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Prediction and Analysis of Water Requirement in Automated Irrigation System Using ANN And Lora Technology

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Abstract: An automated irrigation system was developed to optimize water usage for agriculture crops. The system consisting of wireless sensor unit that is temperature sensor and soil moisture are placed in the plant root zone by using LoRa technology. This desired threshold values from temperature and soil moisture sensor are programmed to controller. The GPRS can be used to send a data to IOT and the user. ANN is use in the paper for optimizing the usage of water in automatic irrigation system

Key Words*: *WSU, WIU, WiFi, IoT, ANN

1. INTRODUCTION:

Agriculture uses 85% of available freshwater resources worldwide and this use of freshwater will continue to be increase because of population growth and increased food demand.

In nations like India most of irrigation system is operated manually. This can overcome by the semi-automated and automated irrigation technique. The available traditional irrigation technique are terraced irrigation, drip irrigation, sprinkler irrigation.

This type of irrigation is waste of water and its poor performance. This problems can be appropriately rectified if we use automated system for irrigation to reduce the waste of water and improve crop performance the automated irrigation system are developed.

This system uses the wireless network of temperature sensor and soil moisture sensors are placed in the root zone of plant and water level sensor is used to find the level of water in the tank. These sensors can be used to provide the right amount of water at the right time which can be provided to plants without using any labor. The temperature varies day by day it cannot be made constant easily but by using this technique we can give the almost constant temperature that plant requires. The data of temperature, moisture and the amount of water is send to IOT through GPRS. This data is applied to ANN'S it works in the principle of prediction, it compares the values of two three days and the output of the ANN'S show the feature days data this helps to store the water for upcoming days. The performance and progress of crop can be analyzed by using the artificial neural network. It is used for optimization of water.

2. METHODOLOGY

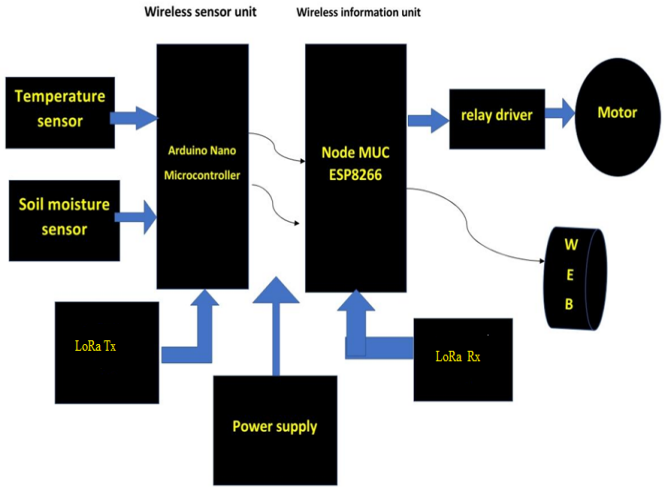


Fig1: Configuration of the automated irrigation system. WSUs and a WIU based on microcontroller and LoRa technologies.

The automated irrigation system mainly consisting of two components wireless sensor unit (WSU's) and a wireless information unit (WIU's). The Wireless sensor unit consisting of moisture sensor and temperature sensor. This can be used to monitoring and recording the

physical condition of the environment. Wireless information unit consists of controller and WIFI technology. Motor is connected through relay. The WIU send the data to the web and user through WIFI. When temperature is below the threshold value, the motor will be OFF and above the threshold value, the motor will be ON. The web data is applies to ANN's. The ANN's network compares the previous temperature and moisture level and it gives the values of next days.

Wireless sensor Unit(WSU):-

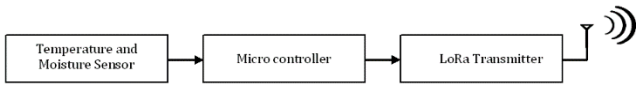


Fig 2: WSU

WSU consists of Temperature sensor, Moisture sensor which is used to read the temperature and moisture level of the soil. The sensor output voltage is directly proportional to temperature that is there will be a rise of 10mV for every 1°C rise in temperature. The Microcontroller in the WSU receives the data from the sensors and provides the sensor data to the LoRa transmitter. LoRa transmitter transmits the sensor data to the WIU.

