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# AgriBot: The Smart Weeding System for Efficient Farming

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**Abstract—This paper addresses a system which can be implemented in agriculture process for weeding purpose. Weed removal is an important part of agriculture process and it is necessary because weed affects plant growth as well as fights with main plant for different factors such as space, nutrients, water and sunlight. Weeding is a crucial part of crop maintenance in agriculture, but it can be a time consuming and labor-intensive process. To address this challenge, we propose a mobile controlled weeding vehicle. The vehicle was equipped with sensors and camera that captures images from fields and microcontroller that transmitting data's to operator's system. Computer vision algorithms used to identify and locate weeds and this system was controlled by a mobile application that allows user to monitor and control the vehicle remotely. To ensure that the vehicle is effective at removing weeds, we implemented a control system that uses machine learning algorithms to optimize the weeding process. The mobile controlled weeding vehicle offers a convenient and efficient solution for farmers looking to weed the field with reduced their workload and this is a micro-volume weed cutting vehicle for early stage weed control.**

**Index terms—Agriculture automation, weed cutter, motion and path planning, precision agriculture.**

## INTRODUCTION

Food is the basic need of human life and it was produced by cultivation process in agriculture fields. In agriculture fields both field crops and unwanted crops were grown and that unwanted crop is known as weed. It is one of the factors affecting level of yield production so hat frequent weeding is essential task for successful gardening and efficient agriculture but it being tedious chore for doing it frequently. There is need for automatic or semi-automatic method of weed handling routine for reduce the manpower taken for weeding process. Existing technologies utilize computer vision, GPS, herbicide spray system and other tools used to remove weeds were often complex and expensive, suited moreover for larger agricultural fields. The major contribution of our work is a real time semi-automatic robotic weeding vehicle system with weed cutting and ploughing modules in front and back of vehicle system respectively which removes early stage weed crops only as per the command of operator through wireless communication.

**Different Types of Weeds**

## RELATED WORK

The mobile controlled weeding vehicle project is a novel application of robotics and automation technology for precision agriculture. In order to prepare a conference paper on this project, it is important to review the related work in this area. Some key areas to consider for related work are:

**WEEDING TECHNOLOGY:**

Weeding is an important task in agriculture, as it can significantly impact crop yields. There are many different types of weeding technology available, including mechanical weeding, chemical weeding, and thermal weeding. It is important to review the current state of weeding technology and identify how the mobile controlled weeding vehicle project fits into this area.

**PRECISION AGRICULTURE:**

Precision agriculture is the use of technology to improve crop yields and reduce waste. There are many applications of precision agriculture, including soilsampling, crop monitoring, and yield mapping. It is important to review the current state of precision agriculture and identify how the mobile controlled weeding vehicle project fits into this area.

**MOBILE ROBOTICS:**

Mobile robotics is a field of robotics that deals with the design and construction of robots that can move autonomously in the environment. There are many different types of mobile robots, including wheeled robots, tracked robots, and legged robots. It is important to review the current state of mobile robotics and identify how the mobile controlled weeding vehicle project fits into this area.

**CONTROL SYSTEM:**

Control systems are a critical component of robotics and automation technology. They are used to control the movement and functional behavior of robots. It is important to review the current state of control systems and identify how the mobile controlled weeding vehicle project fits into this area.

**ROBOTICS AND AUTOMATION IN AGRICULTURE:**

There has been a growing interest in using robotics and automation technology in agriculture to increase efficiency and reduce workers costs. There are many examples of robots being used for tasks such as planting, harvesting, and spraying. It is important to review the current state of robotics and automation in agriculture and identify how the mobile controlled weeding vehicle project fits into this area.

By reviewing the related work in these areas, it is possible to provide context for the mobile controlled weeding vehicle project and highlight its contributions to the field of precision agriculture and robotics.

