A Report on the Course Project of

Engineering Exploration course (15ECRP101)

Titled

MIXING MACHINE 11

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Center for Engineering Education Research

Academic Year 2016-2017, Even Semester

Center for Engineering Education Research

CERTIFICATE

This is to certify that the project entitled "MIXING MACHINE 11" 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 2016-17. The project report fulfills the requirements prescribed.

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Examiner 1: Examiner 2:

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DECLARATION

We hereby declare that the project work entitled "**Mixing Machine 11**" submitted as a part of Engineering Exploration Course during 2nd semester of academic year 2016-2017 to KLE Technological University, Hubballi, is a record of an original work done by us under the guidance of Mr. Sanjeev M. Kavale$_{(B.E)}$., Lecturer, School of Mechanical Engineering. Neither project work nor part of this report is plagiarized to the best of our knowledge.

Date:

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We would like to express our gratitude towards our parents for their kind co-operation and encouragement which helped us in completion of this project.

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Our thanks and appreciation also goes to our team members in developing project and people who have willingly helped us out with their abilities.

Abstract:

As the world is becoming more advanced day by day and it is trend of people to have an automated machines. Therefore our goal is to build an automated mixing machine. In this mixing machine we can mix three dry solid ingredients (of 50 grams each). Input is given through a switch. As soon as we on the switch 3 lids of the containers open and allow the ingredients to fall in the mixing area. In the mixing container they get thoroughly mixed and hence we will get the required mixed output. The process gets completed within 1 minute. It indicates the user the process is completed when the LED bulb starts blinking. This machine is used in bakeries and sweet making industries.

Contents:

List of Figures

List of Tables

1. Problem Statement

"A sweet manufacturer is in need of a machine that adds three different solid materials (groundnut, roasted gram dal, sugar crystals) of fixed quantity one after the other and mix them thoroughly such that homogeneity is achieved, hence design and build a machine that does this job on a click after receiving the input from the user. The machine should be completely automated, it should receive the input of the quantities required from the owner (either 50 grams or 100 grams of each material) and then should do the remaining job on its own. The goal is to build this machine with dimensions less than 60cm (length) x 60cm (width) x 60cm (height), it should indicate the completion of task to the owner, portable, can be easily cleaned and should cost less than Rs.3000/-"

2. Project Schedule

Untitled Gantt Project

25 Apr, 2017
http://

Project manager	
Project dates	30 Jan, 2017 - 3 May, 2017
Completion	0%
Tasks	19
Resources	0

Figure 1: Gantt chart -a

Untitled Gantt Project

25 Apr, 2017

2

Tasks

Name	Begin date	End date
Selection of Need statement	30/1/17	2/2/17
task_58	4/4/17	4/4/17
Defining problem statement	3/2/17	3/2/17
Conducting Literature Survey	6/2/17	14/2/17
Review on problem statement and Literature Survey	16/2/17	16/2/17
Development of Design Criterias	16/2/17	17/2/17
Prioritisation of Design criterias and PCC	20/2/17	21/2/17
Generation of Feasible Alternative Solutions	27/2/17	8/3/17
Review on Design considerations and multiple solutions	9/3/17	9/3/17
Analysis of multiple solutions	10/3/17	13/3/17
Selection of Best solution using Decision Matrix	14/3/17	20/3/17
Detailed design of Feasible Solution	21/3/17	30/3/17
Review on Developed Detailed Design	31/3/17	31/3/17
Designing of Model	3/4/17	14/4/17
Implementation : First cut	17/4/17	17/4/17
Re-work on the designed model	18/4/17	25/4/17
Implementation : Second cut	26/4/17	26/4/17
Re-work on the built model	27/4/17	2/5/17
Project Exhibition	3/5/17	3/5/17

