MODEL OF CROP HARVESTING MACHINE APPARATUS

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Abstract - 'Small-scale farmers face many challenges when it comes to harvesting their crops. Labour costs can be high, and finding enough workers to harvest the crops can be difficult. Larger harvesting equipment can be expensive and not practical for small farms with limited land area. These factors can impact the profitability of small-scale farming operations and make it difficult for farmers to compete in the market.

To address these challenges, our project aims to design a mini crop harvesting machine that is efficient, cost-effective, and easy to use. The machine is specifically designed for small-scale farmers with land areas less than 5 acres, and it is tailored to harvest a variety of grains efficiently. We have taken into account different factors such as equipment cost, ease of use, time of operation, and climatic conditions to ensure that the machine is practical and effective for small-scale farmers.

The mini crop harvesting machine is equipped with cutting blades that can harvest up to two rows of crops in a scissoring motion, making it efficient and fast. The machine is powered by a 14.25 HP petrol engine that transmits power through a gearbox, sprocket-chain mechanism, and other power-requiring mechanisms for cutting, harvesting, and separation. This power unit provides enough power to ensure that the machine can perform well in various conditions.

Our project has also focused on making the mini crop harvesting machine easy to use, so small-scale farmers with little experience in operating machinery can use it without difficulty. We have designed the machine to be user-friendly, with simple controls and clear instructions.
Mini crop harvesting machine is a practical and cost-effective solution for small-scale farmers who face challenges related to labour availability and cost of harvesting. The machine can improve the efficiency and profitability of small-scale farming operations and help farmers compete in the market.

I. INTRODUCTION (HEADING 1)

Small-scale farmers with limited land area often face challenges when it comes to harvesting their crops, such as high labour costs and difficulties in finding enough workers to complete the task. To address these challenges, our project aims to design a mini crop harvesting machine that is efficient, cost-effective, and easy to use. This machine is specifically tailored to the needs of small-scale farmers with land areas less than 5 acres and is designed to harvest a variety of grains efficiently. Taking into account factors such as equipment cost, ease of use, time of operation, and climatic conditions, our mini crop harvesting machine is an effective solution that can improve the efficiency and profitability of small-scale farming operations. In this paper, we will discuss the design and development of the mini crop harvesting machine, its key features and specifications, and its potential impact on small-scale farmers.

India is agriculture based country. Near about 70% people of our country are farmers. Our economy also depends on agricultural products. Nowadays tremendous changes have occurred in conventional methods of agriculture like seed plantation, irrigation system, pesticides and spray used. For developing our economic condition, it is necessary to increase our agricultural productivity and quality also.

Recently India has seen a shortage of skilled labour available for agriculture. Because of this shortage the farmers have transitioned to using harvesters. These harvesters are available for purchase but because of their high costs, they are not affordable. However, agriculture groups make these available for rent on an hourly basis. But the small holding farm owners generally do not require the full-featured combine harvesters. Also, these combine harvesters are not available in all parts of rural India due to financial or transportation reasons. Thus, there is a need for a smaller and efficient combine harvester which would be more accessible and also considerably cheaper. The mission is to create a portable, user-friendly and low cost mini harvester.

Taking into account the requirements of current situation, the idea was created to prepare a machine which is cheap and will reduce the labour required to cut crops. This machine has the capability and the economic value for fulfilling the needs of farmers having small land holdings. This machine is cost effective and easy to maintain and repair for the farmers. The machine model is designed based on the demand for a compact and economical reaper. This demand is taken into consideration by consulting farmers in person, for their problems and requirements. Taking into account the present scenario of corn harvesting we decided to prepare a model of corn reaper with compact construction which will be mostly suitable for farmers having small land for agriculture. The machine prototype will be economical and most convenient for cutting corn stalks and other similar plant shaving same or less shear strength than corn.

II. LITERATURE SURVEY

Liu, J., Wang, Y., & Ma, Y. (2019). [1] Design and analysis of corn harvester based on virtual prototype technology. Journal of Agricultural Machinery, 50(8), 53-59.

This paper discusses the design and analysis of a corn harvester using virtual prototype technology. The authors describe the development of a three-dimensional virtual model of the corn harvester, and the simulation and analysis of its performance in harvesting corn.

