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Cropping OF Weeds in the Farm Field by Image Acquisition and Processing Methods

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Abstract – Agriculture plays one of the most important role in economy and therefore lowering the costs and improving the quality of agricultural products is highly demanded. A weed is a plant which grows in wrong place at the wrong time and doing more harm than good. Weed competes with the crops for water, light, nutrients and space, and therefore it reduces crop yields. In olden method, the weeds can be destroyed by using the controlled spray of herbicides. A major problem is that the heavy herbicide usage causes some of more prolific weeds becoming more resistant to the regular herbicides and therefore more powerful and more expensive options are being pursued. To overcome such problems with aiming at the reduction of herbicide usage, this proposed system focuses on developing a robotic system which can detect and mapping the weeds and then clearing of the weeds. And by this view, our proposed system provides a key solution to improve its quality by means of controlling the weeds and to increase the yield of crops in the farm field by mechanical cropping. The work is performed using 10 images and in this work the image is classified into pre-processed image and test image. Thereby, the needed solution is recovered in our proposed system. The proposed system can detect the early level of weeds in the farm fields with the accuracy of 85%. And so on, our system provides the following operation to cut the weeds in the farm field.

Index terms – Graphical User Interface, Weed Detection

1. INTRODUCTION

An image may be defined as a two dimensional light intensity function, f(x, y), where x & y are spatial coordinates and the amplitude of 'f' at any pair of co-ordinates (x, y) is called intensity or gray level of the image at that point. When (x, y) and the amplitude values of 'f' are all finite, discrete quantities then the image is said to be digital image. The Digital image is composed of a finite number of elements, such of which has a particular location and value. These elements are referred to as a picture elements, image elements and pixels is the term most widely used to denote the elements of digital image.

Over 200 functions for colour space transformations, connected component analysis, the watershed transform, canny and shen-castan edge detection, smoothing nice reduction, image morphology operations, iterative and non-iterative image restoration , spectral analysis and more allow routine and advanced processing tasks to be accomplished with ease and efficiency. Image can also be quickly enhanced by manipulating contrast, image geometry and colour.

Image regions can be interactively selected with a mouse for convenient and effective region-of-interest processing. The proposed data embedding procedure contains several basic steps.First, divide the cover image into non overlapping pixel-pairs. Then, embed the secret message into a part of cover image. The cover image is desynchronized by the partitioning scheme discussed above.

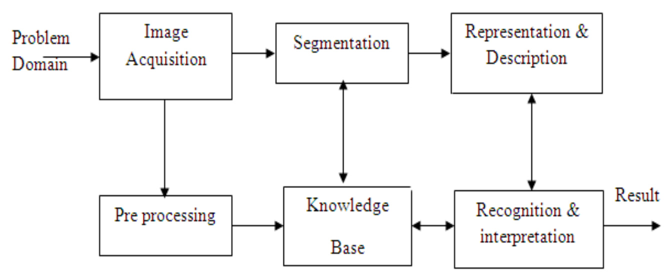

Figure 1: Fundamentals of Image Processsing

As detailed in the diagram, the first step in the process is image acquisition by an imaging sensor in conjunction with a digitizer to digitize the image. The next step is the pre-processing step where the image is improved being fed as an input to the other processes. Pre-processing typically deals with enhancing, removing noise, isolating regions, etc. Segmentation partitions an image into its constituent parts or objects. The output of segmentation is usually raw pixel data, which consists of either the boundary of the region or the pixels in the region themselves. Representation is the process of transforming the raw pixel data into a form useful for subsequent processing by the computer. Description deals with extracting features that are basic in differentiating one class of objects from another. Recognition assigns a label to an object based on the information provided by its descriptors.

Interpretation involves assigning meaning to an ensemble of recognized objects. The knowledge base guides the operation of each processing module and also controls the interaction between the modules. The composition of the image processing system depends on its application. The frame rate of the image processor is normally around 25 frames per second.

2. EXISTING SYSTEM

Controlling weeds is one of the most important and also expensive labours in agriculture which can be automated using robotic cultivators. These robots should be armed with a digital camera which uses a method to classify between weeds and crops based on captured image and then remove the weed by spraying herbicide accurately on the weed, cutting with blades or damaging with electric shock devices.

In this method is proposed which utilizes fast Fourier 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.

3. METHODS

Methods applied for weed detection are usually have three main phases:

1. Capturing a top-view image and background segmentation
2. Noise removal and pre-processing
3. Extracting features of each plant for weed/crop classification

This results to herbicide usage reduction to even 100% when mechanical or electrical devices are used for weed removal.

4. FAST FOURIER TRANSFORM-BASED ALGORITHM FOR WEED DETECTION

Using specific, distinguishable leaf features of crop and weed for classification is a common method for weed classification. In this algorithm three features are used: Colour, frequency of edges, and density of edges. Colour differences are used for background removal and edge frequency and density are used for plant classification.

