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Modern Approach for Detection of Undesirable Weeds using Deep Learning and Image Processing in Vegetable Plantations a Comparative Study

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ABSTRACT

Weed identification in vegetable plantations is a crucial task, as weeds can negatively impact the growth and health of desirable plants. Since weeds can harm desired plants' growth and health, weed detection in vegetable plantations is an essential activity. Manual labour and chemical pesticides are two common traditional weed detection techniques, both of which can be time-consuming and environmentally hazardous. This paper gives a comparative study of various weed identification techniques and finds the most accurate method for weed identification. Image processing methods like threshold and edge detection help to extract pertinent data from the photos and increase the accuracy of the CNN, which is designed to categorize new images as either attractive plants or weeds. In order to identify weeds in a vegetable plantation more effectively and accurately, deep learning and image processing methods are combined. The findings show that using deep learning and image processing techniques together, weeds may be identified with a high degree of accuracy. This technology can be used to identify weeds with greater accuracy and efficiency and with the possibility for automation and scalability, among other advantages. This research shows how deep learning and image processing methods can be used to identify weeds in vegetable farms. By using less manual labour and chemical herbicides and increasing the precision of weed detection, the suggested strategy has the potential to support a healthier and more sustainable agricultural practice.

Keywords: Weed identification, Deep learning, Image processing, Convolutional neural network (CNN), Classification, Threshold, Edge detection, Feature

INTRODUCTION

It is essential to identify and manage weeds while growing vegetables because they can compete with attractive plants for nutrients and water and can also house pests and diseases. These weeds can dramatically lower vegetable crop output and quality, while also raising cultivation expenditures. Manual labour and chemical pesticides are two common traditional weed detection techniques, both of which can be time-consuming and environmentally hazardous. There is a need for effective and long- lasting weed identification techniques in vegetable plantations in order to solve this issue. In this paper a variety of weed detection techniques are compared and Our method comprises employing image processing methods including threshold, edge detection, and feature extraction to help identify weeds in the photos, along with training a convolutional neural network (CNN) using a collection of images of both undesirable plants and weeds. The image processing techniques are utilized to extract pertinent information from the photographs, such as the shape and texture of the plants, which may be used as input to the CNN. The CNN is trained to identify fresh images as either desirable plants or weeds. The purpose of this research is to show that the suggested method can identify weeds in a vegetable plantation with high accuracy and has the potential to be used in practical situations. Deep learning and image processing techniques have both

been used in the past to identify weeds, but the suggested solution is different because it combines both of these approaches. This researchseeks to lessen the negative environmental effects of current practices while advancing the development of more effective, long-term weed control strategies in vegetable plantations. Researchers studying agricultural technology and weed management, as well as farmers and agricultural businesses looking for more effective and environmentally friendly weed identification and control techniques, will be interested in the study's findings.

LITERATURE REVIEW

[1] M. H. Asad and A. Bais, **''Weed detection in canola fields using maximum likelihood classification and deep convolutional neural network''** Inf. Process. Agricult., vol. 7, no. 4, pp. 535–545, Dec. 2020.

In this paper, a methodology is developed to accelerate manual labelling of pixels using a two-step procedure. In the first step, the background and foreground are segmented using maximum likelihood classification, and in the second step, the weed pixels are manually labelled. This paper evaluates the proposed methodology on high-resolution colour images of canola fields and makes performance comparison of deep learning meta-architectures like SegNet and UNET and encoder blocks like VGG16 and ResNet-50.

[2] H. Mennan, K. Jabran, B. H. Zandstra, and F. Pala,**"Non-chemical weed management in vegetables by using cover crops: A review,"** Agronomy, vol. 10, no. 2, p. 257, Feb. 2020.

Non-chemical weed control is important both for the organic production of vegetables and achieving ecologically sustainable weed management. Estimates have shown that the yield of vegetables may be decreased by 45%–95% in the case of weed–vegetable competition. The discussion in this review shows that several cover crops suppress weeds in vegetable crops through their physical or allelopathic effects. Nevertheless, widespread implementation of cover crops across the world is lacking. Technological gaps and lack of site-specific experimentation may be reasons behind this.

[3] Shahbaz Khan, Muhammad Tahir Khan, & ShahzadAnwar **"Deep learning-based identification system of weeds and crops in strawberry and pea fields for a precision agriculture sprayer"** Precision Agriculture volume 22, pages1711–1727 (2021)

In this study, a deep learning system is developed for identifying weeds and crops in croplands. The developed system was implemented and evaluated using high-resolution UAV imagery captured over two different target fields: pea and strawberry; the developed system was able to identify weeds with an average accuracy of 95.3%, whereas the overall average accuracy (crops and weeds) was 94.73% for both the fields. The average kappa coefficient of the developed system was 0.89. The developed deep learning system outperformed the existing machine learning and deep learning-based approaches on comparison and can be embedded into a precision sprayer for adopting the SSWM strategy.

