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Weed Detection Using Machine Learning Techniques - A Review

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Abstract — Weeds are one of the biggest barriers to crop productivity in recent years. Many efforts are being made to enhance the quality of agricultural crops which is a challenging task for farmers. Weeds are also affecting the quality of the crops along with the productivity of the crops. Weeds are the reason for the lack of water in the crops, because they absorb the moisture of the land, due to which the crops do not get proper water. Weeds also create hindrance during harvesting of crops. When farmers harvest crops, often toxic weeds also get mixed, due to which farmers do not get fair price for their crops. To prevent weeds, farmers spray herbicides uniformly throughout the field without knowing what type of weed it is. Due to which there is a lot of damage to the crops. Spraying herbicides also affects the environment, so it is essential to have a thorough knowledge of weeds so that specific weeds can be controlled. The main objective of this paper is to improve the accuracy of weed detection using machine learning techniques.

Keywords—Weed detection, Machine Learning, Random Forest, Support Vector Machine.

I. INTRODUCTION

Weeds are one of the biggest constraints to crop productivity, competing with crops for useful elements such as water, nutrients and sunlight [1].Due to weeds, farmers do not get proper price for their crops. There are many factors which hinder the productivity of crops like pests, crop diseases, weeds etc. In this paper, we will discuss the issues related to weed. Weeds have always been a problem for farmers. In such a situation, in view of the increasing population of the whole world, there is a need to take proper steps to control weeds to increase the quality and productivity of crops.Since the traditional period, the control of weeds has been done in two ways - Mechanical and Chemical. Mechanical means where farmers do weeding in a wide area for which they need proper equipments and farmers also have to charge reasonable price for hiring the equipments. Apart from this, chemical is another method that is used. Farmers hire chemical agents for weeds, and without knowing about the weeds, sprinkle them on all the crops[2]. Due to which the environment is also polluted a lot [3].Apart from this, they also damage the crops.The main objective of this paper is to study the tools and techniques used by the researchers for identification and classification of weeds in their paper. Due to which they increased the production of crops by controlling weeds using technology. This paper is divided into various sections like section 2 contains related works which have details of all the papers in which different techniques have been used to control weeds. In section 3 the various techniques of classifying and controlling weeds are discussed. The methodology is described in section 4 and the conclusions are in section 5.

II. RELATED WORKS

In this section we have studied the work of researchers in which they have worked on various techniques to control weeds.

The author[4] collected images from private farms to detect and classify crops and weeds, for which RF

classifier was used and got 95% accuracy.[5] Focused on land cover mapping for which 9 perennial crops were targeted and SVM was used for the model.[6] In their research, they have described the capability of DCNN to identify the weeds present in the bell pepper field, for which they have identified the weeds in the bell pepper field using 4 deep learning models (Alexnet, GoogLeNet, InceptionV3 and Xception). [7][8] Image processing and machine learning have been used for weed detection on chilli crop. The UAV image is collected from Chilli field. RF, SVM and KNN are the three classifiers used in which RF has the best result.[8]have used SVM classifier with texture feature for crop and weed recognition in their research.The researcher[9] has worked on the weeds occurring in the corn field and whose image has been taken from the Belgian field. RF and KN models have been used to recognize weeds in the corn field. The researchers [10] collected soybean images from Sa Jose farm in Brazil and used SVM model for weed detection. [11] used SVM classifier to detect weeds in sugar beet with the help of shape feature. The images was taken by the researcher from Shiraz University in Iran. Photographs of 1600 weeds were taken from the fields of South China, from which weed species out of eight weeds were recognized with the help of [12]. [13] Suggested convolutional neural networks were used to detect weeds from wild blueberries in Canada. [14]Deep learning approach was used for crop and weed detection. DenseNet 169 and MobileNetV2 are the two models used for weed detection.in this research paper [15] VGG-16 model was used to classify weeds from paddy crop.

III. CLASSIFICATION OF WEEDS

It has been found in a research that there are about 30000 weed species in the whole world, if these weeds are classified by paying attention to their form, climate, soil, water etc. characteristics instead of species, then it will be easy to identify the weed. Weeds are divided into major parts which are as follows-

Weeds are divided into 12 parts which we will see in detail.

1. CLASSIFICATION OF WEEDS ACCORDING TO LIFE CYCLE

   Each weed has its own life cycle so weeds are divided on the basis of life.

A. Annual Weeds
Weeds complete their life cycle within one year. Annual Weeds classified into four parts-

a. Kharif Annual/ Kharif Weeds-
These weeds grow on the arrival of monsoon and their life cycle continues till the end of the rainy season, ie their period lasts from June-July to October-November.

b. Rabi Annuals/ Rabi Weeds
These weeds complete their life cycle till the winter season or from October - November to February.

c. Summer Annuals/ Summer Weeds
These weeds grow during the summer season between February and May.

d. Ephemerals
The duration of these weeds is very short, they complete their life cycle in 2 to 4 weeks.

B. Biennial Weeds
The duration of these weeds is two seasons or 2 years with the first year completing vegetative growth and the second year having seeds.

