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Versatile Fruit & Vegetable Cutter

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***Abstract**: The main goal of our group to develop a fruit cutter and cutter mechanism that is manually operated and which is small in size operated by the usual farm labor whether such laborer be a man, women or child by a single user without the use of any electrical operated hardware. Our instrument uniquely designed with an adjusted pole mechanism making capable to reach fruit at different heights, the device is also equipped with a capped pipe that catches and picked the fruit. Each component of this instrument is designed ergonomically to reduce fatigue, stress and require minimum amount of strain. The device is targeted for homeowners therefore, the entire assembly is cheaper, making easy to transport and priced at an affordable cost. The provision of mechanical fruit cutting device, as previous attempts has been made to provide powered picking equipment. However, such proposed equipment has for one reason or another not been completely satisfactory. For example , some of the existing cutters and cutter are very large, weighing hundreds of pounds and therefore expensive to purchase and maintain. Fruit cutter with efficiently mechanism will develop through this project and will meet customer requirement where can help people easily cut and pick local fruit such as mango, Chiku, small height coconuts, Ramfal and Drumsticks etc.*

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I. Introduction

Fruit-picking is an activity that not only provides a stress-free setting tointeract with nature, but it also allows the cutter to spend much needed time with family and friends. Currently, anyone that decides to part take in such activity is forced to choose between two possible approaches 1) climb onto a ladder and pick each fruit by hand or 2) purchase a small pruning shear and then climb onto a ladder and pick each fruit by hand. The primary goal of the Fruit Cutter design is to provide an easy, inexpensive tool package for anyone looking to pick a couple of fruits. The following section states the goal and the Fruit Cutter 2000 Design Team's solution to the lack of creativity found in the fruit picking market.

The Fruit Cutter is fruit cutters and cutter and picking equipment which uses to help people pick and cut fruit in easy way and save time. Normally, people cut the fruit with a pair of scissors. The cutters and cutter person grasps the fruit in his left hand, for example, and cuts the branch supporting the fruit with the scissors held in his right hand. It is necessary to use both hands and stair for tall trees. The Fruit Cutter is created to help people easily cut fruit whether at shrubs or tall trees. As we know, Maharashtra is rich with local fruits. To ensure the fruit is not damaged during picking, fruit cutter was designed. Basically fruit cutter has a pair.

Problem Statement

The high height level fruits we can't cut properly by using conventional fruit cutters and cutter. The fruits are cut by using hooks, bamboos as well as climbing the tree is very difficult hence there is chances of injuries. Heavy tools used in the conventional fruit cutters and cutter so it was not good to handling in the conventional fruit cutters and cutter. No selectivecutting so major losses occurs so it not good to use. By using the conventional method the skin damages occurs of fruit due to skin damages the market value of fruit is less By using conventional fruit cuttermore time is consumed i.e.(3/4 hrs.) it is the reparative and tedious job so it was boring to cut the fruits. In conventionalcutters and picking tool is very difficult to carry and store. It may be dangerous for the worker who works with conventional fruit cutter. It gives the problem of back pain,neck pain,shoulder pain &Eyes strain.Fruit-picking is an activity that not only provides a stress free setting to interact with nature, but it allows users to and friends. Currently anyone interested - in such an activity is forced to choose between two possible approaches. The first one is climb on a ladder to pick each fruit by hand. And the second approach is to purchase a small pruning shear then climb on to a ladder and pick each fruit. Therefore, it was important to develop a fruit cutterand cutter to serve such users. The goal of our project to provide an easy to inexpensive tool package for anyone interested in picking and cutting fruits.

Scope of project

This project is narrowed down to certain scopes that been identified based on project objectives. Among the scopes that been emphases are:

a) To develop a fruit cutter within the criteria such as ergonomic, easy to fabricate, with aesthetic value.

b) The provision of mechanical fruit cutters and cutter device, as aforesaid, which is small in size and simple enough to be hand held and manually operated by the usual farm laborer whether such laborer be a man, woman or child.

