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DESIGN AND FABRICATION OF WEED REMOVING ROBOT USING ARTIFICAL INTELLIGENCE AND MACHINE LEARNING

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ABSTRACT

Weeding is a labor -intensive task that can be time-consuming and expensive. Deep learning- based weeding robots offer a potential solution to this problem by automating the weed detection and removal process. These robots can be equipped with cameras and sensors to identify weeds and then use deep learning algorithms to determine the best way to remove them. In this project, we present the design and fabrication of a deep learning-based weeding robot. The robot is designed to be used in small-scale fields and is equipped with a single camera and a weeding mechanism that uses a rotating blade to cut weeds. The deep learning system is trained on a dataset of images of weeds and crops. Once the robot is deployed, it can identify weeds in real time and provide instructions to the weeding mechanism on how to remove them. The robot will be tested in a small-scale field with a variety of weeds. The results can show that the robot will be able to identify and remove weeds with a high degree of accuracy. The robot will also weed the field more quickly and efficiently than traditional weeding methods. The deep learning-based weeding robot will have the potential to revolutionize the way that weeds are removed. The robot will be able to help reduce labor costs, increase efficiency, and reduce the use of herbicides.

INTRODUCTION

Innovation has always been the driving force behind the progress of agriculture, shaping the way we cultivate, harvest, and manage our fields. In the pursuit of higher yields, sustainable practices, and economic viability, farmers and researchers have continually sought groundbreaking solutions to age-old challenges. Among these challenges, weed infestation has remained an enduring adversary, demanding ever more innovative approaches. This project, "Design and Fabrication of Weed-Removing Robot using Deep Learning," exemplifies this spirit of innovation. It explores the convergence of modern technology, deep learning, and robotics to provide a novel answer to the age-old question of effective weed control. This introduction lays the groundwork for a journey through the history, objectives, and potential benefits of our innovative project.

OBJECTIVE:

1. Automated Weed Detection: Develop AI/ML models to accurately identify and distinguish weeds from crops.
2. Effective Weed Removal: Implement mechanisms to efficiently remove weeds without harming crops.
3. Autonomous Navigation: Enable the robot to navigate fields and avoid obstacles autonomously.
4. Energy Efficiency: Optimize power consumption and explore renewable energy options.
5. Durability and Reliability: Ensure robust design for harsh outdoor conditions and minimize maintenance needs.
6. User-Friendly Interface: Create an intuitive interface for easy control and monitoring by farmers.
7. Data Collection and Analysis: Gather and analyze data on weeds, soil, and crops to provide actionable insights.
8. Scalability: Design the robot to be adaptable for various field sizes and crop types.
9. Cost-Effectiveness: Keep design and production costs low to make the robot affordable for small to medium-sized farms.
10. Environmental Impact: Use eco-friendly materials and methods to minimize environmental impact.
11. Integration with Agricultural Practices: Ensure compatibility with existing machinery and farming practices.
12. Continuous Improvement: Regularly update the robot based on user feedback and technological advancements.

PROBLEM STATEMENT:

Crops are often grown with gaps between rows to prevent interference, but these gaps allow weeds to thrive, depleting vital nutrients. Traditional weed control methods like manual labor, chemicals, and machinery have drawbacks, such as environmental harm and high costs. To address these issues, we propose a deep learning based automatic weeder robot that efficiently removes weeds without harming the main crop, ensuring affordability and ease of use for all farmers.

SCOPE :

The future scope of the weed-removing robot project includes significant technological advancements, such as improved AI for better weed detection and advanced sensing technologies like multi-spectral imaging. Expanded applications will see robots compatible with various crops and integrated with IoT for comprehensive farm management. The project promises environmental benefits by reducing herbicide use and promoting soil health, along with economic advantages through cost reduction and increased labor efficiency. Long-term visions include fully autonomous farms and global collaborations to standardize and optimize the technology, contributing to sustainable agriculture and enhanced global food security

METHODOLOGY:

Weed cutting robot using ESP32, Wi-Fi cam, and a cutting system can be used to automate the process of weeding. The robot can be controlled using a smartphone or computer, and the Wi-Fi cam can be used to monitor the robot's progress and ensure that it is weeding the correct areas.

