

FINAL REPORT

Project name- Castor Plucking Device.

Team members

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Date – 24th May to 12th June 2017

Location – Grambharati, Gandhinagar

Summary

The project is aimed towards developing a device that transforms the traditional and not so efficient process of picking the castor fruits to a more efficient and safe method. The traditional method involves holding the thorny castor bunch with one hand and cutting it using a sickle with the other hand. Because of the sharp, thorny spikes on the fruit, getting hurt while holding it is an obvious thing. Using a sickle for cutting the branch shakes the entire bunch and the dry fruits fall off. The fallen fruits, although being healthy for further use are not picked up by the farmers due to the tedious nature of the process. Moreover, once the castor bunch is plucked, farmers put it in a cloth wrapped around their shoulder and waist. The cloth having limited volume to accommodate the bunch, needs to be emptied in a common collection point every now and then - increasing the distance they have to walk.



To tackle these issues, we defined our problem statement as - *“Design a device for castor farmers that will increase the efficiency of plucking, capacity of collection and reduce the time taken in separation”*.

After 3 prototypes, 20 user reviews and 10 days of time, we developed our final prototype which can be readily used in the castor farms. The final prototype works on the principle of passing the stem through a small hole with a cutting edge on the inside which strips the stem removing all the fruits. The device has 2 long semi cylinders hinged on the lateral edge such that it creates an open-able cylinder. The device has a semi-circular blade attached to the bottom of both the semi cylinders. The Velcro handles attached on the sides are wearable and adjustable - giving a tight grip on the device. The internal blade is detachable and can be sharpened at will.

Further, we would like to embed a cutting mechanism in the device which offers both the options to the farmers – cutting and plucking. Cutting would be very much useful when the bunch is at height. We also would like to design a trolley which can address the issue of repetitive to and fro motion of emptying the cloth. The device can be used for a few more crops as well, one tested crop is *moong*.

Problem Definition

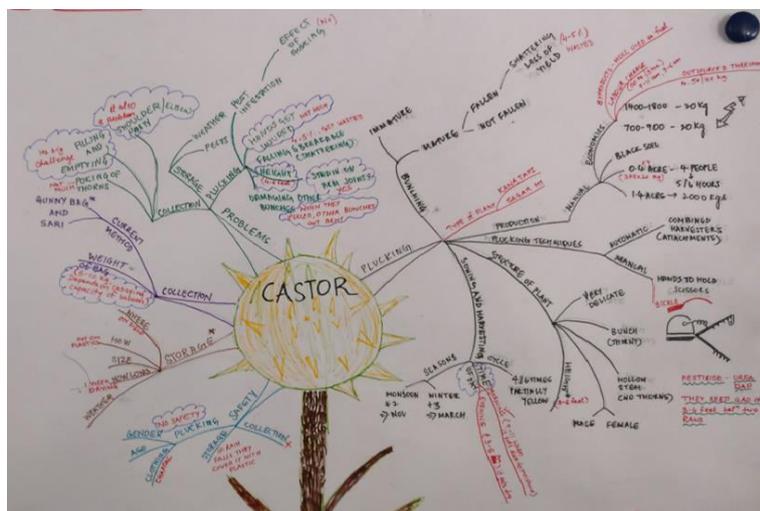
The castor plant is roughly 4-6 feet in height, the fruits are very thorny and they grow in clustered bunches. In the traditional method of plucking, the farmers hold on to the bunch with one hand and cut it with a sickle that is held with the other. They put it into a cloth/plastic bag that is slung over their backs. If the bunch is at a height they bend the branch and then they cut it. Sometimes the castor fruits fall – either due to the wind or because of harsh movement of the hand. The farmers do not pick up the fallen ones because it is very time consuming, this leads to a 4-5% percent loss. When they hold the bunch, they injure their hands. Sometimes the thorns go in their eyes and cause irritation. The bag that is used for temporary collection becomes very heavy. Also, it has limited capacity, so the farmers have to keep emptying it on a large plastic sheet. This leads to a repetitive to and fro walking motion that is very time consuming and tiring. After plucking the bunches they dry it under the sun for a week. The dried bunches are beaten so that the fruits separate out. Later, they are put in the thresher and sent for oil extraction.

