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CLEVER FARMING WITH CROPS DISEASE DETECTION SYSTEM USING IOT AND ML.

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***Abstract*— Agriculture is the backbone of our country. Almost about 40% of annual global food supply loss is due to plant diseases. In developing countries, farmers generate 80% of agricultural products. For them, the loss of crops has a devastating consequence. Sometimes farmers lost 100% of crops due to some plant disease or illness. This makes crop illness a major threat to food security around the world. Identification of crop disease might be challenging due to the lack of lab infrastructure. Many IOT based manufacturing industries play an important role in the economic development of smart agriculture. Smart agriculture can include effective use of rain water, detection, and prevention of crops illness, detection and prevention of fire, prevention of animal intrusion in the field, etc by using different sensors and alarms. Crop disease is one of the most common problems which annoys farmers. So many times, farmers are not able to produce a good yield which results in less income for the farmer. This occurs due to various reasons like lack of minerals, soil humidity, changes in temperature, etc. Due to these parameters, illness in crops occurs which has an impact on product quality and quantity. IOT sensors can provide all necessary information to the farmers by properly monitoring the crops.**

Our goal is to create smart agriculture that utilizes the technologies like NodeMCU ESP8266, IOT, Android, WSN, and ML. The system monitors the temperature, humidity, wetness of the crops by using sensor NodeMCU ESP8266 and the farmer will receive a warning SMS on his smartphone using Wi-Fi. By using this proposed system farmers can easily detect the problemin the crop and this will help them to yield more healthy crops which will increase farmers' profit and food products in the country.

***Keywords*— Internet of Things (IOT), Wireless Sensor Network (WSN), Machine Learning (ML), NodeMCU sensor.**

I. INTRODUCTION

The art and science of refining the soil, growing crops, and raising livestock is known as agriculture. The role of agriculture in economic development is crucial because a majority of the developing countries population make their living from agriculture. It is more than just an industry; it is the foundation of human society, as the purpose is not just to cultivate food, but to achieve human perfection. The foundation for a happy and healthy society can be found in a booming agriculture industry. Because of the shrinking agricultural workforce in recent decades, the adoption of internet connectivity solutions in farming techniques has been sparked to reduce the demand for physical labor. Internet of Things (IoT) is an integration of multiple devices which can communicate, sense and interact with their internal and external state models. Due to these features IoT has become the best performance for next generation technology which can impact the whole spectrum with extended benefits which includes connectivity of end devices, system and services. IoT offers appropriate solutions for multiple applications such as IoT-cloud enabled CLAY-MIST measurement (CMM) index for smart agriculture monitoring system, using cloud IoT for disease prevention of in precision agriculture, IoT based smart agriculture: Towards making the fields Talk. A significant amount of work has been done regarding IoT technology in agricultural area to develop smart farming solution. IoT has brought a great revolution in agriculture environment by examining multiple complications and challenges in farming. Now a days with the advanced technology it has been expected that by using IoT agriculture and technologies are finding out the solution of those problems which farmer are facing such as diseases for plants, cost management and productivity issues. The IoT technologies have detected all these issues and provide solutions to increase productivity in less cost. Wireless sensors networks enable us to collect the data from sensor devices and send it to the main servers Data collected through sensors gives information about different environment condition to monitor the whole system properly. Monitoring the environment conditions or crop productivity is not only the factor for the evaluation of crop but there are many other factors which effect the crop monitoring movement of an unwanted object, sudden dry of water and attack of disease etc. Moreover, IoT provides a well-organized scheduling of restricted resources which makes sure that the best use of IoT enhances the productivity.

