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Design and Development of Tree Plantation Machine Using Robotic Arm for Agriculture Purpose

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Abstract: The foundation of surgical robotics is in the development of the robotic arm. This is a thorough review of the literature on the nature and development of this device with an emphasis on surgical applications. We have reviewed the published literature and classified robotic arms by their application: show, industrial application, medical application, etc. There is a definite trend in the manufacture of robotic arms toward more dextrous devices, more degrees of freedom, and capabilities beyond the human arm. da Vinci designed the first sophisticated robotic arm in 1495 with four degrees of freedom and an analog onboard controller supplying power and programmability. von Kemplen's chess-playing automaton left arm was quite sophisticated. Unimate introduced the first industrial robotic arm in 1961, it has subsequently evolved into the PUMA arm. In 1963 the Rancho arm was designed; Minsky's Tentacle arm appeared in 1968, Scheinman's Stanford arm in 1969, and MIT's Silver arm in 1974. Aird became the first cyborg human with a robotic arm in 1993. In 2000 Miguel Nicolalis redefined possible man–machineBP capacity in his work on cerebral implantation in owl-monkeys directly interfacing with robotic arms both locally and at a distance. The robotic arm is the end-effector of robotic systems and currently is the hallmark feature of the da Vinci Surgical System making its entrance into a surgical application. But, despite the potential advantages of this computer-controlled master–slave, a Z-AXIS System, robotic arms have definite limitations. Ongoing work in robotics has many potential solutions to the drawbacks of current robotic surgical systems.

I. INTRODUCTION

An agricultural robot is a robot deployed for agricultural purposes. The main area of application of robots in agriculture today is at the harvesting stage. Emerging applications of robots or drones in agriculture include weed control, cloud seeding, planting seeds, harvesting, environmental monitoring and soil analysis. According to Verified Market Research, the agricultural robots market is expected to reach $11.58 billion by 2025.Fruit plucking robots, driverless tractors/sprayers, and sheep shearing robots are designed to replace human labor. In most cases, a lot of factors have to be considered (e.g., the size and color of the fruit to be picked) before the commencement of a task. Robots can be used for other horticultural tasks such as pruning, weeding, spraying, and monitoring. Robots can also be used in livestock applications (livestock robotics) such as automatic milking, washing, and castrating. Robots like these have many benefits for the agricultural industry, including a higher quality of fresh produce, lower production costs, and a decreased need for manual labor. They can also be used to automate manual tasks, such as weed or bracken spraying, where the use of tractors and other manned vehicles is too dangerous for the operators. Our project is mainly emphasized planting trees which reduces the planting time. Our project is based on planting coconut trees which are taken as an example.

II. LITERATURE SURVEY

1. LINGARAJ N et, al The traditional method of plant conservation has become a common problem. This paper deals with the process of relocating the plant from one place to another. If a building or a structure has to be raised on a location where a plant is situated, a stereotypic method is followed (i.e.) uprooting the plant from that location.

2. TIINA LAINE [2012] The first planting machines were continuously advancing and designed for the afforestation of obstacle-free arable land. These machines required two operators; one driver and one that inserted the seedling into some kind of pipe or dibble. Intermittent work with a boom-mounted planting device resulted in the Öje planter, Eco Planter, and Ilves planting device

3 KARLIS DUMINS et, al Soil preparation method – mounding (with varying depth of the pit and the mound height) – may be the solution for establishing new forests when the soil water regime is unfavorable since the pit serves as a reservoir for water during rainy periods and can retain water for the dry season. During the last decades, forest management in Latvia has been intensified.

III. PROBLEM OBJECTIVES

In the literature review, it is found that greener and pollution-free energy is not been utilized properly during design and developing vehicles for handicapped people. This research gap found in the literature review can be solved with the following objectives:

- To design, develop, test, and adopt improved coconut planting machine implements and machinery for different agro-climatic regions, crops, and operations suitable for animate, mechanical, and electric power sources to increase plantation production and land and labor productivity.
- To conduct feasibility testing of prototypes of proven designs of farm implements and machinery on farmer's fields, selected from different regions for adoption under local conditions to bridge the identified mechanization gaps.
- To conduct a frontline demonstration of new designs of farm implements and machinery selected from different regions on farmer's fields to test their efficiency for adoption and popularization under local conditions to bridge the identified mechanization gaps.

IV. METHODOLOGY

1. Planning.
2. Designing of Model.
3. Selection of Components.
4. Working
5. Software Used in the project

PLANNING.