Figure 2: Gantt chart-b

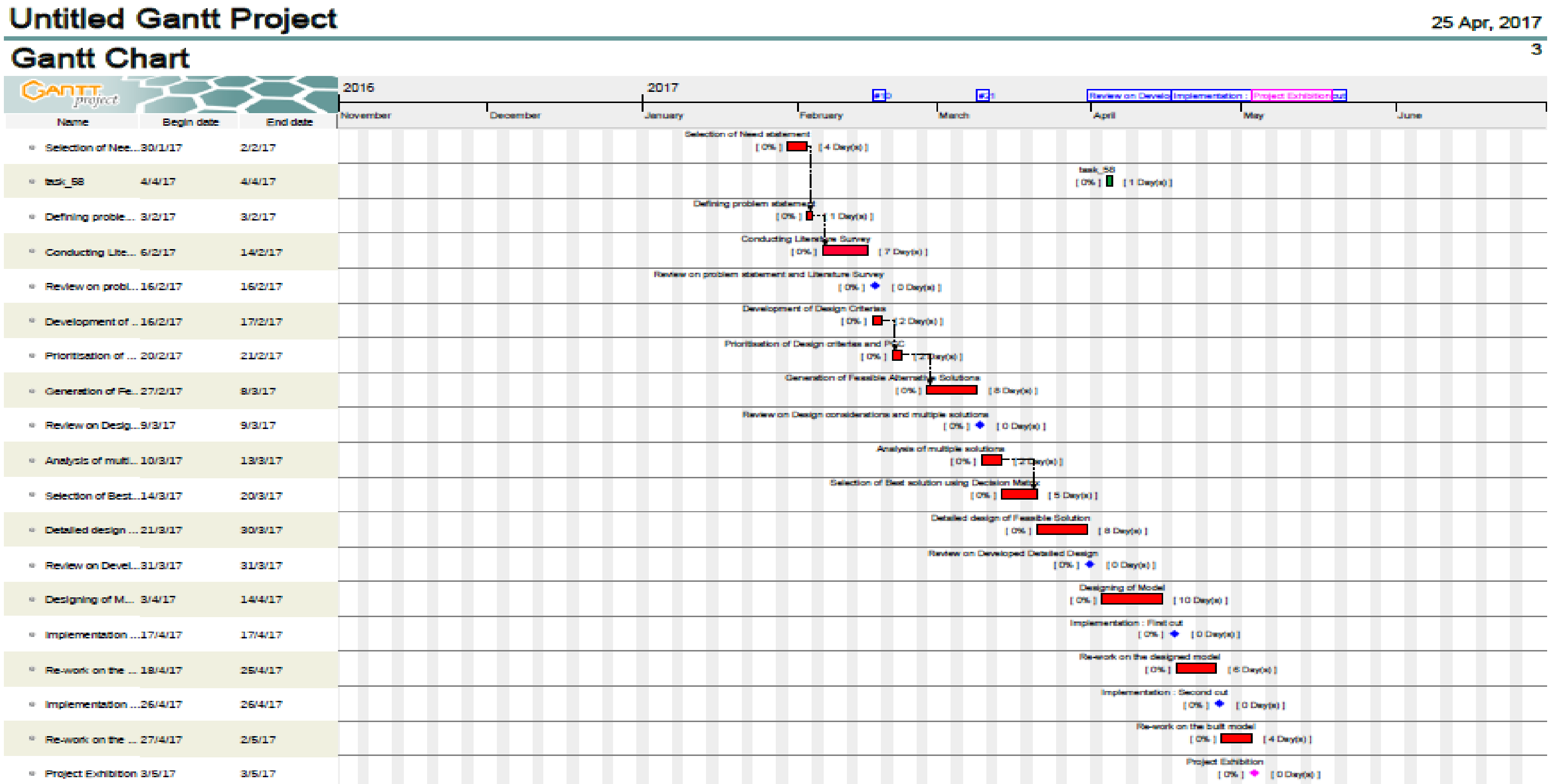


Figure 3: Gantt chart-c

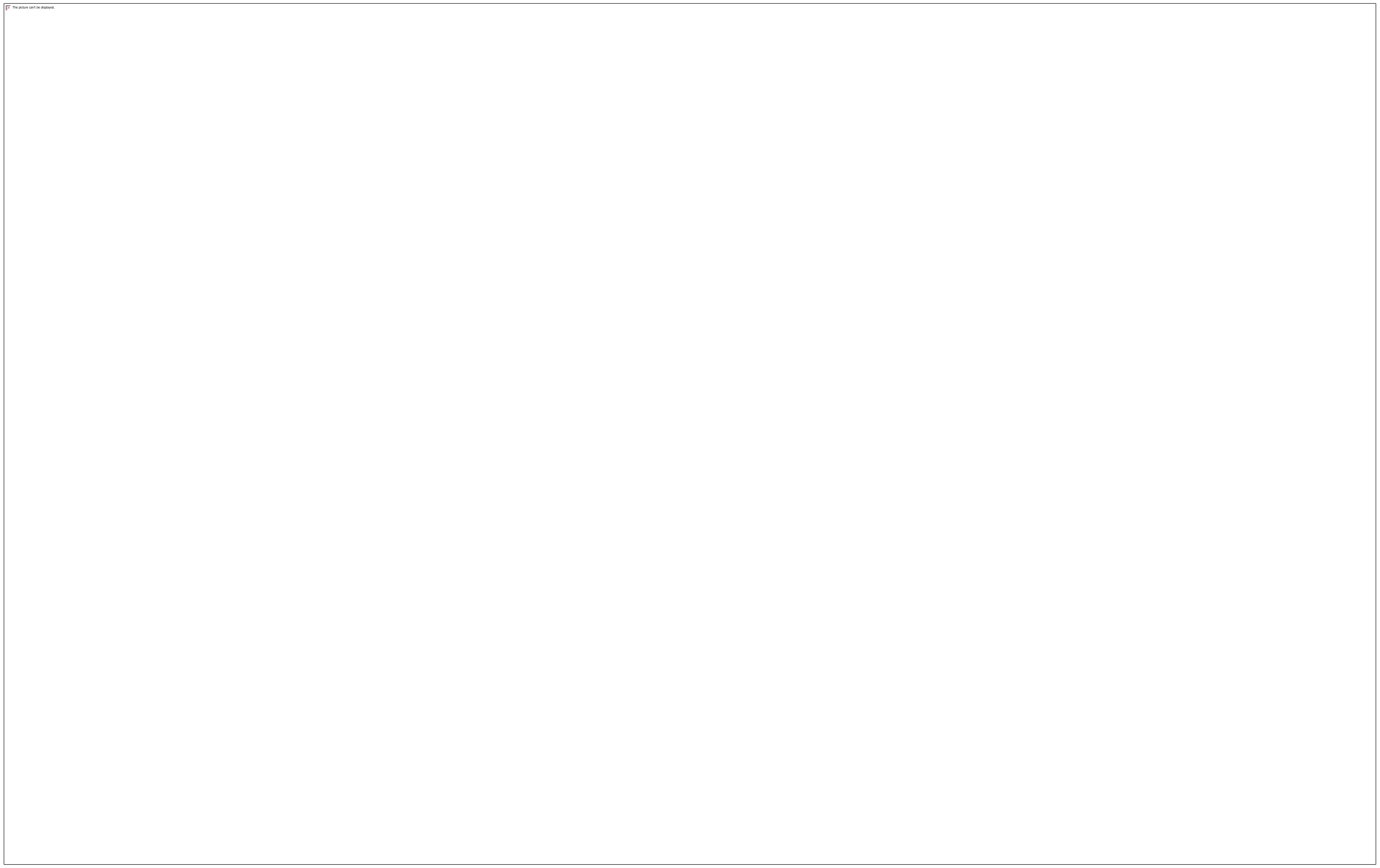


Figure 4: Gantt chart-d

3. Feasible Design Considerations and their Prioritization

The following is a list of preliminary criteria for "MIXING MACHINE 11".

1. The design must be at a low cost.
2. The design should be safe.
3. The design should be user friendly
4. The designed prototype should be easily maintained and cleaned.
5. The designed prototype should be small and portable.
6. The designed prototype must be made from disposable materials.
7. The designed prototype should allow the flow of exact quantity of materials required.
8. The designed prototype can be easily disassembled and assembled whenever required by the user.
9. The wastage of the materials should be minimum in the designed prototype.
10. The designed prototype must complete the task in less than 5 minutes.

They can be simply written as

1. Cost of the prototype.
2. Size of the designed prototype.
3. Low and easy maintenance.
4. Time to complete the task.

For the above stated criteria, prioritization will be done using pairwise comparison chart. Below is the pairwise comparison chart.

Table 1: Pairwise Comparison Chart

	Cost of the prototype	Size of the designed prototype	Low and easy maintenance	Time to complete the task	Row Totals	Normalized value
Cost of the prototype	--	4	3	2	9	(9/24) x 100 = 12.537.5
Size of the designed prototype	0	--	4	2	6	(6/24) x 100 = 25
Low and easy maintenance	1	0	--	1	2	(2/24) x 100 = 8.33
Time to complete the task	2	2	3	--	7	(7/24) x 100 = 29.16
Column Total					24	

The design criteria for better mouse trap design according to priority are as mentioned below

1. Time to complete the task.
2. Size of the designed prototype.
3. Cost of the prototype.
4. Low and easy maintenance.

Our justifications to the above PCC charts are:

1. Cost vs Low and easy maintenance: Cost controlling is important because when it comes to investment an average consumer looks for the cheaper product than the one which is easy to maintain and also it is important to sell our product in large numbers.

2. Cost vs Time to complete the task: We give equal importance to time and cost because when the sweet manufacturer is opting for an automated machine he wishes the task to be completed fast and also the price of the machine he is using should also be as low as possible.

