IOT Based Precision Farming Using Machine Learning

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***Abstract*—The scarcity of easy water sources around the globe has generated a need for their ultimate utilization. Internet of Things (IoT) solutions, primarily based on the software unique sensors, facts acquisition and smart processing are bridging the gaps between the cyber and physical worlds. IoT based clever irrigation management systems can help in reaching highest quality water-resource utilization. This paper gives an open-source technology based clever gadget to predict the irrigation necessities of a area the use of the sensing of floor parameter like soil moisture, temperature, and environmental conditions along with the weather forecast information from the Internet. The intelligence of the proposed gadget is primarily based on a clever algorithm, which considers sensed facts along with the weather forecast parameters like precipitation, air temperature, humidity, wind velocity and UV for the close to future. The entire machine has been developed and deployed on a pilot scale, where the sensor node statistics is wirelessly gathered over the cloud the use of web-services and a web-based facts visualization and decision assist system gives the real-time statistics insights based totally on the evaluation of sensors information and weather forecast data. The paper describes the gadget and discusses in detail the information processing effects of 4 days information based totally on the proposed algorithm of our project.**

***Index Terms*—Internet of Things (IoT), Irrigation System, Weather Forecast, Pilot Scale.**

I. INTRODUCTION

In recent times the agriculture is sliding into many problems which encompass the scarcity of water, the diseases took place on the flowers etc. With the interplay of wi-fi sensor networks agriculture has introduced evolution to deal with such problems. As wi-fi sensor networks are used, they are beneficial in detecting and managing many environmental records which include the humidity, the temperature while concerning the production and the cost. So, this gadget has made the farmers work into a computerized way so that they can manipulate the whole farm even from the faraway areas. The overall performance of farming is in the farmers capability to determine out the stipulations happened in the surroundings and revert to the modifications as early as possible. This clever farming is applied to the IoT for higher utilization of sources as IoT includes the crop fertilizing, ailment prevention, livestock, seeding and irrigation. The advantages caused with Precision agriculture when associated to IoT will be the increase in profitability and the discount in the environmental crash. As noted above, smart farming is a strategy which collects, analyses and operates every data with the information furnished within the machine to show the editions in the efficiency, sustainability and quality.

Wireless sensor networks are self-center and shape less networks which monitor with the help of wi-fi medium in bodily stipulations to have a look at and analyze the data. In wi-fi sensor networks the base station as a source of medium between the person and the receiver. The data in wi-fi sensor networks can be retrieved at the vacation spot by using forming loops and structures. The nodes in a wireless sensor networks have an option of communicating with each other with the assist of radio signals. In wireless sensor networks the nodes which are used for transferring the data very constrained assets such as feed potential the band with storage. Wireless sensor networks can enable many applications such as military functions transportation as properly as agricultural applications.

The actual world is coming across many issues in the courtroom of choice guide system to overcome this wi-fi sensor networks can be a higher answer the foremost application the place the decision assist system can be widely used is the Precision agriculture. Wireless sensor networks when brought on with agriculture can be able to resolve problems related to land managing optimization of the resources associated to farming and as nicely as making smart decisions for keeping the resources. Application of wireless sensor networks we can be in a position to remedy the troubles using a actual time information.

Precision agriculture is a modernized structure of farming practices which strengthen inputs such as water and pesticides for improving the discipline exceptional and productivity for a better yield. To limit the pest and the illnesses caused thru them are additionally targeted the usage of a specialized application with the required number of pesticides. The complete field is educated in fantastic methods due to the fact each part of the area offers with distinctive necessity of the inputs such as the amount and the quality of soil may additionally be different, the daylight drawing near every part of the subject can be differing with perspective of slopes. Apart from this there are many such cross elements which come across the field, thinking about all this and maximizing the crop productiveness is important. In agriculture domain, the wi-fi sensor community (WSN) may additionally bring out the important contribution to precision agriculture (PA). In precision agriculture, a variety of parameters such as environment temperature, soil type, moisture, humidity etc. vary hastily from one region to some other vicinity and these parameters affect the effectivity and great of production. Therefore, we need to format some decision based automated tools or methods for making use of the right amount of input (water, fertilizers, pesticides, at the right time and at a proper region to improve the production fantastic of crops.