Wireless Information Unit(WIU):-

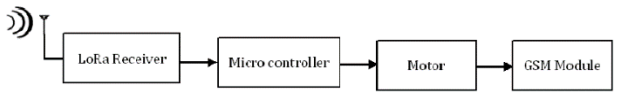


Fig 3: WIU

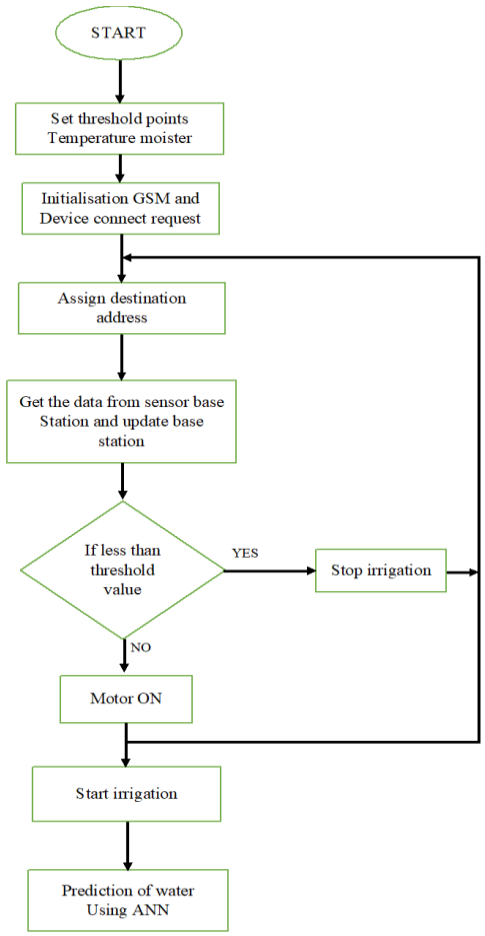
WIU consists of LoRa receiver, Microcontroller, Motor control Unit, Relay, ANN and Wifi module. The LoRa receiver receives the data transmitted by the LoRa transmitter and provides this data to the controller unit. The controller unit processes the data and compares with the predefined threshold value. If the value is greater than the threshold value, then it turns the motor on, else it turns the motor off. And the same status is sent to GSM module.

The Wifi module is used to send the motor status by sending the message to the registered user.

Once the motor is turned on/off, then the values of temperature sensor, moisture sensor and the amount of water taken to reach the threshold value are sent to the web (Thingspeak). Thingspeak is used to store the all the sensor data and consumption of water for the particular temperature/moisture.

3. FLOWCHART

Sensors	***Threshold pointes***			
Temperature	<27^{0}c	Motor off	>27^{0}c	Motor on
Soil Moisture	<807	Motor off	>807	Motor on



Algorithm steps:

Step 1: Start irrigation system

Step 2: Initialize the threshold level of the both temperature and moisture sensor

Step 3: Initialize the GSM

Step 4: Collect the sensor data from the WSU

Step 5: If the values of temperature and soil moisture is greater than threshold value, then start the irrigation system.

Step 6: If the values of temperature and soil moisture is less than threshold value, then stop the irrigation system.

Step 7: Send the sensors values, motor status and consumption of water to Thinkspeak and ANN.

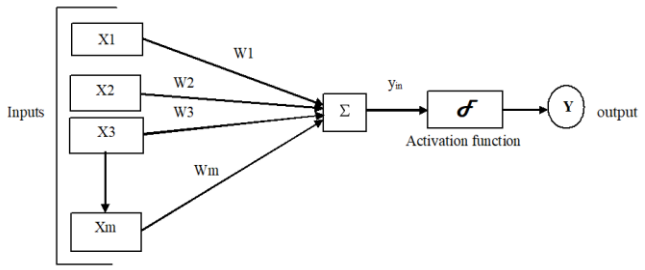
Step 8: ANN analysis the data and calculates the amount of water required for the coming days.

4: Date Stored In Web (IOT).

IOT is used to provide sensor information as well as enable device-to-device communication so that we can exchange the data between physical devices and web. Software allows the user to visualize the data through the authorized devices which consists internet. The stored data in the web will be read by the software and used to predict the upcoming data.

Table Column Head					
Date	***Temp***	***Moisture***	***Motor Status***	***Water Pumped***	***Total Usage***
Day 1	27.55	500	On	100 ml	100 ml
Day 1	26.23	450	Off	00 ml	100 ml
Day 1	28.56	750	On	150 ml	250 ml
Day 2	29.23	895	On	110 ml	360 ml
Day 2	31.23	754	On	60 ml	420 ml
Day 2	26.95	659	Off	00 ml	420 ml
Day 2	27.56	862	On	50 ml	470 ml
Day 3	29.01	430	On	60 ml	530 ml
Day 3	26.01	301	Off	00 ml	530 ml
Day 3	25.96	900	On	90 ml	620 ml

Water usage approximation using ANN's:



The net input can be calculated by using the below formula.

yin = x1.w1+x2.w2+x3.w3+……..+xm.wm

i.e., Net input $_{yin} = \sum_i^m$ xi. wi

The output can be calculated by applying through the activation function over the net input.

