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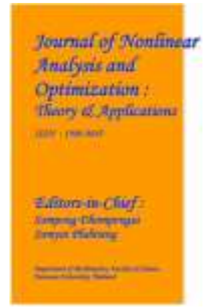

DEEP NEURAL NETWORKS FOR AUTOMATED WEED DETECTION IN CROP LANDS

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ABSTRACT— Weed management has a vital role in applications of agriculture domain. One of the key tasks is to identify the weeds after few days of plant germination which helps the farmers to perform early-stage weed management to reduce the contrary impacts on crop growth. Thus, we aim to classify the seedlings of crop and weed species. In this work, we propose a plant seedlings classification using the benchmark plant seedlings dataset. The dataset contains the images of 12 different species where three belongs to plant species and the other nine belongs to weed species.

Index Terms – Cotton Weed Control, Deep Learning, Precision Agriculture, Weed Dataset, Weed Detection.

I. INTRODUCTION

Precision farming is the revolution of traditional agriculture which focuses on crop production with controlled quality using evolving technologies. It focuses on the usage of drones, autonomous vehicles, robots and information technologies to achieve structured, sustainable, environment-friendly and cost-effective agriculture. Weed management is one of the key challenges of precision farming. Weeds are non-targeted plants that do not yield any profit to the farmers still compete for space and nutrients with the target crops which intern degrades the plant growth. Managing the weeds by human laborers is time-consuming and expensive. Even applying the herbicides uniformly across the farms will harm the unintended crops. Identifying and managing weeds based on their location and density helps to overcome the disadvantages of earlier approaches. Nowadays researchers have used the stateof-art algorithms of deep learning to implement many agricultural applications. Even we have used the deep CNNs to implement the plant seedlings classification. Many researchers have proposed frameworks for weeds and plant seedlings classification using a transfer learning approach and CNNs. Authors in have implemented maize and weed classification using LeNet, AlexNet, cNET and sNET architectures and used outperformed cNET for real-time implementation. Authors in have implemented a framework to classify weeds of Australian rangelands using pre-trained ResNet50 and InceptionV3 architectures and proposed a real-time robotic weed control system using outperformed pre-trained ResNet50. Authors in have proposed the Philippine Indigenous plant seedlings classification frameworks by fine-tuning pre-trained AlexNet, GoogleNet and ResNet50 architectures. ResNet50 performs better over the other two architectures. Authors in have implemented a carrot and weed classifier using the CNN. Authors in have introduced a robotic weed control system using two CNNs serially. Authors in have collected the benchmark plant seedlings dataset and made it publically available to ease the work of researchers. Authors in used the same dataset and designed a CNN to classify the plants and weeds. Authors in used the same dataset to propose plant seedlings classification frameworks using five different CNNs.

They compared the performance of convolutional neural networks using three different training approaches, namely training the architectures from scratch, training the pre-trained architecture with fixed feature extractor and fine-tuning the models during training.

Authors in used the same dataset and proposed framework to classify plant seedlings using transfer learning and compared the performance of ResNet50, VGG16, VGG19, Xception and MobileNetV2 architectures. Authors in used the same dataset to train the LeNet5, VGG16, DenseNet121 and ResNet50 architectures to classify the plant seedlings. The comparative study results that ResNet50 performed better over other models with the highest accuracy. Authors in used the same dataset and compared the performance of the CNN and VGG16. The VGG16 model performed better over CNN. Authors in used the same dataset to implement the crop and weed seedlings classification using transfer learning. Authors in have used the segmented plant seedlings dataset to classify the plant seedlings using VGG16 architecture. They have used three different training approaches, among them fine-tuning VGG16 model exhibits the highest accuracy which has trained using balanced dataset. In this project, we present a framework for plant seedlings classification using deep convolutional neural networks. The main contributions towards the proposed work are: Fine-tuning the pre-trained models, namely ResNet50V2, MobileNetV2 and EfficientNetB0 using a transfer learning approach. Comparing the performance of fine-tuned models using a test set to get the better performing architecture and comparing the proposed framework with existing methods to showcase the improvement in accuracy and F1-Score. Weed management is a critical aspect of modern agriculture, influencing crop productivity, resource utilization, and environmental sustainability. Traditional methods of weed control often rely on manual labor or indiscriminate herbicide application, leading to labor inefficiencies, increased costs, and ecological concerns. As a result, there is a growing need for automated and precise weed detection and classification systems to optimize weed control strategies and minimize agricultural impacts.

For classifying weeds using deep CNN architectures stem from the need for efficient, sustainable, and technology-driven solutions to address challenges in traditional weed management and enhance agricultural practices for the future.

II. LITERATURE SURVEY

A. Philippine Indigenous Plant Seedlings Classification Using Deep Learning

Plant taxonomists have specialized knowledge on a specific plant species. The shortage of these experts and their unbalanced distribution throughout the globe remains to be a serious problem worldwide. Deep learning technology can be used to create tools that will help them speed up the process of plant classification. This study implements three deep learning models to classify images of Philippine indigenous plant seedlings into five species. AlexNet, GoogLeNet, and ResNet50 were fine-tuned for this purpose. In the three pre-trained models, the weight and bias learning rate factors of the fully connected layers were both increased to 20 to speed up learning.

Augmentation techniques such as rotation, random flip, and random horizontally and vertically translations were performed to training images to avoid the effects of overfitting.