To build a weed cutting robot, will need the following components:

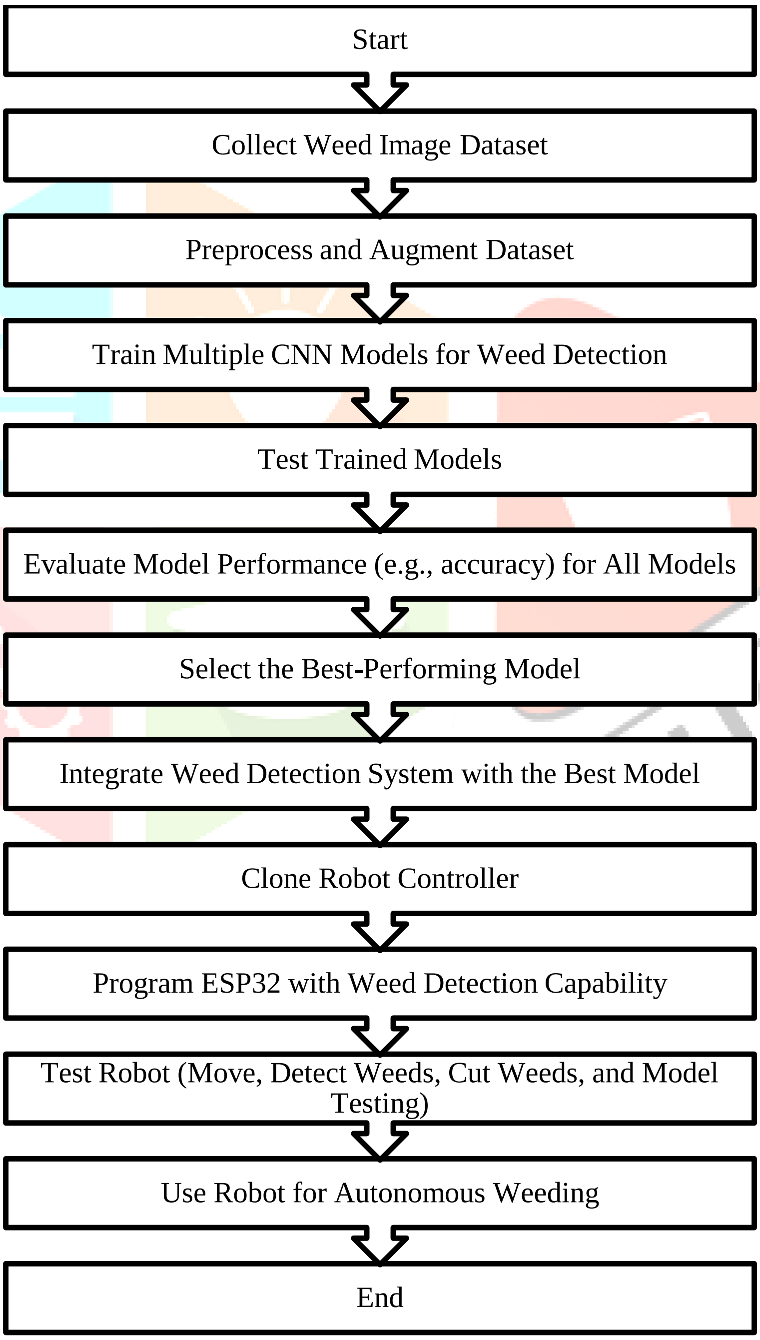
- ESP32 microcontroller board
- Wi-Fi camera
- Cutting system (e.g., trimmer blade, rotating brush, etc.)
- Motor driver board
- DC motors
- Battery
- Chassis
- Wheels
- Other hardware (e.g., screws, nuts, bolts, etc.)

