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Smart Agriculture System to Monitor Plant Growth

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ABSTRACT: An automated plant growth monitoring framework for proficient harvest yield and an irrigation system for effective water management is proposed. Soil Parameters like soil moisture, field parameters such as light intensity, temperature and Humidity is estimated, and the detected qualities are shown on a progressive web application which can be viewed on any device such as smart phones and computers. Plant growth and development is checked by monitoring plant tallness using Ultrasonic Sensors, realizing the light intensity of filed also helps to set the level of irrigation threshold, this threshold helps our irrigation system to retain sufficient water to keep up with the rate of photosynthesis when the light intensity is higher than usual, so that plants stay healthy. The Wi-Fi module inbuilt in NodeMCU has been utilized to lay out a corresponding connection between the agronomist and the field. The instantaneous field status will be featured to the agronomist through a computerized alert and refreshed every second with updated information in the application. The agronomist can get to the server about the field condition whenever and wherever, consequently decreasing the labour and time.

KEYWORDS: Plant growth, NodeMCU, Ultrasonic sensor, light intensity, temperature, progressive web application, irrigation threshold.

I. INTRODUCTION

Progression in innovation is changing the world at extraordinary speed. New strategies and frameworks are being created all through the world in various application regions. This headway can demonstrate as a shelter to the agriculture business to satisfy the rising needs of food and grain all over the planet. This paper proposes a non-contact plant development checking framework utilizing sensors. The proposed system estimates aspects of the plant by utilizing an Ultrasonic sensor and creates the most extreme height of the plant as plant growth parameters, utilizing estimated information. The proposed plant growth monitoring also monitors current light intensity of field.

For the most part, plant growth is estimated as an expansion in the size of plant stature. Visual checking of plant development for distinguishing the well-being status of a singular plant or ranch crop has been attempted generally all through the world. This anyway relies upon the human judgment and unobtrusive changes are not promptly recognizable by people or distinguished past the point of no return. Thus, a nonstop development checking framework is required that is exact, modest, and easy to use. Likewise, there is a requirement for far-off information move as the information handling destinations are typically far away from the fields/ranches and gathering information by physically moving toward each test site is unreasonable.

Plant development depends on a progression of collaborations that include the presence of light. Photosynthesis empowers plant metabolism cycles to happen and gives the energy that energizes these cycles. Light power levels can fundamentally affect photosynthesis rates, which are straightforwardly connected with a plant's capacity to develop. Photosynthesis processes empower plant creatures to deliver required food supplies. That is the reason a light sensor is being used to monitor the light intensity. A further extension to monitoring this parameter of plant growth would be adding of an UV index sensor which would enhance, give us better results and make it much more viable to set the irrigation standards where plants could stay healthy and hydrated even if evaporation rate of atmosphere is higher or if its sunnier. Light intensity therefore plays a vital role in plant growth. Light intensity monitoring applies to various fields of agricultural like indoor farming and lab research.

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II. Literature Survey

Gaurav Patil (September 2021) This proposed paper talks about a plant growth monitoring framework using IOT. In this task they utilized various modules like IOT, NodeMCU, Temperature sensor, Moisture sensor, Humidity sensor. just centered around soil dampness and water irrigation system, No Cloud Storage for additional examination and development are some of the disadvantages found in this system.[1]

Thiruwieddhi Hanumann Nune Veera Venkata Satya Narayana Swamy (March 2022) talks about a plant monitoring system, an IoT based water framework for checking and keeping up with the homesteads with estimated dampness content in the soil in view of temperature, dampness, stickiness and light intensity. They can record the temperature day to day. Ranchers can realize field details of that specific land in view of their sensor values investigation. The use of Arduino, and no ambient light measurement, are some of the disadvantages found in this system.[2]

A. Pravin, T. Prem Jacob, and P. Asha (2018) proposed a plant monitoring framework that will catch every one of the insights concerning the dirt and the temperature through various sensors. The detected data will be shipped off to the processor, upon the result the alarm message will be passed, and the fitting measure of water will be delivered to the crop. The upside of this framework is that it will observe the recent concerns as far as soil condition, dampness, and yield condition and the data will be quickly passed to the ranchers.[3]

R. Aravind, Dr. D. Maheswari (2020) talks about a framework that records parameters of the plant by using an infrared sensor and judge height, width, and distance across the stem of the plant as plant development boundaries, using assessed data. The proposed plant development observing framework has been executed by organizing a motorized analyzing framework. Finally, the framework execution is differentiated and checked, and the assessment data has been scraped by practical field tests. When the growth parameters are recorded, they are sent to the client using the GSM module. Extra expenses for GSM Module, just centered plant growth and use of IR Sensor which can only read height when plant reaches a certain height are some of the disadvantages of this system.[4]

