SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
Kuniamuthur, Coimbatore, Tamilnadu, India
An Autonomous Institution, Affiliated to Anna University,
Accredited by NAAC with "A" Grade & Accredited by NBA (CSE, ECE, IT, MECH ,EEE, CIVIL& MCT)

Department of Mechatronics Engineering

AUTOMATIC WASTE SEPARATOR FOR HOME

Project Members:

1. 18EUMT104 – Tansin K
2. 18EUMT105 - Tazmeel Ahamed S
3. 18EUMT106 - Tharun Sri Ram N
4. 18EUMT112 - Venuprasath S

Industry Guide:

Mr. Anand Bala Ganapathy,

FLICKERHIVE,
Coimbatore.

Project Guide:

Ms. M. Bhuvaneswari,

Assistant Professor.

INDUSTRY DETAILS

FLICKERHIVE

1, Subramaniapuram 1st Street,

R.S.Puram,

Coimbatore – 02,

Contact- +91-9944776365

Email – flickerhive@gmail.com

APPROVAL LETTER

FLICKERHIVE

TO
The Head Of the Department,
Mechatronics Department,
Sri Krishna College of Engineering and Technology,
Kuniyamuthur,
Coimbatore-641008

Dear Sir/Madam,

We hereby agree to allow the following students to do their project work in our organization, For the duration of 4 months (15.02.2022 to 15.05.2022),

1. 18EUMT104 - Tansin K
2. 18EUMT105 - Tazmeel Ahamed S
3. 18EUMT106 - Tharun Sriram N
4. 18EUMT112 - Venuprasath S

During their project work in our company Flickerhive, Coimbatore, the students must abide by our rules and regulations.

Sincerely,

ANAND BALA GANAPATHY

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1, SUBRAMANIYAPURAM 1ST STREET, R.S.PURAM, COIMBATORE-641002

INTRODUCTION

- To design a waste separator machine which separate waste into dry, wet, and metal waste for the process of home automation.
- This project aims to develop a domestic garbage separation system for household needs which can also be used in public places like schools, colleges, railway stations and airports etc.
- For the current project we consider the types of waste as

