Smart Irrigation System Using ML

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Abstract: - Agriculture is one of the most fundamental resources of food production and also plays a vital role in keeping the economy running of every nation by contributing to the Gross Domestic Production. But there are several issues related to traditional methods of agriculture such as excessive wastage of water during irrigation of field, dependency on non- renewable power source, time, money, human resource, etc. Since every activity nowadays becoming smart it needs to smartly develop agriculture sector for the growth of the country. The Smart Irrigation System using IoT and Machine Learning projects present a system through which the water utilization is monitored according to the soil moisture and environmental conditions. A machine learning model is used to estimate the growth of the shoot length using the above-gathered parameters and assist the farmer. Various sensors like Soil moisture sensors are used to record the soil moisture levels and soil pH levels, the humidity, and temperature is measured using DHT11 a basic, ultra low-cost digital temperature, and humidity sensor. This data is analyzed to generate two outputs. The first is to decide the amount of water required henceforth using current and past data to automatically triggering the irrigation system. The second is to capture the image of the plant by using stationary camera and after clicking the picture if there is any problem or defect, it will immediately notify the farmer to take some action. This will reduce the efforts of the farmer and help to improve quality farming.

Key Words: — ***Irrigation, IoT, Machine Learning, Microcontroller, Sensor.***

I. Introduction

Aim is to develop a wireless three level controlled smart irrigation system to provide irrigation system which is automatic for the plants which help in saving water and money. The main objective is to apply the system for improvement of health of the soil and hence the plant via multiple sensors. Appropriate soil water level is a necessary pre-requisite for optimum plant growth. Also, water being an essential element for life sustenance, there is the necessity to avoid its undue usage. Irrigation is a dominant consumer of water. This calls for the need to regulate water supply for irrigation purposes. Fields should neither be over-irrigated nor under-irrigated. The objective of this thesis is to design a simple, easy to install methodology to monitor and indicate the level of soil moisture that is continuously controlled in order to achieve maximum plant growth and simultaneously optimize the available irrigation resources on monitoring software LabVIEW and the sensor data can be seen on Internet.

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In order to replace expensive controllers in current available systems, the Arduino Uno will be used in this project as it is an affordable microcontroller. This research work enhanced to help the small-scale cultivators and will be increase the yield of the crops then will increase government economy.

II. RELATED WORK

Paper 1: “IoT BASED IRRIGATION REMOTE REAL-TIME MONITORING AND CONTROLLING SYSTEMS” (2019)

The Internet of Things (IoT) attempts to make daily objects smooth, giving them the skills to sense numerous situations of their environment or of their own action interconnect and reply to real-world events. Farming uses 85% of accessible fresh water resources world-wide, and this proportion will continue to be leading in water resources intake because of population growth and bigger food demand. There is a crucial need to produce to produce plans based on science and technology for bearable use of water, comprising technical, agronomic, Administrative, and institutional improvements. Irrigation plays a significant role in agricultural does, and agricultural irrigation schemes are the largest user of water in the water. In this work, IoT based irrigation system by examining the pH value, of the water accumulated in the pond and soil moisture in the soil to make it more innovative, risk minimize, user friendly, time saving and more efficient than the existing system. The pH value sensor, Water level sensor and temperature sensor measure the water, soil.

Paper 2: “PRECISION AGRICULTURE FOR SMALL TO MEDIUM SIZE FARMERS – AN IoT APPROACH” (2019)

In this Paper, two important effects related to population growth which are respectively, cities being bigger and decreasing arable surface. Improving the soil yield with IoT is a new to feed this population growth. Proposed solution integrates IoT to monitor more precisely agriculture. This development of the first prototype and are going to start the tests on the fields. The subsequent manufacture of a SoC will demonstrate on site how farmers can be helped to improve soil yield.

Paper 3: “SMART AGRICULTURE SYSTEM USING IoT TECHNOLOGY” (2019)

This paper proposes a thought of consolidating the most recent innovation into the agrarian field to turn the customary techniques for water system to current strategies in this way making simple profitable and temperate trimming. Some degree of mechanization is presented empowering the idea of observing the field and the product condition inside some long separate extents utilizing cloud administration. The points of interest like water sparing and work sparing are started utilizing sensors that work consequently as they are modified. This idea of modernization of farming of farming is straightforward, reasonable and operable. As relying upon these parameters esteem rancher can without much of a stretch choose which fungicides and pesticides are utilized for enhancing crop creation.

Paper 4: “IMAGE PROCESSING FOR SMART FARMING : DETECTION OF DISEASE AND FRUIT GRADING” (2013)

In this paper image processing used as a tool to monitor the disease on fruit during farming, right from plantation to harvesting. For this purpose artificial neural network concept is used. Three disease of grapes and two of apple have been selected. The system uses two databases, one for training of already stored disease of images and the other for implementation of query images. Back propogation concept is used for weight adjustment of training database. The images are classified and mapped to their respective disease categories on basis of three feature vector, namely, color, texture, and morphology. From these feature vector morphology gives 90% correct result and it is more than other two feature vectors. This paper demonstrates effective algorithms for spread of disease and mango counting. Practical implementation of neural networks has been done using MATLAB.

