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Weed Detection in Agriculture Using Image Processing

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ABSTRACT: Nowadays everything has changed modern. But our basic needs has not changed and its demand is increased by the increase in population. The need for food has increased by every decades. Agriculture is the backbone of our country and our country is famous for all spices. But now our agricultural lands are devastated by modernization and in the remaining agricultural land, more use of herbicides make them poisonous. In the early days all foods are organic and those people were healthy. But now due to this, all food materials are full of chemicals and the life span of the people has been decreasing by generation. Our day to day life of earning is to satisfy the need of food. Now people are searching for organic food by the increase in awareness. The food now they eat is full of chemicals. The main aim of using herbicide is to kill the weeds in the agricultural land. But the drawback is that the herbicide is sprayed is all through the land. So the land also gets spoiled and the food also gets spoiled.

KEYWORDS: Weeds, MATLAB, Arduino, LCD, Pump

I. METHODOLOGY

To reduce this, in our project the idea is proposed to spray herbicide on the weeds to kill them by reduction in spraying of herbicide over the plant. Here the weeds are detected by the MATLAB coding. MATLAB is a high-performance language for technical computing. Identification of weeds is done in MATLAB and spraying of herbicide is done in arduino.

II. BLOCK DIAGRAM

Here weed detection is done using MATLAB simulation and the corresponding result is given to the arduino uno which is connected with the LCD and pump.
The complete block diagram of weed detection is shown in figure 1.1

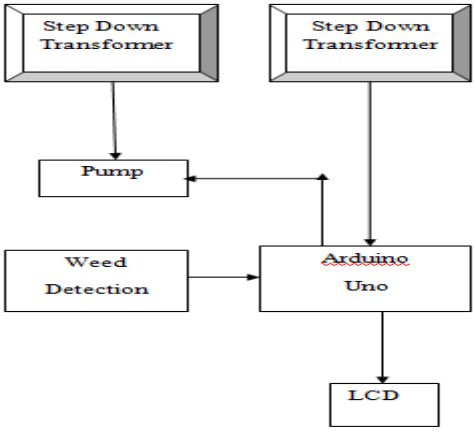

Figure 1.1 Block Diagram of Weed Detection

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III. WEED DETECTION (MATLAB SIMULATION)

4.1 Image Processing

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

4.2 Image Acquisition

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, Here the image is acquired from the camera.

4.3 Colour Channel Separation

The RGB image is separated into individual red, green and blue images. This separation is done to take only the green component of the leaf. The image is converted only to red, green and blue images

4.4 Thresholding

Thresholding is a simple and effective technique used to partition the image into background and foreground. Here “graythresh” is used to convert the green image into global image threshold by using Otsu’s method.

The flowchart for weed detection is shown in figure 1.2

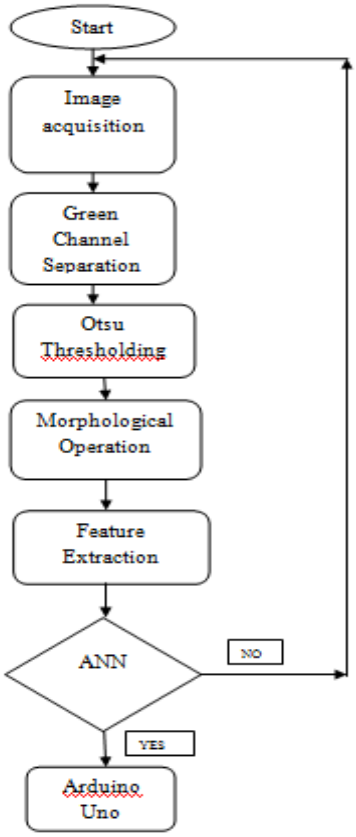

Figure 1.2 Flow Chart for Weed Detection

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4.5 Otsu Thresholding

Otsu's method performs clustering-based image thresholding or the reduction of a gray level image to a binary image.

