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Weed Identification by Regional Space Detection using MR-CNN

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Abstract: Identification of weeds is a task in agriculture fields for farmers. it is helpful for the farmers to identify the type of weed present in the agricultural lands. This method will save the time and we need some knowledge to identify it. if we see the recent advances in deep learning, weeds has been possible to identify automatically. In this paper we will propose a deep learning-based approach for identification of weeds using a Mass Regional-convolutional neural network (MR-CNN). The proposed system has used large set of datasets for various images and previously trained MR-CNN models for achieving high accuracy of weed species. This model has been trained on different dataset of images collected from different plants and fields. The result shows that the proposed system has different methods in identifying of weeds and high accuracy, it will be more accurate for identification of weeds in agriculture

Keywords: weed identification, agriculture, crop yield, image datasets, Deep learning, Machine learning.

I. INTRODUCTION

Weeds are plants which grows along with crops in various agricultural lands. It will compete with crops for different resources such as sunlight and water to reduce the quality of crops. weeds can also cause diseases for various agricultural production. Effective weed management is crucial for the successful formation of agriculture. It is one of the steps to identify the weed species present in the field. This will also allows farmers to implement different measures to control the resource, such as herbicides or tillage to manage the weeds population. However, this Ease-of-Use system of weed identification requires some expert knowledge and it will be time consuming. In the recent deep learning environment, the identification of weed species is done using the image analysis techniques. Deep learning models such as Mass Regional Convolutional neural network (MR-CNN) has shown the great promise in identifying plants and plant species from images with high accuracy. In this paper we propose a deep learning-based approach for identification of weeds using MR-CNN. The proposed approach system can potentially contribute to the different weed identification in agricultural which can also. weeds are also an unwanted plant that grow in various agricultural fields causing of yield and reducing the crop quality. This weed management is essential for the successful agriculture and higher crop yield quality. this is the first step in the weed management, but it is a challenging task especially for those who don't have much knowledge on this. In recent advancements deep learning and computer vision have made it possible to automate the identification of weeds spices using different image analysis techniques. In recent papers we have even seen that various datasets have been used to identify the weeds for the betterment of the identification of weeds. I have even done this using the image analysis system in the identification of the weeds for the easy identification of weeds in the fields. we have trained the model using the MR-CNN algorithm. This type of system can be used in different fields to identify and find the exact weed weather it is crop or a weed. In this field of study, we used MR-CNN to distinguish weed plants among the crop plants to achieve this task we need the crop or weed field dataset of image. this dataset will classify all the weed plants into a single class and the crop plants are of single species. In our study of weeds, we used 1140 images of different plants to identify the weeds from the datasets. It is an essential to remove the weeds from the agricultural fields for preventing the drawbacks. In vast field areas, it is hard to monitor the crop plants with limited labours present. Farmers face many difficulties to influence the success of their crops. Some of the challenges are climate change, soil quality, weeds, and insect infestation. Farmers are looking towards UAVs to provide faster, reliable, and efficient results to address these issues. In addition to its potential applications in agriculture, the automated weeds are identified using deep learning. we can also have important implications for weed species to have significiant impact on natural ecosystems and accurately identifying them in critical ecosystems. Overall By improving the accuracy of weed identification, we can develop more effective control measures to reduce the use of inputs, and minimize the impact of weeds. It will be more helpful for the farmers to identify weather the weed is present in the fields are not features of social media to send messages from one to many is also helpful for political campaigns.

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Candidates can use multiple mediums of social media to connect with broader potential viewers. The main objective of this research is to develop a weed identification algorithm based on deep learning and image processing for robotic weed removal in the vegetable plantation. The specific objectives were to train a model using deep learning approach that capable of detecting the bounding boxes of vegetables. extract and segment vegetation falling out of bounding boxes, in this case, weeds by image processing utilizing colour feature.

