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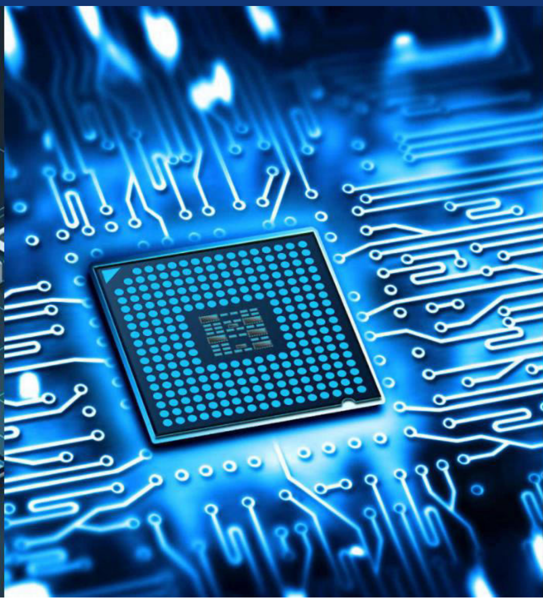

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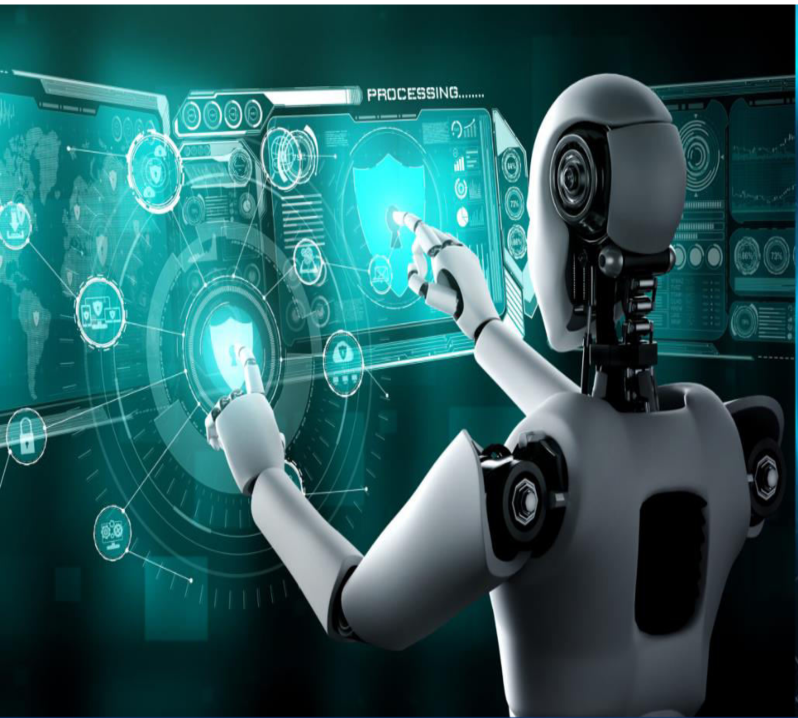