B. Crop Weed Identification System Based on Convolutional Neural Network

In the context of precision agriculture, the effective distinction between crops and weeds is the key to weeding. In recent years, various fields such as deep learning and machine vision have been combined with modern agriculture, and have achieved relatively good results. This paper introduces a weed identification system based on convolutional neural networks. Label the images in the dataset. Based on this, a convolutional neural network is used to identify crops and weeds in the image. Based on the datasets collected during the carrot seedling period, the convolutional neural networks with different structures were used to compare the recognition results and evaluate them. The system can also be applied to the classification and identification of other types of weeds and crops.

C. Crop and Weeds Classification for Precision Agriculture Using Context-Independent Pixel-Wise Segmentation

Precision agriculture is gaining increasing attention because of the possible reduction of agricultural inputs (e.g., fertilizers and pesticides) that can be obtained by using hightech equipment, including robots.

In this paper, we focus on an agricultural robotics system that addresses the weeding problem by means of selective spraying or mechanical removal of the detected weeds. In particular, we describe a deep learning based method to allow a robot to perform an accurate weed/crop classification using a sequence of two Convolutional Neural Networks (CNNs) applied to RGB images. The first network, based on an encoder-decoder segmentation architecture, performs a pixelwise, plant-type agnostic, segmentation between vegetation and soil that enables to extract a set of connected blobs representing plant instances. We show that such network can be trained also using external, ready to use pixel-wise labeled data sets coming from different contexts. Each plant is hence classified between crop and weeds by using the second network.

Quantitative experimental results, obtained on real world data, demonstrate that the proposed approach can achieve good classification results also on challenging images.

The new images in the dataset will help in training the network as well as increasing the efficiency of classifying the testing data or the new data.

III. PROPOSED SYSTEM

The overview of our proposed system is shown in the below figure.

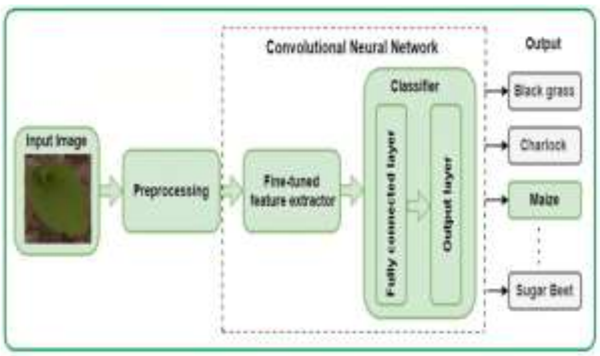

Fig. 1: System Overview

Implementation Modules

Load Dataset

- In this phase, load images .zip dataset into program and extract the images from .zip file.
- This data can be analyzed and extract the best features to preprocess the data.

Data Augmentation

- Data Augmentation is the process of increasing the size of the data set. There are ways in which the process is done by rotating, flipping, shearing, and adding random noise, along with other types.

Preprocessing

- In this module, we pre-process the image data and convert the image data into numpy array data. This step is very important to identify the feature of the image data.
- This extracted features are show as array data and size can be represented as (733, 128, 128, 3).

Train Model

- In this module, after spilt data as train and test data in the ratio of 80% and 20% respectively.
- The train data can be used for train the model and the test data can be used for test the model performance. In this project we applied CNN Model and to train the model we are using fit() method in python programming.

IV. RESULTS

Fig. 2: Upload

Fig. 3: classify Plant

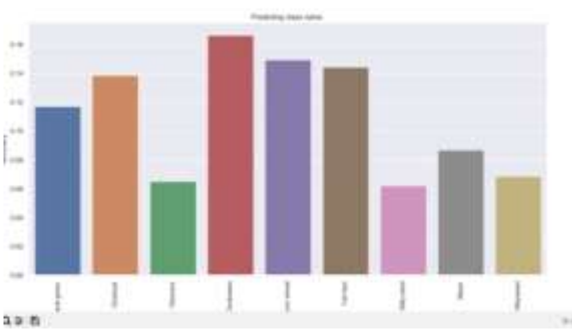

Fig. 4: Prediction Graph

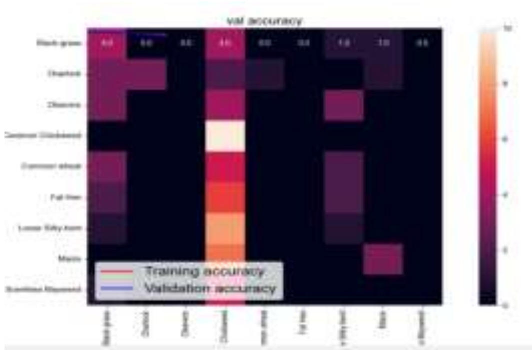

Fig. 5: Accuracy Graph

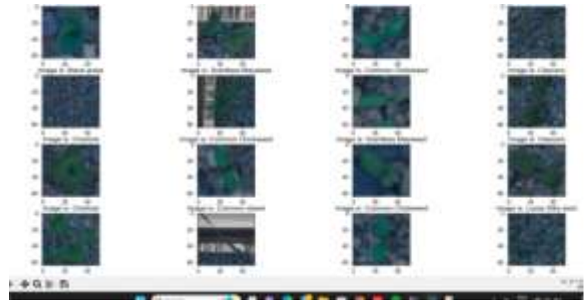

Fig. 6: Predicting Weed

V. CONCLUSION

We proposed a plant seedlings classification framework using MobileNetV2 and CNN architectures. The models are validated using the benchmark plant seedlings dataset, which contains 12 different species where three belongs to plant species and the other nine belongs to weed species. We compared the models and demonstrated that the our proposed model.

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