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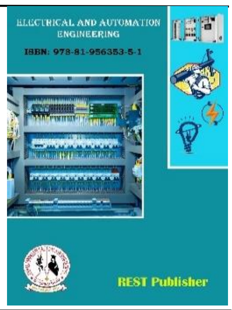

Weed Identification in Agricultural Fields Using Machine Learning Techniques

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Abstract. *Weeds compete with crops for water, nutrients, and sunshine, which is one of the most detrimental restraints on crop development. They also constitute a danger to agricultural output. The loss of worldwide productivity due to weeds and pests is likely to rise over the next few years. Using herbicide spray particularly in the field where the weeds are present is an efficient technique to manage the problem. For the weed control system to be properly deployed, weeds must be accurately and precisely detected. Traditional weed management techniques, however, take a long time and a lot of human resources, and they may have an adverse effect on the environment. To overcome this a model called Automatic weed management, a potential remedy that makes use of deep learning and machine learning approaches, has emerged to deal with these issues. This method increases agricultural productivity and reduces herbicides.*

1. INTRODUCTION

Agriculture is recognized as the backbone of the economy of emerging countries and has a substantial economic impact. Agriculture is the process of utilizing natural resources for both economic gain and human nourishment. In order to increase agricultural productivity and provide more effective ways of self-sufficiency, humans devised tools and techniques. Since they contain enough vitamins, minerals, and antioxidants, crops are recognized as one of the most nutrient-dense foods in the entire globe. The inability of Indian agriculture to utilize the proper quantity of pesticides to eradicate weeds is one of their issues. Weeds frequently cause farmers to worry that agricultural production may suffer. Wang claims that because weeds frequently utilize agricultural plants' nutrients in nearly comparable ratios, an average of 34% of productivity is lost. Moreover, they consume resources like water, sunlight, and space that could have been used for agriculture. The more closely a crop's needs resemble those of weeds, the more they will fight for the same resources. Because of the uneven distribution and overlap with other crops, weeds are much more challenging to notice. Crop yields are decreased by weeds that aggressively compete with them. If weeds gain an edge over the crop, crop yields will be most negatively impacted. Several machine vision approaches for weed detection have been the subject of much investigation. In light of this, a system is developed to identify weeds utilizing deep learning methods like Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) as well as machine learning methods like Random Forest (RF), K-Nearest Neighbor (KNN). We might utilize this method to identify weeds rather than applying poisons to the crops.

2. LITERATURE REVIEW

In the literature survey, studies of many authors are discussed.

Alberto Tellaeche, Gonzalo Pajares, Xavier P. Burgos-Artizzu, Angela Ribeiro proposed a method with title " A Computer Vision for weeds identification through Support Vector Machine". In this paper image segmentation and decision making are the two sub-processes that make up the entire weed detection procedure. The input image is divided into cells during image segmentation process and the characteristics and attributes are extracted that are usedin the decision-making process. The second step decides whether the to spray the cell or not.

Xiaojun Jin, Jun Che, Yong Chen had produced a concept close to ours in 2021 with a title "Weed IdentificationUsing Deep Leraning and Image Processing in Vegetable Plantation". The trained Center Net Model is used in this proposed system to identify vegetables, and any leftover green items that fall out of the boxes are classified as weeds.

Akhil venkataraju, Dharanidharan Arumugam, Calvin Stepan, Ravi Kiran, Thomas Peters in 2023 published a paper titled “Smart Agricultural Technology: A review of machine learning techniques for identifying weeds in corn”. In this paper they use two ML algorithms namely Convolutional Neural Networks (CNN) Support Vector Machine (SVM) and are implemented for identifying weeds in corn crop. The performance metrics used to evaluate the performance are Accuracy and F1 score.

In 2021 Srinivas Rao Madala, Vepa Venkata Raja Simha published a paper titled “An Advanced Weed detection using Deep Learning Techniques”. In this paper machine learning and image processing are used to detect the weeds in chilli field. The chilli farm provided the UAV photos, which were then pre-processed utilising image processing methods. The characteristics of weeds and the crop were then separated using the attributes that had beenretrieved from the photos. The algorithms used in the proposed method are SVM, RF, KNN.

