International Journal of Management, IT & Engineering
Volume 9, Issue 2 (February 2019),
ISSN: 2249-0558 Impact Factor: 7.119
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Crop Disease Detection Using Cloud Computing & IoT:- A Review

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Abstract

The technologies of Internet of Things and Cloud computing are used for contemporary production of agriculture to encourage its efficient growth. It is now possible to complete the associated agricultural operations correctly with the capabilities of identifying, sensing and monitoring based on internet of things and the storage of large amounts of data for cloud. There is also a significant role of detection of disease in crops in agriculture. If adequate measures are not carried out in this region, it can have a severe impact on crops and will affect the quality and the amount or productivity. So, integrating modern technology in agriculture can help in early detection of diseases while also increasing the yield of crops and eventually benefitting the farmers. In this paper a survey has been done for identifying various diseases in crops that uses IOT and Cloud as their backbone for sustainable agriculture.

Keywords:

Cloud Computing;
IoT;
Agriculture;
Plant Disease Detection;

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1. Introduction

In recent years, due to better healthcare the quality of life for people has significantly improved. This has resulted in a huge increase in the population in the entire world and according to various sources it is only supposed to increase in the future. To provide food to this ever-growing population is a huge challenge since, the land for agricultural is declining owing to multiple factors such as rapid industrialization and urbanization. Besides this, there is also an issue of the crops being damaged due to various harmful diseases and pests that destroy the agricultural yield and leads to huge losses of money and time for the farmers. Therefore, there is a huge need to get rid of traditional agricultural practices and instead improvise modern methods of technology for precision agriculture, so as to increase the crop yield and feed a greater number of people as well as bring profits to the farmers.

The implementation of different technologies and devices such as internet, cloud and IoT devices with agriculture is known as Smart farming. It is much better than primitive farming that still uses traditional techniques and ancient tools for growing of crops without any pre-assessment of market requirements, prices and weather reports [1]. Smart farming also has benefits of detecting different types of diseases in various crops at an early stage which is highly essential for the optimum yield and quality produce. Plants get affected mainly due to bacterial, fungal and viral diseases. The current techniques for identifying and detecting plant disease is merely by observing through naked eyes of a specialist, which requires a big team of these experts for continuous monitoring of plants, that is very costly to do especially for large farms. Automatic disease detection by looking at the symptoms on the leaves of the plant makes it both easier and cheaper as well as it requires

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less time, effort and is more accurate [2]. This therefore calls on researchers to implement smarter plant disease detection software systems that do not require human interference.

The goal of this paper is to review and discuss different parameters of plant disease detection techniques. The paper is structured into the following parts. A brief introduction to the significance of plant disease detection is provided in the first section. The second and third sections discusses the concepts of Internet of Things and Cloud Computing respectively. The fourth section addresses the recent work in this area and describes the methods used. Finally, in the fifth section conclusion is given followed by the references.

2. Cloud Computing and IoT in Agriculture

Cloud computing is defined as an internet-based computing approach that enables distributed software and hardware data to be provided on request to computers and other devices. End users only need to know what type of resources they need rather than any professional knowledge to use cloud [5]. Cloud computing offers economical resource sharing. It also provides several services like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) at low costs. It is used together with IoT in the farming sector [6]. Various organizations can make use of space for storing the messages and framework sharing given to them through cloud suppliers. There is no need for buying the machines as the data can be stored in the cloud servers. It also provides farmers with knowledgeable information and more accurate payments, along with coordinated approaches contrary to usual methods as the ranchers are less educated [7].

Conventional approaches used in farming leads to many problems such as huge cost of labor, energy and water. The existing issues are solved by researchers with the help of precision agriculture that makes use of IOT which focuses on the automation of all areas of farming to make the process simpler and efficient. Internet of Things is a network that connects all objects to attain internet-based interconnection and interoperability. It uses many end devices and equipment's that are not restricted by region. Four primary techniques are intended for the practical implementation of the Internet of Things i.e. a sensor technology that can sense the information of objects and convert the information it feels into signals or other forms for output according to certain rules; an RFID technology which combines radio frequency with embedded technology; a Quick Response Code which is a recognition technology and an Embedded system technology that refers to an operating system applied to small devices [3]. In agriculture data is acquired using sensors and information is then transferred using wireless sensor network or GPRS/GSM network technology. WSN comprises of mostly sensors that measure the environmental conditions such as temperature, humidity, soil temperature etc [4].

