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AI Driven Applications for Precision Weed Management in Agricultural Crops

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Abstract - Agriculture plays a most important role in our Indian economy and therefore lowering the cost of production and improving the quality of agricultural products is highly demanded. A weed is a plant which grows in wrong place at the wrong time and doing mostly harm than crops. Weed competes with the crops for water, light, nutrients and space, and therefore it prevents crop yields. This paper proposes a new method in a contrary way, which combines deep learning and image processing technology to prevent these weeds. Machine learning technologies, are becoming crucial in agriculture to increase productivity, where advanced automation and control have been required. Based on large training datasets and pre-trained models, (Deep Learning) DL-based Convolutional Neural Networks (CNN) methods have proven to be more accurate than previous traditional techniques. Recently, Deep Learning (DL) has gained much attention due to its advantages in object detection, classification, and feature extraction. The system implementation of image processing technique for weed detection, a trained image is taken as a sample in order to demonstrate the difference between weed and the crop. Yolo frame work is used for annotate boundary boxes to the image with datasets. The effectiveness of the (You Only Live Once) YOLO-WEED system for real-time Unmanned Aerial Vehicle (UAV) weed detection, given its high speed and high accuracy in detection. After certain steps, we get desired output, where the weeds are separated from the crop that has been taken in the sample image.

***Key Words*:** DeepLearning,CNN, Unmanned Aerial Vehicle (UAV), Precision Weed Detection.

1.INTRODUCTION

1.1 Weed Detection Methods

Weed detection and classification system, and there are a variety of ways to use one. Using either spectral or color imaging, individual plant categorization has been effectively shown. Spectral methods' spatial resolutions are generally insufficient for reliable individual plant or leaf detection. Color imaging techniques with better spatial resolution, on the other hand, do not give the critical extra information that spectral data does. During the summer, Caltrans sprays roadside plant material with pesticide to prevent weeds from becoming a fire danger. The classification of pixels is the initial stage in recognizing weeds in a picture. A point operation will be used to classify the pixels. A pixel's categorization will not be influenced by its surroundings.

Figure 1. Weeds in Agriculture Lands

The goal of segmenting the picture into plant and background pixels is to determine how much plant material is present in a given region. The region is targeted for herbicidal spray treatment if the amount of plant material reaches a certain level. The proportion of background pixels misclassified as plant stuff limits the spray threshold. Herbicide will be spent spraying background if the spray threshold is set too near to the background misclassification rate. Weed management is a crucial farm activity that may have a big impact on crop output. Herbicides are essential for weed management, although their usage has been criticized

due to concerns about overuse and associated side effects. Patch spraying has been shown in several trials to significantly reduce pesticide consumption.

1.2 Weed Detection Using Image Processing

Manual scouting for patch spraying wastes a lot of time and money, therefore it's not a viable alternative for many farms. Patch spraying has been studied by several researchers with varying degrees of success utilizing remote sensing and computer vision. Computer vision systems are ideal for applying herbicides at the plant level, although remote sensing is frequently used on a plot level. Both of these technologies need the capture and processing of images. Processing time varies from 0.34 seconds to 7 seconds, depending on picture resolution, crop and weed type, method utilized, and system settings. To distinguish between weed and crop, the machine vision-based method employs form, texture, color, and location-based characteristics separately or in combination. The studies show a wide range of results for these characteristics and their combinations. An image sensor is an important part of nearly any As a result of the higher misclassification rate, the smallest plant that may be identified without spraying the background is limited.

A system that could use real-time spatial distribution information to administer just the appropriate amounts of herbicide to the weed-infested region would be considerably more efficient and less harmful to the environment. As a result, for site-specific weed control, a high spatial resolution, real-time weed infestation detection system appears to be the solution.

2.OBJECTIVE

To use machine learning model with Deep learning algorithms can accurately identify and classify weeds even in complex agricultural settings. They can identify weeds based on their features, such as colour, texture, shape, and size.

Deep learning can detect weeds much more quickly and economically than human weed identification and pesticide application, which saves time and money.

