Iot And Python Based Smart Agriculture System For Effective Plant Growth

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ABSTRACT

The Internet of Things (IOT) is a reassuring technology that offers methodical and rational answers to the transformation of numerous domains. Several studies and analyses have been undertaken, and several ways have been developed to deploy IoT technology to agricultural areas. IoT may play a critical role in detecting diminishing plant health and taking relevant steps. It is a significant step toward smart farming. In this research, we offer a methodology for developing an automated framework that would spot crop degradation in its early stages, which are invisible to bare humanoid senses. This strategy aids in the avoidance of large victims while also saving a significant amount of time and work. The suggested approach creates a credit outline by by means of instruments such as humidity, wetness, temperature, and vegetable foliage colour. The information after the sensors is transferred to the Arduino Cloud, which analyses the information and aids in the identification of plant degradation. The IoT will play an important role in the smart agricultural system in the next years.

Keywords: Smart farming, IoT, python, crop development

1. Introduction

India is an agrarian nation, and as 2/3 of the population relies on agriculture for basic needs, it is the mainstay of the nation's rapid economic development. Furthermore, a significant portion of the population might find work opportunities in agriculture [1]. Farmers need healthy plants in order to provide a decent crop. In order to prevent diseases that restrict plant growth, it is crucial to monitor plant health at different phases of plant development. When vermin and sicknesses are widespread, crop growth and agricultural output are dramatically decreased. The techniques used in the agricultural sector nowadays need independent judgement, which takes a more time and work. Automated diagnostics may be able to detect plant diseases early, which would enhance productivity by stopping further plant deterioration [2].

Actual objects that are now connected to the Internet and gather and share data are referred to as "Internet of Things" (IoT) devices. By being connected to one another and equipped with sensors, the gadgets gain a level of digital development that enables them to convey data in real period without an operator's involvement. Agriculture businesses must use Internet of Things (IoT) technologies [3]. The Internet of Things raises field production efficiency, enhances crop quality, and lessens unfavourable environmental effects [4]. By connecting the agricultural sector to computer-based systems, the Internet of Things (IoT) might lessen the need for direct human interaction. The need for food will increase due to the exponential growth in global population [5].The main objective of the proposed system is to use IoT to identify and determine if the plant is unwell or deteriorating.

The majority of plant diseases first appear on the leaves [6]. As a result, the information provided in this research, based on variations in temperature, humidity, wetness, and colour, aids in the differentiation between healthy and diseased/decayed plant leaves. The devised system makes use of Arduino as well as a number of sensors to keep track of the health of the crops [7]. This study's objective is to provide real-time environmental monitoring sensors built on the Arduino platform for the identification of agricultural diseases. The overall effectiveness, output, and efficiency of the agricultural system are improved through the deployment of Wireless Sensor Networks (WSNs) in agriculture [8], [9]. Wireless technology is being developed to track agricultural deterioration as well as field air quality. The goal of the projected project is to use sensors to evaluate temperature, colour, moisture content, and humidity in order to detect plant problems early. Subsequently, the collected data will be transferred to the Thingspeak cloud-based website. The economic paradigm is being significantly changed by cloud computing [10].

The remaining body of research is structured as follows: An introduction to the related works in the chosen subject is given in Unit 2. The structure and building of an IOT-based system for spotting plant degradation, together with algorithms and pseudocodes, are presented in Unit 3. While Unit 4 addresses the experimental and performance analysis findings in Unit 5, Unit 5 finishes the study with a comparison of related studies and recommendations for future work.

2. Research problem

In India, the majority of people rely on agriculture for their livelihood. It is our top goal to provide India's growing population with the food it needs. Therefore, finding a strategy to boost agricultural productivity has become essential. Crop deterioration, which might comprise root rot, disease infections, nutrient deficiencies, etc., has had a negative impact on agricultural production. One method is to spot plant degradation in its early stages so that farmers may take the appropriate steps to offer their crops a better life. Legal phytosanitary examinations are necessary to forecast plant diseases at all stages of plant growth. Technology based on sensors and actuators will assist in identifying the plant circumstances based on atmosphere temperature, humidity, wetness, and colour. This is the driving force for the implementation of this IoT system, which will benefit farmers in terms of technology. Farmers' crops will be better protected as a result. To solve this issue, a simple model must be created that uses sensors and actuators to track crop deterioration.