II. LITERATURE SURVEY

1.Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Areas
Authors: Nurzaman Ahmed, Debashis de
Year: 2017
The report states that they integrated cross-layer channel access for sensing and actuating with the routing solution to build a system that minimizes network latency. The throughput latency and coverage range of this network are examined. The suggested paper is an IoT-connected system that is used in rural areas for a variety of farming applications, and it has introduced a network for commuting solutions with a large coverage area and little latency. It used a cross-layer-based Mac approach to improve throughput performance. Using the wild network, the mac approach delivered higher energy and throughput performance. It is feasible to lower the latency and increase the throughput all the way to the end of the connection. As a result of our deployment of the fog computing solution,A shorter delay saves a lot of network bandwidth.

2. SmartIrrigationSystemUsingMachine Learning and IoT.
Authors: Revanth Kondaveti, Akash Reddy, Supreet Palabtla
Year: 2018
This project focuses on the variables that contribute to the transformation of a village into a smart village. It has developed an autonomous irrigation system that can also predict rainfall, assisting farmers in determining which crops may be cultivated in a given location. The research explains how traditional methods compare to precision agriculture, which produces a greater, more efficient yield with less investments. Water is an important aspect in crop farming, whereas monitoring the health of cattle is important in livestock farming. Under regular field conditions, this study covers both aspects of crop and livestock farming. Soil moisture prediction using support vector machines is a derivation of statistical learning theory that is used to estimate soil moisture using a prediction approach with the help of support vector machines.

III. PROPOSED SYSTEM

Existing System
Despite the fact that farming practices have evolved, there is still a long way to go in terms of maximizing irrigation water use. As a result, the final productivity is inadequate. Farmers with traditional methods manually monitor the field to check the crop's resource requirements, with less frequency between them. As a result, an improved smart irrigation system is required to provide adequate output while conserving water. So far, only field sensors such as

temperature, humidity, and soil moisture have been employed to estimate the motor's water retention capacity for smart irrigation.

In the traditional agricultural system, practices are organized according to a schedule that has been developed over time. As technology advances, practices have begun to modernize. For example, animals were once used to plough, but now tractor machines are more comfortable, therefore habits have been regenerated in some ways. As these methods were extended, the attention shifted to planting, harvesting, and fertilizing, and to doing so in a more efficient manner in order to increase field output.

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Disadvantages

- Lag in optimum use of irrigation water.
- Need to be checked Manually.
- Prediction has less accuracy.

Proposed System

This study describes an open-source technology-based smart system that uses sensing of ground parameters such as soil moisture, temperature, and ambient variables, as well as weather forecast data from the Internet, to estimate a field's watering requirements. Soil moisture, air temperature, ultraviolet (UV) light radiation, and relative humidity of the agricultural field are among the sensing nodes used in ground and environmental sensing. The proposed system's intelligence is based on a clever algorithm that takes into account observed data as well as weather forecast characteristics such as precipitation, air temperature, humidity, wind speed, and UV for the near future.

Advantages

- Reduces work load.
- Gives accurate prediction.
- Optimum use of irrigation water.
- Water need for upcoming days can be predicted.

Block Diagram

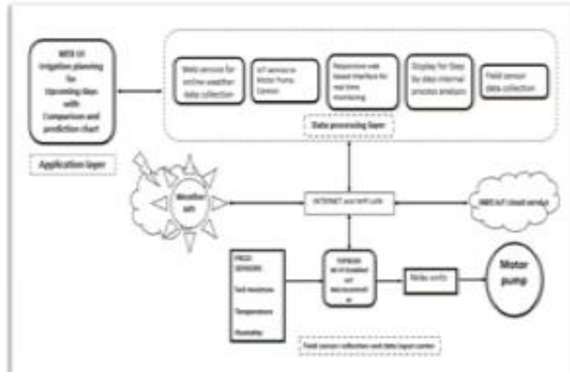

Figure 3.1: Block Diagram

ESP8266 IoT Microcontroller

A WIFI enabled microcontroller which controls the motor depending upon the field sensor data and weather data in JSON format from data processing layer which is embedded as program in controller.