Once all the necessary components are gathered, then begin to assemble the robot. The first step is to connect the ESP32 board to the motor driver board and the Wi-Fi camera. We Can use a breadboard or per board to make the connections. Once the ESP32 board is connected to the motor driver board and the Wi-Fi camera, you can mount it to the robot chassis. You can use screws, nuts, and bolts to mount the board to the chassis.

Next, you need to connect the DC motors to the motor driver board. We can use the motor driver board to control the speed and direction of the motors. Once the motors are connected to the motor driver board, you need to connect the battery to the robot. We can use a lithium-ion battery or a lead-acid battery to power the robot. Finally, you need to attach the wheels to the robot chassis. We can use screws, nuts, and bolts to attach the wheels to the chassis. Once the robot is assembled, we need to program the ESP32 board. We can use the Arduino IDE to program the ESP32 board. The program for the weed cutting robot should be able to control the motors to move the robot around and to control the cutting system to cut the weeds. The program should also be able to connect to the Wi-Fi network and receive commands from the smartphone or computer. Once the ESP32 board is programmed, now test the robot by moving it around and by cutting some weeds. If the robot is working properly, we can start using it to weed your farm. Use a powerful motor driver board that can handle the current requirements of the motors.

- A battery with a high enough capacity to power the robot for a long period of time.
- A Wi-Fi camera with a wide field of view so that you can monitor the robot's progress from a distance.
- A cutting system that is appropriate for the type of weeds that you need to cut.
- Program the ESP32 board to include safety features, such as an emergency stop button.

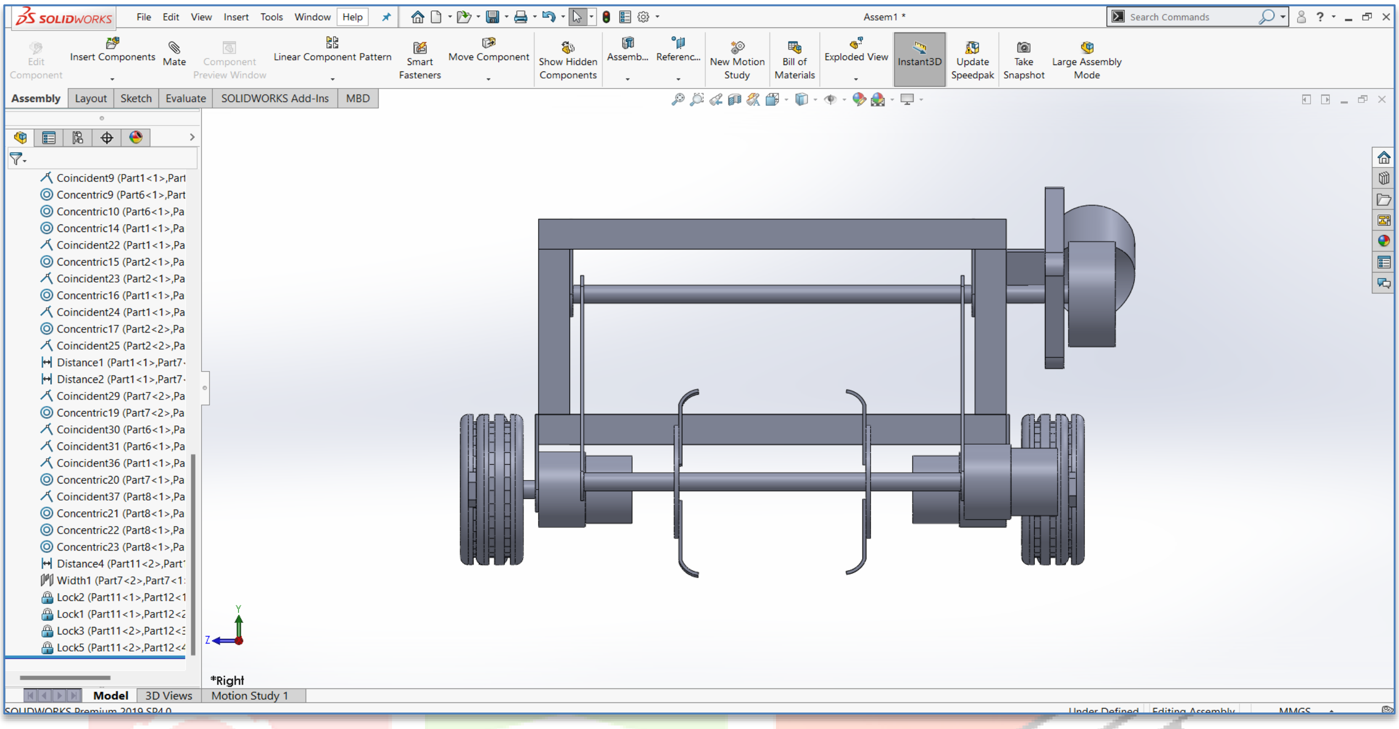
Once the weed cutting robot built, then automate the process of weeding. This can save a lot of time and efforts.