3. IMPLEMENTATION

The implementation of the proposed method consists of 5 modules

i. Image Selection
ii. Image Pre-processing
iii. Image Splitting
iv. Classifiers
v. Performance metrics

Image selection:

- The dataset used in this proposed method is weed dataset and it is taken from dataset repository.
- The weed dataset is taken as input and it must be in the format of “.png” and “.jpg”.
- In this step we have to load the input image using imread () function.

Image pre-processing:

- In this step we need to resize the image and convert it into grayscale.
- To resize an image, use the resize () method on it supply a two-integer tuple parameter that represents the image’s new width and height.
- Instead of changing the existing image, that function creates a new image with the modified dimensions.
- And for grayscale conversion use the formula imggray = 0.2989 *r +0.5870 * g +0.1140 * b.

Image splitting:

- In this process we have to divide the dataset into training and testing data.
- And the splitting can be done in 3:1 ratio.
- The data used to develop a predictive model is training data and data used to evaluate the performance of the model is testing data.

Classifiers

Long Short-Term Memory, K-Nearest Neighbor, Convolutional Neural Network, and Random Forest are some of the machine learning and deep learning techniques employed in this model.

Random Forest

Random forest is the most popular machine learning algorithm belongs to supervised learning technology. It maybe used for ML problems requiring both regression and classification. It is based on the concept of ensemble learning,a technique for combining several classifiers to handle more critical problems and improve performance of the model.

K-Nearest Neighbour

One of the simplest machine learning algorithms in supervised learning method is K-Nearest Neighbour. It can beused for both classification and regression problems and mostly frequently used for classification issues. The K-NN approach, assuming that the new case/data and the old cases are comparable, places the new case in the category thatis most similar to the available categories. The K-NN method catalogues existing data based on similarity and preserves all accessible information. This indicates that new data can be reliably and quickly categorised using the using the K-NN approach. The flow chart describes in detail of KNN.

Convolutional Neural Network

Covnets is another name of Convolutional Neural Networks and these are the neural networks with shared parameters. CNN is highly helpful since it detects characteristics automatically by reducing the need for human intervention. A CNN is formed only when the convolutional layers, pooling layers, and fully-connected (FC) layers are stacked. In CNN there are two more important parameters namely dropout function and activation function. The first layer is the convolutional layer that is used to for feature extraction from the input images. The major objective of the pooling layer that comes after the convolutional layer is to reduce the size of the convolved feature map in order to reduce computational costs. The Fully Connected (FC) layer, which is positioned before the output layer and connects the neurons between the two, mostly consists of weights and biases.

