

SEMI-AUTOMATIC TEA LEAF HARVESTING MACHINE

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Abstract— Tea is one of the major and cheapest beverages in India. Tea cultivation in India has a long history and used in traditional system of medicinal application as well as for consumption. India is cultivating and consuming it for hundreds of years. India is the second largest producer of tea in the world after china and also one of the largest consumers. Tea is manufactured by processing the leaves in the factories which are plucked and graded with various grades depending on the quality. The best quality is the bud and the two leaves along with it. The major problems faced by tea industry in India such as shortage of laborers, decrease in wages and attack of pests led to decrease the production rate. Thus mechanization of tea leaf harvesting was introduced. Tea leaves harvesting machine will have an important role in improving the tea production by employing the innovative cutting edge technology with blades made of ferrous metal. This article gives a brief idea about the existing methodologies and also proposes a new model to overcome the disadvantages in existing mechanism. The proposed model is designed in such a way that both the pesticide sprayer and the harvester are integrated in a single machine, which does not compromise on crop safety and the production rate. Semi-automatic tea leaf harvesting machine is more viable, feasible and profitable than manual harvesting.

Keywords: Harvesting, Mechanization, Pests, Plucking machine, Sprayer, Tea.

I. INTRODUCTION

India continues to be the largest producer of tea accounting for 32.08 per cent of the global output. India is also one of the largest consumers of tea. In terms of area, it occupies about 20.07 per cent of the world tea area. Although India holds a leading position in production and export, the current position of tea trade reveals that its share in the world production and export has been declining steadily over the past three decades.

There are various reasons behind the decline of production rate, one of the major reasons is shortage of laborers and increase in wages, another major reason is the attack of pests. Tea is grown in a monoculture and often subject to attack by insects and other pests, hence pesticide use is not uncommon. Taking into consideration the former one mechanization of tea leaf harvesting was introduced which not only increased the production rate but also required less man power. Though production rate was increased the use of machines caused damage to the tea bushes and was difficult to maintain height and carry all over the tea estate.

There are two major ways of harvesting tea leaves, manual plucking and harvesting using mechanisms.

A. Manual Plucking

In this type of tea leaf harvesting the labor selects the leaf, cut and collects it. There are two types: Hand plucking and cutting with the help of scissors like equipment as shown in Fig1and Fig 2. Hand plucking requires quick and sharp eyes. Though the production rate is low, the best quality of tea leaf can be obtained by this method.



Fig.1.Tr aditional way

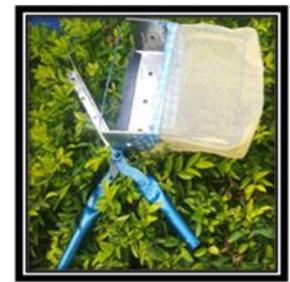


Fig.2 Scissor type equipment

The scissor type of equipment consists of a permanent blade and collecting box attached to one handle which is fixed and other handle with sharp blade could be moved like scissors.

B. Existing models

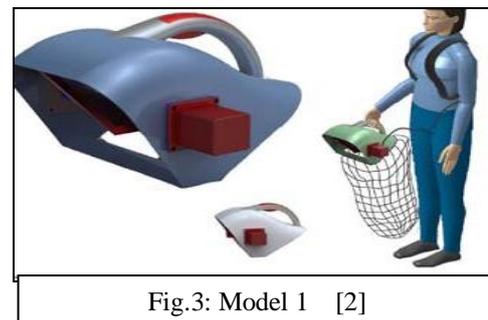


Fig.3: Model 1 [2]

Model 1 is a handy battery operated machine as shown in Fig 3. A nonmetallic sheet is twisted and used as a blade in this machine. Rotating blade chops off the leaf and pushes it into the bag attached at the backend of the machine. This machine proved to be advantageous in terms of weight. It was easy to operate, clean and service. As the person could carry it to the required bush, less damage is caused to the bushes, but the disadvantage was poor vision of the cutting process.



Fig 4: Model 2 [4]

Model 2 is similar to that of model 1. To increase the speed of work three blades are involved, which are placed at equidistance and are responsible for tea leaf cutting. When the bag is filled it is replaced with an empty bag.