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III. PROBLEM DEFINITION

In India, agriculture is the need of most of the Indians livelihood and it is one of the main sources of livelihood. Agriculture also has a major impact on economy of the country. The consumption of water increases day by day that may leads to the problem of water scarcity. Now a days not only for crops outdoor plants in home becoming quite difficult for them.

- Conventional Irrigation Methods The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surfaces saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone. Water is supplied frequently, often daily to maintain favourable soil moisture condition and prevent moisture stress in the plant with proper use of water resources. Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labour. Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry.

- Problems in Traditional System In the case of traditional irrigation system irrigation is done manually by farmers. Since, the water is irrigated directly in the land, plants under go high stress from variation in soil moisture, therefore plant appearance is reduced. The absence of automatic controlling of the system result in improper water control system. The major reason for these limitations is the growth of population which is increasing at a faster rate. At present there is emerging global water crisis where managing scarcity of water has become a serious job. This growth can be seen in countries which have shortage of water resources and are economically poor. So this is the serious problem in Traditional Irrigation System. Limitations of existing system: Physical work of farmer to control drip irrigation Wastage ofwater Wastage of time.

- Smart Irrigation System Smart irrigation systems offer a variety of advantages over traditional irrigation systems. Smart irrigation systems can optimize water levels based on things such as soil moisture and weather predictions. This is done with wireless moisture sensors that communicate with the smart irrigation controls and help inform the system whether or not the landscape is in need of water. Additionally, the smart irrigation controlled receives local weather data that can help it determine when a landscape should be watered. The Smart Irrigation System is an IoT based device which is capable of automating the irrigation process by analysing the moisture of soil and the climate condition (like raining). Also the data of sensors will be displayed in graphical form on BOLT cloud page. The advantages of these smart irrigation systems are wide reaching. The smart irrigation system will help you have better control of your landscape and irrigation needs as well as peace of mind that the smart system can make decisions independently if you are away.

IV. PROPOSED SYSTEM

Sensor: They are generally use to sense the environment and give the output to the user with respect to the readings.

IoT gateway: Establish the connection between the IoT module on internet

Node MCU: IT use to establish local client and cloud network communication

Pump Control: Used for water supply.

Thinkspeak: For Visulization of the sensed data by the sensor o real time bases.It is connected with Node MCU.

Machine Learning: Support to various algorithums used for image recognization purpose. CNN and Classification algorithm are used.

Camera: It is used for the capture the plants growth after the specific time interval.

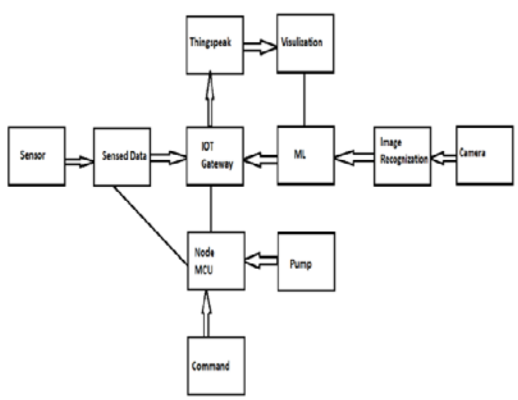


Fig.1.Prototype Of Smart Irrigation System using IoT

4.1 Architectural diagram:

Every Convolution Neural Network include local or global pooling layers, which combine the outputs of neuron clusters. They also consist of various combinations of convolutional and fully connected layers, with point wise nonlinearity applied at the end of or after each layer. A convolution operation on small regions of input is introduced to reduce the number of free parameters and improve generalization. One major advantage of convolutional networks is the use of shared weight in convolutional layers, which means that the same filter (weights bank) is used for each pixel in the layer; this both reduces memory footprint and improves performance.

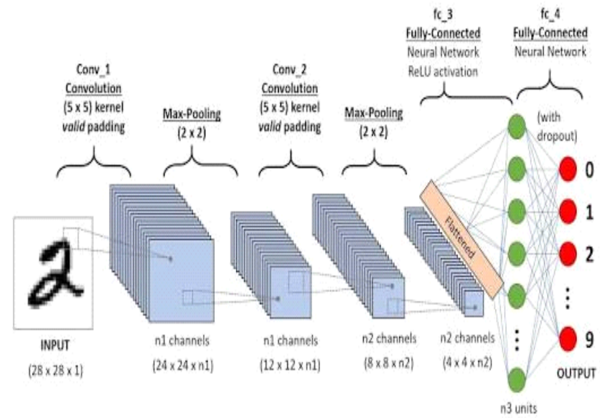


Fig.2. Architecture of proposed system.

4.2 Advantages of Proposed System:

- Save water and money.
- Save your customers money.
- Make maintaining yard easy and convenient.
- Minimize the infrastructure to store and carry wate.
- Protect the water resources for future generations.