Chen, H., Zhao, Y., & Li, Y. (2020) [2] Research on intelligent corn harvester based on Internet of Things. Journal of Intelligent & Fuzzy Systems, 38(4), 3925-3934.

This paper explores the development of an intelligent corn harvester that incorporates Internet of Things (IoT) technology. The authors describe the design and implementation of a system that uses sensors and data analysis to optimize the harvesting process and improve yield.

Liu, Y., Li, J., & Li, X. (2019). [3] Development of a mini harvester for small-scale grain production. Journal of Agricultural Engineering Research, 15(2), 1-9.

This paper describes the development of a mini harvester for small-scale grain production, designed to meet the needs of small farmers with limited land area. The authors discuss the design and testing of the mini harvester, and its performance in harvesting wheat and rice.

Zhang, Y., Guo, Y., & Zhang, Y. (2019). [4] Design of a small wheat harvester based on kinematics analysis. Journal of Agricultural Mechanization Research, 41(9), 103-107.

This paper presents the design of a small wheat harvester based on kinematics analysis. The authors describe the development of a virtual model of the harvester, and the analysis of its performance in harvesting wheat.

Ghadge, P. V., & Chaudhari, S. G. (2017). [5] Design and development of a mini maize harvester. International Journal of Science, Engineering and Technology Research, 6(8), 1037-1040. This paper describes the design and development of a mini maize harvester for small-scale farmers. The authors discuss the design and testing of the harvester, and its performance in harvesting maize.

Parhizkar, M., & Mohammadabadi, M. (2018). [6] Design and development of a rice harvester for small-scale farmers. Journal of Agricultural Science and Technology, 20(1), 59-71. This paper discusses the design and development of a rice harvester for small-scale farmers. The authors describe the design and testing of the harvester, and its performance in harvesting rice.

Ding, Y., Liu, J., & Li, S. (2020). [7] Design and simulation of a small-scale maize harvester. Transactions of the Chinese Society of Agricultural Machinery, 51(9), 131-138.
This paper presents the design and simulation of a small-scale maize harvester. The authors describe the development of a virtual model of the harvester, and the simulation and analysis of its performance in harvesting maize.

Wang, Y., Liu, J., & Ma, Y. (2021). [8] Optimization of corn harvesting mechanism based on virtual prototype technology. Journal of Agricultural Machinery, 52(3), 85-91.

This paper discusses the optimization of the corn harvesting mechanism based on virtual prototype technology. The authors describe the development of a three-dimensional virtual model of the corn harvester, and the simulation and analysis of its performance in harvesting corn, with a focus on optimizing the harvesting mechanism.

III.PROPOSED SYSTEM

Reaper machine

Grain harvesting is the important part in agricultural mechanization. The use of reaper technology in developing countries to minimize the product cost which will be result in economic development of agricultural production. This paper tends to provide the design and development of manually or mechanically operated reaper machine

Manual method of crop cutting

To the cutting and threshing machine for seed separation this method the crop are remove as mentioned in the traditional method. These method crops are tied together to from a bundle. These bundles are garnered and taken to threshing machine. This machine separates the seed from the crops.

IV.METHODOLOGY

The aim was to create a cost-effective reaper collector to improve the economic situation of small-scale farmers as the demand for grains increased. To achieve this goal, the following steps were determined:

- Interview the local farmers who have small scale land holding and enquire about the harvesting practices and the crops produced and emerging trends in crop harvesting.
- Interview agricultural equipment manufacturers to get information about various equipment's that are available and are in demand.
- Refer various international papers in small scale harvesters produced earlier.
- Design of reaper collector harvester.

A. Conducting Interviews with Farmers:

To design a compact and affordable harvester, it was necessary to understand the demand for such a machine by interacting with small-scale farmers. As a large number of farms in and around Pune and Nashik cities are small-scale, a visit was made to these areas to observe and inquire about the harvesting machines used by the farmers. During this visit, the farmers were asked the following questions:

[1] What are the machines available for harvesting?

[2] What do these machines cost?

[3] Are these machines feasible for small scale farms?

[4] What are the traditional techniques used for harvesting?

[5] Can a small reaper collector be able to satisfy the increasing prices of labour?

[6] What is the labour cost for harvesting, as it is the most labour intensive work?

These questions gave the basic idea about the situation of small scale farmers. We came to know the needs and the requirements of the farmers.