  a) Dry wastes

  b) Wet wastes

  c) Metal wastes

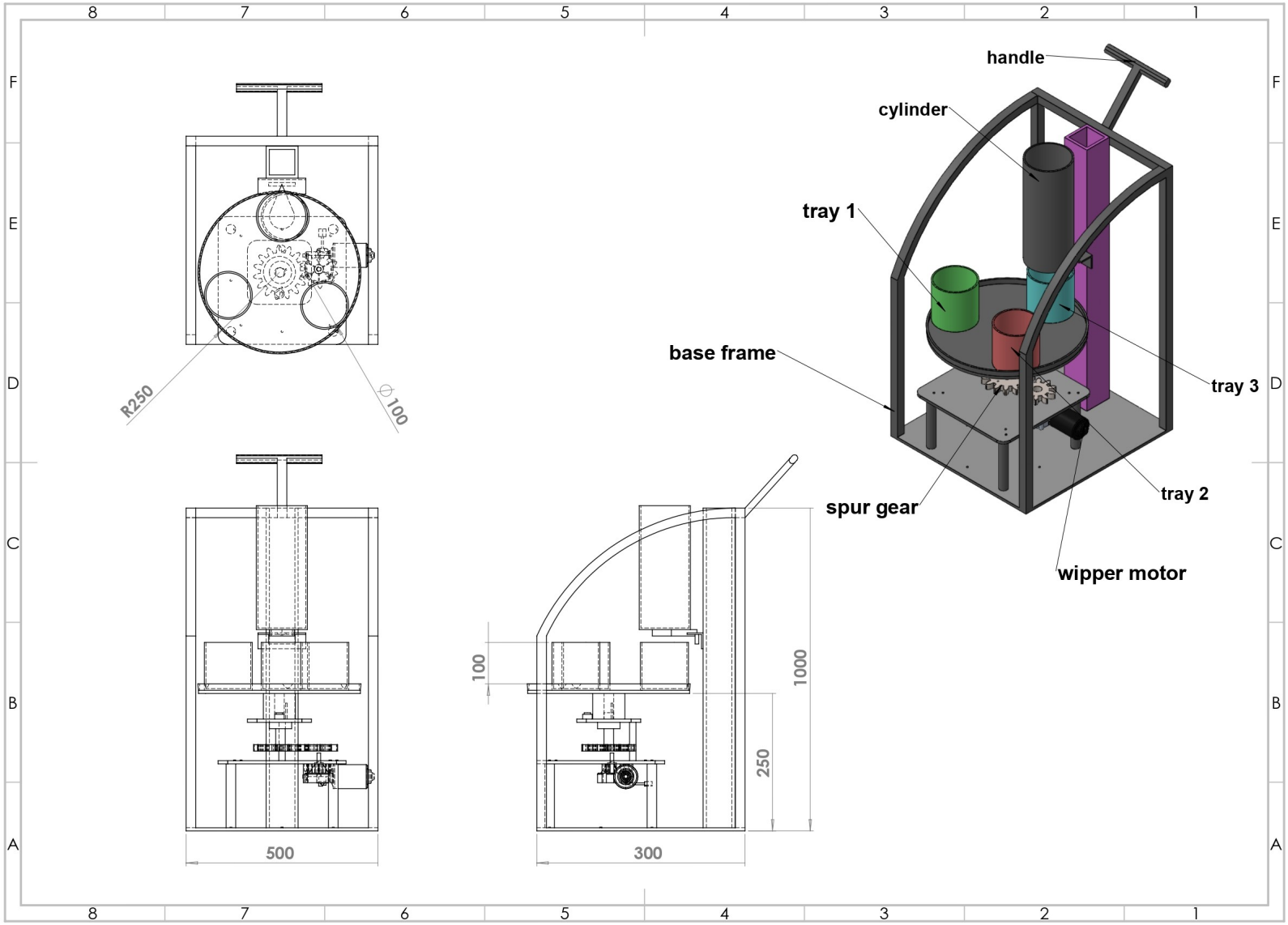
LITERATURE REVIEW

S.NO	Paper Title	Authors	Journal Name, Year of Publication	Inference
1	Automatic Waste Segregation System	Venkatesh Naik	May 2020	It focuses on how the waste segregated separately by using particularly respective sensors.
2	Automatic Waste Sorter Machine using Proximity Sensor	Vivi Tri Widyaningrum	Oct 2020	The aim is to automate waste sorting by applying techniques to recognize the type of waste.
3	Waste Segregation Using Smart Dustbin	SHADAKSHARI R	Jan 2021	It proposes an automated waste classification system. It is used to classify objects into dry, wet and metal wastes, based on the object recognition accuracy in real-time. It is suitable for a large amount of waste segregation process.