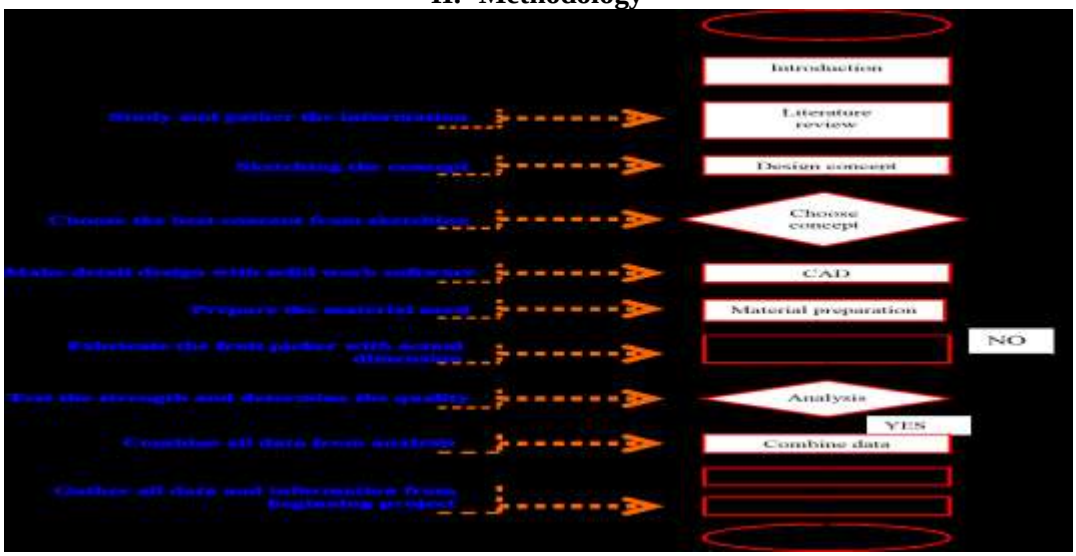
Objectives

The main objective of this project was to design a manually operated fruit cutter that can be used by homeowners and small farms to pick fancy fruits such as apples, oranges, peaches and pomegranates, and figs. a single user should be able to manually operate the device without the use of ladders or any electrical devices. The primary focus of the project was to develop a device that is safe, lightweight, and easy to use and also inflict no damage on the fruits that are being picked. Therefore, ergonomic and safety were addressed when developing each component of the fruit cutter. The goal met by our team was to provide an easy, inexpensive tool for anyone looking to cut fruits.

The specific objectives are given below:

- Overcome the efforts of human being
- Maintain the quality of fruit & vegetables
- It should allow selective cutting
- It should gather fruits safely
- It should eliminate fruits-skin damage
- It should be easy to cut / hook / picked
- It should be affordable [Rs. 1200 max.]
- It should be light weight [Not more than 3 Kg
- It should be maintenance free / repairable at home
- It should be easy to operate
- It should be easy to carry and store
- It should be steady and strong

II. Methodology



The design and fabrication of mechanical fruit cutter must be compliance to several aspects. The design consideration must be done carefully in order that design can be fabricated and all parts are functioning. The aspects must be considered in designing the fruit cutter such as the bucket strength. The bucket needs to have certain strength to ensure that it can load the fruit. The second thing is material. Usually use the available material is one of aspects that have been considered. The materials used depend on their purpose and their function. Then another factor must be consider is cost. The cost of whole system must be not exceeding from budget and reasonable. It should reduce the cost to the minimum. Besides that the ergonomic factors also need to be considered. The fruit cutter must be user friendly and give a pride to people to have it.