IOT is useful in many industries like Aerospace and aviation industry, automotive industry, Telecommunication industry, Medical and Healthcare industry, Environmental Monitoring. User awareness of IoT threats is evolving. Since 2008, Data Privacy Day (January 28th) has promoted consumer and community awareness of privacy and security controls over data. This awareness continues to grow with a steady drumbeat of headlines about malicious attacks ranging from extremes of "hacking the planet" to 2 malicious accessing of household items such as baby monitors. IoT awareness is defined as the degree to which users know the basics of growing security/privacy threats of IoT that they may encounter on a routine basis. Moreover, IoT privacy knowledge is defined as the degree to which users of IoT devices know about the unauthorized collection, secondary storage, and improper access of their personal information by IoT service providers. Additionally, IoT security knowledge is defined as the degree to which users of IoT devices know whether IoT service providers safeguard them against IoT security vulnerabilities to keep attackers from infiltrating their IoT devices and networks [2]. The Internet of Things (IoT) isa technology that allows any device to send or receive data over the Internet to a server. IoT solutions are aimed at assisting farmers in closing the supply-demand gap by ensuring high yields, profitability, and environmentalpreservation. The method of utilizing IoT technology to assure the most efficient use of resources in order to generate high crop yields while lowering operating costs. Sensors connected to the internet of things can provide data on agricultural lands. Farmers can use this technology to check the actual state of their crops without having to be present in the field. They surveyed various common uses of Agriculture IoT Sensor Monitoring Network technologies employing Cloud computing as the backbone in their study. This survey will be used to better understand the various technologies and to develop sustainable and intelligent agriculture. Equipment for indicating, observing, and controlling moisture levels as well as creature detection is available. The soil dampness sensor detects and measures the amount of moisture in the soil. The critters are detected by the PIR sensor, and a high recurrence sound flag is set. The pH sensor and the water stream sensor are used to speed up the composting process. Crop disease recognition using android phone is quite difficult. The application of several machine learning algorithms for crop disease categorization has recently become popular, with encouraging results in a few diseases and crops. The development of deep Convolutional Neural Network (CNN) based architectures has considerably improved classification accuracy [3]. MANET, is a technology for dynamic wireless networks, had been deployed in military since 1970s, and thereafter it had been applied in various applications such as; patient monitoring, airplane exhaustion breakage supervision, business associates sharing information during a meeting; attendees using laptop computers to participate in an interactive conference, remote landscapes monitoring, and emergency disaster relief personnel coordinating efforts after an earthquake [9]. We can include it in future for sending information to the farmer. Using 2 Ack protocol we can identify the authentication of the user. This will provide security to the user so that the warning SMS will be sent to proper user. By using this system can easily identify the malicious node in the network. The main infected parts of the plant include leaf blade, panicle and neck node. The diseases are differentiated with various applications including neural networks, fuzzy logic, remote sensing and SVM. Mostly recommended techniques are image processing for diseases identification system [10].

In proposed system we are creating a smart system for monitoring agricultural land and detecting crop diseases. Expected outcomes are:

- To identify the various diseases that impact plants at various stages of development.
- To keep track of variables such as soil moisture, temperature, humidity.
- Using a mobile application, provide farmers with real time alerts and notifications.
- To make farming easier for farmers by allowing themto manage all activities from their homes.

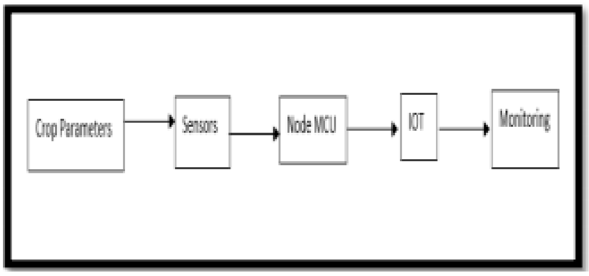

Fig 1: Flow diagram of IOT

From Fig 1 we can analyses the flow of system process, once the crop parameters are received then the it sent to Node MCU (ESP8266) through sensors. A soil moisture sensor, a humidity and a temperature sensor (DHT11) are all part of the IoT system. It is responsible for connecting these sensors to the NodeMCU (ESP8266). Finally, a farmer can monitor the system from his home.

Our goal is to identify the illness or decease if any present in the crop by using image processing and machine learning to distinguish the illness in a plant by looking at its morphology.

Plant Morphology is the study of the physical form and external structure of plants. For this purpose, we need to use ML algorithm which will identify the type of decease or illness and inform the farmer for cure.

This paper is divided into four parts: Literature Survey,

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Proposed Methodology, Result and Conclusion.

