Edge based Real-Time Weed Recognition System for Selective Herbicides

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Abstract— **The identification and classification of weeds are of major technical and economical importance in the agricultural industry. To automate these activities, like in shape, color and texture, weed control system is feasible. The goal of this paper is to build a real-time, machine vision weed control system that can detect weed locations. In order to accomplish this objective, a real-time robotic system is developed to identify and locate outdoor plants using machine vision technology and pattern recognition. The algorithm which is based on edge based weed classifier is developed to classify images into broad and narrow class for real-time selective herbicide application. The developed algorithm has been tested on weeds at various locations, which have shown that the algorithm to be very effectiveness in weed identification. Further the results show a very reliable performance on weeds under varying field conditions. The analysis of the results shows over 94 % classification accuracy over 140 sample images (broad and narrow) with 70 samples from each category of weeds.**

Keywords— **Weed detection, Image Processing, real-time recognition, Edge-based.**

I. INTRODUCTION

WEEDS are "any plant growing in the wrong place at the wrong time and doing more harm than good" [1]. Weeds compete with the crop for water, light, nutrients and space, and therefore reduce crop yields and also affect the efficient use of machinery. A lot of methods are used for weed control. Among them, mechanical cultivation is commonly practiced in many vegetable crops to remove weeds, aerate soil, and improve irrigation efficiency, but this technique cannot selectively remove weeds from the field. The most widely used method for weed control is to use agricultural chemicals (herbicides and fertilizer products). In fact, the success of agriculture is attributable to the effective used of chemicals.

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Agricultural production experienced a revolution in mechanization over the past century. However, due to the working environment, plant characteristics, or costs, or there are still tasks that have remained largely untouched by the revolution. Hand laborers in 1990's still may have to perform tedious field operations that have not changed for centuries. Identification of individual weeds in the field and location their exact position is one of the most important tasks needed to further automate farming. Only with the technology to locate individual plants, can "smart" field machinery be developed to automatically and precisely perform treatments.

Simple methods of weed control avoid using chemicals. They are often used by farmers. However weed control can also be achieved by the use of herbicides. Selective herbicides kill certain targets while leaving the desired crop relatively unharmed. Some of these act by interfering with the growth of the weed and are often based on plant hormones.

A real-time automatic weed control system can reduce or eliminate the need for chemicals between broad and narrow weeds.

The purpose of this paper is to investigate a real-time automatic machine vision system to distinguish weeds into broad and narrow categories.

II. OBJECTIVE

There are only two types of herbicides used: broad leave weed and narrow leave weed, our objective is to develop an algorithm which can

- Recognize the presence of weeds
- Differentiate the broad leaves weeds and narrow leaves weeds.

III. MATERIALS

A Hardware Design

The concept of the proposed automated sprayer system is shown in Fig.2, which includes camera, Central Processing Unit (CPU), and Decision Box which is used to control dc pumps. The images were taken at an angle of 45 degree with the ground. Using this method, the long narrow area in front of the sprayer could be captured with high resolution without increasing the image size.

The images are given to Central Processing Unit. The Decision Box is connected to the Central Processing Unit through a parallel port which ON or OFF the corresponding pumps, based on the type of image processed by the Central

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Processing Unit.

B. Software Development

The software is developed in Microsoft Visual C++ 6.0. A Graphical User Interface (GUI) is developed for Original image and processed image is based on edge based weed classification operation. The image resolution was 240 pixel rows by 320 pixel columns.

IV. METHODOLOGY

Fig. 2 shows the Flow Chart of a Real-Time Specific Weed Recognition System which were developed to recognize the broad and narrow weed classification [2]. The algorithm was based on edge based weed classification operation.

A. Image acquisition

Our system get image as RGB color format with a resulation of 320 * 240 . this mage can be a stored image or it can be areal image get from a attached camera or even in can be an image obtained from a vadio. If an image is not in the given resulation our system convert it into the standerd format.

B. RGB to Grayscale

In the start of the image preprocessing operation the input image is decomposed into red, green and blue components to create a binary image using the following transformation.

If G>R and G>B and G>150 then
PIMG = 1
Else
PIMG = 0
End if

Where R, G and B are the red, green and blue components and PIMG is the processed binary image.

The resulting binary image will have weeds in bright pixels and background in dark pixels.