4.3 Algorithm:

- Internet of Things Model

loop()

{

//read value from LDR pin

val = analogRead(LDRpin)

if(val is greater than set threshold)

{

1) Start Irrigation System Mechanism

2) Set val to 0

3) Delay

}

Else {

- Stop the Irrigation System
- Set val to 1;

}

Print (val) to online server

}

4.4 Machine Learning Model:

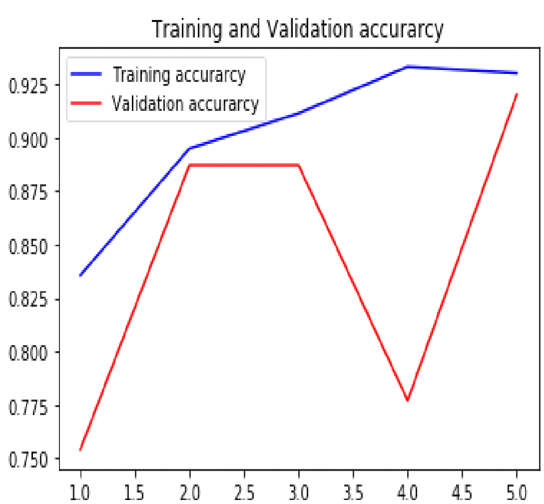
- *Step 1*: Get current image of leaf form stationary camera.
- *Step 2*: Feed the image to the CNN module.
- *Step 3*: The module process the image to identify if the is any effected area of the leaf with diseases
- *Step 4*: The output of the neural network classifies the plant condition nto 5 categories which are
  a) Healthy
  b) Bacterial Spot
  c) Early blight
  d) Late blight
  e) Septoria leaf spot
- Step 5: End

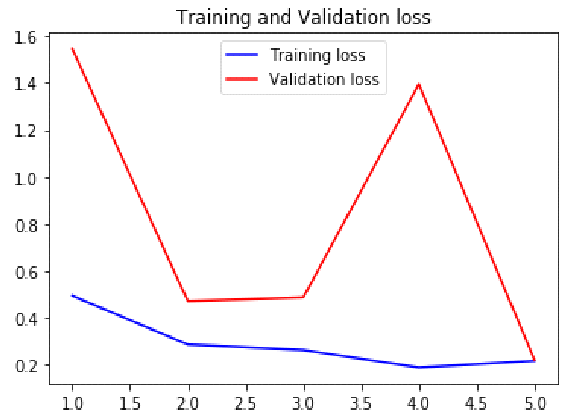
V. RESULTS

Compare old and new results (table)

Accuracy histogram

```
[INFO] Calculating model accuracy
200/200 [==============================] - 43s 216ms/step
Test Accuracy: 91.99999952316284
```





5.1 Experiment Results

Details of number of hidden layers:

Deep CNN with ReLUs trains several times faster. This method is applied to the output of every convolutional and fully connected layer. Despite the output, the input normalization is not required; it is applied after ReLU nonlinearity after the first and second convolutional layer because it reduces top-1 and top-5 error rates. In CNN, neurons within a hidden layer are segmented into “feature maps.” The neurons within a feature map share the same weight and bias. The neurons within the feature map search for the same feature. These neurons are unique since they are connected to different neurons in the lower layer. So for the first hidden layer, neurons within a feature map will be connected to different regions of the input image. The hidden layer is segmented into feature maps where each neuron in a feature map looks for the same feature but at different positions of the input image. Basically, the feature map is the result of applying convolution across an image. The convolutional layer is the core building block of a CNN.

Three hyper parameters control the size of the output volume of the convolutional layer: the depth, stride and zero-padding.

Depth of the output volume controls the number of neurons in the layer that connect to the same region of the input volume. All of these neurons will learn to activate for different features in the input. For example, if the first Convolutional Layer takes the raw image as input, then different neurons along the depth dimension may activate in the presence of various oriented edges, or blobs of color.

Stride controls how depth columns around the spatial dimensions (width and height) are allocated. When the stride is 1, a new depth column of neurons is allocated to spatial positions only 1 spatial unit apart. This leads to heavily overlapping receptive fields between the columns, and also to large output volumes. Conversely, if higher strides are used then the receptive fields will overlap less and the resulting output volume will have smaller dimensions spatially.

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VI. CONCLUSION

The application of agriculture networking technology is need of the modern agricultural development, but also an important symbol of the future level of agricultural development; it will be the future direction of agricultural development. After building the agricultural water irrigation system hardware and analyzing and researching the network hierarchy features, functionality and the corresponding software architecture of precision agriculture water irrigation systems, actually applying the internet of things to the highly effective and safe agricultural production has a significant impact on ensuring the efficient use of water resources as well as ensuring the efficiency and stability of the agricultural production. With more advancement in the field of IoT expected in the coming years, these systems can be more efficient, much faster and less costlier. In the Future, this system can be made as an intelligent system, where in the system predicts user actions, rainfall pattern, time to harvest, animal intruder in the field and communicating the information through advanced technology like IoMT can be implemented so that agricultural system can be made independent of human operation and in turn quality and huge quantity yield can be obtained.

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