Survey on IoT Based Crop Monitoring Systems for Early Disease Detection

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Abstract— Today we are living in a world were IoT (Internet of Things) devices are widely used. IoT is widely used in many fields like health monitoring and agriculture. This paper holds a review on various paper that uses IoT based plant monitoring system for crop leave disease detection and monitoring other parameters of crop. This paper discusses various machine learning algorithm like SVM, CNN used for leave disease detection and also extend survey about various sensors used in IoT based crop monitoring. The main focus of this paper is to make an analysis of various techniques used in IoT based crop monitoring and leave disease detection systems.

Indexed Terms— Internet of Things, SVM, CNN, Machine learning

I. INTRODUCTION

Agriculture is a practise that provides all types of foods and fabrics to people around the globe. Especially, in our country agriculture is considered as backbone of economy. On the other hand, technology is growing day by day that today it has become an indispensable part of everyone's life. Thus, technology can also be used in the field of agriculture to increase productivity of crops and improve the quality of crops. In lot of cases, crop diseases are caused due to various fungus and microorganisms due to impure soil and improper amount of water. But using IoT, we can continuously monitor the leaves and detect diseases at a very early stage and treat them. Thus, we can improve the quality and quantity of crop production.

In the following survey paper, each author uses different techniques for implementing IoT based crop disease detection. In this paper, review all techniques used in various paper. The section 1 gives a detailed introduction about need for technology in agriculture. The section 2 gives a literature review of all the papers. The third section is a tabular description about the literature review. The last section gives the conclusion of the paper.

II. LITERATURE REVIEW

In paper [1] the authors propose a concept of smart farming using IoT technology to monitor air temperature, humidity and other factors that affect plant growth. In the paper, a framework is used for pump switching control which is implemented using advanced fuzzy logics. The various sensors used in the proposed system are DH11 temperature and humidity sensor, capacitive soil moisture sensor and ultrasonics sensor. The three important input membership function in this paper are air humidity measured in percentage (%), soil moisture in percentage (%) and temperature in celcius(^{o}c). The output membership function is only the watering time in seconds.

In paper [2] the authors give an integral technology of IoT, Machine learning and drone technology for agriculture. Each technology has its own importance. In the proposed solution, the IoT sensors provide the real-time status of environmental parameters impacting the crop's Vegetation Indices (VIs). Deep neural network with two hidden layers was found to be the most optimal model among all the selected models, providing an accuracy of (98.4%). The crop health maps were validated through the ground surveys and agriculture experts due to the absence of reference data. The drone technology gives a multispectral data for crop health monitoring. This datum has to be integrated because they are not heterogeneous but also has different temporal fidelity. The optimal integration

of this sensing modalities has been addressed in this paper.

In paper [3] a IoT framework using various sensors and cameras has been used to continuously monitor the crops and leave diseases. Machine learning techniques like Support vector machine and convolution neural network are helpful in irrigation and nutrition planning. This paper proposes EPRPC (Ensemble classification and pattern recognition for crops) for early leaf disease detection. The proposed ECPRC uses Ensemble Non-Linear Support Vector Machine (ENSVM). The paper also performs comparative study between various ML techniques like SVM, CNN, naïve bayes and k- nearest neighbour with each other ensuring real time crop monitoring system.

In paper [4] the authors mainly focus on LWD (Leaf Wetness Duration) which is the main reason for fungal disease. But commercially available LWD sensors have operational issues like weight of sensor and contact resistance between leaf and sensor. To overcome this issue the author has fabricated IoT enabled IoT sensor on flexible substrate. The LWD sensor fabricated on flexible substrate is most effective for in-situ measurement of leaf disease management considering both price and accuracy.

In paper [5] author uses IoT and artificial intelligence technique to detect RiceTalk disease in paddy plant. Using IoT sensor makes real time disease detection effective rather than doing image-based detection. The IoT sensors are used in finding min/max and the range measures for relative humidity and the average measure for temperature that have significant effects on rice blast prediction. The proposed system is very effective in detecting RiceTalk disease.

In paper [6] the author has combined IoT with image processing and environmental sensing which is very effective in monitoring plant health. The paper uses raspberry pi based IoT system that are used for disease classification and also used in updating environmental parameters like air temperature, humidity and soil moisture in MySQL database in a real time. Multiclass SVM is used for classification of disease. The paper attains 97.33% accuracy in classifying disease captured through IoT sensors.