By concentrating on certain weed-infested areas, machine learning-based weed detection can help farmers use herbicides more efficiently while using less herbicide overall. In addition, it can prevent over spraying, which hurts crops and the environment.

3.EXISTING SYSTEM

The classification of weed gained attention with the advancements of Machine Learning (ML) and Deep Learning (DL) techniques, such as MLbased Support Vector Machine (SVM), Random Forest (RF), ANN (Artificial Neural Network), Machine Learning (ML) has been utilized for weed detection, such as: compared (Machine Learning) ML-based feature classification of an area infested due to weed and concluded that the Relief method outperformed other methods based on f-score values. Other models applied were Support Vector Machine (SVM), Decision Tree Learning (DT), and Random Forest (RF) to map the parthenium weed. These are achieved an accuracy ranging between 70.3% to 82.3% for the weed classification.

4.METHODOLOGY PROPOSED

In this project proposed a convolution neural network as artificial intelligence to train all plant diseases images and then upon uploading new images Convolutional Neural Networks (CNN) will predict weed available in uploaded images. For storing Convolutional Neural Networks (CNN) train model and images Al author predicting weed from crop so we build it as python. Using Convolutional Neural Networks (CNN) model will get trained and user can upload images and then application will apply Convolutional Neural Networks (CNN) model on uploaded images to predict weed from crop here we used the yolo frame work to annotate the image and apply the boundary boxes our approach gives 97 % accurate results in detection of weed from the crop.

4.1 MODULES DESCRIPTION

This section presents the materials and methodologies used in the proposed weed detection method. the workflow diagram showing different stages between the initial stage of inputting RGB images and the final stage of detecting weed. The materials and experimental methods of different stages are presented in the following subsections.

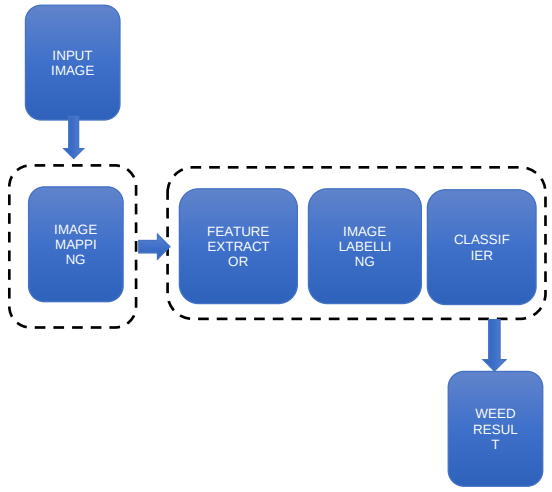

Figure 2. The workflow of our proposed approach.

4.2 METRICS

The models were tested and thoroughly evaluated using several metrics: accuracy, precision, recall and F1 score metrics, which are defined as follows:

Accuracy (Acc): it isthe percentage of images whose classes are predicted correctly among all the test images. A higher value represents a better result.

Precision (P): the fraction of correct prediction (True Positive) from the total number of relevant result (Sum of True Positives and False Positives).

Recall (R): the fraction of True Positive from the sum of True Positive and False Negative (number of incorrect predictions).

F1 Score (F1): the harmonic mean of precision and recall. This metric is useful to measure the performance of a model on a class-imbalanced dataset.

Confusion Matrix: it is used to measure the performance of machine learning models for classification problems. The confusion matrix tabulates the comparison of the actual target values with the values predicted by the trained model. It helps to visualize how well the classification model is performing and what prediction errors it is making.

5.CONCLUSION

In this project, it created a system for identifying invasive weeds in lettuce plants using pictures and videos. Modern objection detection models can detect weeds with high accuracy and high recall, according to tests conducted on a variety of models. We were able to identify some of the major flaws, such our inability to find tiny weeds. These findings allow us to draw the conclusion that real-time object detection algorithms are just as accurate at weed detection as their non-real-time counterparts. Next, we discovered that deep learning base models can forecast yield prediction more accurately. The model was able to predict yield of data with low variance and very early in their growing stage. However, the prediction from imagery struggled to predict high yield plants. In such case, these models have the potential of replacing classical methods.

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