II. LITERATURE SURVEY

Smart Agriculture includes development in different areas such as monitoring of water supply, water absorption in the soil, Fire detection and preventionsystem, plant discus identification and prevention and so on. An autonomous sensor-enabled architecture usingdifferent self-powered wireless sensors that support real-time monitoring of agricultural parameters over various heterogeneous sensing data streams. This system allows the farmers to measure and monitor their farms remotely. The architecture is tested and evaluated using real scenarios encompassing the various aspects of theprecision agriculture process. The empirical results showthat the proposed architecture can be used in a variety of agricultural activities, including the control of irrigation water and the monitoring of agrarian conditions. Sensing and monitoring soil moisture play a significant role in the agriculture domain for assisting farmers in controlling and managing their irrigation methods more efficiently [1].

A smart watering system (SWS) based on a Fuzzy Logic controller using an Android to optimize water in small and medium-scale fields. They deployed a set of sensors based on Blockchain technology that allows trusted devices to capture plants' real time data and environmental conditions such as soil moisture, humidity, temperature etc. The Fuzzy Logic method is used to control the watering requirements and make the right decisions for turning water tunnels ON/OFF.

By using Fire Detection System (FDS) and Fire Prevention System (FPS) we can easily identify the firein the field. Once the fire is detected servo motor turns the pump towards the detected location and sprinkles the water in a very effective manner as set in Fire PreventionSystem (FPS) algorithm. The android application notifies the user/farmer on the regular status of the field and alarms notification when a fire is detected. The mobile application also has an option for the user/farmer to activate the water sprinkle system [4].

By using rain water properly in agriculture we can avoid crop damage against rains and downpours and can achieve good yield in farming lands. By using solar roof tops instead of normal panels, we can generate energy from it and it can be used for Agriculture activities[5].

IoT uses most advanced and simplest method of efficient crop monitoring for agricultural field. It observes soil condition and monitors the crop diseases. This application monitors a particular plant through web camera using IOT. The data is to be stored and retrieved from anywhere. After monitoring the crops, we can easy use the data for irrigation [6].

In future if we want to send information from one node to another node, MANET is the best solution for it. In MANET, nodes usually cooperate and forward each other's packets in order to enable out of range communication. However, in unfriendly environments, some nodes may deny to do so, either for saving their own resources or for intentionally disrupting regular communications. This type of misbehaviour is generally referred to as packet dropping attack, which is considered as one of the most destructive attacks that leads to the network collapse [7].

In the era of information technology, the elderly and disabled can be monitored with numerous smart devices. Sensors can be implanted into their home for continuous mobility assistance and non-obtrusive disease prevention. Modern smart houses, cannot only assist people with reduced physical functions but help resolve the social isolation they face. They are capable of providing assistance without limiting or disturbing the resident's daily routine, giving him or her greater comfort, pleasure [8].

III. PROPOSED METHODLOGY

As a part of smart agriculture farmer can use IOT based system and mobile applications. In hardware side we have IOT based systems which includes sensors which measure parameters like soil moister, humidity and temperature etc. Android Application comes under a software part which controls the hardware side in the system and provide information to the farmer which is our ultimate goal. We will create an Android app which will be connected to the hardware system via IOT and alerts so that the farmer can see the live status of temperature, humidity and moisture at any time.

Components required for the system: 1.Temperature and Humidity Sensor

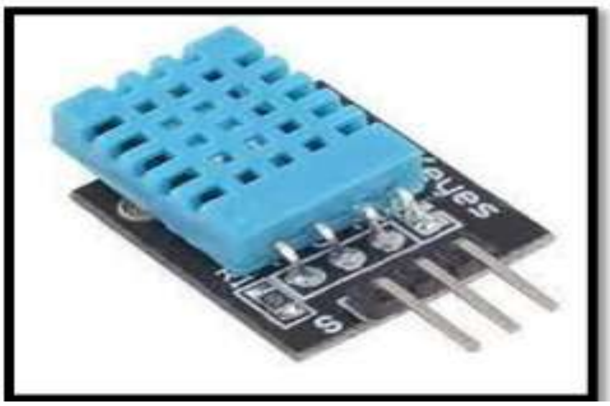

Fig 2 : Temperature and Humidity Sensor

The DHT11 is a basic digital temperature and humidity sensor with a modest price tag. It measures the ambient air with a capacitive humidity sensor and a thermistor and outputs a digital signal on the data pin. It is simple to use, but data collection takes careful scheduling.

