Smart Mulberry Plant Cutter

R. Ranjith kumar1*, T.M. Navinkumar2, P. Aravindh3, T. Kavinesh3, Y. Sathyanarayanan3, P. Sedhumaadhavan3

1 Assistant Professor (Sr.Gr), Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, Erode-638060, Tamilnadu, India
2 Assistant Professor, Electrical and Electronics Engineering, K. Ramakrishnan College of Engineering, Samayapuram, Trichy, Tamilnadu, India
3 Final Year Student, Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, Erode-638060, Tamilnadu, India

*email: ranjithsat8@gmail.com

Abstract: Sericulture is the process of farming silkworms to cultivate silk from it. In sericulture the silkworms are fed by mulberry leaves. The major problem in this field is cultivation and cutting of mulberry plants. More manpower is required to cut the mulberry plants and carry them to the silkworm shed. Also, it needs more time. This project “Farmer’s friendly mulberry plant cutter” gives solution for the above-mentioned problems. The project is designed with a movable holder or arm and a rotating cutter. Initially the arm will hold the mulberry plant and the cutter starts to cut the plant. The plant cutter comprises of a storage area to store the plants. The arm holding the plant will drop the plant in the storage area. The entire plant cutter should be moved manually to locate the plant properly. The holding and cutting process are automated.

Keywords: Silkworm, Arm, Holder, Cutting, Automation, Mulberry, Feeding.

1. Introduction

The silkworms are mostly fed by the mulberry leaves. This mulberry plant is planted in the field specifically for the silkworms in their fields. There are different types of cutting methods for the mulberry plant cutting. The manual cutting process and the machine cutting process. The machine cutting is easy compared to manual cutting, because the time will be majorly reduced and the number of workers can also be reduced. But the only thing is that the leaf will fall on the ground and the cutting process is not automated. This paper comprises the new technique of automated machine cutting process of the mulberry plant from the field for the silkworms.

The ultimate aim of the project is to help the small farmers, who are willing to involve in Sericulture. Since the major hurdle for their involvement is Labor shortage. Thus, the project paved the solution for the reduction in manpower requirement for the collection of “Mulberry Leaves” which is to be feed for the Silkworms. In this project a rover mounted with the cutter and the holder is designed to cut and carry the chopped plant to the nearby silkworm rearing shed. Let see the project work in detail. The limitations found during literature review is that most processes use petrol engine with high power motors and sensors which makes it less economical. This smart mulberry plant cutter overcomes these problems and it makes it more economical and so it can make huge impact in sericulture farming.
2. Literature review
Balaji A, Jahir Hussain H, Faheem Ashkar MR, Gowsick C, Subakar K were made a paper on Design and Fabrication of Agro-based Automatic Plantain Tree Cutting Machine. They have fabricated low cost cutting machine for banana tree on a large scale. In existing system, the cutting and decomposition process takes much time and the cost requirement is also high. The mechanical part of the machine consists of lead screw, journal bearing and cutter blade. High strength lead screw is used to eliminate the thrust. The cutter blade is designed to rotate at high speed. The electrical system of the machine contains wiper motor and inductive type proximity sensor. Due to the continuous motion of the cutter blade and lead screw movement, the banana trees are cut into pieces. The machine is designed with economic feasibility by including sensors and relays.

Ghumadwar R A, Bankar V H has developed a paper called Design and Analysis of Crop Cutter. This title presents the concept for design and analysis of crop cutter. The crop cutting is important stage in agriculture field. Currently in India farmers use conventional method for the crop cutting i.e. the conventional method for crop cutting is as manually cutting using labour but this method is lengthy and time consuming. This project aim is to design and analysis of small field crop cutter machine for small height crop. To analysis cutting roller and horizontal cutting blade by using Pro-e and anises software. The machine consists of petrol engine to operate cutting roller and blade. When compare to manual crop cutting by and this machine has a capacity to cut the crop in faster. This machine to helpful for both the small as well as big farm.