3. Literature survey

Crop health may now be assessed without the intervention of labourers, due to IoT. It is recommended to gradually increase watering and plant growth. They were having difficulty regulating the slow plant development. For a number of reasons, research has sought to minimise soil removal, but they were unable to ignore the significant energy cost. They also lacked food and soil resources. Ramesh et al. present a strategy for detecting early disease and informing farmers. The amount of pollutants absorbed by the plant and the various sorts of sickness may be estimated using cloud computing. Farmers get this information using a smartphone app. In agricultural situations, IoT may be utilised to detect obvious improvements in productivity and can even assist raise crop yield. The leaves, according to the researchers, may provide information on present weather conditions such as temperature, humidity, and colour. Temperature, humidity, and colour sensors detect changes in a plant's environment, which the Arduino software analyses and examines. As they analyse the input photographs, a number of researchers highlight the merits and limitations of machine learning and artificial intelligence. There are articles that summarise the possible solutions to the given problem. In one research, an IoT device based on a Raspberry Pi is used to update database components as well as to photograph plants for plant disease detection. The afflicted area is segmented using the K-mean cluster approach. For recognising plant diseases, researchers have proposed a programming framework based on computer vision. caused sickness.

Two phases in the identification procedure employing PC vision technology are the separation using k mean bunch and emphasising the removal of the distorted area of the leaf. The proposed work allows you to monitor the Internet of Things, collect data from a plant disease detection module, and receive and store signals from sink nodes. Norm filtering is used to generate the node images, which may be utilised to identify plant ailments. The researchers detailed how they employed image segmentation and feature extraction algorithms on leaf pictures to identify plant illnesses in their presentation. Khattab developed a cultivation monitoring system to maintain the plants' perfect growth and to predict early epidemic circumstances in order to defend the plants. The farming monitoring scheme delivers the facility of recording earth and ecological data in a database through radio sensor networks. As a consequence of IoT improvements, investigators industrialized a mist system and analyse and predict data from agrarian regions on a communal mist stage. In addition to monitoring environmental and growth data, the scheme annals, protects, and regulates IoT plans. Researchers developed an embedded system that analyses sensor data and predicts the requirement for irrigation depending on soil moisture using classification machine learning algorithms. The system is an intelligent autonomous irrigation system that collects sensor data on the temperature and moisture content of the soil through the Internet of Things.

There have been efforts using Python and OpenCV that just consider the colour of the leaves, ignoring other important climatic parameters. The Arduino was coded in C, while machine learning researchers must build their systems in Python. The similar consequences were obtained by means of the Raspberry Pi and machine learning. There are papers that describe an procedure that just uses soil moisture and optional sensors to irrigate crops. Other models, on the other hand, take into consideration more than five variables, such as pH and sunlight. This system might be better additional by adding extra sensors and mixing them with IoT. We utilised a Wi-Fi module in this model to send data and graphs from Tinkercad to the internet.

4. Proposed system

For collecting information from verdure leaves, the recommended architecture consists of temperature, moisture, and colour sensors. The colour, moisture, temperature, and humidity sensors capture these changes in a crop, which are then analysed by the Arduino software. The foundation for identifying plant degradation is shown in Figure 1. The information gathered by the Arduino gadget is then wirelessly directed to Thingspeak, a cloud website, for analysis and research. Farmers are then supplied the data once it has been analysed so they may take the necessary precautions to prevent plant diseases in the future. Fig. 2 depicts the schematic layout of the system that we propose.

Generally speaking, the techniques listed below may help diagnose plant diseases and direct information to the cloud:

(a) Data collection: At this step, we gather data by collecting samples of different leaves. After operating on examples, the sensors analyse them founded on their numerous features and gives information.