B. Surveying Agricultural Machines Manufacturer:

We took information about the manufacturability for the harvester. The following questions were focussed to get a generalised idea about the various types of manufacturing equipment.

[1] What are the equipment's manufactured for the farmers today?

[2] How many of these manufactured equipment's are available for small scale farmers?

[3] Why are there no small scale harvester manufactured for farmers?

[5] What difficulties are faced while designing a machine based on the needs of the farmers?

Taking into account the present scenario of corn harvesting we decided to prepare a model of corn harvester with compact construction which will be mostly suitable for farmers having small land for agriculture. Machine prototype will be economical and most convenient for cutting corn stalks and other similar plants having same characteristics as corn.

V. SELECTION OF MECHANISM

Round Cutter

We took into consideration mechanism in which round cutter can be used. However with round cutter it occurred that more power will be required in addition efficiency of cutting will be low. Large vibration will also be induced which will make harvesting process difficult and inconvenient.

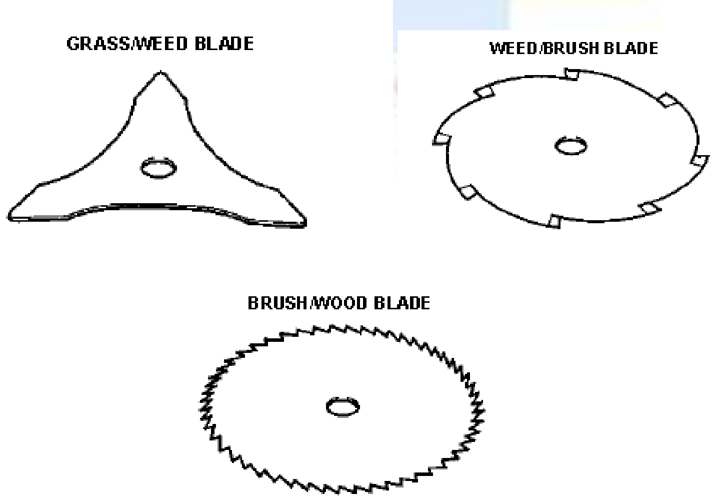

Figure 1 : Round Cutters

With translating cutter:

Translating cutter is more advantageous than round cutter as it can take more stalks for cutting. Also less power will be required as compared to round cutter. Two mechanisms available for this are

1) Trimmer Mechanism

   This mechanism is used in portable trimmers. If the size of cutter is increased it can be used for cutting stalks with moderate diameter.

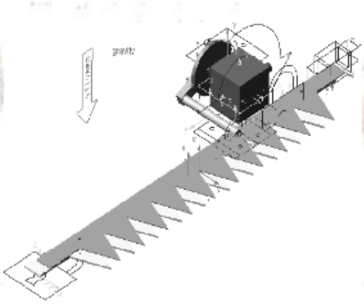

Figure 2 : Trimmer Mechanism of Cutter

2) *Scotch yoke Mechanism*

   Scotch yoke mechanism is most suitable mechanism for our application. It gives optimum cutting requirements and is also easy to implement for our purpose of cutting small stalks.

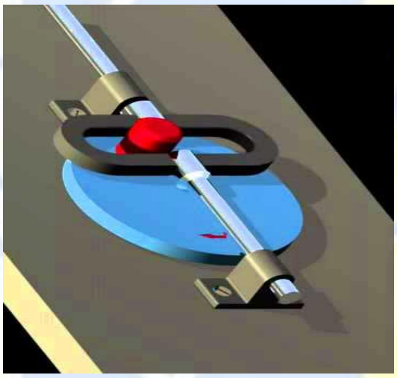

Figure 3 : Scotch Yoke Mechanism

Test Performed: Shear Test on Universal Testing Machine

In order to obtain precise values from calculations we performed a test on several stalks of corn plant to obtain shear strength. The values obtained from the test were matching with those obtained from concerned research papers.

Figure 4 : Test Specimen (corn stalk)

Figure 5 : Fixture for shear test

We performed the test by following the procedure given as, place the shear test attachment on the lower table, this attachment consists of cutter. The specimen is inserted in shear test attachment & lift the lower table so that the zero is adjusted, then apply the load such that the specimen breaks in two or three pieces. If the specimen breaks in two pieces then it will be in single shear & if it breaks in three pieces then it will be in double shear.