Srinidhi Siddagangaiah (2017) In this paper, they examine about the execution of plant wellbeing. Which will check some climate boundaries like temperature, dampness, and light intensity that makes impact on plant growth. What's more, recover the dirt dampness. If there are any deviations in parameters, then alerts are sent to the client's cell phone. The use of Arduino, and no ambient light measurement, are some of the disadvantages found in this system.[5]

Subhanshu Gupta (2012) This paper proposes a non-contact plant growth observing system utilizing infrared sensors. The proposed project estimates aspects of the plant by utilizing an infrared sensor and produces the greatest stature, width, and breadth of the stem of the plant as plant development boundaries, utilizing estimated information. When the growth attributes are estimated, they are communicated to a remote server/client by utilizing GSM innovation. Use of Arduino, Extra expenses for GSM Module, use of IR Sensor which can only read height when the plant reaches a certain height, and No Cloud Storage for additional examination and development are some of the disadvantages found in this system.[6]

S P Vimal, N Sathish Kumar (2021) is centered on an automated irrigation system. The work determines the dampness level detecting of the yields and supplies water when required. The parts remembered for this work are ATmega328 Microcontroller, GSM Module, Humidity sensor, and soil dampness sensor. A model has been created to safeguard the plants or harvests more independently from watering and daylight. The model reports the situation through the GSM module. The model is a circle shut control framework intended to persistently screen the stickiness, temperature, and soil dampness level, and control the water system frameworks from the result of the siphoning unit. Use of Arduino, Extra expenses for GSM Module, just centered around soil dampness and water irrigation system, and No Cloud Storage for additional examination and development are some of the disadvantages found in this system.[7]

Gheorghe Ilie Aurel (2021) The paper is centered around the turn of events and execution of an independent and programmed framework for watering in a strawberry field. For this reason, a brilliant water system framework utilizing Arduino was made. The product considers data connected with water tank level, soil dampness and solenoid valve position, while furnishing ranchers with day-to-day data about the condition of the culture. The result of the sensors communicated to the microcontroller is broken down and, contingent upon the threshold forced by the client, a choice is made regardless of whether to water the plants. Along these lines, the microcontroller provides the order to open or close the solenoid valves. The water level in the tank used to supply the establishment is likewise monitored utilizing an ultrasonic sensor. Framework data like date and time, soil dampness in the three regions, the condition of every

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solenoid valve, and how much water is in the tank are shown continuously. The outcomes yielded by different tests affirmed the usefulness of the water system framework, which stayed in activity all through the season.[8]

III. PROPOSED SYSTEM

A smart agronomy system touch on the activity of the system with no or simply least manual mediation next to the observation. Almost every system (drip, sprinkler, surface) can be automated with the help of sensors and Microcontrollers. It makes the irrigation process more efficient and allows workers tofocus on other important agricultural tasks. On the other hand, such a system can be inexpensive and very simple in its design and may not need experts to plan and implement. Apart from smart irrigation, the proposed system also helps monitor the growth of plants using ultrasonic and using a light sensor to assess the current field light intensity. The plant height is then calculated using ultrasonic sensor placed on top of the subject which is to be monitored. As we are using a cloud database, we can further extend the project and add more sensors with ease such as UV index sensors and air quality sensors. All the parameter values could then be extracted from the cloud through a React JS based progressive web app which is cross platform web app and can be used on any device across the internet, making this system highly extendible, efficient, and flexible.

