Weed Detection Using Convolutional Neural Network

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Abstract. Precision agriculture relies heavily on information technology, which also aids agronomists in their work. Weeds usually grow alongside crops, reducing the production of that crop. Weeds are controlled by herbicides. The pesticide may harm the crop as well if the type of weed isn’t identified. In order to control weeds on farms, it is required to identify & classify them. Convolutional Network or CNN, a deep learning-based computer vision technology, is used to evaluate images. A methodology is proposed to detect weed using convolutional neural networks. There were two primary phases in this proposed methodology. The first phase is image collection & labeling, in which the features for images to be labeled for the base images are extracted. In second phase to build the convolutional neural network model is constructed by 20 layers to detect the weed. CNN architecture has three layers namely convolutional layer, pooling layer & dense layer. The input image is given to convolutional layer to extract the features from the image. The features are given to pooling layer to compress the image to reduce the computational complexity. The dense layer is used for final classification. The performance of the proposed methodology is assessed using agricultural dataset images taken from Kaggle database.

Keywords: CNN, Weed, Precision Agriculture & Segmentation.

INTRODUCTION

Farmers’ main issue is detecting weeds from the crop during the irrigation process. Manual work for detecting the crop & weed takes a long time, & more human effort is required to complete this procedure. Weed identification in plants has become more challenging in recent years. So far, there hasn’t been much effort put into identifying weeds while growing crops. Traditional methods for identifying agricultural weeds focused on directly identifying the weed; nevertheless, there are substantial differences in weed species. In contrast to this method, this study proposes a revolutionary technique that combines deep learning with imaging technology. The dataset was first trained using the CNN model. We can categorize & predict the provided input image as weed or crop once the training is completed. The major goal of this project is to use the CNN deep learning algorithm to detect & classify weeds & crops.

As a result, we are building our project to detect weeds utilizing the CNN method to solve this challenge. Our findings will aid with crop & weed classification, saving humans time & effort. Manual labor may overlook proper classification on occasion, which is where our project will come in handy in finding the correct classification & projection.

LITERATURE SURVEY

Object oriented algorithms is proposed to detect the weed in the agricultural field [1]. The paper presents a thorough & critical examination of image-based plant segmentation approaches. The process of categorising a picture into plant & non-plant pixels is referred to as “segmentation” in this application [2]. Non-chemical weed control is essential for both organic vegetable production & environmentally sustainable weed management. In the event of weed–vegetable competition, estimates reveal that vegetable yields can be reduced by 45 percent to 95 percent. There are various reasons why non-chemical weed management in crops is sought [3]. The mixer is used to spray pesticides to alleviate weeds from crops [4]. Robot technology is used to find weed & pesticides is used to alleviate weeds [5]. A thorough assessment of studies on machine learning applications in agricultural production systems is offered. The works examined were divided into four categories: (a) crop management, which included
applications for yield prediction, disease detection, weed detection, crop quality, & species recognition; (b) livestock management, which included applications for animal welfare & livestock production; (c) water management; & (d) soil management [6]. Weed identification, recognition, & management have all benefited from ML & DL approaches. Kamilaris & Prenafeta-Boldu (2018) presented a study of 40 research publications in 2018 that used DL-techniques to address a variety of agricultural challenges, including weed identification. According to the study, DL-technologies outperformed standard image processing approaches [7]. Ten basic components & potential roadblocks to developing a completely autonomous mechanical weed control system were discussed [8]. The authors concentrated on several machine vision & image processing approaches used for ground-based weed detection [9]. Fernández-Quintanilla et al. (2018) assessed technologies for monitoring weeds in crops. In agricultural settings, they investigated several remotely sensed & ground-based weed monitoring methods. They stated that weed monitoring is critical for weed control. They anticipated that data acquired by various sensors would be stored in cloud systems for later use in appropriate situations [10]. The VGG-16 model is used to categorise agricultural plants & weeds. They also trained the algorithm on one dataset comprising sunflower crops & tested it on two separate datasets featuring carrot & sugar beet crops [11]. The author shows how they can identify & differentiate weed afflicted areas from crop plants using image processing in “Weed detection using image processing” [12]. A methodology is proposed to detect weed using image processing techniques. The properties are extracted from the image & weed is detected from the extracted features [13]. Machine vision uses unique image processing technique. Weeds in agricultural field had detected by its properties such as Size, Shape, Spectral Reflectance, Texture features [14]. two methods proposed for weed detection: crop row detection in images from agriculture fields with high weed difficulty & to further differentiate between weed & crop [15]. Author proposed “Crop & weed detection based on texture & size features & automatic spraying of herbicides” they developed the image processing algorithm for yield finding & management of weed [16]. A computer vision application to detect unwanted weed in early stage crops is proposed [17]. A Novel approach for weed classification using curvelet transform & tamura Texture feature (CTTTF) with RVM classification methodology is proposed [18]. Robots are working collaboratively with humans & learning from them how to realize the basic agriculture tasks such as weed detection, watering or seeding (Marinoudi et al., 2019) [19]. Weed detection using deep learning is proposed [20]. Implementation of image processing in drones instead of robots, that way, they not only detect weeds, but also monitor the growth of crops is proposed. By combining image processing & CNN in drones, they get different accuracies depending on the processing, which is from 98.8% with CNN to 85% using Histograms of Oriented Gradients (HOG) [21]. The authors combined Hough transform with simple linear iterative clustering (SLIC). This method focuses on the detection of crop lines [22]. A threshold based on the classification values of the area for a crop or a weed is proposed [23].