The TMP36 is a minimum-voltage, very accurate Celsius sensor. b) Temperature sensors. gives out a voltage in proportion to the temperature in Celsius. In the absence of external calibration, TMP36 maintains standard accuracy. The temperature of the leaf will be calculated by this sensor, and it will be compared to the perfect temperature obligatory by the plant.

(c) Light Sensors: The microcircuit is built to identify the kind of bright that it is being exposed to. Numerous photodiodes covered in four distinct types of filters make up this device. This would enable us to evaluate the leaf's condition before degeneration started.

(d) Humidity Sensor: A DHT11 is used as a humidity detector as a sensor with a display and light indication is used to detect humidity. The sensor will display the proper amount of moisture that the plant needs.

(e) Tinkercad: A group of free connected tools called Tinkercad may assistance persons all around the globe think, make, and do things. The system are combined with Tinkercad to produce a simulation.

(f) Website: Sends the collected data to the cloud via the "ThingSpeak" cloud stage. We may gather, visualise, and analyse real-time data streams in the cloud using the ThingSpeak IoT inquiry platform service. It uses architecture to transmit our data, which is then received and shown with charts.

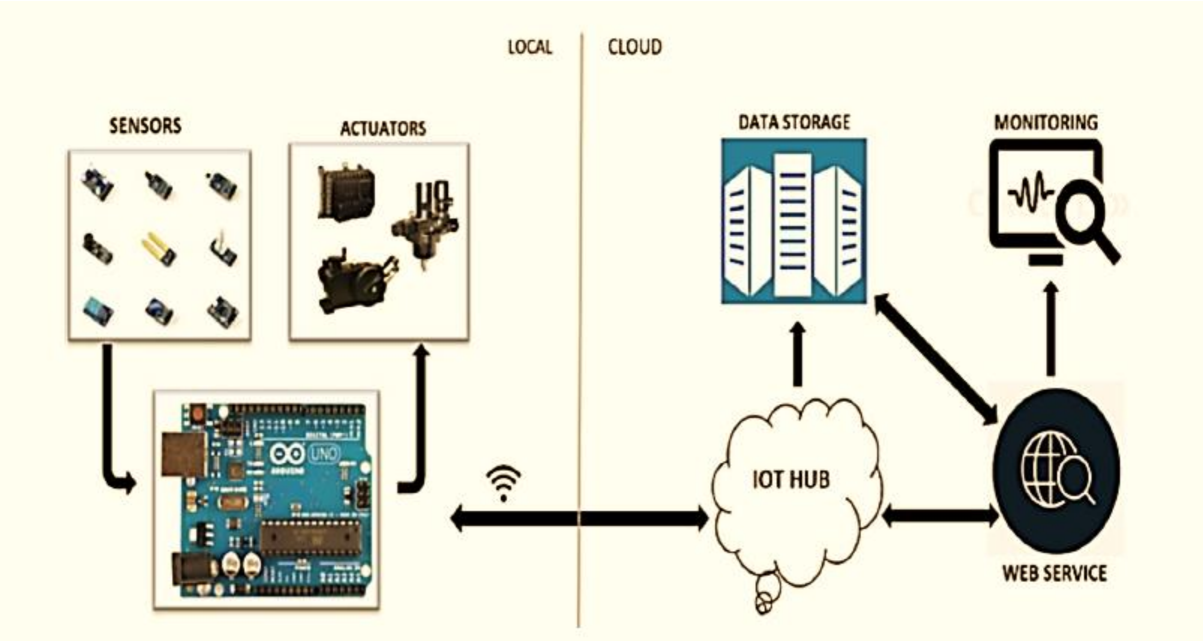

Fig. 1. Plant decay proposed system

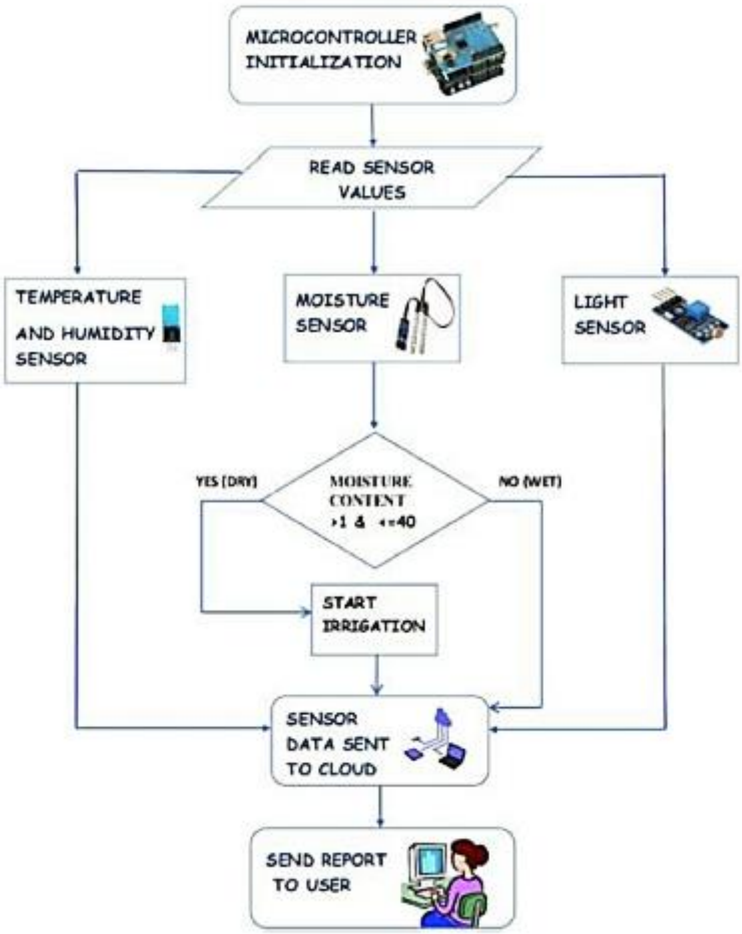

Fig. 2 Flowchart of the proposed system

5. Algorithm and programming

Our method entails captivating a real plant leaf and passing it via devices. If image processing had been utilised, this might have also been done with a plant picture. This will contribute to the advancement and smartening of agriculture's artificial intelligence. SCA refers to our goal of automating agricultural chores (smart croft algorithm). The Smart Croft Algorithm identifies plant damage by monitoring water, sunshine, and temperature. The algorithm used in this research is shown in figure . The algorithm is converted as a python program and transmitted for further processing.