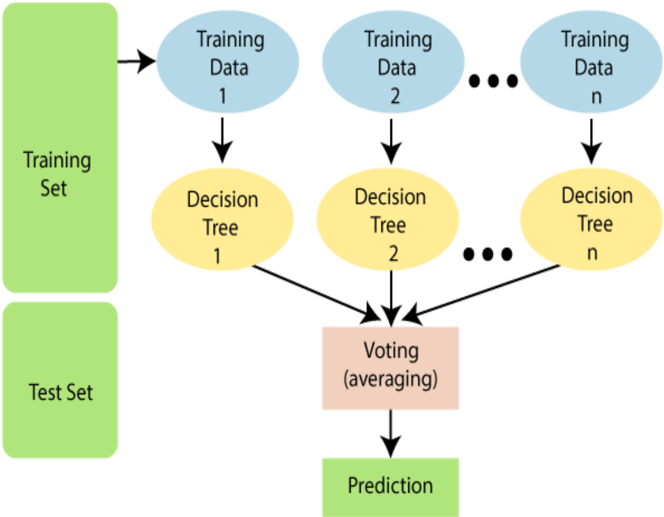


FIGURE 1. Random Forest

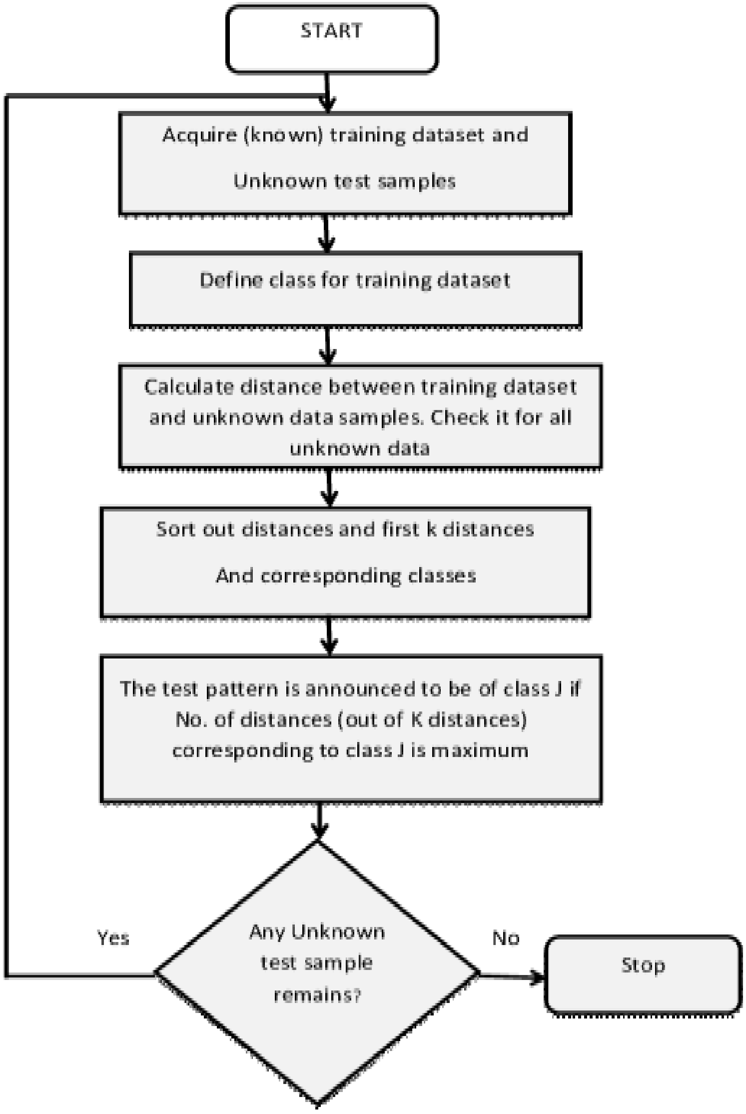


FIGURE 2. The flow chart describes in detail of KNN.

