IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, November 2022
Impact Factor: 6.252

Weed Identification using Deep Learning and Image Processing

Prof. A. H. Khadke[1], Sudhanshu Shinde[2], Vedant Sawant[3], Nishant Kadam[4], Aditya Patole[5]
Professor, Department of Computer Science Engineering[1]
B.E Students, Department of Computer Science Engineering[2,3,4,5]
SKN Sinhgad Institute of Technology & Science, Lonavala, Maharashtra, India

Abstract: *Weed identification in vegetable plantation is more challenging than crop weed identification due to their random plant spacing. So far, little work has been found on identifying weeds in vegetable plantation. Traditional methods of crop weed identification used to be mainly focused on identifying weed directly; however, there is a large variation in weed species. This paper proposes a new method in a contrary way, which combines deep learning and image processing technology. Firstly, a trained CenterNet model was used to detect vegetables and draw bounding boxes around them. Afterwards, the remaining green objects falling out of bounding boxes were considered as weeds. In this way, the model focuses on identifying only the vegetables and thus avoid handling various weed species. Furthermore, this strategy can largely reduce the size of training image dataset as well as the complexity of weed detection, thereby enhancing the weed identification performance and accuracy. To extract weeds from the background, a color index-based segmentation was performed utilizing image processing.*

Keywords: Weed identification, deep learning, image processing, genetic algorithms, color index.

I. INTRODUCTION

Vegetable is considered one of the most nutrient-dense food all around the world due to its sufficient vitamins, minerals and antioxidants. Raising living standards boosts the consumption of green vegetables, which makes them a substantial part of our lives and possess great commercial value [1].Invasive weed growth is difficult to control because it grows quickly and aggressively composts with another crop. Fungal bacteria and nematodes can be introduced, which is difficult to control and causes the grower to reduce crop yield and yield. Killing weeds with herbicide and reducing the edge of the cultivator is expensive. One of the most challenging challenges is weed control. Weeds compete with crops for sunlight and water. Cultural practices can minimize infestations, known as appropriate irrigation, fertilization and mowing. However, herbicides can offer a highly effective forage control process [2].

II. LITERATURE REVIEW

Due to the variable plant spacing in vegetable plantations, weed identification is more difficult than weed identification in crops. There has been minimalre search on weed identification in vegetable plantations thus far. Traditional crop weed identification approaches have mostly focused on detecting weeds directly; nevertheless, weed species vary greatly. In contrast, this research provides a new method that blends deep learning and image processing technologies. The first step was to use a trained CenterNet model to detect veggies and create bounding boxes around them. The remaining green objects that fell out of the boundary boxes were then labelled as weeds. As a result, the model concentrates solely on detecting vegetables, avoiding the handling of numerous weed species. Furthermore, by reducing the amount of the training image data set and the complexity of weed detection, this technique can improve the weed identification performance and accuracy. A colour index-based segmentation was used in image processing to extract weeds from the backdrop. Genetic Algorithms (GAs) were used to determine and assess the colour index used, which was based on Bayesian classification error. The trained CenterNet model had a precision of 95.6 percent, a recall of 95.0 percent, and an F1 score of 0.953 during the field test. In comparison to the widely used ExG index, the proposed index 19R + 24G 2B 862 delivers high segmentation quality at a substantially lower computing cost. The findings of these experiments show that the proposed method for ground-based weed identification in vegetable plantations is feasible [1].

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In order to use precision agriculture techniques like patch spraying, it's necessary to monitor and map weeds within agricultural crops. Both environmentally and economically, precision and targeted weed eradication would be beneficial. When high spatial and spectral resolution data (i.e., from UAV platforms) is available, VNIR hyper spectral data can be a strong tool for performing effective weed monitoring and identification. This study investigates the spectral differences between crops and weeds in order to assess the potential of UAV hyper spectral data to distinguish maize crops from weeds and different types of weeds. During the 2016growing season in Italy, UAV and field hyper spectral data were collected in a few corn fields. The results demonstrated that leaf chlorophyll and carotenoid content, extracted using spectral indices or inverting PROSAIL, may be used to distinguish between maize crops and weeds, as well as between weed species. The approach allowed for the measurement of crop/weed relative ground cover, which demonstrated a strong correlation with the obtained relative LAI values [3].

