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Technical Design of Multi-setting and Multipurpose Agricultural Tool Assembly - An Approach

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Abstract: ***Agriculture is the backbone of the Indian economy, and a large number of farmers still rely on traditional tools for farming activities. The use of multiple separate tools for operations such as ploughing, seed sowing, and soil cultivation increases both labor and time requirements. This paper presents the development, fabrication, and analysis of a multi- setting and multipurpose agricultural assembly designed to perform different farming operations using a single frame structure. The system integrates tools such as a three-line cultivator, ploughing tool, seed sowing mechanism, and liner tool. The design was prepared using CAD software and fabricated using standard manufacturing processes. Field observations and basic mechanical analysis were conducted to evaluate the strength and performance of the assembly. The proposed system helps reduce labor effort, saves operational time, and improves efficiency in small and medium-scale farming.***
Keywords: Agriculture Tools, Multipurpose Machine, Cultivator, Seed Sowing Machine, Agricultural Fabrication

I. INTRODUCTION

Agricultural productivity depends heavily on efficient farming tools and machinery. In many rural areas, farmers still depend on individual tools for different operations such as soil preparation, sowing, and cultivation. This increases the cost of equipment and requires more labor. A multipurpose agricultural assembly can combine several tools into a single structure, making farming operations easier and more efficient.

The objective of this project is to design and fabricate a multi-setting agricultural assembly capable of performing multiple field operations. The machine is designed to be simple, affordable, and suitable for small-scale farmers. The design process included field visits to farms, understanding farmers' requirements, CAD modeling, mechanical analysis, and fabrication of the prototype.

II. FIELD STUDY AND REQUIREMENT ANALYSIS

Field visits were conducted to understand the actual needs of farmers and the challenges they face during agricultural operations. Observations were made on farms owned by farmers such as Gopichand Shende and Ananta Channe. These farms primarily grow crops such as cotton and soybean using tractor-based tools.

The study showed that farmers often require multiple tools for ploughing, cultivation, seed sowing, and row alignment. Purchasing and maintaining separate equipment increases cost. Therefore, a multipurpose assembly was proposed to combine these functions into a single machine.

III. COMPONENTS OF THE AGRICULTURAL ASSEMBLY

The developed agricultural assembly consists of the following main tools integrated into a single frame.

A. Three Line Cultivator

The cultivator is used for soil preparation before sowing. It loosens and aerates the soil, making it suitable for seed germination. It also helps remove weeds between crop rows and can assist in mixing fertilizers with soil.

B. Ploughing Tool

The ploughing tool is used to turn and loosen the soil. It helps remove weeds and mix crop residues into the soil, improving soil fertility and preparing the land for sowing.

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C. Seed Sowing Machine

The seed sowing mechanism places seeds at a uniform depth and equal spacing. This improves crop growth and reduces manual labor. It also allows faster sowing compared to traditional methods.

D. Liner Tool

The liner tool helps create straight planting rows and ensures equal spacing between crop rows. This simplifies irrigation and crop management.

IV. DESIGN AND MECHANICAL ANALYSIS

Mechanical calculations were carried out to ensure that the frame and components can withstand the forces applied during operation. The pulling force considered for men was approximately 230 N and for women around 160 N. Stress analysis was performed on components such as the rod handle and support plates.

Crushing stress was calculated using the relation $\sigma = F/A$. The resulting stress values were within safe limits for the selected material. The material used for fabrication was carbon steel (SAE 1020 / IS Grade 20 hot rolled steel), which provides good strength and durability.

Deflection calculations were also carried out to ensure that the structural members do not deform significantly under load. The results confirmed that the design is safe for agricultural usage.