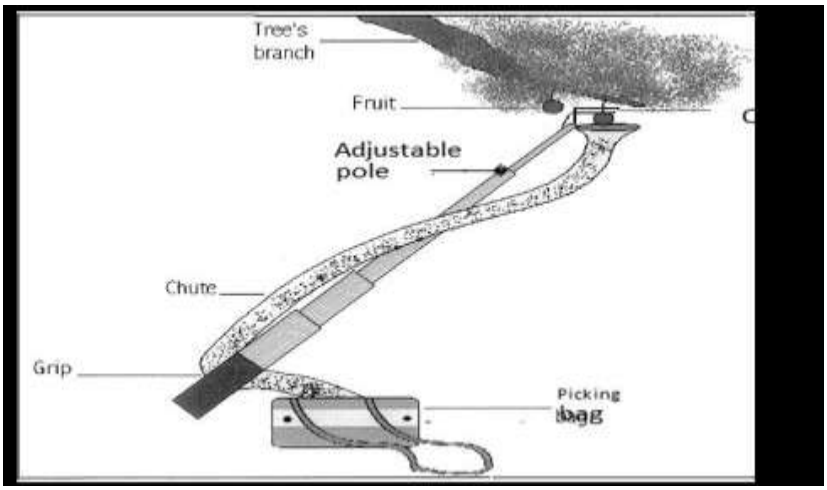
Design Description

The final design included most of the features evolved during the conceptual phase. This design included all of the components named above and also introduced the capped pipe assembly that transports the fruit down from the tree and onto an ergonomically picking bag. In addition, this design includes adjustable heads: A Cutter Head which are easily interchangeable and can be adjusted under a minute.

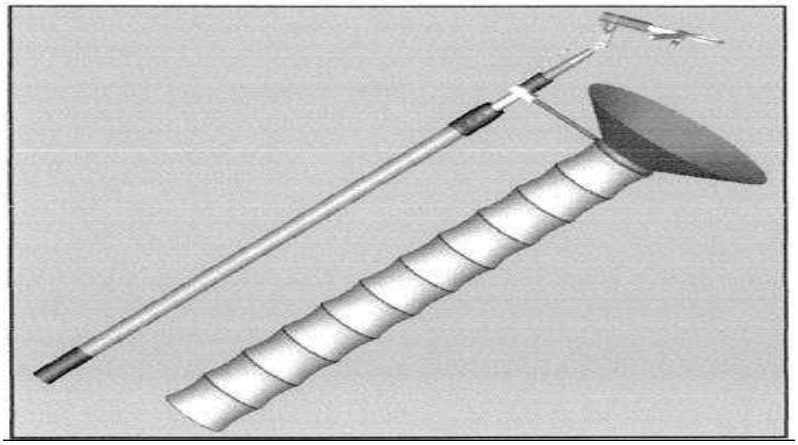
Design concept

In the initial conceptual phase the our team decided that the most efficient way to begin the instrument concepts was to come up with a list of all of the components that would make up the Fruit Cutter and Cutter. Once the list was created, all of the components were classified into two main categories; Primary Components and Secondary Components. The Primary Components are the following: the adjustable heads (Cutter), and the telescopic pole. These primary components are the components which the group felt were important to the project and thus should be designed first. The secondary components which are: the capped pipe.

Rough drawing



Final drawing



Design requirement

There are nine major design requirements used to decide on our final design. Our design will be extremely simple, making our INSTRUMENT easy to maintain and mass-produce.

- The device must be easily operated by a single user to separate fruit from a tree.
- Our product must be targeted for user of approximately ages 12 and up
- Our product will require a minimum physical input from the user
- The device must be manual & band-operated
- The device will be priced at an affordable cost for an average homeowner or small farmer
- The device should be able to reach different ranges of tree heights
- The device will be able to retrieve a wide variety of fruits
- The device will protect the fruit from being damaged or bruised during any part of the retrieval process
- Our device will highly consider ergonomics