## LITRATURE SURVEY

Many researchers developed the weed detection systems by algorithms and removing autonomous systems. Some of the recent techniques, algorithms presented in the papers are summarized in the following:

**W. McAllister, J. Whitman, J. Varghese, A. Davis, and G. Chowdhary [2022], "AGBOTS 3.0: ADAPTIVE WEED GROWTH PREDICTION FOR MECHANICAL WEEDING AGBOTS".**

This work presents advances in predictive modelling of weed growth, as well as an improved planning index to be used in conjunction with these techniques, for the purpose of improving the performance of coordinated weeding algorithms being developed for industrial agriculture. In this demonstration of evolving Gaussian process (E-GP) method applied to measurements from the agents can predict the evolution of the field within the realistic simulation environment, Weed World. This method also provides physical insight into the seed bank distribution of the field. In this work, the E-GP model extended in two important ways. The comparison of done between the predictive approach with one that relies on known properties of the weed growth model and show that the E-GP method can drive down the total weed biomass for fields with high seed bank densities using less agents, without assuming this model information. The improved planning index was used, the Whittle index, which allows a balanced trade-off between exploiting a row or allowing it to acquire reward.

**Gaurav Sethia; Harish Kumar S. Guragol; Swati Sandhya; J. Shruthi; N. Rashmi [2020], "AUTOMATED COMPUTER VISION BASED WEED REMOVING BOT"**

The conventional method of removing weeds was either ploughing manually or spraying herbicides uniformly all over the field. Spraying herbicides not only contaminates crops but also gives rise to many health-related issues because it will affect the cultivated

field crops also. Mobile model that can detect weeds in real- time with their position coordinates and scrape them off. The model first scans the specific area for leaf detection and classifies it as weed or crop with a prediction accuracy of 99.5%. If the classified leaf is a weed, the coordinates are found and the robotic arm removes them with the help of a high-speed rotating blade, without harming the crops and environment. The left outs can further be utilized as fertilizer and no harmful chemicals have been used.

**Ajinkya Paikekari, Vrushali Ghule, Rani Meshram. V.B. Raskar. [2016], "WEED DETECTION USING IMAGE PROCESSING"**

How to detect and separate out weeds affected area from the crop plants using image processing. The motivation for increasing such technique is to identify and reuse weed affected area for more seeding. This specific area can be considered for further weed control operations, resulting in more production. They have implemented various methods such like colour segmentation and edge detection to decrease the handling of herbicides by spraying them only in the areas where weed was present.

**Beatriz Nathalia Serrato Panqueba, C. C. Medina *[2016]*, "A COMPUTER VISION APPLICATION TO DETECT UNWANTED WEED IN EARLYSTAGE CROPS"**

Method of using computer vision to detect unnecessary weed in mix up of crops from one area with extra agricultural impact. An Image processing was developed to get the region of attention were finally processed throughout neural networks. Some methods like image acquisition, segmentation and ANN were used for effective weed detection. The method by applying herbicides, in the exacting case of this application, image processing was a important aspect since obtaining the mask and the identification of regions of interest, taking same levels of light intensity, and it was a major challenge.

## SYSTEM DESIGN

The main objective of the project is to develop weed removing vehicle to clean remove the unwanted grass and weeds. The cutter and plougher are placed in bottom of mobile robotic vehicle and it was guided by operator through wireless communication. To obtain effective outcomes of this processes the hardware system designed with more features and to enable the hardware system, efficient software system implemented in system.

