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IoT-BASED SMART AGRICULTURAL SYSTEM WITH AUTOMATIC TEMPERATURE MONITORING FACILITY

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Abstract : Temperature is crucial in agriculture as it impacts the growth, development, timing, and quality of crops. Temperature monitoring is essential for agriculture because it helps farmers optimize plant growth, control diseases and pests, manage irrigation, and make informed decisions based on accurate weather forecasts. So, in agriculture purpose for detecting or monitoring the temperature a monitoring system is needed by which the temperature can easily be given in the proper way and the needful steps can be taken for the specific purpose. In this research paper, a system is introduced by defining its proper application in real-world scenario. The system gives the output in a tabular form as well as in a graphical representation also. It gives the output in three different categories depending on time and temperature. It also gives the data along with time and date and also runs until anyone stops the system.

IndexTerms - Temperature monitoring, IoT, Smart Agriculture

I. INTRODUCTION

Temperature stress in plants is classified into two types depending on the stressor, which may be high, chilling or freezing temperature. Temperature-stressed plants show low germination rates, growth retardation, reduced photosynthesis, and often die. Here are some of the reasons why temperature monitoring is important for agriculture: Optimal plant growth: Different crops have different temperature requirements for optimal growth. For example, warm-season crops like tomatoes and peppers require temperatures between 70-85°F, while cool-season crops like broccoli and lettuce prefer temperatures between 60-70°F. Monitoring the temperature of the soil and air can help farmers ensure that the crops are growing in the right conditions, which can maximize yields and improve crop quality. Disease and pest control: Temperature can affect the occurrence and severity of diseases and pests. Monitoring the temperature can help farmers predict when certain diseases or pests are likely to occur, allowing them to take preventive measures such as applying pesticides or taking steps to reduce humidity.

Weather forecasting: Temperature monitoring is an essential component of weather forecasting, which is critical for agriculture. Accurate weather forecasts can help farmers make informed decisions about when to plant, when to harvest, and how to manage their crops. Irrigation management: The temperature affects the rate at which plants consume water. Monitoring the temperature can help farmers determine how much water to apply to the crops, which can reduce water waste and optimize irrigation management. Iot based smart agricultural system with automatic temperature monitoring facility can be effectively used for temperature monitoring purpose. After sensing the temperature, it automatically generates data regarding the fluctuation of the temperature and constructs a graph, corresponding the time and date. By observing the graph, the necessary steps should be taken for protecting the plants. One of the most important features of the system is it can be used in any area and without any time limitation. In the section 2 Literature Review is discussed. In section 3 proposed works is mentioned along with Components Required, Circuit Diagram, Pin Diagram and Algorithm. In section 4 there working process is given along with the Flowchart. In the section 5 Experimental dada and analysis is going to be discussed with the data in tabular form. In section 6 the advantages are presented. In section 7 Conclusion and Future scope is presented and section 8 References are present.

II. LITERATURE SURVEY

The paper published on 2022 by Tanuj Manglani, Aman Vaishnav, Ajayraj Singh Solanki, Rajkumar Kaushik, titled “Smart Agriculture Monitoring System Using Internet of Things (IoT)”, the knowledge which is gained is the New beginning of computing technology is arriving such as the Internet of Things (IoT). It is a kind of Global Neural Network the cloud that interfaces various gadgets. Human life and the way work have been revolutionized by the Internet in the past decade. Currently, IoT is changing the trends of human life as the use of emerging technologies which consist of heterogeneous communication devices is increasing. IoT are relevant in different strategies of agriculture. India has agriculture as its essential occupation. As per IBEF (India Brand Equity Foundation), 58% individuals living in rural areas in India are reliant upon agriculture. The agricultural advancement is sped up with the increment in the profitability and up gradation of the plantation frameworks. The IoT has the capacity to change the world.

In any case, the use of innovation like IoT in agriculture could have the best effect. Smart Agriculture is an idea where in data and correspondence innovation is carried out to deal with every one of the exercises and cycles identified with the agriculture space. With the quick improvement of the world population, huge space of land is used to foster lodging and the capacity of creating food is decreased. Farming has gotten essential in present pattern and keeps food on the tables. Farming with IoT helps in moderating the lack of food by requesting the current land for more grounded usage at least expense. Smart agriculture is an idea that rapidly snaps on the agricultural field [4].