Fig 5: Model 3 [3]

Model 3 is one man operated machine with series of light weight noiseless blades. This works on 2 or 4 stroke petrol engine. This equipment is equipped with flexible shaft for power transmission and sturdy steel blades for cutting the leaves. A large bag is provided with this machine to effectively pluck and collect the tea leaves in bag without any wastage as shown in fig.5. The advantages are that it is cost effective, labor and time saving device which increases the productivity almost 5 times compared to manual plucking.



Fig 6: Model 4 [9]

Model 4 is two men operated tea leaf harvesting machine of Japan as shown in Fig 6. The capacity of harvesting and fuel consumption is comparatively more in this machine.



Fig 7: Model 5 [4]

Model 5- The Williames Tea Pty Ltd has a new 2 person selective leaf cutting machine called UL-750 tea harvester as shown in fig.7. The plucker selectively plucks 92,000 times per hour across the tea at 4 kms with quality as good as hand plucked leaf. It only picks mature tea leaf while leaving the immature buds for the next round to improve yield. Only two persons are required to operate the machine which can do the work of 15 hand plucker.

The existing harvesting machines require human resource and make use of fuel such as petrol and diesel increasing the production rate by increasing the speed of plucking with reduced manpower when compared to hand plucking. But these machines could not solve the problem of selectively plucking the tea leaves along with maintaining its quality and crop safety. It also did not ensure the prevention of crop from pest attack.

II. METHODOLOGY

India is one of the largest producers of tea in the world, but it has a poor development of mechanization. There were no demands of tea plucking machine for the sufficient supply of human labors last century. Next, applications of new technologies and science in agricultural field are always lagging behind those in the industrial.

The most big gardens, especially those gardens that export tea, avoid using such sprays due to fear of pesticide residual content as western and European countries are very choosy about tea with pesticide residues.

In flat regions for the conditioned farming drainage system should be maintained for growing healthy bushes. The machines with four wheels have better control over maintaining the height of the bush than two wheeled machines, since they have a tendency to tilt. Details are collected from newspaper, reports, handouts, and journals. In addition to this, relevant materials are also collected through the internet as well. A market study was carried out to understand the different types of machines available in the Indian market as well as abroad for harvesting tea leaves. A detailed study was done on machines available in India, especially about the features like harvesting capacity, weight of the machine, ease of handling, clear vision of the process, cleaning, servicing etc. The results confirmed that mechanical harvesting method is more viable, feasible and profitable than manual harvesting. Lot of research must be carried out to employ innovative cutting edge technology with blades made of ferrous metal for the selective tea leaf harvesting.

India's tea production has been hit with rampant pests eating away the crop, adding to the woes of the cash-strapped tea industry. According to tea growers, the bugs tend to attack plantations during the winter when the young leaves brown. Though use of pesticide is essential, most of the tea estates fear using pesticide as improper application of pesticide, improper dosage and improper method of application may destroy the crop. Manual application of pesticide may lead to contamination of skin, mouth, eyes and also inhaling while mixing or spraying against the direction of wind may lead to serious health issues.

III. PROPOSED MODEL

The proposed model is an integrated system having both pesticide sprayer and mechanized harvester. This machine is semi automated and can be controlled by using mobile phone application. The person sitting in a control room can control the machine movement, cutting blades and pesticide sprayer with the help of live video streaming on the android phone. This machine is particularly designed for conditioned farms only.

Working

The block diagram of the proposed model is shown in the Fig 8. The commands given using the cell phone are communicated to the microcontroller with the help of Bluetooth module. When the front command is given the microcontroller sends signal to the motor driver which rotates the DC motor connected to the wheels and blades as shown in the Fig 9. Thus the machine moves forward and cut the leaves.