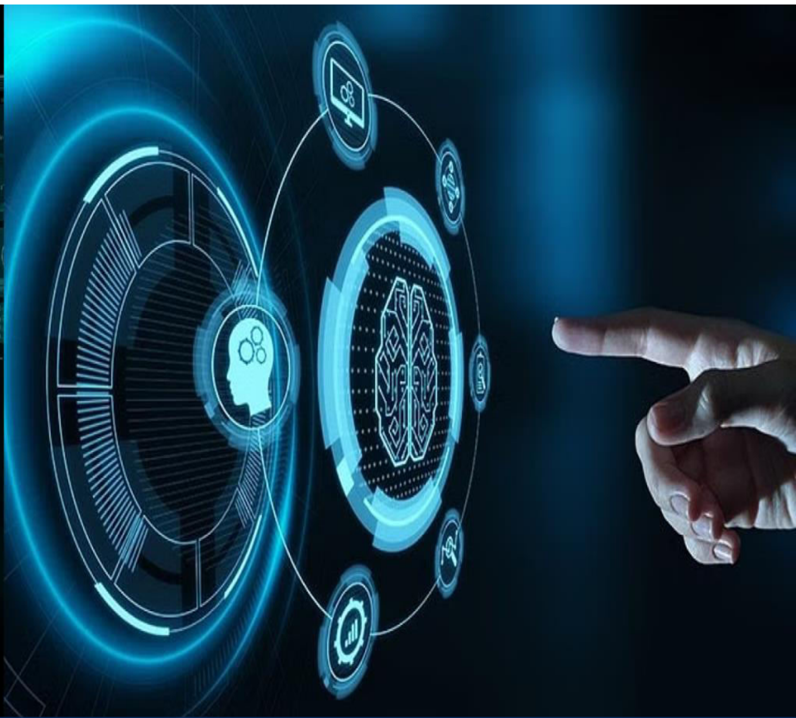

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Manual & Semi-Autonomous Weed Identification Robot

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ABSTRACT: The persistence of weeds remains one of the most taxing challenges in modern agriculture, as these invasive plants aggressively compete with crops for sunlight, water, and vital soil nutrients. Unlike traditional methods that rely on back-breaking labour or environmentally damaging chemicals, our system identifies weeds in real-time and neutralizes them using a precision motorized cutting blade.

KEYWORDS: IoT in Agriculture, Crop Health Monitoring, Autonomous Weed Identification, Agricultural Robotics, and Weed Management.

I. INTRODUCTION

The productivity of agriculture and the sustainability of the economy are seriously threatened by Weeds are unwanted vegetation that compete with farmed crops for resources. They outcompete crops, reproduce quickly, lower yields, and affect the quality of agricultural products. Conventional weed control techniques, like hand labor and chemical herbicides, have drawbacks in terms of sustainability, efficiency, and the environment. Biological weeding (using natural enemies like insects or microorganisms, requiring careful selection and management), mechanical weeding (physically removing weeds through tillage, hoeing, or mowing), chemical weeding (using herbicides with concerns about pollution, herbicide resistance, and harm to non-target organisms), and thermal.

II. RELATED WORK

IMAGE CAPTURING: THE ROBOT CAPTURES IMAGES OF THE AGRICULTURAL FIELD USING AN ONBOARD CAMERA. PRE- PROCESSING THE IMAGES: THE CAPTURED IMAGES ARE RESIZED (E.G., 128×128 PIXELS) AND CONVERTED INTO FLOATING- POINT TENSORS FOR NEURAL NETWORK PROCESSING.

FEATURE EXTRACTION: USING MACHINE LEARNING ALGORITHMS (SUCH AS YOLO AND TENSORFLOW LITE), THE SYSTEM EXTRACTS RELEVANT FEATURES FROM THE IMAGES TO IDENTIFY PATTERNS DISTINGUISHING WEEDS FROM CROPS. CLASSIFICATION OF WEEDS AND CROPS: THE EXTRACTED FEATURES ARE FED INTO A TRAINED DEEP LEARNING MODEL, WHICH CLASSIFIES THE DETECTED PLANTS AS EITHER WEEDS OR CROPS.

DATASET UTILIZATION: THE MODEL IS TRAINED USING A DATASET CONSISTING OF IMAGES OF WEEDS AND CROPS (E.G., 200 IMAGES, SPLIT INTO 175 FOR TRAINING AND 25 FOR TESTING). MODEL TRAINING AND VALIDATION: THE DATASET IS DIVIDED INTO TRAINING AND TESTING SETS, AND THE MACHINE LEARNING MODEL IS TRAINED USING MULTIPLE ITERATIONS (EPOCHS) TO IMPROVE ACCURACY.

