Weed Detection using MATLAB

Stage-II Progress Report

Submitted in partial fulfilment of the requirement of the degree of Bachelor of Engineering

Semester-VIII (Revised)

By

Name of students	Roll no.
1) Parag Ingale	19
2) Anirudha Bramhe	07
3) Amaresh Godbole	16

UNDER THE GUIDANCE OF

Prof. J.M.HATWAR

Department of Electronics and Telecommunications engineering

Konkan Gyanpeeth College of Engineering

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CERTIFICATE

(2017-18)

This to certify that the project entitled **"Weed Detection Using Matlab"** is a bonafide work of **"Parag Ingale, Anirudha Bramhe, Amaresh Godbole"** submitted to the University of Mumbai partial fulfilment of the requirement for the award of the degree of **"Bachelor of Engineering in Electronics and Telecommunications Engineering".**

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DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas and words have been included, I have adequately cited and referenced the original sources, I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea in my submission. I understand any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date: 23/4/18

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Name of Student	**Signature**
1)Parag Ingale (19)	
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ABSTRACT

Agriculture is backbone of human sustenance on this world. Nowadays with growing population need the productivity of agriculture to be increased. In olden days people used natural methods such has cow dung and fertilizers to increase productivity. That resulted in increase in productivity enough to meet requirements of people. But later people started thinking of methods to earn more and more profits. So, there came a revolution called 'Green Revolution'. We have developed method for weed detection in matlab using image segmentation and edge detection. In this project we will acquire images of crops with the help of camera and then process these images with the help of matlab to detect weed. Then the next step is to use sprinkler to spray pesticides on the weed and pest areas using arduino hardware mechanism.

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CHAPTER 1

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1. INTRODUCTION

1.1. History

Since before 2000 BCE, humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulfur dusting used in ancient Sumer about 4,500 years ago in ancient Mesopotamia. The Rigveda, which is about 4,000 years old, mentions the use of poisonous plants for pest control. By the 15th century, toxic chemicals such as arsenic, mercury, and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum, which is derived from chrysanthemums, and rotenone, which is derived from the roots of tropical vegetables. Until the 1950s, arsenic-based pesticides were dominant.Paul Müller discovered that DDT was a very effective insecticide. Organochlorines such as DDT were dominant, but they were replaced in the U.S. by organophosphates and carbamates by 1975. Since then, pyrethrin compounds have become the dominant insecticide. Herbicides became common in the 1960s, led by "triazine and other nitrogen-based compounds, carboxylic acids such as 2,4-dichlorophenoxyacetic acid, and glyphosate" The first legislation providing federal authority for regulating pesticides was enacted in 1910; however, decades later during the 1940s manufacturers began to produce large amounts of synthetic pesticides and their use became widespread. Some sources consider the 1940s and 1950s to have been the start of the "pesticide era. Although the U.S. Environmental Protection Agency was established in 1970 and amendments to the pesticide law in 1972, pesticide use has increased 50-fold since 1950 and 2.3 million tonnes (2.5 million short tons) of industrial pesticides are now used each year. Seventy-five percent of all pesticides in the world are used in developed countries, but use in developing countries is increasing. A study of USA pesticide use trends through 1997 was published in 2003 by the National Science Foundation's Centre for Integrated Pest Management. In the 1960s, it was discovered that DDT was preventing many fish-eating birds from reproducing, which was a serious threat to biodiversity. Rachel Carson wrote the best-selling book *Silent Spring* about biological magnification. The agricultural use of DDT is now banned under the Stockholm Convention on Persistent Organic Pollutants, but it is still used in some developing nations to prevent malaria and other tropical diseases by spraying on interior walls to kill or repel mosquitoes.

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Fig.1.1.1 Pesticides Spraying techniques

1.2. Introduction and Motivation

In olden days weed detection was done by employing some men especially for that purpose. They will detect the weed by checking each and every place of the field. Then they will pluck them out manually using their hands. Later with the advancement in the technology they started using the herbicides to remove the weeds. But to detect the weeds they are still using manual power in many parts of the world. Later there came few methods to detect the weeds automatically but due to lack of their accuracy they are unable to reach to the people. Then they started using image processing for this purpose .In this paper our main aim is to detect the weed in the crop by using image processing. Then we will give the inputs of the weed areas to an automatic spray pesticide only in those areas. For this we need to take a photograph of the field with good clarity to detect the weeds with more accuracy. Taking a photograph can be done by attaching a camera to a tractor or taking them manually. Then we will apply image processing to that image using MATLAB to detect the weed.

