DESIGN AND FABRICATION OF ARECA NUT PROCESSING UNIT

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Introduction:

"A tool is but the extension of a man's hand, and a machine is but a complex tool. He that invents the machine augments the power of a man and the well-being of mankind." – Henry Ward Beecher Areca Nut (Areca Catechu L.) is widely used in Asian and mainly by South East Asian population. Areca Nut more commonly known as Betel Nut is a very important commercial crop in India.It takes approximately five years for an areca nut palm to mature and bear fruit.Each areca palm is harvested once a year. The cultivation of arecanut can be traced back to Vedic periods. Arecanut was even used in Ayurvedic and Ethane veterinary medicines. It is commercially available in dried, cured, and fresh forms. While fresh, the husk is green and the nut inside is so soft Once mature, the palm can provide nuts annually for up to fifty years. An areca nut is the seed of the areca nut palm. It is used in every corner of the country in various walks of life. It is common for Indians to use areca nuts along with betel leaves as digester in small quantities. Areca Nut has uses from Indian weddings, to various industries like Paint, and even for oral consumption. Areca Nut production is the largest in India according to FAO statistics. According to this in 2013, Indian production of Areca Nut counts for 49.74% of the total world production. In India, Karnataka has the highest production percentage of 62.69%.

Below is a summary of the current methods of extracting areca nut from the areca nut palm for use and a brief introduction to our machine. This summary is for the areca nuts cultivated in the areas of Shimoga, Thirthahalli etc.

Traditional methods for areca nut processing.

The traditional steps for areca nut processing involves the following steps:

- Harvesting of the Areca Nut Palm
- Separating the fruits in a bunch
- Storing and transportation
- Peeling the palm to get the seed (de-husking)
- Boiling the seed
- Sun drying of areca nut
- Sorting of areca nut

This whole process takes up to 10 days. As one can see this involves a lot of time, labour, money and effort to get one quintal of processed areca. And if the farmers don't get the first grade of areca then there won't be much profit.

Mechanized method for areca nut processing.

There are existing de-huskers for areca nut but these are not so sophisticated. The nut we get usually sustains certain damage and after drying we don't get the first grade areca. Apart from this there are no other automation processes available in India for farmers.

Objectives:

This project has mechanized the whole process. The de-husking is done by blades, boiling done by pressurized boilers, drying by air-steam heat exchangers and sorting using cameras and sensors. This machine will reduce a lot of time and manual effort traditionally required.

The objective of this project is as follows.

- To process raw arecanut using the mechatronic system, to get maximum efficiency and to utilize the energy
- To reduce the processing time and to increase the quality of the product.
- By implementing automation reducing the human effort and labour problem.
- To reduce human error in the whole process.
- To improve the quality of employees.

Methodology:

The methodology of fabrication and working of areca nut processing unit is as follows:

1. The parts of the areca nut are fabricated as the design and then assembled into one unit.
2. The de-husker is fabricated as a separate unit that includes the blade to peel the husk and the support to hold the nut in place. The areca nut holder and block is 3D printed by Mr Vion's 3D printer. The material for the same is PLA (Poly Lactic Acid). The frame is made up of steel and the blade out of spring steel.
3. The areca nut holder moves in according to the way it has to be cut using pneumatic piston cylinder arrangement.
4. There are conveyors to move the areca nut throughout the processing unit.
5. Hoppers are there in the start of the different parts to send the areca nuts into the system. There is a system of pipes and conveyors to move the nuts from one place to another.
6. In the boiler there are two pipes, one for areca nuts and one more for water flow. Required no of areca nuts and water is sent into the boiler and along with this areca nut precipitate is added for the colour. The current system is specifically designed for 18kgs (3000) areca nut. There is constant water flow which is controlled using valves and gauges.
7. The fuel for boiling of areca nut is nothing but the dried husk that was peeled of the seed. The husk is dried in the sun and used as fuel. So the husk from previous cycle is used for current cycle. There are heat sensors to and thermocouples to calculate the temperature of the water while boiling.The boiler is made up of aluminium and the base where the fuel is burnt is surrounded by bricks to trap the heat inside.
8. The boiled nuts are extracted without the water and then fed to drying system. The drying system is made up of heat exchangers and fans for the complete extraction of moisture from the nuts. And three stepped conveyors to keep all the nuts separately for equal flow of heat throughout the system.

9. The steam from the boilers is used in the radiator to dry the areca nuts. The heat from the steam is used to heat up the surrounding air and thus soaks up the moisture from areca nuts.
10. The next part i.e. sorting system involves sensors, camera, servo motors, and My Rio. The areca nuts are again fed to hopper that sends the nuts one by one. These nuts are detected by the sensors connected to My Rio. The camera clicks an image of the areca nut in test. A program of machine vision is coded into the My Rio. The nut is sensed by My Rio and colour sorted accordingly, the servo motor pushes the nut in the direction of traverse.
11. Thus, the nuts are sorted and the process is complete.

Here are images of designs of the major parts in the areca nut processing unit:

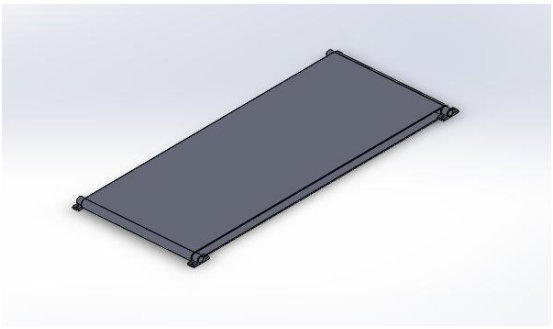

Fig1: Design of the conveyors used throughout the areca nut processing unit.