The paper published on 2021 by Shrey Chirag Shah, Anwita Chakraborty, Yelithoti Sravana Kumar, Tapaswini Samant, Swati Swayam siddha, titled "A Novel Approach towards using Internet-of-Things in Smart Agriculture Monitoring System", gives a complete understanding of the system such as With the introduction of the Internet-of-Things (IoT) in the field of agriculture, the concept of agribusiness has witnessed a surge in the production of high-quality crops, better yearly yield, and reduction in manual labor. This proposed technique is low-cost and easy to implement, which provides farmers with a smart field monitoring system with the aid of a mobile application and also provides a solution to tackle unsolicited climatic conditions without human intervention. Prediction of temperature, humidity, and rain for the next day is also a key feature of the system. In our proposed system, we have used a Node Micro Controller Unit, a Wi-Fi microchip for connectivity, various sensors for monitoring, various actuators for taking suitable actions, and an android application for displaying real-time data. The cloud used for storing real-time data is Firebase. The proposed technique will reduce human efforts to a great extent compared to the traditional way of farming [2].

The paper published on 2022 by Doru Cornei, Cristian Foșalău, titled "Using IoT in Smart Agriculture: Study about Practical Realizations and Testing in a Real Environment", defines the concept of smart agricultural system on farm management. The Smart Agriculture concept has emerged as a solution to provide a decision support system for farm management. Although extensive research has been done in this field, many solutions involve substantial costs and are not feasible for small farms.The development of communication technologies and the accessibility of internet connections facilitatethe production of cheap IoT nodes for agriculture [5].

The paper published on 2022 by Megha Mudholkar, Pankaj Mudholkar, Venkata Harsha vardha Reddy Dornadula, K.Sreeni vasulu, Kapil Joshi, titled "A Novel Approach to IoT based Plant Health Monitoring System in Smart Agriculture", the study and practice of recognizing and resolving physiological and biologic processes that prevent plants from reaching their full hereditary potential for applications such as food, decorations, lumber, or other uses is known as plant health care. One of most crucial tasks in any setting based on agriculture is crop management. The establishment of a programmed for monitoring plant health is covered in this study. which will evaluate certain environmental factors that impact plants, such as temperature, humidity, and light intensity. Restore soil moisture as well [3].

The paper published on 2022 by Pittaya Supanirattisai, Kongpop U-Yen; Alongkorn Pimpin, Werayut Srituravanich, Nattapol Damrongplasit, titled "Smart Agriculture Monitoring and Management System using IoT- enabled Devices based on LoRaWAN", Environmental conditions are automatically regulated through actuator end devices that receive activation command from a network server, allowing precise control of the water and mist pumps. Real-time data and system status are sent to the cloud and can be accessed via customizable dashboard [1].

III. PROPOSED METHOD

A. Wi-Fi-Module

Wi-Fi modules (wireless fidelity) also known as WLAN modules (wireless local area network) are electronic components used in many products to achieve a wireless connection to the internet. Wi-Fi modules or Wi-Fi microcontrollers are used to send and receive data over Wi-Fi. They can also accept commands over the Wi-Fi. Wi-Fi modules are used for communications between devices. They are most commonly used in the field of Internet of things. The most important component of this system is Wi-Fi Module. Every component is connected with the module. After monitoring the temperature, it basically converted the voltage into Celsius, and also helps to run the system without any connector just only use the wi-fi that running on the computer and mobile also.

