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Internet of Things (IOT) FOR AGRICULTURE

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Abstract— Agriculture is a sector that contributes highest to India's GDP. The present necessity is that the utilization of water must be efficient and effective. As the population is growing rapidly and there is rapid urbanization and climatic changes, the stress for managing the water resource has been increased. When there is mismanagement of this natural resource in the fields, it not only leads to water scarcity but also affects the crops in the field due to under or over watering. The human interpretation in fields leads to wastage of energy and time. And also the human calculations regarding the soil moisture, water content in the fields cannot be accurate. So, there is need of optimizing the water consumption, where for the irrigation process, a control system and a monitor is required. In our paper, we have focused on the automation of irrigation process aiming on higher growth of crops and efficient use of water. The hardware consists of DHT11 sensor which measures the surrounding air, soil moisture sensors which estimates the volumetric water content and a raspberry pi. Furthermore, the model also monitors the weather conditions and ensures the water is used smartly.

Keywords- internet of things, temperature, agriculture, automation, irrigation, weather prediction

I. INTRODUCTION

Agriculture is the major contribution to Indian Economy. The demand for food is increasing as the population is growing rapidly [6]. The production of the crops depends on different factors. One of the major factor is water. It is very important for the farmer to make sure that there is equal amount of water to all the crops across the whole field [7]. The fields needs an automatic irrigation method that suits any soil type, crop type and weather condition. Irrigation management results in improved production of crops. Usually the farmers depend on the rain to water their crops, but when there is no rain they water their crops with available water resource. This requires manual checking of the fields and switching on/off the motor

[8]. This leads in wastage of time and energy. Also, when the crops are given sufficient amount of water and if this is not noticed by the farmers they don't switch off the motors, this result in water wastage. The farmers need to check their farms regularly in order to determine if sufficient amount of water is given to the farms. The introduction of automatic irrigation helps the farmers to water the plants and also save the water resource without any human interpretation.

II. OBJECTIVE

The objective of our project is to propose a model that automates the irrigation process and monitors and controls the process without any human interpretation that results in growth of production of crops and saves water resource [8]. We check the humidity, temperature and soil moisture using different sensors. We have use the electronic technology that automates the control features and turns the motor ON and OFF on detecting the water content in soil, humidity and temperature. It also gets the weather of future from Open Weather API and determines if the field needs to be watered or not. Since this works automatically, it reduces the man power and time. And also the manual checking can lead to inaccurate results and when this is automated we get the accurate results. The two important factors of watering process is, when and how much to water. When these factors are checked automatically, the farmer's work gets easy and good amount of production is yielded.

III. LITERATURE SURVEY

1." IoT Based Smart Controlling System and Controlling System Irrigation Monitoring" (2017 IEEE)

Dhanashri.H.Gawali, Shwetha.B.Saraf Interconnection between number of electronic devices using internet describes the Internet of things . Zigbee was used to establish communication between sensor nodes and base station. Wireless monitoring of irrigation system reduces manual human work and allows remote monitoring and operating on android phone. Cloud technology is used to save the data received from sensors. Host server has to run long durations for monitoring to be always on which is not ideal so cloud technology makes it easier for the server to take care of the required resources. This model improves the fields quality and quantity by sensing the values received from sensors like soil moisture, temperature and level of water in the tank from the field without any human interpretation .[1]

2. "INTELLIGENT IRRIGATION SYSTEM – AN IOT BASED APPROACH"(2017 IEEE)

S. Abinaya, Dr. V.Venkatesa Kumar, S. Abinaya, Dr.M.Newlin Rajkumar Irrigation monitoring system using Arduino. Proposed model uses android application to control the pumps via GSM network which uses SMS to enable pump control and Blue-tooth. The proposed system provides real time information on the field irrigation. In this model there is a challenge in addressing the generated and collected data from sensors. Aurdino board is used to make connections between all the sensors. Temperature, humidtity, soil moisture sensors are used. Power supply is given by using 5volt battery. Monitor is used to display the values

on the screen and operate aurdino OS. Connection is establishment providing using java coding.[2]