### A. HARDWARE DESIGN

**NODE MCU:**

Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

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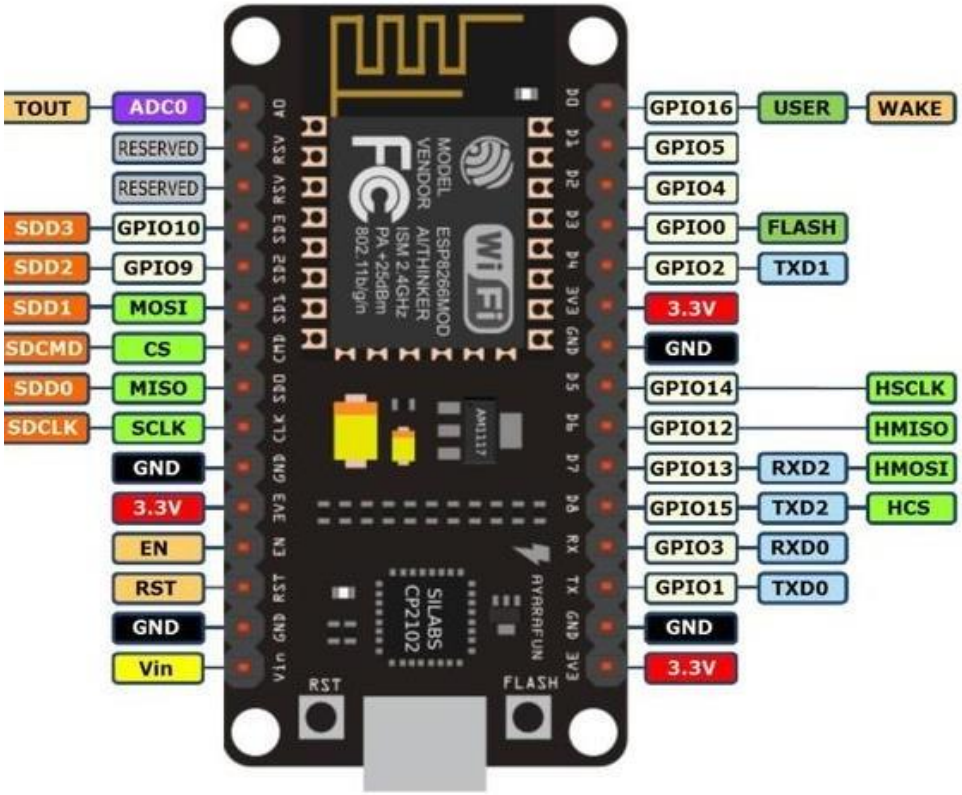
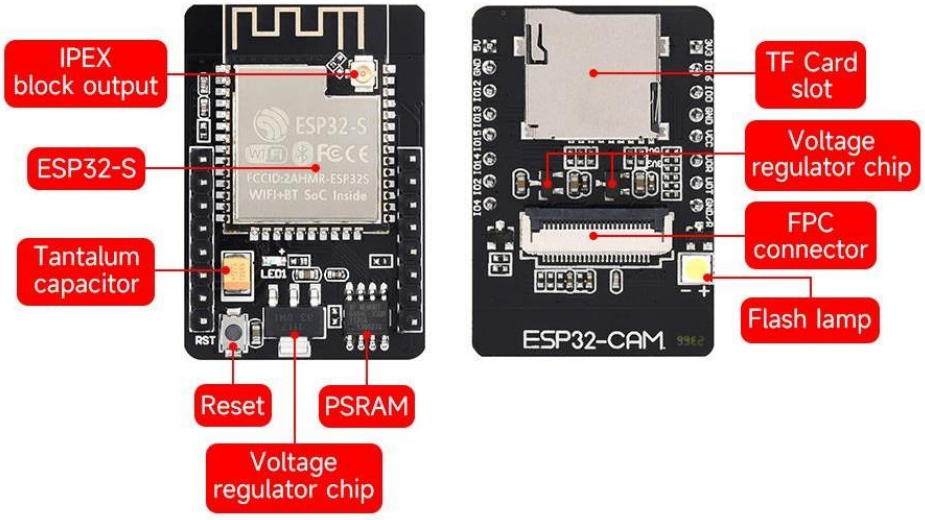



**ESP32 CAM :**

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and an ESP32-CAM-MB micro USB to serial port adapter. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload, QR identification, and so on.



**Motor Drivers:**

Separate motor drivers to control the speed, direction and cutter module. L293D motor drivers used and it was main reasons of vehicle actions.

**Motors:**

Multiple DC motors for drive the vehicle and also for rotate the cutter blades. High-torque DC motors with suitable gearing to provide enough power to the wheels.

**Batteries:**

Power source needs to power the microcontroller, Bluetooth module, motor, ploughing module and cutter module. Rechargeable batteries used for this purpose.

**Sensors:**

Some sensors to detect the presence of weeds and obstacles, rain detection and other purposes. The combination of IR sensors, ultrasonic sensors, humidity sensors used for this purpose.

**Weeding Mechanism:**

Weeding mechanism used to remove the weeds from earth. At bottom of frontend the cutter module which has rotating blades for cutting weeds placed as well as plougher module placed at back end of the system.

