

# Design and Fabrication of Areca Nut Collecting and Bagging Machine

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**Abstract:-** Agriculture is now one of the most important sectors in the Indian economy. Areca nut Cultivation is one of the major livelihoods of farmers of Kerala and Karnataka. Labour Problems in every sector is leading to mechanization of processes. Agricultural sector is also facing such problem due to which most of the farmers tend to give up the practice. Areca nut cultivation is a long process involving harvesting, , separating the fruits from bunches, moving the areca nut to ground, drying, de-husking, separating, bagging. Several machines are being developed to help farmers to aid the aforementioned processes. Areca nut collecting and bagging machine is a new one among them.

The machine is intended to collect areca nuts from ground directly to gunny bags fixed in a moveable trolley.

After the bag is filled the trolley can also be used to move the bags to store rooms. The machine is operated by single person so that farmer himself can use it. In addition, since the machine doesn't use any power units, it can be used anytime.

Since the machine is manually driven, the machine is made light weight materials to reduce the user effort. The major enabling mechanism in the machine is an inversion of slider crank mechanism that pulls the areca nuts from ground. A belt driven Conveyer carries the collected areca nuts up into the bags.

## INTRODUCTION

Product design is the process of creating a new product which has to be accepted by the customers. In a broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new product. In a systematic approach, product designers will conceptualize and [evaluate](#) ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products so, that the consumers can use.<sup>4</sup>



Fig.1 Areca nut plantation



Fig.2 Areca nut plant

Research was carried out through product study, market study, literature review, user study etc. Quality function deployment (QFD) was prepared where the customer voice were converted into technical voice.

Areca nut is the chief crop that is cultivated in south coastal Karnataka and Kerala. In these areas farmers are facing severe problem to carry over their task day by day due to

increased demand of labors. Now a day's labor problem is one of the major problems especially in agriculture sector. Some of the problems that are faced by farmers from labors are delayed reporting time, in efficient working and higher wage. Hence to tackle labor problem farmers has to find some alternative means to carry on their tasks. After harvesting from the areca plant/tree, the soggy areca nuts are dried by exposing it to sun on flat prepared ground for about 30-45 days, depending on intensity of sunlight. These areca nuts after sufficient drying it is put in to use. After proper drying, areca nuts are collected from the ground to cane basket manually with the help of fiber scrapper fixed to a lengthy wooden handle. This process is laborious, requires more time and human effort.

The collecting process manually requires 3 - 4 persons in which one or two people is required to collect the areca nut by a cane basket and other person is required to hold the gunny bag. This task consumes lot of time to collect the areca nut for more no. of gunny bags. Therefore human interfere is more and money spent on labors also increases.

The machine consists of bucket elevator and crank and slider mechanism, which are driven by electric motor. Bucket elevators are used to lift areca nuts from downstream to up stream. Crank and slider mechanism is used to scrap the areca nut from the floor in to the bucket elevator system. From elevator system areca nuts are made to fill in the gunny bag through a fiber Chanel.

In order to overcome all these problems this machine is designed which will collect the areca nut from the floor and fill it to a gunny bag. This machine is operated by a single person in whom little effort is required by the user to operate it.

#### OBJECTIVES;

The major objectives of this design of areca nut collecting & bagging machine are:

1. **Power Drive:** Use of manual power so that the machine can be used anytime.
2. **Simple design:** since manual power is used the machine must be easy to carry. Hence light weight materials are used in the design.
3. **Collection rate:** higher collection rate is obtained by widening the area of areca nut collection and two scrapper arms.
4. **Filtering:** provision for filtering of dust, stones or other impurities, which is not possible in manual method of collection.
5. **Bagging:** provision to hold large gunny bags directly and easy removal of the same.

6. **Transportation:** The machine is designed to have smooth driving with steering provisions so that it can be easily moved to desired location.
7. To reduce the adverse effects on the environment, and to use ethically justifiable production methods.

#### EXISTING CONCEPTS<sup>1</sup>

##### *Concept 1 (Engine driven)*

An engine capable of generating high power is proposed for the machine with very less human effort to operate. The machine would contain an engine directly placed over the back wheel and driving the same. The motion for the vehicle as well as the all mechanisms is provided by the Engine itself. The wheel will drive the bucket elevator and Vacuum pump.

**limitations:** The major disadvantage of the machine is that it can be used anytime if fuel is available. But due to high fuel price, the other concepts rates more viable. The use of engine also adds weight to the machine with its accessories and higher costs. Maintenance, noise and air pollution are other noticeable limitations of the machine.

