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Crop Monitoring by Drone for Plant Pathology

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Abstract: ***The method proposed in the paper is to build a drone with camera to capture images of crops, soils and those images are processed to get required results. Building of Drone is the first part. Artificial Neural Network algorithm is then applied on the test image and specific features are extracted. These features are matched against the features of images in the predefined data set. The data set has classified categories of different types of crop images. After matching result is given as the name of the category to which the test image belongs.***
Keywords: Artificial Neural Network Algorithm, Test Image, Predefined dataset, Classified categories

I. INTRODUCTION

There are areas which encompass wide area to monitor and may also be inaccessible such as dense forest. A basic model in which there is a drone that captures images from remote location will be helpful to monitor in the above mentioned condition. This carries multiple applications such as identification of gas leakage, cultivable land in the forest area, detection of flora and fauna, disaster management and relief, surveillance etc. This product can reach anywhere easily. This project combines application of image processing i.e. Feature Selection and is implemented through the embedded system domain. The images are captured through a camera (OV 0706) and stored in the SD card. MATLAB 2016b is used for programming the feature extraction algorithm. Post-processing methods include extraction of a feature vector and design of a unique linear classifier which differentiates and categorizes these objects.

This extraction and processing has a repertoire of applications. As an example consider a scenario with respect to gas leakage and the same has to be detected then, the image which is obtained from drone is processed through different feature extraction algorithms and thereby determines that there is leakage in the gas pipeline. Similarly advanced detection of floods by measuring the increase in water level rises compared to its previous level which aids in saving life and property. It is also very useful in surveying locations where industry needs to be setup so as to find an appropriate geographical location. Other applications include surveillance systems, disaster management and relief, capturing number plates of traffic law offenders thus this system is extremely beneficial to the society.

KK Multicopter is used as the flight controller to fly and Arduino to take the image and store it. The model uses brushless dc motor and ESC (Electronic Speed Controller) to control the speed of flight. As for the future scope the project can be upgraded to function as an autonomous drone which again has numerous applications such as guiding a blind person etc. and also improve the processing speed on chip.

II. LITERATURE SURVEY

The objective of the research [1][2] is to classify data finding discriminative features and its analysis. Feature selection weighing based method has been used to discriminate different categories based on the weight of each feature. Among the data of different categories margins are maximized and weight of each feature is determined. The author has proposed Kernel Gram Schmidt process in order to get orthogonal basis set of training and test data in Kernel Space. The paper [3] uses concave minimization and Support Vector Machines for Feature Selection. When features are discriminated using discriminating plane in an n- dimensional feature space, only n features can be utilized which limits the efficiency of classifier. A classifier with large number of features is more efficient in discriminating the classes. Two approaches are used to achieve this objective. In a concave minimization approach, separating planes weighted distance from cluster of points belonging to different classes is minimized. In SVM approach along with first approach the distance between two planes that generate a separating plane is maximized. On comparing these approaches more features are extracted in SVM technique than Concave minimization approach. Thus SVM approach is better technique to train a classifier as it is more efficient.

The survey of research [4] tells about the optimal features to be selected while training and using SVM (Support Vector Machine) as a classifier. SVM in recent year has become one of the most popular classification tool due to its flexibility, efficiency and higher capacity to handle dimensional data. But it is need to keep track of what features are being used in SVM for classification.

Traditional Classifier applies feature extraction and then uses these features to learn SVM parameters for classification. The system performance is affected due to irrelevant features which including accuracy of classification and efficiency. To overcome these problems optimal feature learning is used, which proposes to extract features, calculate their latent weights and then use the relevant feature to determine the SVM parameters. Paper [5] and [6], tells that that entire process of object recognition is divided into three parts including extraction of features, encoding of features and classification of image. For encoding, Bag of Words technique can be used where features are organized as histograms and saved as visual words to build a visual encyclopedia. Here many different encoding schemes like Histogram encoding, Fischer encoding, Super Vector Encoding, LLC encoding are compared based on its function and efficiency. All the above encoding scheme can be used with linear kernel for training SVM but another class of kernels exists called Non-linear additive kernels. This type provides same efficiency as that of a Linear kernel bot the accuracy is much better in this case.