Y = F(y_{in})

Output = Function (net input calculated).

Artificial neural networks (ANN) are used for modeling non-linear problems and to predict the output values for given input parameters from their training values. The neural network similar to the human brain because of its function so that it including classifying information, predicts outcomes and cluster data. As the networks process and from data they can classify a given data set into a predefined class, it can be trained to predict outputs that are expected from a given input and can identify a special feature of data to then classify the data by that special feature.

Thing speak stores the data and provides the same data to the ANN. When all data is provided to the ANN, based on that data, it calculates the quantity of water required. The main objective of using this ANN is to know quantity of water required for the upcoming days, so that we need to store the water in order to utilize in future days.

Historical data of water usage

The above table shows the historical data of temperature sensor values, moisture sensor values and the amount of water used to reach the required threshold value.

Water usage data of previous days					
Date	***Temp***	***Moisture***	***Motor Status***	***Water Pumped***	***Total Usage***
Day 1	27.55	500	On	100 ml	100 ml
Day 1	26.23	450	Off	00 ml	100 ml
Day 1	28.56	750	On	150 ml	250 ml
Day 2	29.23	895	On	110 ml	360 ml
Day 2	31.23	754	On	60 ml	420 ml
Day 2	26.95	659	Off	00 ml	420 ml
Day 2	27.56	862	On	50 ml	470 ml
Day 3	29.01	430	On	60 ml	530 ml
Day 3	26.01	301	Off	00 ml	530 ml
Day 3	25.96	900	On	90 ml	620 ml

Water prediction data of upcoming days

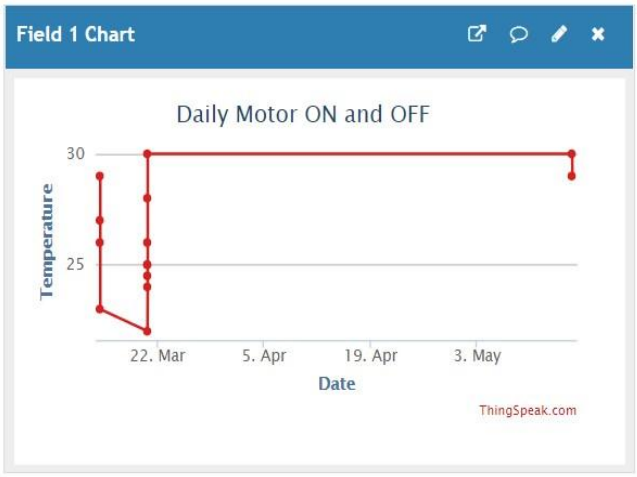
Water prediction data of upcoming days					
Date	***Temp***	***Moisture***	***Motor Status***	***Water Pumped***	***Total Usage***
Day 4	28.10	610	On	110 ml	110 ml
Day 4	26.33	511	Off	00 ml	110 ml
Day 4	28.30	841	On	220 ml	310 ml
Day 4	29.59	796	On	170 ml	480 ml
Day 5	31.00	673	On	90 ml	570 ml
Day 5	28.55	751	On	85 ml	655 ml

Water prediction data of upcoming days					
Date	***Temp***	***Moisture***	***Motor Status***	***Water Pumped***	***Total Usage***
Day 5	28.00	558	On	55 ml	710 ml
Day 6	26.99	645	Off	00 ml	710 ml
Day 6	27.05	873	On	50 ml	760 ml
Day 6	26.9	465	On	00 ml	760 ml

This table shows the predicted water required for the coming days, which is calculated by using ANN. ANN analyses the previous data based on that, it predicts the amount of water required in upcoming days.

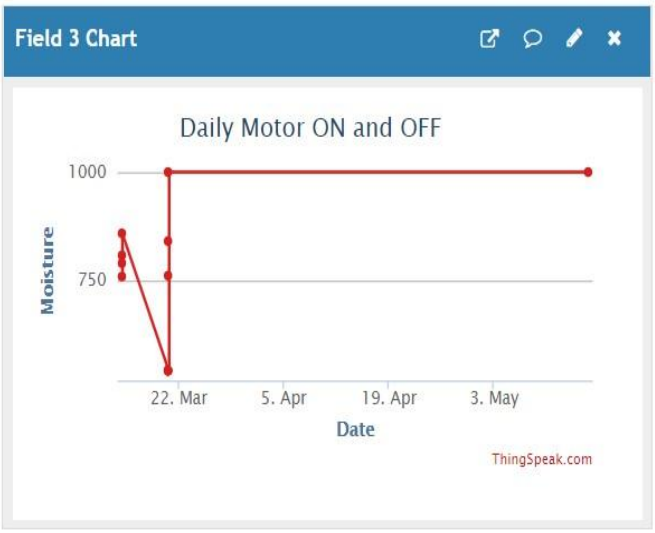
5.RESULT.