C. Perennial Weeds
These weeds just keep on growing for many years.

2. ACCORDING TO ROOT SYSTEM

   These weeds are classified on the basis of the depth of the root system.

a. Shallow Rooted Perennials
The depth of the root system of these weeds varies from 20 to 30 cm.

b. Deep Rooted Perennials

The depth of the root system of these weeds is up to about 1 meter.

3. ACCORDING TO MODE OF REPRODUCTION

a. Simple Perennials

Mostly these weeds are produced from seeds.

b. Bulbous Perennials

The origin of these weeds is from the underground parts like bulbs, rhizomes, tubers, seeds etc.

c. Creeping Perennials

These weeds spread either through above-ground stems, or through roots or seeds.

4. ACCORDING TO THE PLACE OF OCCURRENCE HABITAT

These weeds are classified on the basis of location.

5. ACCORDING TO NATURE OF STEM

a. Woody Weeds

These weeds are like stemmed shrubs which are woody, semi woody and rough semi woody which when collected together are called brush weeds.

b. Herbaceous Weeds

These weeds are commonly seen in agricultural land, their stem is green and succulent.

6. ACCORDING TO THE ORIGIN OF WEEDS

a. Allien Weeds

Many weeds are established from their original place by seed or by reaching some other place by any means, then such weeds are called foreign weeds.

b. Indigenous Weeds

Most of these weeds originate in India.

7. FACULTATIVE WEEDS OR APOPHYTES

These are those weeds which are called close communities, which are sometimes found in cultivated crops.

8. OBLIGATE WEEDS

These are the weeds that grow in the cultivated area.

9. NOXIOUS WEEDS

Many weeds are undesirable and difficult to control.

10. OBJECTIONABLE WEEDS

Some weeds are such that they produce seeds and if these seeds are mixed with the seeds of crops then it is difficult to separate them.

11. INDUSTRIAL WEEDS

Weeds that are seen growing on gates, buildings, railway lines, fence lines, electric and telephone poles etc. are called industrial weeds.

12. POISONOUS WEEDS

It is clear from the name that such weeds are poisonous.

WEEDS CONTROL METHODS

Weed control methods are basically divided into two groups.

A. PREVENTIVE MEASURES

In this, farmers prevent weeds from growing and spreading in the fields, it includes the following-

i) To use the seed after cleaning it for the fields.
ii) Clean the place where the seeds are to be sown.
iii) Clean and seed-free the drainage channels that deliver water to the fields.
iv) Clean the agricultural equipment thoroughly before using it in the fields.

B. CURATIVE MEASURES

Following measures are taken to remove weeds-

1. Mechanical Methods

i) Hand Pulling
ii) Hand Weeding
iii) Burning

2. Cropping And Competition Methods(Cultural)
The following measures are included-

i) Crop Rotation - The growth of weeds is less on the change of crops from season to season.
ii) Use of Fertilizers –By adding proper amount of fertilizers to the crops, the yield of the crops will increase.
iii) Date & rate of planting or sowing
By sowing the crops at the right time, the crops will be spread in the ground, due to which the growth of weeds will reduce due to lack of sunlight.

3. Biological Methods
Plants, micro-organisms and animals play a big role in destroying weeds. These animals are helpful in destroying the weeds growing in the fields, which make only the weeds their food and not the crop. These organisms are called bioagents.

4. Chemical Methods
Chemicals are used to prevent or destroy the growth of weeds, which are also true to some extent, but spraying any chemical on the weed without knowing it, there is a possibility of loss of crops and the environment is also polluted.

IV. PROPOSED METHODOLOGY

Machine learning techniques will be used to detect weeds. The most important thing that will help in weed detection is the weed related data which will be collected from different sources. After pre-processing the data, feature extraction techniques will be used to extract important features. Random Forest, Support Vector Machine and Hybrid approach will be used for weed detection which will give better results.

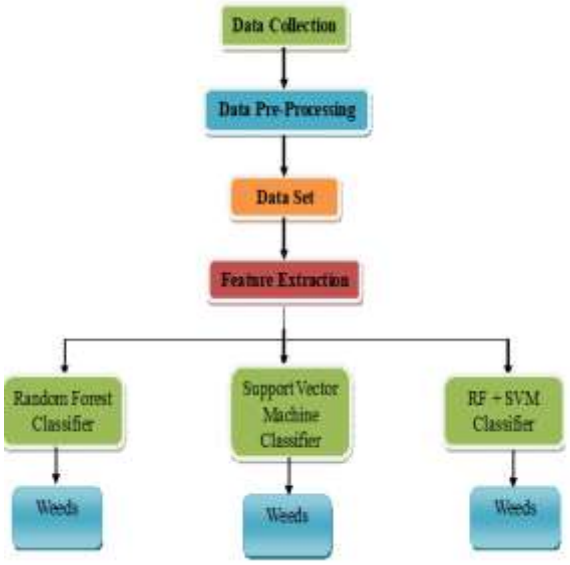

Figure 1. Work Flow of Machine Learning Models

V. CONCLUSION

All the papers discussed in this research have used different algorithms for weed detection. After reading the research it is concluded that using Random Forest, Support Vector Machine and Hybrid approach is expected to give better results.

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