##### *Concept 2 (Electric powered )*

The Electric powered areca nut collecting and bagging machine consists of an electric motor, a battery and the mechanisms similar to above concept. The battery powered electric motor drives the back wheel which intern drives the bucket elevator and scrapping mechanism. The noteworthy advantages of this machine are- it is noiseless, efficient, variable speed provision.

**limitations;** The problems with the machine are frequent removal of battery for the replacement/ recharging. The battery is to be properly protected from water during raining. The major disadvantage of this machine is that it is a power driven machine.. Also large reduction of speed is also leads to losses (Higher speed of buckets is not useful since the areca nuts fly out rather than collected).

##### *Concept 3 (Pedal type)*

Where the motion for the vehicle as well as the all mechanisms is provided by the human effort itself.

**limitations:** Major disadvantage is require more man power. from continuous work he will get more tired.

##### *Concept 4 (Hand push)*

#### **PROPOSED DESIGN CONCEPT CONCEPT GENERATION**

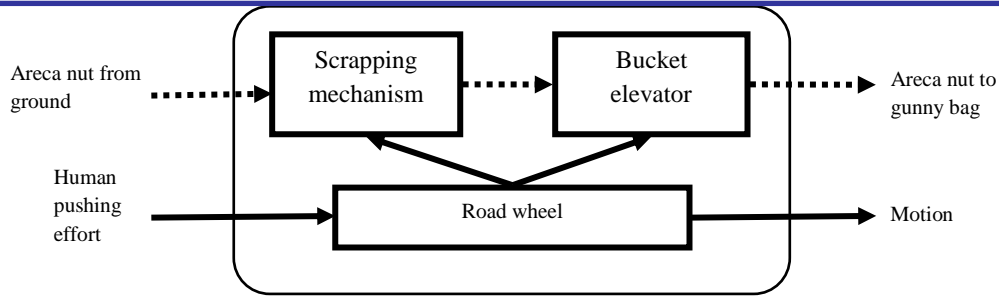


Fig.3 Functional Diagram of areca nut collecting and bagging machine

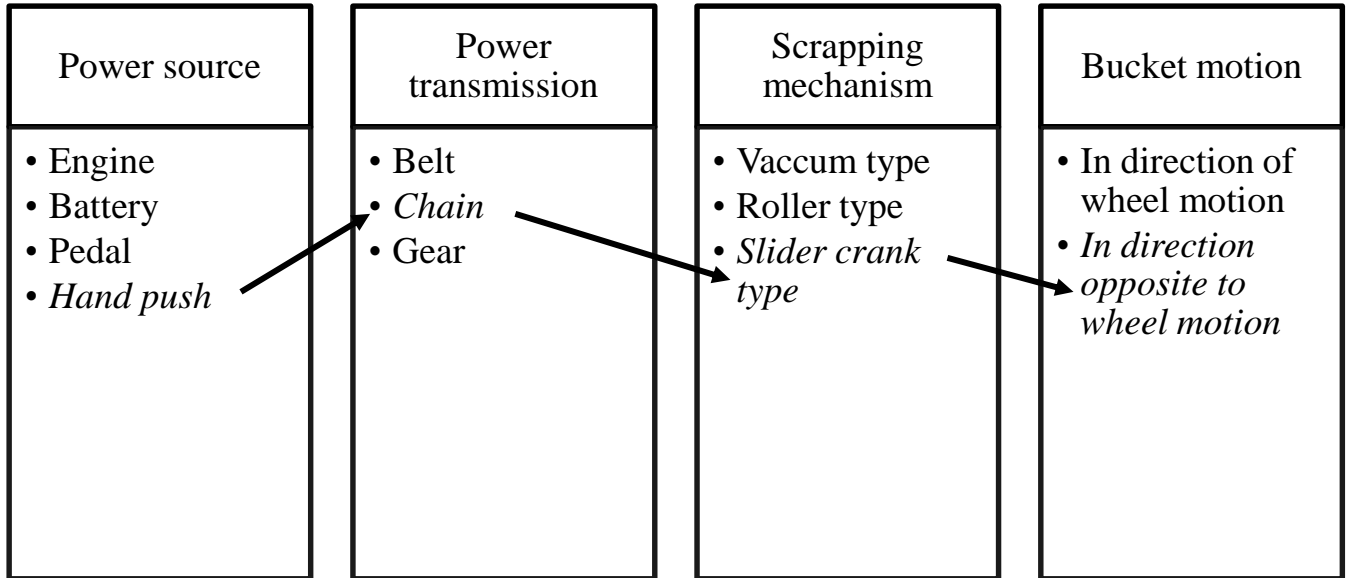
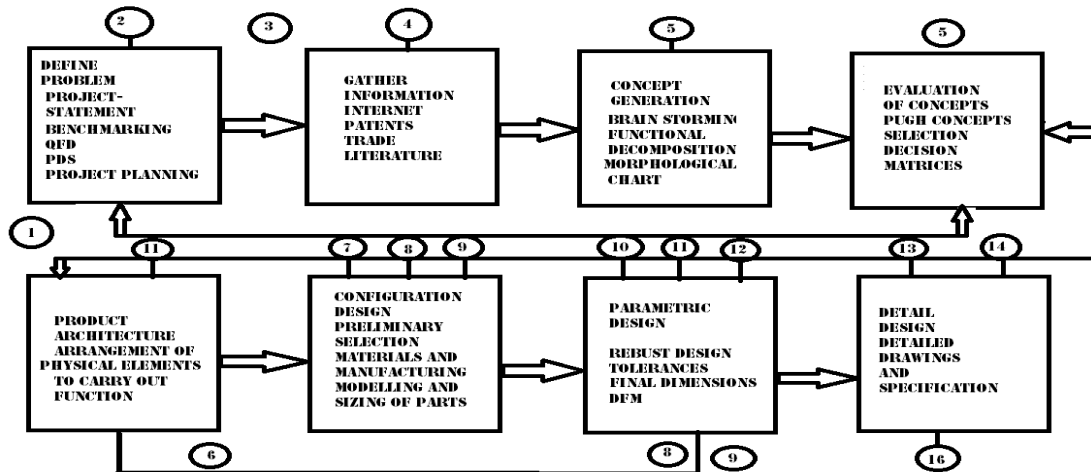