MODEL & DESIGN:

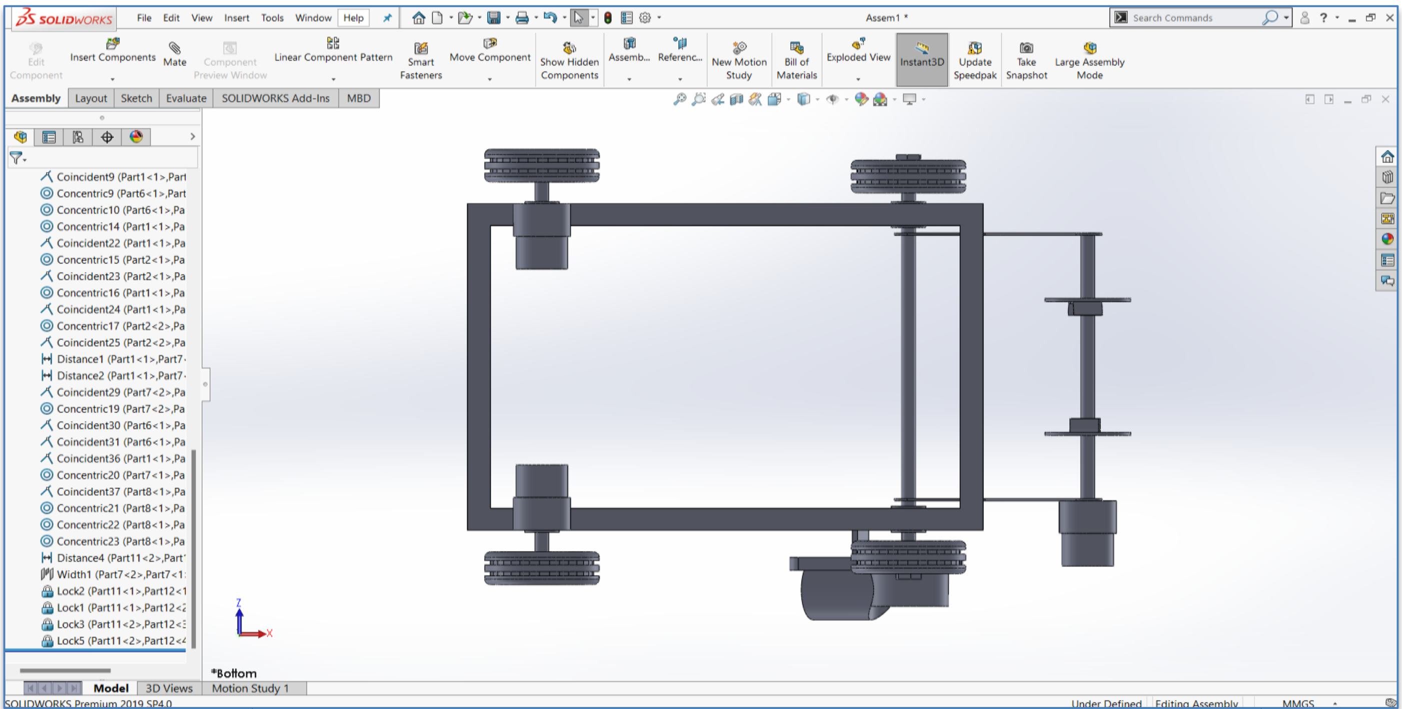
FRONT VIEW OF 3D MODEL

The front view of the 3D model offers a direct look at the autonomous weeding machine's frontal aspects. This view showcases the machine's chassis, including the weeding mechanism and the navigation sensors situated at the front. It provides a clear visualization of the machine's appearance from the vantage point of someone observing it head-on.



