iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: https://doi.org/10.22214/ijraset.2024.58941

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue III Mar 2024- Available at www.ijraset.com

Design and Development of Marigold Flower Petal Separating Machine

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Abstract: ***A marigold flower petal separating machine has been fabricated. The machine is fabricated for separating flower in two different parts, upper part consist of petals and lower part consisting of seeds. This project focuses in design fabrication of mechanical part of machine and the system of petal and seed separating machine. To achieve this project objective, the machine body structure and the mechanical system need to analyses some other criteria such as performance, strength, safety, and ergonomic design. Design of Model (Mechanism). Fabrication of Model setup as per CAD or CREO design. Conducting Experiment on the Model setup. Results and discussions. Conclusion as per results. After testing and obtaining results the conclusion of project will be done and put to use.***
Keywords: Machine, Cutting, Seeds, Mechanism, Cutter.

I. INTRODUCTION

A Marigold flower has a very important and prominent place on any occasion of celebration, marriage ceremony, festival or any other function. Because of this major part of the flower, waste is generated especially from the temples. When this flower are collected in large quantity, it make very difficult to manage such large quantity of flowers. These flowers are collected and utilize for better purpose, they are needed to be converted into compost by separating seed from it. In addition, oil is extracted from the seeds of marigold flower and is used for medicinal purpose. In this project, we describes the design based on the separating operation of the seeds and petals of marigold flower. Machine uses the 'belt and pulley drive mechanism'. The purpose of mechanism is to separate the seeds from flower in downwards direction while the blade cuts the flower. This machine can provide above 95% of cutting efficiency. For this, we work on cad model of machine with the help of cero parametric 3.0. Flat belt is operated by the rotor of gear DC motor at the speed of 60 rpm and cutting blade is rotated with the high rpm DC motor which is rotating at 4000 rpm. After finalizing the mechanism, we attempting various experiments on the machine. During the process if any flower comes out of the machine uncut, the machine, resulting in the increase in accuracy of the machine, can still report it. The aim of this project is economically feasible and we are under the impression that it can be further reduced, when it produced on large scale.

II. PROBLEM IDENTIFICATION

Marigold flower has a very important and prominent place on any occasion of celebration, marriage ceremony, festival or any other function. Because of this major part of the flower, waste is generated especially from the temples. Normally, we garland or offer flowers to almighty while worshiping. After 24 hours they are removed and thrown. It is called Nirmalya. In the process of throwing the flowers' waste is not segregated and take a form of filth that smell very bad. City college has come up with a solution that can become a part of waste management of flowers. The machine can separate petals and seed of the Marigold Flower, thereby, paving the way for efficient management of flower waste in India.

III. AIM & OBJECTIVES

1) *Aim:* Design and Fabrication of Machine for Separating the Seeds from Flower.
2) *Objective:* To Decide and Design the Separate Components of Machine.

IV. LITERATURE SURVEY

1) *Shrimp-cutting machine for cutting intermediate joints*

Derrell Sawyer [1]

An apparatus for cutting a shrimp body, the shrimp body having a tail portion that includes a plurality of tail sections connected by joints. A motorized driving mechanism mounted inside a housing drives a cutting mechanism mounted outside the housing.

The cutting mechanism includes a rotating cutting disk and a holding and carrying mechanism configured to securely hold the shrimp body and carry the shrimp body past the rotating cutting disk. The holding and carrying mechanism is configured to position the shrimp body in relation to the rotating cutting disk so that when the cutting disk cuts the shrimp body, the cutting disk leaves intact, a first joint at a head end of the tail portion and a last joint at a tail end of the tail portion, while cutting at least one intermediate joint between the first and last joints.

2) Automatic boning system of upper half of slaughtered edible fowl

FUJIWARA YOSHIMITSU [2]

An automatic boning system of the upper half of a slaughtered fowl is provided, in which the number of processing steps is decreased, integrated control using cams is adopted instead of individual control of prior art using hydraulic actuators, and an improvement in yield is achieved. The automatic boning system of the upper half of a slaughtered fowl comprises a main intermittently stepwise feeding section (11), a group of eight stations, and a cam mechanism (14). The main intermittently stepwise feeding section (11) comprises a rotary disk (12) which is rotated intermittently stepwise at an angle of 45° by means of a stepwise driving device (12a), and eight attachment cones (13) located on the peripheral part of the disk (12) at a spacing of an angle of 45°.