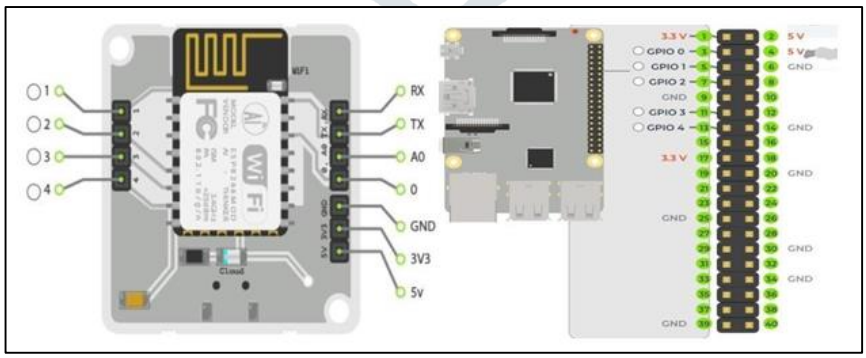

Fig.1 Wi-Fi Module

B. LM 35 Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. LM 35 sensor uses the basic principle of a diode, whereas the temperature increases, the voltage across a diode increases at a known rate. By precisely amplifying the voltage change, it is easy to generate an analogue signal that is directly proportional to temperature.

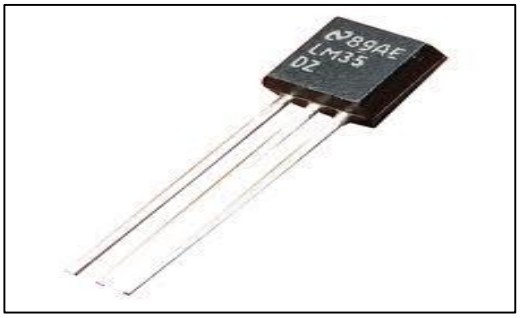

Fig.2 LM 35 Sensor

IV. CIRCUIT DIAGRAM

At first, we connect every pin of LM 35 sensor with the jumper wires. Then the female part of the jumper wires is connected with the LM 35 sensor, and the male part is connected with the Wi-Fi Module. By this way the circuit diagram is completed. We use a Wi-Fi module, LM35, temperature sensor, a USB cable, a smart phone, a laptop to construct the total system.

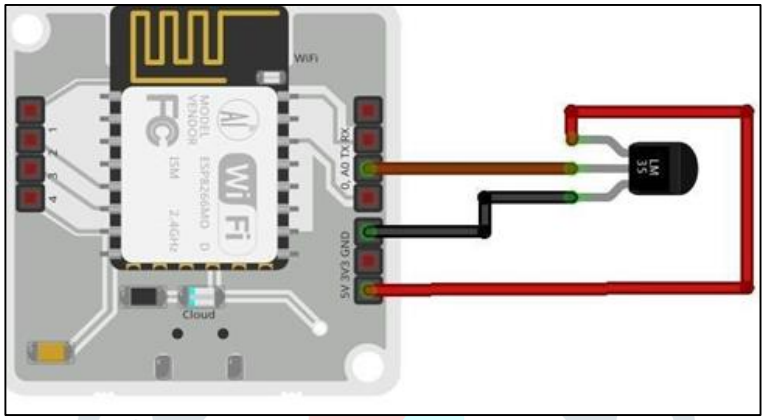

Fig.3 Circuit Diagram

V. PIN DIAGRAM

Connect the pins as given in the table below.

LM35 Pin	Corresponding Bolt Wi-Fi Module Pin	Comment
Vs Supply Voltage	5V	LM35sensoroperatesat 5V
V out - Output	A0	Since the output is analogue andA0 is the only pin on Bolt Wi-Fi module that can read an analogue input.
GND Ground	GND Ground	The ground pin of the LM35 to be connected to the ground pin of Bolt Wi-Fi module.

VI. WORKING PROCESS

LM35 is the sensor that senses the temperature of its environment and based on its value it generates an analogue output voltage. This analogue voltage produced by the LM35 is then given as input to the wifi module's A0 pin. The module then converts the analogue value into a 10bit digital value that varies from 0-1023. This digital data is sent to the cloud. Hence, while plotting the temperature, it is required to convert the raw sensor values into the actual temperature value, which is done using the given formula: temp = (analog_value100)/1023*. The converted digital data is then plotted for visual representation.