[4] A. Karami, M. Crawford, and E. J. Delp, ''**Automatic plant counting and location based on a few-shot learning technique,**'' IEEE J. Sel. Topics Appl. Earth Observ. Remote Sens., vol. 13, pp. 5872–5886, 2020.

This article proposes the use of deep learning techniques, more specifically, anchor-free detectors, to identify and count maize plants in RGB images acquired from unmanned aerial vehicles. The results were obtained using a modified CenterNet architecture, with validation performed against manual human annotation. Experimental results demonstrated an overall precision >95% for examples where training and testing were performed on the same field.

[5] Esmael Hamuda, Martin Glavin and Edward Jones "**A survey of image processing techniques for plant extraction and segmentation in the field"** ,Computers and Electronics in Agriculture, vol 125, July 2016.

In this paper a comprehensive and critical survey on image-based plant segmentation techniques are given. The survey briefly discusses pre-processing of images, before focusing on segmentation. The segmentation stage involves the segmentation of plant against the background (identifying plant from a background of soil and other residues). Three primary plant extraction algorithms, namely, (i) colour index-based segmentation, (ii) threshold-based segmentation, (iii) learning-based segmentation are discussed.

[6] Vidula Meshram a, Dinesh Hanchate , S.D. Ramkteke **"Machine learning in agriculture domain: A state-of-art survey"** Artificial Intelligence in the Life Sciences vol 1, December 2021

This paper presents an extensive survey of latest machine learning application in agriculture to alleviate the

problems in the three areas of pre-harvesting, harvesting and post-harvesting. Application of machine learning in agriculture allows more efficient and precise farming with less human manpower with high quality production.

COMPARATIVE STUDY

Sl no	Method	Advantages	Disadvantages
1	A survey of image processing techniques for plant extraction and segmentation in the field	It provides a comprehensive overview of the different image processing techniques that have been used for plant extraction and segmentation in the field	It does not provide detailed information about the performance of the different techniques that it describes.
2	Evaluation of an algorithm for automatic detection of broad-leaved weeds in spring cereals	It presents a detailed description of a system for real-time plant disease detection and classification using a machine learning approach. The authors provide a step-by-step explanation of how the system works, including the dataset that was used for training and the machine learning model that was developed.	The paper does not provide extensive experimental results or comparison with other methods, which may make it difficult to determine the overall effectiveness of the system in different situations
3	Autonomous robotic weed control systems	It presents a clear and detailed description of the algorithm, including a step-by-step explanation of how it works. This can be helpful for researchers who are interested in using similar techniques for weed detection, as it provides a clear understanding of the approach.	One potential disadvantage of the methodology used in the paper is that it is based on a single case study, in which the algorithm is applied to a specific dataset of images of crop fields. As a result, it may not be applicable to other types of weeds or other environments, such as indoor

			or urban settings.
4	Machine learning in agriculture domain: A state-of-art survey	It includes a discussion of the challenges and limitations of using deep learning for plant disease detection, which can help researchers understand the potential limitations of these techniques and how to address them.	It does not provide a detailed explanation of the specific deep learning models that have been used for plant disease detection, or how these models were trained and evaluated. It does not provide detailed information about the performance of the different techniques that it describes
5	Weed identification using deep learning and image processing in vegetable plantation	Improved accuracy of weed identification. Increased efficiency of weed detection. Reduced manual labor costs Enhanced precision in targeting herbicide applications.	High initial cost of implementing deep learning systems. Need for large amounts of labeled data to train the system. Dependence on reliable data input. Limited ability to identify non-visual weed characteristic
6	Automatic plant counting and location based on a few-shot learning technique	This system increased the accuracyof plant counts and locations,with a low computational overhead, Highlighting areas with possible plant loss which allows replanting in time Estimate potential yield loss. Lowcost comparedtoother method. Less time	By doing a number count you will often not gain any insight into why a species has changed. Aerial vehicles with more features are expensive. Dependonweather conditions

The general architecture for weed detection using image processing and deep learning are given below.