The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread (intra-class variance) is minimal, or equivalently (because the sum of pairwise squared distances is constant), so that their inter-class variance is maximal. The extension of the original method to multi-level thresholding is referred to as the multi Otsu method.

Algorithm

Step1:Find the threshold that minimizes the weighted within –class variance.

Step 2: This turns out to be the same as maximizing the between –class variance .

Step3:operates directly on the gray level histogram

The weighted within class variance is:

$\sigma_w^2(t)=q1(t)\sigma_1^2(t)+q2(t)\sigma_1^2(t)$

Where the class probabilities are estimated as:

$q1(t)=\sum_{i=1}^{t} p(i)$ $q2(t)=\sum_{i=i+1}^{i} p(i)$

And the class means are given by:

$$\mu 1(t) = \sum_{i=1}^{t} \frac{ip(i)}{q1(t)}$$

$$\mu 2(t) = \sum_{i=t+1}^{i} \frac{ip(i)}{q2(t)}$$

Finally,the individual class variances are:

$\sigma_1^2(t)=\sum_{i=1}^{t}[i-\mu 1(t)]\frac{p(i)}{q1(t)}$

$\sigma_2^2(t)=\sum_{i=t+1}^{i}[i-\mu 2(t)]\frac{p(i)}{q2(t)}$

After some algebra,we can express the total variance as

$\sigma^2=\sigma_w^2(t)+q1(t)[1-q1(t)][\mu 1(t)-\mu 2(t)]$

4.6 Morphological Operation

Morphology is a broad set of image processing operations that process images based on shapes. In morphological operation, erosion and dilation is done. Dilation means growing image regions. Dilation is done with the help of imdilate function. Erosion means shrink image regions. Erosion is done using imerode function.

4.6.1 Dilation

- Dilation is used for expanding an element A by using structuring element B
- Dilation of A by B and is defined by the following equation:

$$A \oplus B=\{Z|[(\hat{B})z \cap A \neq \emptyset\}$$

- This equation is based on obtaining the reflection of B about its origin and shifting this reflection by z.
- The dilation of A by B is the set of all displacement z, such that $\hat{\beta}$ and A overlap by at least one element. Based On this interpretation the above equation can be rewritten as:

$$A \oplus B= \{Z|[(\hat{B})z \cap A] \in A\}$$

4.6.2 Erosion

- Erosion is used for shrinking of element A by using element B
- Erosion for Sets A and B in Z^2, is defined by the following equation:

$$A \ominus B= \{Z|[(B)z \in A\}$$

- This equation indicates that the erosion of A by B is the set of all points z such that B, translated by z, is combined in A.

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4.7 Feature Extraction

Here the features such as vein feature,shape feature,colour feature and texture feature are extracted in the form of string values.

4.8 Artificial Neural Network

ANNs are considered nonlinear statistical data modeling tools where the complex relationships between inputs and outputs are modeled or patterns are found.ANN is also known as a neural network. An ANN has several advantages but one of the most recognized of these is the fact that it can actually learn from observing data sets. In this way, ANN is used as a random function approximation tool. These types of tools help estimate the most cost-effective and ideal methods for arriving at solutions while defining computing functions or distributions. ANN takes data samples rather than entire data sets to arrive at solutions, which saves both time and money. ANNs are considered fairly simple mathematical models to enhance existing data analysis technologies.

4.9 Resulting Images of MATLAB

Here, the resulting images of MATLAB are shown.Initially the input image is taken and is subjected to thresholding where it gets converted to binary image.Then the Otsu thtresholding is done for 4 values.Then the image is subjected to erosion and dilation.Then the excess green image is detected and the integer values are extracted for the features.Then by ANN, the result is displayed based on the detection of weeds.