III. Experimental Setup

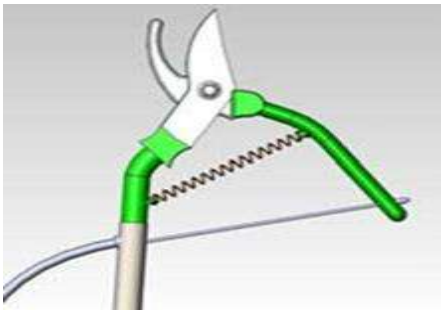
3.1 Primary and secondary components

Assembly, the picking bag, and the grip; could then be designed fitting the specification and dimensions of the primary components. Following is a description of the concepts developed for these components

3.2 Cutter Concept

In order to create a instrument, the project team decided to make a product that would allow the user to easily retrieve any fruit safely and neatly. Thus, the project team focused on making a cutter assembly that would attach to the top of the telescopic pole. Before such cutter assembly could be designed, the group had to first focus on the cutters and cutter geometry. It was in this phase where the group realized the importance of such cutters and cutter geometry and its role in ensuring the user of a successful cut. It was also during thisphase of our project where the group noticed that a simple "dalimb cutter" geometry would be ideal in order to meet our Project Specifications.

Pulling Concepts:



Early on in the Conceptual phase of the project team realized that one Cutters and cutter Head would be an overkill depending on what type of fruit the user decided to pick. Thus, the design team realized that the only way to make our design fully competitive in today's Fruit Cutter Market, we needed to design a second "Pulling" Head in order to give the user a more simplistic/low maintenance choice that will do the job just as easily as the cutter would. The group then developed two different pulling mechanism concepts. The first was a hook like feature located at the top a pole. The user would then aim the hook around the back of the fruit and then pull it down to retrieve it. Another pulling concept developed V slot located on the top of the pole.

Telescopic pipe

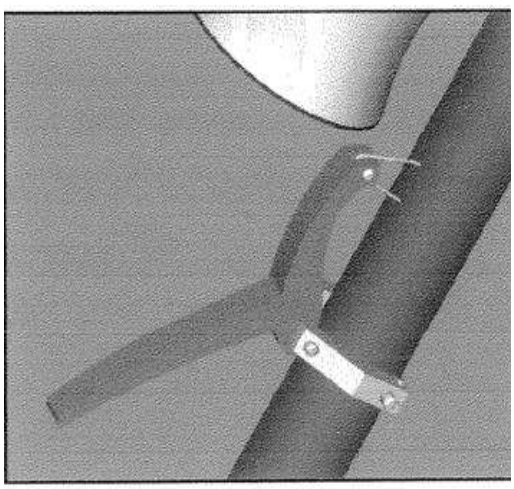
As stated in the Requirements and Specification section, the Fruit cutter will have the ability to reach fruits at different heights, and also be able3 to effectively function at these same heights as well. It was clear from the beginning that the pole design would have to lean towards a "telescopic" design. Therefore, the team focused on the various aspects that would entail producing such telescopic assembly. The Figures show the telescopic function of the pole. During this part of the research, the team determined the telescopic pole assembly involved tedious and tight tolerance. Therefore, the team decided to purchase an already existing off-the-shelf product instead of going with an outside vendor that could custom build a telescopic assembly to meet all of our team's specifications. After some careful considerations the group has decided to purchase telescopic pipe. This telescopic assembly features two concentric poles: an steel pipe within a aluminum pole. Also this telescopic assembly has a retracted length of 5 feet while extended this pole reaches 15 feet. The base diameter of this assembly is 1inches while the top diameter is 0.5 inch. This pole assembly was ideal for many reasons. Primarily, the overall length would provide enough reach for an 5 foot person to be able to reached at the required heights. Also this pole assembly is very light in weight (no greater than 3 kg) and doesnot feel awkward when handling.