3) Design and Fabrication of Automatic Cutting Machine

ANKIT PATNALA and MANAS RAJAN PATRA [3]

The project undertaken is about the design and fabrication of a machine known as the motor driven cutting machine for food items. This machine was made with the intention of helping the fish sellers or also making the household task easier. This machine mainly comprises of two mechanism, i.e., Crank-Rocker mechanism and the Scott-Rusell mechanism clubbed together. A motor input was provided to drive the crank. The Scott Rusell then came into the picture with the desired blade movement that led to the subsequent cutting of the food items. This project was actually designed to benefit the fish sellers by increasing their productivity. There, it takes a long time to cut fishes so this mechanism would prove to be both handy as well as affordable for the fish sellers to cut the fish quickly and appropriately. Since the machine as fabricated in wood, it was light weight and portable.

V. METHODOLOGY

1) *Design of Model In Software:* After making the experimentations & calculations as per our requirements, we tried to imitate the real product in CREOPARAMETRIC 3.0.
2) *Motion Verification:* Using kinematics and stimulation section in CREO we were able to verify whether the path traced by the disc is meetingour requirement or not.
3) *Fabrication:* After getting the desired output in step 2, we started manufacturing each part of desired shape in mild steel material. Wefabricated the pressure plate according to our requirements.
4) *Assembly:* Proper assembly of the fabricated parts produced in step 3 with the help of bolts, nuts, washers and more.
5) *Modification:* Some fallacies were observed after the assembly while in motion due to dynamic instability. In order to make it stable wehad to modify our design either by changing equipment or by adding a new part.
6) *Completion:* After various modification we have got the 100% success in cutting the seed portion and petal portion.

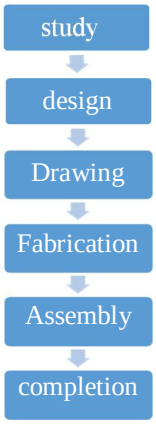


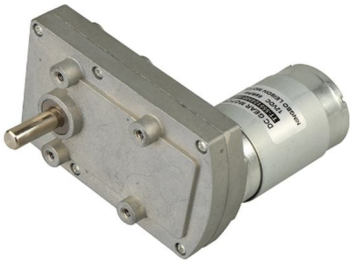
Fig: Flow chart for fabrication of Marigold flower seed and petal separating machine.

Components Used

SR NO.	COMPONENTS	PURPOSE
1	1/8 HP Gear DC Motor	A 1/8 horsepower gear motor designed to rotate a belt would feature a mechanism to transfer power from the motor to the belt. Motor rotate at 60 rpm and generate 100Nm Torque. This setup often involves a pulley system where the gear motor is connected to a pulley, and the belt is then placed around this pulley. As the motor operates, it turns the pulley, causing the belt to rotate.
2	High Speed DC Motor	A high-speed DC motor with a 4000 RPM (revolutions per minute) specification for cutting purposes is engineered to deliver rapid rotational speeds suitable for efficient cutting applications.
3	Pulley	The belt is then looped around the pulley's groove. As the pulley rotates, it engages with the belt, causing the belt to rotate along with it.
4	Flat Belt	A belt is placed between two pulleys, it forms a belt drive system. The belt wraps around the grooved wheels (pulleys), creating a continuous loop. One pulley is typically connected to a 1/8 HP gear dc motor, while the other is linked to a secondary pulley for continuous loop of belt.
5	Bearing	A shaft connecting to a pulley, a bearing is often positioned between the shaft and the pulley. This arrangement ensures that as the shaft rotates, the bearing facilitates the movement with minimal friction. The shaft is mounted through the inner ring of the bearing, and the outer ring of the bearing is typically secured within the pulley or its housing.
6	Cutting Blade	A cutting blade is utilized to delicately separate marigold flowers into petals and seeds. With careful precision, the blade is employed to cut through the flower head, allowing for the extraction of individual petals and the collection of seeds.

VI. DESCRIPTION OF COMPONENTS

A. 1/8 HP Gear DC Motor



Product Description

12v DC Square Gear / Geared Motor 60 RPM - High Torque is a very high torque motor that should be used to make big robots or robotized platforms. The gear box is built to handle the stall torque produced by the motor. The drive shaft is supported with metal bushes. A gear DC motor is a small electric motor with a power rating of 1/8 horsepower. It is likely equipped with a gear mechanism, which helps in controlling speed and increasing torque for specific applications.

