Early Pest Detection in Rice Crop Using Extended SIFT

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Abstract-- **Agriculture in India is aimed towards increase of productivity and food quality at reduced expenditure and with increased profit. In Tamil Nadu, rice is cultivated in 28 districts out of which 27 districts are under high productivity group and it covers a total area of 20.56 lakh hectares. It is the staple food of almost entire population of Tamil Nadu. But a great hindrance for farmers is the presence of pest in agricultural field. The presence of pest greatly damages the crop production. The technique of image processing is applied to agricultural science and it has great prospective especially in the plant protection field, which alternatively leads to pest control. This paper uses an image processing technique called Extended Scale Invariant Feature Transformation in order to detect and classify the pest.**

I.INTRODUCTION

Agriculture is the backbone of the economic system of a country. India's agriculture is composed of many crops, with the foremost food staples being rice and wheat. It also provides employment opportunities. Agriculture is the main source of livelihood, main source of national income for developing countries and provides raw material for industries. Nations export trade depends on agricultural sector and it ensures food security of the nation. Most of the country depends on agricultural products as well as industries associated with agriculture products for their main source of income.

Research in Rice production is aimed towards the increase of productivity and food quality with less expenditure and having good profit, which is very important in recent time. A strong demand now exists in our country to control pest by applying less and proper pesticides. It is only possible when the farmer can able to identify the type of Pest. In fact, the farmer periodically visits the crop field to observe whether the crop is affected by the Pest or not. And also tries to identify the type of pest, so that proper pesticides can be applied. This traditional method is unreliable and time consuming. The advancement of the image processing technique is used to identify and classify the Pest reliably with less time.

In this paper, the proposed technique is Extended Scale Invariant Feature Transform. In SIFT, the represented as image gradients within the local region of an image. The SIFT feature is invariant to the changes in scale, illumination, and local affine distortions. Because of the invariant to image transformations, in recent years, feature-based methods using SIFT in image registration has been widely researched and applied. The dimensionality of SIFT feature is 128 and very high, so it critically effects the performance of image registration system. Application of SIFT includes object recognition, robotic mapping and navigation, image stitching, 3D modeling etc

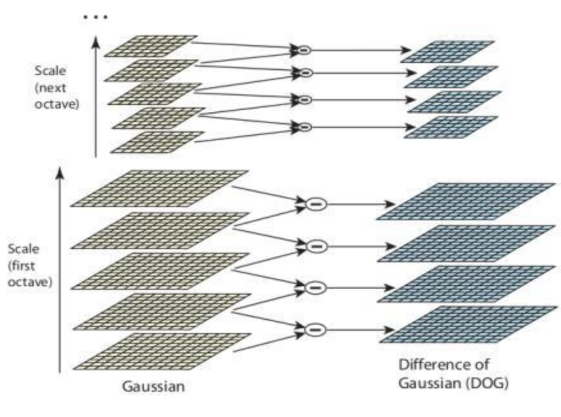
II.PROPOSED METHOD

The proposed method explains about SIFT algorithm in Open-CV. In this, Scale Invariant Feature Transform extracts key points and computes its descriptors. The SIFT mainly consist of four steps. They are explained below.

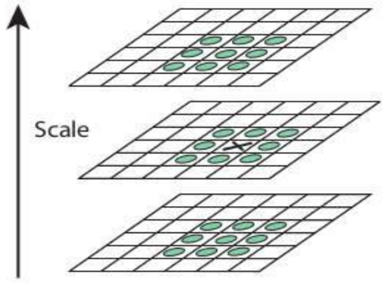
A. Scale-space Extrema Detection

From the image above, it is obvious that we can't use the same window to detect keypoints with different scale. It is OK with small corner. But to detect larger corners we need larger windows. For this, scale- space filtering is used. In it, Laplacian of Gaussian is found for the image with various values. LoG acts as a blob detector which detects blobs in various sizes due to change in sigma. In short, sigma acts as a scaling parameter. For eg, in the above image, Gaussian kernel with low sigma gives high value for small corner while Gaussian kernel with high sigma fits well for larger corner. So, we can find the local maxima across the scale and space which gives us a list of x, y, sigma values which means there is a potential keypoint at (x,y) at sigma scale.