3. Conventional Method
The existing method to cut the mulberry leaf is manually by using hydraulic cutter and other plant cutting machines. This manual cutting needs workers and each branch of the mulberry plant is cut individually.

Hence to overcome these problems we have designed a new mulberry plant cutting rover. It helps to reduce the cost and manpower needed.

4. Proposed Method
The objective of the proposed work is to cut the mulberry plant by using the movable arm and the cutter. The chopped plants are stored in the storage area available in the plant cutter. The Mulberry plants usually cultivated in a proper row-based manner which is suitable for collecting the plants, Let’s see the process of automatic chopping of the plant from the field. The block diagram given below explains the course of the plant cutter.
Initially the plant cutting unit which is attached to the chopper has to be taken to mulberry field. It has to be moved manually to locate the plant to cut. After placing the chopper in the correct position, the cutting process is started. The arm comes out and holds the plant, then the cutter starts to cut the plant. Then the arm comes to its initial position and drops the chopped plant in the storage area after the completion of one cycle there will be a delay time in which we have to move the plant cutter to the next plant. This process is repeated until the entire row of plants is chopped.

Here, the arm is attached to a rod with a wiper motor. By controlling the actions of the wiper motor, we can move the arm in the required direction. The arm consists of gears enclosed with a DC
motor. The opening and closing of arm are controlled by the DC motor. The circular saw is used to cut the mulberry plant. The saw is connected with dc motor. It is attached with wiper motor setup to control its actions. The circular saw will come out after the arm holds the mulberry plant. High torque DC motor is required to cut the plant properly.

5. Experimental Setup and Implementation

The hardware of the project is designed as shown above in the Fig 4, the entire hardware model is built by considering the real time implementation of the project in the actual mulberry farm. The working of the project is quite simple and easily handle by the farmers, since the entire process of cutting is automated through this project, the only need of the manpower is to monitor the proper functioning of the equipment and it needs their guidance to park near the respective row which is to be chopped.

The functioning of the entire system is also classified into four steps based on the sequence to be executed. Initially the rover will be park in the row of plants which is to be cut, Once the rover is parked and the auto mode is enabled then the controller system will take care the following steps:

1. Firstly, the holder will open and the arm on which it is mounted will moves towards outside to catch the plant, once it reaches the plant then the holder will close to grip the stems (Bunch of Stems).
2. Once the above actions get done then the Arduino will actuate the cutter to turn ON, simultaneously the arm on which the cutter will move towards out so the stems which are gripped by the Cutter will be Chopped and get separated from the plant.
3. Now, it the time for the arm that holds the mulberry plants to move inwards and fill the tray by loosening the holder, this sequence will also be takeover by the controller and relay module.
4. Finally, the plants get loaded and this is the time to move to the next nearby plant to proceed further and to repeat the same steps since the tray get filled.
6. FIELD ANALYSIS
The developed model has been tested in the real field and performance analysis is made which is shown in the table.

Table 1. Performance analysis

| Action                         | Observations          |
|--------------------------------|-----------------------|
| Time needed to cut 10 plants   | 2 Minutes             |
| Maximum leaf carrying capability| 9 Kg (Green mulberry leaves) |
| Total X-axis length covered    | 3.5 Feet (Arc Shaped) |
| Total Y-axis length covered    | 5 Feet (Arc Shaped)   |
| Maximum pay load               | 15 Kg                 |

6.1 Amount of time consumed
To obtain the time period, opinion from different sericulture farmers are taken and the time consumption chart is obtained which is given below.

Figure 5. Total consumed time comparison among existing and designed model

The given graph shows the time taken by two labors cutting the mulberry plants as per the requirement. It also shows the consumed time by the smart cutter where a single person is enough to operate the cutter. By comparing the time taken by both processes, we can observe that time needed for the designed cutter is very low which brings the solution for manpower shortage and wastage of time.