Weakly supervised learning is used to reduce the amount of human intervention required to train the models using examples that are only partially labeled. In research [7], Multiple Instance learning is used for labeling the features in an image to train a classifier. It makes use of set of patterns called bags. Two such bags namely positive and negative bags are used. At least one-member pattern in positive bags is a positive example. Negative bags contain all negative instances. These positive bags are then used to localize the object in the image. Examples of Non-linear Kernels are Hellingers Kernel and X2 kernel. Thus feature selection using non-linear additive kernel produces a better classification performance than that of linear kernels. The process of using image processing for effective feature selection is discussed in [7] and [8]. This technique is time and performance efficient than other Weakly Supervised Learning techniques used. One of the key challenges in MIL is the ambiguity of the actual positive patterns in a positive bag than those of negative instances in the same bag. This information in [8] provides us an in -depth knowledge of the mechanics involved in the working and mechanics of the quad-copter. The lift in quad-copter is generated with the help of rotors. Two of these rotors move in Clockwise direction and the other two rotors move in an anti-clockwise direction this ensures that the quad-copter is stable while lifting.

The paper [9] helps to understand the various components of the quad copter. The quad copter employs brushless DC motors which are similar to DC motor other than the fact that the three coils inside the motor are responsible for switching the power direction. As brushless motors have 3 phases the DC power supply cannot be given directly. The ESC is used to keep the motor running by generating high frequency signals of controllable yet different phase. There are four propellers. Each of these is mounted on top of the motor if all of them will spin in the same direction it will make the quadcopter spin around itself without any chance of stabilizing it. The larger the diameter the more thrust.

III.PROPOSED SYSTEM

The components required for drone are Electronic Speed Controller(ESC), Motors , Quadcopter frame, Remote Controller (RC) ,KK Multi -copter Board , Arduino Uno Board ,OV 0706 Camera ,SD Card. All the above components are assembled and KK Multi-copter is configured according to the height of the drone fly.

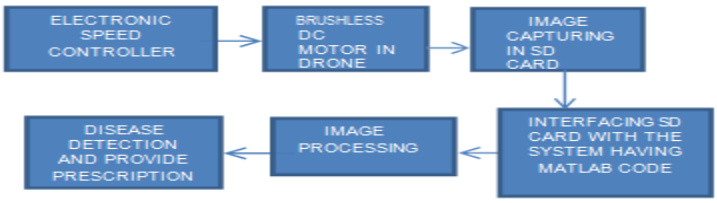

Fig1. Block Diagram of Crop Monitoring System

A. SD Card Interfacing

The image extraction from the SD card can be done wired/wireless manner and the processing is done by a MATLAB application on a system. With more number of images the toolset performance gets significantly better. After SD card interfacing is finished, drone is assembled using all the components mentioned in section III part A according to the block diagram shown in Fig1.

B. Feature Extraction And Selection

Using drone pictures are taken and the processing methods used on those images are explained in this section. MATLAB is software that has been used and exploited over and over again for its feasibility and the availability of abundant number of packages that come by default with it. In this paper Computer Vision System Toolbox is utilized extensively to implement pattern and machine learning algorithms for classification of images. Matlab-1016b is used as it has few inbuilt functions that the previous versions did not consist of. Bag of visual words are created for image category arrangement utilizing the Computer Vision System Toolbox. Computer Vision System Toolbox is used to create Bag of visual words to classify images categories. Visual words histogram is produced which is used to train an image category for classification. Following steps are followed to setup the images, generate a bag of visual words, and then to train and test an image category classified.

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Fig 2. Image set containing Test Sets

C. Artificial Neural Network

The images are divided and sorted out into training set and test set as shown in Figure 2. The image Data store function is utilized to store images to use for preparing an image classifier. Sorting out image into categories means taking care of vast arrangements of images simpler. In the example below 30% of the images are exploited for training set. A visual vocabulary or bag of features is created by extracting the feature descriptors from delegated images of each category. The Bag of Features object characterizes the elements, or visual words, by utilizing k-means clustering on the component descriptors separated from training sets. The computation iteratively clusters the descriptors into k fundamentally unrelated groups. The subsequent groups are reduced and isolated by comparable attributes. Every cluster point refers to a feature or visual word. The features are extracted in view of a feature locator or can be characterized by a matrix to extract the descriptors. In this manner, the grid of images that don't contain distinguished elements, for example, a picture containing landscape, similar to the shoreline are utilized. Utilizing Speeded Up Robust Feature (or SURF) indicator gives more noteworthy scale invariance. Naturally, the calculation runs the "grid" method.