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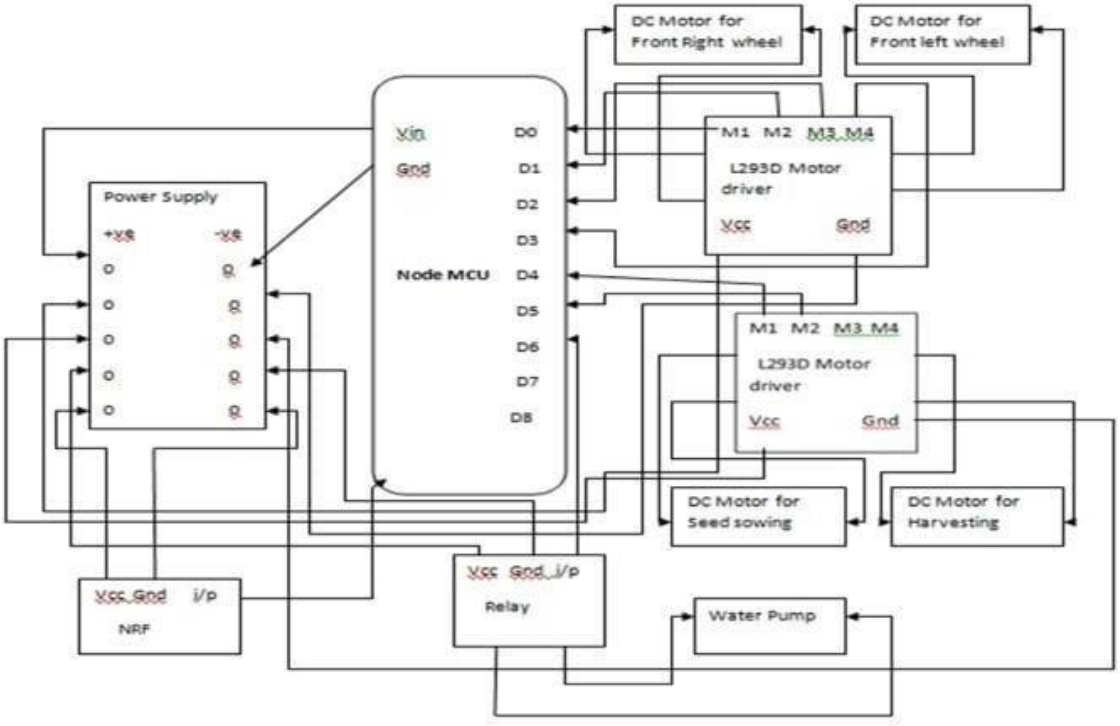
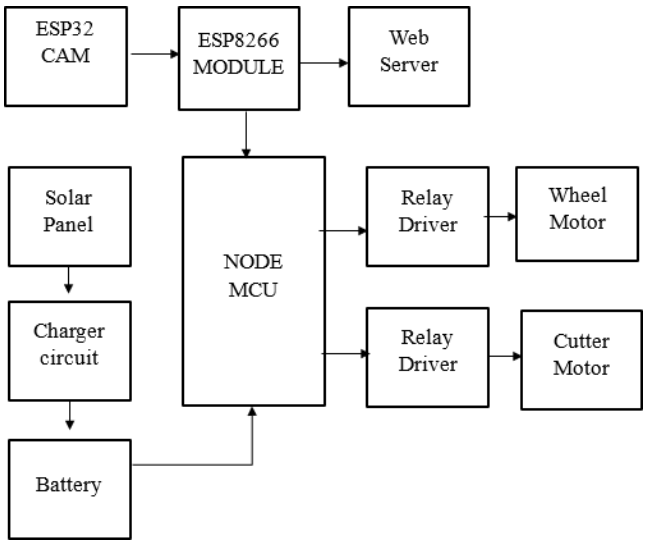
## PIN DIAGRAM OF ROBOTIC VEHICLE:




## BLOCK DIAGRAM FOR PROPOSED SYSTEM:



## B. SOFTWARE DESIGN:

In this system image processing techniques and their algorithms were used and Computer vision algorithms used to identify and locate weeds in agriculture fields and it is a set of techniques used to process and analyze digital images or videos, with the goal of extracting useful information or performing a specific task. Here are some common computer vision algorithms:

**Image Segmentation:**

This algorithm partitions an image into multiple segments or regions based on the pixel properties such as intensity, color, texture, or motion. This technique is used for various applications such as object recognition, image enhancement, and video surveillance.

**Object Detection:**

This algorithm identifies the location and boundaries of specific objects in an image or video. Object detection is commonly used in many applications such as self-driving cars, automation devices, facial recognition, and security cameras.

**Image Classification:**

This algorithm categorizes an image into one of several predefined classes or labels. For example, an image classification algorithm can identify whether an image contains a cat, dog, or a bird. This technique is used for various applications such as medical diagnosis, autonomous vehicles, and social media analysis.