But this LoG is a little costly, so SIFT algorithm uses Difference of Gaussians which is an approximation of LoG. Difference of Gaussian is obtained as the difference of Gaussian blurring of an image with two different sigma, let it be sigma and k\sigma. This process is done for different octaves of the image in Gaussian Pyramid. It is represented in below image:



Once this DoG are found, images are searched for local extrema over scale and space. For eg, one pixel in an image is compared with its 8 neighbors as well as 9 pixels in next scale and 9 pixels in previous scales. If it is a local extrema, it is a potential keypoint. It basically means that keypoint is best represented in that scale. It is shown in below image:



Regarding different parameters, the paper gives some empirical data which can be summarized as, number of octaves = 4, number of scale levels = 5, initial sigma=1.6, k=sqrt{2} etc as optimal values.

B .Keypoint Localization

Once potential keypoints locations are found, they have to be refined to get more accurate results. They used Taylor series expansion of scale space to get more accurate location of extrema, and if the intensity at this extrema is less than a threshold value (0.03 as per the paper), it is rejected. This threshold is called **contrastThreshold** in OpenCV DoG has higher response for edges, so edges also need to be removed. For this, a concept similar to Harris corner detector is used. They used a 2x2 Hessian matrix (H) to compute the principal curvature. We know from Harris corner detector that for edges, one Eigen value is larger than the other. So here they used a simple function, If this ratio is greater than a threshold, called **edge Threshold** in OpenCV, that keypoint is discarded. It is given as 10 in paper. So it eliminates any low-contrast keypoints and edge keypoints and what remain are strong interest points.

C .Orientation Assignment

Now an orientation is assigned to each keypoint to achieve invariance to image rotation. A neighborhood is taken around the keypoint location depending on the scale, and the gradient magnitude and direction is calculated in that region. An orientation histogram with 36 bins covering 360 degrees is created. (It is weighted by gradient magnitude and Gaussian-weighted circular window with \(\sigma\) equal to 1.5 times the scale of keypoint. The highest peak in the histogram is taken and any peak above 80% of it is also considered to calculate the orientation. It creates keypoints with same location and scale, but different directions. It contributes to stability of matching.

D .Keypoint Descriptor

Now keypoint descriptor is created. A 16x16 neighborhood around the keypoint is taken. It is divided into 16 sub-blocks of 4x4 size. For each sub-block, 8 bin orientation histogram is created. So a total of 128 bin values are available. It is represented as a vector to form keypoint descriptor. In addition to this, several measures are taken to achieve robustness against illumination changes, rotation etc.

E. Keypoint Matching

Keypoints between two images are matched by identifying their nearest neighbors. But in some cases, the second closest-match may be very near to the first. It may happen due to noise or some other reasons. In that case, ratio of closest-distance to second-closest distance is taken. If it is greater than 0.8, they are rejected. It eliminators around 90% of false matches while discards only 5% correct matches, as per the paper.

F.Extended SIFT:

In SIFT, the low frequency component is extracted and the further manipulations are done on that component. In order to the enhance the features present in that low frequency component, it is multiplied with a factor of 5 or 10. When the low frequency component is multiplied with a factor, it enhances the features present in it, so it is easier to identify the needed features present in the image.

PEST ATTACKING RICE

Rice weevil

Rice stemborer

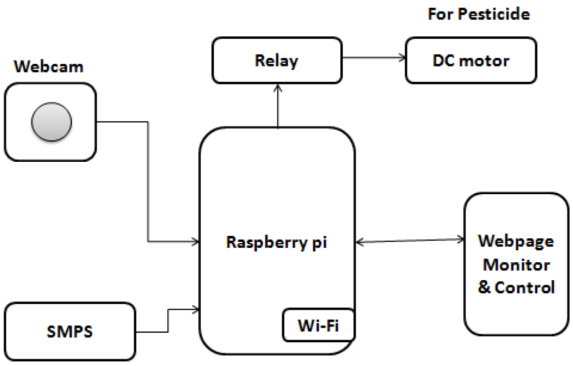
Rice caseworm

SIFT in OpenCV

Coding

```
import cv2
import numpy as np

img = cv2.imread('home.jpg')
gray= cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)

sift = cv2.xfeatures2d.SIFT_create()
kp = sift.detect(gray,None)

img=cv2.drawKeypoints(gray,kp)

cv2.imwrite('sift_keypoints.jpg',img)
```

Block



RESULT

The main objective of this paper is to detect the pest present in the rice crop and to control the pesticide according to it. Here, the SIFT algorithm is extended and this is used to identify and classify the pest present in the rice crop in a early stage.

CONCLUSION

In this paper we introduced a pest identification system using image processing. This system was tested on different images. By this method the pests can be identified in its early stage. Thus we can reduce the use of pesticide. The proposed system helps to save the environment as well as the cost. This system is simple and yet efficient.

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