FUNGAL DETECTION IN AGRICULTURAL CROPS USING IOT AND SVM

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Abstract: *There is a need for a system which provides real-time local environmental data in rural crop fields for the detection and management of fungal diseases. This paper presents the design of the Internet of Things (IoT) system consisting of a device capable of sending real-time environmental data to cloud storage and a machine learning algorithm to predict environmental conditions for fungal detection and prevention. The stored environmental data on conditions such as air temperature, relative air humidity, wind speed, and rain fall is accessed and processed by a remote computer for analysis and management purposes. A machine learning algorithm using Support Vector Machine (SVM) regression was developed to process the raw data and predict short-term (day-to-day) air temperature, relative air humidity, and wind speed values to assist in predicting the presence and spread of harmful fungal diseases through the local crop field. Together, the environmental data and environmental predictions made easily accessible by this IoT system will ultimately assist crop field managers by facilitating better management and prevention of fungal disease spread.*

Key Words: ***Internet of Things (IoT), Fungal Disease, Support Vector Machine (SVM) and Agricultural Crops.***

1. INTRODUCTION

Computers have made impact in all the spheres of life through their tremendous technological development in terms of more powerful and flexible computing devices. The potential of computer and communication technologies are exploring in science, engineering, medicine, commerce, law, agriculture, horticulture and the list become endless. The days are not far off, wherein robots control everything in this universe. The field of agriculture and horticulture is not an exception. Computer vision applications are slowly making their way in the fields of agriculture and horticulture. We can able to see in computer deployed in inspection of food product, interpretation of grain and crop image in the agro food industry. The major advantage of using computers is that they are accurate and precise and efficient as compared to human beings in the real world. Significance in the area of computer vision and image processing has led to good number of real world application in industry, business, biological science, material science and medical science.

Development in certain disciplines of computer science like artificial intelligent, pattern recognition, image processing, neural network etc., promise the required technology support to tackle the various issues in computer vision. One of the applications considered in the present study is dealing with processing of images of agriculture and horticulture of crops affected by fungal disease. To find the fair amount of scope for plant disease identification in the area of agriculture, we need to have the design of a machine vision system that automatically recognizes, classifies and quantitatively detects plant disease symptoms. Many diseases exhibits general symptoms that are caused by different pathogens produce leaves, fruits, stem, roots etc. Plant diseases are caused by bacteria, fungi, virus, and nematodes. The fungi are responsible for a large number of disease symptoms in plants. Fungi take their energy from plants on which they live. They are in charge of a lot of damage and are described by withering, scabs, rotten coatings, rust, blotches and decayed issue. This being the inspiration, the visual side effects based identification and classification of fungal disease in agribusiness crops is proposed to help the farmers technologically. The development of an automated system also helps farmers to avoid consulting divine experts. Use of the PC vision and the image processing techniques unquestionably help farmers in every aspect of agricultural exercises. A general writing study in this association is been done. The software which recognizes, describes and figures level of area affected with disease using digital image processing.

2. PROPOSED METHODS

In the proposed work, we have focused on early detection of fungal disease from visual symptoms. The useful work in the real world comprises of the task like image acquisition, preprocessing of images, feature selection, development of methodologies for identification of fungal disease symptoms affected on different agricultural crops and finally the development of architecture for the Computer Vision System (CVS).

A. Identification of Fungal Disease Affected on Commercial Crops

Fungal disease symptoms can be recognized which affect the leaves, stem etc. Fungal disease symptoms namely anthracnose, powdery mildew, spot smut, wilt and gravy mildew affect on leaves and stems in commercial crops. The average classification accuracy is found to be 83.17% for the test samples using mahalanobis distance classifier. It has increased to 86.48% using PNN(Probabilistic Neural Network) classifier.

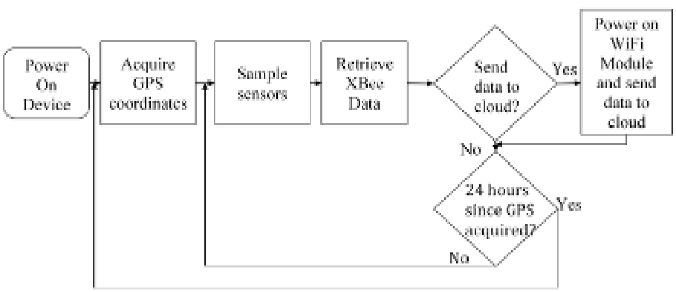
B. Identification of Fungal Disease Affected on Cereal Crops