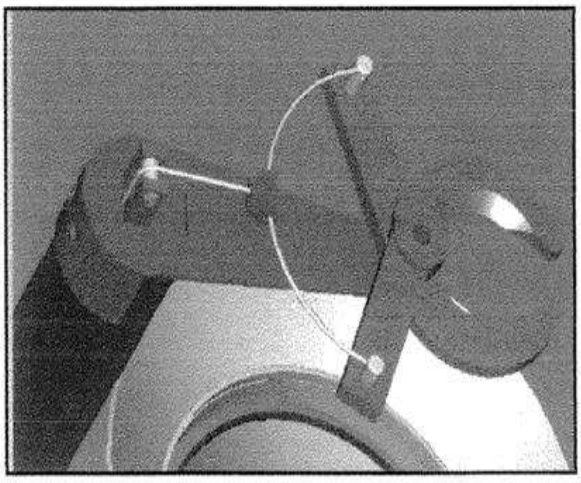
Cutter design

As started earlier in the requirement and specification section, the fruit cutter must be retrieve the fruit stem off the tree branch. During the preliminary design phase, the team as urged to use off the shelf shear in order to eliminate any possible lead time and complication that arise when attempts to design a shearing feature. After all the design consideration the team decides that in the saving time and money, the simplest way of Acquiring cutter for our fruit cutter instrument.

Actuating mechanism design

Out of the entire component in the fruit cutter design, the actuating mechanism will most likely be the one with the most modifications again, as stresses earlier in the report ergonomics is an important factor consideration of the team. Therefore, no matter what grip designed and analyzed there is no way to get an idea of how the component will actually feel unless a prototype is built. The grip design been modified already a number of times, however, the design team has agreed on the latest grip design. As seen on Figure 7.5 the latest actuating handle is meant to resemble a bicycle brake mechanism. In fact, everything from the handle on the bottom of the cutter, to the cable geometry at the cutter assembly region as seen on Figure was designed with such brake mechanism in mind. To activate the cutter, the user pulls back on the handle similar to a bike rider pulling back on a brake lever. This will cause the cable to be pulled in a downward fashion. This motion causes a decrease in length of the cable that connects the cutter handles. The design team agrees that this type of mechanism will provide the user with enough mechanical advantage to easily cut the stem of almost any fruit.





Refined actuating mechanism design

After the Winter Quarter, the instrument design team met in order to address several issues regarding some flaws observed in the actuating mechanism; in particular the cutter mechanism. One of the main flaws detected had to do with the vulnerability of the cutters and cutter mechanism when placed into the tree. The team noticed that the current actuating mechanism did not protect the cable enough from existing debris that could obstruct any of the moving objects. Therefore the group began to redesign the cutter block that would be located at the top of the Fruit Cutter. Figure 7.8 shows the design of the new redesigned block. As it becomes apparent in the Refined actuating mechanism figure, another issue that was addressed was the Issue regarding the fixed perpendicular angle that was shown in the first Mechanism developed in the Winter Quarter.

Figure refined instrument team realized that having a fixed angle would Actuating Mechanism make it extremely difficult to guarantee a perfect cut to the user as he/she decides to change the angle of operation. Therefore, as seen in Figure the team decided to go with a rotary hinge in order to provide easy angle adjustment. Also the cutter block was modified in order to accommodate most of the cable, thus protecting it from any form of debris that might interfere and obstruct any of the motion.

Capped Pipe

As seen on Figure team chose to go with a capped pipe -like approach in order to solve the collapsibility and durability concerns. Since the team was concerned in obtaining a capped pipe that would not get caught in the tree branches. Capped pipe design and at the same time not add too much weight to the fruit cutter assembly. The team decided to look at the plastic capped pipe. In addition, the particular pipe purchased by the team. Overall diameter of capped pipe is 6 inches.

Wing screw

A wing screw or wing nut is a type of nut with two large metal "wings", one on each side, so it can be easily tightened and loosened by hand without tools.A similar fastener with a male thread is known as a wing screw or a wing bolt. We use this type of wing screw for lock cutter end to the pipe end. We can pack the screw by hand without any instrument hence it is easy to pack. So we choose this type of screw for better easy work.