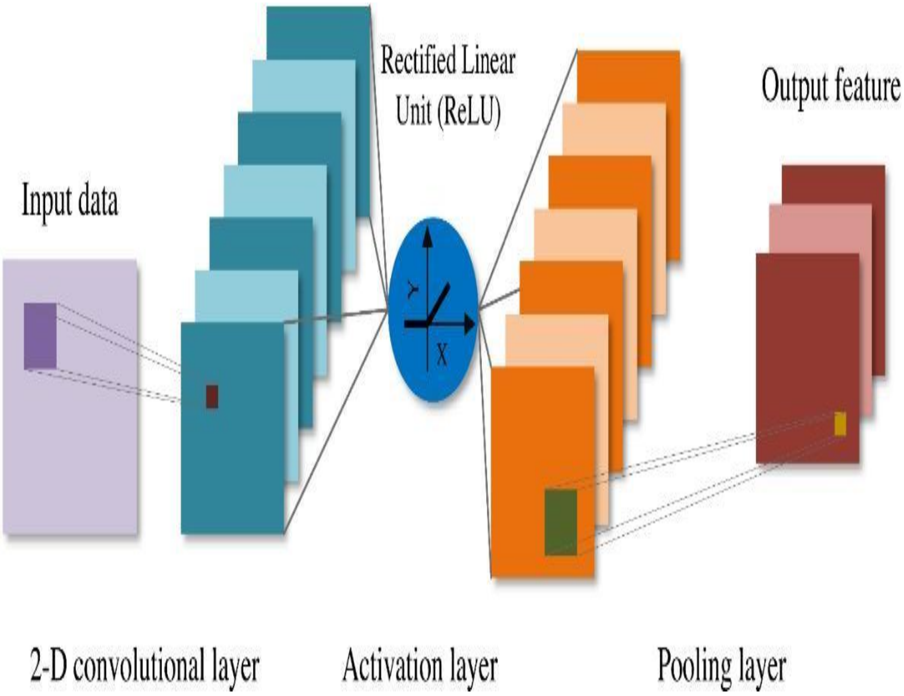


FIGURE 3. Convolutional Neural Network

Long Short-Term Memory

LSTM is a type of recurrent neural network architecture used for sequential data processing. Additionally, it is designed to get around the drawbacks of conventional RNNs and capture long-term dependencies in sequential data. In traditional RNNs, the gradient descent algorithm used for training the network can suffer from the "vanishing gradient problem," where the gradients become very small as they are backpropagated through time, leading to a lossof information over long sequences. LSTM networks use special memory units called "cells" to address this issue. The input gate, output gate, and forget gate are the three gating mechanisms that make up an LSTM in addition to thememory cell.

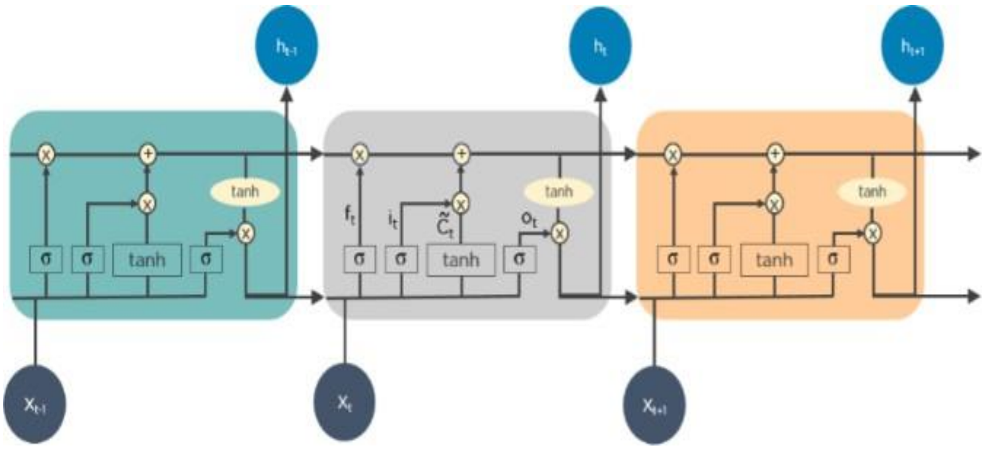


FIGURE 4. Long Short-Term Memory

Performance Metrics

i. Accuracy = TN+TP/TN+TP+FN+FP
ii. Precision = TP/TP+FP
iii. Recall = TP/TP+FN
iv. F1 score = 2* precision * recall/precision + recall

Where,

When the model accurately predicts a positive class, the result is called TP = True Positive.
When the model successfully predicts the negative class, the result is TN = True Negative.
When the model forecasts the positive class inaccurately, the result is FP = False Positive.
When the model predicts the negative class erroneously, the result is FN = False Negative.