PERFORMANCE EVALUATION: THE TRAINED MODEL IS TESTED ON NEW IMAGES, AND PERFORMANCE IS ASSESSED USING METRICS SUCH AS ACCURACY, CONFUSION MATRIX, TRAINING LOSS, AND VALIDATION LOSS.

DECISION MAKING: BASED ON THE CLASSIFICATION, THE SYSTEM DETERMINES WHICH PLANTS ARE WEEDS AND WHICH ARE CROPS

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III. METHODOLOGY

This paper introduces the model for the "Autonomous Weed Identification Robot" is modelled to address the challenges of traditional weed operation by integrating computer vision and machine literacy ways. vibrations. It uses the " YOLO(You Only Look formerly) algorithm for real- time object discovery and bracket, icing high delicacy in distinguishing between plants and weeds. The system begins with an "image- landing module" — a camera mounted on the robot which continuously captures images of the agrarian field. These images go through a "pre-processing stage", where they're resized (e.g. 128 × 128 pixels) and converted into floating- point tensors to meet the input specifications of the machine literacy model. "point birth" is performed using "TensorFlow Lite", where the system identifies patterns and identifying characteristics of crops and weeds. The uprooted features are also fed into a "trained deep literacy model" that classifies the shops into either the "weed" or "crop" order. The training of this model is grounded on a dataset of 200 images, with 175 images used for training and 25 for testing, icing proper confirmation and performance tuning. The model is continuously meliorated through multiple duplications, optimizing delicacy and minimizing crimes. Once stationed, the robot processes live camera feeds to make real- time opinions, relating weeds with high perfection while minimizing damage to the crops. This model's design eventually aims to reduce "labor costs", "minimize the use of chemical dressings", and "promote sustainable husbandry practices" through effective and independent weed operation.

Block Diagram:

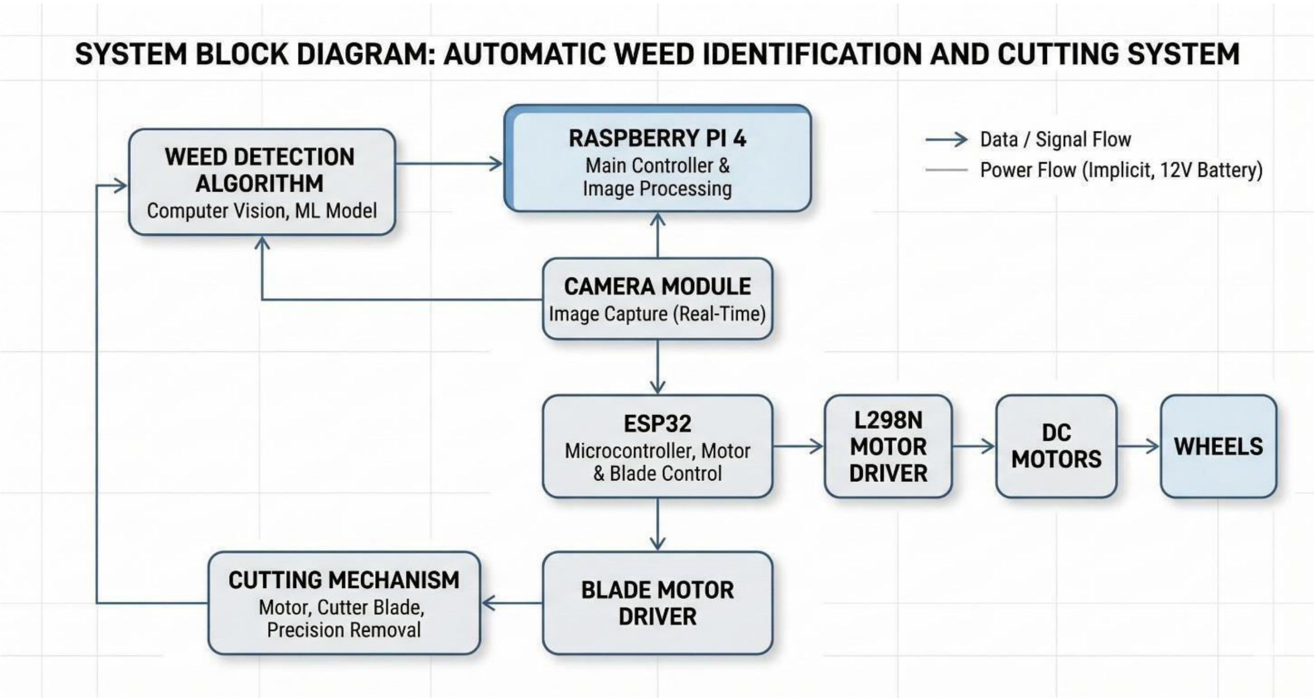

FIG.1 BLOCK DIAGRAM OF MANUAL & SEMI- AUTONOMOUS WEED IDENTIFICATION ROBOT

In conclusion, the development of an autonomous weeding robot has the potential to revolutionize the agricultural industry by reducing the labor-intensive task of manual weeding and increasing efficiency. Such a robot could significantly improve crop yield, minimize the use of herbicides, and reduce the environmental impact of farming practices. By leveraging technologies such as computer vision, machine learning, and robotics, an autonomous weeding robot can identify and selectively remove weeds while leaving the desired crops intact. This technology offers several benefits, including:

Increased efficiency: Autonomous weeding robots can work tirelessly and cover large areas of farmland, significantly reducing the time and effort required for manual weeding.

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Precision and accuracy: With advanced computer vision algorithms, the robot can precisely identify and target weeds, ensuring selective and effective removal while minimizing damage to the crops.

Reduced herbicide usage: By specifically targeting weeds, the robot can minimize or eliminate the need for herbicides, leading to more sustainable and environmentally friendly farming practices.

Data-driven insights: Autonomous weeding robots can collect valuable data about weed distribution, growth patterns, and crop health. This data can be used to optimize farming practices, improve yield, and make informed decisions.

IV. EXPERIMENTAL RESULTS

Robotic systems equipped with weed identification models can autonomously navigate through fields to detect weeds, reducingthe need for manual labour. Autonomous weed identification helps in early detection of weed outbreaks.

This allows farmers to implement timely control measures, preventing weed from spreading and reducing crop competition. By controlling weed growth, these models indirectly help in managing pests and diseases. Weeds can often harbor pests, and their control can help prevent pest infestations in crops. Autonomous weed identification models can be integrated into farm management systems to provide real-time data on weed distribution and crop health.