**Optical Character Recognition (OCR):**

This algorithm converts printed or handwritten text into digital form that can be recognized and analyzed by a computer. OCR is commonly used for tasks such as scanning documents, reading license plates, and recognizing text in images.

**Motion Tracking:**

This algorithm tracks the movement of objects or people in a video sequence. It is used for various applications such as video surveillance, sports analysis, and robot navigation.

**Image Restoration:**

This algorithm removes noise, blur, or other distortions from an image to restore its quality. It is used for various applications such as medical imaging, satellite imagery, and photography.

## IMPLEMENTATION

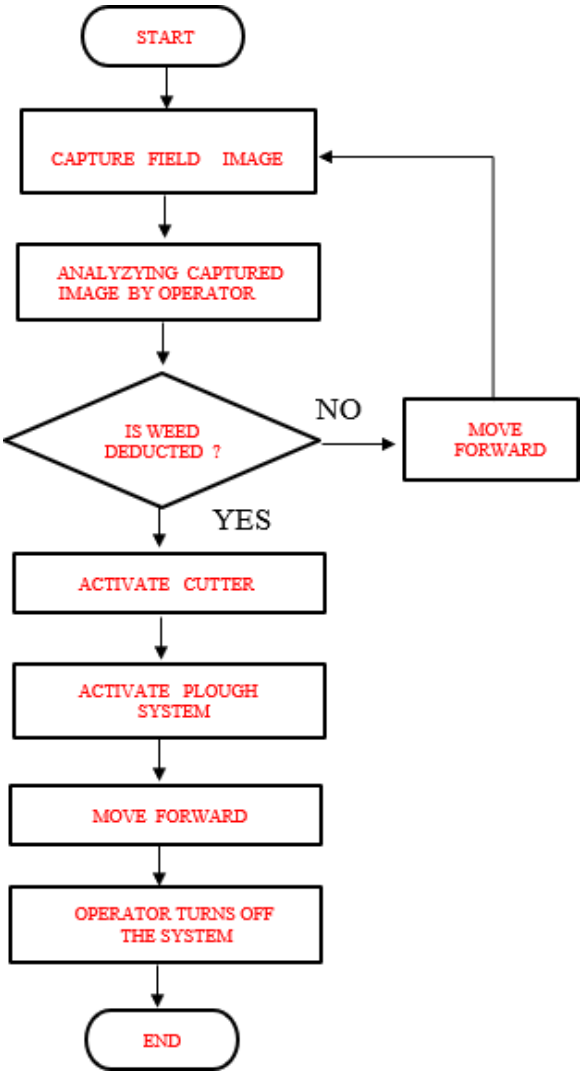
In this system weed identification and removal was processed based on digital image processing techniques. The images of crops in the field captured by camera and processed further to transmit operator device for decisioning of operations.

The operator decides future functional operations of system based on the obtained data's. If weeds are not deducted, this system moves forward and captures upcoming images.

If weeds are deducted then the operator passes the commands to activate cutter module. Then the cutter will activate and it cuts down weed very near to earth surface. After this the plougher module activate as per the commands of operator.

These steps are repeated for the entire area of field to be weeded. This system powered by solar cells with battery. This system working based on the commands of operator which more suitable for cases of complex identification between weed and field crops.