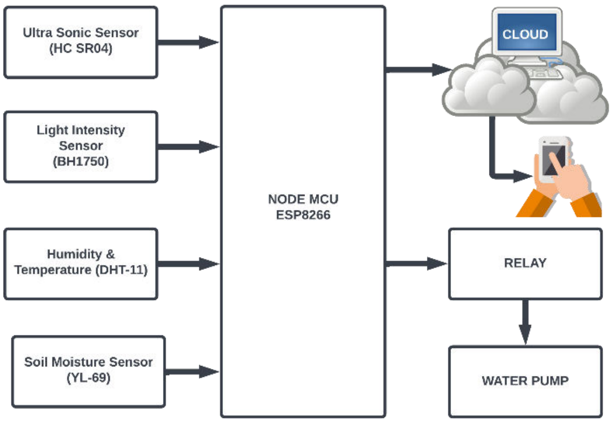

Fig 1. The proposed methodology of the block diagram

The inputs for the NODE MCU are few sensors which we had used in the project. The first one is Ultra Sonic Sensor, which in this project we used it for measuring the height of the plant so that if any plant stops growing the certain amount of height the crop originally grows, we can conclude that the plant is unhealthy. Then next comes light intensity sensor, which is placed in field with good lighting to read the light intensity level of area so that, the irrigation level of water can be identified in prior to providing water to the farm. Followed by Humidity and Temperature sensor which is placed in farm to get the readings of Humidity in air and temperature in the farm. As we know both the factors i.e., Humidity and Temperature plays vital role in plant growing. And finally comes the soil moisture sensor, which is placed inside the soil of the farm, to get to know whether the water is availed or to know whether the soil is wet or dry. So that farmer gets to know about the moisture content in the soil and takes appropriate action. All these inputs are being connected to the Node MCU and thus are provided by following outputs.

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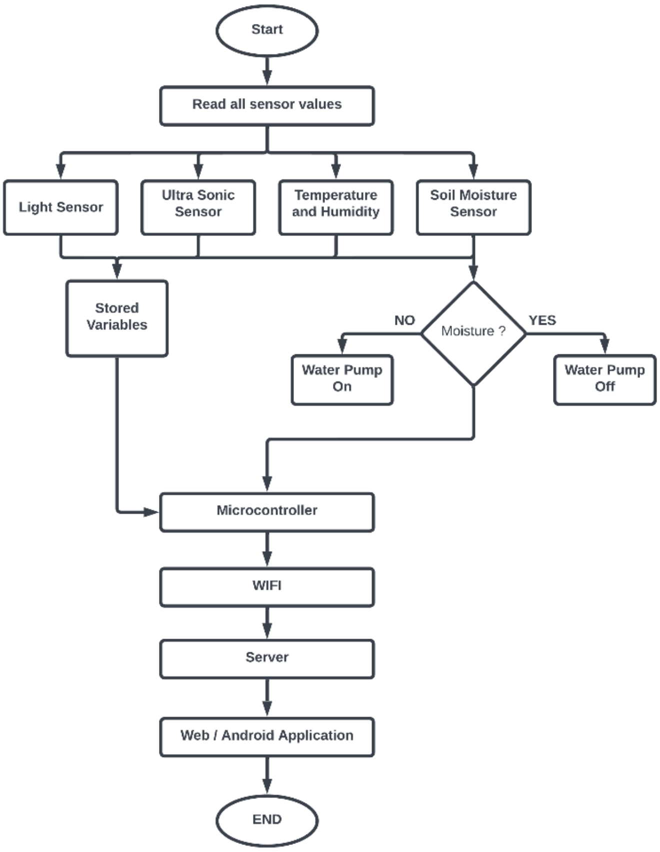

Fig 2. The proposed methodology of the flow chart

As the flowchart begins, we read all the sensor values prior. Sensors like light intensity sensor, soil moisture sensor, temperature and humidity sensor, and ultra-sonic sensor are being included in it. The values of the light intensity sensor, ultrasonic sensor and temperature, and humidity sensor are being stored and are sent to the microcontroller. The soil moisture temperature is verified by whether the soil is wet or not. If wet, the motor will be turned off and in an alternative way, the motor will be turned on. The information from this sensor too will go to the microcontroller.

From the microcontroller, all the values relating to the sensor will be sent to the in-built Wi-Fi module and to the server. From the server, the values are being processed to the Android application which is been built specifically to read all the values from the field. So that the farmer can view and organize his farm through the application by remaining in his home rather than going to farm. This application is speciallydesigned to read all values froma field. Allowingfarmersto view and organizetheirfarms through applications by stayingat home insteadof going to the farm. And thus, we stick to our sole motto that, “to reduce the frequency of a farmer going to his field than he usually does while working on farm without our application”.

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IV. CIRCUIT DIAGRAM

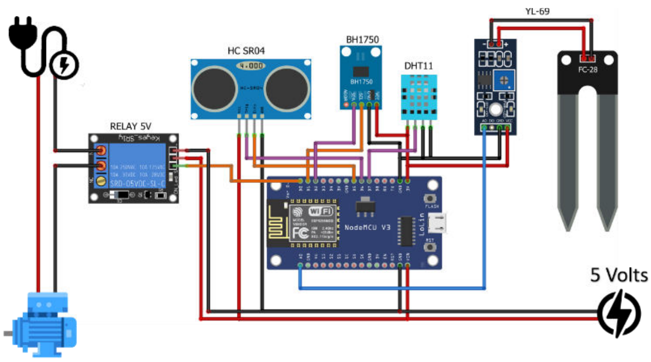

Fig 3. The proposed methodology of the circuit diagram

In the above circuit diagram, there are three digital sensors (SR-04, DHT-11) and one analog sensors (YL-69), finally BH1750 is being used with an I2C communication between nodeMCU and sensor.