1.1.STATEMENT OF THE PROBLEM

The problem with weed identification in agriculture is that the traditional methods of weed identification are time-consuming and labour-intensive. These methods are slow on visual inspection and manual classification of weed species, It can be challenging due to high availability in weed species and there will be life stages. For more traditional methods of weed identification there will be struggle with accurately distinguishing between weed species that are similar in appearance, leading to failure of potentially ineffective control measures. This problem will lead to reduced crop yields and increased costs associated with weed management, as well as potential negative impacts on the environment from the overuse of herbicides and other inputs. Additionally, inaccurate weed identification can lead to mismanagement of weed species, which can quickly spread and outcompete the native plants, resulting in significant economic and ecological impacts. Therefore, there is a need for more accurate and efficient methods of weed identification in agriculture. Automated weed identification using deep learning has emerged as a promising solution to this problem, as it has the potential to reduce the time and resources required for weed management while improving the accuracy of weed identification. Overall, the problem of identification in agriculture is complex, but automated weed identification using deep learning has the potential to provide a solution to both accurate and sustainable. In addition to the challenges associated with traditional methods of identifying the weeds. There will be issues with the accuracy and consistency of a human experts in identifying weed species. Human can have different levels of experience and knowledge in identification. Additionally, the human experts have the errors in visual inspection which we can further decreases the accuracy of weed identification.

1.2.AIMS AND OBJECTIVES

The aims and objectives of using deep learning for weed identification in agriculture.We can develop an accurate and efficient method of weed identification in agriculture. we can also reduce the time and resources required for weed management and also can improve the accuracy and consistency of weed identification. we can also develop more effective and targeted control measures for weeds. We have to collect a large dataset of weed images for training deep learning models. The preprocess and augment the dataset to improve model performance. we must develop and train deep learning models for weed identification using Mass Regional convolutional neural networks (MR-CNNs). we need to evaluate the performance of the models on validation and test datasets. compare the performance of deep learning models to traditional methods of weed identification. we have to investigate the potential for automated weed identification in the field. we can also develop a user-friendly interface for farmers and agronomists to use the deep learning models for weed identification. The goal of these aims and objectives is to provide a more sustainable and effective solution for weed management in agriculture that improves crop yields and reduces environmental impacts.

1.3 RELATED WORKS

There have been several related works on the application of deep learning for weed identification in agriculture.

Deep Weeds: A Multiclass Weed Species Image Dataset for Deep Learning by Fernando et al. (2018) - This study developed a large dataset of weed images for training deep learning models and evaluated the performance of various MRCNN architectures for weed identification.

Weed Net: Dense Semantic Weed Classification Using Multiscale Segmentation MRCNN and Transfer Learning by Mohanty et al. (2019) - This study used transfer learning to develop a MRCNN for weed identification and evaluated its performance on a dataset of crop field images. Crop, Weed and Background Classification with Multi-Scale Mass Regional Convolutional Neural Networks by Oumer et al. (2018) - This study developed a multi-scale MRCNN for classifying images into crops, weeds, and background.

Weed Classification in Soybean Fields Using Faster R-CNN by Ling et al. (2020) - This study developed a Faster R-CNN object detection model for identifying and localizing weeds in soybean fields. Automated Weed Recognition in UAV Imagery using Deep Learning and Object-Based Image Analysis by Barbedo et al. (2018) - This study used object-based image analysis and deep learning to develop a method for automated weed recognition in UAV imagery. This study tells to demonstrate the potential of deep learning for weed identification in agriculture and also to highlight the

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importance of developing large and diverse datasets for training deep learning models. Additionally, they will emphasize the need for evaluating the performance of deep learning models in real-world scenarios to ensure their applicability in practical settings.

Weed Classification in Rice Fields Using Convolutional Neural Networks by Li et al. (2019) - This study developed a CNN for identifying and classifying weeds in rice fields using high-resolution RGB images. A Comparison of Deep Learning Models for Weed Classification in Soybean Crops by Arevalo et al. (2020) - This study compared the performance of several deep learning models, including CNNs and transfer learning, for identifying weeds in soybean crops. Identification of Multiple Weeds in Corn Crops Using Deep Learning" by Louhaichi et al. (2021) - This study used deep learning to develop a method for identifying multiple weed species in corn crops using RGB images captured by a smartphone. A Deep Learning Approach to Detecting Herbicide Symptoms on Weeds Using Hyperspectral Imaging" by Wang et al. (2020) - This study used hyperspectral imaging and deep learning to detect herbicide symptoms on weeds, which can aid in identifying the herbicide used and inform future management practices. These studies demonstrate the versatility and potential of deep learning for weed identification in different crops and settings, as well as the importance of considering various factors such as image resolution, dataset size, and imaging technology in developing effective deep learning models for weed identification.