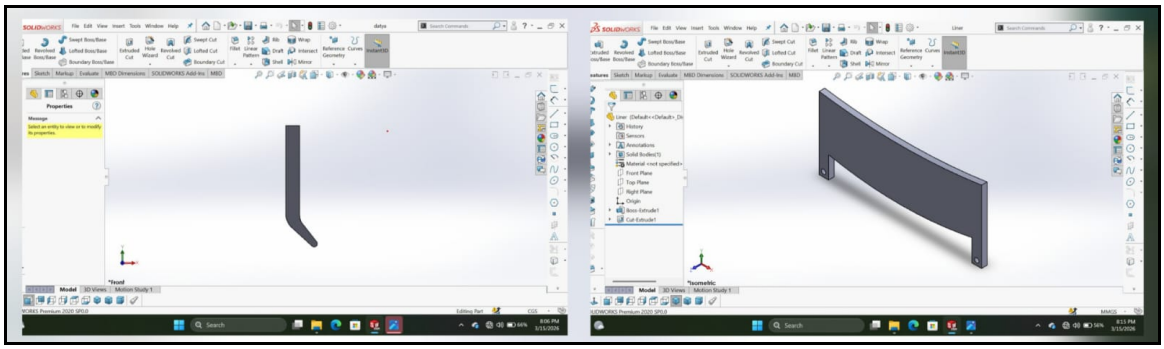


Fig.:1-Parts of assembly

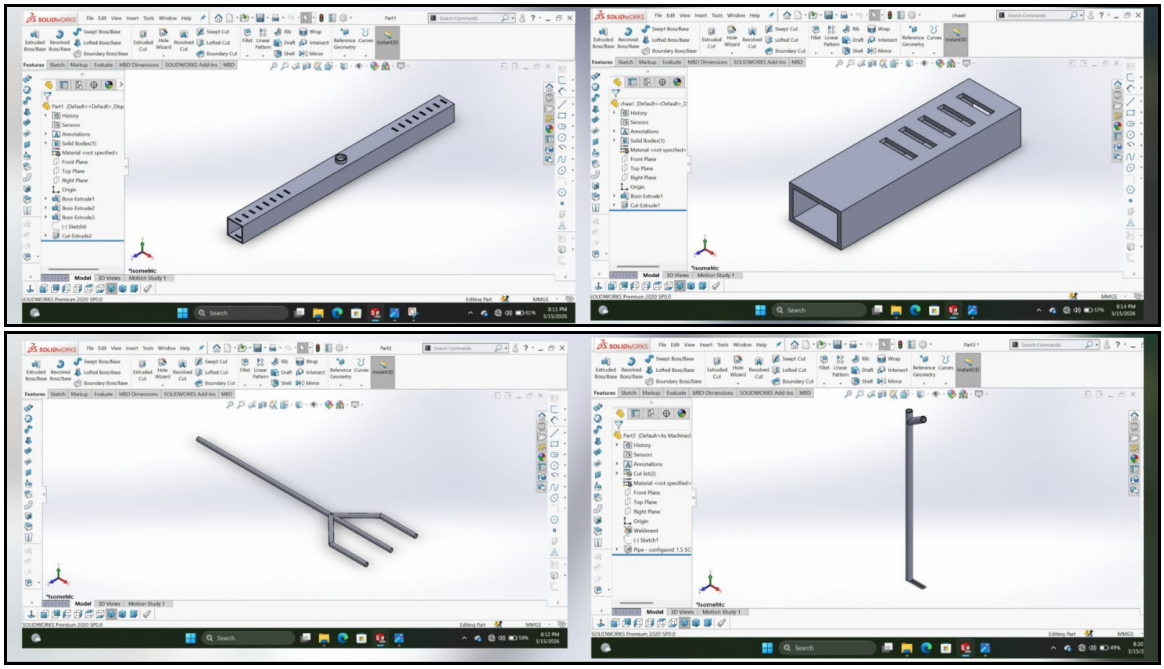


Fig.:2-Parts of assembly

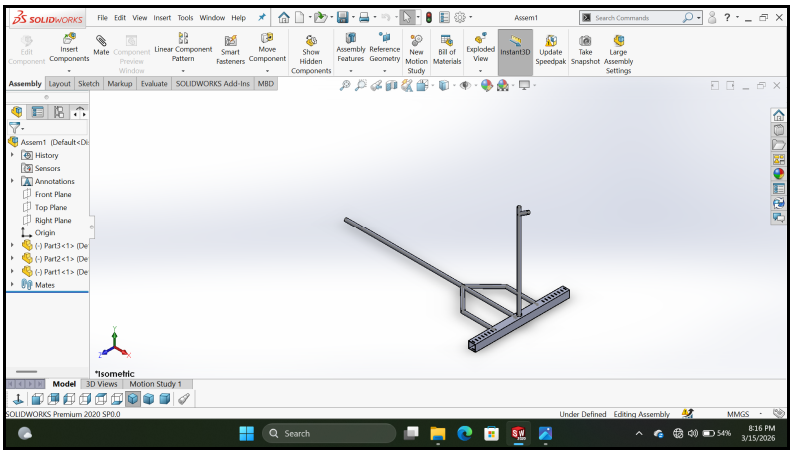


Fig.:3-assembly

V. FABRICATION PROCESS

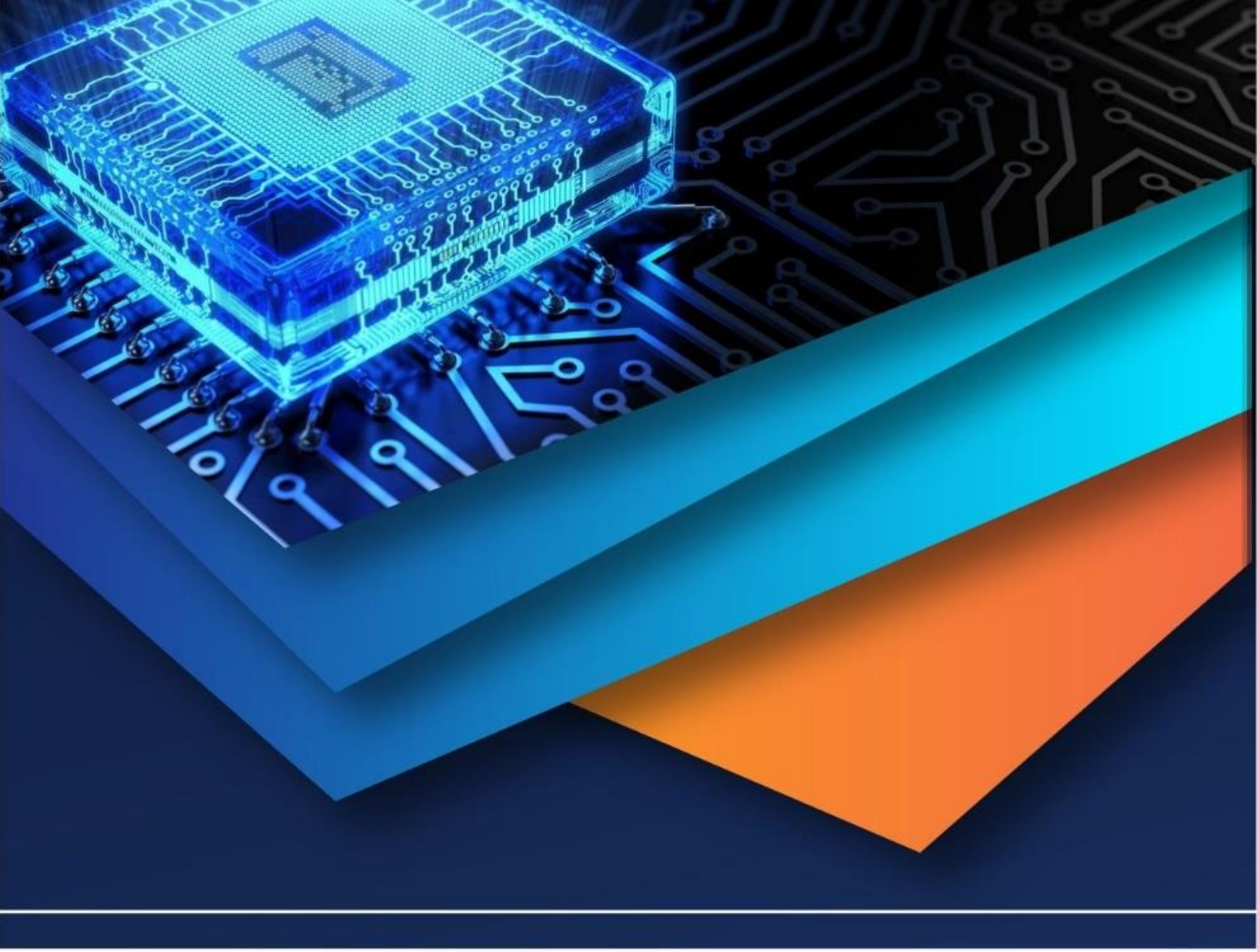
The fabrication process involved cutting, welding, drilling, and assembling various steel components to form the main frame and tool attachments. CAD design was used to visualize the structure before manufacturing. After fabrication, all components were assembled and tested to verify alignment and functionality.

VI. CONCLUSION

The developed multi-setting and multipurpose agricultural assembly successfully integrates multiple farming tools into a single structure. The system reduces the need for multiple machines, saves time, and decreases labor effort. It is especially useful for small and medium-scale farmers who cannot afford expensive agricultural machinery. Future work can focus on improving automation and adapting the system for tractor or motorized operation.

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