Begin the algorithm.
Step 1: Provide a leaf as input.
Step 2: Measure the temperature of the plant leaf using the TMP36 sensor.
Step 3: Determine the temperature if (temperature minimum range temperature maximum range)
"Normal leaf" display
Else
"Affected leaf" Display
Step 4: Determine the RGB value
If (minimum RGB value, maximum RGB value)
Otherwise, display "Normal leaf."
"Affected leaf" should be shown.
End
Step 5: Determine the humidity if the moisture value is more than 40.
Begin Irrigation
Otherwise, send data to the cloud.
"Normal leaf, no watering required"

5. Result and Discussion

The Tinkercad connections below take into account the humidity, temperatures, and photocells mentioned above. These circuits may be easily comprehended as graphs when connected to a cloud-based tool like Thingspeak, helping farmers spot issues. Sensors that measure temperature, light, humidity, and moisture gather data from the plant. Following that, the measurements are contrasted with the user-specified goal values. The plant is regarded as being free of disease if the results are significantly below the threshold. However, the plant could get polluted if the temperature is greater than is ideal. Similar to this, if a plant is the wrong colour, it can be unhealthy. This is seen by the light sensing device. The vegetable may be rotting if its moisture content reading is greater. The irrigation system, on the other hand, is straight on to water the fields if the plants has a very small wetness content. The farmer may use this model to predict crops and take the appropriate action. Temperature: The pigments utilised in the leaves are what give them their vibrant colours. As the temperature varies, the colour of the leaves also changes. Tinkercad's TMP36 was used in this experiment. The temperature of the leaf below thought is measured using the TMP36. Sensor information is sent to a website via a WiFi screen. The inputted data is stored on the cloud website for future use. The farmer may take the appropriate action if the temperature fluctuates more than is healthy for the plant.