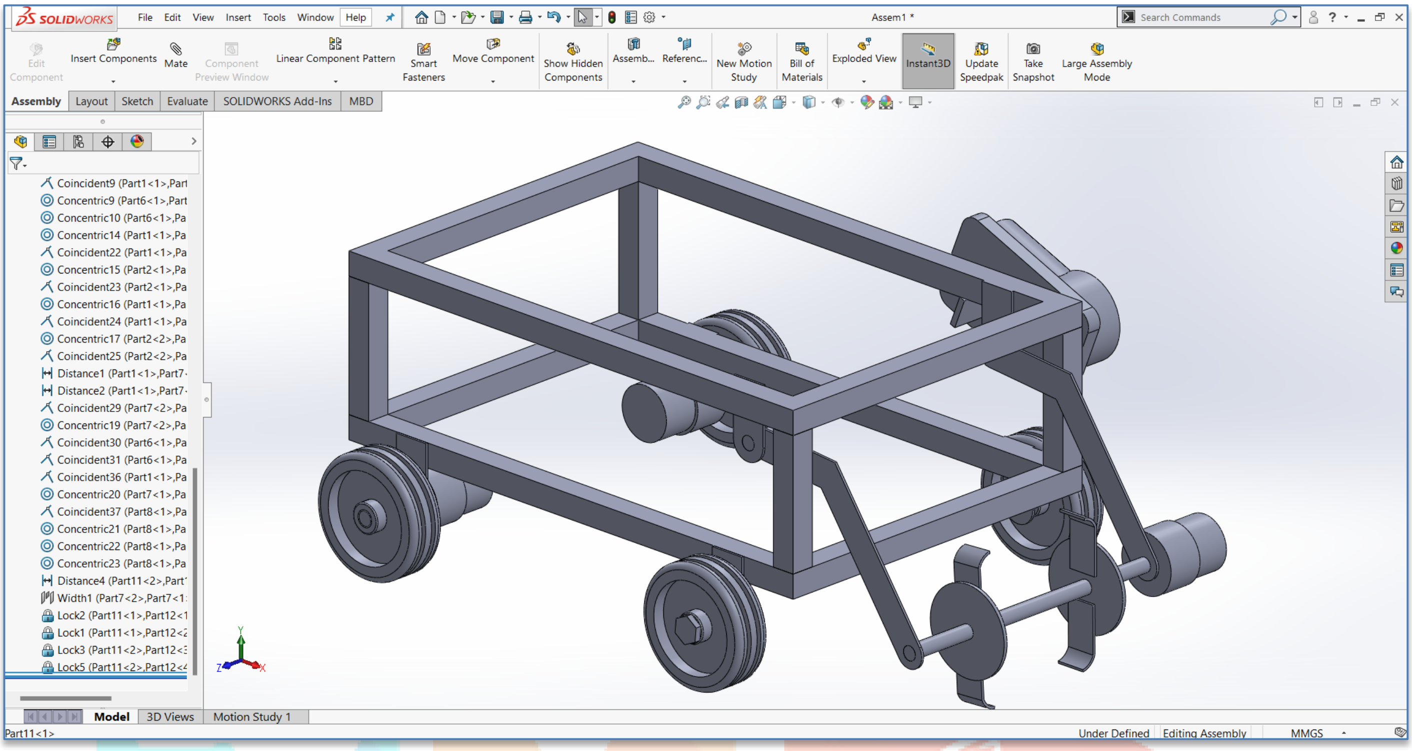
TOP VIEW OF 3D MODEL

The top view of the 3D model presents an overhead perspective of the autonomous weeding machine. This view allows you to see the layout of components from an aerial angle, revealing the arrangement of the robotic arms, the navigation system, and the power source. It is particularly useful for understanding the machine's spatial organization