In this paper we have implemented two methods for weed detection. They are:

1. Inter row weed detection
2. Inter plant weed detection

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The final result will be containing the weed areas which we will give as inputs to the automatic sprayer, implemented using „Arduino uno" microcontroller. A weed is a plant considered undesirable. Weeds have no botanical classification value, since a plant that is a weed in one context is not a weed when growing where it is wanted. It is applied to any plant that grows or reproduces aggressively, or is outside its native habitat. The term is occasionally used to broadly describe species outside the plant kingdom that can live in diverse environments and reproduce quickly. These have seeds that persist in the soil seed bank for many years. They compete with the desired plants for the resources that a plant typically needs, namely, direct sunlight, soil nutrients, water, and (to a lesser extent) space for growth. Weed classification is a serious issue in the agricultural research. Weed classification is a necessity in identifying weed species for control. There are two types of weed based on the frequency of the edges present in them.

Fig 1.2.1. weeds with narrow leaves

Fig 1.2.2. weeds with wide leaves

In this method we can detect the weed that is present in between the rows of the crop. Here it will process the images taken in real time to get the weed areas. We will take pictures at 25 frames per second. Each frame needs to be operated for 0.04 sec. Here we will take the first eight frames generated in 0.3 sec time and we will perform the logical AND operation between them to get a reference image called crop row image. This reference crop row image will be changed after 0.3 sec and will be replaced by the new crop row image formed by the AND operation of the frames obtained in next 0.3 seconds. After obtaining the reference

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image we will compare the next coming image with it and we will get the weed output. The things which are present in the processed image and are absent in the reference image will be treated as the crop. For this we will do XOR operation of the processed image with the already existing reference image will give the output image containing the weed that is present in between the rows .The main disadvantage of this method is that it cannot identify the weed that is present in between the plants in a crop row. Also if the crop is present outside the row then it will take that as a weed. So we cannot relay much on this method to detect the weed. Inter row weed detection does not deal with the weed between the plants in the rows. In order to overcome this problem Inter Plant Weed Detection is employed. This part of the algorithm prepares an image for further advanced processing and is consists of: Loading the image from source, colour segmentation and edge detection.

Fig 1.2.3. This is the input image we have taken for weed detection

Colour segmentation is one of the image segmentation method used to separate the crop (which also include weed) from the background. This is done through K means clustering. The method helps in separating all the visually distinguishable colours from one another. The L*a*b* colour space (also known as CIELAB or CIE L*a*b*) enables to quantify these visual differences. The L*a*b* space consists of a luminosity layer 'L*', chromaticity-layer 'a*' indicating where colour falls along the red-green axis, and chromaticity-layer 'b*' indicating where the colour falls along the blue-yellow axis. All of the colour information is in the 'a*' and 'b*' layers. The difference between two colours can be measured using the Euclidean distance metric. Clustering is used to group the pixels of same colours into group

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of objects, thereby making it easy to segment. The output image comprises of only two colours. The desired image after colour segmentation consists of green colour (the crop and the weed) and the remaining part of image black, making the image feasible to the step in the process, edge detection.

Fig 1.2.4. Output image after colour segmentation.

Edge detection is also a method of image segmentation which uses the fact that the edge frequencies and veins of both the crop and the weed have different density properties (strong and weak edges), to separate the crop from the weed. The image after both colour segmentation and edge detection is left with the edges and veins of both the crop and the weed in white and the remaining part completely black.

