"Future of Farming- IoT powered smart Agriculture system."

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Abstract—Internet of Things (IoT) innovation is currently one of the growing fields across a diversity of industries, together with agriculture. IoT enhances our lives by making and promoting developments in a wide range of actions to encourage them to become more appropriate, practicality, and enhanced using suitable man-made recognition. Smart agricultural frameworks recognize a social trade toward more helpful, lower-cost agribusiness- ness because of this innovation. The proposed work is to use IoT in the agriculture industry to collect real-time data (soil moisture, temperature, and so on) to help one look at a few climate scenarios from afar, efficiently, and greatly increase production. A global solution for monitoring and managing the agricultural field remotely has been proposed. Implementation of a local stand-alone field control unit that includes detection and activation capabilities. Developed a cloud solution for data storage, real-time monitoring, and historical data visualization based on the Thing Speak cloud platform. Remote managing and control functions have been realized in both the local unit and the cloud using IoT infrastructure.

Index Terms—Smart Farming, IoT, Cloud, wireless sensor network, Node MCU, Thing speak.

I. Introduction

Agriculture is a fundamental industry that contributes significantly to the creation and development of the national economy. Agriculture is the world's most important source of employment, in the last decade no yield development. As the use of water increases, there is an urgent need to develop long-term water managing methods. It is more important than ever to stay current with farming as the industry evolves. [1, 2] Agriculture has benefited from increased research and development. Several major events and forces drove technologists from various disciplines to build and apply agricultural system models for various purposes, according to a timeline of the technical phases of agricultural system models in their evolution. [3, 4] The first practical experiences with smart farming technologies date back to the turn of the century, and they concern the possibility of increasing the performance of machines employed in spreading or harvesting activities by using new automated procedures. [5, 6] The ability to correlate the quantities of input/output data flows to the machines in the field was a major factor in the paradigm change in agricultural activity performance. Suggests a remote sensor-based autonomous water system architecture improves water consumption for agricultural purposes. [7] The Internet of Things (IoT) and the Cloud, in conjunction with Wireless Sensor Networks, have the potential to accelerate modernization. The IoT has the possibility to renovate the world, and the products that are being developed will have a surplus of excellent features. [8, 9] IoT enables the interchange of data between objects via Bluetooth, NFC, sensor data, and networks without the need for human intervention. [10-12] Because of these advantages, IoT technology is being used in a variety of industries, including cities, smart healthcare, homes and buildings, energy, transportation, waste management, monitoring, and agriculture. [13, 14] IoT makes a significant contribution to innovative, agricultural automation, smart farming and increasing agricultural production. [14, 15] Furthermore, Agriculture can benefit from IoT by reducing waste, modernizing operations, and forming a safe food supply chain. Smart Farming: Agriculture Embracing the Internet of Things, Food output will need to increase by 70% to feed the world's predicted 9.6 billion people by 2050. As a result, there has been an increase in agricultural productivity, which is required for good yields and farm profitability. [16, 17] In the harvest field, temperature sensors and a soil moisture remote sensor network are deployed. To manage sensor data and water quantity programming using side upsides of sensors sent by a microcontroller, Zigbee communication is employed in the water system architecture. Raspberry Pi keeps track of the dust, moisture level and monitors the framework. [18, 19] The log file is sent to the employee, who can access it from any computer. They are sprinkled on the soil to promote the best possible retention [26]. Soil moisture is a critical problem in high-quality farming, the environment

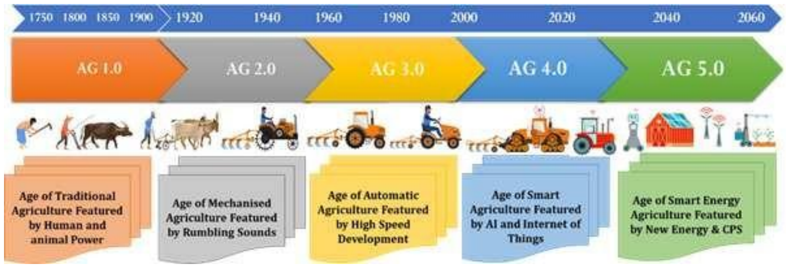

Fig. 1. A chronology of the technological stages of agricultural system models in their progression.