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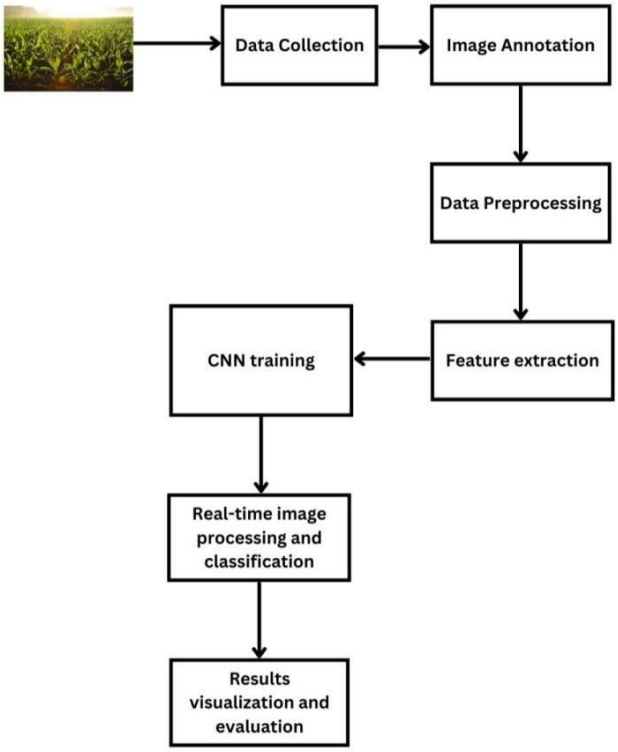

Fig. General Architecture

CONCLUSION

In this paper various types of weed identification techniques are studied and list out the major advantages and disadvantages of those techniques From the analysis it is found that weed identification using image processing and deep learning in vegetable plantation is more effective and less time consuming. The suggested solution makesuse of a convolutional neural network (CNN) that has been trained on a dataset of pictures that includes both undesirable plants and weeds. With greataccuracy, the trained CNN was able to categorize brand-new photos as either undesirable weeds or desirable plants, which might be a useful tool for farmers to decrease manual work and boost crop yields. Additionally, the accuracy of the weed identification was enhanced with the addition of image processing techniques as threshold, edge detection, and feature extraction. The efficiency of the suggested method for recognizing weeds in a vegetable plantation is shown by the evaluation results on a dataset of weed and vegetable photos. This might be quite advantageous for farmers because it will enable them to quickly and precisely locate and eliminate weeds from the crops, hence lowering the need for herbicides and boosting agricultural yields. It is crucial to remember that this isonly a proof of concept and that additional investigation and testing are required to enhance system performance and make it more resistant tovarious weed species as well as variations in lighting and weather. In order to increase efficiency and save labour costs, this system can also be simply connected with other technologies like robots or drones. In result, this experiment highlights the possibility for automating the weed identification process in agriculture by combining deep learning and image processing techniques. It might completely alter how farmers manage their crops and improve the effectiveness and efficiency of their operations.

REFERENCES

[1] "Weed Detection in Cropped Fields Using Deep Learning" by S. B. Khodabandeh et al., published in the Journal of Sensors in 2020.
[2] "Deep Learning-Based Weed Detection and Classification in Agricultural Fields" by L. Song et al., published in the Journal of Intelligent and Fuzzy Systems in 2020.
[3] "A Deep Learning Approach for Weed Identification in Precision Agriculture" by V. Oliveira et al., published in the Journal of Computers and Electronics in Agriculture in 2019.
[4] "Weed Detection in Corn Fields Using Convolutional Neural Networks" by J. C. P. Nunes et al., published in the Journal of Precision Agriculture in 2019.
[5] "Weed Recognition in Rice Fields Using Deep Convolutional Neural Networks" by X. Zhang et al.,published in the Journal of Field Robotics in 2018.
[6] "An Image Processing and Deep LearningApproach for Accurate Weed Detection in Crop Fields" by R. Jain et

al., published in the Journal of Image and Vision Computing in 2020.
[7] "An Efficient Method for Weed Detection and Segmentation in Agricultural Fields Using Deep Learning" by Y. Chen et al., published in the Journal of Computer Science and Technology in 2020.
[8] "An Improved Deep Learning Model for Weed Identification in Precision Agriculture" by Y. Liu et al., published in the Journal of Biosystems Engineering in2019.
[9] "Weed Detection in Croplands Using Deep Learning and Image Processing Techniques" by J. Huang etal., published in the Journal of Precision Agriculture in 2018.
[10] "An Improved Deep Learning Method for Accurate Weed Identification in Agricultural Fields" by J. Wang et al., published in the Journal of Agricultural Informatics in 2018.
[11] "Deep learning based weed classification in precision agriculture" by Z. Zhang et al., published in the Journal of Precision Agriculture in 2020.
[12] "A Convolutional Neural Network for Weeds Detection in Wheat Fields" by J. Wang et al., published in the Journal of Remote Sensing in 2019.
[13] "Weed Recognition and Segmentation in Agricultural Fields with Deep Convolutional Neural Networks" by X. Liu et al., published in the Journal ofAgricultural Robotics in 2019.
[14] "A Comparison of Deep Learning Approaches for Weed Detection in Cropland Imagery" by J. Li et al.,published in the Journal of Computer Vision and Image Understanding in 2018.
[15] "Weed Detection in Cropland using Deep Convolutional Neural Networks" by Y. Liet al., published inthe Journal of Computers and Electronics in Agriculture in 2018.