Random Transform (RT) and Support Vector Machine (SVM) are developed and used for detection and classification of visual symptoms affected by fungal disease. Fungal disease symptoms namely leaf blight, leaf spot, powdery mildew, leaf rust and smut affected on leaves of cereal crops are considered for the study. Algorithms are developed to acquire and process color image of fungal disease affected on cereal crops like wheat, maize, jowar. The developed methodology consists of two phases. In the first phase random transformation and projection algorithm are used to project patches on the surface of cereal crops and detect whether the cereal is diseased or normal. In the second phase fungal disease symptoms affected on cereal crops are classified using support vector machine. The fungal disease affected areas are segmented from normal using K- means clustering technique. Color, shape, color texture features are extracted from disease affected areas and then used as inputs to SVM classifier. The average classification of accuracy is 80.83% has occurred with all the image types using shape feature. The average classification of accuracy is 85.33% has occurred in all the images using color texture features. The result reveals that the color texture features using SVM classifier is more suitable for identification and classification of fungal disease symptoms affected on leaves of cereal crops.

C. Identification of Fungal Disease Affected on Vegetable Crops

Fungal disease symptoms namely leaf blight, leaf spot, powdery mildew, rust. Downy mildew, Early blight, late blight are affected on vegetable crops. The analysis of fungal disease present on the leaves of the vegetables crops is detected in the early stage before it damages the whole leaf and the subsequently the plant. The average classification of accuracy is found to be 84.11% for the test sample using ANN (artificial neural network). It has increased to 91.54% using neuro KNN (k- Nearest Neighbour) classifier.

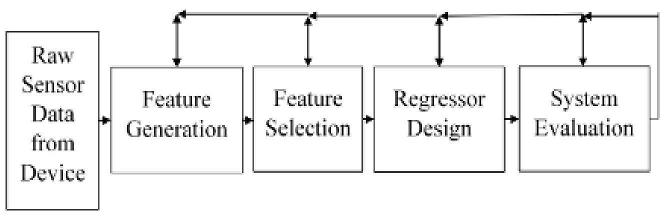
3. INTERNET OF THINGS (IOT) SOFTWARE DESIGN



The diagram shows the high level software block for a single environmental data collection device. The microcontroller is programmed in C using MPLAB XC32, an integrated development environment built by Microchip Technology. The microcontroller is programmed to sample and push data to the cloud at user specified intervals. GPS Coordinates are acquired on power resets and at 24 hour period intervals. The microcontroller has the ability to power off unused modules and to conserve power in the field.

The WiFi module is programmed in Squirrel, an object-oriented programming language. When the WiFi Module is powered on, the Wifi module receives data through the serial pin from the microcontroller. The WiFi module then relays the data to Sparkfun Data, a free online cloud storage service provided by Sparkfun. Additionally, the GPS coordinates are also relayed onto a website built with basic HyperText Markup Language (HTML) and Javascript. The website uses Google Maps to display the location of the devices in real-time.

4. SUPPORT VECTOR MACHINE (SVM) REGRESSION SOFTWARE DESIGN



The diagram shows the high level software block diagram for the short-term environmental condition prediction system. A machine learning approach to environmental condition prediction is used as it only requires the readily available sensor data in cloud storage. Additionally, machine learning approaches have been fairly successful in predicting short-term environmental conditions. SVM regression based wind speed predicting systems have been designed for wind turbine power production and solar irradiance predicting systems have been designed for photovoltaic power production. In both cases it was found that the machine learning systems used to predict wind speeds and solar irradiance were reliable enough for their application in power production models. For applications in agriculture, machine learning has been used to predict daily evapo-transpiration as well as daily atmospheric temperature. SVM regression has been selected as the regressor of choice for this project for its aforementioned success in weather prediction. Additionally, Ridge Regression, Ensemble Regressor method and Random Forests were also implemented. Ultimately, SVM regression performs optimally in terms of accuracy and computational complexity.

Air temperature, relative air humidity, and wind speeds were the focus of the SVM regression optimization for their high correlation to Fusarium presence. In the future, more environmental conditions can be predicted with slight modification.

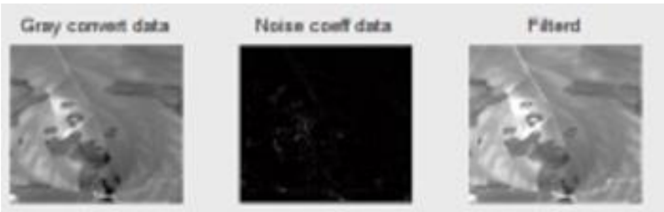
5. EXPERIMENTS

A. Input

A fungal infected leaf is taken for the experiment.