**WORKFLOW:**



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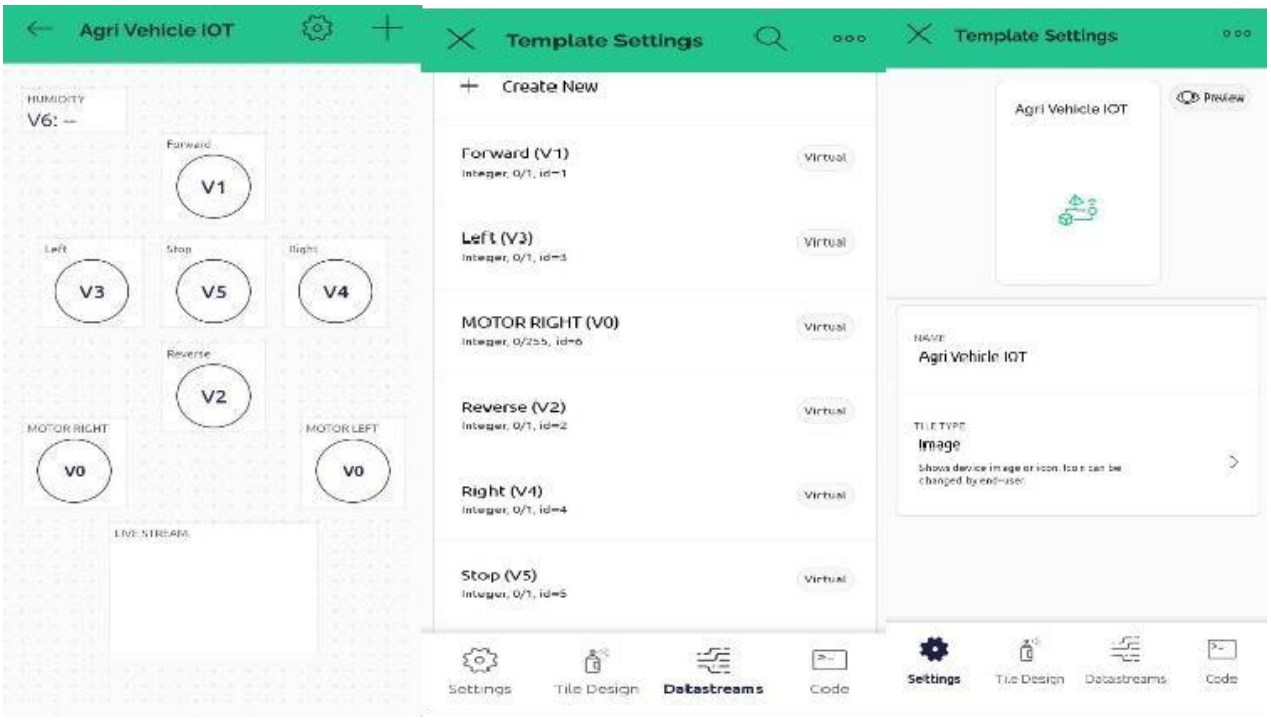
**RESULTS:**




The project involves developing a weeding vehicle that uses cameras and sensors to detect weeds and a microcontroller to control the vehicle's movement. The vehicle is controlled

using a mobile app that allows the user to monitor the progress of the weeding and adjust the vehicle's movement and speed as necessary.

The success of the project depends on the accuracy of the computer vision algorithms used to transmit images of weeds. Therefore, a significant amount of time and effort must be dedicated to collecting and labelling data, training machine learning models, and refining the algorithms to improve their accuracy.

Overall, the mobile-controlled weeding vehicle project is an exciting development in the field of agricultural technology, and has the potential to greatly reduce the time and cost associated with manual weed control methods. As the project advances, it will be interesting to see how it can be further optimized and integrated into existing agricultural systems to create a more efficient and sustainable farming process.

## CONCLUSION:

In conclusion, the mobile-controlled weeding vehicle project has the potential to revolutionize the way we manage weed control in agricultural fields. By leveraging the power of computer vision algorithms and mobile technology, the project aims to create an automated system that can detect and remove weeds with a high degree of accuracy and efficiency.

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## FUTURE WORKS

There are several potential future works for an image processing based weeding vehicle project, some of which include:

**Improving weed detection accuracy:** One possible future work is to improve the accuracy of the weed detection algorithm used by the weeding vehicle. This could involve developing more advanced machine learning models or incorporating new image processing techniques to better distinguish between weeds and crops.

**Incorporating multiple sensors**: Adding additional sensors, such as LiDAR or radar, could help the weeding vehicle better detect and navigate around obstacles in the field, as well as improve weed detection accuracy.

**Optimizing the vehicle design:** Design improvements to the weeding vehicle could include optimizing its size and reducing energy consumption, and improving its durability for use in harsh outdoor environments.

**Implementing a remote monitoring system:** Adding a remote monitoring system could enable farmers to track the weeding vehicle's progress, monitor its performance, and receive alerts when maintenance or repairs are needed.

**Integrating with precision agriculture systems:** Integrating the weeding vehicle with precision agriculture systems could enable farmers to gather more detailed data about their crops, such as soil moisture levels, temperature, and nutrient content, which could help optimize crop yields and reduce waste.

**Exploring new applications:** Beyond weeding, image processing and autonomous vehicles could be used for other agricultural applications such as harvesting, spraying, planting and soil mapping. Further exploration of these applications could open up new areas of research and development.

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