PROPOSED METHODOLOGY

The main objective of the proposed methodology is detect weed. The convolutional neural network is proposed for weed detection. The architecture of proposed methodology is shown in Fig. 1.

The convolution layer is used to extract the features from the image. The Rectified Linear Unit (ReLU) activation function is used in convolutional layer. The ReLU helps to break up the linearity even further, compensating for any linearity that may be imposed on an image during the convolution process. As a result, ReLU aids in avoiding the exponential growth of the computation required to run the neural network. As the size of the CNN rises, the computational cost of adding more ReLUs grows linearly. Another non-linear activation function that has gained prominence in the deep learning sector is the ReLU function. ReLU is an abbreviation for Rectified Linear Unit. The primary advantage of using the ReLU function over other activation functions is that it does not activate all of the neurons at the same time.

The feature maps’ dimensions are reduced by using pooling layers. As a result, the number of parameters...
to learn & the amount of processing in the network are both reduced. The pooling layer summarizes the features found in a specific region of the feature map created by the convolution layer. The pooling layer is a crucial layer that performs down-sampling on the feature maps from the previous layer, resulting in new feature maps with a reduced resolution. This layer significantly decreases the input’s spatial dimension. The input to the completely connected layer is the output from the final Pooling or Convolutional Layer, which is flattened & then fed into the fully connected layer. In neural network models that forecast a multinomial probability distribution, the Softmax function is used as the activation function in the output layer. Softmax is utilised as the activation function for multi-class classification issues that need class membership on more than two labels. CNNs are trained to recognize & extract the best features from images that are relevant to the problem at hand. Their biggest advantage is this. Because of their effectiveness as a classifier, the CNN’s last layers are fully connected. Because CNNs include FC layers, these two architectures aren’t competing as much as you might imagine. Finally, we’ll finish things up & give a quick overview of the section’s main concepts.

RESULTS & DISCUSSION

The agriculture image is taken from kaggle database. It consists of 1000 weeds & crops images. 80% of the images are used for training & 20% of the images are used for validation.

The Fig. 2 shows the performance of the proposed approach. The accuracy of the training set is improved when number of epochs increased. The validation set accuracy is very when number of epochs are less after that the accuracy is increase when number of epochs is increased.

CONCLUSION

Using the CNN model of deep learning, implemented a system that can classify weeds & crops. The features are extracted from the input images using convolutional layer. Pooling layer is used to downsizing the image. Finally, dense layer is used for classification. Further it can be extended in future that which can help in detecting weeds from the large crops or plants sizes & can be improved to make work with the more types of crops & weeds for the accurate classification & to reduce the human efforts. It will be easier to find any weed or crop with less human efforts.

REFERENCES


