POINT FEATURE MATCHING BASED SURF FEATURE EXTRACTION FOR THE DETECTION CORN AND WEED PLANTS IN CROP FIELD

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Abstract: ***This paper proposes a new image processing technique for automatic identification of weed and crop plants in agriculture field. In digital image processing, image matching is one of the primary areas which include object detection and recognition. In this research work point feature matching based on SURF method is used to detect and recognize crop and weed plants. The proposed method is based on comparing and analyzes the points of interest between the reference image and sample image.***

Keywords **- Object recognition, Weed detection, SURF features, Image matching, Precision Agriculture**

I. INTRODUCTION

In agriculture, weed plant identification and control is one of the critical operations for maintaining crop yields. India's economy is mostly depends on agriculture products and processes most of the agriculture processes are manual; It leads to increase in production costs. Precision agriculture is new emerging agricultural activity, it is developed for the purpose of improvement of agriculture processes and also to maximize production rate. There are several methods to maintain and control the weed plants in crop field. The process of eradicating weeds is mostly a manual one. In corn agriculture field, herbicide is sprayed over the entire area even if there are no weed plants. Excess usage of these chemicals leads to environmental pollution. Automatic identification of weeds and crop is an important step for selective herbicide application with the help of precision agriculture techniques the herbicide is applied only on weed plants rather than on the entire field. For selective herbicide application process the proposed image processing technique can able to detect the weeds in the presence of crops.

1.1 **Major weed in Corn crop field**

Parthenium hysterophorus is one of the worst weeds in india because of its invasiveness, potential for spread, and high impact on economic and environmental factors. Parthenium weed is a major problem in corn crop fields. This weed is toxic to cattle and humans suffer severe allergic reactions. It is a fast-maturing annual with a deep tap root and an erect stem. e. It may eventually reach a height of 2 m. Its leaves are pale green, branched and covered with soft fine hairs. The small white flowers (4 mm across) have five distinct corners and grow on the stem tips. Parthenium weed can produce large quantities of seed, up to 100,000 per plant. More than 340 million parthenium weed seeds per hectare can be present in the surface soil, compared to 120,000 native grass seeds. Use mechanical, chemical and biological control and grazing to manage parthenium weed.

Fig.1 Parthenium Hysterophorus

Fig.2 Weed along with corn crop field

1.2 Literature Survey

Jing-Lei Tang et. Al., have investigated the weed detection techniques using image processing under different illumination for site-specific areas spraying. Support Vector Machines (SVM) based method [2] also used to evaluate the performance of an automated weed control system. Object detection based on SIFT algorithm is implemented in [5] to identify clusters belonging to a single object. In [6] Zhiyong Wang et. Al. , proposed a new method for leaf image classification with shape context and SIFT descriptors.

II. METHODOLOGY

SURF (Speeded Up Robust Feature) operation is based on scale and rotation interest point detector and descriptor. This algorithm is implemented for finding the similarity between two images.

The process of objection and matching three tasks;

(i) Detection

Salient & easily matchable points are identified in each image

(ii) Description

Design a descriptor for each feature point

(iii) Matching

Comparing process is performed between descriptor & images to identify identical features $(x_i, y_i) = (x_i', y_i')$

The image comparison operation is performed by comparing the interest point in the test image with the point in reference image. Euclidean distance between the descriptor vectors is the parameter used for comparison operation.

The entire operation involves two processes namely (i) Detect the feature, (ii) Compute the descriptors, for these features by using the proposed algorithm it is possible to generate set of feature points descriptors. For image matching and object recognition operation the challenging task is to detect the local features and computing set of descriptors. In order to increase the speed of operation integral of the image is used. Surface integral of any image is obtained by using (1)

$$I\sum(x,y) = \sum_{i=0}^{x}\sum_{j=0}^{y} I(x,y) \tag{1}$$

For calculating Gaussian and Haar wavelet filter responses

$$H(x,y) = \det\begin{bmatrix} \frac{\partial^2 y}{\partial x^2} & \frac{\partial^2 y}{\partial x\,\partial y} \\ \frac{\partial^2 y}{\partial x\,\partial y} & \frac{\partial^2 y}{\partial y^2} \end{bmatrix} \tag{2}$$

$$H(\tilde{x}) = Dxx(\tilde{x})Dyy(\tilde{x}) - (0.9Dxy(\tilde{x}))^2 \tag{3}$$

$$\tilde{x} = (x, y, s)$$

To locate significant points in images SURF methods uses determinants of Hessian matrices.

The hessian matrix H(x,σ) in x at scale, σ is defined in (4).

$$H(x,\sigma) = \begin{bmatrix} Lxx(x,\sigma) & Lxy(x,\sigma) \\ Lxy(x,\sigma) & Lyy(x,\sigma) \end{bmatrix} \tag{4}$$

Where $L_{xx}(x,\sigma)$ is the convolution result of the second order derivation of Gaussian filter.

$$Lxx(x,\sigma) = I(x) * \frac{\partial^2}{\partial x^2} g(\sigma) \tag{5}$$

$$Lxy(x,\sigma) = I(x) * \frac{\partial^2}{\partial xy} g(\sigma) \tag{6}$$

2.1 Implementation of Algorithm

In order to perform feature detection process, first step is to extract unique features of the object in an image.