Fig 1.2.5. Output image after edge detection

Although several sophisticated and accurate methods for colour segmentation exist, many of them are not fast enough for real-time purposes. As in colour segmentation, several methods with different accuracy and speed are available which their most well-known ones are Canny and Sobel edge detection algorithms. The operations like colour segmentation, edge detection make the image ready for the next operation called filtering. Filter here is used for

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recognizing regions in which edges appear with a frequency in a specific range (weed frequency range). Here the image after the edge detection in above step as input. To apply filtering the image has to be divided into blocks of certain size. There is a trade-off between the block size and gained accuracy. If the block size is too large, frequency estimation can be faulty due to existence of both crop and weed in the same block. If it is too small, the frequency cannot be calculated correctly because of inadequate number of edges in a block. A small block may detect the inner part of the weed leaf as the crop because of less number of edges in it. Also in choosing the threshold value we need to take care because its value depends on two factors. They are:

1. Type of weed present
2. Type of crop

The above factors affect the threshold value in this way: if we have narrow crop leaves and wide weed leaves then we can say that weed has more edge frequency than the crop, so here the threshold value will be more. Otherwise threshold value will be less. In this paper we take the case of corn crop where the edge frequency of weed is more than that of crop. For knowing the value of the edge frequency here, first we took a image which contains pure weed and calculated the number of edges in it by using for loops and then we have calculated the number of edges per block for pure weed. That turned out to be approximately 900. Then we did the same by taking pure plant image and its edge frequency is approximately 100. So in this paper we took 500 as threshold value so that all weed can be detected. Coming to our case in this project.

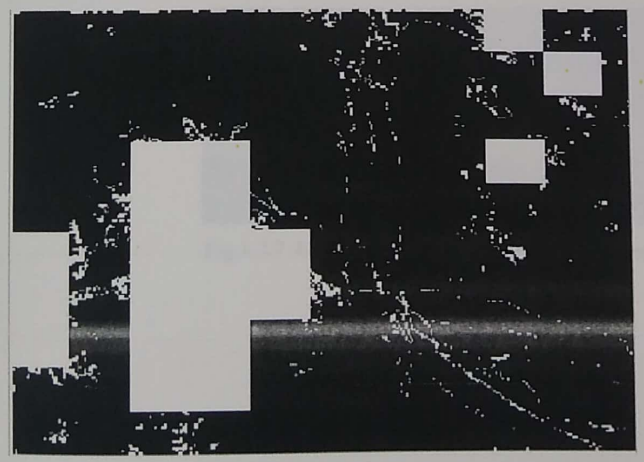

Fig 1.2.6. Final output after filtering showing the weed affected areas as white blocks.

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1.2.2. Motivation

With growing population weed the need the productivity of agriculture to be increased. Usage of deadly poisonous herbicides has increased to drastic levels. Hence to increase the productivity and to decrease the usage of poisonous pesticides we have implemented this work.

1.3. Existing System

Farmers nowadays use four wheeled sprayers and hand held sprayers to spray pesticides on entire plat. Due to this the plants which do not require pesticides also get sprayed and loose their nourishment. In domestic gardens, methods of weed control include covering an area of ground with a material that creates a hostile environment for weed growth, known as a *weed mat*. Several layers of wet newspaper prevent light from reaching plants beneath, which kills them. Daily saturating the newspaper with water plant decomposition. After several weeks, all germinating weed seeds are dead. In the case of black plastic, the greenhouse effects kills the plants. Although the black plastic sheet is effective at preventing weeds that it covers, it is difficult to achieve complete coverage. Eradicating persistent perennials may require the sheets to be left in place for at least two seasons. Some plants are said to produce root exudates that suppress herbaceous weed. A 5–10 centimetres (2.0–3.9 in) layer of wood chip mulch prevents most weeds from sprouting. Gravel can serve as an inorganic mulch. Irrigation is sometimes used as a weed control measure such as in the case of paddy fields to kill any plant other than the water-tolerant rice crop.

Fig.1.2.7. Existing System for pesticides spraying

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1.4. Problem Statement

- Only designated weed and pest areas should get pesticides rather than whole crop.
- Drastic effects on environment need to be addressed due excessive use and spraying of pesticides and herbicides in agriculture.
- It is very difficult to improve the spraying techniques because the actual existing techniques are not suitable for use.