Temperature data



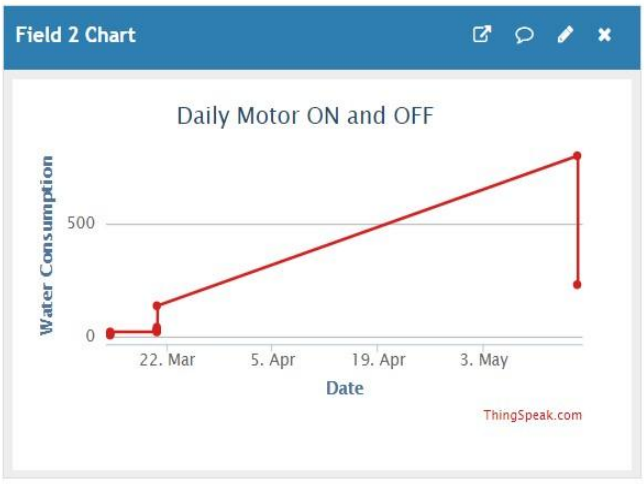
Here we plotting temperature graph on computer using processing environment and Arduino. The graph is used to observe and subsequently describe the visible pattern that exists within the data. We just read the analog output of the temperature sensor as shown in graph. The temperature varies according to the time and it's directly proportional. The graph shows the temperature for particular date and time.

Soil Moisture Data



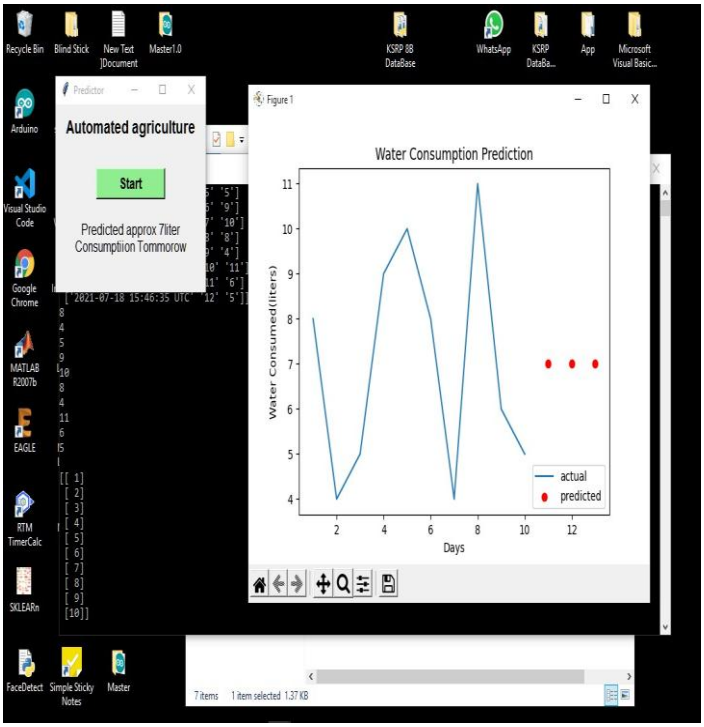
The above graph shows the soil moisture data. Based on the temperature the soil moisture content varies and it stores the data. The variation of the sensor data will be shown in the above graph Based on that data motor works.

Water consumption data



The above graph shows the water consumption. Based on both the temperature and moisture data amount of consumption of water data will be also stored and it is shown in the above graph.

Prediction of water for upcoming days:



The graph shows the relation between the temperature and the consumption of water. X-axis shows the temperature and Y-axis shows the water consumption. Blue dot shows the particular temperature and the amount of water consumed, the red line shows the linear fit, and black star mark shows the amount of water predicted for the upcoming days

6. CONCLUSIONS

1. This Study presented a detailed methodology for developing Successful ANN model for prediction of water characteristics

2. The Smart Irrigation System implemented is cost effective for optimizing water resources for agricultural productions.

3. The Smart Irrigation System proves to be useful as it automates and regulates the watering without any manual intervention.

4. Using this system, we can monitor the status of all the sensors (soil moisture, temperature and water level) and also ON/OFF status of the motor.

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