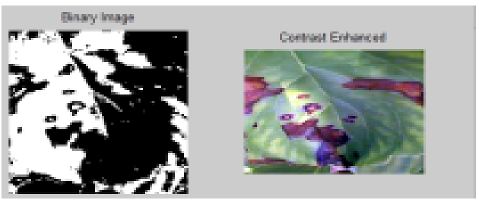
B. Preprocessing

The single image is captured by analog camera. The pre-processing methods are applied over the image. It is the process of imaging which shade correction, removing artifacts and formatting. Formatting deals with storage representation and setting the attributes of an image.



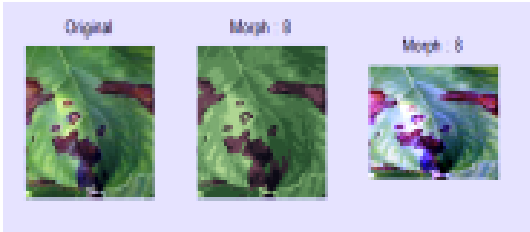
C. Enhancement

Image enhancement includes deblurring, filtering, and contrast methods. It is the process of adjusting digital images so that results are more suitable for the display or further image analysis. For e.g., we can remove the noise, sharpen, or brighten an image. Contrast of the image can be done by mapping the values of the input intensity image to the new values such that, the default 1% of the data will be saturated at low and high intensities of input data.



D. Morphology

It is used to align all the pixel and resolutions as same size of the image. The Image morphological is an interactive exploratory environment in which we can try different morphological operations and structuring elements on image.



E. Cluster

Cluster involves applying one or more clustering algorithms with the goal of finding the hidden patterns or groupings in the dataset. It forms clusters in such a way that data within a cluster have higher measure of similarity than the data in any other cluster. The measure of similarity on which clusters are modeled can be defined by distance, probabilistic distance or another metric.

F. Segmentation

Segmentation is the process of clustering the pixels with certain properties into salient regions and these regions correspond to individual surfaces. The proposed k-means segmentation technique is utilized to divide the target regions. Target regions are those areas in image that are represented in visual symptoms of fungal disease.

6. RESULT

The image processing techniques are applied for identification and classification of fungal disease affected on different agriculture crops. In the field of agriculture, SVM algorithm will plays an important role in the large farms. It saves time and money too. We could see the disease on the image and will come know which part gets affected. This produces great accuracy and faithful results. So the farmers do not need to call the experts for examining the plant disease.

7. CONCLUSION

This paper presents the design of an IoT based system which provides easy accessible real-time local environmental data in rural crop fields. The data are pushed in real-time to easily accessible cloud storage, providing researchers and crop filed managers with accurate environmental data without the need for visits to the crop filed to retrieve local data. A basic machine learning algorithm based on SVM regression was designed to predict average air temperature, relative air humidity, and wind speed values. This system helps to find the disease in the early stage with great accuracy and helps farmer to predict the amount of pesticides needed for the crops. This helps to reduce the cost of production and less time consumption.

8. REFERENCES

[1] A1, hiary H, bani-Ahmed s, reyalat. M, braik M, and AL Rahamneh. Fast and accurate detection and classification of plant disease. International journal of computer application;2013, vol 17, no 1, pp 31-38

[2] Barbedo JCA, digital image processing techniques for detecting, quantifying, and classifying plant disease. Springer plus;2013, vol 2, no 660,pp 1-12

[3] Bauer SD, kore F, forstner W. The potential of automatic methods of classification to identify leaf disease from multispectral images. Precision agriculture; 2011, vol 12, pp 361-367.

[4] Jagadeesh D Pujari et al 2014, "Image processing base detection of fungal disease in plants"

[5] Chen YR, chao.K, moon SK. Machine cision technology for agricultural application. Computers and electronics in agriculture; 2002, vol 22, no 2-3, pp 131-139.

[6] Di cui, zhang Q, Li M, Hartman GL, zhao Y. Image processing methods for quantitative detecting soybean rust from multispectral images; bio system engineering; 2010, vol 107, no 3, pp 186-193.

[7] Boger Z. et al, Finding an Optimal Artificial Neural Network Topology in Real-Life Modeling, Proceedings of the ICSC Symposium on Neural Computation

[8] Patil JK. Raj kumar. Advances in image processing for detection of plant disease. Journal of advanced bioinformatics application and research; 2011, vol 2, no 2, pp 135-141.

[9] Dr.D.DeviAruna, "A Survey on Different Disease and Image Processing Techniques in Sugarcane Crops".

[10] YufengGe et al (2016), "Temporal dynamics of maize plant growth, water use, and leaf water content using automated high throughput RGB and hyper spectral imaging".

[11] Prof. Arati A. Dandavate et al (2015), "E-Agriculture Analysis and Grading Disease of Leaf using Image Processing".