In paper [7] author proposes a scheme that places the nodes over the simulation environment for capturing the plant leaf images. The proposed system has a sinkNode which helps in collecting images through IoT based sensors for leave image detection. The images are pre-processed and segmentation is done. Then the leave disease is classified using Sine- Cosine algorithm-based Ride Neural Network (SCA based RideNN).

In paper [8] the author aims at reducing the frequent use of pesticides and fungicides that not only affect the crop quality but also causes environmental pollution. Here an IoT based correlation is performed between weather and pest that majorly occur a certain weather condition. Thus the system provides disease and pest related information to the farmer at early stage so that it is easy to control them.

In paper[9] the author proposes a IoT based plant monitoring system for precision agriculture application such as endemic disease control. Here the IoT sensors are used to monitor the environmental parameters such as temperature , humidity which helps in controlling various fungal and bacterial disease. The system can be very useful in reducing the use of chemical fertilizer that are harmful to humans in a long term.

In paper[10] author presents IoT based image processing technique for finding disease in citrus plants. There are four types of citrus leaf diseases: (i) Citrus canker, (ii) Anthracnose, (iii) Overwatering, (iv) Citrus greening. The proposed methodology uses image acquisition as first step for capturing image by digital camera in high resolution to create database. Colour space conversion and image enhancement is done in image pre-processing. Discrete cosine transform domain is used for colour image enhancement. Two types support vector machine (SVM) classifiers: SVMRBF and SVMPOLY are used for differentiating citrus leaf diseases.

In paper[11] the authors focus on Wheat aphid which is a destructive pest common in northwest China. Hyperspectral measurements of leaves are used for detecting Wheat Aphid density in that area. The density of more than 60 leaves are used in this paper. The paper obtained 48 SFs derived from vegetation

indices, derivation spectral transform and CWT, and tested their potential in estimating aphid infection density in winter wheat at leaf level.

In paper[12] author concentrates on tomato plants. Here author uses image processing technique for tomato leaf disease detection. The two types of disease concentrated in the paper are early blight and powdery mildew. In this paper a 0V7670 camera module is used to capture leaf images and then the images are pre-processed and segmented to improve image quality. Then Support Vector Machine(SVM) algorithm is used for finding the disease. SVM is employed using Invmult Kernel function.

In paper[13] the author has developed an IoT-based monitoring system for precision agriculture epidemic disease control. Such an agricultural monitoring system provides environmental monitoring services that maintain the crop growing environment in an optimal status and early predicts the conditions that lead to epidemic disease outbreak. The sensors are connected using Arduino UNO through Wi-Fi Module.

III. REVIEW TABLE

PAPER TITLE	PROCEDURE
[1]Towards Smart Agriculture Monitoring Using Fuzzy Systems	Fuzzy Logics
[2]A Multi-Modal Approach for Crop Health Mapping Using Low Altitude Remote Sensing, Internet of Things (IoT) and Machine Learning	Multi-Modal Approach and R-CNN
[3]Ensemble Classification and IoT-Based Pattern Recognition for Crop Disease Monitoring System	EPRPC and ENSVM
[4]IoT Enabled, Leaf Wetness Sensor on the Flexible Substrates for In-Situ Plant Disease Management	LWD sensors for fungal disease
[5]RiceTalk: Rice Blast Detection Using Internet of Things and Artificial Intelligence Technologies	Deep convolutional neural network (CNN)
[6]An IoT Based Plant Health Monitoring System Implementing Image Processing	Multiclass SVM and MySQL
[7]Disease and pest prediction IoT system in orchard: A preliminary study	SCA based RideNN
[8]GANs-Based Data Augmentation for Citrus Disease Severity Detection Using Deep Learning	IoT based correlation technique
[9]Detecting Aphid Density of Winter Wheat Leaf Using Hyperspectral Measurements	ANN
[10]Deep Learning-Based Object Detection Improvement for Tomato Disease	SVMRBF and SVMPOLY
[11]Web Enabled Plant Disease Detection System for Agricultural Applications Using WMSN	Convolution Neural Network(CNN)
[12]Convolutional Neural Networks for Texture Feature Extraction. Applications to Leaf Disease Classification in Precision Agriculture	SVM
[13] An IoT-based cognitive monitoring system for early plant disease forecast	Arduino and Blynk app

IV. CONCLUSION

The paper gives a detailed survey about various IoT based plant monitoring and disease detection systems. The various advantages of using a real time IoT based system is discussed in detail. Different Machine learning algorithms like CNN, RNN, ANN, SVM are effective in leaf disease classification. Thus, using technology in agriculture is beneficial in improving the crop quality as well as saves the time of farmers.

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