3. Size of the designed prototype vs Time to complete the task: We give importance to Time to complete the task because accuracy and precision in mixing can be attained if we maintain the exact time of operation than the size of the design and the sweet manufacture gives more importance to completion of task faster than the size of the machine.

4. Time to complete the task vs Low and easy maintenance: We give Time more importance because when the sweet manufacturer is opting for an automated machine he wishes the task to be completed fast he gives more importance to completion of the task in lesser time than the maintenance.

4. Pertinent information regarding established problem

The historical benchmarks in technology are associated with our projects are:

Mixing is a unit operation that involves manipulation of a heterogeneous physical system with the intent to make it more homogeneous. The type of operation and equipment used during mixing depends on the state of materials being mixed (liquid, semi-solid, or solid) and the miscibility of the materials being processed. In this context, the act of mixing may be synonymous with stirring, or kneading-processes. [1]

The mixer with rotating parts was patented in 1856 by Baltimore, Maryland Tinner Ralph Collier. U.S. Patent 16,267 This was followed by E.P. Griffith's whisk patented in England in 1857. Another hand-turned rotary egg beater was patented by J.F. and E.P. Monroe in 1859 in the US. U.S. Patent 23,694 Their egg beater patent was one of the earliest bought up by the Dover Stamping Company, whose Dover egg beaters became a classic American brand. The Monroe design was also manufactured in England. In 1870, Turner Williams of Providence, R.I., invented another Dover egg beater model. U.S. Patent 103,811

Figure 5: Whisking egg whites with a handheld electric mixer [3]

The first mixer with electric motor is thought to be the one invented by American Rufus Eastman in 1885. U.S. Patent 330,829. The Hobart Manufacturing Company was an early manufacturer of large commercial mixers, and they say a new model introduced in 1914 played a key role in the mixer part of their business. The Hobart Kitchen Aid and Sunbeam Mixmaster (first produced 1910) were two very early US brands of electric mixer. Domestic electric mixers were rarely used before the 1920s, when they were adopted more widely for home use [2].

The existing solutions to the problem are:

In large scale industries the digital weight of different ingredients is taken and is poured into a machine which selects the items and their quantity required automatically on a large scale.

The working principle behind the existing products is:

Mixing has been defined as the intermingling of two or more dissimilar portions of a material, resulting in the attainment of desired level of uniformity either or physical or chemical in the final product.

The different components of the existing products are weight sensors, storage compartments and mixing container with blades (as witnessed in Parle biscuit factory).

Based on the knowledge of the existing products the technology components or modules are that are needed for the design of our product are:

1. Storage boxes.
2. Motors.
3. Gears.
4. Mixer.
5. Actuators.
6. Blades for mixing.

The people of different expertise which we need for designing across institute are:

1. Mechanical Engineering.
2. Automation Engineering.
3. Computer Science and Engineering.
4. Electrical and Electronics Engineering.

We met and discussed with team 7 and 9 who have selected same need statement.

Their solution ideas to design the product are:

Team 7: They are taking any three different materials in storage boxes, measuring their weight using resistance wires (bending of wire due to weight of materials added) and send them into the mixing area based on gravity and mixing there using motors and blades.

Team 9: They are mixing Sugar, cardamom and pigeon peas in three different compartments each of 100 grams and send them into mixing area based on gravity.

When compared with our problem statement, something that is wrong with the way the problem that is solved by the other teams is:

Team 7: They are planning to weigh the materials using the principle of bending of resistance wires every single time they perform the task, and hence they do not have a fixed quantity of materials that they will be mixing every time which can cause further complications in the working of their model, also they have not selected the materials they will be mixing.

Team 9: They have not considered a proper way to measure the weight of the materials to be mixed. They are using the opening and closing mechanism, which when opened will empty all the materials from the storage compartment into the mixing container without considering any weight.

We are using blade rotation mechanism is which the weight of the material required will be calibrated well in advance (for example 60 slow turns would allow 20 grams of material to flow we could use 150 slow turns to allow 50 grams of materials to flow) and also gravity to make the fixed amount of materials to enter into the mixing compartment. We are trying to achieve precise quantity of materials that will be mixed just on click of a button which have been not yet considered by other teams.

When compared with our problem statement, something that is right with the way the problem that is solved by the other teams is:

<u>Team 7</u>: They are using resistance wire bending principle that gives accurate weight measurement of the materials.

<u>Team 9</u>: We did not find any new way of solving the current problem.

Team 7 might be able to achieve the quantity of the materials required easily but we have to calibrate the quantity of required w.r.t to the number of rotations of the blade initially which is a quite difficult job.

BIBILOGRAPHY

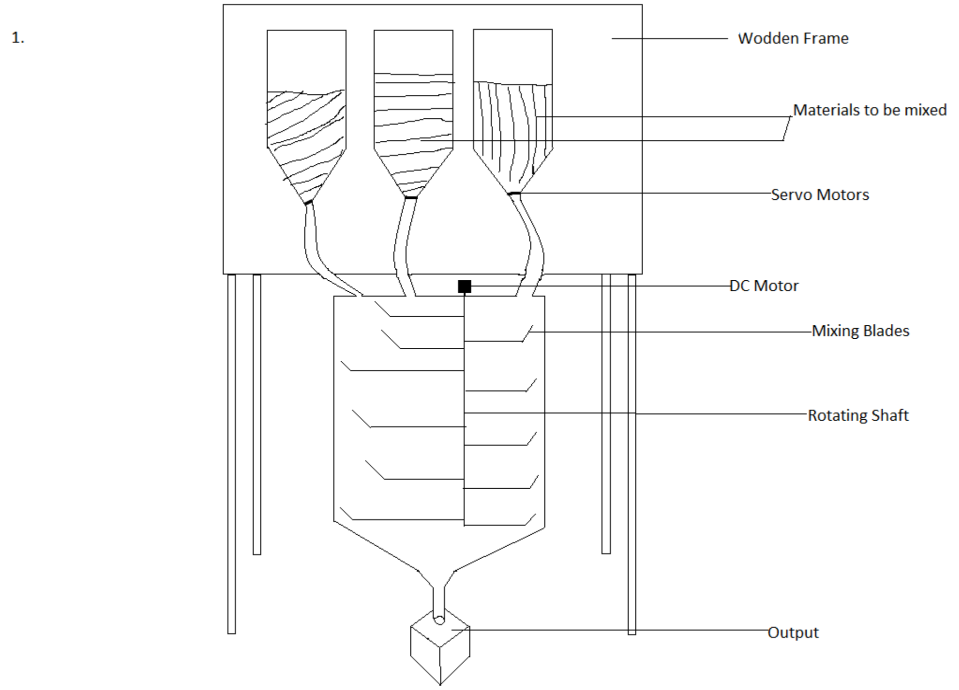
[1]. http://app.knovel.com/hotlink/toc/id:kpUCEPDV02/ullmanns-chemical-engineering

[2]. https://creativecommons.org/licenses/by-sa/2.5/deed.en

[3]. https://en.wikipedia.org/wiki/Mixing_(process_engineering)

5. Feasible alternate solutions

Idea no: 1.