D. Error-Correcting-Output-Codes (ECOC)

The train Image Category Classifier function gives back a image classifier. A multiclass classifier is prepared by utilizing the Error - Correcting-Output-Codes (ECOC) structure with binary SVM classifiers. The train Image Category Classfier function utilizes the Bo v W returned by the Bag-of-Features object to encode the histogram of visual words by the images in the image set. The positive and negative specimens are used to prepare the classifier using the histogram of visual words. The Bag-of-Features encoding method is utilized to encode every picture from the preparation set. This function recognizes and extracts features from the picture and after that uses the approximate nearest neighbor calculation to build a feature histogram for every picture. The function then adds histogram bins depending upon the closeness of the descriptor to a specific cluster point. The histogram length relates to the number of visual words that the Bag-Of-Features object developed. The histogram would only be a feature vector for the image as a result.

E. Database And Image Classification

After successful assembly of various parts the images are captured through drone and classified using the Bo V W model the image classification is very important and preliminary to our sudden decision making .the classification is done with SVM (support vector machine) this is a subset of the main code that runs inside the MATLAB application. The database so considered for example PASCAL VOC is an option. The performance of the system gets better if the spectral components along with the spatial is considered and the images belonging to the same geographic region gets stored and classified in a common place which makes image search and feature comparison all the way more easier and faster the data base should have all possible combinations of an objects perspective without much redundancy. For the feature comparison to be accurate the trained images stored should have good resolution to avoid ambiguity in decision making. The results obtained vary in accuracy with different categories and number of image used. Overall the performance relies upon the creation of a robust Database covering all the pests spectral or spatial or maybe the perspective of the object of interest .after creation of success full data base the image can be classified and features can be matched effectively without any ambiguity or vagueness in decision.

IV. RESULTS

Fig 3. Input Image

Fig 4.Resized Image

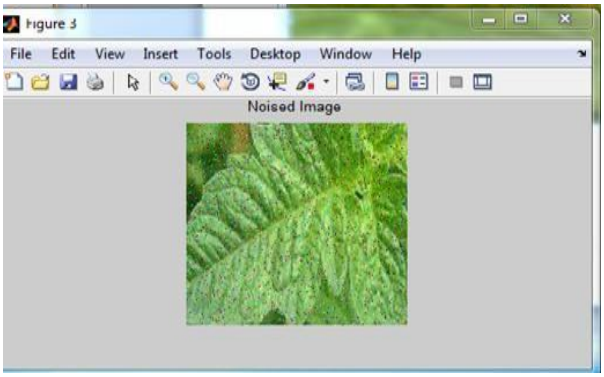

Fig 5. Noised Image

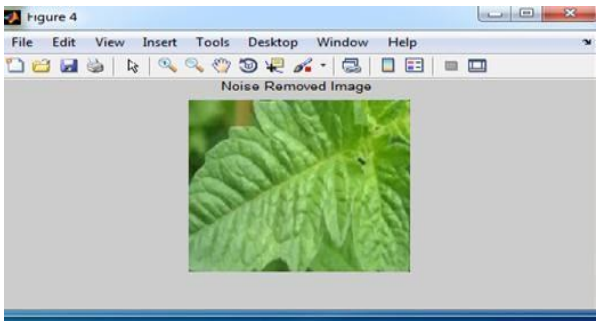

Fig 6. Noise Removed Image

The input image collected is been resized to get the standard pixel size (256*256).the resized image consists of noises. In order to remove those noises, an equal and opposite noise is been added to the image. Thus the noises get cancelled out, so that we get a pure filtered image. This is image is now ready for the comparison process**.**

V. CONCLUSION

For implementing the Bag of Words with weakly supervised- learning, the general algorithm was used, wherein, the key points are extracted from the images and a feature vector is created. Later K-means clustering has been done to determine the vocabularies of visual words. To extract features from the images SURF method is being used in the paper. SURF is the speed up version of Scale Invariant Feature Transform (SIFT) method. The drawback of SIFT method is that it takes more time to extract features. There are other methods for feature extraction like Harris method where brightness level of the image is consider for feature extraction which is not accurate as brightness of the image can be varied. Hence, comparably high amount of accuracy is being achieved using considerably more number of features. Making drone using KK Multi-copter board is easy compared to programming everything on a particular platform because KK board has many inbuilt programs. Cost can be reduced using KK Multi-copter. There is a large scope for drone technology and the proposed system can be improved by considering the implementation of GSM module on the drone so that images can be retrieved as soon as there are taken ,so that they can be instantly processed on the system.