Features:

- Heavy Duty Metal Gears.
- Uniformity of parts.
- ability to absorb shock and vibration as a result of elastic compliance.
- Ability to operate with minimum or no lubrication, due to inherent lubricity.
- Relatively low coefficient of friction.
- corrosion resistance; elimination of plating, or protective coatings.

B. High Speed DC Motor

12V RS-555 Motor 4000 RPM, Large Torque, High Power, Low Noise DC Motor

C. Pulley

A self-fabricated pulley has a diameter of 8 cm, featuring a central hole with a diameter of 0.5 cm at its middle. The pulley has a length of 4 cm and aluminum material, providing a compact and functional design for various applications. The central hole allows for easy mounting on a shaft or axle. The overall dimensions make it suitable for diverse mechanical purposes where pulley systems are employed.

D. Flat Belt

This is essentially a flat belt with tensile polyimide reinforcement, laminated on both sides with friction covers of synthetic rubber, chrome leather, nylon fabric or its combination.
5mm Nylon Sandwich Belt

E. Bearing

UCP205-16 Pillow Block Mounted Bearing, 2 Bolt, 1" Inside Diameter, Set screw Lock, Cast Iron, Inch

F. Cutting Blade

Cutting blade is placed just above the pulleys with a gap of approx. 1mm and is placed between the slotted disc and roller. Two separate sections are also made so that when flower gets separated, the petal and stem portion should get in two different containers.A cover is also provided over the roller for the safety purpose. In this machine, flowers are inserted in the slots of the disc by laborby hands. Inserted flowers moves towards the cutting blade with the disc. As flower moves, it first gets under the roller and then it get cut into two parts as it passes over the cutting blade. These parts are then collected into two different containers.

VII. CONSTRUCTION AND WORKING

1) The said machine consists of structure, upper idlers pulleys, lower live pulleys, belt, geared dc motors, cutter, cutter motor, casing, chute for separating seeds of the flower.
2) The developed machine is capable of separating petals from the seed of a marigold flower at a rate of 5 Kg. per hour. The best part of the machine is that it is portable and can be operated by an unskilled operator.
3) Working is also very simple, in which a manually marigold flower is inserted between the belts running over pulleys. When it is gripped, it is conveyed forward towards the cutter. The cutter is rotating at 4000 rpm with the help of the cutter motor. The moment petals touch blades of the cutter are separated.
4) The importance of this much-sought effort can be understood from the fact that in India about 20 Crore Kilogram of flowers is offered daily to the deities.
5) This enormous waste, when reaches the water bodies, landfill areas, pollutes the sources; thereby affecting aquatic life, human health, groundwater, etc. adversely.
6) The quantity of said waste is also posing difficulties in its management and disposal. The said machine can be a great help in managing the flower waste.
7) An Earthling machine is used to crush all the waste flowers and it is further allowed to decompose to obtain compost.
8) During the process, it was observed that marigold flower, consisting of seed, also gets crushed along with petals and extracts oil that creates the lump of crushed flowers (soiled waste). These lumps find the path onto the working parts of the machine and jam it.

VIII. DESIGN CALCULATIONS

For this project, design and calculation were made to determine dimensional and mechanical properties such as torque, stress, strain and cutting forces so as to withstand the effect of different loads on machine components.

A. *Power Required To Rotate Motor*

$\frac{1}{8}$ HP of High Torque Motor $= \frac{1}{8} \times 746$ W

Power = 94 W

N = 60 Rpm

Find Torque, $\text{Power} = \frac{2\times\pi\times N\times T}{60}$

$$94 = \frac{2\times\pi\times 60\times T}{60}$$

Torque (T) = 14.84 Nm

We design the Flat belt, Pulley, Angle of lap, Belt tension ratio, Belt cross section, Initial tension, Belt thickness, Length of belt, Shaft dimension.