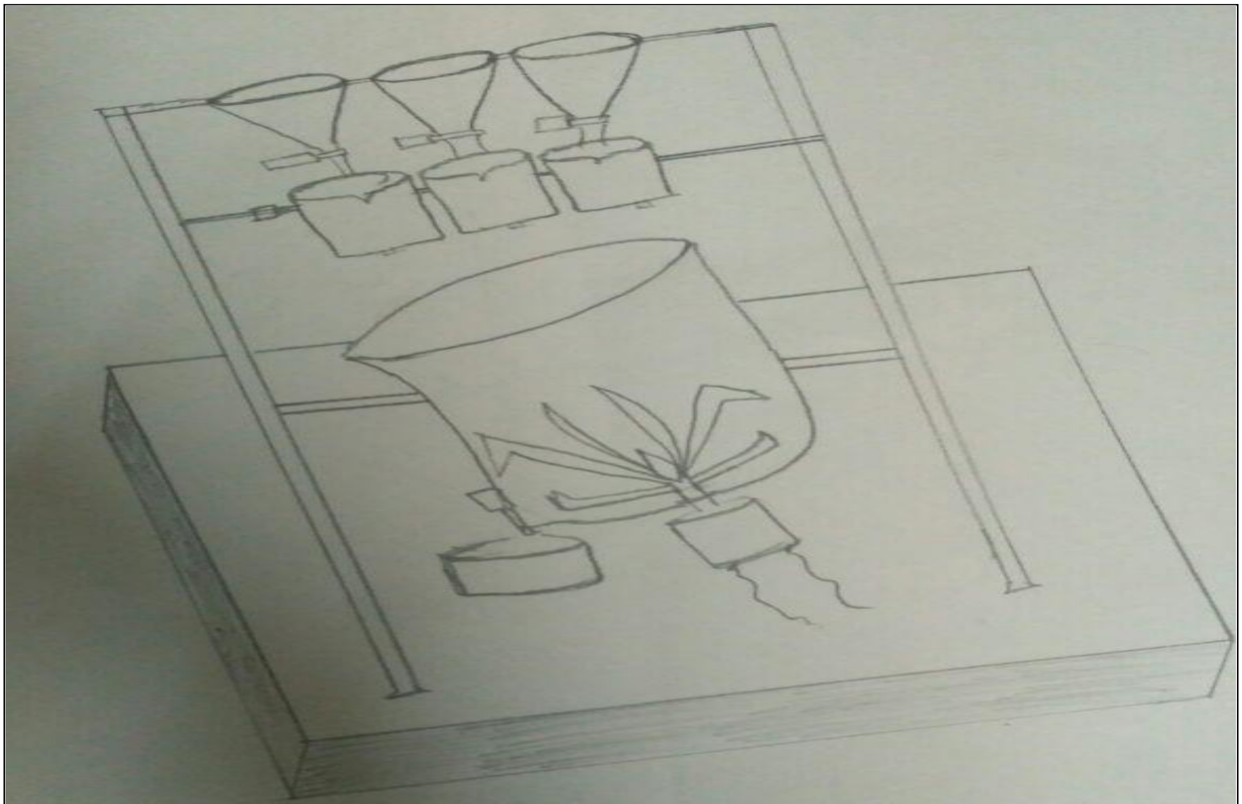
The design has three different storage compartments which has three different materials to be mixed. A servo motor is attached at the end of each compartment as shown, this servo motor is used to control the flow of materials into the mixing area. The time taken by each material to enter the mixing area to get the required quantity of materials is calibrated by trial and error and is set into the program.

Once the materials start entering into the mixing area they are mixed by in it by rotating blades to get the output.

Thus a mixture of three different materials is obtained.

Figure 6: Idea no.1

Idea no: 2.



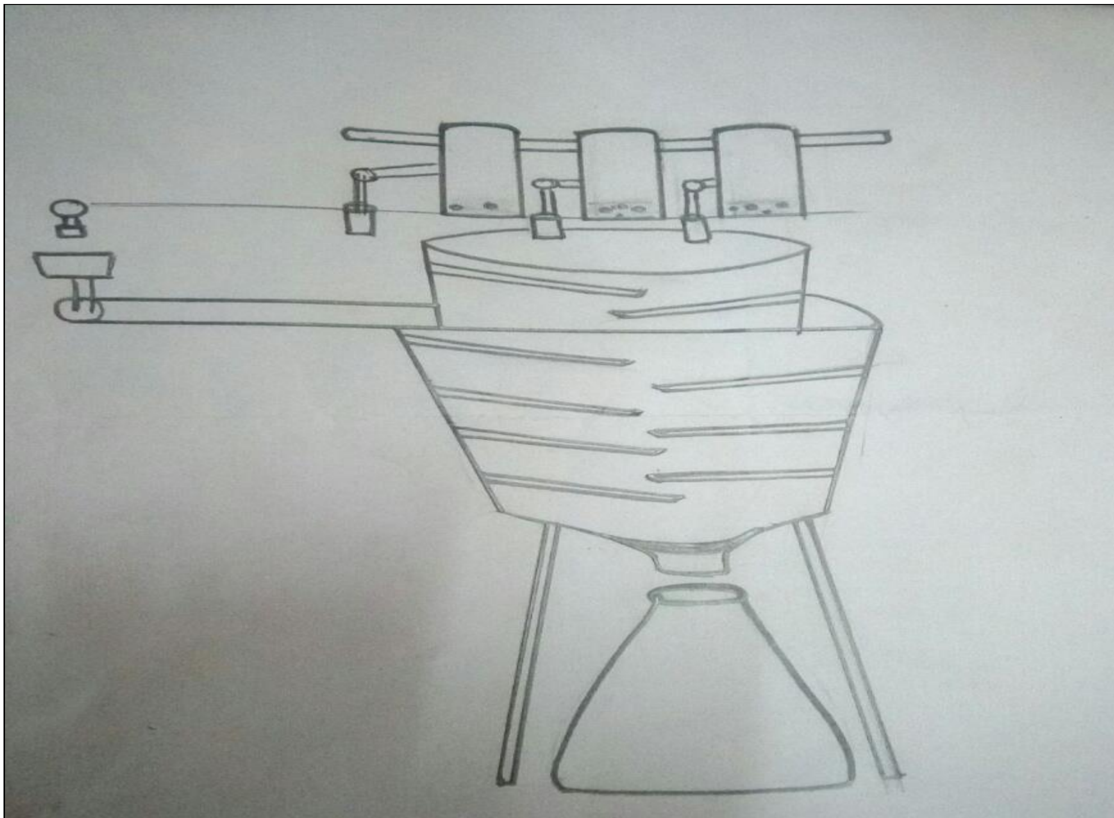
The design has three different storage compartments which has three different materials to be mixed.