HCSR04-Echo	→	ESP8266-D5
HCSR04-Trigger	→	ESP8266-D6
HCSR04-VCC	→	ESP8266-VIN
HCSR04-GND	→	ESP8266-GND
DHT11-D0	→	ESP8266-D7
DHT11-VCC	→	ESP8266-3V
DHT11-GND	→	ESP8266-GND
YL69-A0	→	ESP8266-A0
YL69-VCC	→	ESP8266-3V
YL69-GND	→	ESP8266-GND
BH1750-SCL	→	ESP8266-D1
BH1750-SDA	→	ESP8266-D2
BH1750-VCC	→	ESP8266-3V
BH1750-GND	→	ESP8266-GND
RELAY-D0	→	ESP8266-D0
RELAY-VCC	→	ESP8266-VIN
RELAY-GND	→	ESP8266-GND

V. OBSERVATION AND RESULTS

First, we assembled all the components on a bread board and evaluated the sensors for accuracy and working, later we have transferred the working system to a practically implementable framework, a metal arm was used to place the ultrasonic sensor on top of a plant which was to be monitored. This arm also houses the other sensors like DTH11 and BH1750. Lastly have flashed the required code to the NODEMCU. The figure below shows the working implementation of the project.

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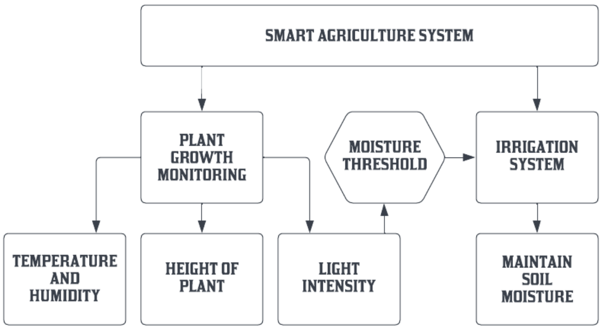