Figure 1.3 Input Image

Figure 1.4 Thresholding

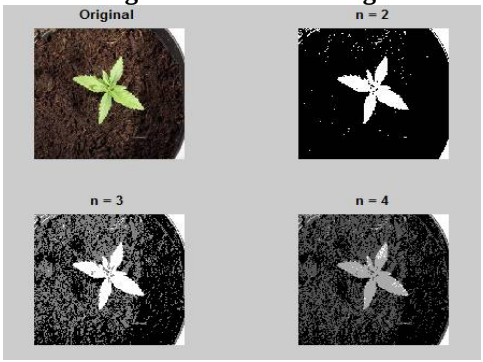

Figure 1.5 Otsu Thresholding

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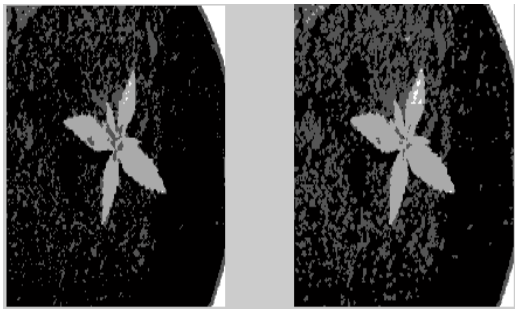

Figure 1.6 Eroded And Dilated Image

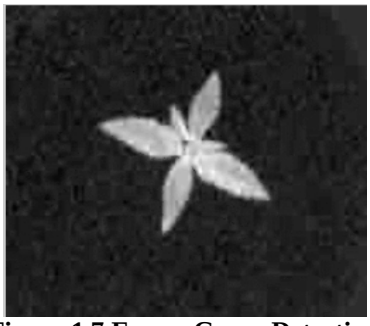

Figure 1.7 Excess Green Detection

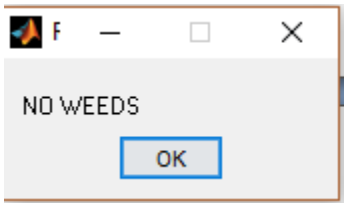

Figure 1.8 Result

V. HARDWARE DESCRIPTION

5.1 Power Supply

Power supply components employed in this section includes

- Transformer
- Rectifier
- Voltage Regulator
- Filter Circuit

Transformer

Transformer is used in step down mode of operation in the sense it provides an output, which is reduced in form compared to input. It depends upon number of turns in the winding i.e., turns ratio. Primary winding is fed with a supply of 230v, 50Hz AC, which appears as an voltage approximately 15v across secondary winding. This voltage is fed into the rectifier circuit for the purpose of rectification i.e., converting a.c. input to D.C. output.

Bridge Rectifier

When four diodes are connected the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

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Voltage Regulator

Voltage regulator is a device, which provides a stable and a constant D.C. voltage irrespective of the change in the load current. Stable and constant D.C, output voltage necessities the usage of voltage regulator in this power section.

Filter Circuit

The output of the voltage regulator is given to this filter unit. Filters are frequency selective electronic circuitry, which allows certain specified band of frequency and attenuate frequencies other than the specified frequencies. Here capacitor is used to short the ripple with frequency of 120 Hz to ground. It is also called bypassing capacitor or decoupling capacitor, which acts as surge arrestors.

5.2 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

5.3 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. Here, LCD module is connected with the arduino kit. If the weeds are detected, the LCD will display the condition as weeds detected. If the weeds are not detected, it will show weeds are not detected.

5.4 Pump

Centrifugal pump is a rotodynamic pump that uses a rotating impeller to increase the velocity of a fluid. Centrifugal pumps are commonly used to move liquids through a piping system. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber, from where it exits into the downstream piping system. Centrifugal pumps are used for large discharge through smaller heads

VI. CONCLUSION

This helps in removing the weeds faster the man power. Also it helps in increasing the productivity of agriculture. If weeds are detected herbicides can be sprayed on it without affecting the plants. It helps in increasing the productivity for the current demand.By this the use of herbicide can also be reduced.

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