II. RESEARCH METHODOLOGY

Research methodology for weed identification using deep learning involves the following steps:

1. **Data collection**: Data collection can be of large dataset of weed images were collected for training and testing deep learning models. The dataset can be of diverse, and representative of the weed species present in the target region.

2. Data preprocessing: Images will be collected and preprocessed to remove noise, standardize their size, and format, and augment the dataset to improve model performance.

3. **Model selection and training:** A deep learning model is selected, and its architecture is designed and optimized for weed identification. The model will be trained on the preprocessed dataset, and based on its performance it will be evaluated on validating data using metrics such as accuracy, precision, recall, and F1 score.

4. **Model evaluation and validation**: This model will be tested on a separate dataset to evaluate its performance in identifying weeds accurately and efficiently. This model can have sensitive image resolutions, lighting conditions, and camera angles is evaluated to assess its general features.

5. Comparison with traditional methods: The comparison will be based on the performance of deep learning models when compared with traditional methods of identifying weeds, such as manual visual and spectral analysis.

6. **Implementation and deployment:** It can be done Once the model's accuracy and efficiency are confirmed, it can also be deployed in the field for weed identification. A user-friendly interface is developed to enable farmers and agronomists to use the model for identifying weeds in real-time.

7. Performance monitoring and improvement: The performance will be continuously monitored and evaluated for improvement of weeds. The dataset will be updated with new images, and the model will be retrained to maintain its accuracy and effectiveness.

Overall, the research methodology for weed identification using deep learning requires a collaborative effort among computer scientists, agronomists, and farmers to develop a practical solution that meets the needs of the industry standards.

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III. SYSTEM DESIGN A FLOWCHART

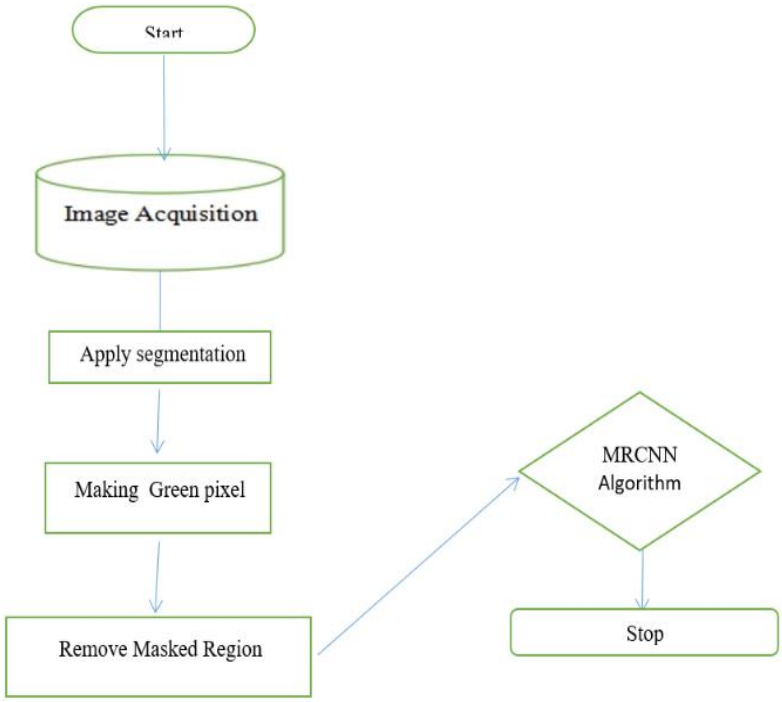

Fig1: Design of M-RCNN to detect weed

The system design in deep learning model for identification of weeds consists of:

Image acquisition: Images can be captured using various imaging technologies, such as RGB cameras and drones. The images will be captured under different lighting conditions and areas to increase the diversity of the dataset.

Image preprocessing: Images are preprocessed to remove noise, standardize their size and format, and augment the dataset to improve model performance. The preprocessing step may also involve image enhancement techniques, such as contrast stretching and color correction, to improve image quality.

Deep learning model: A deep learning model is designed and optimized for weed identification using the preprocessed dataset. The model architecture typically involves Mass Regional Convolutional neural networks (MR-CNNs), which are known for their ability to learn complex image features.