3. Internet of Things Based Smart Irrigation Using Regression Algorithm

Anusha Kumar, Aremandla Surendra, Harine Mohan, Muthu Valliappan K, N. Kirthika(2017)

In this model they have implemented the irrigation system for Drip irrigation and Sprinkler irrigation systems to water the plants that detects moisture in soil sensor, rain detecting sensor, water level flow sensor, external atmosphere temperature sensor Direct Current pump. In this model they have used cloud storage where the data is fed into the cloud for computation, using cloud based models makes it more efficient than using host server as host server can not work for such long durations to monitor it all the time. They have used mobile application as interface which can be used for viewing the status of the field and make it easier for farmer to view the status from anywhere. Usage of cloud helps it easier to access the data from mobile at any point of time from any location.[3]

IV. COMPONENTS

Physical devices that are connected to each other and also to the internet through routers or other network devices is called IOT. These devices can exchange data between themselves. Objects can be controlled remotely by using IOT. IOT is a technology that reduces human efforts and saves time as there is no need of any human intervention. The devices that are connected gather useful information and share the information with other devices in the network.

The following are the components used:

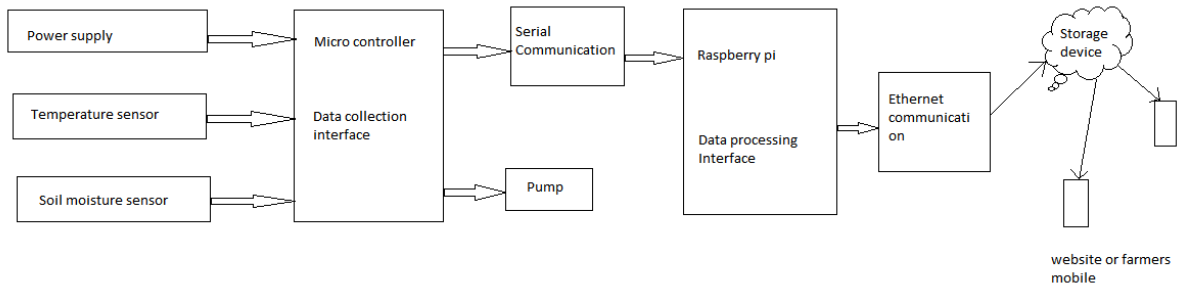

Fig 1.connection of sensor to raspberry pi

A. Raspberry Pi:

It is a piece of mini- computer, which functions similar to CPU of a computer. It is connected to the internet by using an Ethernet cable or by using a Wi-Fi dongle. It acts like a gateway that is used to collect data.

B. DHT11 Temperature-Humidity Sensor:

It is a low cost sensor that is used to measure humidity and temperature. The results of the sensor is sent to the raspberry pi board. It uses thermistor and capacitive humidity sensor that is used for measuring the surrounding air. The result is digital signal. Its simple to use. Careful timings is required to grab data. The new data is caught once in every two seconds, so the readings can be up to two seconds old.

C. Soil Moisture Sensor:

It measures the soil's volumetric water content and the data is sent to raspberry pi.

D. INTERNET:

Inbuilt wifi module is given in raspberry pi board that can be used to connect to internet. The mobile hotspot or wifi is used to connect the Pi board to internet.

V. EXISTING SYSTEM

The shortage of water is one of the major problems in our country [6]. Various methods have been developed in order to save water. Water is the basic need for all living beings. Agriculture is an area where the requirement of water is more. One of the major problem seen in agriculture is that excess amount of water is irrigated to the fields. Different techniques have been introduced inorder to save water like Ditch irrigation, Sprinkler System, Terraced Irrigation. To manage irrigation process in agriculture, an automatic Smart Irrigation Decision support System(SIDSS) is determined[1]. The existing system model waters the plants whenever the water content goes below a threshold. This becomes a disadvantage when it rains after the field has been watered. This may also damage crops as they are over watered [6].