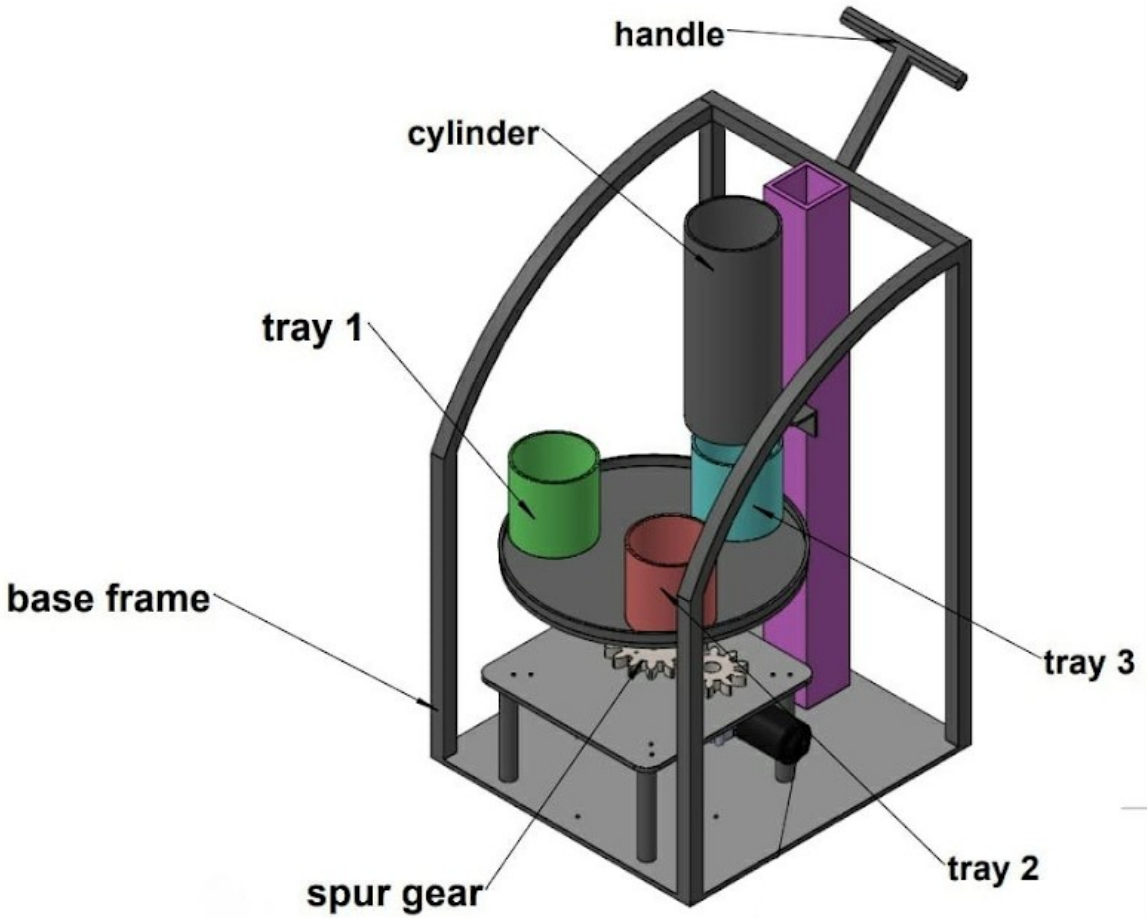
LITERATURE REVIEW

S.NO	Paper Title	Authors	Journal Name, Year Of Publication	Inference
4	Smart garbage management system	Parth Jajoo	June 2020	It focuses on the LCD integration required for this process.
5	IOT based automated waste segregator for efficient recycling	T.Saminathan	Oct 2019	The aim is to automate waste sorting by Using proximity sensor.
6	Automatic waste management and segregation system using IOT	Nandhini.S	Feb 2021	It proposes a software system and sensor integration for this process.