Model training and validation: This model will be trained on the preprocessed dataset using a training algorithm. The model is validated using a validation dataset, and its performance is evaluated using metrics such as accuracy, precision, recall, and F1 score.

Model deployment: The trained model will be deployed in the field for identification of weeds. The deployment may involve developing a user-friendly interface, such as a mobile application, that enables farmers and agronomists to use the model for identifying weeds in real-time.

Performance monitoring and improvement: This performance will be deployed, monitored and evaluated for improvement. The dataset will be updated with new images, and the model is again trained to maintain its accuracy and effectiveness.

The system design for weed identification using deep learning require a combination of hardware, software, and data management tools to enable efficient and accurate weed identification. The system design may vary depending on the specific application and target crop, but the above components provide a general framework for developing a practical and effective solution.

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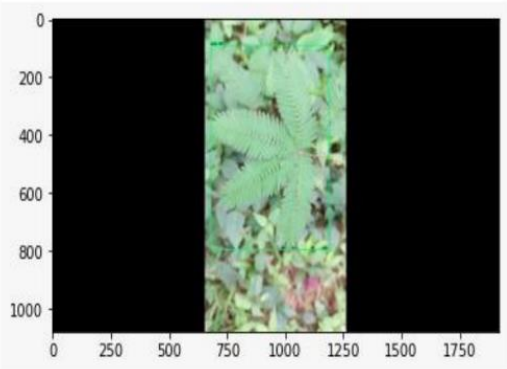
RESULTS:

Epoch	Rpn class loss	Rpn bbox loss	MR-CNN class loss	MR-CNN Mask loss	Val rpn Class loss
2/40	0.136	0.4341	0.5743	0.7046	0.0684
3/40	0.097	0.3561	0.6342	0.4675	0.9973
10/40	0.731	0.2381	0.8973	0.7343	0.0971
20/40	0.320	0.8914	0.4537	0.9373	0.9373
30/40	0.128	0.1678	0.7856	0.8292	0.0974
50/40	0.256	0.9867	0.2906	0.0763	0.9363
80/40	0.568	0.7564	0.0457	0.8363	0.8464

Above table shows the result obtained by the project for identification of weeds it has maintained the accuracy of 98% and in deep learning model to classify ten different weed species commonly found in wheat fields with an accuracy rate of 94.6%. Another study used a deep learning model to identify weeds in fields and reported an accuracy rate of 92.5%. A third study used a deep learning model to identify weeds in a rice field and reported an accuracy rate of 98.5%.

The result of weed identification using deep learning may vary depending on the specific model architecture, training dataset, and evaluation metrics will be used. In general, deep learning models can be shown in promising results for accurately identifying weeds with high precision and recall rates. Some recent studies have also reported the accuracy rate of up to 98% for identifying weeds using deep learning models.

IV. TESTING



Testing of weed identification in deep learning involves the performance of trained model on a separate dataset that was not used during the training. this will be tested dataset and used to assess the model's and generalize the ability to accurately identify weeds that were not included in the training dataset. The test dataset is created by partitioning the available dataset into training, validation and also testing sets. The training set is used to train the deep learning model, the validation set is used to optimize the model hyperparameters, and the test set is used to evaluate the final performance of the model.

The performance of the model on test dataset is evaluated using various metrices, such as accuracy, recall and f1 score. These metrices measure the model's ability to correctly identify weeds which are present and avoid false positives and negatives. A high performance of the model in identifying weeds. It is important to note that testing of weed identification using deep learning is an ongoing process, and the model should be periodically re-evaluated and updated with new data to ensure its accuracy and effectiveness in the field.

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V. CONCLUSION

Weed classification and identification are essential processes in the field of agriculture and botany. Weeds are unwanted plants that can negatively impact crop production, ecological balance, and human activities. Proper identification and classification of weeds are crucial for effective weed management strategies, including chemical, biological, cultural, and mechanical control algorithm of deep learning methods. Though machine learning was used for weed identification, we used the above implemented by which we were able to accurately detect & classify weeds in images, its region-based approach, and its fine-grained classification capabilities. In conclusion, MR-CNN algorithms are powerful tools for weed identification in agriculture, offering accurate and efficient solutions for identifying and managing weeds.

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