Humidity: As plants transpire, the air around them becomes more and more humid, soaking their leaves. A plant cannot create water when the comparative moisture is maximum, there is inadequate mid-air movement, evaporation from the soil. The plant perish if this keeps happening over a lengthy period of time. A plant's transpiration rates increase in response to high temperatures and low humidity, lowering the need for fertiliser. The server, which is connected to the Arduino UNO by a WiFi, receives the data variables from the DHT11 sensor and uploads them to it. If the moisture measurements change more than is required when

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss 1, 2022

nursing the plant, the farmer could be informed. Wetness: The Soil Moisture Sensor uses resistance to determine the electrical conductivity of the immediate environment. Soil electrical conductivity is a measure of the water quality. The sensor makes a voltage proportionate to the soil's conductance, and therefore, to the amount of water in it. A cheap, user-friendly tool for figuring out the moisture content of soil is a soil moisture sensor. Varying crops need different moisture levels for the best yield. Using the soil moisture data provided by the Thingspeak platform, farmers should be able to estimate the quantity of moisture in the soil. Photoresistor: Plants need light to survive. The quantity of light they absorb determines how quickly they grow and how well they live. Intensity of light has a considerable effect on blooming, stem length, leaf colour, and food production in plants. Low-light plants often have tiny, delicate leaves that have a vibrant green colour. Small plants will also flourish in direct sunshine. Bright light-loving plants have smaller, denser, more capacious branches, and dark green leaves. According on how much light they need, plants are divided into three categories. The normal photoresistor value is considered while analysing the Thing speak graphs.

The previously mentioned Tinkercad connections are combined with the Thingspeak internet platform [6]. Thingspeak is an open-source Internet of Things software and API that uses the HTTP and MQTT protocols to store and retrieve data from objects via the Internet. When every link is correctly made, Tinkercad creates graphs to aid with comprehension. A better understanding of the variations in a variety of environmental parameters, such as temperature, humidity, and moisture, would be helpful to farmers. These are some of the elements that must be taken into account since they have a significant impact on the outcome of the crop. Table 1 displays the results of the time vs. temperature experiment. We changed the Tinkercad sensors such that the outdoor environmental factor (Fig. 4(a)) gradually rose before a little decline. The graph in Figure 4(b) in Table 2 shows the time vs. humidity data, and it shows that the atmosphere's humidity fell sharply at first and varied little afterwards.

The monitored time vs. moisture figures are shown in Table 3 as a final illustration. The graph created using the information from Table 3 is shown in Figure 4. (c). The soil is the component that affects a plant's development the most. Rendering to the graph, soil wetness has been increasing over time. Maximum of India's areas have hot or subtropic climates with slight seasonal temperature variation. Since India has a diverse spectrum of climates dispersed across a huge geographic area and varied terrain, it is difficult to generalise about its climate. The complicated meteorological condition that prevails in a particular area and gives that location its own landscape character is known as the climate. All climatic conditions and long-term changes have culminated in it. The most significant meteorological variables are evaporation, temperature, relative humidity, precipitation, and relative wind speed. On the other hand, sensors and actuators are unable to keep track of every one of these parts.