Below to the storage compartments are the containers which consist of IR sensors. Once the materials reach a specific height IR sensor will be blocked and the container is opened and the materials flow into the mixing area where is it mixed to get the required output.

Thus a mixture of three different materials is obtained.

Figure 7: idea no.2

Idea no: 3.



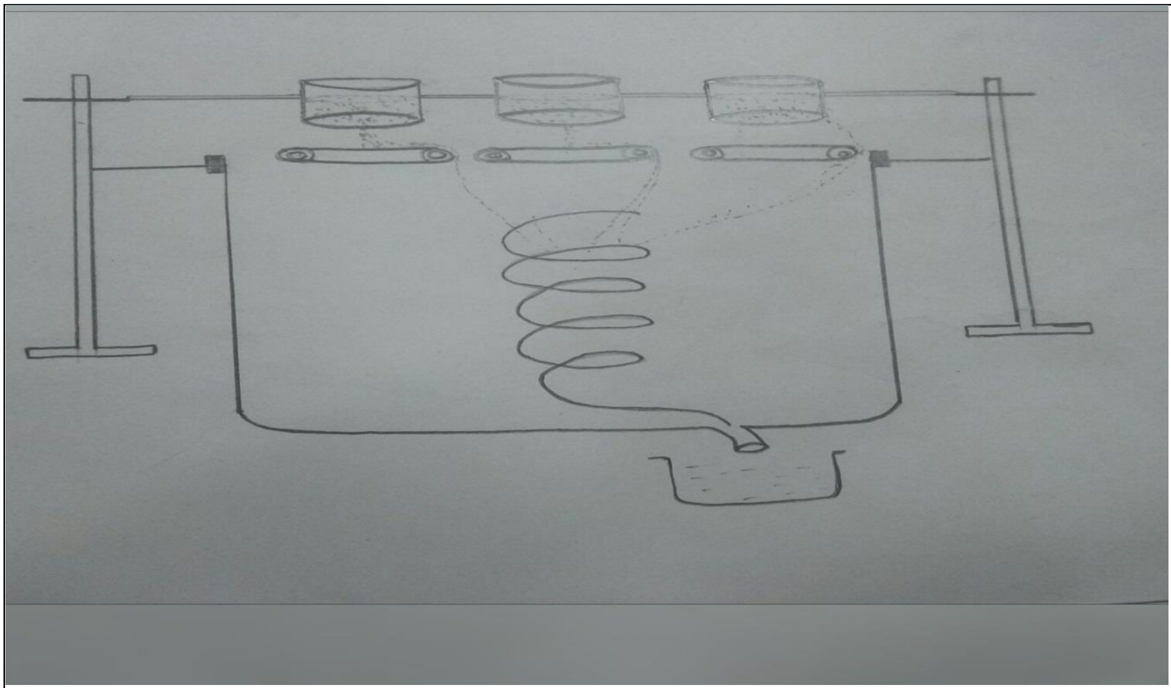
The design has three different storage compartments which has three different materials to be mixed.

The storage compartments are made to move back and forth using rocker and pin mechanism for a specific time to get the required quantity of the material into the mixing area. The materials are mixed by the blades and also by making the mixing container rotate using belt drive and output is obtained.

Thus a mixture of three different materials is obtained.

Figure 8: Idea no.3

Idea no: 4.



The design has three different storage compartments which has three different materials to be mixed.

A belt passed through each compartment for a specific amount of time to get the exact quantity of the material required and then is sent into the mixing area where the materials are mixed to get the required output.

Thus a mixture of three different materials is obtained.

Figure 9: Idea no.4

6. Analysis of alternatives

The weightage given for the design considerations are as mentioned below.

1. Cost of the prototype
2. Size of the designed prototype
3. Low and easy maintenance
4. Time to complete the task

The percent indicating the weightages for the criteria are decided in pairwise comparison chart. Below is the decision matrix for analyzing and selecting the best solution out of four feasible ones.

Table 2: Decision Matrix

Criteria	Weight (%)	Design 1	Design 2	Design 3	Design 4
Cost of the prototype	12.53%	8	7	8	6
Rate X Weight		100.24	87.71	100.24	75.18
Size of the designed prototype	25%	8	7	6	7
Rate X Weight		200	175	150	175
Low and easy maintenance	8.33%	7	6	6	5
Rate X Weight		58.31	49.98	49.98	41.65
Time to complete the task	29.16%	9	6	8	6

Rate X Weight		262.44	174.96	233.28	174.96
Total	100%	620.99	487.65	533.5	466.79

Justifications:

Design 1:

1. Cost of the prototype: 8 points. Cost of this design idea will be lesser when compared with others.

2. Size of the designed prototype: 8 points. This design is small when compared with all other designs.

3. Low and easy maintenance: 7 points. The parts are simple and can be easily cleaned.

4. Time to complete the task: 9 points. We believe that this design completes the task faster when compared to others due to its simple working principle.

Design 2:

1. Cost of the prototype: 7 points. This design is expensive when compared to other designs.

2. Size of the designed prototype: 7 points. This design is quite bigger when compared with other designs.

3. Low and easy maintenance: 7 points. Due to complex mechanism its cleaning and maintaining is a difficult job.

4. Time to complete the task: 6 points. The mechanism is complex hence it takes more time.

Design 3:

1. Cost of the prototype: 7 points. This design is expensive when compared to other designs.
2. Size of the designed prototype: 7 points. This design is quite bigger when compared with other designs.
3. Low and easy maintenance: 7 points. Due to complex mechanism its cleaning and maintaining is a difficult job.
4. Time to complete the task: 6 points. The mechanism is complex hence it takes more time.

Design 4:

1. Cost of the prototype: 7 points. This design is expensive when compared to other designs.
2. Size of the designed prototype: 7 points. This design is quite bigger when compared with other designs.
3. Low and easy maintenance: 7 points. Due to complex mechanism its cleaning and maintaining is a difficult job.
4. Time to complete the task: 6 points. The mechanism is complex hence it takes more time.