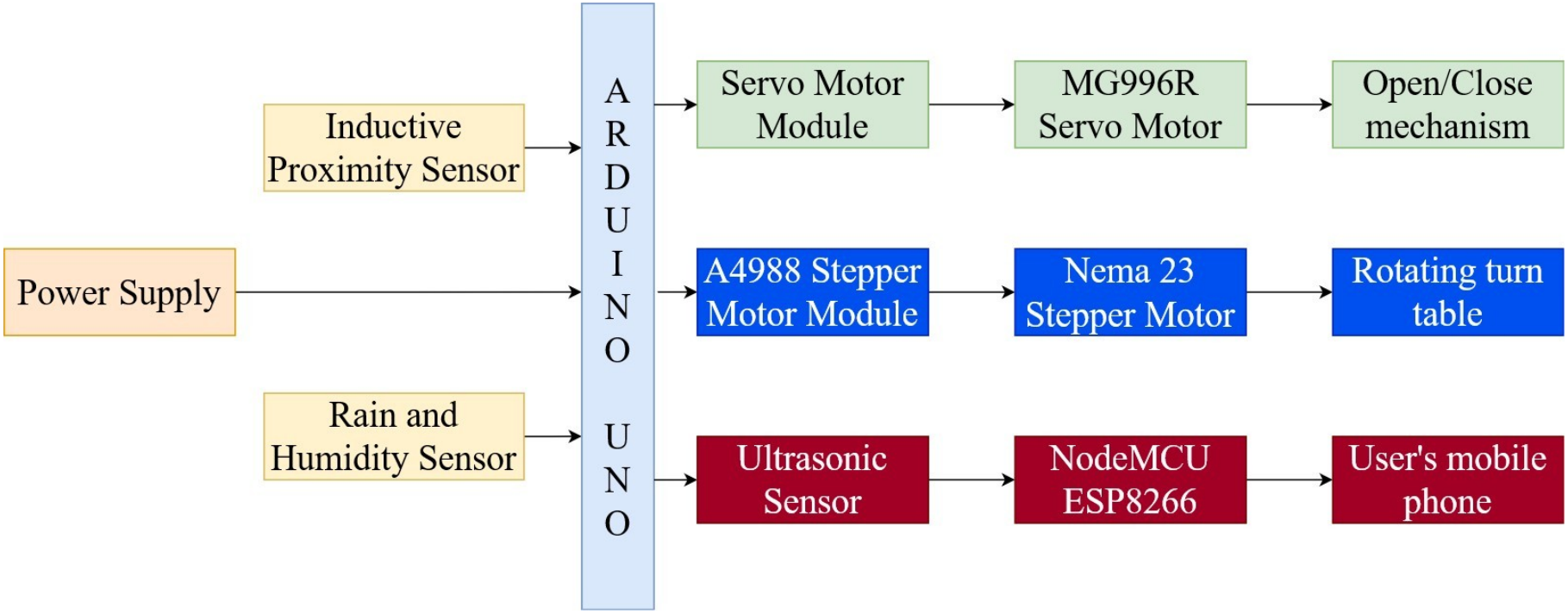
2D DIAGRAM


handle
cylinder
tray 1
base frame
tray 3
tray 2
spur gear
wipper motor
R250
∅100
500
300
100
1000
250

3D DIAGRAM



BLOCK DIAGRAM



CALCULATIONS

Selection of Servo Motor:

- Length of the arc of sector formula = $\boldsymbol{\theta}/360° \ . \ 2\pi r$, where $\boldsymbol{\theta}$=120° r=50mm
- By substituting the known values, we get, L.A of sector = 104.67mm
- For per rotation, L.A. of sector = 104.67/120 = 0.87mm
- By neutralizing it with market values, we use 1mm pitch.
- B_{eff} = 0.92 (Mechanical efficiency of a motor)
- M = 0.1 (Coefficient of friction)
- F = 0 N (External force excluded)

CALCULATIONS

Calculation of Torque for servo motor:

- $T_f = B_p/2pi\ Beff\ (\mu gW + F)$
- m = 1kg ; W = m x g = 1 x 9.81 = 9.81 N
- By substituting the known values, we get Tf = 0.017 kg-cm
- For our application, we require a torque of 0.017 kg-cm. By referring to the servo motor catalogue, MG90 Tower Pro servo motor is selected for this application.

CALCULATIONS

Stepper Motor Calculations:

- Diameter of index table, D_T = 400mm
- Index table thickness, L_T = 100mm
- Diameter of load, D_W = 150mm
- Thickness of load, L_W = 150mm
- Material of table and load = Iron = 7.9×10^3 kg/m^3
- Number of load = 3
- Distance from center of index table to center of load, C = 150mm
- Positioning angle, = 120°
- Resolution, = 0.04°

CALCULATIONS

- Positioning period, t_0 = 0.4s
- Required resolution, s = 0.04° = 0.02° x 2 (pulses)
- The RK series PN geared type (gear ratio 1:36, 0..02°/step) can be used.
- Acceleration & Deceleration period t_1 = 0.4 x 0.25 = 0.1s
- A = 3 = 30°/0.02 = 1500
- Operating Pulse speed f_2 = (A - f1 . t1)/(t0 - t1) = (1500-0)/(0.4-0.1) = 5000Hz
- Standard stepping angle for unipolar inertia of table, $J_t = (\pi/32)\ \rho\ .\ L.\ D_t^4$
- By substituting the known values, we get $J_T = 1.57 \times 10^{21}$ kg.mm^2
- $J_w = (\pi/32)\ .\ \rho.\ Lw.\ D\ w^4$

CALCULATIONS

- By substituting the known values, we get $J_w = 5.88 \times 10^{13}$ kg.mm^2
- $J_w'' = J_w' \times mc^2$
- By substituting the known values, we get $J_w'' = 5.88 \times 10^{13}$ kg.mm^2
- $J_w = 4 \times 5.88 \times 10^{13} = 23520$ kg.mm^2
- Total Inertia, $J_L = 23520 + 1.57 \times 10^4 = 0.3922$ kg.m^2
- Acceleration Torque $T_a = (J_o \cdot i^2 + J_L) \times (\pi \cdot \theta s)/180° \cdot (f2 - f1)/t1$
- By substituting known values, $T_a = 22.619 \times 10^3 J_0 + 1.92$ N-m
- Total required torque = $(T_L + T_a) \times 2$

CALCULATIONS

- By substituting known values, T_m= 4 Nm
- So for the application, the necessary torque is 4 Nm. By looking at the stepper motor catalogue, Oriental Motors RK564BC-N36 is selected for this application.