Problem statement:

“Design a device for castor farmers that will increase the efficiency of plucking, capacity of collection and reduce the time taken in separation”.

We aim to solve the problem of plucking, separating and collection capacity.

Mind Map



*The writing in red are all the changes and additions made after field visits.

Field Visit

INTERVIEW 1

NAME- Gautham

PLACE-Grambharti

DATE -28th May 2017

Ph.No. 9913622503

Key points

The seeds are sown during September and December and are harvested in November and March respectively.

Stats- 4 people take around 5 hours to harvest 0.4 acres (1 beegha).

1.4 acres gives 2000kgs of castor.

Economics- Previously, 20 kgs was sold for approximately ₹1600. Now the price has fallen to nearly half the value.

The farmers use a scissor like device.

PURPOSE OF FIELD VISIT

To analyse and understand the current methodology used for the plucking and collection of castor, to gain insight and identify the problems faced by the farmers due to this method,

FIELD VISIT 1

DATE- 29th May 2017

PLACE- Grambharthi

NAME- Indrajitbhai

Ph.No- 8238281822

Observations

We saw a lone castor tree it was about 10 feet in height.

It was a wild tree and it was completely dried up but it had castor fruits that we could pluck.

We observed the texture of the fruit and structure of the plant. Indrajit bhai explained and showed us how the castor is plucked traditionally.

FIELD VISIT 2

DATE- 29th May 2017

PLACE- Manekpur

NAME- Sohambhai

AGE - 20 years

Ph. No. 8488949700

Key learnings

The species of castor that grew on this plantation was called "kana thapi". There is another special variety - "sagar 111" that has a 5 feet long "maal".

There is a 3 feet gap between 2 rows in the castor plantation.

3-4% of the castors are lost because they fall down, either naturally or in the process of plucking. The farmers don't pick up the fallen ones due to time constraint and the tedious nature of the process.

Most of the plucking is done in the morning- 7 am to 11 am. The labourers are paid ₹60 for this.

- 30-40% profit is gained.

The pests that infest the castor plants are caterpillars (leaves) and termites (stem). There is very minimal loss in production due to this. To prevent this they use Urea and DAP. Branches that are slightly higher are bent with one hand and cut with the help of a sickle. But in the process if the branch is bent too much and it gets damaged, there is very little probability that a new bunch will grow on that branch. Hence a loss is incurred in the productivity. Many of the dry castors fall when they pull the branch. Once it is harvested, the castor fruits are kept to dry under the sun for nearly a week. It's later put in the thresher (costs ₹200 for 1 hour). While plucking the castor seeds, the thorns injure them. They usually wear "chappals" and they sometimes get hurt because of the fallen castors seeds and thorns.

FIELD VISIT 3

DATE- 29th May 2017

PLACE- Grambharati

NAME- Bakanjibhai

AGE - 60 years (*energy of a 20 year old and 40 years of experience!*)

Ph. No. 7069991203

We brainstormed on the observation data that we received from our prior art, first and second field visit and the information mind map. We gathered insights and prioritized on the problems. After that we approached Bankajibhai to verify our research data. He demonstrated the entire process of plucking and collecting the castor fruits using a sickle - "dataradu" and a plastic gunny bag - "faatiyu". Through his demo we could identify the problems and could verify the data.



FEEDBACK on prototype 3:

1. NAME: Bhupendra Singh bhai

PLACE: Aluwa

DATE: 9th June 2017

Ph No: 9898070928

The key learnings from our interaction with him were:

- On his farm, type 4 and 7 of castor grows. These are usually bigger and longer (1 to 1.5 ft in length and 15 cm in diameter). Hence, we must make the blade and the outer cylinder bigger.
- A trolley will not be feasible because they will have to push and pull it every time. One more reason is that, some of the castor bunches grow very low (2 feet off the ground) and this hinders the motion of the trolley.