Field Sensor

Soil Moisture Sensor**:** Measures the water content and helps in determining the threshold value.

Temperature Sensor**:** Measures the temperature content in soil.

Humidity Sensor**:** Measures the humidity in soil.

Relay Units

An electrical switch which controls the opening and closing ofmotors based on thecommand given.

Motor Pump

A mechanical device whichpumps water for the soil based on thecommand given by the controller.

Weather API

It is a programming interface that provides access to current and historical weather data on a global scale. And API we used is called Open Weather API which is an open source and data Provided by them have accuracy rate compared to others.

AWS IoT Cloud Service

A database which stores data provided by weather API as well as field sensor data which uses MQTT protocol which is designed for connections with remote locations that have devices with limited network bandwidth.

Data Processing Layer

It is a stage where machine learning processes the data for the final prediction. It gathers all the data of weather as well as field sensor stored in the cloud. Here the temperature, humidity, Evapotranspiration is calculated based on the data collected and it can also determine when and during what interval the motor pump should be switched on.

The main role here is to calculate how much water should be retained depending on the threshold set which is calculated on the data obtained from soil moisture sensor and finally gives the predicted data for upcoming days for optimum usage of water.

Application Layer

Web development is divided into two categories: front-end development (also known as client-side development) and back-end development (also called server-side development).

Front-end development is the process of creating what a user sees when they open an internet application, including the content, design, and interaction. HTML, CSS, and JavaScript are frequently used to do this. HTML, or Hyper Text Markup Language, is a particular code for ‘marking up' text so that it may be displayed on a web page. HTML is the foundation of every website on the internet, and it will serve as the backbone of every web application. CSS, or Cascading Style Sheets, is a type of coding used to define style guidelines for web pages. CSS is in charge of the aesthetics of the websitewhat happens in the background of an internet application to get the front-end, a back-end frequently employs a database. what happens in the background of an internet application to get the front-end, a back-end frequently employs a database.

A web UI is presented that displays the predicted chart, soil moisture, temperature, and humidity for a specific field's soil, as well as weather API data for that field's location. We can also enable and disable field data sensor data through this UI and control the entire operation of our irrigation system, as well as configure the changes we need for the system to get the predicted data accurately.

Input Data

So here data would be measure and analysis in two different methods:

- Satellite data
- Using real time sensor data

Satellite Data

Weather API

https://openweathermap.org/

- In open weather map we tried many of the API for our projects, at the end we come to conclusion to use some relevant API which is helpful to complete our project.
- They provide lot of available data, but in free account the limitation is unable getting the current values, it may be 3-5 hours difference. Any way in our project it would helpful for analysis and correlate the real time value with the satellite data’s.
- And through HTTPS request we get data in JSON format which is used in machine language process.
- Apart from the given paper we are going to use Agro API.
- So, what is Agro API:
  -- Agro API for natural integration of satellite images to agricultural application and machine learning**.**

IV. RESULTS AND DISCUSSION

Project Result Description

This project displays the results of an experiment conducted on home plants, which resulted in a more accurate measurement of actual moisture. The irrigation process is controlled and an optimal irrigation mode is prepared using field data and weather data information. A motor pump installed in the field has two modes of operation: manual and automated. When the system hits the threshold, the field is irrigated; however, if it rains on the irrigation day or close to the irrigation date, the irrigation process might be postponed for a few days. This project also discusses the soil's ability to retain water. Furthermore, the system's intelligence explains the system's reliance on the soil moisture prediction value to validate the correctness for four days in a row. The protected soil moisture data for the next few days is projected to meet the accuracy and real requirement in this application. With low mean square error, SVR with kernel functions is used.