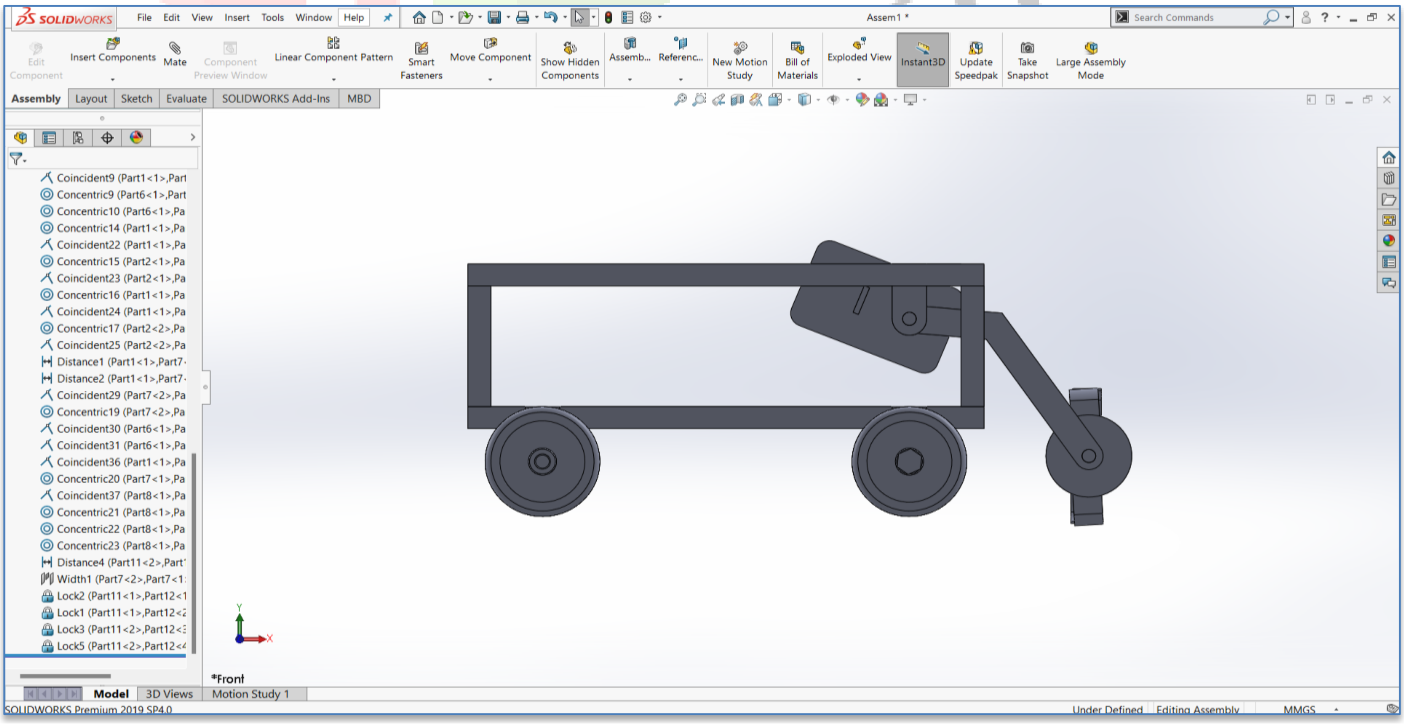
ISOMETRIC VIEW OF 3D MODEL

The isometric view of the 3D model offers a three-dimensional representation that combines various perspectives. It provides an angle that shows the machine from both the front and the sides simultaneously. This view highlights the overall shape and structure of the weeding machine in a visually engaging manner.