The colour segmentation is a fast and accurate method for removing 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. In leaves of crops like corn, leaf veins are parallel to the main vein and the whole leaf has a flat surface. Although this central vein is thick, other leaf veins in the corn leaf is not strong enough to produce strong edges in ordinary edge detection techniques. On the other hand, for main type of corn field weeds, amaranth, leaves have an uneven surface, caused by its specific type of leaf veins. This difference cause the edges to appear with a relatively high frequency and high density in weed leaves which can then detected using proper filters.

Density filter is similar to frequency filter as it crops the image into blocks and tries to differentiate between crop leaves and weed leaves using their edge densities. This is again feasible because detected edges for weed leaves are noticeably more than crop leaves.

5. CLASSIFICATION OF IMAGE PROCESSING

On this feature selection basis, the entire algorithm is sectioned into three parts:

1. Pre-processing
2. Frequency and density filtering
3. Post-processing

Image processing algorithm is explained in the figure 2 which shows the complete structure.

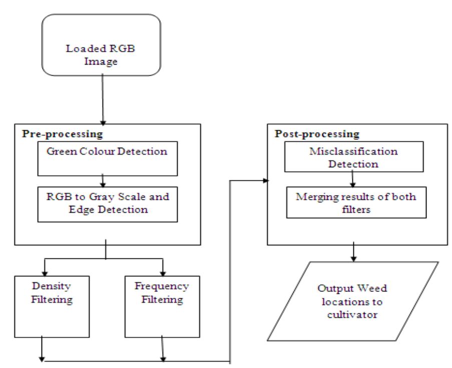

Figure 2: Process of weed detection in corn field

5.1 Pre-Processing

This part of the algorithm prepares an image for further advanced processing and is consists of: Loading the image from source, colour segmentation, RGB to gray-scale conversion, and edge detection. Due to nature of loading image, there is a platform and device dependent task.

Colour segmentation part, goal is to differentiate between plants and background with a reasonable accuracy and speed. Although several sophisticated and accurate methods for colour segmentation exist, like K-means [7], many of them are not fast enough for our real-time purposes. Therefore we have chosen to use simple Euclidean distance algorithm, applied on green and red values of each pixel for segmentation. According to several tests, blue value of pixels does not affect the segmentation and therefore can be ignored.

5.2 Frequency and Density Filtering

The pre-processing operations make the input image ready for next step, filtering. At this level frequency and density filters are applied on edge detected plant leaves. Fast Fourier transform is a well-known and efficient algorithm to compute discrete Fourier transform (DFT) and it's inverse.

This matrix is program's actual output to the weeding device informing positions which should be sprayed. There is a trade-off between 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 leaves in a block. If it is too small, the frequency cannot be calculated correctly because of inadequate number of lines in a block. A linear classifier such as Fisher linear classifier (FLD) [8] can be used for this calculation. The result from the FLD is then used as a threshold to differentiate between weed frequency range and crop frequency range.

Although same block size as frequency filter block size can be used for this part, a new linear classifier should be employed to find the threshold optimally. Here again, FLD can be used as well. Density filter is similar to frequency filter as it crops the image into blocks and tries to differentiate between crop leaves and weed leaves using their edge densities.

5.3 Post-Processing

Frequency and density features can be tuned for an optimal classification and there will be probability still false classifications. Therefore another part is added to presented weed detection algorithm as a final correction section. This post-processing part is based on the fact that a block of one leaf-class cannot be surrounded by blocks of the other leaf class, where leaf-classes are either weed or crop and the block size is small enough. For each cell, number of opposite class surrounding cells are counted.

If this number is more than a certain threshold, the cell label will be toggled from one leaf type to the other. Surrounding cells are defined as the 24 cells around each cell. After rechecking, two $N \times M$ matrices are available, in which each cell represents a block of original image, marked by either crop, weed, or background. After performing the post-processing task, these two matrices should be collapsed into a single matrix using Boolean AND function on weed marked cells. This leads to more accurate detection of weed leaves using both frequency and density filters results.

The other two flags, crop and background, are no more important because cultivator device merely consider the weed blocks. As a result an $N \times M$ matrix is returned from the entire algorithm.

Homomorphic filtering is a generalized technique for signal and image processing, involving a nonlinear mapping to a different domain in which linear filter techniques are applied, followed by mapping back to the original domain.

Image segmentation is the process of dividing an image into multiple parts. This is typically used to identify objects or other relevant information in digital images. There is a trade-off between block size and gained accuracy. According to several tests in figure 3, blue value of pixels does not affect the segmentation and therefore can be ignored.