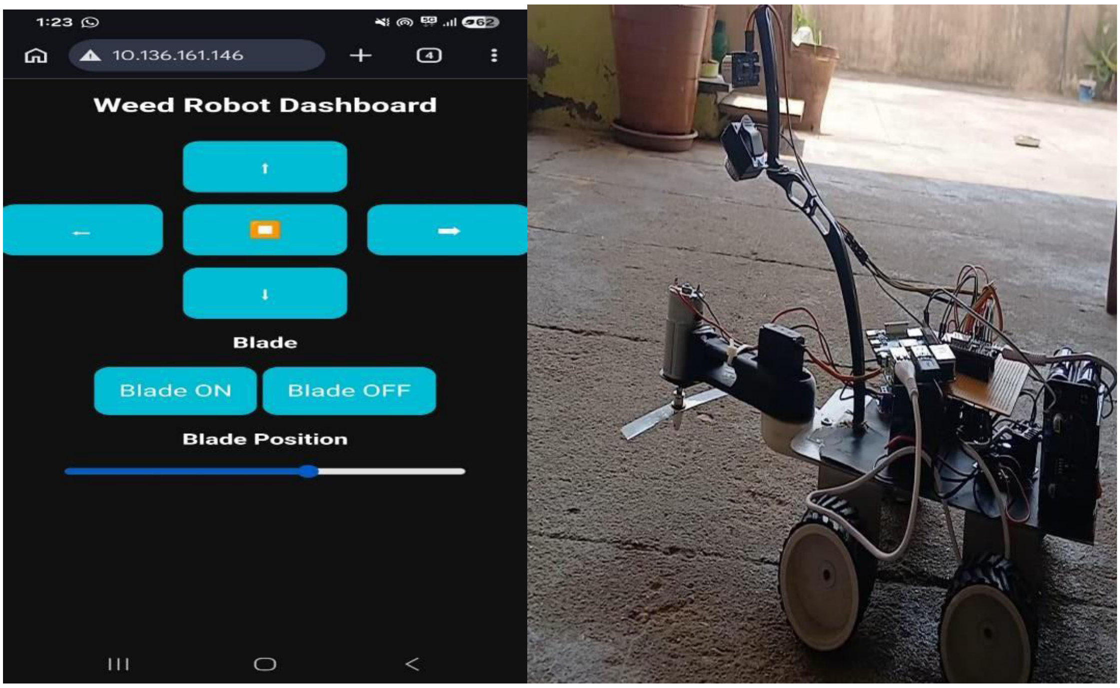

Fig-1 Manual Weed Identification Robot

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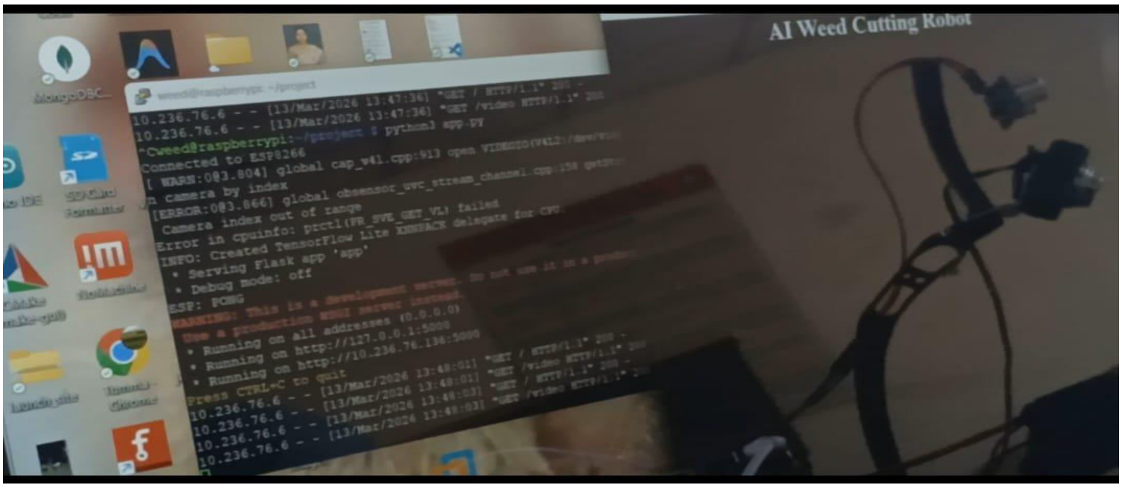

Fig-2: Semi-Autonomous Weed Identification Robot

V. CONCLUSION

The manual and semi-autonomous weed identification robot is an effective solution for modern agriculture. It helps in identifying and removing weeds with reduced human effort and improved accuracy. In manual mode, the farmer can control the robot easily, while in semi-autonomous mode, the system can detect weeds using sensors or image processing techniques and take necessary action.

This project presents a practical approach to weed control by combining manual operation with semi-autonomous features. It improves precision in weed detection and supports farmers in maintaining healthy crops with less effort. The system is cost-effective and easy to operate, making it suitable for small and medium-scale farming. With further improvements in sensors and automation, this robot can become a reliable solution for smart agriculture.

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