4. FLOW CHART

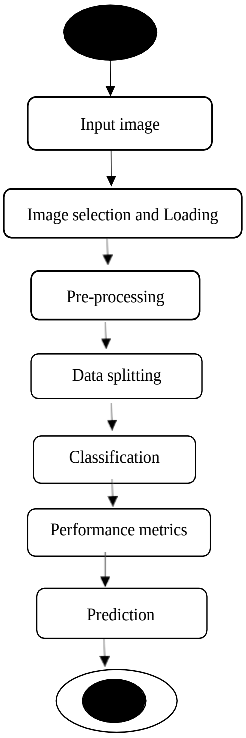
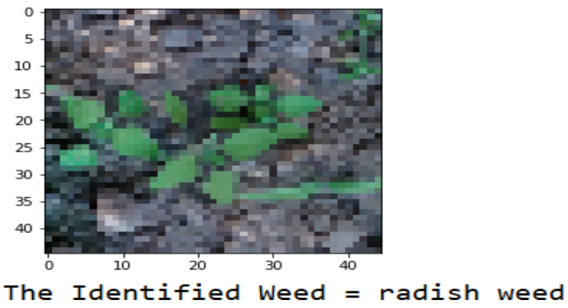


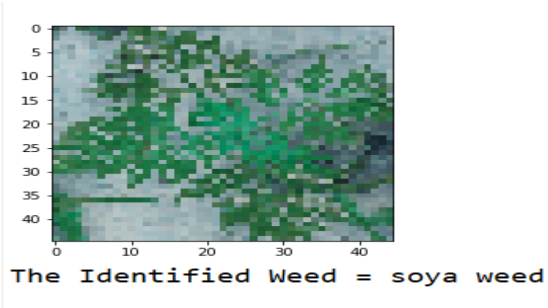
FIGURE 5. Flow chart

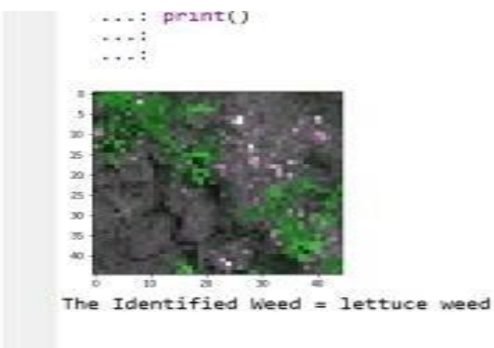
5. RESULTS AND DISCUSSIONS

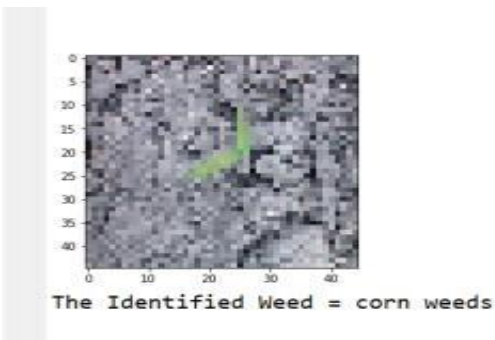
In this proposed method two datasets of size 750 and 1000 is taken and can be predicted using machine learningand deep learning algorithms.

prediction results









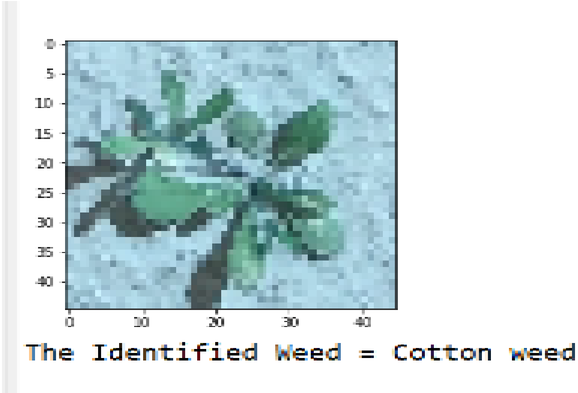


FIGURE 6. prediction results

Comparison of performance metrics of 750 and 1000 dataset

TABLE1. (750dataset)

	Random Forest	KNN	CNN	LSTM
Accuracy	82.73	87.68	86.84	92.10
Precision	98.27	100	92	90
Recall	83.82	86.92	83	88
F1 score	90.47	90.47	84	88

TABLE 2. (1000 dataset)

	Random Forest	KNN	CNN	LSTM
Accuracy	84.32	93.68	92.12	97.42
Precision	97.28	100	94	94
Recall	83.82	93.46	91	92
F1 score	96.62	90.47	92	93