C. Classification of weeds using edges

In this technique, we analyzed the images of the weeds and found that the leaves of broad weeds are closer to each other than the narrow weeds i.e there is larger gap between narrow weeds. We used dilation to remove the small gaps among broad weed leaves. In the resulting image if we find the edges of weeds; the narrow weeds will have greater number of pixels than broad weed image. We then calculate the number of edge pixels in the processed image and use it to classify weeds as

$$T = (n(E) \times n(W))/n(P)$$

Where T is the threshold value, n(E) is the number of edge pixels, n(W) is the number of weed pixels in the preprocessed binary image and n(P) is the total number of pixels in the image.

D. Algorithm for the classification of Images

The images are classified using the following procedure.

Start
If T >= T1
Type = 'Broad weed '
Elseif T>=T2
Type = 'Narrow weed '
Else
Type = 'little or no weed '
Endif
End

T1, T2 are threshold values [3], [4], [5].

V. RESULTS AND DISCUSSIONS

The results are shown in fig-3. Which were classified using edge based weed classification operation [6]. The 140 images of 70 for each class were taken. The algorithm classified 100% for little weed or no weed and 90% for narrow and braod weeds as shown in table 1 and table 2.

VI. CONCLUSION

A real-time weed control system is developed and tested in the lab for selective spraying of weeds using vision recognition system. In this paper, feature extraction based system for weed classification and recognition is developed. The system shows an effective and reliable classification of images captured by a video camera. The system composes of four main stages: image capturing, image pre-processing, feature extractions and classification.

VII. FUTURE WORK

In this paper weed image, which has one dominant weed species can be classified reasonably accurate. But the case of more than one weed classes cannot be accurately classified. Further research is needed to classify mixed weeds. One way is to break the image into smaller region. With smaller region, there will be less possibility to find more than one weed classes in this small region.

VIII. REFERENCES

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TABLE 1
Results of different types of weeds

Weeds Type	Results %
Broad Weeds	94%
Narrow Weeds	92%
Little Weeds	96%

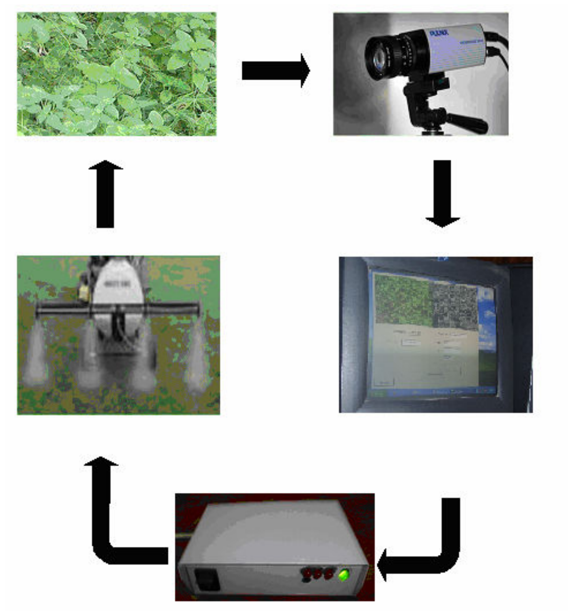
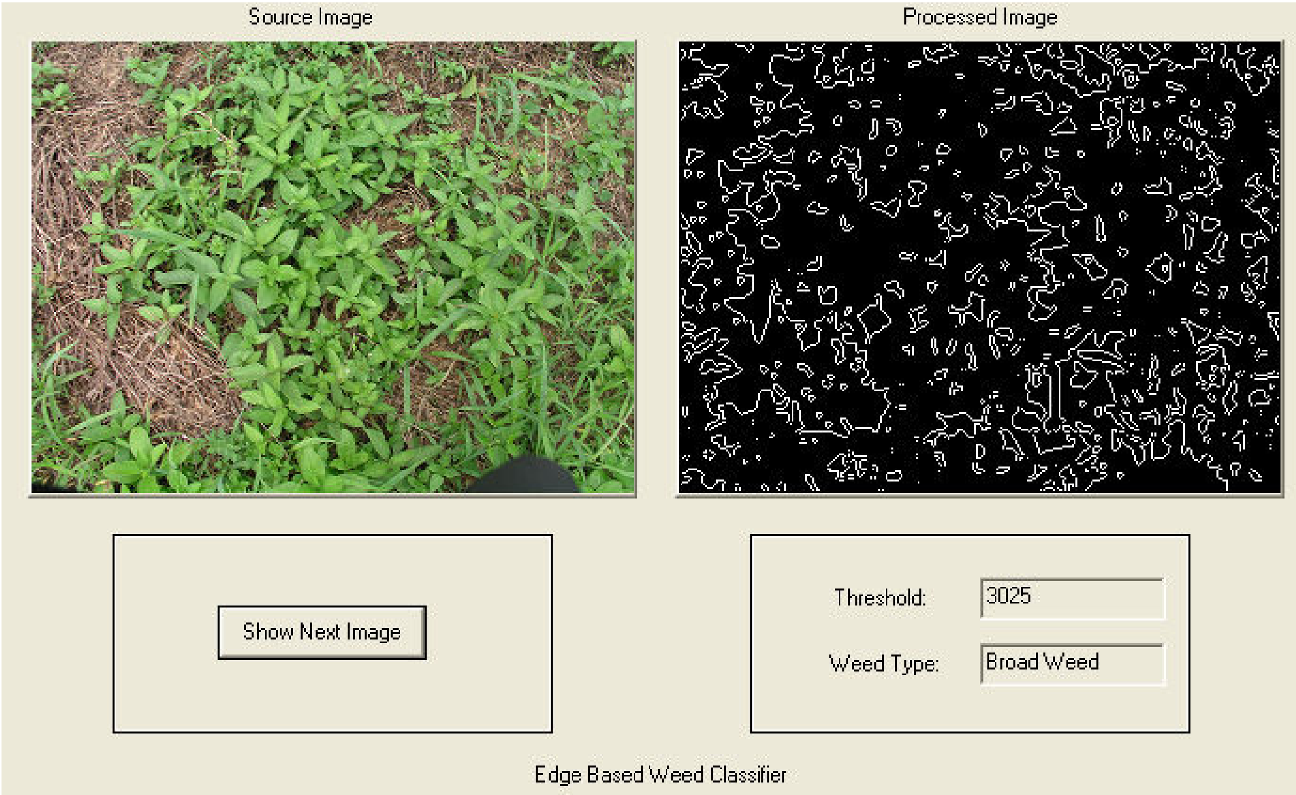