Fig 4. The proposed methodology of smart agriculture system

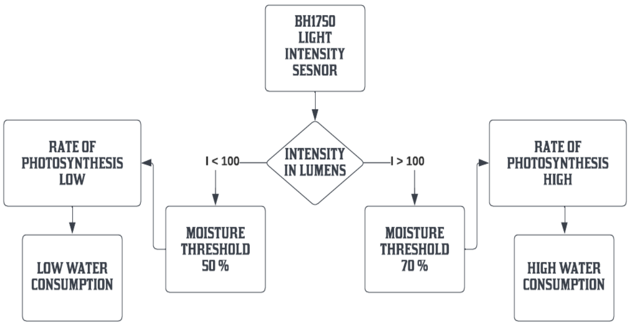

Fig 5.light intensity consideration in moisture thresholds

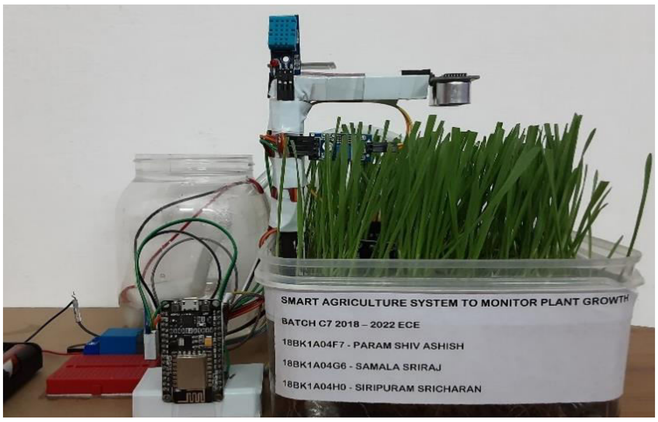

Fig 6. Prototype side view

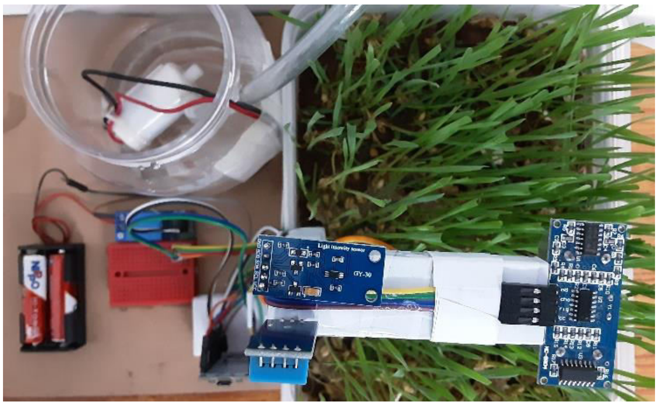

Fig 7. Prototype top view

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This react application is a progressive web app which can be used on any device as it has cross platform compatibility i.e., android and web browsers. The sensor values are variables and are updated every second as we are using real-time database implemented in firebase.

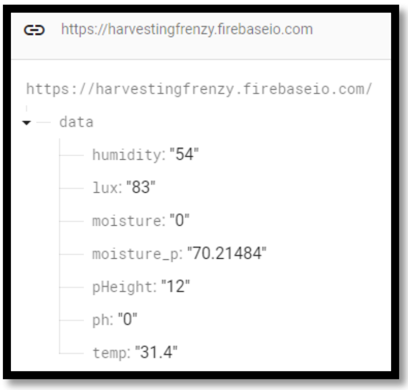

Fig 8. Firebase Real-time Database

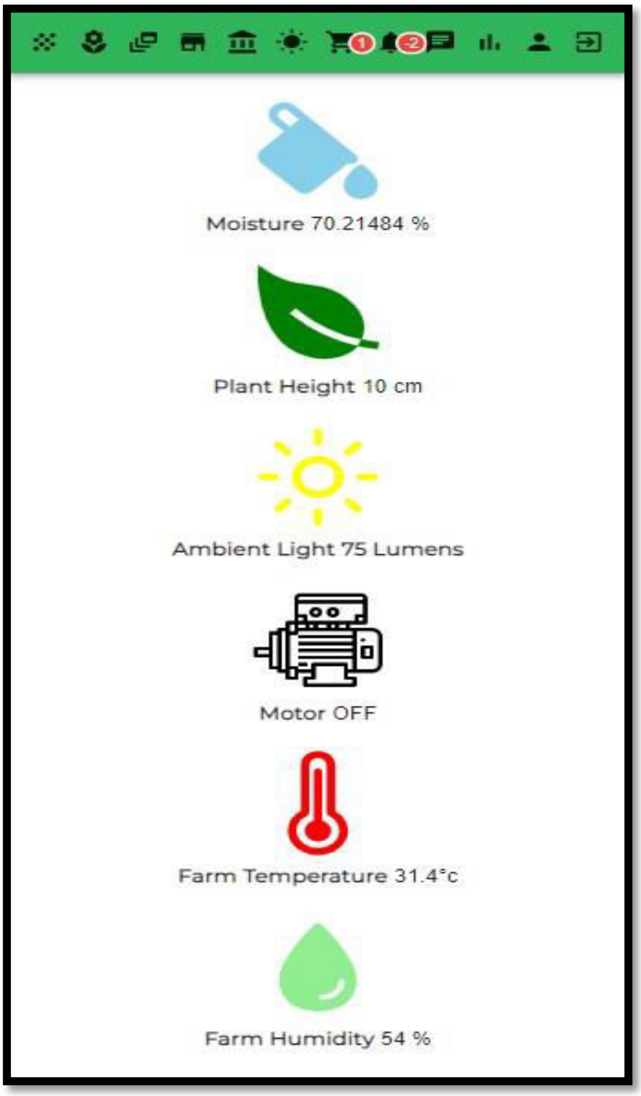

Fig 9. Mobile View

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VI. CONCLUSION

In conclusion, tasks which could be easily automated using modern technology i.e., irrigation, soil conditions such as light intensity and moisture value of soil, field humidity, field temperature and average height his crop etc. our project is the foundation to reduce the frequency of a farmer visiting his farm conserving his energy for tasks which could not be automated. A smart phone with our application installed in it is the sole solution for a farmer to sit back and monitor his fields from the comfort of his house. This system allows farmers to work more effectively and efficiently with more innovative ideas.

This system covers the aspect of being autonomously controlled and could be applied in various fields of agriculture. Few areas where this system could be recommended are indoor farming, research labs, small scale farming and gardens

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