Fig.4 Concept Combination



CHAPT. 1-- THE PRODUCT DESIGN PROCESS

- CHAPT. 2--NEED IDENTIFICATION AND PROBLEM DEFINITION
- CHAPT. 3--TEAM BEHAVIOR AND TOOLS
- CHAPT. 4--GATHERING INFORMATION
- CHAPT. 5--CONCEPT GENERATION AND EVALUATION
- CHAPT. 6--EMBODIMENT DESIGN
- CHAPT. 7--MODELING AND SIMULATION
- CHAPT. 8--MATERIALS SELECTION AND MATERIALS IN DESIGN
- CHAPT. 9--MATERIALS PROCESSING AND DESIGN
- CHAPT. 10--ENGINEERING STATISTICS

CHAPT. 11--RISK, RELIABILITY AND SAFETY

- CHAPT.12--ROBUST AND QUALITY DESIGN
- CHAPT.13--ECONOMIC DECISION MAKING
- CHAPT.14--COST EVALUATION
- CHAPT.15--LEGAL AND ETHICAL ISSUES IN ENGINEERING DESIGN
- CHAPT.16--DETAIL DESIGN
- CHAPT.17--COMMUNICATING THE DESIGN

Fig.5 METHODOLOGY<sup>3</sup>

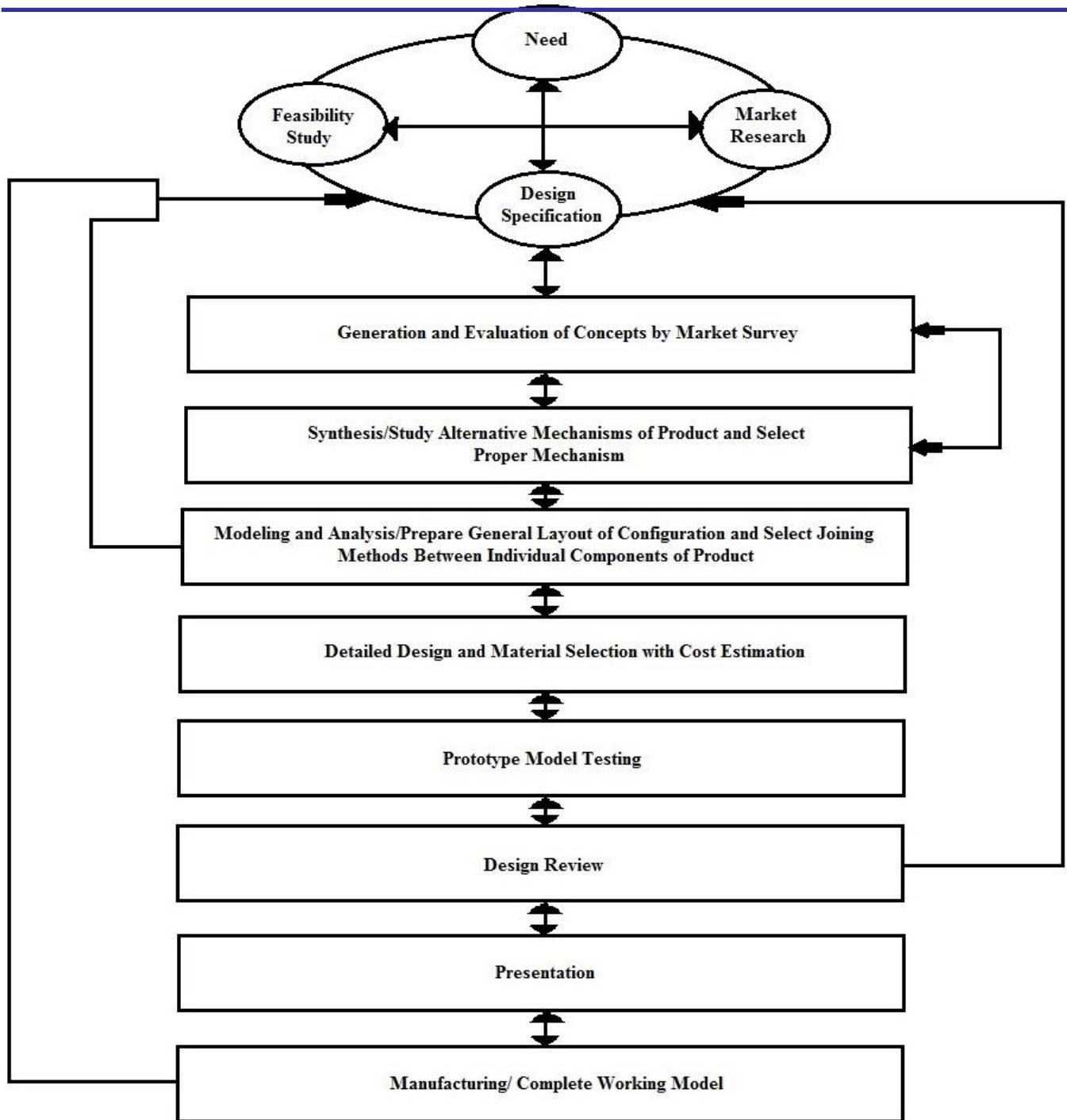


Fig.6 BASIC PROCEDURE OF MACHINE DESIGN

Design of machine elements is the most important step in the complete procedure of detail design. In order to ensure the basic requirements of the machine elements, calculations are carried out to find out the dimensions of the machine elements.

These calculations form an integral part of the Design of machine elements. basic procedure of design of machine elements is shown in above flow chart.

Machine design is defined as the use of scientific principles, technical information and imagination in the description of a machine or product or mechanical system to perform specific functions with maximum economy and efficiency.

**CONCEPT SELECTION**

The concept selection is done in two stages:  
Concept screening and concept scoring

**Concept screening**

- Step 1: preparing screening matrix
- Step 2: Rating of the concepts
- Step 3: Ranking of concepts
- Step 4: Combining and improving of concepts
- Step 5: Selection of one or more concepts
- Step 6: Reflect on the result and process

**Table 1 concept screening matrix**

Selection criteria	Concepts			
	Concept 1	Concept 2	Concept 3	Concept 4
Ease of handling	+	+	-	0
Ease of manufacturing	+	0	+	+
Portability	+	+	-	0
Durability	0	-	+	+
Power source	+	0	0	0
Human effort	+	+	-	0
Collection time	+	+	0	+
Cost	-	0	+	+
Noise	-	+	+	+
Maintenance	-	-	+	+
Weight and size	-	0	0	+
Sum +s	5	5	5	6
Sum 0's	1	3	2	4
Sum -'s	5	2	3	0
Net score	1	3	2	6
Rank	4	2	3	1



**Concept scoring**

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Table 2 concept scoring matrix