Fig 2: Design of the cutter blade of de-husker.

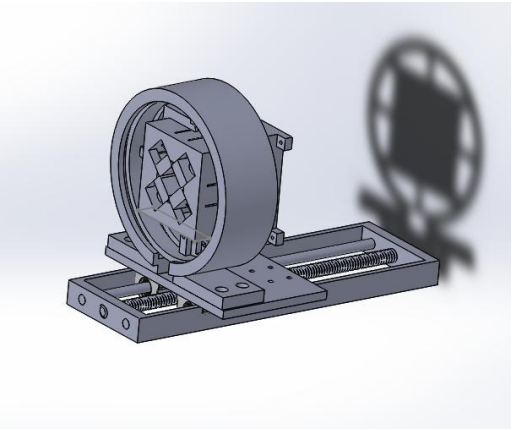

Fig 3 : Design of areca nut holder. (It holds the nut during the process of de-husking and cutting the nut into two.)

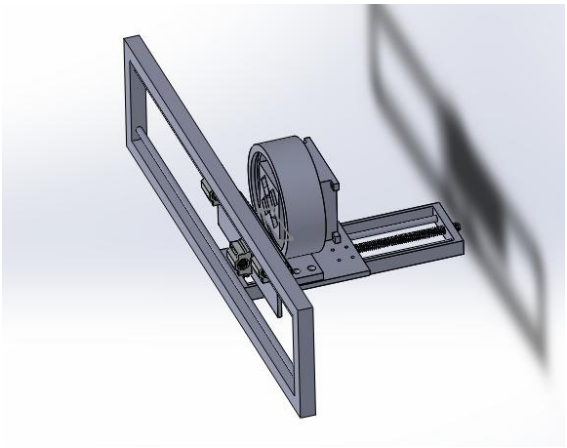

Fig 4: Top view of the areca nut holder in its frame with the cutting blade frame.

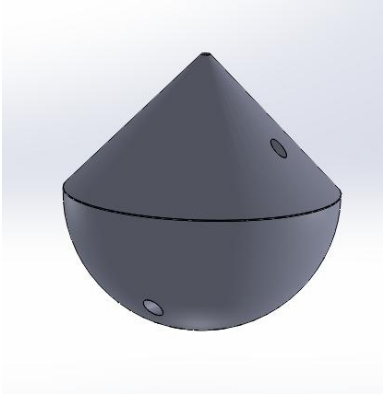

Fig 5: Areca Nut boiler Frame.

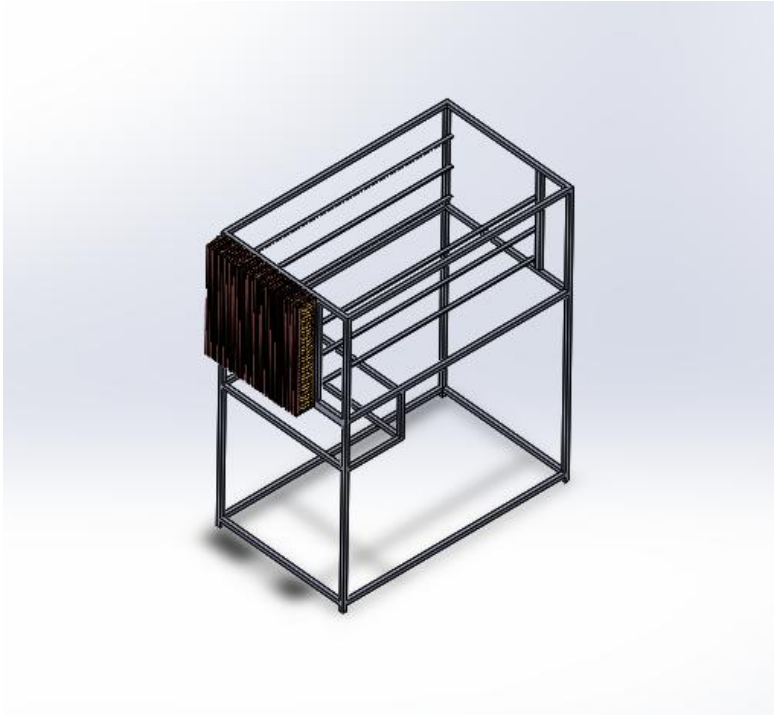

Fig 6: Areca Nut Dryer Frame with the heat exchangers. The three bars on the sides of the frame are where the conveyors will be fixed for drying of areca nuts.

Conclusion and future scope for improvement:

An attempt is made to design and fabricate a whole areca nut processing unit. This unit involves de-husking, boiling, drying and sorting of areca nut seeds. This unit can do all the different processes required for the processing of an areca nut seed in one go. This saves a lot of time and manual labour for the cultivator.

In conclusion, one can say that this unit is effective in the processing of areca nut in small scale and the design can be used for production, moreover the design can be effectively used for larger weights of areca nuts with changes in the dimensions and structure.

This project have been designed and fabricated with an intention of providing demonstration to the students, plus being cost effective. Further work has been made in this direction and significant progress has been achieved. However, there is a scope for further improvements.

- This design can be incorporated and developed for processing unit for larger weight of areca nuts.
- There is always a scope for improvement in performance of a machine and there is for the processing unit as well.
- This unit can be converted to a fully automated machine, saving any work from the cultivator.
- Smoke coming out of the boiler can be used to dry the husk from de-husker which is further used as fuel for boiler.
- A de-buncher can also be added as another part in the assembly unit, so all the processes can be done in one system.