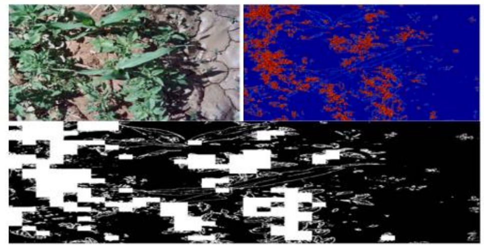

Figure 3: Sample results of applying frequency and density filters to detect weed regions

6. PROPOSED SYSTEM

In this project we use IR SENSOR for image detection and clearing of the weeds in fields. Here we have three sections, which has PIC microcontroller, buzzer, robotics system for enhancing the process by depiction of weeds at the field.

6.1 IR SENSOR

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed in straight line to each other.

The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with the comparator. The comparator is constructed with LM 741 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal.

The non inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher than inverting input. Now the comparator output is in the range of +12V. This voltage is given to base of the transistor Q1. Hence the transistor is conducting. Here the transistor is act as switch so the collector and emitter will be closed. The output is taken from collector terminal. Now the output is zero. The following diagram will show the complete function of transmitting and receiving section in figure 4.

6.2 TRANSMITTER SECTION

The components of transmitter section is mentioned below in figure 4.

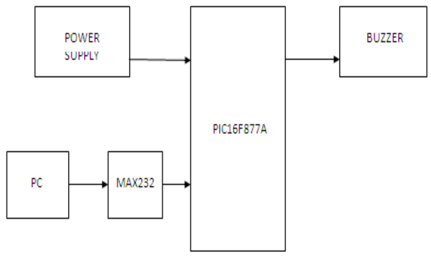

Figure 4: Block Diagram of Transmitter section

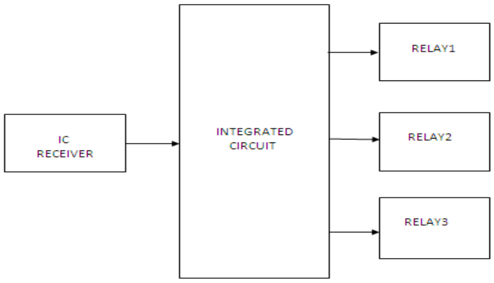

Figure 5: Block Diagram of Receiver Section

6.3 RESULTS:

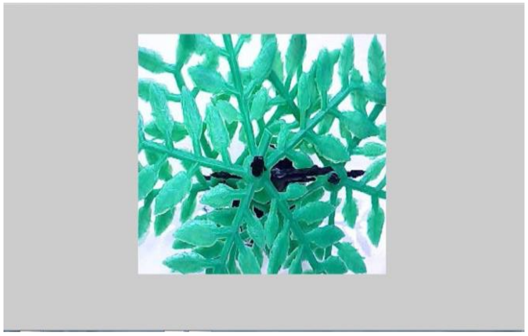

Figure 6 Acquisition of digital image of weed

1. Video Preview

The running video of farm field will be shown in the figure 7.

Figure 7 Video preview of a digital image

2. Image comparison

The weed image will be compared with the database image in the figure 8.

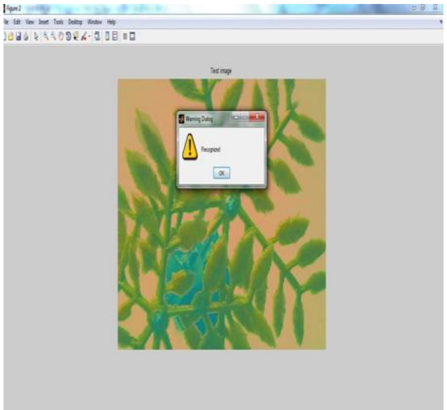

Figure 8: Compression of a digital image

3. Test Image

After compared with the database, the test image will be generated in figure 9.

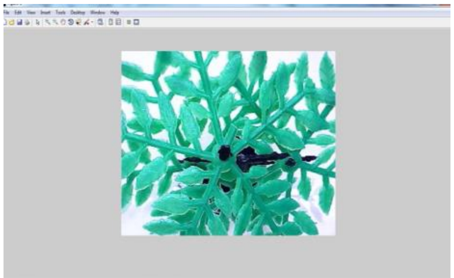

Figure 9: Test image after compression

4. Matched Image:

Once the test image is generated, a dialogue box will be shown as recognized image in figure 10.

Figure 10: Matched image after testing

7. CONCLUSION AND FUTURE SCOPE

Conclusion

The proposed system results in identifying and cropping of weeds in the farm field by image capturing and processing methods. First the image is captured and then it is matched with the data provided in the database and if the match is identified the intimation will be given to us by beep sound, then we can crop the weed by use our robot by manual control. Finally we can have about 80% of weed removed without providing any damage to crops in the farm field. Thus the proposed technique gives better results than existing methods and our project enhances the growth of plants and provides enormous results in the yield of crops.

Future Scope

Automatic precision control of robot which directs to the weed by identifying the latitude and longitudinal directions and cropping the field without human interface.

In future it can be modelized by providing heat and radiation sensor and the robot can be mobilised in detection of bombarding metals in mines to reduce the damage level of human**.**

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