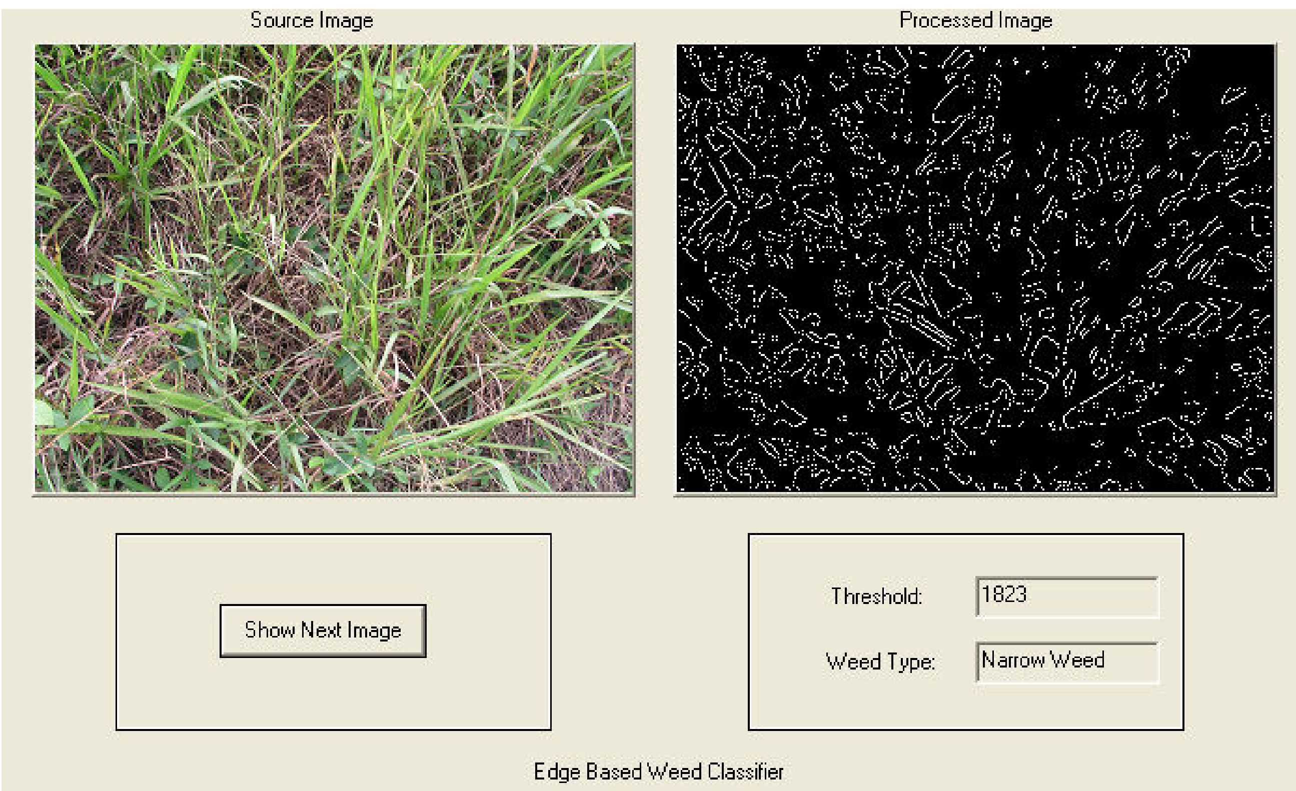
Fig 2
The concept of real time weeds control system