7. Detailed design of final solution

Detailed Drawing

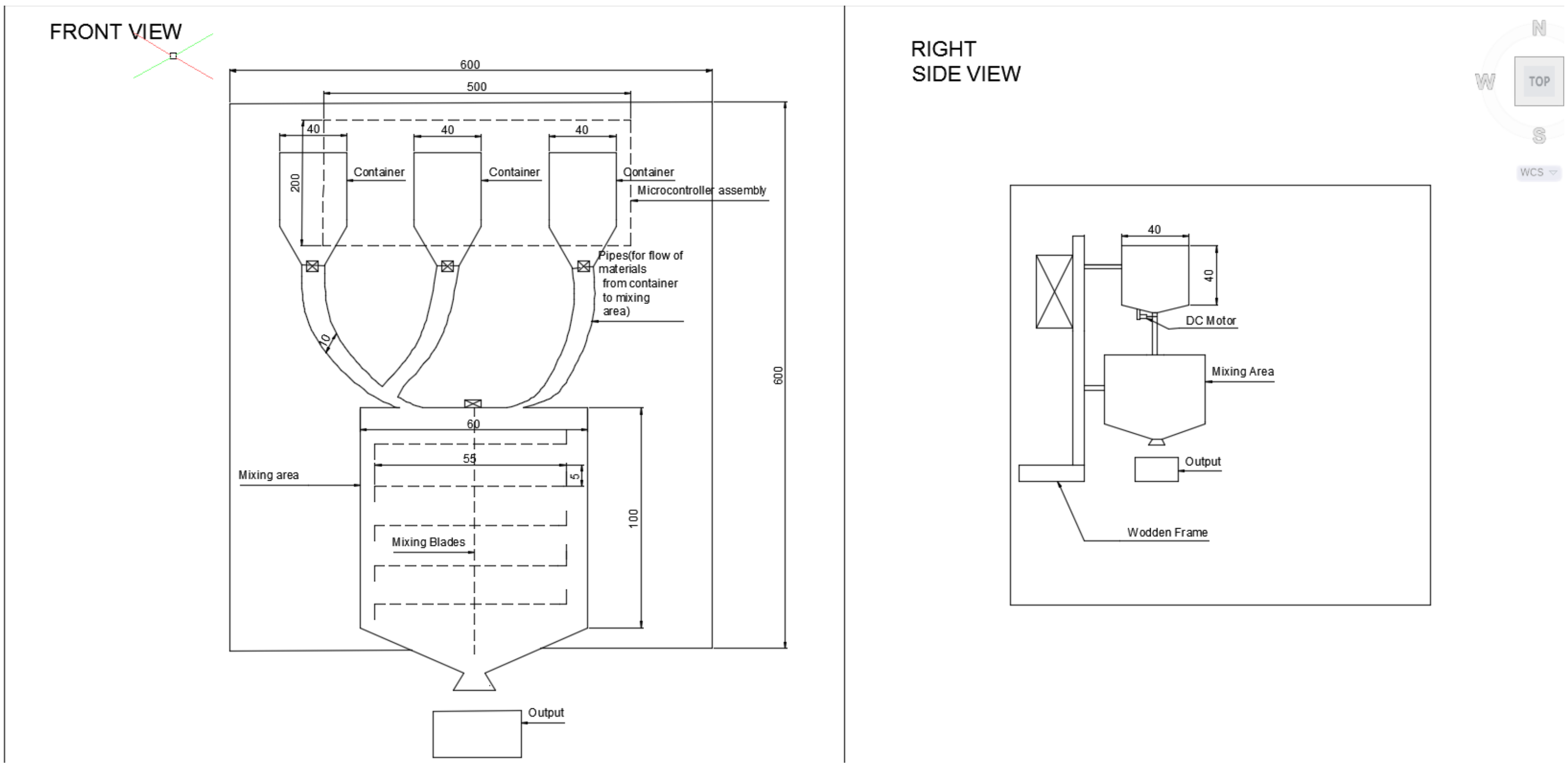


Figure 10: Detailed drawing-a

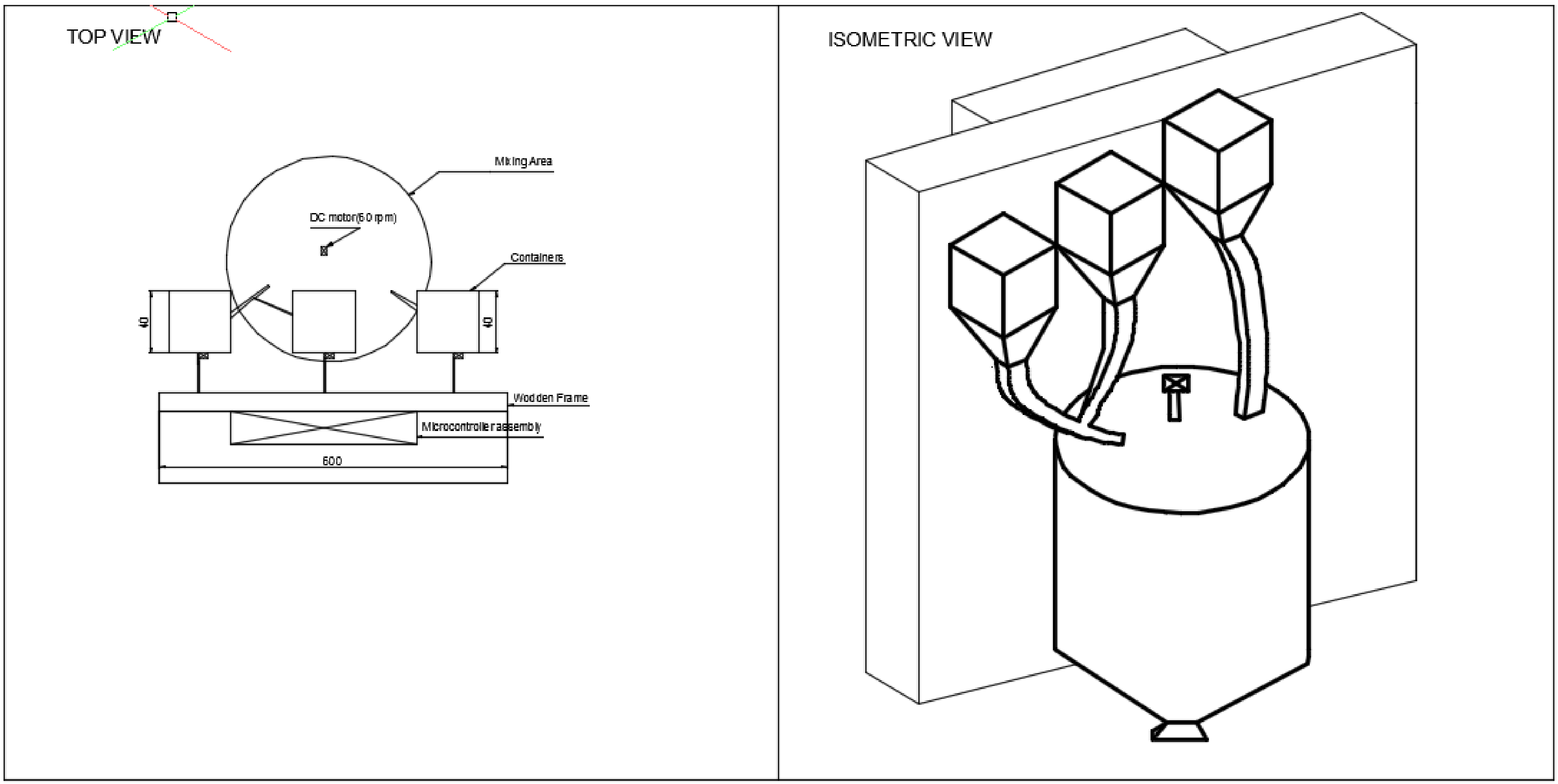


Figure 11: Detailed drawing-b

Electrical/Electronic Circuit Diagram

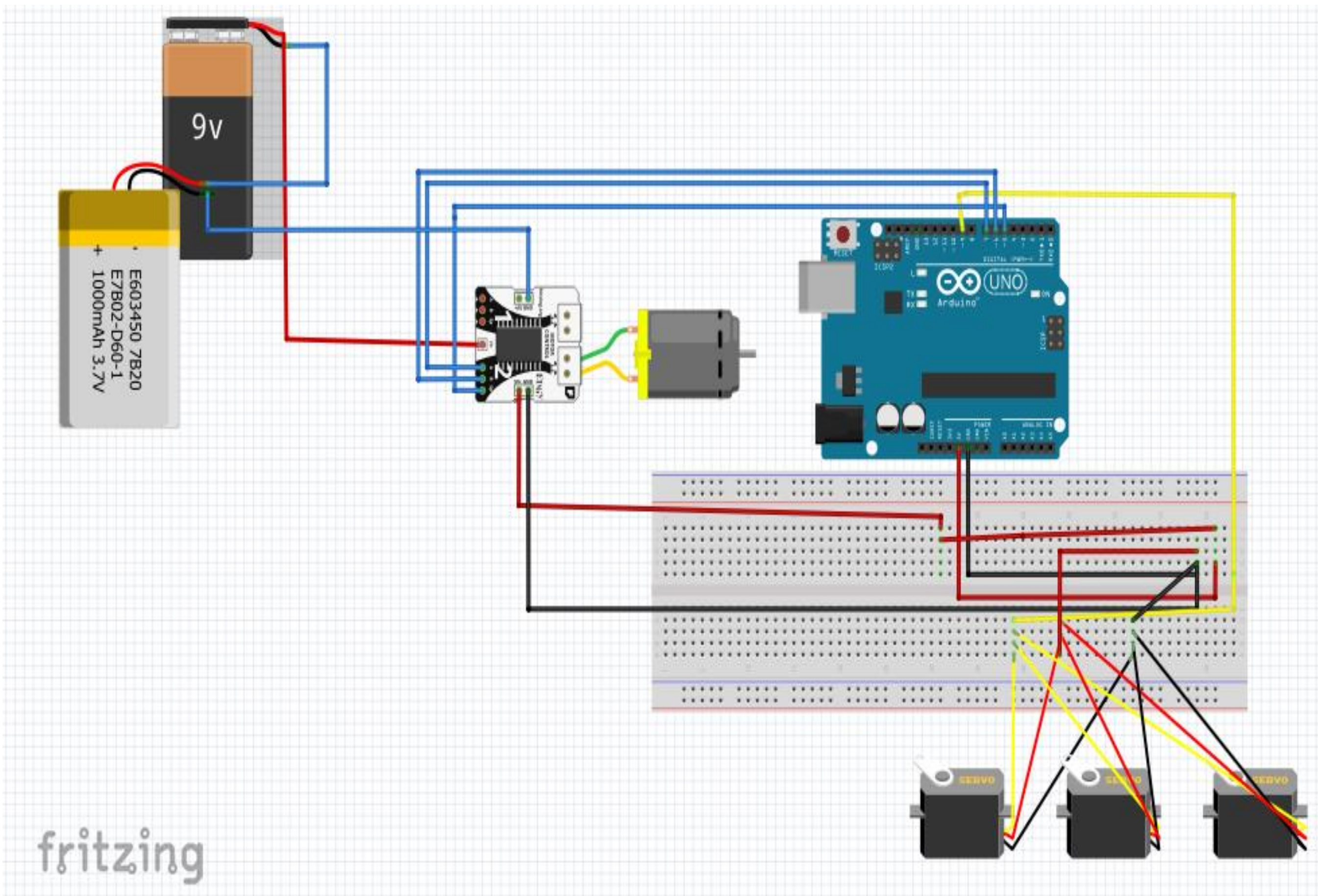


Figure 12: Circuit diagram

Flow chart

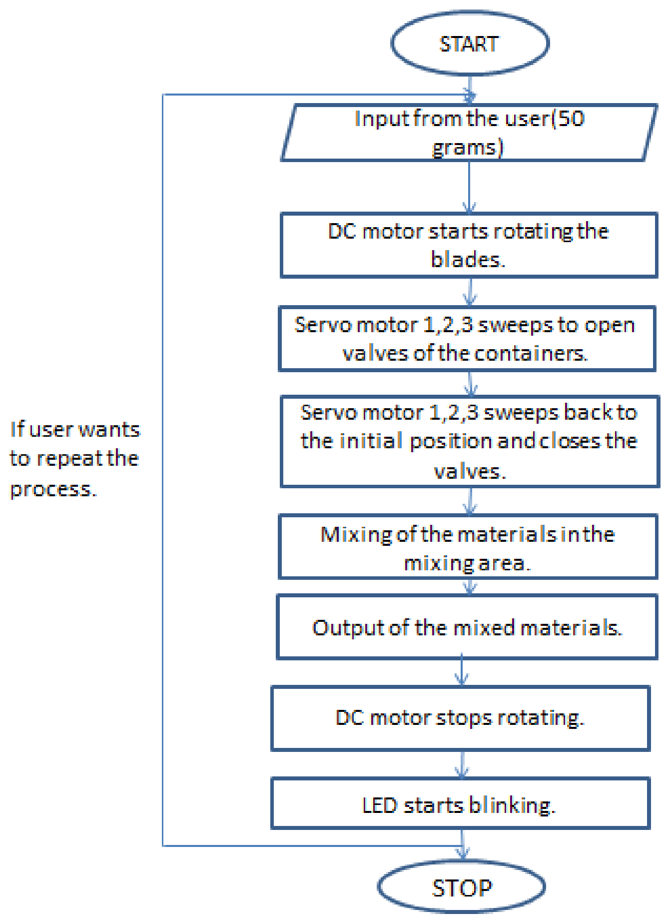


Figure 13: Flowchart

Arduino Program

```
#include <Servo.h>

Servo myservo;

int pos = 0;

void setup()

 {

  myservo.attach(9);

  pinMode(6,INPUT);//Enable

  pinMode(7,INPUT);//IN1

  pinMode(8,INPUT);//IN2

  pinMode(10,INPUT);//LED

}

void loop() {

  int i=0;

  digitalWrite(7,HIGH);

  digitalWrite(8,LOW);

  digitalWrite(6,HIGH);

  for (pos = 0; pos <= 45; pos += 1)

  {

    myservo.write(pos);

    delay(10);
```

```
}
delay(4000);
 for (pos = 45; pos >= 0; pos -= 1)
 {
   myservo.write(pos);
 }
 delay(4000);
  i=1;
 if(i==1)
 {
 exit(0);
 }
}
```