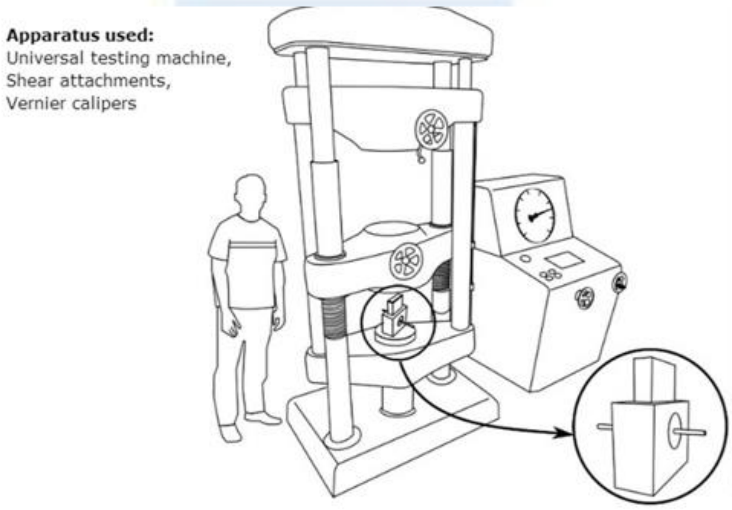

Figure 6 : Universal Testing Machine and Shear Fixture

Figure 7 : Specimen under test

CATIA MODELLING

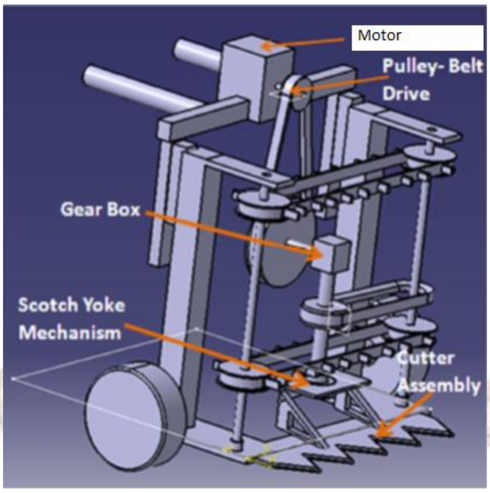

Figure 8 Primary Design: Model 1 CATIA

The primary design is as shown in figure. In this model the Motor is mounted on the top frame. Taking into account the space requirement, the location of engine is modified. It is placed on the base frame. Also for lowering the push force required for moving the machine, two more wheels are added.

The power is taken from Engine which is transmitted with suitable speed reduction using belt drive and Gear Box. The change in Direction of travel of driving force is obtained using Gear Box which is placed on output shaft of belt drive. Main shaft bears the Output of gear on one end whereas scotch yoke mechanism is mounted on the other shaft. Main shaft also carries belt drive for Transmitting power to side shaft. Pedestal bearings are used to support the shaft. Scotch yoke mechanism results in conversion of rotary motion to translating motion. This Mechanism is connected to cutter assembly. Plants are cut by trimming mechanism by the cutter assembly. The cut Plants are swept Away from the direction of travel by swapping belt mounted on side shaft. Thus cut plants are collected on one side of the travel.

III. CONCLUSIONS

Our team has successfully developed a prototype corn harvesting machine that has the ability to cut corn plants and remove them using a conveyor. To ensure that the machine is both compact and affordable, we focused on designing it based on the specific needs of small-scale farmers. In order to determine the optimal motor power for the machine, we conducted shear tests on the universal testing machine with appropriate fixtures, which enabled us to determine the shear strength of corn stalks.

We discovered that the machine is capable of cutting stalks from any plant that has a shear strength equal to or less than that of corn plants. We conducted tests on both corn and sorghum stalks and were pleased to obtain satisfactory results. Additionally, we found that the machine can be modified to be self-propelled, eliminating the need for manual operation. This can be accomplished by modifying the drive line.

Furthermore, the cutter's speed can be easily adjusted by replacing the motor with an engine, enabling greater flexibility in the machine's operation. The height at which the corn stalk is cut can also be adjusted by modifying the wheel axle's height, making it even more versatile for use in different farming contexts. Finally, we found that precise and accurate manufacturing processes can help to reduce induced vibrations during the machine's operation, ensuring a smoother and more efficient harvesting process.

IV. References

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