B. *Design of Belt Drive*

P_R = 94 W, N_1 = 60 Rpm, N_2 = 58 Rpm, C = 500mm, D_1= 80mm

$\pi \times D_1 \times N_1 = \pi \times D_2 \times N_2$

$\pi \times 80 \times 60 = \pi \times D_2 \times 58$

$\therefore D_2 = 82.75$ mm

- Peripheral Velocity (Vp),

$Vp = \frac{\pi\times D_1\times N_1}{60} = \frac{\pi\times 0.08\times 60}{60} = 0.251$ m/sec

- Design Power (P_d)

$P_d = P_R \times K_L \times K_\theta$ $K_L = 1.10$ $K_\theta = 1$

$P_d = 94 \times 1.10 \times 1$

$P_d = 102.575$ W

- Belt Tensions F_1 ,F_2

$(F_1 - F_2) = \frac{Pd}{Vp} = \frac{102.575}{0.251} = 408.66$ ____1

- Belt Tension Ratio, $\left(\frac{F_1}{F_2}\right)$

$\frac{F_1}{F_2} = e^{\mu\theta}$

We Select Pulley Material as Aluminum so Coefficient of Friction (μ) = 0.30

Angle of Lap, θ

$\theta = \pi - \frac{D_2 - D_1}{C} = \pi - \frac{82.75-80}{500} = 3.13$ rad

$\frac{F_1}{F_2} = e^{\mu\theta} = e^{0.30\times3.13} = 2.557$

$F_1 = 2.557\ F_2$ ___ 2

Put the value in Equation___1

$(2.557\ F_2 - F_2) = 408.66$

$F_2 = 262.46$ N

From Equation ___1

$F_1 = 2.557 \times 262.46$

$F_1 = 671.11$ N

$F_1 = 671.11$ N

- Initial Tension (F_i)

$2\sqrt{Fi} = \sqrt{F_1} + \sqrt{F_2}$

$2\sqrt{Fi} = \sqrt{671.11} + \sqrt{262.46}$

$F_i = 443.23$ N

$S_i = \frac{F_i}{b \times t}$ Assume, $S_i = 1.5$ Mpa

$1.5 = \frac{443.23}{b \times t}$

Belt Cross section $(b \times t) = 295.48\ mm^2$

- Belt Thickness, t

$t = 0.02 \times D_1$ $\quad b \times t = 295.48\ mm^2$

$= 0.02 \times 80$ $\quad b \times 4 = 295.48$

$t = 1.6$ mm

Select Standard Thickness, $\boxed{b = 74 \text{ mm}}$

$\boxed{t = 4 \text{ mm}}$

- Length Of Belt (L)

$$L = \frac{\pi}{2} \times (D_1 + D_2) + 2C + \frac{(D2-D1)^2}{4C}$$

$$= \frac{\pi}{2} \times (80 + 82.75) + 2 \times 500 + \frac{(82.75-80)^2}{4 \times 500}$$

$\boxed{L = 1256 \text{ mm}}$

C. Design of Shaft (Ds)

$$T = \frac{\pi}{16} \times \tau_{max} \times Ds^3$$

$$P_{ds} = \frac{2 \times \pi \times N_2 \times T}{60} \qquad 102.575 = \frac{2 \times \pi \times 58 \times T}{60} \qquad = 16.88 \text{ Nm}$$

$P_{ds} = 16.88 \times 10^3$ N-mm

$\tau_{max} \leq 0.30\ S_{yt}$ ____for shaft material is SAE 1030 (DB 109)

$S_{yt} = 296$ Mpa

$\tau_{max} = 0.30\ S_{yt}$ $= 0.30 \times 296$ $= 88.8$ mpa

$$\therefore 16.88 \times 10^3 = \frac{\pi}{16} \times 88.8 \times Ds^3$$

Ds = 9.89 mm

Select standard diameter,

$\boxed{Ds = 10 \text{ mm}}$

D. Cutting Force Acting On Flower Stem

Power of Secondary Motor (P_c) =15 W

N = 4000 Rpm

$$P_c = \frac{2 \times \pi \times N \times T}{60}$$

$$15 = \frac{2 \times \pi \times 4000 \times Tc}{60}$$

$\boxed{\text{Torque, Tc} = 0.0358 \text{ Nm}}$ → $\boxed{\text{Torque, Tc} = 35.8 \text{ Nmm}}$