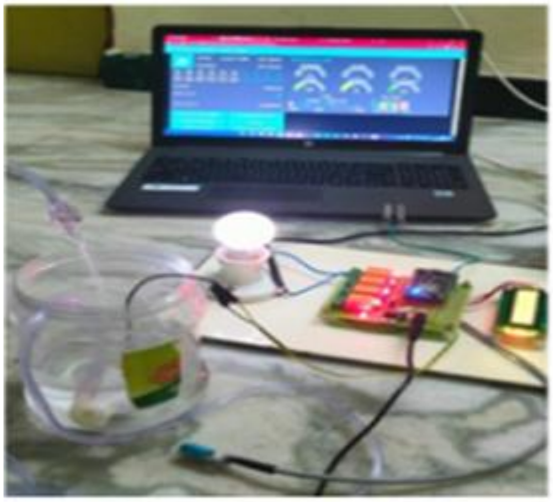

Figure 4.1:MoistureUnderThreshold

The fig 4.1 shows the moisture level which is 2.71 and fig 4.2showsthemoisture level after irrigation 83.72 maintaining the threshold.

When the moisture level was below the threshold soil moisture level, the water pump starts pumping until it attains its threshold level as shown in fig 4.1. When it reaches the threshold soil moisture level, the motor pump stops pumping, which is shown in fig 4.2.

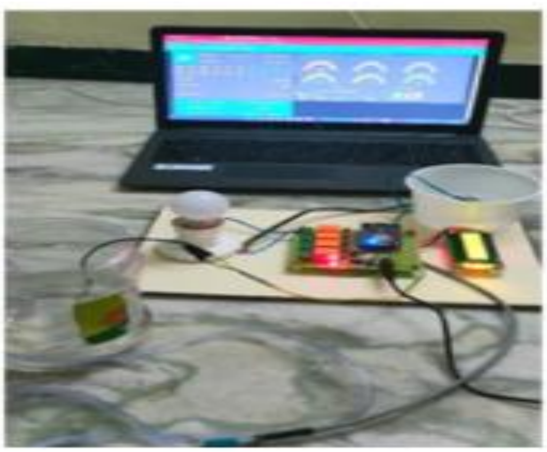

Figure 4.2:MoistureOverThreshold

Temperature And Humidity

Day	Evapotranspiration
1	166.63
2	229.20
3	218.76
4	217.08

Table 4.2: Temperature and Humidity Sensor values

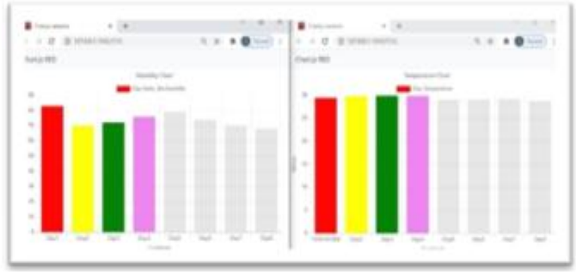

Figure 4.3: Temperature and Humidity chart

Soil Retaining Capacity

Day	Evapotranspiration	Precipitation	Humidity
1	33.32	0	79
2	45.84	11	70
3	43.75	0	72
4	43.41	3.35	76