matters, and the amount of moisture in the air, as well as the temperature, are important factors to consider. Which is also an important aspect of farming. [20] The amount of water in plant cells is calculated and excessive transpiration depletes the water content of plant cells. For example, Soil moisture and water level sensors are used in agriculture and farming technology to assess the field environment in smart farming. [21, 22] This work aims to design, develop, and implement IoT platforms for agricultural ecosystems. The specific goals are as follows: collecting data from the various sensors in which the existing system is applied to agriculture, farming and transferring the data through networks with a controlled process and monitoring the system through a remote location. In this project, we design and employ a remote monitoring and controlling solution for agriculture established on the Thing Speak platform. The planned system consisted of a local control component as well as a cloud service component. To perceive the climate, a continuous environmental factors are monitored in the local part [25]. To ensure security and availability, the data are constantly retrieved and sent to the cloud via the Wi-Fi. In our solution, the irrigating and

managing functions are clearly regulated by a local microprocessor based on predefined programs and the data sets are stored internally and it can be remotely coordinated with the cloud. The cloud element makes use of the remote infrastructure with web visualization and storage services provided by the Thing Speak platforms. End users can monitor the environment in real-time, verify historic data and renew the water pump programs using a web user interface.

II. METHODOLOGY

The developed systems provided a solution for the farmer's automatic watering equipment and rooftop control system. Figure 2 depicts the overall hardware block diagram of the IoT-based smart farming system, as well as the signal path. Node MCU is a free and open microcontroller platform that includes hardware and software [24]. It collects analog data from sensors, analyses it, and then activates the actuators. The embedded Wi-Fi module on the NodeMCU is also used to upload data to the server. This device's visual display unit display temperature, humidity, rainfall, and soil moisture. When the soil moisture threshold values are consistent, a set of criteria is implemented. NodeMCU consists of a substantial programmable circuit board like other development boards Arduino or Raspberry Pi board. NodeMCU programming can be done with Arduino IDE in which writing and the uploaded to the microcontroller. Figure 2 depicts the various sensors used to measure the environmental parameters. The DHT11 sensor measures temperature and relative humidity and gives a digital data that ensures consistency and practicability. The sensor gives a standard of the water substance along its length. The photo resistance was used to measure the light illumination intensity parameters. The system's actuators are a pump and lights. The actuator water pump is powered on and off by AC power supply through relays.

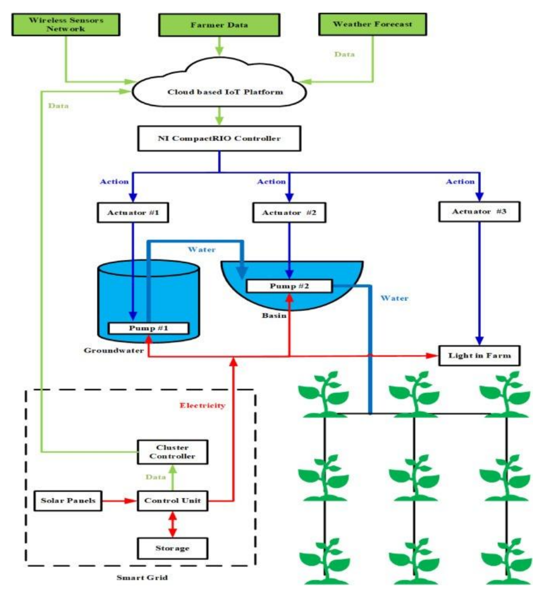

Fig. 2. Hardware Block Diagram IoT-Based smart farming system.