Column calculation:

- Breadth of column, b = 80mm
- Length of column, l = ?
- By Golden ratio, lb =1.67, l = 1.67 x 80 = 134mm. We take 700mm as length
- $\sigma = \sigma_a + \sigma_b$, $= \sigma y/FOS$ where $_y$ is the yield strength of steel = 250 N/mm^2
- FOS = 2 (Ductile material)
- Total mass = 1.25+0.25+0.25+0.25 = 2kg

CALCULATIONS

- $F = W = mg = 19.62N$
- $A = b \times t$
- $\sigma_b = bt^3/12$
- $\sigma = \sigma_a + \sigma_b$
- $125 = 19.62/80t + 80t^3/12$
- By simplifying it, we get $t \sim 3mm$
- For safety, we are considering 10mm thickness
- Area of moment of inertia of rectangle
- $Ixx = bt^3/12 = 6667\ mm^4$
- $I_{yy} = b^3t/12 = 426667\ mm^4$
- $K = \sqrt{(I/A)} = 2.8$

CALCULATIONS

- $(l/k)_1 = 250$
- $\sigma y/FOS = n\pi^2E/(l/k)^2$
- By substituting known values, $(l/k)_2 = 62.8$
- So, it is long column, thus has to be proceeded with Euler's formula
- Euler's Formula
- $PCr = \pi^2EI/le^2$
- By substituting known values, PCr = 6708N
- $P_{actual} = 19.62N < 6708N$
- So, the design is safe.

CALCULATIONS

Bending Stress Calculation for plate:

- $y = d/2$
- $W = 91.723N$
- $l = b = 350mm$, $d = ?$

Bending stress:

- $M/I = \sigma/y$
- $\sigma = \sigma_y/FOS$; σ_y = yield strength of steel = 420 N/mm^2
- FOS = 2 (Ductile material)
- $\sigma = 210\ N/mm^2$

CALCULATIONS

- Moment of resistance, $M = W l / 4 = 8025.76$ N-mm
- Moment of Inertia, $I = bd^3/12$ $y = d/2$
- By substituting the known values, we get d = 0.82mm.

  We got the value of 0.82mm for the safety and allowance, the value can be rounded to 2mm to the thickness of the plate. So, the dimensions are safe.

Column calculation:

- Mass of disc = 3kg = 3000g
- Mass of all 3 dustbins = 750g
- Mass of total waste = 600g

CALCULATIONS

- Mass of stepper motor = 5000g
- Mass of plate = 3000g
- Total mass = 3000+750+600+5000+3000 = 12350g
- F = W = mg = 12.35kg x 9.81
- P or W = 121 N
- $\sigma = P/A$
- $\sigma = \sigma_y/FOS$; σ_y = yield strength of steel = 250 N/mm^2
- FOS = 2 (Ductile material)
- $\sigma = 125\ N/mm^2$
- $A = 1\ mm^2$
- Area of circle = πr^2

CALCULATIONS

- $r = 0.56$ (approx. 1.5mm)
- As per the market standard, diameter is taken as 3mm
- Area of cross section of circle = $\pi r^2 = 7\ mm^2$
- Area of moment of inertia:
- $I_{xx} = I_{yy} = d^4/64 = 3.97\ mm^4$
- $I = 4\ mm^4$, $A = 7\ mm^2$
- $K = \sqrt{I/A} = 0.75$
- $l/K = 200$
- $\sigma y/FOS = n\pi^2 E/(lk)^2$
- Both ends are fixed. So, n=4
- $E = 2 \times 10^5\ N/mm^2$

CALCULATIONS

- By substituting known values,
- $l/K = 251$
- $251 > 200$, So, it is a short column.
- We get into Johnson's Formula
- Johnson's Formula
- $PCr = \sigma yt \times A \times [1 - (\sigma yt)/ (4\, n\, \pi^2\, E) \,.\, (lk)^2]$; Both ends are fixed, so $n = 4$
- By substituting the known values, we get $PCr_{actual} = 876N$
- $PCr_{actual}/P = 876/121 = 7.2N$
- So, design is safe.

CALCULATIONS

Circular Disc Calculation

- Mass of 3 no. of dustbin = 900g
- Mass of 3 no. of waste (approx.) = 600g
- Total mass = 900g + 600g = 1650g
- Total mass, m = 1.65kg
- F = W = m x g
- F = W = 1.65 x 9.81
- F = W = 15.7N

CALCULATIONS

- $y = t/2$
- $W = 15.7$ N
- $t = ?$
- Bending Stress
- $M/I = \sigma/y$
- $\sigma = \sigma_y / FOS$
- σ_y = Yield strength of steel = 250 N/mm^2
- FOS = 2 (Ductile material)
- $\sigma = 250/2 = 125$ N/mm^2

CALCULATIONS

- M = Moment of resistance for simply supported beam
- M = Wl/4 = (15.7 x 400)/4 = 1570N-mm
- I = Moment of inertia for rectangle = $bt^3/12$
- y = t/2
- M/I = σ/y => $1570/(400t^3/12) = 125/(t/2)$
- $t^2 = 18840/100000$
- t = 0.43mm
- For safety and allowance concerns, the value t = 0.43mm is rounded off to 3mm to the thickness of the plate. Hence, the design for the circular disk is safe.