1.5. Objective

After Green Revolution usage of deadly poisons as herbicides has increased to a drastic level. By doing so we got success in increasing the productivity but we have forgot damage done to the environment, which will arise a doubt in our sustenance on this beautiful earth. So, in this project we have implemented some methods to reduce the usage of herbicides by spraying them only in the areas where weed is present. In this work we implemented image processing using MATLAB to detect the weed areas in an image we took from the fields.

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1.6. Scope

In this paper we have developed a method by which we can detect weed by using image processing. Then we gave the input of the weed blocks to the automatic sprayer which sprays only in these blocks. By doing so we can reduce the usage of herbicides , thus saving the environment. If we have two are more types of weeds of different edge frequencies present in the same field. Then the threshold value must be less than the minimum edge frequency of the weeds present. If a small weed is present separately in the field means not in a group then it cannot be detected because it cannot meet the threshold condition. If both the weed and crop have nearly same edge frequency we should be very careful in selecting the threshold value. The weed block numbers from the filtering step cannot be given automatically to the motor, it has to be done manually. This will take some time.

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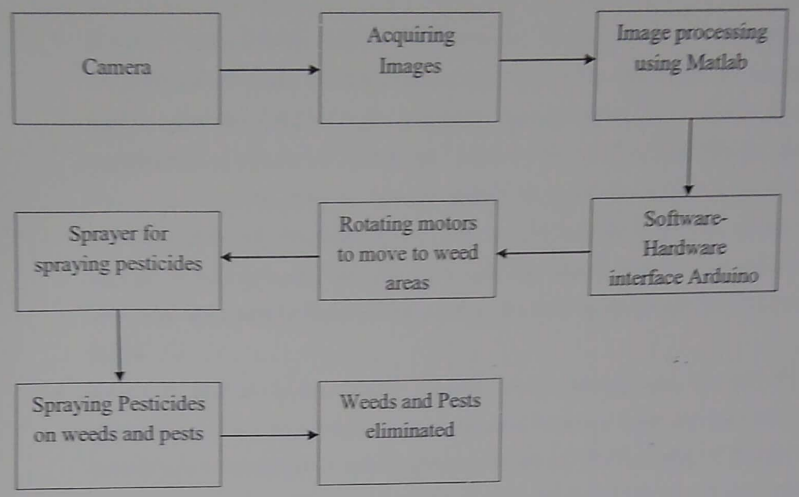
1.7. Proposed system



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CHAPTER 2

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2. REVIEW OF LITERATURE

- Hossein Nejati, Zohreh Azimifar and Mohsen Zamani introduced a method of automatic cell counting based on microscopic images [2]. Histogram information is used to calculate adjustable lower and upper threshold value. This value is used for segmentation of objects and background. Effect of Flood fill method fills the objects region. It is used to mark or separate regions in an image. A blob is an area of touching pixels with the same logical state. All pixels in an image that belong to a blob are in a foreground state. All. Blob analysis consists of a series of processing operations and analysis functions that produce information about any 2D shape in an image.
- Xavier P. Burgos-Artizzu, Angela Ribeiro, Maria Guijarro and Gonzalo Pajare presented a method for counting of microorganisms in maize fields that use a series of morphological operations to create a representation in which objects of interest are easily isolated and counted [7]. First step of this method is RGB to gray conversion. After that, two-dimensional median filter is applied, in order to eliminate noise and other artifacts. Ideal size of the neighbourhood over which filter should be applied depends on three main factors: size of objects of interest, size of spurious artifacts and resolution of the image.
- P.W.Jayasuriya and Vilas M. Salokhe have made use of remote sensing (LARS) platform. Then, a set of geodesic and Euclidean distances, together with nose volume and ratios between geodesic and Euclidean distances, has been computed and summed in a final score, used to find crop growth in soyabeen plantation.
- Rong-Xiang Hu , Wei Jia [3] Xiang Hu and David Zhang proposed hand shape recognition method which they named as Coherent Distance Shape Contexts (CDSC). It is based on two classical shape representations, i.e., Shape Contexts (SC) and Inner-distance Shape Contexts (IDSC). CDSC is capable of capturing discriminative features from hand shape. It can very well deal with the inexact correspondence problem of hand landmark points. Specifically, it can extract features mainly from the contour of fingers.
- Anup Vibhute, S K Bodhe Li et al. (2004) introduce an interactive means of segmentation based on graph minimization techniques very similar. It involves two major steps. The first step is the object marking stage in which hard constraints are set so that regions are set to be either definitely background or definitely foreground. The

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second step is a boundary editing step in which individual vertices on the segmentation can be moved around until the user is satisfied.