The continuous data has been received from the microcontroller unit through Wi-Fi for different public services like web visualization and storage. The end user capable of view real- time data visualization in the form of graphical display on the Thing Speak platform. In this platform user could interface data either one revising the conditions and modify the time schedules to execute task based on the current requirements and future needs.

The users could connect to the Internet to their smart devices via Wi-Fi connections [23]. This is used perform remote observing of agricultural environmental data from the sensors and to the actuators. The system consists of a water pump that, depending on the moisture content of the soil,

Fig. 3. System overview of IoT-based remote monitoring and managing system.

automatically turns on or off using a motor. Furthermore, temperature and humidity values from the DHT sensor provide an environmental context. The user can view the standard data stored in the server cloud, like temperature, humidity, soil moisture, and light switches.

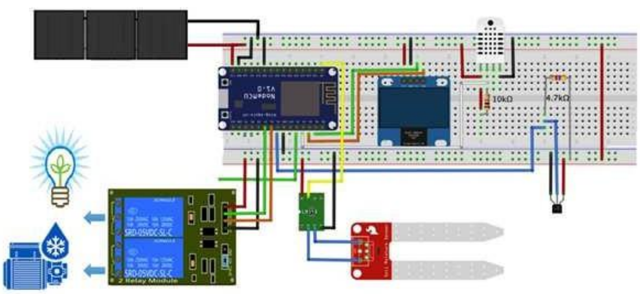

Fig. 4. Schematic diagram for connecting the proposed smart farming system's components.

Schematic diagram for connecting the proposed smart farming system's components is depicted in Figure 4. The smart farming system of the agricultural field is equipped with a power source, soil moisture sensor module, temperature and humidity sensor, light sensor, relays, ESP 8266 Wi-Fi module, and water pump motor. The required electronic circuit stimulation results obtained from the simulation software was represented in Figure 4. After the successful simulation result the hardware electrical and electronic components were assembled and connected to the microcontroller unit and programmed using the IDE. Finally, the proposed system has been developed and tested experimentally in local and cloud environment. The flowchart of the smart farming system's overall workflow is shown in Figure 5. Initially when the NodeMCU was turned on, it needs to be connected to a pre- configured Wi-Fi network. The sensors are used to check the measured data values before the system begins to perform. Due to a high or low value, the quantified reading may trigger. As a result, for actuation recognition, a range of threshold values was founded. When low moisture is identified and the assessed value is less than the threshold value, the pump is immediately started by turning on motor via relay. Meanwhile, the room temperature, humidity, and light intensity are all measured, and the light is turned off if the intensity exceeds the threshold value. The user is noticed through the LCD and can also view the fields in real-time conditions through the web and mobile applications.

III. RESULT ANALYSIS

This section discusses the device's benefits and key features, a farmer needs to have and use this system in his or her fields. The device functions successfully when the sensor's values are met. It's simple to use and maintain, and it's also one of the most cost-effective developments and maintenance expenses. The ThingSpeak, and mobile apps synchronize and display the same readings uploaded by the smart forming system's NodeMCU microcontroller, as seen in Figures 6 and 7. When the soil moisture sensor detects a low moisture level, the water pump can turn on automatically. Complete data information is shown in Figure 7, data is sent to the user over a mobile application.