Selection criteria	Weight	Concepts							
		Concept 1		Concept 2		Concept 3		Concept 4	
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	weight
Ease of handling	05 %	4	0.2	3	0.15	2	0.1	3	0.15
Ease of manufacturing	10 %	3	0.3	2	0.2	3	0.3	3	0.30
Portability	04 %	3	0.12	3	0.12	3	0.12	3	0.12
Durability	04 %	4	0.16	2	0.08	4	0.16	4	0.16
Power source	15 %	2	0.30	1	0.15	4	0.60	5	0.75
Human effort	15 %	4	0.60	4	0.60	1	0.15	3	0.45
Collection time	15 %	4	0.60	3	0.45	3	0.45	3	0.45
Cost	15 %	1	0.15	2	0.30	4	0.60	5	0.75
Noise	05 %	2	0.10	3	0.15	4	0.20	4	0.20
Maintenance	04 %	2	0.08	1	0.04	4	0.16	5	0.20
Weight and size	08 %	2	0.16	2	0.16	4	0.32	4	0.32
<b>Total score</b>		2.77		2.28		3.16		3.85	
<b>Rank</b>		3		4		2		1	

**PROPOSED DESIGN CONCEPT AND WORKING PRINCIPLE**

Areca nut collecting and bagging machine is one which aid the process of collecting areca nuts from ground to gunny bags as well as transportation of the same to the storerooms. The areca nuts also be saved from the rain which if not decrease the quality. Hence this machine can be useful to such situation where labour is not available (the machine can be operated by one person).

The manual method of collecting areca nuts from ground is as follows. It requires about 5 persons, one for scraping the areca nuts to baskets, one to carry the basket and fill into gunny bag, one to hold gunny bag, one to stitch the bags, one to move the bag to storeroom



Fig. 6 Proposed Concept

### WORKING PRINCIPLE

1. **Pulleys** are used in a variety of ways to lift loads, apply forces, and to transmit power.
2. **Crankshaft** pulleys transmit mechanical power and torque, or the force of motion, through the pulley system
3. **Drive shaft**, is a mechanical component for transmitting torque and rotation
4. **Bearing** is a machine element that constrains relative motion and reduces friction between moving parts to only the desired motion.

The Whole mechanism used to collect and bag areca nut is mounted on a moveable vehicle as shown in fig. The Belt Conveyor is made up of a belt drive consisting of Blades that carry the areca nut in the constrained space. The scrapper mechanism consists of a crank wheel, driving a scrapper arm that is pivoted at its centre. The enlarged collecting area leads to the belt Conveyor and scrapper arm moving on its top dragging the areca nuts. At the Back of belt elevator is a provision for bag that is telescopically fixed, so that height can be adjusted. After filling bags with areca nuts /goods we will sew bags by areca nut collecting and bagging machine only.

### FEATURES

- Two scrapper arms
- Use of light weight material
- Increased collecting area
- Provision for filtering dust etc
- Manual operation
- Telescopic bag fixture
- Steering provision
- Bagging provision

### ADVANTAGES

1. Manually operated. No Fuel and electricity
2. Ease of operation
3. Single user is sufficient
4. Turning Provision
5. Machine can be operated in straight standing position. So strain to various body parts can be eliminated.
6. Single time investment and life time validity

5. **Bolts & Nuts:** are used in several applications, with a primary function to hold things or components together.
6. **Chain drive** is a way of transmitting mechanical power from one place to another. It is often **used** to convey power to the wheels
7. **Belt conveyors** are used throughout the world for the conveying of bulk materials

### APPLICATIONS

1. Collecting areca nuts: both red supari and white supari
2. The machine can also be used for: cashew nuts, groundnuts, coffee, pepper etc.

### CONCLUSION;

Based on the concept screening and concept scoring methods the priority given to rank 1. Further during the work evaluation some needed improved modifications can be adapted.

Depends upon the features of the proposed concepts following are the key points

1. It required less effort.
2. User friendly.
3. Ease of handling.
4. Proposed concept is simple and cost effective then compare to existing concepts, which helps to achieve objectives of the project.

### REFERENCES

1. Research Article, Kiran K et al Int, "Design and Development and Testing of Areca nut De-husking Agri-Machine" Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 4, Issue 7 (Version 2), July 2014, pp 109-115.
2. A text book of machine design by R.S Khurmi and J.K Gupta.
3. Product design and development by Karl T. Ulrich and Steven D. Eppinger.
4. <http://www.campco.org/>
5. <http://tssindia.in>.