- Ruzon and Tomasi and Chuang et al. "Introduction to digital image processing using MATLAB(2004)" paper on digital transform use colour samples from the background and foreground regions to perform the matting using statistical information about these colour samples. These approaches are not interactive, and once the tri-map is specified no further editing of the matte can be performed. This solves the effects of the wrong classification of colours in complex scenes in the statistical methods. The gradient of the matte is estimated in the image, and then recreated by solving Poisson equations. A smooth gradient is assumed between the foreground and background.
- Meunkeewjinda A.,P. Kumawat "Grape leaf disease detection from colour imagery paper using hybrid intelligent system, IEEE" on digital transform for weed detection proposed a method which utilizes Hash transform and leaf edge density to classify between crop and weed leaves in corn fields in real-time. This method is based on specific shapes of these leaves and leaf vein structures. Testing the method on a sample set of corn field images showed more than 92% accuracy in detecting weed plants. The resulting application is finally compiled to a dynamic linked library (dll) and used in a graphical user interface (GUI) to be used further by a cultivator robot in a real field.
- N.Osu paper "A threshold selection method from gray-level histogram, IEEE(1979). Mainly, the vegetable leaf disease is focused in this work. The proposed system consists of three main parts: (i) vegetable leaf colour segmentation, (ii) vegetable leaf disease segmentation, and (iii) analysis & classification of diseases. The vegetable leaf colour segmentation is pre-processing module which segments out any irrelevant background information. A self-organization feature map together with a back-propagation neural network is deployed to recognize colours of vegetab leaf.
- Rakesh Kundal, Amar Kapoor, GajendraRaghva(2006) in paper machine learning techniques for disease forecasting. This paper aims to advance research in image segmentation by developing robust techniques for evaluating image segmentation algorithms. The key contributions of this work are as follows. First, we investigate the characteristics of existing measures for supervised evaluation of automatic image segmentation algorithms. We show which of these measures is most effective at distinguishing perceptually accurate image segmentation from inaccurate segmentation. Second, we develop a complete framework for evaluating interactive segmentation algorithms by means of user experiments.

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- H. Zhou and T. Chao in 1999 proposed. ASD Field Spectrum recorded the spectrum of crops and weeds. Its waveband is 325-1075nm and with resolution of 3.5nm. One crop seedling and three kinds of weeds living together were tested. Each species has at least 30 sampling spectrum taken down. As one sample spectrum has too much data, wavelet transform reduced the data volume firstly, which compressed source signals to tens of floating numbers from 751 floating numbers. Totally 160 samples were used to build a radial basis function neural network, the object output was a 4 by 1 dimension vector.
- Ioannis Kypraios, Rupert Young, Philip Birch, Chatwin(2004) proposes in his paper of image recognition (2009) proposes an objective quality meter for quantifying the combined blockiness and blurriness distortions in frequency domain. The model first applies edge detection and cancellation, then spatial masking to mimic the characteristics of the human visual system. Blockiness is then estimated by transforming image into frequency domain, followed by finding the ratio of harmonics to other AC components. Blurriness is determined by comparing the high frequency coefficients of the reference and coded images due to the fact that blurriness reduces the high frequency coefficients. Then, both blockiness and blurriness distortions are combined for a single quality metric. The meter is tested on blocky and blurred images from the LIVE image database, with a correlation coefficient of 95-96%.
- C.R.Chatwin(2002) proposed on multiple regression analysis, the study found that simply increasing Simpson's Index does not influence dietary diversity of farm households due to the presence of interaction effect between Simpson's Index and crop income. It is much more critical and significant to increase the revenue generated from diversified crops along with other socioeconomic endowment characteristics of farm households. This is particularly applicable to poorer smallholder farmers who receive crop income less than US$85 per sales transaction and per season. Particularly, marginal and smallholders might be exposed to the effects of crop diversification and crop income toward increasing in their household dietary diversity score.

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