TABLE 2
RESULTS OF CLASSIFICATION OF NARROW, LITTLE, AND BROAD WEEDS

Narrow Weed		**Little Weed**		**Broad Weed**	
S.No	**Threshold**	**S.No**	**Threshold**	**S.No**	**Threshold**
1.	1850	1.	301	1.	3042
2.	835	2.	393	2.	2949
3.	2146	3.	241	3.	2949
4.	1537	4.	17	4.	2730
5.	1850	5.	131	5.	2890
6.	2410	6.	390	6.	2949
7.	2462	7.	25	7.	2730
8.	1392	8.	190	8.	3039
9.	1870	9.	256	9.	3131
10.	1950	10.	372	10.	3082
11.	2196	11.	268	11.	2891
12.	1533	12.	39	12.	3140
13.	919	13.	191	13.	3031
14.	1881	14.	221	14.	3121
15.	835	15.	199	15.	2824
16.	1850	16.	255	16.	2863
17.	839	17.	18	17.	3036
18.	1592	18.	69	18.	2726
19.	1746	19.	198	19.	2865
20.	2269	20.	205	20.	2762
21.	1176			21.	2737
22.	2107			22.	2698
23.	1094			23.	3022
24.	558			24.	2548
25.	644			25.	2949
26.	775			26.	2767
27.	1520			27.	2960

