

Detection of Weed between Crops in Agricultural Field using Image Processing

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Abstract: Agriculture is the important factor and is backbone for the entire world. Weed control in an agriculture has become a highly specialized activity. Many of the weeds are the hosts of insect pests, and a number are invasive species. In earlier days, weed detection was done by employing some men in field, particularly for that intention only, then weeds were manually removed. The Herbicides were used and by spraying them in the entire field the removal of weeds was done. They cause adverse impacts to the crops and to the environment as the land becomes infertile and thereby reducing in the production of the crops. In an agriculture, the weed control is very essential for maintaining high levels of production of crops. There are many more reasons for controlling weeds and becomes more complex with the increasing development of technology. This project deals with the weed detection technique which uses image processing and CNN algorithm using Keras model technique. By this process we can detect weed so that we can spray herbicides only on the weed rather than spraying in the entire field or we can directly pick it from there place of existence.

Key Words: Agriculture, CNN, Crop, Image Processing, Weed Detection, Raspberry Pi.

I. Introduction

Earlier weed detection was done by employing some men, only for that intention. In olden days, weed detection was done by doing inspection of each and every place in the field. Then weeds were manually removed. Later with the improving technology, people started using herbicides to take out the weeds. But to identify the weed still physical power is used in many parts of the world.

Image processing is the process of performing mathematical operations and functions on an image, images or video. In image processing, the input is of lower quality image, and the output is an image with improved quality. The output that we get after image processing contains set of parameters or some altered image, images or videos. Common image processing includes image enhancement, encoding, and compression.

II. System Design and Hardware

The Raspberry Pi 3 Model B+ board is a central

module used for whole embedded image capturing and processing system, as shown in fig1. Its main parts include: main processing chip, power supply, memory, HDMI Out, Ethernet and USB ports.

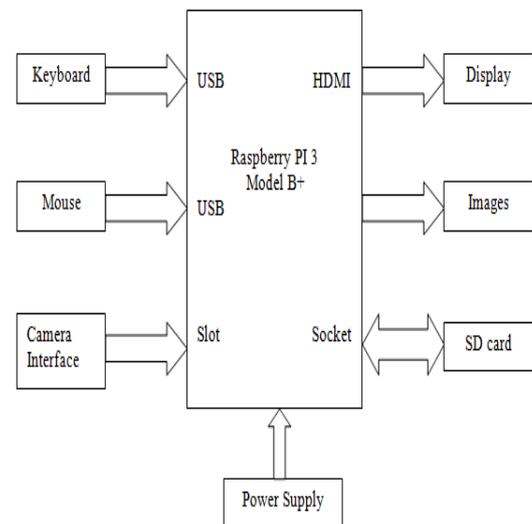


Fig.1 System Block Diagram

A. Raspberry Pi 3 Model B+:



Fig.2 Raspberry Pi 3 Model B+

It is a tiny computer board which comes with CPU, GPU, I/O pins, USB ports, WiFi, Bluetooth, USB and network boot and is capable of doing some functions like a regular computer. It comes with a capacity of 64 bit and with a clock speed of 1.4 GHz Broadcom BCM2837B0 that contains quad-core ARM Cortex-A53 and RAM memory is around 1GB. Pi can run a full range

of ARM GNU/Linux distributions, including Raspbian, and Arch Linux, as well as Microsoft Windows 10 IoT Core.

B. Raspberry Pi Camera Module:



Fig.3 Raspberry Pi Camera Module

The Pi Camera Board plugs directly into the CSI connector on the Raspberry Pi and able to deliver crystal clear 5MP resolution image and 1080p HD video recording at 30fps. The module attaches to Pi module, using 15 Pin Ribbon Cable, to the dedicated 15-pin MIPI Camera Serial Interface. The CSI bus is capable of extremely high data rate, and it carries pixel data to the BCM2835 processor.

III. Flow Chart

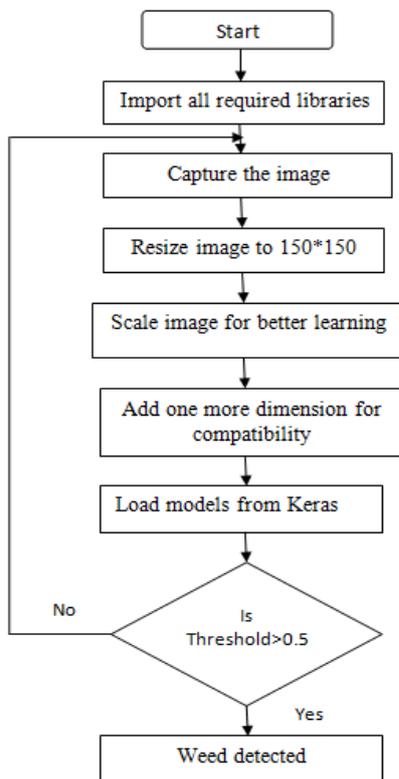


Fig.4 Flow Chart

The above Fig.4 shows the flow chart for the proposed system. This shows that, first we are importing all the required files. Then we are capturing image with the help of Pi Camera module. After that the image is scaled properly. Then one more dimension is added for better compatibility with the Keras model. And finally we get the values that lies in between 0 to 1. If the threshold value detected is more than 0.5 then it is detected as weed and crop otherwise.