Algorithm for detecting corn and weed plants in an agricultural field is presented in Figure 3.

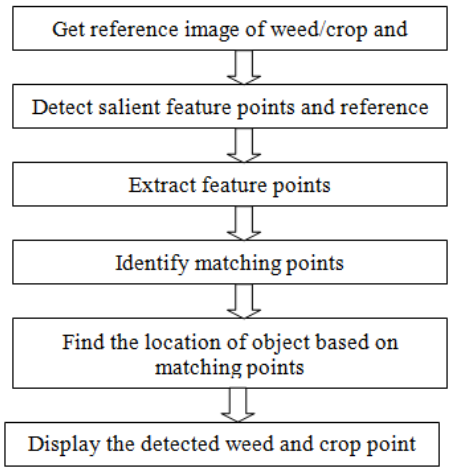

Fig.3 Algorithm for detecting corn and weed plants

Object detection and recognition algorithm is implemented in MATLAB 2014 software environment.

2.2 Extraction of corn plant image from soil image background

The weed plant leaves and the crop leaves are both in green color naturally. Color detection process can be used to separate crop/weed leaves from soil background.

Fig.4 Corn plant

2.3 **Algorithm Steps**

i. Extract each color corresponding to the red, green, and blue components of the image to extract three 2D matrices
ii. View different color planes
iii. Create one matrix that represents an intensity of green Green only = g - r/2 - b/2;
iv. Threshold the image to set a threshold to separate the parts of green Bw= Green only > 20;
v. Remove small unwanted objects
vi. Filling holes of the image
vii. Edge detection

III. SIMULATION RESULTS

Fig.5 Image after thresholding (Threshold limit > 20)

Fig. 6 Image after thresholding (Threshold limit > 40)

Fig.7 Edge detection

Fig.8 Parthenium hysterophorus along with weed

Fig.9 Parthenium hysterophorus (Gray Scale Image)

Fig.10 Corn plant

Fig. 11 100 strongest feature points from Parthenium Hysterophorus image

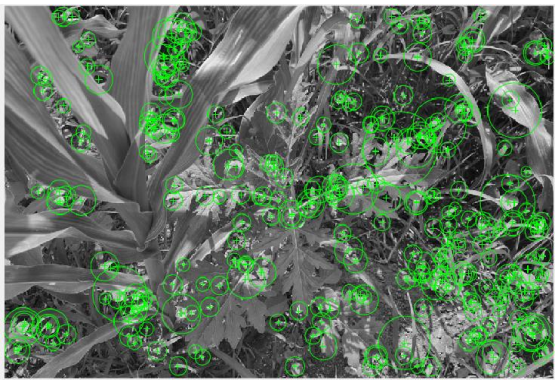

Fig. 12 300 strongest feature points from weed /crop image

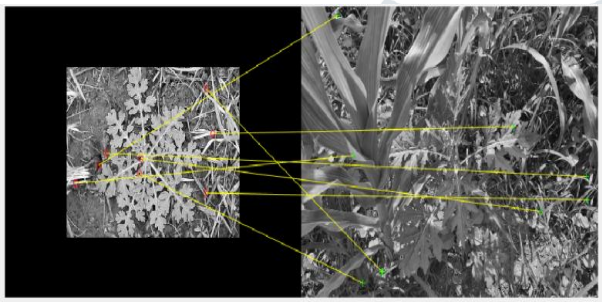

Fig.13 Putatively matched points (Including outliers)

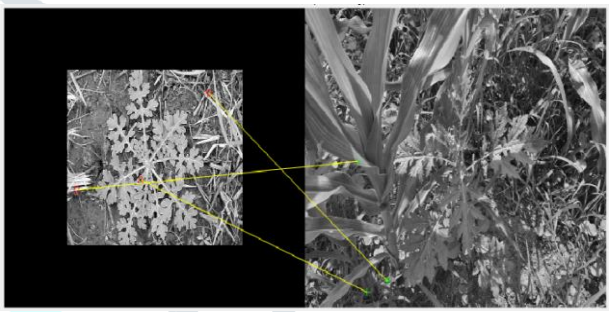

Fig.14 Matched points (Including inliers)

IV. CONCLUSION

Based on the result obtained from the experiments the detection of weed in crop field can be improved with this image processing operation. This simulation analysis is the preliminary stage that allows the controlled application of herbicides. Proposed methodologies successfully detects weed and corn plants by selecting the strongest feature descriptor based on SURF algorithm. The proposed algorithm's accuracy varies according to different types of weed and crop plants. Weed and crop images that have distinct leaves are provides maximum accuracy.

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