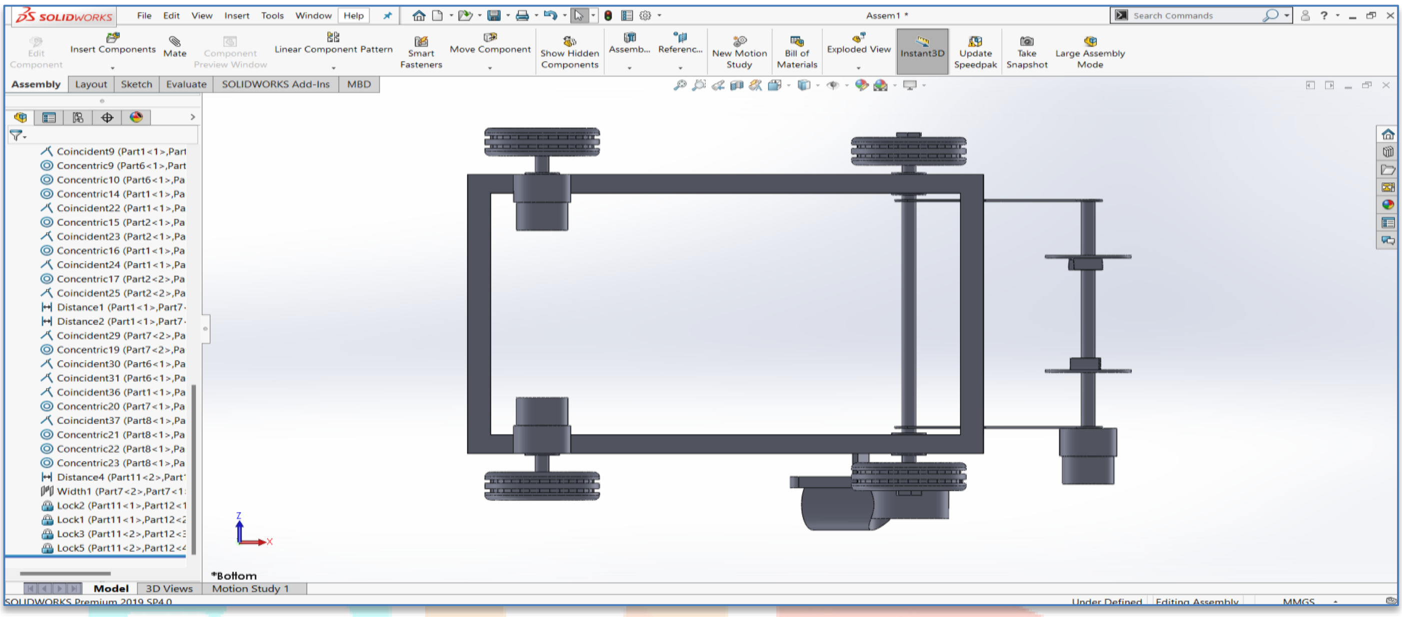
SIDE VIEW OF 3D MODEL:

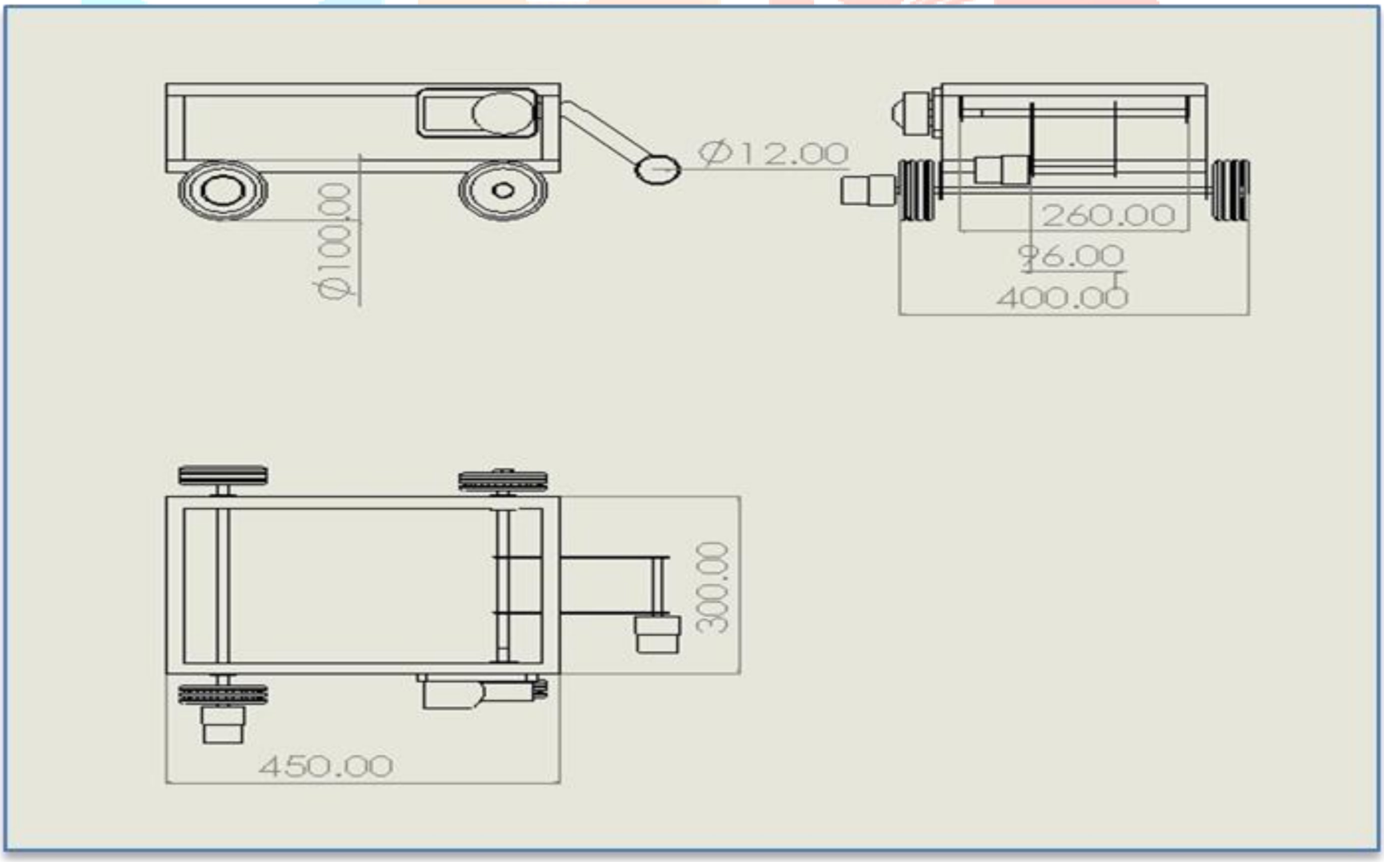
The side view of the 3D model offers a profile view of the autonomous weeding machine. It reveals the machine's lateral features, including its height and length. This view is essential for assessing the machine's overall dimensions and how various components are aligned along its side



BOTTOM VIEW OF 3D MODEL:

The bottom view of the 3D model provides a perspective from underneath the machine. This view is crucial for understanding the clearance and ground contact points, which are essential for navigation and ensuring the machine's stability over uneven terrain. It showcases the underside components like wheels, sensors, and protective shields.





2D VIEW

CONCLUSION

The design and fabrication of a weed-removing robot using artificial intelligence and machine learning represent a significant leap forward in agricultural technology. This project successfully integrates advanced AI for accurate weed detection, efficient weed removal mechanisms, and autonomous navigation, resulting in a versatile and reliable solution for modern farming challenges. The robot not only enhances labor efficiency and productivity but also promotes sustainable agricultural practices by reducing herbicide use and improving soil health. With the potential for future technological advancements, broader applications, and global impact, this project lays the groundwork for more innovative, eco-friendly, and cost-effective farming solutions, ultimately contributing to global food security and environmental conservation.

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