Bhupendra Singh bhai wasn't a labourer and he completely denied the existence of the problem. This was a very important piece of learning for our team, we realised that all the feedback must be taken only from the people who actually do the work on the farm. The data we got from him was contradicting and very discouraging for our team, but the learning was very important.

2. NAME: Keshav bhai

PLACE: Aluwa

DATE: 9th June 2017

Ph No: 8140419809

Our interaction with Keshav bhai was interesting and very useful. He has been working for nearly 60 years, his daughters also used to work on the farm before they got married. On the farm that he works they plant a hybrid type (this gave them double the yield). This particular type gives long and large bunches, they are harvested when they are partially dry – and the thorns really hurt their hands at this stage. He really liked our device. He can carry roughly 30 kgs on his back and he uses a fertilizer bag to temporarily store the castor bunches on his back. He found the idea of a trolley very good but he said that we will have to test this on a field to be sure about its feasibility. Regarding the cost, he said that he was willing to pay about 250 rupees for our device.

3. NAME: Arjun bhai and Jeevatben

PLACE: Aluwa

DATE: 9th June 2017

Ph No: 9824735215

This interaction was wonderful because we got to talk to a woman farmer. We got some great insights through this interaction. Some key highlights were-

- Firstly, our device must have a bigger blade and cylindrical covering.
- The weight of our device is fine.

- In the process of plucking, they do hurt their hands- they have to oil it every night. Sometimes the thorns even go in their eyes.
- Jeevatben said she could carry a maximum of 10kgs on her back. Hence, she had to make many more trips in the emptying process. She liked the trolley idea but said that the “faatiya” that they use currently is more convenient for them.
- They pay around rupees 50 for a sickle. Thus, they would not pay more than 100 rupees for our device.

4. NAME: Taljabhairabara
 PLACE: Aluwa
 DATE: 9th June 2017

On Taljabhai’s field, type 4,5 and 7 of castor variety is grown. He has around 50 to 60 years of experience. Yet again, the first thing he said was that it must be made bigger. He liked the concept and said that it would save a lot of time (they spend a whole day in beating the fruits of the dried castors) and 50% of the work is reduced. He could verify one major concern we had- the arm movement- he said that there is no major strain on his arm and the arm movement is not very different from what is currently being done (still, it must be tested on a field for complete verification). Although, accommodating to the device will take some time. In the design – he said that the rubber handle is more convenient and having 3 blades s better than having one blade. At the most he was willing to pay 100 rupees for the device as the current technique- the sickle, is extremely cheap.

- He didn’t find any major difference between prototype 2 and 3 - based on comfort level.

On his farm he also grew “moong” and he said that this device can be used to harvest the moong beans as well. He tried it and was very happy about it. Using this device in harvesting moong will reduce the work load of 5 people to one person.



Design Concepts

initially we kept trying to create devices that will help in the “cutting”, but after analysing the whole process, we realised that the farmers actually spend a whole day in separating the fruits from the

bunch. So, now we focused on combining the plucking and separating – creating the device that does both. We thought about a circular blade that could travel the length of the stem and in the process cut off the fruits. So, our final concepts were –

Circular blade in the centre.

Outer container to collect the falling fruits.

An opening and closing mechanism to enclose the bunch.

Prof Anil Gupta liked the concept as he told us to test its feasibility and he also told us to make sure that we don't complicate the mechanism.

Prototype Development

We developed our first prototype using a simple circular blade that is mounted on a larger cylindrical outer covering. It is operated (opening and closing) with scissor like handles. When pulled upwards, the blade will travel the length of the stem and all the fruits will get cut off. As they fall they will get temporarily stored in the larger outer cylinder. As the prototype was made using metal it was very heavy and had to be operated with both hands. But after user and mentor feedback we realised that the way the force was being applied here was very strenuous – and hence this model was not feasible. Prof Ted Moallem helped us in understanding and systematically approaching the problem.