2. Soil Moisture Sensor

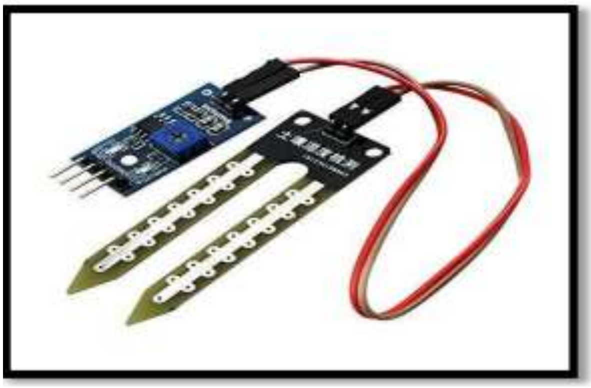

Fig 3: Soil Moisture Sensor

A soil moisture sensor is a device which is used to determine the volumetric water content of soil. The sensor uses other soil indirectly detect volumetric water content without removing moisture. It considers environmental factors like as soil type, temperature, and conductivity which may affect the final result, so it must be standardized.

3. Node MCU (ESP8266)

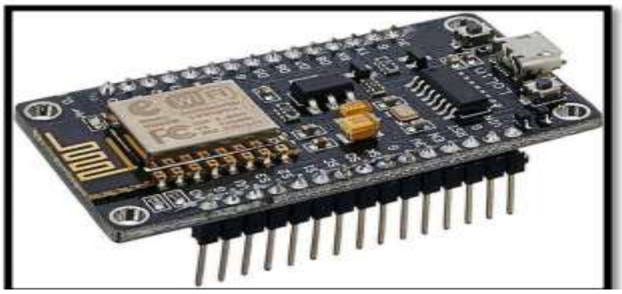

Fig 4: NodeMCU

The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" refers to the firmware rather than the associated development kits. The ESP8266 is a microcontroller with Wi-Fi capability. There are different modules and development boards with this system. NODEMCU is a development board with ESP8266 and a firmware with the same name.

In fig 5 we can see the arrangement of all components discussed in this part. These sensors collect data such as temperature, humidity, and moisture level from the farms and send it to the Node MCU, where the data is stored (ESP8266). It is a Lua based open-source firmware and development board designed specifically for IoT applications.

It consists of firmware that runs on ESP8266 Wi-Fi SoC and hardware that is based on the ESP-12 module.

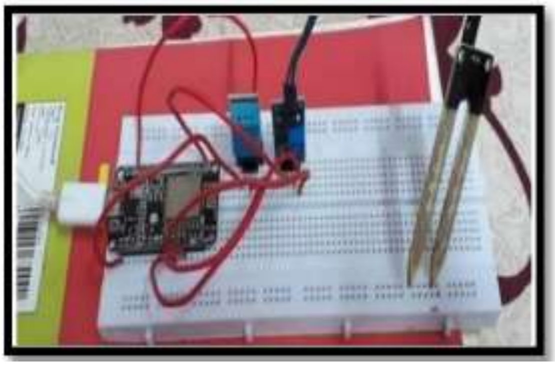

Fig 5: Hardware System

IV. CROP ILLNESS DETECTION ALGORITHM USING IOT AND ML

For identification of disease in crops, we will use the leaf images. On the bases of proposed algorithm, we will analyse the image and then our system will identify whether the leaf is infected or not. By giving knowledge to the system, we can reduce the loss of farmer.

A. Baseline Model in the proposed system:

- **Random Classifier:**

If we consider the random guessing as our baseline classifier then we will have an accuracy of about 2.6% approximately.

- **SVM Binary Classifier**

Another baseline model we can use is SVM binary classifier where we have 2 classes: Healthy or class zero and disease or class one.

For training the machine we can use 3000 images to train or test the SVM model. In this model 60% data for training and 40% for testing.

