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Controlling Agricultural Weeds Using Image Processing: A Review

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Abstract*: Farming plays nearly the greatest key roles in the economy of nations. This statistic has commanded to changed tactics toward dropping the costs and improving the quality of products in the agricultural industry. Every single year a huge quantity of herbicide is utilized for eliminating weeds from farming areas which are not only costly but moreover a cause of environmental pollution. Our core goal is to detect the weed in the harvest by means of image processing. Then we will provide the responses of the weed areas to the user. This outcome to herbicide consumption drops to even 100% when machine-driven or electrical devices are cast-off for weed elimination.*

1. Introduction

Farming plays nearly the greatest key roles in the economy of nations. This statistic has commanded to changed tactics toward dropping the costs and improving the quality of products in the agricultural industry. One of the extremely essential and also expensive work in this industry is controlling weeds. As weed can be defined as all vegetation which has grown up in an unsuitable place, weed monitoring can be extended from farmhouses to grasslands, golf grounds, and game grounds.

In past times, weed detection was done by engaging some men specifically for that determination. They used to will spot the weed by inspection each and every place of the ground. Then they will take them out by hand. Every single year a huge quantity of herbicide is utilized for eliminating weeds from farming areas which are not only costly but moreover a cause of environmental pollution. Hand workforce is also expensive and interval consuming. Therefore, several studies have been done to utilize computer vision and robotics to develop robotic cultivators for instantaneous weed detection and removal.

2. What is Weed?

A weed may be defined as any plant or vegetation that interferes with the objectives of farming or forestry, such as growing crops, grazing animals or cultivating forest plantations.

A weed may also be defined as any plant growing where it is not wanted. For example, a plant may be valuable or useful in a garden, or on a farm or plantation – but if the same plant is growing where it reduces the value of agricultural produce or spoils aesthetic or environmental values, then it is considered a weed. However, some plants are weeds regardless of where they grow.

There are numerous definitions of a weed, including:

- a plant out of place and not intentionally sown
- a plant growing where it is not wanted
- a plant whose virtues have not yet been discovered. (R.W.Emerson)
- plants that are competitive, persistent, pernicious, and interfere negatively with human activity (Ross, et. al.)

and many others

3. Characteristics of weeds

Certain characteristics are associated with and allow the survival of weeds. Weeds possess one or more of the following:

a) abundant seed production;
b) rapid population establishment;
c) seed dormancy;
d) long-term survival of buried seed;
e) adaptation for the spread;
f) presence of vegetative reproductive structures;
g) ability to occupy sites disturbed by human activities.

There are approximately 250,000 species of plants worldwide; of those, about 3% or 8000 species behave as weeds.

Weeds are troublesome in many ways. Primarily, they reduce crop yield by competing for water, light, soil nutrients, and space. Other problems associated with weeds in agriculture include:

h) Reduced crop quality by contaminating the commodity;
i) interference with harvest;
j) serve as hosts for crop diseases or provide shelter for insects to overwinter;
k) limit the choice of crop rotation sequences and cultural practices;
l) production of chemical substances which are toxic to crop plants (**allelopathy**), animals, or humans.

4. Weed Detection

A weed is a wild plant measured uninvited. They have no botanic cataloging value, meanwhile, a plant that is a wild plant in one situation is not a weed when rising where it is desired.

It's realistic to any vegetable that raises or replicates aggressively or is outside its native habitat. The term is irregularly used to generally define classes outer the plant empire that can be alive in diverse environments and reproduce quickly. These have seeds that remain in the soil seed group for several years. They contest with the preferred plants for the assets that a plant naturally wants, viz., direct daylight, soil nutrients, rainwater, and space for growth. Weed ordering is a severe subject in the agronomic study. Weed cataloging is a need in recognizing weed classes for the regulator.

There are two types of weed-centered on the rate of the edges existing in them.

They are:

A. Weed with slim leaves.

Fig.1: *Weed with slim leaves*

B. Weed with wide leaves.

Fig.1.2: *Weed with wide leaves*

5. Literature Survey: Use of Image Processing in Agriculture

In last few years, various researchers have been attracted towards image processing and its implementation in real life application such as automation industry and agricultural field**.**

Hossein Nejati et al. [1] proposed an algorithm where three features are used: Color, frequency of edges, and density of edges. Color differences are used for background removal and edge frequency and density is used for plant classification. The color segmentation is a fast and accurate method for removing the background, preparing the captured image for further processing. The two later features are capable of being used in this classification problem due to special and different orientations of leaf veins in crops and weeds.

Grianggai Samseemoung et al. [2] developed crop growth and weed infestation in monitored by processing Low Altitude Remote Sensing (LARS) images taken from crane-mounted and unmanned radio operated helicopter-mounted platforms. Images were taken for comparison between true color (R-G-B) and color-infrared (NIR) digital cameras acquired at different heights above ground. All LARS images were processed to estimate vegetation indices for distinguishing stages of crop growth and estimating weed density.

Xavier P. Burgos-Artizzu et al. [3] presented a computer vision system that successfully discriminates between weed patches and crop rows under uncontrolled lighting in real-time. The system consists of two independent sub-systems, a fast image processing delivering results in real-time (Fast Image Processing, FIP), and a slower and more accurate processing (Robust Crop Row Detection, RCRD). The system successfully detects an average of 95% of weeds and 80% of crops under different illumination, humidity.

G. Jones et al. [4] proposed a new method for weed detection based on modeling agronomic images taken from a virtual camera placed in a virtual field is proposed. The aim was to measure and compare the effectiveness of the developed algorithms. Two sets of images with and without perspective effects were simulated. For images with no perspective, based on Gabor filtering and on the Hough transform, the performance of two crop/inter-row weed discrimination algorithms were tested and compared.

Anup Vibhute et al. [5] introduced real-time weed recognition system for identifying outdoor plant using machine vision uses edge based classifier to identify broad and narrow weeds. Images acquired in RGB were converted to gray scales and used to process as a binary image. Bright pixels in the dark background were identified as weed and classified as

in broad and narrow using threshold values. The limitation that proposed model does not classify mixed weeds.

6. Conclusion

Image processing technique has been proved as effective machine vision system for agriculture domain. Imaging techniques with different spectrum such as Infrared, hyper spectral imaging, X-ray were useful in determining the vegetation indices, canopy measurement, irrigated land mapping etc with greater accuracies. Weed classification which affects the yield can be correctly classified with the image processing algorithms. The accuracy of classification varies from 85%- 96% depending on the algorithms and limitations of image acquisition. Thus with such great accurate classification farmers can apply herbicides in correct form. This approach helps to save the environment as well as the cost. In case of fruit grading systems the segmentation and classification can also be achieved with great accuracy as the case with weed detection. In this case also the classification accuracy can be obtained up to 96% with correct imaging techniques and algorithms.

Thus we can conclude that image processing was the noninvasive and effective tool that can be applied for the agriculture domain with great accuracy for analysis of agronomic parameters

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