The use of precision agriculture tools for weed management in crops was the subject of this study. Its focus has been on developing an image-processing system to detect the presence of weeds in a specific agricultural site. The main goal was to find a formula that could be used to create a weed detection system using binary classifications. The first step in image processing is to detect green plants inorder to remove all of the soil from the image and reduce unnecessary data. Then, using medium and morphological filters, it focused on the vegetation, segmenting and removing unwanted data. Finally, the image has been labelled with items such that weed detection may be done using a threshold depending on the detection area. This algorithm establishes accurate weed monitoring and can be used in automated systems for weed eradication in crops, either through the use of specific-site automated sprayers or a weed cutting mechanism. Furthermore, it improves the efficiency of crop management operational operations by reducing the time spent searching for weeds across a plot of land and concentrating weed removal tasks on specific places for effective control [4].

One of the variables that contribute to a decline in agricultural yield is the presence of weeds in the crops. Weeds take up nutrients and water, causing the plant to lose weight and reduce the number of grains per ear and grain output. So, using new drone technology and deep learning in the field of convolutional neural networks, a way must be devised to detect these weeds in the field and then sprayherbicide on them to completely eliminate them. The authors used a data set from the Indian Agriculture Research Institute (IARI) fields to apply a transfer learning technique to identify three weeds: Phalaris minor, Dactyloctenium aegyptium, Digeraarvens is, and Echinochloa colona, with an accuracy of 95 percent, 65 percent, 61percent, and 54 percent for datasets that were not used in model training [5].

Pesticides and fertilisers used in agriculture are utilised to educate the human community about environmental issues. Agriculture producers must meet anever-increasing demand for food. Precision agriculture based on IoT has evolved to address environmental challenges and food security. Precision agriculture enhances production and quality while lowering costs and waste. Based on the collected photographs of the farm, we present a system to recognise and locate weed plants among the farmed agricultural crops. We also propose employing parallel processing on the GPU to improve the performance of the above system so that it may be used in real-time. The suggested method uses a real-time image of a farm as an input to determine the kind and position of weeds in the image. The proposed work uses photos of crops and weeds to train the system using a deep learning architecture that incorporates feature extraction and classification. The findings can be employed by an automated weed detection system for precision agriculture operations [6].

A weed control robot system in general consists of a weed classification and a weed destruction unit, both of which are physically separated from one another inside the robot, resulting in the weed distraction result. As a result, tracking of classified weed positions with a low-resolution VGA camera and a developed matching algorithm is an important step for weed destruction in organic farming with a robot system. In this paper, tracking is done with a low-resolution VGA camera and a developed matching algorithm. Because the robot's position can shift owing to a stone or other obstruction in its path, tracking is required. Also, modifications in the robot's pace resulted in weed destruction. Simulation and experimental results are used to illustrate the performance of the picture matching technique [7].

Weeds compete with crops for resources like sunshine, nutrients, water, and space. Weeds can develop dozens to hundreds of thousands of seeds that can survive for a long period, posing a serious threat to crops once they reach maturity. The easiest strategy to eliminate weed risks is to remove weeds before they blossom, which reduces the likelihood of weed seeds dropping into the soil. The majority of existing drone-based weed identification technologies

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rely on extra equipment to improve their accuracy. Drones' power consumption and load burden rise as a result of such solutions, in addition to raising their cost. In this paper, we propose a low cost Weed Identification System (WIS) that uses RGB photos captured by drones as training data and builds the identification model using Convolutional Neural Networks(CNN). The WIS results can be used as a reference for agriculture researchers, as well as to alert farmers about the activities that need to be undertaken. The WIS can accurately identify weeds up to 98.8 [8].

In order to reduce the expense of farming and the impact of herbicides on human health, automatic weed detection and mapping are essential for site-specific weed control. In this paper, we use hyperspectral images to examine patch-based weed identification. For this aim, the Convolutional Neural Network (CNN) is evaluated and compared to the Histogram of Oriented Gradients (HoG). Patch sizes that are appropriate are studied. The limitations of RGB imaging are shown. The results of the experiments show that the overall accuracy of weed categorization using CNN improves as the number of bands employed increases. When compared to the traditional HoG feature extraction method, CNN extracts more potent and discriminative features, resulting in enhanced classification. The computing load of CNN, on the other hand, increases little as the number of bands grows [9].

III. CONCLUSION

In this study, we have proposed an approach to identify weeds in vegetable plantation using deep learning and image processing. The algorithm is depicted in two steps. A Deep Learning model is trained to detect vegetables. Then the remaining green objects in the color image are considered as weeds. To extract weeds from the background, a color index is determined and evaluated through Genetic algorithms according to Bayesian classification error. In this way, the model focuses on identifying only the vegetables and thus avoid handling various weed species.

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