Radius of Cutting blade $r_c = 40$ mm

$Tc = F_c \times r_c$

$35.8 = F_c \times 40$

$\boxed{F_c = 0.895 \text{ N}}$

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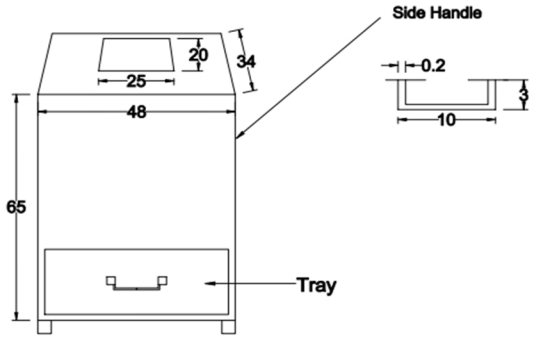
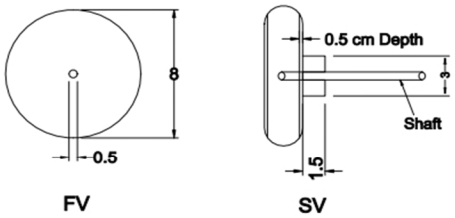
IX. CAD DRAFTING

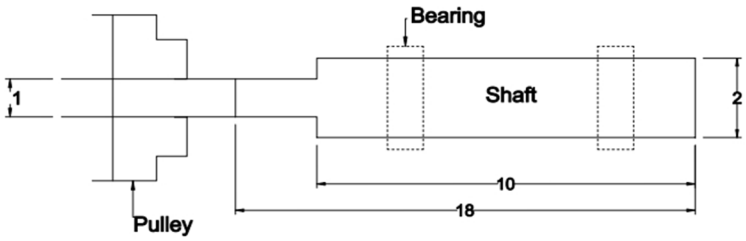
Box Dimension :



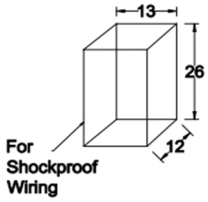
Pulley :



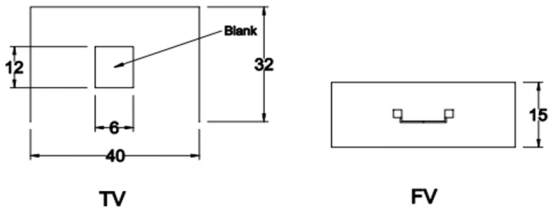
Bearing Shaft :



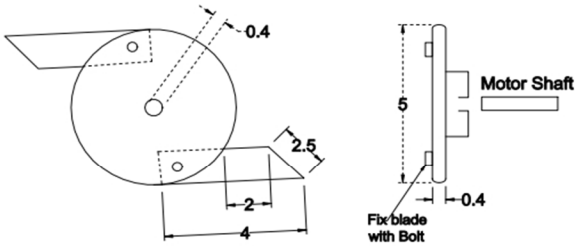
Wood Box :



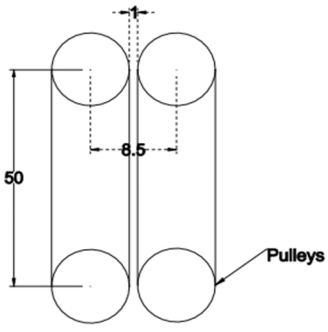
Tray :



Cutter :



Belt & Pulley Mechanism :



All Dimensions are in Centimeter

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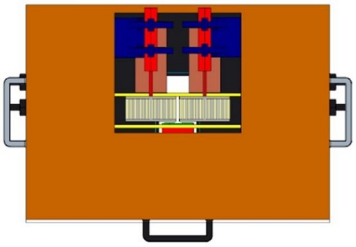
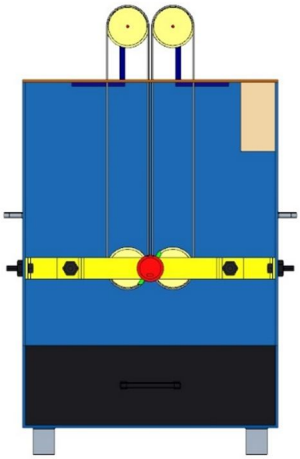
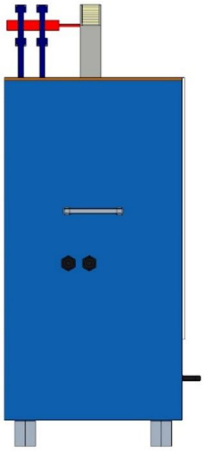
X. CAD MODELING