Construction and working

 Construction

It consist two pipes connected with each other by locking mechanism. One pipe is steel pipe and another is aluminum. At the top of the aluminum pipe the cutter is connected by nut and bolts, which is adjustable i.e. we can replace the cutter by another. The another main component of instrument is a rod which is connect top and low point of instrument. At the lower point the rod is connected to the handle and handle is connected to the rod. Further the rod is connected with the cutter. At the bottom of the pipe locking mechanism is provided which connects strip to the rod. It also provide handle which provide grip so pipe cannot slip. At the top of the pipe the fruit picking pipe also provide. Capped pipe design and at the same time not add too much weight to the fruit cutter assembly. It caught the fruit and slowly down the fruit from the higher height to lower height without damage the fruit safely.

 Working

The working principle of versatile fruit and vegetable cutter is based on the brake lever mechanism. The instrument with two pipes, one is aluminum and other is steel. The 6 holes are providing on the aluminum pipe, which is help to connect two pipe each other. We increase the length of pipe by increasing length of aluminum pipe. Where the steel pipe is stationary which is cannot be adjustable. We can increase the length at required height. When we get require height, the aluminum pipe is connect to steel pipe and also the rod is connect with the strip by locking mechanism. When we press the handle rod moves down due to this movement cutter also move clockwise direction and cuts the required level fruits. The cut fruit is then caught by capped pipe and slowly get down to the tree without damage. We can operate same operation at different heights but below the 20 feet's. The stationary condition of instrument is 10 feet and we increase the length up to 15 feet's. By adding human height it increases up to 20 feet's.

IV. Manufacturing Process And Assembly Work

4.1 Manufacturing Process

Drilling

Drilling is the important factor for our manufacturing process. We used two types of drilling machines two create holes in aluminum pipe. These holes are required for locking system. Locking system is used for adjusting the height of pipe as per requirement. The hand drilling machine used for create holes. Each hole is drilled in a same distance. There are six hole which is in same diameters is drilled is aluminum pipe at a same distance. And one hole is drilled in steel pipe for locking arrangement.

Grinding

Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool. To provide smoothness for cutting tool and also provide sharp cutting edge to the cutter we used angle grinder for grinding. The parts which are provided with grinding operation are easy to handle as sharp edges are removed due to grinding operation. Grinding is commonly used on cast iron and various types of steel. These materials lend themselves to grinding because they can be held by the magnetic chuck commonly used on grinding machines, and they do not melt into the wheel, clogging it and preventing it from cutting. Materials that are less commonly ground are Aluminum, stainless steel, brass & plastics.These all tend to clog the cutting wheel more than steel & cast iron, but with special techniques it is possible to grind them.

Forging

Forging is a manufacturing process involving the shaping of metal using localized compressive forces. The blows are delivered with a hammer (often a power hammer) or a die.Forging is one of the oldest known metalworking processes. Traditionally, forging was performed by a smith using hammer and anvil, though introducing water power to the production and working of iron in the 12th century allowed the use of large trip hammers or power hammers that exponentially increased the amount and size of iron that could be produced and forged easily. The smithy or forge has evolved over centuries to become a facility with engineered processes, production equipment, tooling, raw materials and products to meet the demands of modern industry.

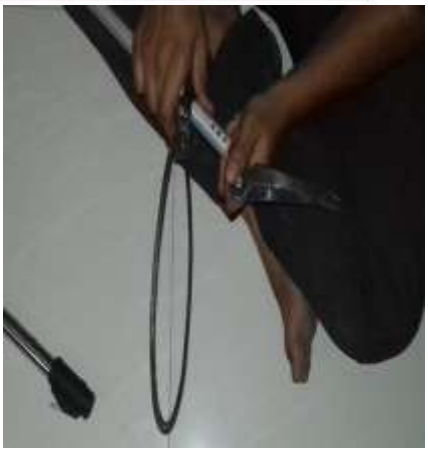
Threading

There are two type of threading internal and external threading. Internal threading and external threading as fallows,

Internal threading

The method of internal threading we used to create internal threads in the cutter end, to fix the cutter at the end of the aluminum pipe. Internal threading is done by using internal threading tool tip. First we create hole at the surface of cutter by using vertical drilling machine. There were three same diameter hole we had creates. Then we fix the cutter between the jaws and by using internal threading tool tip we create the thread.