Table 4.3:Evapotranspiration,precipitationand Humidity values

Figure 4.5: Soil Retaining Chart

Evapotranspiration

Day	Temperature	Humidity
1	83	29.45
2	70	29.81
3	72	29.85
4	76	29.9

Table 4.4: Evapotranspiration Values for Upcoming days

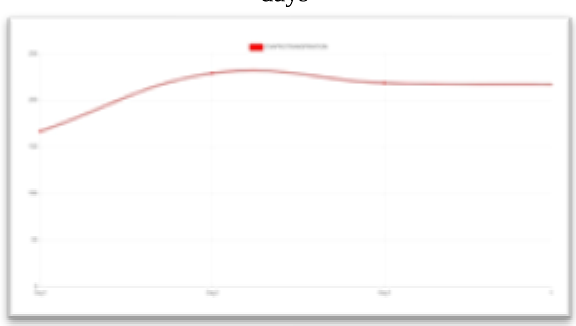

Figure 4.6: Evapotranspiration Chart

Prediction Model

Day	Moisture content	Irrigation requirement
1	56	1.0
2	36	1.0
3	29	1.0
4	36	1.0

Table 4.5: Moisture Content and Irrigation Requirement

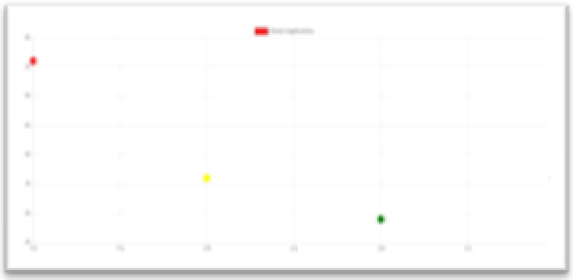

Figure 4.7: Prediction Model

V. CONCLUSION AND FUTURE SCOPE

The moisture level in the crop was detected by a vital metric termed evapotranspiration in this paper, which led to the development of a smart irrigation system. Weather conditions and crop factors have an impact on evapotranspiration. The farming system has advanced as precision agriculture techniques have improved. For soil moisture prediction, this project used a hybrid machine learning approach. It forecasts moisture for the next few days using field sensor data and weather data. The system is both cost-effective and plainly functional, and it is built on open-source technologies. The system's auto mode can be adjusted for other applications. Weather data is collected via a weather API, whilefield data is collected using physical sensors. To calculate soil moisture, the prediction algorithm uses an SVR-based kernel function. The KCCA function is used to calculate evapotranspiration with a low mean square error. As the model's complexity decreases, it becomes more accurate. Furthermore, the device may be used to accurately monitor moisture levels on vast farm fields. This system can be further modelled with more advanced characteristics, such as minimizing the physical setup and capturing data mostly through forecast data to reduce costs.

REFERENCE

[1] Allen,R.G., Pereira, L.S., Raes,D., Smith,M., (1998). “Crop evapotranspiration -guidelines for computing crop water requirements”. FAO - Food Agric. Organ. United NationsRome, pp.1-15.

[2] Chen, Q., Chen, T.Y., (1993). “Estimation of river basin evapotranspiration-ration over complex terrain using NOAAAVHRR data”.ActaGeogr.Sin.48(1), pp.61-69.

[3] Cobaner, M., (2011). “Evapotranspiration estimation by two different neuro-fuzzy inference systems”.J.Hydrol.398, pp.292-302.

[4] DaCruz, M.A.A.,Rodrigues,J.J.P.C.,Al-Muhtadi, J.,Korotaev,V., Albuquerque, V.H.C., (2018). “Areferencemodelforinternetofthingsmiddleware ”.11.IEEEInternetThingsJ.5, pp.35-56.

[5] Davis, S.L., Dukes, M.D., (2010). “Irrigation scheduling performance by evapotranspiration based controllers”.Agric.WaterManage.98,pp.35-47.

[6] Drucker,H, C.J.,Kaufman,L., Smola, A,,Vapoik, V., (1997). “Support vector regression machines”. Adv. Neural Inf. Process. Syst. 1, pp.155-161.

[7] Goldstein,A., Fink,L., Meitin, A., Bohadana,S., Lutenberg, Ravid,G., (2017). “Applying machine learning on sensor data for irrigation recommendations: revealing the agronomist’s tacit knowledge”. Precis. Agric. 19, pp.421-444.

[8] Gutierrez, J., Villa-medina, J.F., Nieto-Garibay, A., Porta-gandara, M.A., (2014). “Automated irrigationsystemusingawirelesssensornetworkand GPRSmodule”.IEEETrans.Instrum. pp.19-28.

[9] Jaguey, J.G., Villa-Medina, J.F., Lopez-Guzman, A., Porta- Gandara, M.A., (2015). “Smartphone irrigation sensor”. IEEE Sens. 15, pp.5122-5127.

[10] Pandey,V.S.,Sharma,D.,Shukla,A.X.,Tyagi,S.,(2017). “Alow-costZigBeebasedtemperature and humidityacquisitionsystemfor research and industrialapplications”.In:Dutta,C.R.K.S.D.K.(Ed.),InternationalConferenceonCommunicationComputingandNetworking,pp.379-385.

[11] Roopaei,M.,Rad,P.,Choo,K.R.,Choo,R., (2017). “Cloud ofthingsinsmartagriculture:intelligent irrigation monitoringby thermal imaging”. IEEE Cloud Comput.4, pp.10-15.

[12] Bertolli, M., Salucci, M., Polo, A., (2017). “Low-cost wireless monitoring and decision support for water saving in agriculture”. IEEE Sens. J. 17, pp.4299-4309.