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Automated Irrigation using IoT and Plant Disease Detection using Image Processing and Artificial Intelligence

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Abstract - *India is the largest freshwater user in the world. 86% of water is used for agriculture, 5% for industry and the remaining 8% for domestic purpose. Water plays an important role in plant lifecycle. India is mainly an agricultural country. Irrigation is a vital component of agricultural production. The irrigation system can be classified as either manual or automatic. Compared to manual irrigation, the automated irrigation system can save water and maximize productivity. This method may sometimes lead to over or under irrigation. Manual irrigation takes a lot of time and effort. In automated irrigation water is supplied only when it is required with minimal or no human intervention. With the invent of plant diseases, the yield is affected adversely. Hence it is important to identify the disease at its earliest stages and find a cure to eradicate the disease.*

Key Words: **Farming, IoT, Machine Learning, Sensors, Digital image processing, Disease.**

1. INTRODUCTION

The main aim of this project was to provide water to the plants or gardening automatically using a microcontroller (Arduino Uno). We can automatically water the plants when we are going on vacation or don't we have to bother my neighbors, sometimes the neighbors do too much watering and the plants end up dying anyway. There are timer based devices available in India which waters the soil onset interval. They do not sense the soil moisture and the ambient. Temperature to know if the soil actually needs watering or not. Assimilation is that the artificial application of water to the land or soil. Re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. When a zone comes on, the water flows through the lateral lines and ultimately finally ends up at the irrigation electrode (drip) or mechanical device heads. Several sprinklers have pipe thread inlets on the lowest of them that permits a fitting and also the pipe to be connected to them. The sprinklers are usually used in the top of the head flush with the ground surface.

It has been well said that India is an agricultural country. According to 2014 the land share for agriculture is 60.4% and growing at an alarming rate of 0.03%. A country where there is a huge share of agriculture should be well acquainted with irrigation. Irrigation plays an important role in India, not only to artificially supply water to our crops but also to make our crops healthier. Due to global warming, there has been an unprecedented rise in temperature .across the globe and as a result, there are irregular and uncertain monsoons in the country. Technologies are growing and so do humans grow with them, and so do the automated irrigation in our country, which is a major step ahead to a modern India.

Irrigation helps to water the crops in the event of unexpected rains. There are a variety of crops grown in India, of which some require water in excess while others in very less water. To meet these requirements irrigating the crops is vital. Jute and Paddy require excessive amounts of water which cannot be fulfilled by rains and there is a need for watering them artificially. It also controls drought and other calamities faced by the country. For a country like India where the population is solely dependent on crops for the food, there is a necessity of further advancing our irrigation system so that our farmers do not toil all day.

Microcontrollers like Arduino are being used to make the system to nearly completely automated. Arduino like any other device is an open source platform which is capable of interacting with the objects by sensing them in the real world. The advantage of this little small electronic device is that it is very easy to learn and Irrigation Station with Supervised Learning using Artificial Intelligence implement. Arduino can receive inputs from many sensors and in turn can control the motors, solenoid valves. The image processing techniques can be used in the plant disease detection. In most of the cases disease symptoms are seen on the leaves, stem and fruit. The plant leaf for the detection of disease is considered which shows the disease symptoms. This paper gives the introduction to image processing technique used for plant disease detection.

1.1 Types of Irrigation

Surface Irrigation: Surface irrigation is the oldest form of irrigation and has been in use for thousands of years. In surface (furrow, flood, or level basin) irrigation systems, water moves across the surface of an agricultural lands, in an order to wet it and infiltrate into the soil. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding or near flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land and still used in most parts of the world.

Micro Irrigation: Micro-irrigation, sometimes called localized irrigation, low volume irrigation, or trickle irrigation is a system where water is distributed under low pressure

through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Traditional drip irrigation using individual emitters, subsurface drip irrigation (SDI), micro-spray or micro-sprinkler irrigation, and mini-bubbler irrigation all belong to this category of irrigation methods

Drip irrigation: Drip (or micro) irrigation, also known as trickle irrigation, functions as its name suggests. In this system waterfalls drop by drop just at the position of roots. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation if managed properly, evaporation and runoff are minimized. The field water efficiency of drip irrigation is typically in the range of 80 to 90 percent when managed correctly.

Sprinkler Irrigation: In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in^2 (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging.

Green wall Irrigation: Green wall also use a type of drip irrigation for watering. Gradient plays an important role in the way the green wall irrigation controller is set. If set incorrectly it could cause flooding at the lower half of the green wall and dry conditions at the top.