Assembly work




Final Model Photo

V. Safety And Ergonomics

Ergonomics is the science of fitting a job task to the person who does the work, instead of forcing the person to fit the job. The use of an ergonomically well designed hand device reduces the risk of certain types of injuries and illnesses, it provides safer conditions, and increases job efficiency. Some injures can be caused by the impact and vibration caused by the device. Other injuries occur when over exhausted muscles swell, reducing the blood flow. According to the Consumer Product Safety Commission, in 1982 there was an estimation of 240,000 medical injuries by chain saws and 133,000 injuries by garden tools. Therefore, ergonomic aspects had great impact when designing the fruit picker. Those ergonomics aspects are discussed below.

5.1 Weight

Heavy or unbalanced devices tire the upper arm, and shoulder muscles, especially when the job task requires you to straighten your arm out. In some cases, the user needs to straighten the arm out to reach fruits at higher elevations. The amount of weight that can be handled comfortably varies from one person to another. The recommended safe load of carrying is approximately between 5 to 8 kg. However, the fruit picker is carefully designed to weigh less than that, approximately 3 kg Furthermore, maintaining balance device would reduce injuries associated with the back pain since 20% of garden tools injuries and illnesses occurs from back pain.

5.2 Neck Posture

The neutral position for the neck is facing forward and slightly bending downward between 10° to 15°. Yet neck flexion of over 20° is a risk factor for the neck. Therefore, the pole design reach maximum length of 15feet in order to reduce any backward bending of the neck that is greater than 20°.

Advantages, Disadvantages

 Major advantages

- It is light weight and therefore can easily be carried from one place to another. Its price comes to nearly Rs.1250/- which is affordable to common man. Since this equipment is a simple one, chances of frequent maintenance will be less.
- The design of the versatile fruit and vegetable cutter helped us develop ideas about fruit gathering. It is more efficient to have the picked fruits come down the tree, and into a basket, instead of fruits gathering up at the top of the fruit picker.
- The main advantage of this design is the telescopic pole. This allows for a more compact design for easy storage as well as an adjustable length for optimum performance.
- The advantages of this design are the use of a flexible sleeve to deliver the fruit to the operator. This is a crucial aspect of the preliminary design the group has come to developed.

 General advantages

 It overcome the efforts of human being
 It maintain the quality of fruit & vegetables
 It allow selective cutting and picking of fruits
 Itgather fruits safely to the down of tree
 It eliminate fruits-skin damage and increase the value in market
 It is affordable [Rs. 1250 max.]
 It is light in weight [Not more than 3 Kg]
 It is maintenance free / repairable at home
 It is easy to operate

It should be steady and strong

 It do not require any external electric power supply

 Disadvantages

- It is used only for small fruits like Mango, Naseberry (chikku) etc
- We cannot cut fruits above 20 feet height.

VI. Conclusion

The inspiration for designing this equipment originated from the fact that the fruits cultivating field does not have any equipment for cutting drumsticks. It is usually seen that the cultivators by using bamboo poles and ladders climb on the trees and harvest drumstick with their hands. By conducting user study, market study, ethnography research, literature survey and interviews, the data generated. Based on these various concepts of the proposed equipment are created. The selected concept was developed into a working model. After conducting feasibility test the model was validated for studying human factors. So it can be very well concluded that the development of such kind of equipment will surely find a place in the market.

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