Comparison graphs between the classifiers

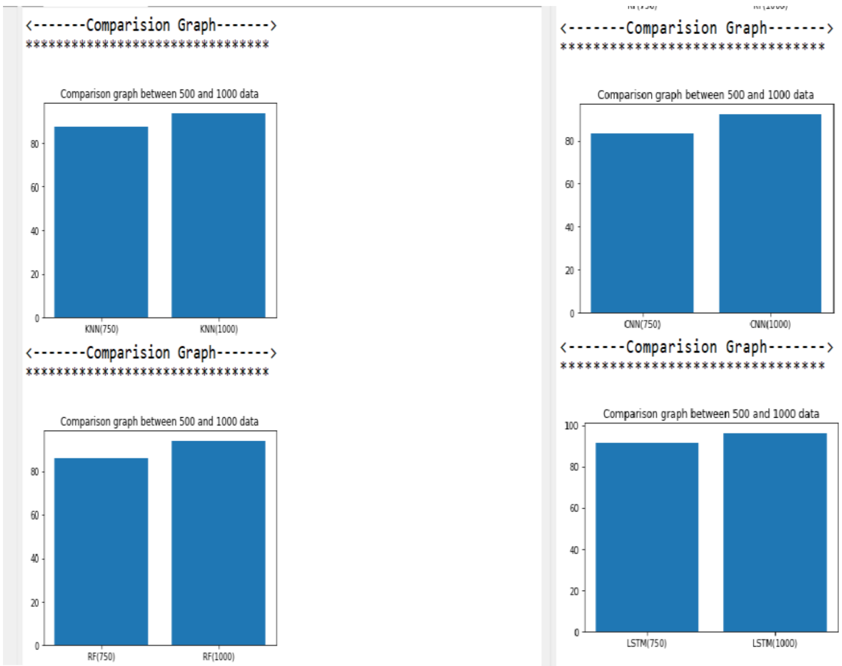


FIGURE 7. Comparison graphs between the classifiers

6. CONCLUSION

This model helps to detect the type of weed in the agricultural field using the techniques of machine learning anddeep learning. By using this model, we can find the type of weed and can be removed without using any herbicides atan early stage. And we can achieve a good accuracy for deep learning technique. And as a future scope we can deploythis system into a machine so that it will automatically detect the weed without human interaction.

REFERENCES

[1]. Akhil Venkataraju, Dharanidharan Arumugam, Calvin Stepan, Ravi Kiran, Thomas Peters, "Smart Agricultural Technology: A review of machine learning techniques for identifying weeds in corn",2022.
[2]. Srinivasa Rao Madala, Vepa Venkata Raja Simha," An Advanced weed Detection Using Deep Learning Techniques", vol. 8(6) pg: 1273-1280.
[3]. 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.
[4]. A. Wang, W. Zhang, and X. Wei, ''A review on weed detection using ground-based machine vision and image processing techniques,''Comput. Electron. Agricult., vol. 158, pp. 226–240, Mar. 2019.
[5]. K. Liakos, P. Busato, D. Moshou, S. Pearson, and D. Bochtis, ''Machine learning in agriculture: A review,'' Sensors, vol. 18, no. 8, p. 2674, Aug. 2018.
[6]. S. Shafique and S. Tehsin, ''Acute lymphoblastic leukemia detection and classification of its subtypes using pretrained deep convolutional neural networks,'' Technol. Cancer Res. Treatment, vol. 17, Sep. 2018, Art. no. 1533033818802789.
[7]. B. K. Das and H. S. Dutta, ''Infection level identification for leukemia detection using optimized support vector neural network,'' Imag. Sci. J., vol. 67, no. 8, pp. 417–433, Nov. 2019.
[8]. M. Fatma and J. Sharma, ''Identification and classification of acute leukemia using neural network,'' inProc. Int. Conf. Med. Imag., m-Health Emerg. Commun. Syst. (MedCom), Nov. 2014, pp. 142–145.