2. LITERATURE SURVEY

The author Ms.Sarika Rakshak et al., presents that the Cultivation Management System mansion here is based on cloud. The architecture of system allows user to achieve the above mentioned activities in prearranged time so that farmers can examine their farm field data details from anywhere in between the range. Monitor system mainly consist Hardware module that situated in farm or farm field that has various sensors, devices, ICs for data transformation and transfer. Then Cloud implemented as Software as a Services (SaaS) so that the Android smart phone used as a remote control to make Arduino based automated irrigation system easy-to-use. The system design includes a soil moisture sensor placed in different direction of farm field that provides a voltage signal proportional to the moisture content in the soil which is compared with a predefined threshold value. [1]

The author Mr.Chandan kumar sahu et al., presents a prototype for automatic controlling a irrigation system. Here prototypes includes sensor node and control node. The sensor node is deployed in irrigation field for sensing soil moisture value and the sensed data is sent to controller node. On receiving sensor value the controller node checks it with required soil moisture value. When soil moisture in irrigation field is not up to the required level then the motor is switched on to irrigate associated agriculture field and alert message is send to registered mobile phone. The experimental results show that the prototype is capable for automatic controlling the experimental results show that the prototype is capable for automatic controlling of irrigation motor based on the feedback of soil moisture sensor. This system is used in a remote area and there are various benefits for the farmers. [2]

The author Yunseop (James) Kim et al., presents. An automated closed-loop irrigation system requires three major components: machine conversion, navigation, and mission planning to support the solid communication protocol. This paper developed the machine conversion from a conventional irrigation system to an electronically controllable system for individual control of irrigation sprinklers and formulated the navigation of the irrigation system that was continuously monitored by a differential GPS and wirelessly transferred data to a base station for site-specific irrigation control. This paper also provided extensive details for the wireless communication interface of sensors from in-field sensor stations and for a programmable logic controller from a control station to the computer at a base station. Bluetooth wireless technology used in this paper offered a plug-and-play communication module and saved significant time and expense by using commercially available sensors and controllers equipped with serial communication ports.[3]

The author Sharada Prasanna Mohanty et al., proposed Using Deep Learning for Image-Based Plant Disease Detection Used For In the following method, the training dataset containing 150 -170 images of mulberry plant leaves are analysed and tested against the test dataset having images of 20 to 30 of the same leaf. The leaf is categorised into diseased and normal leaves. The normal is categorised into 2 species of the same plant namely red mulberry and white mulberry. Using the deep convolutional neural network architecture, the model is trained on images of plant leaves with the goal of classifying both crop species and the presence and identity of disease on images.

The image dataset before performing deep learning algorithms, are first processed. Across all our experiments, we use three different versions of the dataset. We start with the dataset as it is in colour. [4]

The author Sachin D. Khirade et al., proposed Plant Disease Detection Using Image Processing system where the system first acquires the image then image pre-processing is done. Then image segmentation is performed, later feature extraction in image is done which is then followed by detection and classification of plant disease. The system also uses the color co-occurrence model. The use of ANN methods

for classification of disease in plants such as selforganizing feature map, back propagation algorithm, SVMs etc. can be efficiently used. From these methods, we can accurately identify and classify various plant diseases using image processing techniques. [5]

3. PROPOSED SYSTEM

A] Image Acquisition

The images of the plant leaf are captured through the camera. This image is in RGB (Red, Green and Blue) form. Color transformation structure for the RGB leaf image is created, and then, a device-independent color space transformation for the color transformation structure is applied

B] Image Pre-processing

To remove noise in image or other object removal, different pre-processing techniques is considered. Image clipping i.e. cropping of the leaf image to get the interested image region. Image smoothing is done using the smoothing filter. Image enhancement is carried out for increasing the contrast. The RGB images into the grey images using colour conversion using equation.

f(x)=0.2989*R + 0.5870*G + 0.114.*B

Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images. The cumulative distribution function is used to distribute intensity values.

C] Image Segmentation

Segmentation means partitioning of image into various part of same features or having some similarity. The segmentation can be done using various methods like otsu' method, k-means clustering, converting RGB image into HIS model etc. In Proposed system data is sensed through sensors then ANN Machine learning algorithm is used for data Prediction. Sensed data is compare with data set which are stored on past experience, and result is produced.
As per the predicted result farmer will take decision from this system for profit gain.

As shown in above scenario sensors are deployed in farm which use are to sensed the data related to humidity, temperature, sunlight and wind speed. Artificial neural network algorithm is applied on sensed data to classify and to form cluster. Clusters are then analyses with predefined data set to generate the output. The predicted result shows the whatever diseases can be cause due to particular crop condition.