We realised that directly pulling and separating the castor fruits from the stem was easier than replicating the same motion at a distance. In the second prototype, we wanted to imbibe the natural pulling motion of the hand. So, we retained the principle, but instead of having a scissor like mechanism we converted it into a wearable device (glove like handles on the 2 sides). We made this using a PVC pipe, 3D printed base, sharpened metal pipe as a blade and rubber handles. Prof Anil Gupta liked the concept but the concern was – how to pluck the castor fruits that were at a height. Also, what we had designed was for a right-handed person, we had to make it compatible for all users. Chetan Bhai suggested we have a mesh covering, as it would make the device lighter and increase the visibility. Bakanji Bhai (Our user) really liked the idea and said the device was feasible. But, our device was too small – we had to increase the size. Prof PVM Rao analysed the strain that was on the wrist due to the opening and closing motion and suggested that we come up with a more efficient way of applying the force (ie maybe change the shape of the device) he also suggested having a v-shaped blade instead of circular.

For the cutting mechanism, we decided that the user can hold the bunch using the device and cut the bunch using a cutter which is held in the other hand. This way no castor fruits will fall. This is a temporary arrangement until we find a method to embed the cutter in the device itself.

The third prototype has an oval shaped outer covering because this way the user need not strain his/her wrist as much. It has a mesh like covering on the top (this makes it lighter) and it also has an adjustable Velcro strap for handles (this way, both right handed and left-handed users can use this device). Prof KM Patel gave us some inputs in improving the blade design – we could make it stronger and more durable. We shaped this blade using a lathe machine. The user feedback on this prototype was mostly positive – the farmers said that this device could greatly reduce their work load. But, yet again it had to be much bigger (the blade). One user said that we could use this device in the harvesting of *moong* as well.

Our 4th and final prototype has a larger inner circular blade, cylindrical outer covering, ply wood base and Velcro with cloth lining adjustable handles. It has a mesh like outer covering at the top (this makes it lighter).

Bill of Material :

<u>S.No</u>	<u>Material</u>	<u>Dimension</u>	<u>Quantity</u>	<u>Unit of measurement</u>
<u>1</u>	<u>PVC pipe</u>	<u>Ø 90x2x460</u>	<u>1</u>	<u>mm</u>
<u>2</u>	<u>Mild Steel tube Blade</u>	<u>Ø35x Ø 12x40</u>	<u>1</u>	<u>mm</u>
<u>3</u>	<u>Wooden ply</u>	<u>95x95</u>	<u>1</u>	<u>mm</u>
<u>4</u>	<u>Stainless steel net</u>	<u>75x250</u>	<u>2</u>	<u>mm</u>
<u>5</u>	<u>Screw M4x15</u>	<u>Standard</u>	<u>10</u>	<u>Nos.</u>
<u>6</u>	<u>Hinge 1.5"</u>	<u>Standard</u>	<u>2</u>	<u>Nos.</u>
<u>7</u>	<u>Bolt M3X10</u>	<u>Standard</u>	<u>16</u>	<u>Nos.</u>
<u>8</u>	<u>Nut M3</u>	<u>Standard</u>	<u>16</u>	<u>Nos.</u>
<u>9</u>	<u>Screw M4x10</u>	<u>Standard</u>	<u>4</u>	<u>Nos.</u>
<u>10</u>	<u>Velcro strap</u>	<u>12</u>	<u>2</u>	<u>inches</u>
<u>11</u>	<u>Steel wire</u>	<u>Ø 2x50</u>	<u>4</u>	<u>mm</u>

Limitations of our prototype:

Ergonomically the opening and closing motion of device can induce strain in palm of the worker.

Economically the device is more expensive than the sickle that they use. Moreover, the device can only be used for plucking purpose while the sickle can be used for multiple tasks.

Leaving traditional plucking method and adapting new technology/device may be of concern.

Road Ahead

The device will be made more cost effective.

A cutting mechanism will be embedded in it.

Device will not only be used for plucking castor but for other crops which requires time and are laborious like "Moong" as well.