The basic aim of this project is to develop a multipurpose machine, which is used for digging the soil, planting the saplings, and leveller to close the mud and water sprayer to spray water with least changes in accessories with minimum cost. This whole system of the vehicle works with the battery . The Tree Plantation Technology is a method design in order to reduce human efforts as it requires less amount of manmade Labour and can be handle efficiently without a skilled operator. Seeding manually requires lots of time, therefore this technology develops which eradicated much amount of time with proper efficiency, less time consuming, accuracy in sowing seed at a specific distance

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The base frame is made for the vehicle with 4 wheels connected and driven the rear wheel is a DC motor. At one end of the frame, the cultivator is fitted which is also driven by a DC motor, and the design is made to dig the soil.

V. DESIGNING OF MODEL USING AUTODESK FUSION 360

Autodesk, Inc. is an American multinational software corporation that makes software products and services for the architecture, engineering, construction, manufacturing, media, education, and entertainment industries. Autodesk is headquartered in San Rafael, California and features a gallery of its customers work in its San Francisco building. The company has offices worldwide. Its U.S. locations are California, Oregon, Colorado, Texas, Michigan, New Hampshire and Massachusetts. Its Canada offices are located in Ontario, Quebec, and Alberta. Autodesk became best known for AutoCAD, but now develops a broad range of software for design, engineering, and entertainment—and a line of software for consumers, including Sketchbook. The manufacturing industry uses Autodesk's digital prototyping software—including Auto Desk Inventor, Fusion 360, and the Autodesk Product Design Suite—to visualize, simulate, and analyse real-world performance using a digital model in the design process.

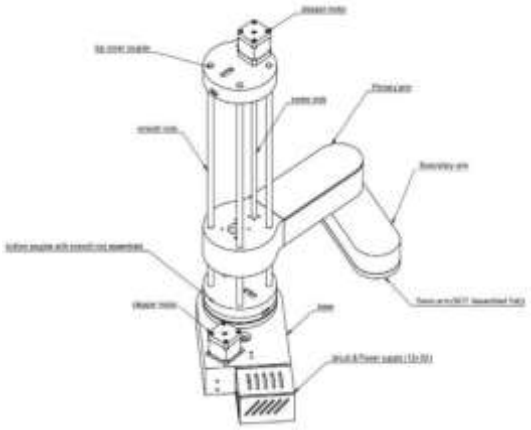

Fig 1. Iso View of The Robotic Arm

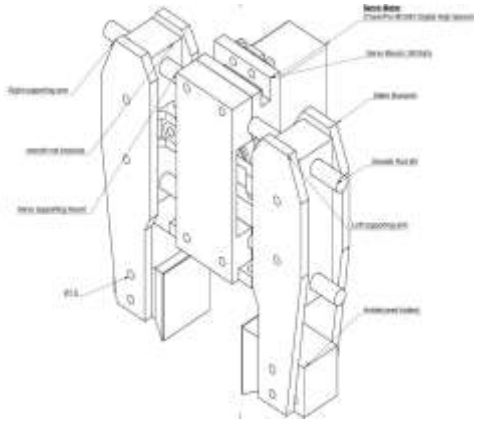

Fig 2. Tip Assembly

MESHED 3D MODEL FOR ANALYSIS IN ANSYS 18.1 WORKBENCH

Figure 3 shows meshed part of model

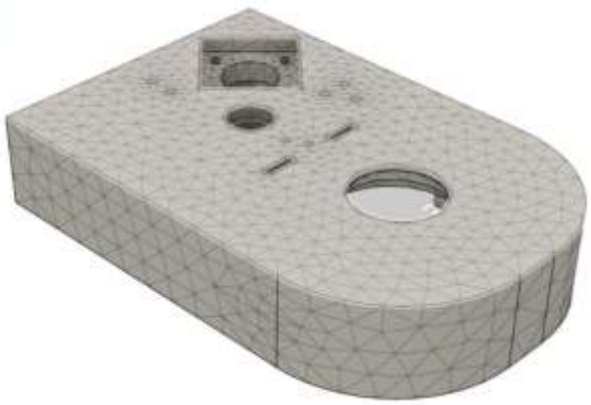

Fig 3. Meshed model in Ansys 18.1

- Mesh Details :

⊟ **Mesh**

Average Element Size (% of model size)	
Solids	10
Scale Mesh Size Per Part	No
Average Element Size (absolute value)	-
Element Order	Parabolic
Create Curved Mesh Elements	Yes
Max. Turn Angle on Curves (Deg.)	60
Max. Adjacent Mesh Size Ratio	1.5
Max. Aspect Ratio	10
Minimum Element Size (% of average size)	20

V.CONDUCTING STATIC STRUCTURAL ANALYSIS USING ANSYS 18.1 SOFTWARE

STATIC STRUCTURAL ANALYSIS:

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. A static structural load can be performed using the ANSYS, or ABAQUS solver.