Steps involved in testing as below:

- Color image is converted into grayscale
- Generate histogram of originated gradients.
- Create the feature matrix
- Standardize the matrix
- Apply PCA for feature reduction
- Train the model
- Test

On the bases of the above algorithm, we can test the samples randomly and easily identify the problems in crops on early stage. This will increase the production and meanwhile give some positive impact on our economy.

V. RESULT

While implementing the system we can analysis the sample of random leaf for analysing as per the steps discussed in above section. Fig 6 shows the sample of random leaf and fig 7 represents the grayscale conversion of the same.

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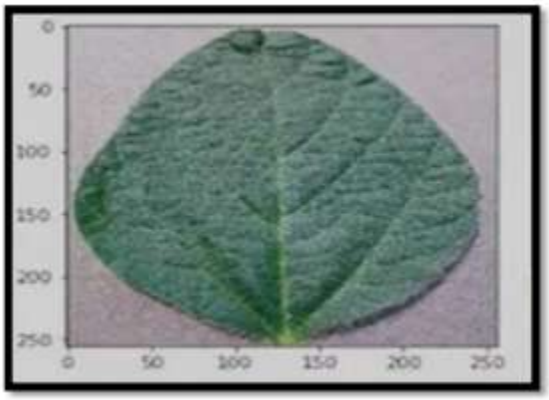

Fig 6: Random Leaf Image

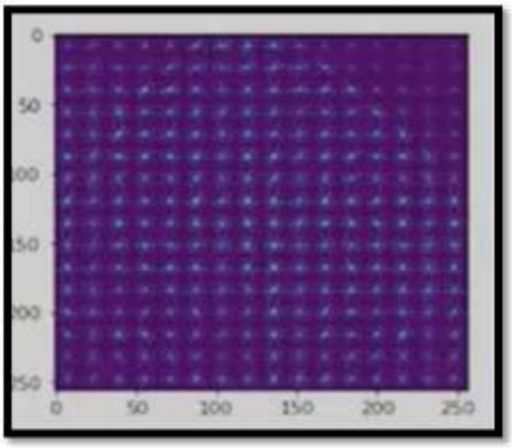

Fig 7: Grayscale of above image

Class	Precision	Recall	F1-score
0	0.68	0.68	0.68
1	0.66	0.67	0.66
accuracy			0.67

Fig 8: Accuracy by baseline model

On the bases of the algorithms, we can create an application which involves analysis of the images taken by the system. After capturing the image, the system will diagnose the image by using models like Random Approach model and SVM Model as discussed in previous section.

When we will use the application created for identification of disease, we need to upload the image from the browser then will get the uploaded image on left side of the screen and diagnosed information regarding that leaf on right side of the screen as shown in fig 9.

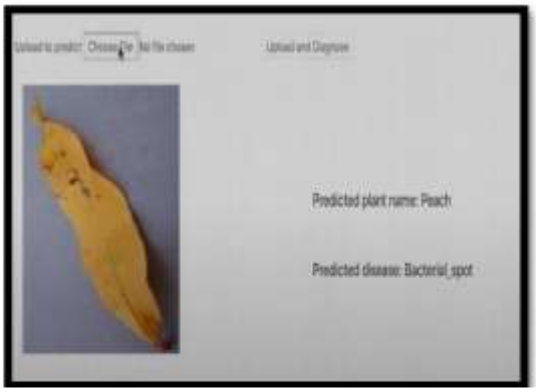

Fig 9: Output after diagnoses of the image by the system

Fig 10 Output after diagnoses of the image by the system.

Now we will try for healthy leaf, so we need to upload the leaf of a tree which seem to be healthy for testing. Herein fig 10, leaf of corn has been uploaded andafter diagnoses we can see the result on left side of the screen which shows that the leaf is healthy. In this way we can check the health of the crops by analysing the images.

VI. CONCLUSION

This paper explores IoT-based Smart Farming technology, as well as Machine Learning-based plant disease detection technique. The system helps the farmer in reducing his physical labour and increasing his output.Hardware part and software parts of the system like algorithms for identification of disease discussed in detail.

VII. FURTURE SCOPE

We can install the application on the drones to scan the entire field to improve the efficiency and save the time of the farmer by increasing the coverage of inspected area.

VIII. REFERENCE

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