density=1.27cm
- Factor safety=1.2
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(17 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =124.35g
- Torque=Force x distance =(124.35 x 17) / 1000 =2.11 kgcm
- **For Servo 5 SG90 servo motor is used**

Servo 6

- Length=7cm
- Breadth=4cm
- Thickness=2.5cm
- Density=1.27cm
- Factor safety=1.2
- Total Force=Volume x Factor of safety x Density x Co-efficient of friction =(7 x 4 x 2.5) x 1.2 x 1.27 x 0.48 =51.20g
- Torque=Force x distance =(51.20 x 7) / 1000 =0.358 kgcm
- **For Servo 6 SG90 servo motor is used**

Adapter Calculation

5V	**in mA**
• Arduino	40
• MG996R servo motor x3	2700
• SG90 Servo motor x3	1950

	5V	in mA
• bluetooth module		250

Total 4950*1.2=5940

We used 5V 5A Dc Power Supply

5.Statement of Expenditure

Sl. No	Item with description	Quantity	Price in Rs.
1	Servo Motors(MG996r)	3	840
2	Servo Motors(SG90)	3	360
3	Bluetooth Module	2	480
4	Arduino UNO	1	920
5	Adapter 5V,2A	1	300
6	Breadboard	1	40
7	Female Jack	1	20
8	Jumpers(Male to Male)	20	60
9	Jumpers(Male to Female)	20	60
Total			3080

6. Limitations of Present work and Future Scope

Limitations:

- Model is very complex to operate but when once the commands are given it is easy it operate.
- It is expensive.
- Model needs high maintenance.

Future Scope:

- Making it completely AI.
- Make it less complex.
- Make it more easier so that the user can handle it properly.
- Make it inexpensive.

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How to Mechatronics (August 31, 2017). Control a Robotic Arm using Ardiuno Fully .

http://www.how to mechatronics.com/Control-Robotic-Arm-using-Ardiuno-Fully

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Book:

Elements of Mechanical Engineering by K.R.Gopalkrishna, Sudhir Gopal Krishna, S.C.Sharma

Published by Subhas Stores

Circuit Diagram:

https://www.tinkercad.com/

Code Testing:

Ardiuno.IDE Software

3d printing:

Snapmaker Luban Software

Snapmaker A350 Machine