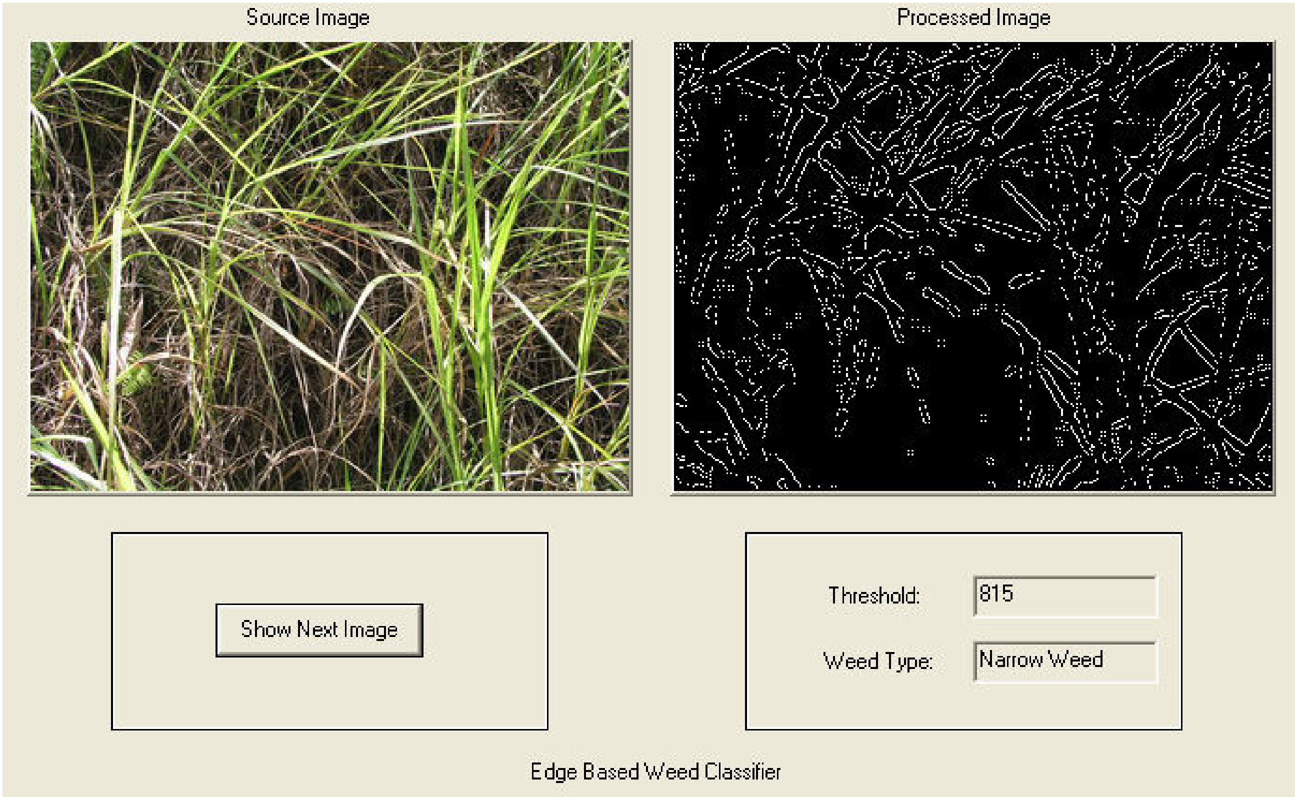


(a) Broad weed

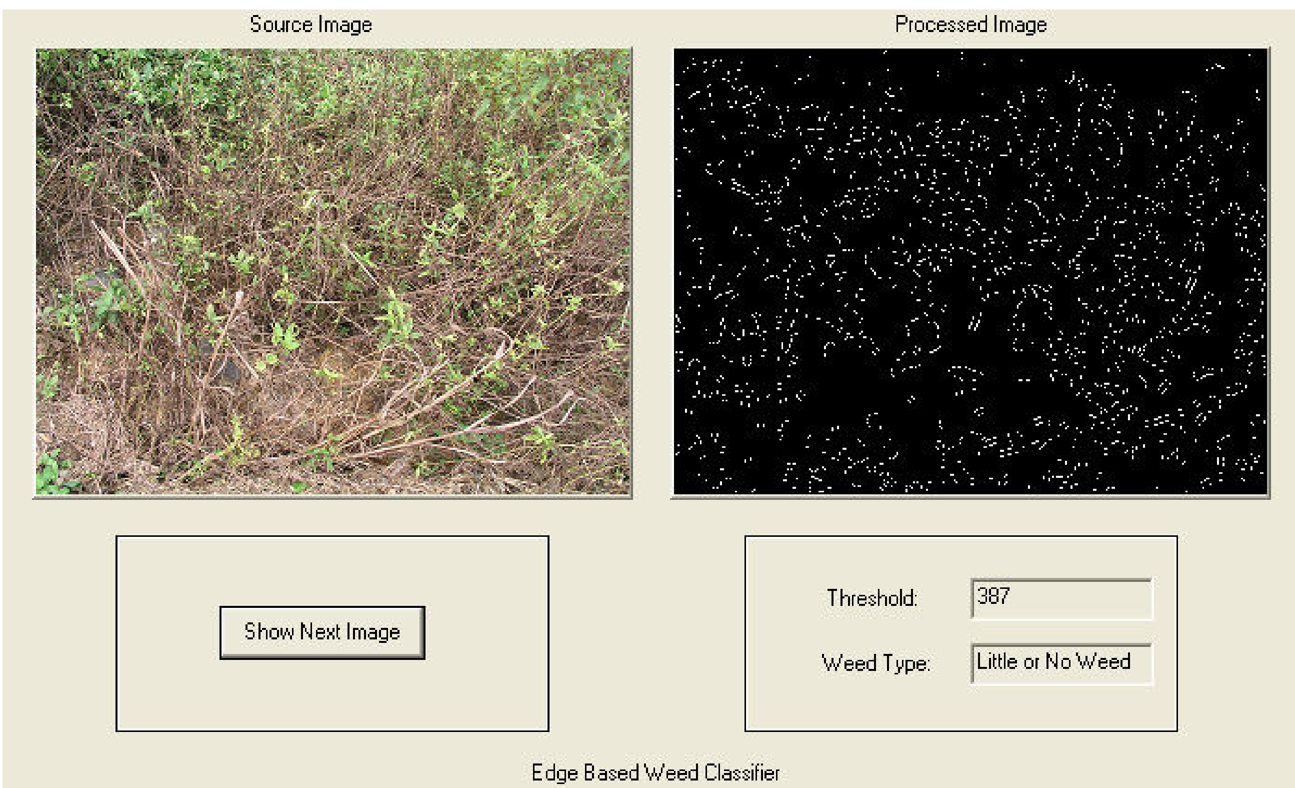


(b) Narrow weed

Fig 3 Classified Images



(c) Narrow weed



(d) Little weed

Fig 3 Classified Images