6.2 Operating Cost
The graph given below shows the operating or labor cost of the existing method and also when the designed smart cutter is used.
Figure 6. Comparison of operating cost between existing method and designed model

From the graph we can observe that the usage of the smart cutter reduces the operating and cutting cost of the mulberry plant cutting process. Thus it also increases the profit for the farmers.

7. Conclusion
This smart mulberry plant cutter significantly reduces the labor wages and manpower requirement. It can be controlled by a single person and also it saves more time in the mulberry plant cutting process. Thus, manufacturing of these kind of machines can increase the revenue in sericulture farming in India and also increases the involvement of more people in agricultural activities. Also, this machine can be used to cut as well as to store the mulberry plant in it, which makes it easy to carry the plants to the silkworm shed. Hence the on field efforts from the farmers can be reduced which brings the solution for shortage of labor problems. The limitations of this project is that the location of plant has to be traced manually which requires one person and high torque motors are required for good performance.

References
[1] Balaji A, Jahir Hussain H, Faheem Ashkar MR, Gowsick C, Subakar K, 3 March 2015, “Design and Fabrication of Agro-based Automatic Plantain Tree Cutting Machine” International Journal of Innovative Research in Science, Engineering and Technology. An ISO 3297: 2007 Certified Organization, Vol. 4, Issue 3.
[2] Mutke Suraj Rajendra, Pande Vishal, Rajput Monika Naraynsing, Jondhale Chetna Eknath, Tambe Sonali Sahebrao, Munjal Nilesh Mahalu, Thorat Rohit Jayram, Nehe Sachin Ashok, Dr. B. R. Borkar, 2017, “Design and Manufacturing of Onion Root and Stem Cutting with Sorting Machine” International Journal of innovative Research in Technology. Impact factor 5.86.
[3] Wang Hongpo, Zhou Hong, 18 June 2018, “Study on precise mushroom cultivation based on feedback perception”.IEEE - DOI: 10.1109/ICCCBDA. 2018.8386568.
[4] Srinivasan K, Venkatesh M, Vetri Vel S, Umapathi S and Santhosh Kumar M, 2016 , “Design And, Fabrication of Non-Dust Paper Wood Cutter”. International Journal of Design and Manufacturing Technology (IJDMT) Volume 7, Issue 1, pp. 37–49, Article ID: IJDMT_07_01_004
[5] Gunasheela T J , Renuka V Tali , Prathiba S N ,Shilpa A, 01 October 2015, "Implementation Of Sericulture Farm Automation Using Sensor Network And GSM Technology", International Journal of Pure and Applied Mathematics Volume 119 No. 14 2018, 13-20, K.S. School of Engineering and Management Bengaluru, India.
[6] Siddhesh Phapale, Atamboli, Shinde D L, “Design and Fabrication of Sugarcane Node Cutting Machine”. International Engineering Research Journal (IERJ), Volume2 Issue 9Page3802-3805, 2017 ISSN 2395-1621.
[7] Manjeet Prem, Nikhlesh Kumar Verma, Dabhi K L, Swarnkar R, “A Critical Study on Crop Harvesting Machines”. An International Refereed, Peer Reviewed & Indexed Quarterly Journal in Science, Agriculture & Engineering. ISSN 2277-7601.

[8] Ghumadwar R A, Bankar V H, 07 July 2016, “Design and Analysis of Crop Cutter”. International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue.

[9] Pramod R, Datta Sandesh M, Sandeep Jayaram M, Kottakota Kalasagarreddi, 2014 “Design and Development of Sustainable Weed Cutter”. 3rd International Conference on Eco-friendly Computing and Communication Systems, DOI: 10.1109/Ecofriendly.2014.65, IEEE, Mangalore, India

[10] Ranjith kumar R, Aravindh P, Kavinesh T, Sathyanarayanan Y, Sedhumaadhavan P, December 2019 ,“Automatic Feeder for Sericulture”, International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-9 Issue-2.