2. Review of work done

In this section a review of already presented work in the field of plant disease detection has been provided along with the proposed methods. time data which is then transferred using the Zig-Bee module. This data is then sent to the server where data is analyzed for classification of diseases using the Hidden Markov Model. Raheela Shahzadi et al,[9] presents an expert system based on IOT for cotton crop. Various sensors for monitoring the crop are deployed in the field. The data from sensors is then sent to a server for processing. An expert system has been deployed at the server side that does analysis of the data using a knowledge base and provides information related to prediction of diseases as well as suggestion of pesticides for weeds and pests. A mechanism for the irrigation of the crop has also been provided. The information to farmer is given through a cell phone. The objective along with the parameters and hardware used have been demonstrated in the tabular form in table 1. The table has contrasted the comparison of existing disease prediction systems for crops. The issue of predicting crop diseases has been solved by various researchers in many ways.

S. Aasha Nandhini et al,[10] have proposed a Web Enabled Disease Detection System in this paper. Cameras are used in the field to capture the affected plant leaves on which a statistical based thresholding strategy of segmentation is performed. The technique of compressed sensing is used on the segmented images to lower the amount of data while uploading it on the cloud for further classification, using a support vector machine classifier. The reports are assessed by the experts after classification, and the data is sent to the farmers along with the solution, for the identified diseases for suitable intervention to enhance the crop yield. A high accuracy for detection of the disease has been obtained with this method.

Apeksha Thorat et al, [11] have made an attempt to detect the presence of diseases on plant leaves. They have collected data related to temperature, humidity and soil moisture using sensors in the farm, which is sent to Raspberry PI. Then image processing techniques are applied for detection of any disease on the plant leaf. Jayraj Chopda et al,[12] have worked on predicting the occurrence of disease in the cotton crop. Real time environmental data such as temperature and soil moisture are acquired with the help of sensors that are sent to an Arduino board. The collected data is then sent to cloud platform where it is analyzed with the help of Decision Tree Classifier. A mobile application is then developed to send alerts to the farmers.

Karim Foughali et al,[13] has presented a system for prevention of late blight disease in potato plant at an early stage. An application has been developed that makes use of a sensor network and a cloud server for the storage of temperature and humidity data. Then using a SIMCAST prediction model the risks that could damage the plants are predicted. The farmers are alerted about the attack of Late Blight disease. Sehan Kim et al,[14] This research proposes a model for the detection of Botrytis cinerea disease present in the strawberry plant. It is implemented using an IOT Hub network layer, that provides effective transfer of data for all the IoT devices as well as high communication reliability despite poor communication environments. Also, a middle layer of FaaS, a cloud-based technology capable of processing, analyzing and collecting the data is used.

Rajesh Yakkundimath et al,[15] in the paper proposes an automated system for identification of plant diseases. Various parameters like temperature, humidity and color of the plant are measured using various sensors. The data is then processed using the Arduino and is stored using a cloud platform where it is compared with some already present dataset which detects the presence of any disease on the leaf. S. Ramesh et al,[16] has used a system in this paper for the detection of blast disease in the rice crop. A camera is used for capturing the images of the plant on which image analysis algorithms like edge detection, thresholding etc. are used. The data is then sent to the cloud which has been synchronized with a mobile application that gives information to the end users. Ramesh S. et al,[17] In this paper the authors have proposed a method for the detection of diseases in rice crop at an early stage to save it from damage and increasing the agricultural productivity.The suggested system utilizes iot devices for monitoring the crop field and the information gathered is sent via the iot gateway in the field to the cloud. Cloud computing is then used to determine the crop's disease type and amount of infection and the farmers are notified about it through a mobile application. Table 1 summarizes the work done in the area of crop disease detection.