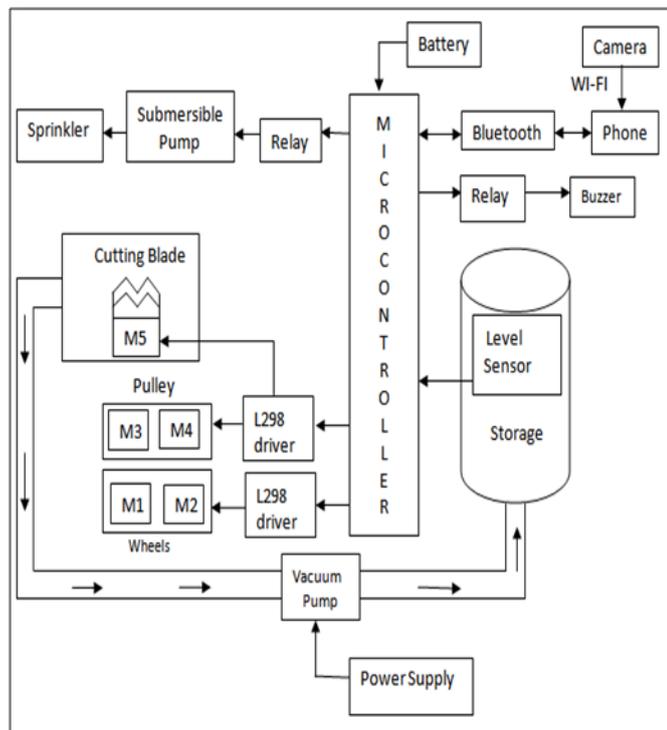


Fig.8: Block diagram of proposed system

The cut leaves are sucked using the vacuum pump and stored in the container. Once the container is full, all the operations are stopped and the buzzer buzzes indicating to empty the container. The machine can be called back by giving back command. The motor driver connected to the wheels, drives the machine back making it convenient to empty the storage or refill the pesticides tank.

During operation, the machine is solely supported on the wheels moving on the ground. Another feature of this machine is the pesticide sprinker. When sprinkle command is given, the submersible pump in the pesticide tank is turned on and the pesticide is pumped to sprinker evenly throughout the bush. Relay acts as a switch for the submersible pump and the buzzer. The blades are designed in such a way that it selectively plucks the tea leaf maintaining its quality without harming the bush. Motor drivers are used to operate the DC

motors to provide the sufficient supply. The 360 degree rotation of the camera is also controlled with the help of the android mobile phone application. The adjustment of height of the blades is done as per the height of the bush by the up and down commands. The rotation of DC motor connected to the pulleys help in adjustment of height of the machine. The person in the control room can continuously monitor the machine with the help of IP camera mounted on the machine.

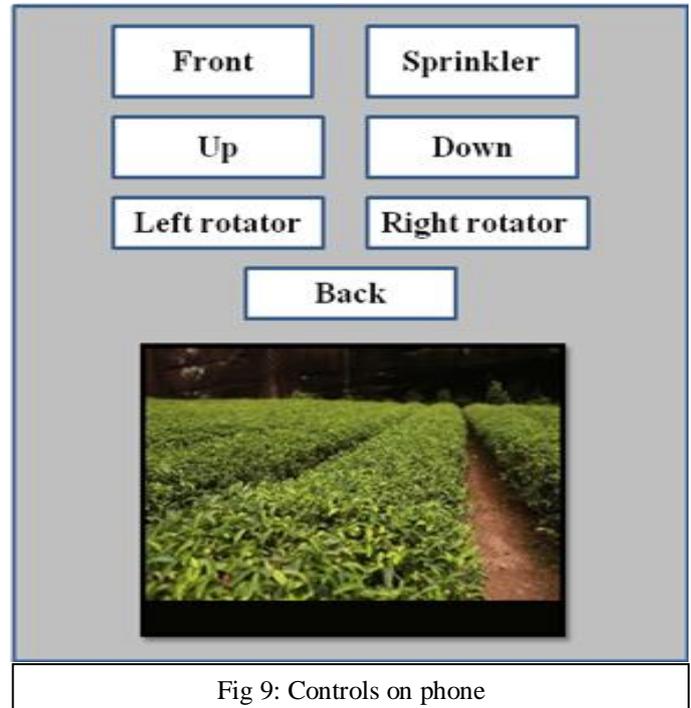


Fig 9: Controls on phone

Real Time Streaming Protocol (RTSP) is a networking protocol mainly used to stream real time media data like audio or video. It establishes a streaming session between client and server. In the Internet of Things world, an interesting android application is build to send real-time video images on an Android device. An Internet protocol camera is used for the real-time streaming application. But this solution requires an IP camera compatible with an Android device. The IP cameras are designed to send video images to a WI-FI router. Another Android device is connected to the router to display video images. By using android operation system this application presents a wireless multi hop video streaming application. This application allows sharing live information which is captured by camera.