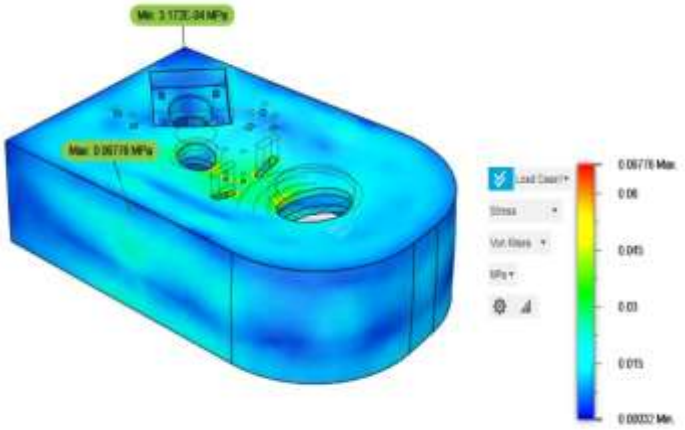

Fig 4. Applying boundary condition on the base of the robotic arm

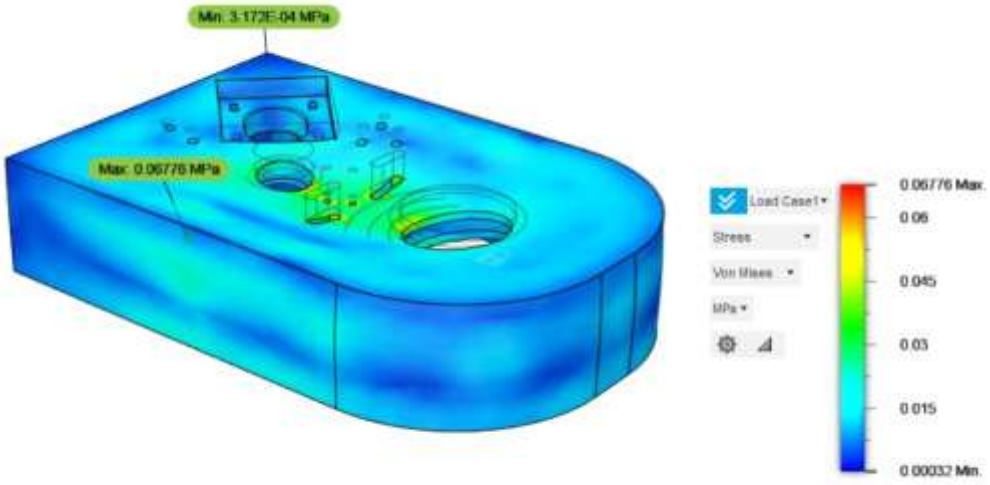

Fig 5. Von- Mises stress Acting on the base

Von- Mises stress result:

The figure 4 and 5 represents von mises stress analysis conducted on the base the results show that the maximum stress concentration is 0.6776 Mpa and the minimum stress concentration is 0.00032 Mpa.