A. Flowchart of the proposed system

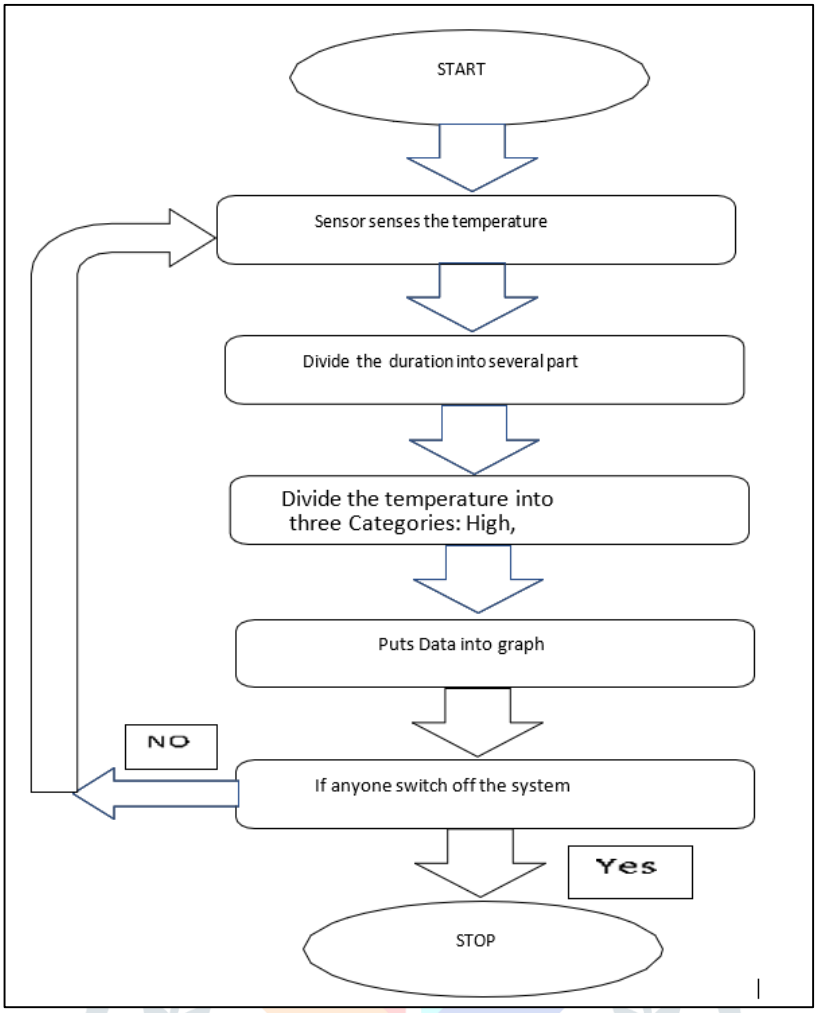

Fig: 4 Flowchart of the proposed system

VII. EXPERIMENTAL DATA AND ANALYSIS

The system is used in real world agricultural purpose, where it detects the environmental temperature. After monitoring the temperature, it provides some data along with the graph which shows the fluctuation of temperature with the particular date and time. It runs five hundred times, and the output which are produced, are same as the temperature given by the weather forecasting report. Though it gives accurate results, sometimes the results don't match with the weather report. It can be observed that the output results are 98% accurate depending on the forecasting report. In the following table there are total 50 results have been shown and a link is also attached for showing the rest of the output.

Link:https://drive.google.com/file/d/1Qx1ohvMIvlEmCaE6AJwoGmwF56a7_uq/view?usp=share_link