IV. RESULTS AND DISCUSSION

Tea plucking machines are designed in many countries for plucking and selecting method. But the machines are very large and expensive. The present machine design is compact and light weight and can be used for the flat land in the conditioned farming. Tea harvesting is completely mechanized to improve productivity, yet retaining the high quality and accuracy of selective plucking. The semiautomatic designed machine avoids stripping of leaves and not damages the upper layer maintenance foliage. It ensures high harvesting efficiency and increase productivity without compromising on crop safety. By making use of less man power it reduces the plucking cost .It helps in maintaining uniform plucking table.

Additional feature of sprinkling pesticide in equal proportion avoids loss of crop due to pests and also the health issues.

Based on the various discussion results confirmed that mechanical harvesting method is more viable than hand harvesting as it has a higher gross margin and benefits than hand harvesting methods. The results also established that mechanical harvesting method is feasible and profitable which reduces costs in tea production since benefits outweigh costs as compared to hand harvesting method. As mechanical harvesting method is capital intensive one, this helps reduce the need to hire more labor to operate in the field as the machines substitute labor demand. The proposed design works on rechargeable batteries which can be charged using solar power, so this machine is much more efficient in fuel consumption and does not cause any damage to the plant. This machine can be operated without fatigue which is completely based on less weight of the machine, holding and container arrangement of the cutting mechanism. After cutting the tea leaves are transported to the container with suitable convey system maintaining the leaf quality and also the crop safety.

It is one of the major problems in the Tea Industry to harvest tea leaves for processing into tea where agriculture workers are not plentiful or workers cost are high. There is no satisfactory mechanical tea harvester been developed for tea harvesting in India because the handheld and hovercraft type machine pluck irregular height cut. The present design is directed to a mechanized tea leaves harvesting system for automatic plucking and collection of tea leaves in tea garden having specified disposition of tea bushes. Turning or reverse motion of the device can be provided manually by an operator by means of android phone application. The plucking point can be adjusted accordingly to the height of tea bushes. Spraying of pesticide evenly at regular intervals in required amount is taken care of to avoid the damage caused by the pests resulting in low production.

A vast market survey has been conducted within the user to know more about the problem they are facing and to arrive at a new design. The customers or the users are given prime importance.

The user survey helps to understand the ways through which the people are using the product and the difficulties which they are facing. The key findings from the user study conducted to understand more about the current situation and the real time problems of harvesting tea per day. Hand plucking produces the best quality leaf but lowers the tea production and income to compete with the global market. Increasing price, fumes and smell, body pain due to overweight are the common complaints about petrol operated machine. It enhances the tea production but quality and safety of the crop is at risk. Damage to tea leaves is the complaint about diesel operated machine. Body pain while using scissor type harvesting in maintaining the height of the bush are the major observations.

A detailed analysis of the market, evolvement of a strategy and a business plan is required. Various management programmes should be initiated by the industry as well as by the Government to develop and automate the tea leaf harvesting. The tea industry should get modernized with a

change in technique of plantation and improvement in technology by implementing the 'Semi-automatic tea leaf harvesting machine' which has an additional feature of sprinkling pesticides.

A. Applications

1. Large scale tea harvester.
2. Pesticide sprayer.
3. Can be used for gardening.



Fig.9 Prototype of the proposed model

B. Future enhancements

1. To automate tea leaf cutting in unconditioned farms.
2. Employs innovative cutting edge technology with blades made of ferrous metal.
3. Plucking of side shoots.
4. Operate the machine in hilly-terrain areas.

V. CONCLUSION

Tea industry contributes large amount to the national income of India, as it is one of the largest exporters of tea in the world. Therefore it is necessary to overcome the problems existing in the tea industry such as shortage of laborers, increase in wages, and decrease in production due to improper application of pesticides. The proposed model is an effort made to increase the production rate by overcoming these challenges. Both the pesticide sprayer and the harvester are integrated in a single machine, which does not compromise on crop safety and the production rate. Mechanization of tea leaf harvesting is more viable than hand harvesting. Battery/solar power operated and extremely environment friendly - a truly green machine in a green environment.

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