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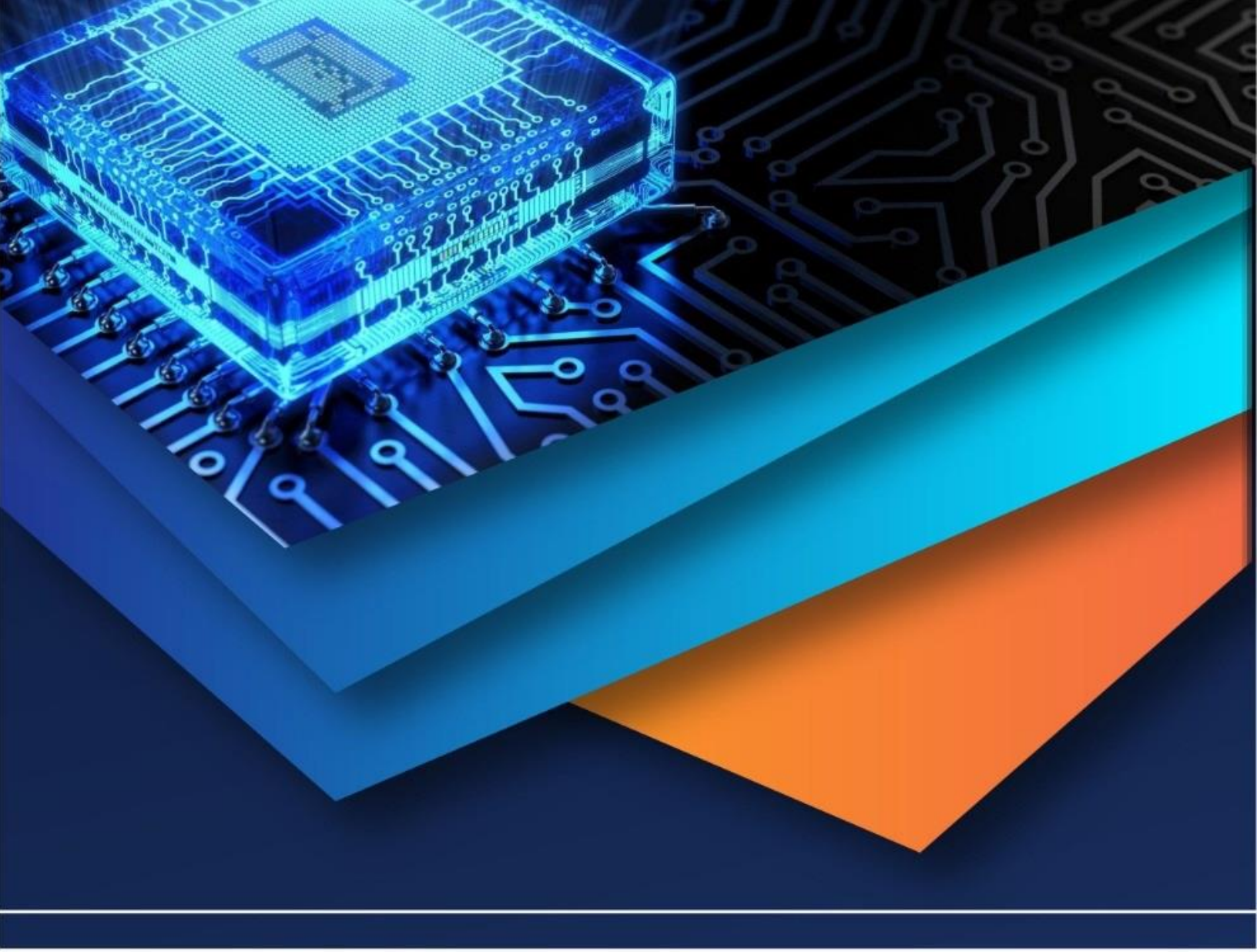

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