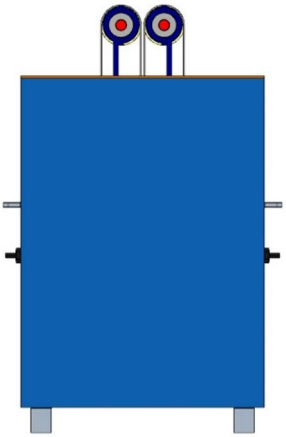
TOP VIEW



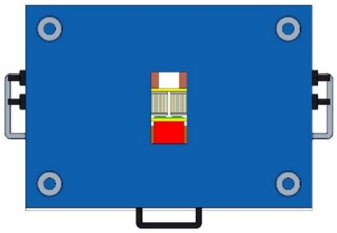
FRONT VIEW



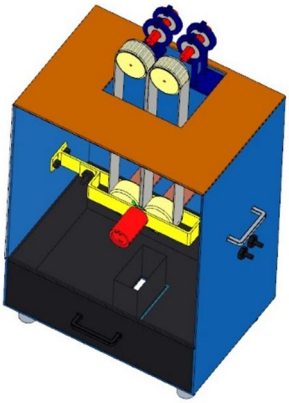
SIDE VIEW



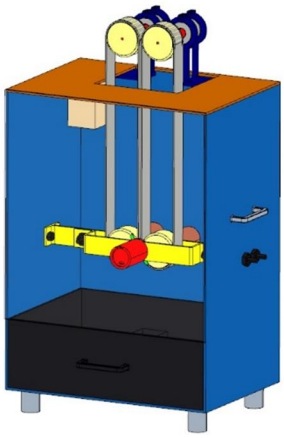
BACK VIEW



BOTTOM VIEW



ISOMATRIC VIEW 1



ISOMATRIC VIEW 2

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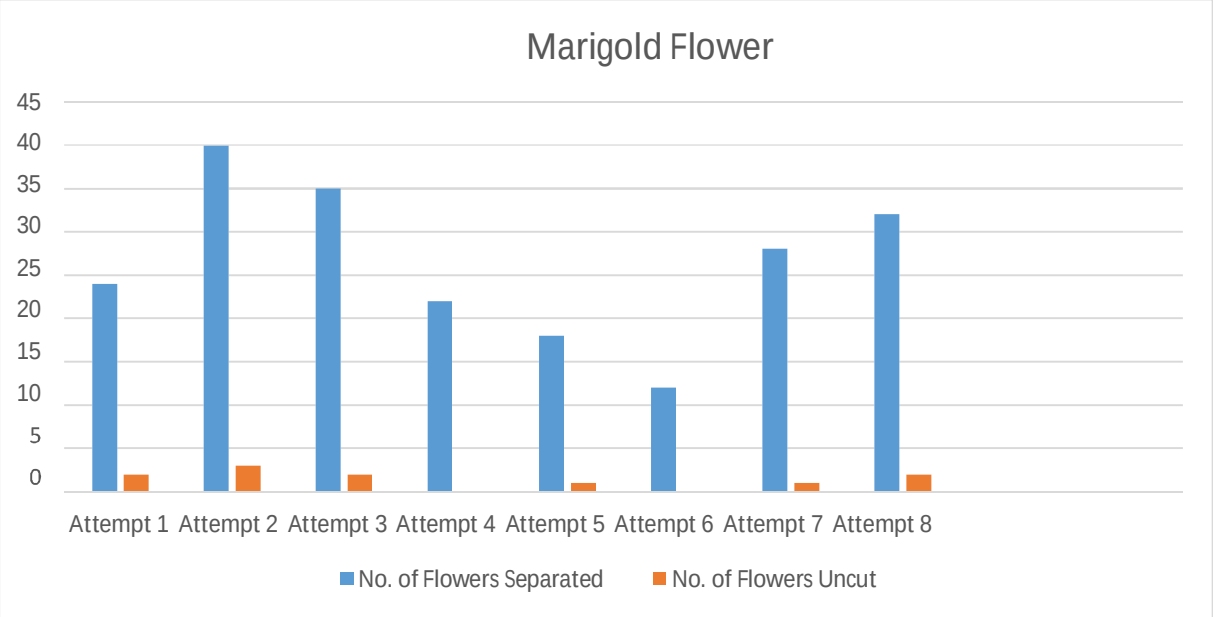
XI. TRAIAL AND EXPERIMENTATION



After finalizing the mechanism, we attempted various experiments on the machine. Above graph shows the reading of the flowers operated versus the reading of flowers that remained uncut after processing. During the process if any flower comes out of the machine uncut, it can still be reoperated by the machine, resulting in the increase in accuracy of the machine. After the experiment above 90% flowers get processed successfully and nearly 5% to 8% flowers remained uncut.