LIMITATIONS OF THE EXISTING SYSTEM

The Existing system do not use the water efficiently. This may lead to water scarcity. In irrigation process, the quantity of water is not supplied for each water supply.

VI. PROPOSED MODEL

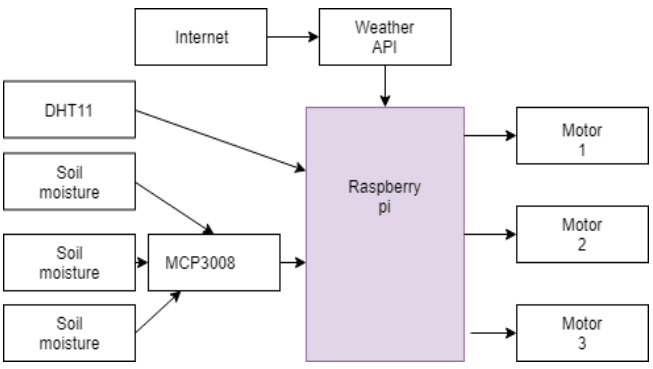

Fig 2. Block Diagram

The production rate of a field depends on various factors, the availability of water being one of them. The proposed model is about automatic irrigation system, as automation is one among the main role present in human life. Automation reduces human efforts and also saves time. Nowadays, many industries have been using the automation and control machines which is very expensive and not affordable to use in agricultural lands. Our model is affordable smart irrigation technology where the farmers need not be present near the fields inorder to water the plants on time. The model helps farmers to get his plants watered even if he is residing in an place in the whole world. Our model focuses on temperature, soil moisture and weather predictions. Automated irrigation system is developed in order to optimize water for agricultural crops. This allows us to automatically control the appliances. The main objective of the model is to control the motor automatically based on factors like temperature, humidity, soil moisture and weather predictions.

The above diagram is the overall block diagram of the proposed model. We have built a automatic irrigation system for which raspberry pi being the most important component. Atmospheric temperature, wind pattern, radiation pattern of soil and humidity are the key factors that leads to water loss. We chose to build a prototype taking the temperature and humidity as the key factors. DHT11 sensor is being used for this purpose where the temperature and humidity is measured and the readings are sent to the raspberry pi. We also use the soil moisture sensor that measures the volumetric water content in the soil and sends the data to the raspberry pi.

ADVANTAGES OF THE PROPOSED SYSTEM

This proposed model reduces human efforts and saves time. It also saves water. It predicts the weather reports and alerts farmers. It utilizes the resources efficiently. This monitors the amount of soil humidity as well as temperature present in the soil. The weather predictions are determined. A threshold range is set for temperature, humidity, soil moisture and weather. This threshold can be varied according to the soil type and crop. When the results from the sensors are sent to raspberry pi, and if found below the threshold and if it's not going to rain in few hours then the motor is turned ON. Once sufficient amount of water is given to the field the motor is automatically turned OFF. The motor is usually turned ON if the soil is dry or if the temperature is high.

VII. METHODOLOGY

Supervised Learning Workflow and Algorithm

The main goal of supervised learning algorithm is to construct a system that makes predictions based on condition in the presence of not valid values. As an adaptive algorithm identifies patterns inside the data, a computer 'learns' from the observations[9].

Specially, a supervised learning takes also known set of computer input datasets and also take responses to the dataset and trains a method to develop reasonable predictions for the response to new dataset.