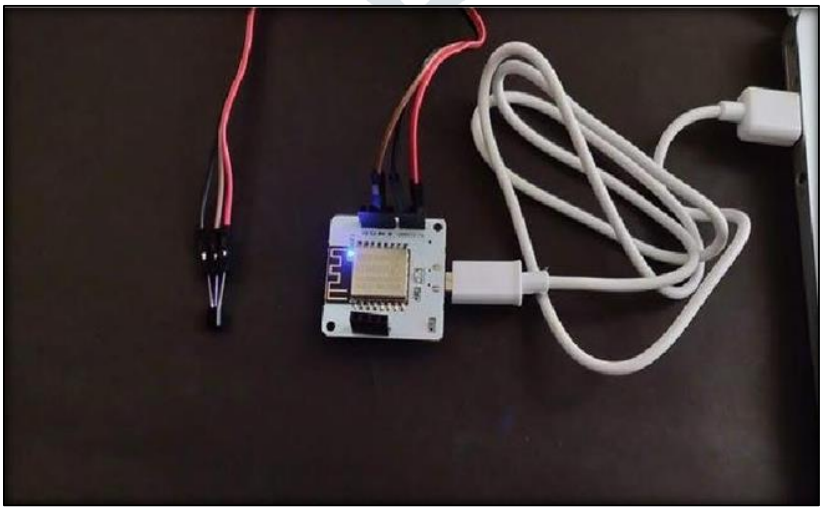

Fig: 5 Prototype of the proposed system

A. A Temperature Table Day Wise

SL No	Day wise	Time	Temperature
1	1	7.00 AM	28
2	1	7.14 AM	28
3	1	7.28 AM	28
4	1	7.42 AM	28
5	1	7.56 AM	28
6	1	8.10 AM	30
7	1	8.24 AM	30
8	1	8.38 AM	30
9	1	8.52 AM	30
10	1	9.06 AM	30
11	1	9.20 AM	32
12	1	9.34 AM	32
13	1	9.48 AM	32
14	1	10.02 AM	32
15	1	10.16 AM	32
16	1	10.30 AM	32
17	1	10.44 AM	32
18	1	10.58 AM	33
19	1	11.12 AM	33
20	1	11.26 AM	33
21	1	11.40 AM	33
22	1	11.54 AM	33
23	1	12.08 PM	33
24	1	12.22 PM	34
25	1	12.36 PM	34
26	1	12.50 PM	34
27	1	1.04 PM	34
28	1	1.18 PM	34
29	1	1.32 PM	36
30	1	1.46 PM	36
31	1	2.00 PM	36
32	1	2.14 PM	36
33	1	2.28 PM	36
34	1	2.42 PM	36
35	1	2.56 PM	36
36	1	3.10 PM	36
37	1	3.24 PM	30
38	1	3.38 PM	30
39	1	3.52 PM	30
40	1	4.06 PM	30
41	1	4.20 PM	30
42	1	4.34 PM	30
43	1	4.48 PM	29
44	1	5.02 PM	29
45	1	5.16 PM	29
46	1	5.30 PM	29
47	1	5.44 PM	29
48	1	5.58 PM	29
49	1	6.12 PM	27
50	1	6.26 PM	27

In the following graph it is clearly visible by anyone that the temperatures are shown along with the time and date. In the graph there are total three type's ranges such as: high, average and minimum. When the temperature is higher than the other data than it falls into the high range, when the temperature is lower than the high range but greater than the lower level then it falls into the average range and the rest of the data are fall into the minimum range.

Fig: 7 Temperatures vs. Time & Date Graph

VIII. ADVANTAGES

System can be used by anyone anywhere even in rural area also. It is very cost effective, easy to make, portable and its flexibility helps one to adapt the system easily and can use in their own purpose. There is no need to start the system time to time as it requires no one for controlling the system, it runs as long as anyone want without any interaction and gives the output according to the specific situations. One of the unique features of it is the graphical representation with date and time, which gives us the complete scenario about the circumstance.

IX. CONCLUSION AND FUTURE SCOPE

IoT based smart agricultural system with temperature monitoring facility works effectively and smoothly in agricultural purpose. It provides the required data which is beneficial for the plant. This smart agricultural system can be used by the farmers over a wide range of farming system. From the graph it is easy to understand the fluctuations of temperature which provides a complete understanding of needful work. In future it is assumed this work can be used for large agricultural sector. Along with the detecting system, some extra features are wished to be added such as temperature controlling feature. It can be assumed that in future the total system will work with the new features in such a way like there will be a threshold value of temperature, if the temperature will cross the threshold limit the system can reduce the temperature and if the temperature will decrease from the certain value then it can help to gain the temperature.

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