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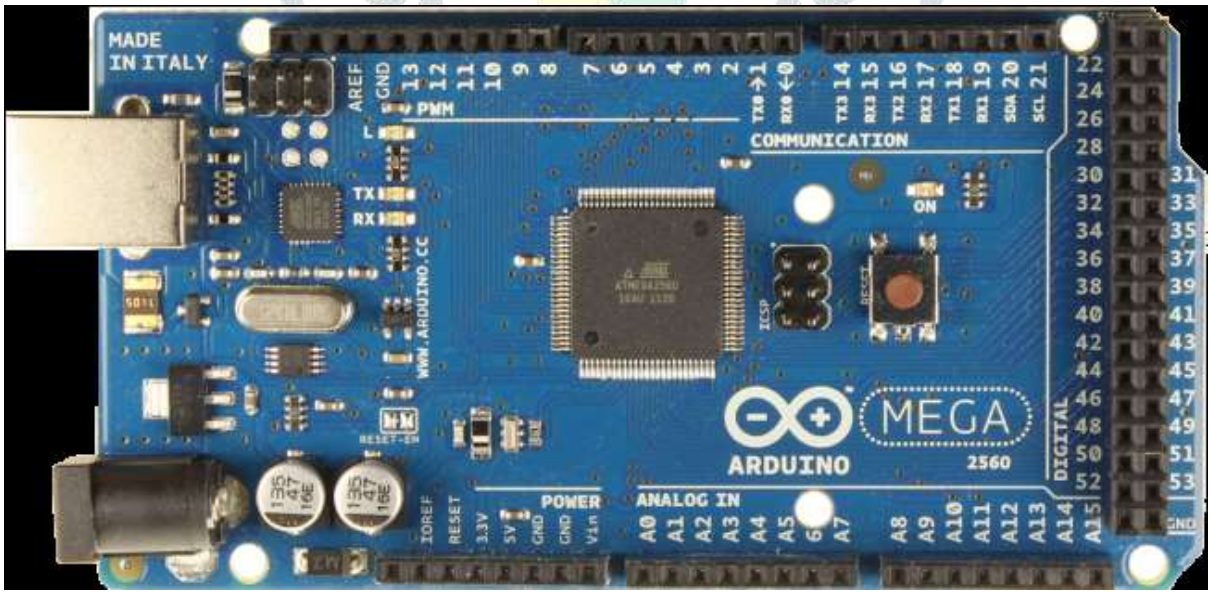
VI.RENDERED 3D MODEL OF THE PROTOTYPE

Rendering or image synthesis is the process of generating a photorealistic or non-photorealistic image from a 2D or 3D model by means of a computer program. The resulting image is referred to as the render. The term "rendering" is analogous to the concept of an artist's impression of a scene.

Fig 6. Assembled and Rendered Modelled (Iso-metric view)

X.COMPONENTS USED IN THE PROJECT



ARDUINO MEGA BOARD

NIMO STEPPER MOTOR | LIMIT SWITCHES | SERVO MOTOR

Fig.7 Accessories

XI. WORKING OF THE TREE PLANTING ROBOTIC ARM

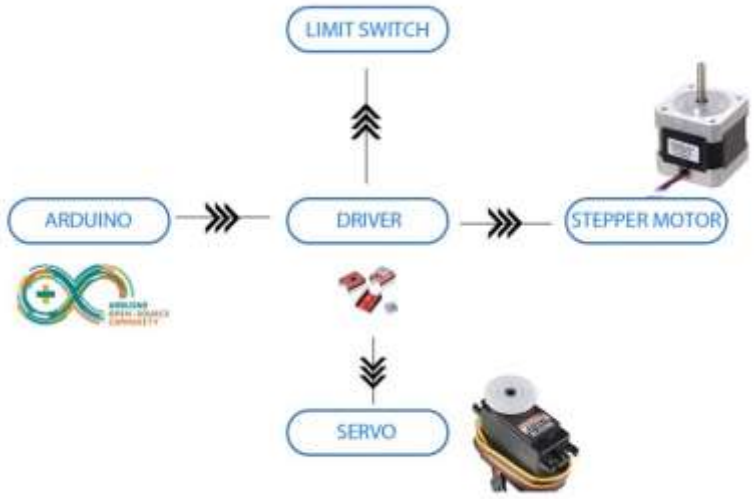


Fig 8. Process Flow Diagram

XII.SOFTWARE USED

Engineering as a discipline often requires more integration than large amounts of original development. In a typical subject, writing new code presents significant challenges, and the number of features shared between projects means that it is possible to create shared components with implement common features. A library or an existing module shows the use of well developed and tested components, which saves significant resources in the implementation of the project. The programs and tools we choose for this project are all open source, and use international standards which allowed us to rapidly develop the features needed.
The project software system consists of :

1. Auto Desk fusion 360
2. ANSYS
3. ARDUINO IDE

XII. APPLICATIONS

- It is used to plant trees.
- Land plotting
- Sowing
- Harvesting
- Manuring
- Pest control

IX. RESULTS AND CONCLUSION

Practically our multipurpose agricultural equipment can be used for tilling, sowing, leveling and also used for weed removal purposes. All the parts are connected in such a way that in every stage of agriculture the equipment can be

rearranged or easily assembled with fasteners to the required length and specifications of field operation. A multipurpose sowing machine is designed for small farmers to improve their productivity.

The existing sowing machine had an individual storage place and separate seed metering mechanism which leads to more cost. The drawbacks in the existing sowing machine are rectified successfully in our machine. It will be more useful for small farmers and the agricultural society. Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labor effort and expenses. The whole idea of multipurpose equipment is a good concept and can be successfully implemented in real-life situations.

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