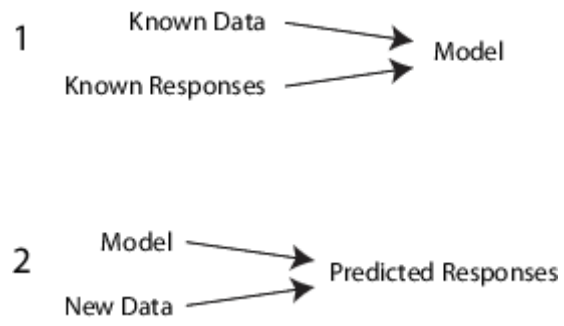

Fig 3 Supervised Algorithm Working

Process in Supervised Learning

There are many ML Toolbox algorithms and Statistics for supervised learning algorithms, there are many uses in the same basic work-flow for originating a predictor method. The process for supervised learning are [9]:

A. Arrange Datasets
B. Determining an Algorithm
C. Choose a best fit Model
D. Determining a Validation Method
E. Inspect Fit and Update till Satisfied
F. Using a right Model for Predictions

A. Arrange Datasets

Supervised learning algorithm strategies begin with the computer dataset matrix, typically know 'x'. Every rows of 'x' will be one information. Every column of 'x' will be one predictor, or variable. In this represent missing entries with not valid values in 'x'. Machine Learning Toolbox and Statistics supervised algorithms will handle a not valid value, either by avoid them or by avoid any row with a not valid value [9].

B. Determining an Algorithm

Decision tree is a flowchart-like tree structure where the internal nodes represent features (or attributes), the branch nodes represents a rule based on which the decision is taken, and leaf nodes represents the outcome. The topmost node in the decision tree is called root node. This node partitions based on the attribute value. In the same way, it partitions the tree recursively based on decisions. This helps you in taking decisions based on different conditions.

Decision Tree is a of ML algorithm which is of white box type. It also shares the logic in decision making which is not possible by the algorithms belonging to black box type. The function of the number of attributes and records in the data given, gives us the time complexity. The decision trees never depend on the probability distribution assumptions. It also gives good accuracy even with high dimensional data.

WORKING OF DECISION TREE ALGORITHM:

1. Use Attribute Selection Measure (ASM) to select a attribute based on which the records are spitted. The first attribute is the root of the tree.
2. The selected attribute is now a node that takes decision. This partition the data set into smaller data sets based on the condition.
3. Repeat the process, and in each repetition the child node becomes the decision node. This process must be recursively applied to each child node until one of the below condition is matched:
    a. All tuples have the same value.
    b. No instances are left
    c. No attributes are left

Decision tree can be easily visualized and interpreted; the pre-processing required for decision tree from the user is less. There are few limitations for this algorithm as well it is sensitive to noisy data. If there is a minor difference in data also it leads to complete different decision tree. Algorithms like bagging and boosting can be used for this.

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C. Choose a best fit Model

a) Classification tree strategies (i.e., decision tree methods) square measure counselled once the information extracted task consist of classifications of outcomes, and therefore the aim is to come up with rules that may be simply explained and translated into SQL or a natural search language.
b) A Classification tree verifies, store, and initialize variables to distinct categories. A Classification tree also can offer a high degree of confidence that the classification is valid.
c) A Classification tree is constructed through a method referred to as binary recursive partitioning. This can be a repetitive method of splitting the information into partitions, so rending it up to add on every one of the branches.

D. Determining a Validation Method

To get a more robust sense of the prophetic accuracy of your tree for brand new information, cross-validate the tree. By default, cross validation splits the training information into ten components randomly. It trains ten new trees, each on 9 elements of the information. It then examines the prophetic accuracy of every new tree on the info not enclosed in training that tree. This methodology provides a decent estimate of the prophetic accuracy of the ensuing tree since it tests the new trees on new information.

E. Inspect Fit and Update till Satisfied

The Robust-Boost algorithmic program will observe for right classification model predictions even once the training datasets has disturbance. However, the default values in Robust-Boost parameters will turnout an ensemble that doesn't predict good values. This instance shows a method of calibration the parametric values for higher predictive accuracy.