IV. Algorithm & Results

- **Convolutional Neural Network(CNN):**

The convolutional neural network is the class for deep learning of neural network. CNN represent a huge breakthrough in image recognition. They're most commonly used for analyzing visual imagery and are frequently working behind the scenes in an image classification. In short CNN is a machine learning algorithm that can take in an input image and assign importance i.e. learnable weights and biases to various objects in an image so that it will be able to differentiate one from the other. CNN has:

1. **Convolution:**

Convolutional layers apply a convolution operation for the input and the information on to the next layer. Main purpose of the convolutional step is to extract the features from the input image. It is having an input image, a feature detector, and a feature map. It uses the filter and apply it pixel block by pixel block to the input image. It is done through the multiplication of the matrices.

2. **ReLU:**

The ReLU (rectified linear unit) layer is one more step to convolution layer. It is a process of applying an activation function to increase the non-linearity of the network without affecting the receptive fields of a convolution layer. It allows faster training of the data. It handles the problem of vanishing gradient. An activation function is applied onto feature maps to increase non-linearity in the network. This is because images themselves are highly non-linear. By setting zero it removes negative values from an activation map.

3. **Pooling:**

Pooling is done by combining the outputs of clusters of neurons into a single neuron present in the next layer. It progressively reduces the size of the input representation. This makes possible to detect objects in an image wherever they're located.

This layer applies a non-linear down sampling on the convolved feature often referred to as an activation

map. This reduces the computational complexity required to process the huge volume of data which is linked to an image. Pooling is not compulsory and it can be often avoided. There are three types of pooling: Max pooling, Average Pooling, Min Pooling. In this we have used Max Pooling which returns the maximum value from the portion of the image covered by the Pooling Kernel.

4. Flattening:

After the pooling is done the output needs to be converted in to a tabular structure so that can be used by neural network to perform the further classification. Also often a drop out layer is added to prevent over fitting of the algorithm. The Dropout layer randomly sets input units to 0 with a frequency of rate at each step during training time, which helps prevent over fitting. Inputs are not set to 0 and are scaled up by $1/(1 - \text{rate})$ such that the sum of over all inputs is unchanged.

5. Fully connected layer:

Fully connected layer connects each neuron in previous layer to each neuron present in the next layer. In this step, an artificial neural network is added to the convolution neural network. Main purpose of this is to combine our features into more attributes. These will predict the classes with greater accuracy. In this step the error is calculated and back propagated.

- **Keras:**

Keras is an open-source software library that provides a python interface for artificial neural network. For the TensorFlow Library it acts as an interface. Keras is having number of implementations, that are used for neural-network building blocks such as layers, activation functions, optimizers, objectives, and a host of tools to make working with image and text data easier for simplifying the coding and necessary for writing deep neural network code. Along with the standard neural networks, Keras has support for recurrent and convolutional neural network. It supports other common utilities layers like batch normalization, pooling, and dropout.

Images shown below are the results of proposed system. Fig.4 shown is having weed and detects the same and displays message with input image. And Fig.5 shown is not having weed and detects the same and displays message with input image.

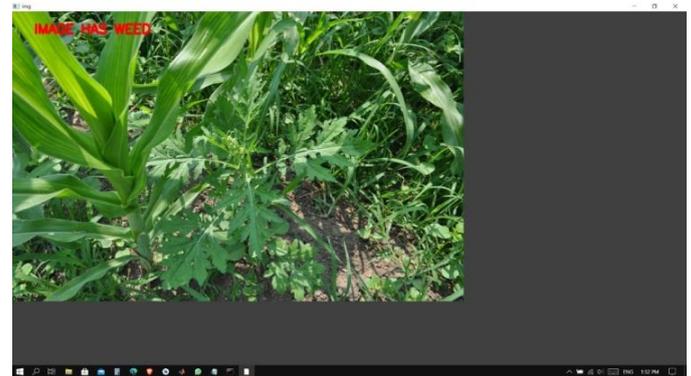


Fig.5 Weed Detected Image

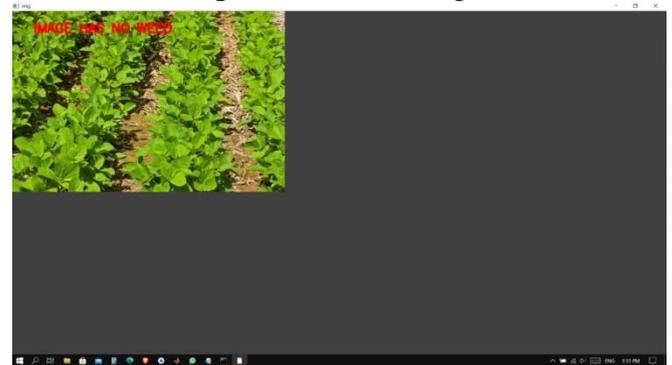


Fig.6 No Weed Detected Image

V. Conclusion

With the help of this system, we will develop a method by which we can detect weed using Image processing by using Convolution Neural Network. Due to the use of our system, we can detect and separate out weed affected area from the crop plants so that further weed control operations can be taken.

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