Table 1. Period and humidity of the environment

Time (PM)	Humidity
2.20	35.8
2.22	32.4
2.24	29.8
2.26	33.1
2.28	35.1
2.30	34.5

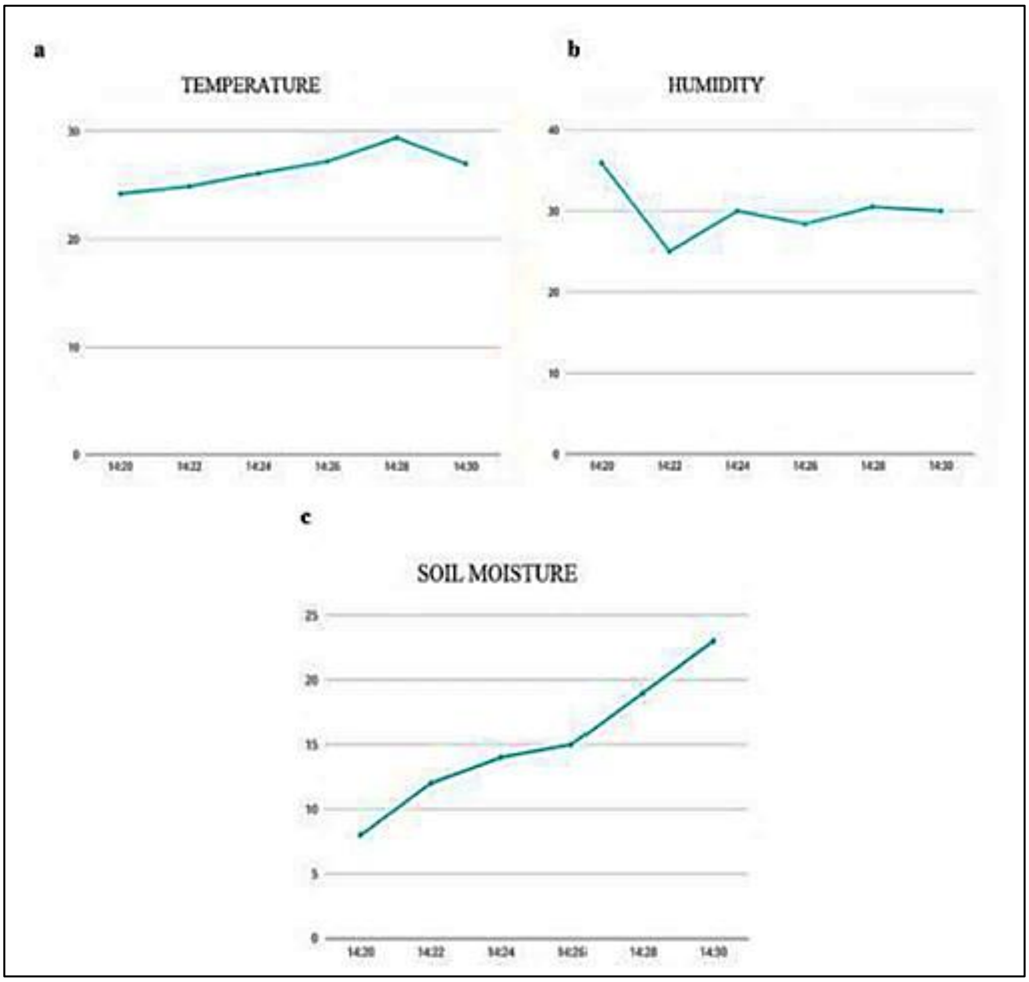

Fig. 3. (a) Atmospheric condition; (b) Humidity (c) Moisture content of the soil

Table 2. Time and humidity of the environment

Time (PM)	Moisture content in the soil
2.20	9.2
2.22	12.5
2.24	17.5
2.26	28.1

2.28	32.2
2.30	37.5

Conclusion

In this work, a method is created to assess the leaf consistency. The future system uses sensors to notice several parameters, such as environmental condition, moisture, wetness, and light concentration. As part of the strategy, we may employ an image dispensation technology to determine the disease. An intelligent system that many people can use has been developed. It facilitates widespread early sickness diagnosis.

This method assists farmers in improving their results and increasing their production by using technology that is easy for them to understand, use, and spread to other farmers. Only a leaf's health or illness may be determined using the suggested method. This method already specifies using a Wi-Fi module to send the sensor data collected to an online application. The projected system enhanced by including the GSM and informing farmers in real-environment on the state of their crops, which would help to detect plant degradation even earlier. The procedure, a major of sicknesses found in plants, and a list of those ailments may all be added to this. The main research areas in this study are temperature, humidity, moisture, and leaf light. Another drawback is that while determining the parameters under consideration, we employed a collection of opinions rather than exact numbers. By including these factors, any present agricultural sector will be better equipped to comprehend plant health and be prepared in advance to make decisions more swiftly

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