Develop datasets with disturbance. This instance has 20 regular uniform random numbers per classifies, and observation the observation as one of the total of the first 5 values increase to 2.5 (so is larger than average), and zero otherwise

F. Using a right Model for Predictions

To predict classification responses for the many fitting models, use the prediction method:

Ypred = predict1 (object,Xn)

a) object is the model for the algorithm.
b) Xn is latest input dataset.
c) Ypred is the classification model for predictions.

Dialogflow

It is a google hosted software with a very easy interface, Dialogflow can be used to build a chat bot [10]. Famous chatbots already exist are Apple siri, Samsung Bixby, Amazon Alexa, Google Assistant. Dialogflow can be used to create an agent which further can be integrated to any of the above mentioned chat bots or devices, which makes the hosting process lot easier in these assistants chat bot can either be hosted by giving certain permissions where it has to be purchased. Dialogflow is compatible for many other software's like facebook messenger for developing an auto-reply bot for the messages facebook page is receiving. It can be integrated to third party applications using web hooks, where connection can be established from your personalised application to the dialogflow [10]. It allows API calls where intent can be sent in responses. It is highly secured when using api calls it has Client key and Developer key which are unique and given only to the owner of the agent. Using developer token you can attempt to create, delete and modify the intents inside the agent.

Process of creating an agent:

1. Create an account in api.ai (Dialogflow), Go to console.
2. Create new agent give a name which suits your application.
3. Go to intents and start creating, inside the intent you can give number of statements how an intent can be invoked google uses Its special machine learning algorithm technique to train the intents and understand them.
4. Response text can be given inside the intent.
5. For testing your agent an environment inside that particular website itself
6. Once everything is ready it can be given permissions and can be accessed through any of the devices which are setup to it.

After developing the agent, inside every intent there is an option called fulfilment where it can be toggled on or off, there is always a default response but when there is fulfilment toggled on inside that intent it goes to fulfilment tab and searches for the URL given and it sends a post request with a body in "JSON(JavaScript Object Notation)" which has the information about the invoked intent and HTTP method POST is made to the endpoint given,

Server where application is running has to be in that URL when it receives a POST request it responds back with another JSON object from server which contains response for that particular intent. If there is any error in server or application Dialog flow responds back with default response

Application in the model is developed using python, server in python language can be run using Flask application where application will be running on local host and on system port. In the model flask application is running to get local host URL, then in raspberry pi terminal we can get the IP of the device connected to network using IFCONFIG from that we can get the IP address of raspberry pi, IP can be given in Fulfilment in dialog flow followed by the local host "URL" where application is running.

To make the above process even easier we can make use of third parry applications like Ngrok where Local host "URL" and port number can be given to the Ngrok, It creates a tunnel and a "URL" which is specific to our local host and that "URL" can be entered inside the dialog flow fulfilment.

VIII. SYSTEM IMPLEMENTATION

In the models referred they have used only Hardware components where the live data of the soil moisture is considered as a parameter, but that will not be accurate as there are other conditions which has to be taken into consideration like weather conditions.

The current model implements API calls and gets climatic conditions in that particular area and uses it in algorithm for decision making of weather to irrigate the plant or not.

And coming to the interface which has been developed in existing models it is quiet complicated, considering the fact that this application is being created for farmers where most of them are not well educated, it is difficult for them to use computer and check the application, current model uses an advanced featuring chat bot which comes with additional features but easy to use. It is very simple application which even does not installation process it can just start working by giving permissions to users. It just needs a smart phone with internet connection.

IX. CONCLUSION

The development phase of the automatic irrigation system based on internet of things(IOT) is described in this paper. IOT which plays a very important role in day to day life, collects all the data using sensors and passes it onto the raspberry pi. The regression algorithm is used to forecast the amount of water required for irrigation.

This setup helps in watering the plants automatically without any human

Interpretation and allows the usage of water efficiently and conserves water. It reduces human efforts and saves time.

The proposed system also predicts the future weather and based on this the decision of whether to water the plants or not is taken.

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