Table 1. Summary of work done

Title	**AUTHOR NAME**	**YEAR, & COUNTRY**	**PARAMETERS USED**	**HARDWARE USED**	**CLOUD PLATFORM USED**	**OBJECTIVE**
Early Detection of Grapes Disease Using Machine Learning and IOT [8]	Suyash S. Patil, Sandeep A. Thorat	2016, India	Temperature, Relative Humidity, Leaf Wetness.	Temperature Sensor, Relative Humidity Sensor. Leaf Wetness Sensor, Zig-Bee Module, Arduino Board, USB serial Adaptor.	Nil	In this paper an early and accurate identification of disease in grapes is done according to which right amount of pesticides and fertilizers can be scheduled and used by the farmers.
Internet of Things based Expert System for Smart Agriculture [9]	Raheela Shahzadi, Javed Ferzund, Muhammad Tausif, Muhammad Asif Suryani	2016, Pakistan	Temperature, Humidity, Leaf Wetness and Soil.	Waspmote Agriculture Sensor Board.	Nil	This paper presents an expert system based on IOT for disease detection and pesticide recommendation for cotton crop.
Web Enabled Plant Disease Detection System for Agricultural Applications Using WMSN [10]	S. Aasha Nandhini, R. Hemalatha, S. Radha, K. Indumathi	2017, India	Plant images	Raspberry Pi 3 Model B.	ThingSpeak	A high accuracy method for detection of the disease has been obtained, for pomegranate leaves,

						bri njal leaves and tomato leaves.
An IoT Based Smart Solution for Leaf Disease Detection [11]	Apeksha Thorat, Sangeeta Kumari, Nandakishor D. Valakunde	2017, India	Temperature, Soil Moisture, Humidity	Temperature sensor, Soil Moisture sensor Humidity sensor, Camera, Raspberry Pi.	Nil	In this paper the authors have developed a system for early detection of presence of diseases in the plant leaves.
Cotton Crop Disease Detection using Decision Tree Classifier [12]	Jayraj Chopda, Sagar Nakum, Vivek Nakrani, Prof. Hiral Raveshiya.	2018, India	Temperature and Soil moisture	Arduino Uno, Temperature Sensor (DHT 11), Soil Moisture sensor (KG003), Serial Wifi Wireless Transceiver Module.	ThingSpeak	In this paper the occurrence of diseases such as Anthracnose, Areolate and Wilt in cotton crop are predicted.
Using Cloud IOT for disease prevention in precision agriculture [13]	Karim Foughali, Karim Fathallahb, Ali Frihidab	2018, Tunisia	Temperature and Humidity	Wasmposte Nodes, XBee 802.15.4 Pro SMA 5dBi module, Zigbee interface, Meshlium Gateway.	Ubidots	This paper presents a system for prevention of late blight disease in potato plant at an early stage.
IoT-Based Strawberry Disease Prediction System for Smart Farming [14]	Sehan Kim, Meonghun Lee and Changsun Shin	2018, Korea	Temperature, Humidity, CO2 concentration, Nutrient Solution and Illumination Intensity	IoT-Hub (Samsung Exynos 4412 ARM Cortex-A9(Q-Core) 1.5 GHz) IoT devices (like greenhouse main sensors, load sensors, generic sensors, humidity and temperature sensors, actuators) Wired communication (RS-485, CAN, etc.) and nutrient solution supply system.	FaaS (Farm as a Service) System	This study provides a service for prediction of the presence of Botrytis cinerea disease in the strawberry plant using iot and cloud.

Plant Disease Detection using IoT [15]	Rajesh Yakkundimath, Girish Saunshi, Vishwanath Kamatar	2018, India	Temperature, Humidity and Color.	Temperature Sensor, Color Sensor, Humidity Sensor and Arduino UNO.	ThingSpeak	The paper proposes an automated system for identification of plant diseases
Rice-Blast Disease Monitoring Using Mobile App [16]	S. Ramesh, D. Vydeki	2018, India	Plant images.	USB Camera, Raspberry Pi 3 model.	Microsoft One Drive	This paper uses image analysis algorithms for detecting the blast disease in rice crop.
Crop Disease Identification Using Embedded Iot Systems [17]	Ramesh.S, Vydeki.D	2018, India.	Moisture, Water level, Humidity, Pesticides and Fertilizers.	Iot devices, iot gateway, cloud server.	Nil	The purpose of this paper is to provide help in detection of diseases in rice crop earlier.

4. Conclusion

In this age of IT and mobile internet, to attain more effective and precise agricultural development it must be integrated with sophisticated technologies such as IoT and cloud computing. There are various areas of agriculture where these techniques are employed. One of the most important amongst these domains is the detection of diseases and pests in various crops. Identification of these diseases at a preliminary stage is crucial as it protects the crops from damage and results in greater quality of yield and more profit for the farmers. This paper explores the researches carried out by various experts related to automated plant disease detection. This study can be valuable to scientists in discovering new methods and alternatives to counter the present agricultural trends, and to make the automation method more productive and efficient in the farming sector, thus achieving excellent business results.

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