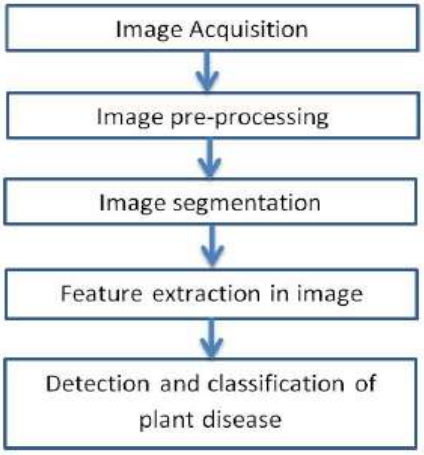

Fig -1: Plant disease detection flowchart

3.1 Technique

Artificial neural networks are most powerful learning models. They can have wide range of complex functions which represents multidimensional input-output maps. ANN is also an information processing paradigm that is motivated by way biological nervous system, such as brain. ANN is generally presented as system of interconnected "neurons" which send message to each other. Various types of artificial neural networks are available that are Perceptron, Multi-Layered Perceptron (MLP), Recurrent Neural Networks, Self Organizing Maps. In proposed system the MLP technique is used for data prediction. Artificial Neural Network are typically difficult to configure and slow to train, but once prepared are very fast in application. With image processing, first we need to pre process the image data i.e, the training data and then train the system using ANN algorithm to predict whether the plant has a disease or not.

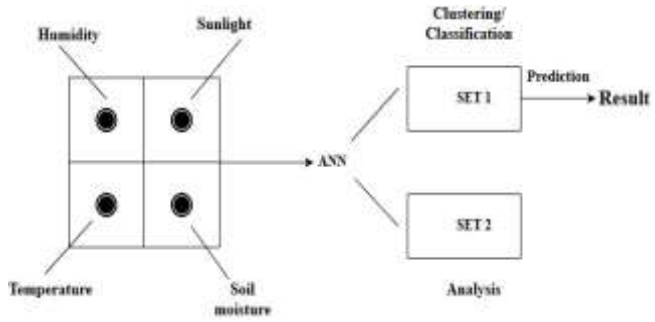

Fig -2: Sensor classification

Advantages:-

1. A neural network can perform tasks which linear program cannot.
2. It works even in the presence of noise with good quality output.

Disadvantages:-

1. Requires a lot of training and cases.
2. Often abused in cases where simpler solution like linear regression would be best.

4. ARCHITECTURE DESIGN

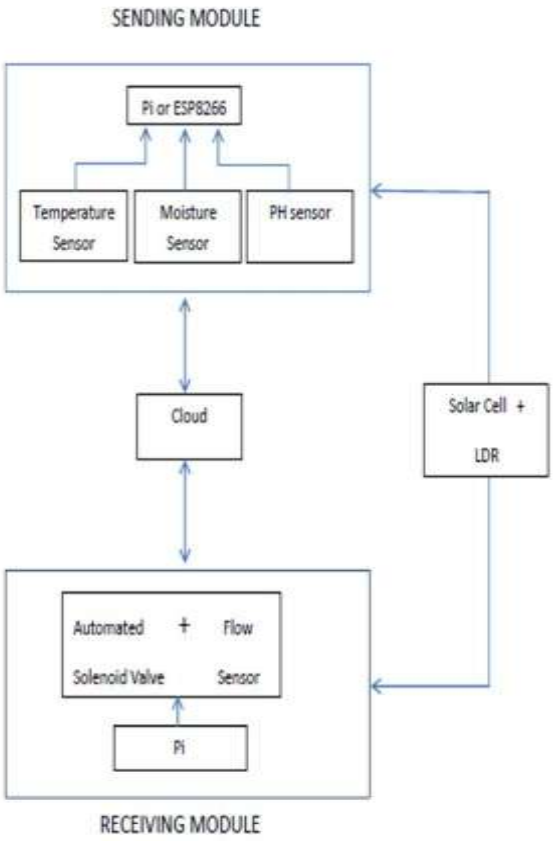

Fig -3: Architecture diagram

Acquiring data (Humidity, Temperature, Wind speed, Sunlight) from sensor nodes. Data transfer using IoT devices. Perform data prediction using Artificial Neural Network algorithm. Prediction about crop growth and diseases using machine learning.

Component of architecture design

Sensors:-
Sensors are used to sensed raw data related to humidity temperature, Wind speed, Sun-light.

Micro Controller:-
Micro controller is used to passed data from sensor to the IoT module.

Sending Module:-

Arduino esp8266 or raspberry pi, DS18B20 temperature sensor, Dielectric or electrochemical moisture sensor and analog ph sensor to sense the moisture and ph content in the soil, a solenoid automated value and flow sensor for flow controlled automated irrigation and solar cell as a power source and LDR to obtain the light Intensity.

Cloud:-

Data from each node is transferred to a gateway, using the wifi module in the esp8266. Then this data received by the gateway is uploaded to the cloud like firebase storage.

Receiving Module:-

In the receiving system, the data in the cloud is processed using AI based machine learning algorithms to obtain the best possible hypothesis, whose output contains the amount of water flow to particular segments in the field.

5. CONCLUSION

The proposed system provide agriculture solution using Artificial Neural Network Machine learning algorithm which is used for performing data prediction on data sensed by sensors. Due to use of IoT devices system provide automated solution for data prediction. The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing.

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