Bill of materials

Table 3: Bill of Materials

Sl.No	Part Name	Material with which the part is made up of	Description about part	Quantity required
1	Container(12 cm in diameter)	Plastic	12 cm in diameter and 5 cm in height	3 No's
2	Mixing container	Plastic	4cm in diameter and 5 cm in height	1 No.
3	Pipes	Plastic	3cm diameter, 20 cm long	1 No.
4	Mixing blades	Acrylic	1 cm in radius	25 No's
5	Arduino UNO	-------	Microcontroller	1 No.
6	DC motor	Silicon	200rpm	1 No.
7	Frame	Wooden	45x50x1.5cm and 40x40x1.5cm	3 No's
8	Wires	Copper	2m wires	1 No.
9	Motor Drivers	------	L298	2 No's
10	Battery (12 V)	Copper	3 meter long	1No.
11	Nuts and bolts	Silicon	L298, 5 cm long and 0.2 inch diameter	2 No's
12	Weighing Machine	----------	12 v, 10 kg max weight	1 No.
13	Breadboard	Iron	0.2 inch	10 No's

14.	Plastic Glue	-------	Kitchen Weighing Scale	1 No.
15.	Double sided tape	--------	9 v to power Arduino	1 No.
16.	Funnel	--------	plastic,11.5 c m diameter	1 No.
17.	Output container	--------	1 cm diameter and 10x5x4 cm	6 No's
18.	LED	---------	R,G&B	1No.
19.	Jumper Wires	---------	4m, M to F, F to F, M to M	1No.
20.	Gum tape	Plastic	1 inch wide and 3m long	1 No.
21.	Servo Motor	Plastic	1.2kg Torque	1 No.
22.	Foam Board	Plastic	30x30 inch	1 No.

8. Implementation

Figure 14: Building up of the model (front portion)

Figure15: Building up of the model (rare side)

Figure 16: Tweaks and changes in the model

Figure 17: Final changes in the Prototype

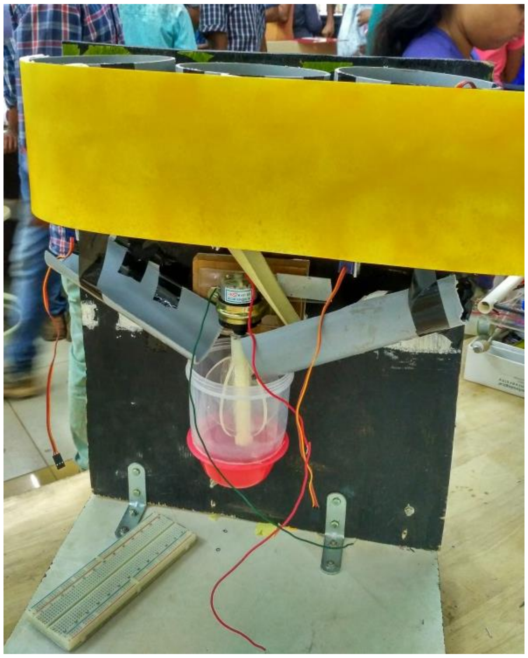


Figure 18: Final Working prototype

Statement of Expenditure

Table 4: Statement of Expenditure

Sl. No	Item with description	Quantity	Price in Rs.
1	Container(12 cm in diameter)	3	75
2	Mixing container(4cm in diameter and 5 cm in height)	1	20
3	Pipes(3cm diameter, 20 cm long)	1	---
4	Mixing blades(1 cm in radius)	5	----
5	Arduino UNO	1	390
6	DC motor(200rpm)	1	140
7	Frame- wooden plank (45x50x1.5cm) and (40x40x1.5cm)	1	-----
8	Wires(2m copper wires)	1	10
9	Motor Drivers(l298)	1	300
10	Battery (12 V)	1	600
11	Nuts and bolts (5 cm long and 0.2 inch diameter)	25	-----
12	Weighing Machine(10 kg max weight)	1	320
13	Breadboard	1	70
14	Plastic Glue	1	------
15	Double sided tape	1	------
16	Funnel(plastic,11.5 c m diameter)	3	30
17	Output container(10x5x4 cm)	1	30

18	LED(R,G&B)	1	3
19	Jumper Wires(M to F, F to F, M to M)	20 each	-----
20	Gum tape(1 inch wide and 3m long)	1	30
21	Servo Motor(1.2kg torque)	3	600
22	Foam Board(30x30 inch)	1	100
TOTAL= 2718			

9. Testing

The users were successful in using our prototype without any problems or questions. The users were successful because the machine is user friendly as it has just a single switch which on using it gets the user a 50 gram of each material a total of 150 grams thoroughly mixed materials in less than two minutes.

The users were have to be explained regarding the working of the prototype and also the quantity of materials that would be mixed initially, these were only perquisites that are needed by the users to take advantage of the prototype and we helped them in doing it.

The users understood the working of the prototype and used it as explained.

Initially the problems we faced was the jamming of the valves due to increased rate of contact between the valve pipes and the open-close mechanism, this was corrected by proper alignment of the servo motors and their shafts.

We had a measurable target to get 50 gram of each material to be mixed at once so that output mixed materials would be a total of 150 grams, after many trial and error attempts we were finally able to get the exact quantity of the materials i.e. 50 grams of each and a total of 150 grams.

Initially we thought sending the materials from the container to mixing areas in closed pipes as the time duration for the travel of materials increased due to less available space we changed to wide open pipes to make the flow of materials from the container to the mixing area.

10. Limitations of Present work and Future Scope

The limitations of our work is that we can get each materials mixed in either 50 grams or multiple of 50 grams only, if the user wants other than the mentioned values he/she cannot obtain it through our prototype this is because the opening and closing of valves of the container is calibrated such that only 50 grams of material at each instant flows, the model has servo motors whose angle alignment is difficult if the user wants to open and clean the prototype.

The future scope is that we can use weighing sensors instead of open close mechanisms to get the quantity of the materials as per the user requirements; this also enables the user to open and clean the prototype without worrying about the angle alignment as it is in our present model.