XII. CONCLUSION

1) The fabrication of marigold flower seed separating machine was successfully completed as per the design specification.
2) It is easy to operate and handle. This project has been designed to perform the required task taking minimum time.
3) This project is economically feasible and we are under the impression that it can be further reduced, when it produced onlarge scale.
4) For operating the machine there is requirement of one person so it increase employment for one person.
5) This project is very useful for farmers. It improves the quality of compost by separating oil from it and it is superior forbetter crop quality.

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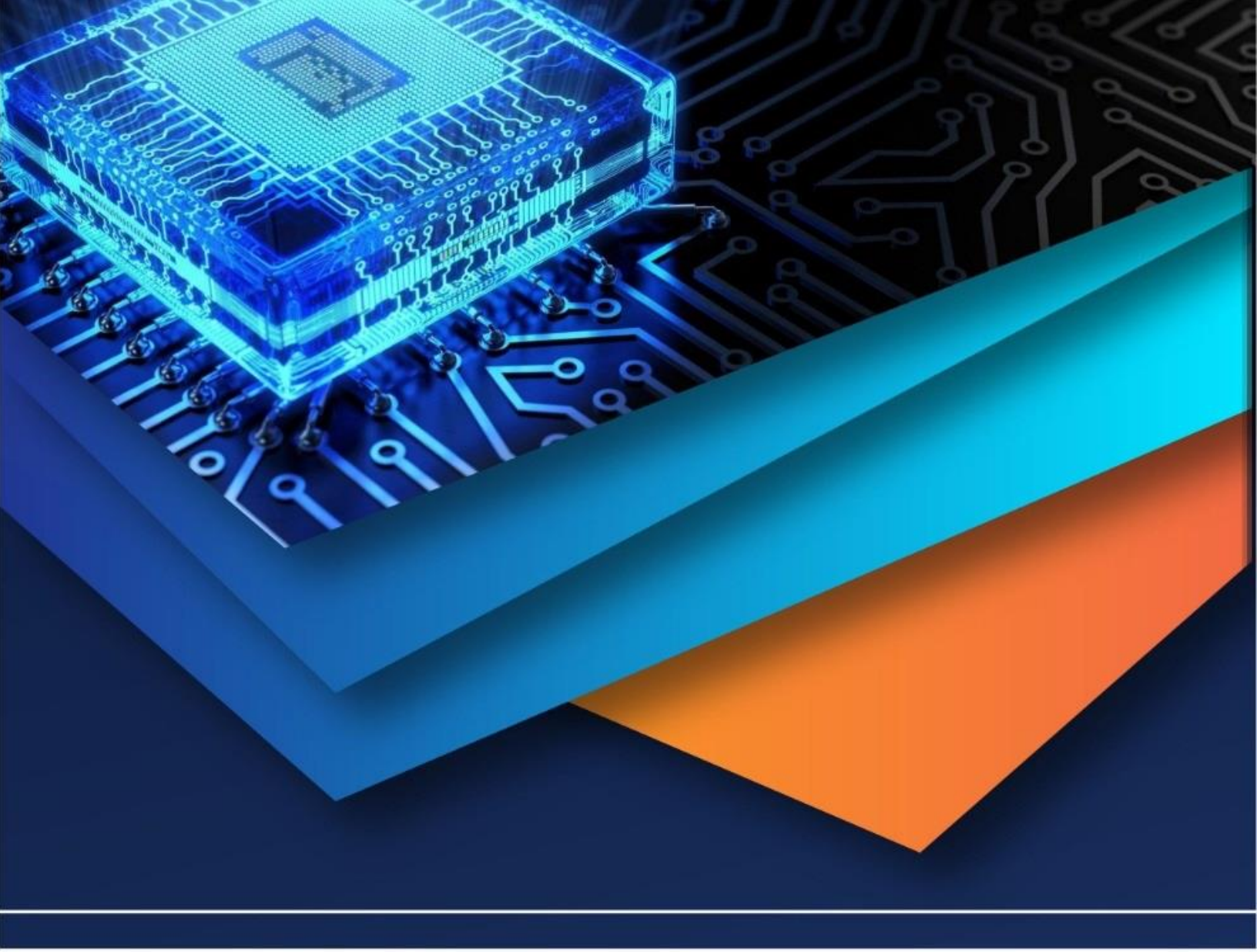

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