CALCULATIONS

Circular Flap Calculation

- Mass of waste (approx.) = 0.25 kg
- Mass of servo motor = 0.25kg
- Total mass = 0.25kg + 0.25kg
- Total mass, m = 0.5kg
- F = W = m x g
- W = 0.5 x 9.81
- W = 5N
- t =?
- Bending Stress
- $M/I = \sigma/y$

CALCULATIONS

- $\sigma = \sigma_y$ / FOS
- σ_y = Yield strength of steel = 250 N/mm^2
- FOS = 2 (Ductile material)
- σ = 250/2 = 125 N/mm^2
- M = Moment of resistance for simply supported beam
- M = Wl/4 = (5 x 100)/4 = 125 N-mm
- I = Moment of inertia for rectangle = bt^3/12
- y = t/2

.

CALCULATIONS

- $M/I = \sigma/y$
- $(125 \times 12)/(100t^3) = (125 \times 2)/t$
- $t^2 = 1500/25000$
- $t = 0.24mm$
- For safety and allowance concerns, $t = 0.24mm$ is rounded off to 2mm to the thickness of the table. Hence, the design for the circular flap is safe.

FINAL PRODUCT

FINAL PRODUCT

- Drive link: Automatic Waste Segregation Machine

PAPER ACCEPTANCE LETTER

7th International Conference on Communication and Electronics Systems (ICCES 2022)

22-24, June 2022 | icoecs.org/2022/ | icces2022@gmail.com

Acceptance Letter

International Conference on Communication and Electronics Systems
Coimbatore, India
22-24, June 2022

Paper ID : **ICCES135**

Manuscript Title : **Internet of Things based Intelligent waste segregation and management system for smart home application**

Author/s : **M.Bhuvaneswari,K. Tansin,S. Tazmeel Ahamed, N.Tharun Sri ram, S. Venu Prasat**

On behalf of the Conference committee, I would like to congratulate you on your to the ICCES 2022 IEEE Conference, which will be held from 22nd July to 24th June 2022 at PPG Institute of Technology, Coimbatore, India. You have been selected to deliver your oral presentation at the International Conference on Communication and Electronics Systems.

ICCES 2022 is an internationally-recognized IEEE Xplore IEEE conference, which dedicated solely for publication in Springer Lecture Notes in Electrical Engineering. Please visit the conference website for further updates [http://icoecs.org/2022/].

As a result of the review and results, we are pleased inform that you can now submit the full-length paper for inclusion into the IEEE Xplore ICCES proceedings. We appreciate if you could send the final version of your research paper at your earliest convenience, in order to ensure the timely publication. When submitting your final paper, please highlight the changes made according to the review comments.

Thank you for your contribution to the ICCES 2022 conference.

Yours sincerely,

V. Bi

Dr. V. Bindhu
[ICCES 2022 – Conference Chair]
Professor and Head
ECE Dept, PPG Institute of Technology
Coimbatore, India

COMPONENTS OF THE MODEL

S. No.	Components Required	Specification	Units	Cost
1	Stepper motor	Oriental Motors RK564BC-N36, 5-Phase Micro stepping motor	1	5500
2	Servo motor	Towerpro MG90 Servo Motor	1	599
3	NodeMCU	NodeMCU ESP8266	1	362
4	Arduino UNO	ATmega328P based board	1	1385
5	Inductive Proximity Sensor	M8 Inductive Proximity sensor	1	550
6	Ultrasonic Sensor	LM393 IR Sensor	4	140
7	Temperature Humidity Sensor	Evelta SHT20 I2C Rain & Humidity Sensor	1	1108
8	Liquid Crystal Display	16x2 Alphanumeric Display JHD162A	1	230
9	Wi-Fi Module	HC-05, RF Transceiver Module	1	454
			Total	~₹15500 (including fabrication costs)

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THANK YOU