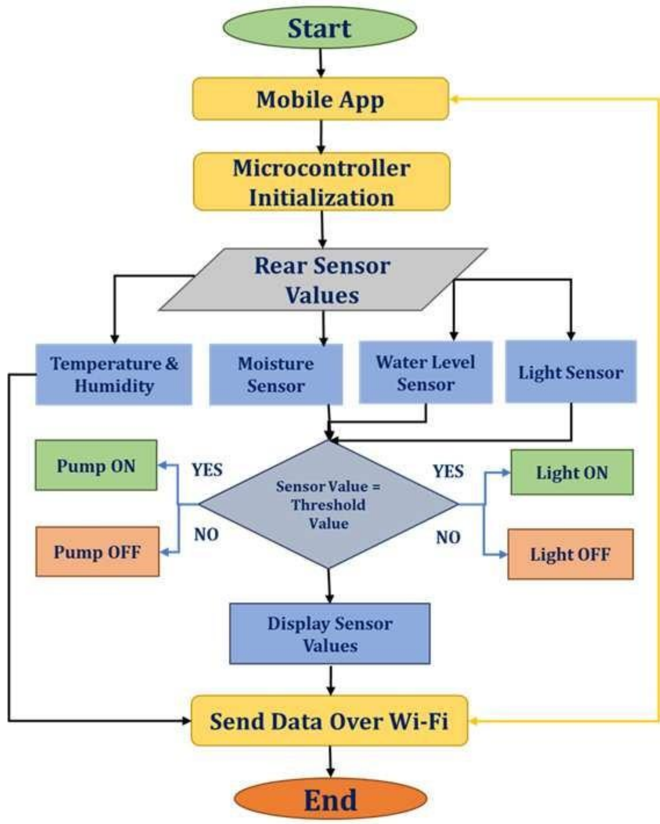

Fig. 5. Workflow of the proposed smart farming system.

A cloud server and an LCD monitor are used to provide real-time visual monitoring. Move on the switch in the server or mobile apps allows the user to turn on the motor manually. The user interface, which is used by both administrators and

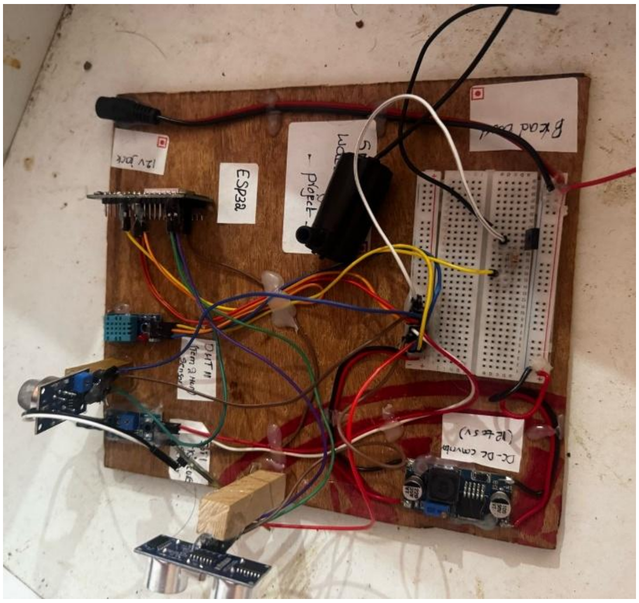

Fig. 6. Practical hardware implementation of the proposed smart farming system.

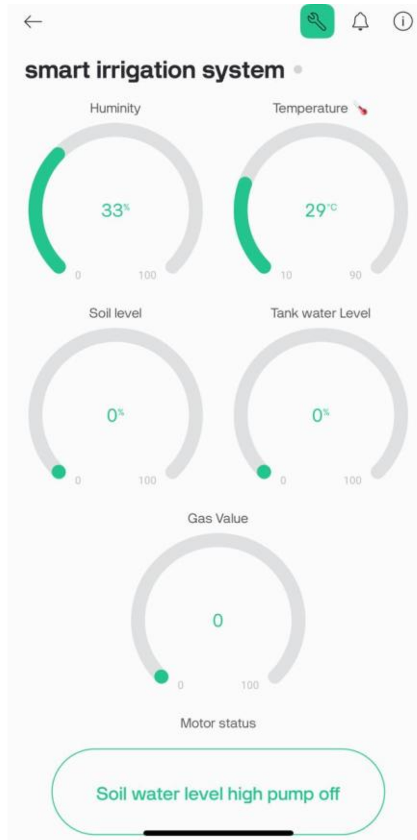

Fig. 7. Blynk software for controlling the smart farming system.

end-users, is a critical component of the cloud solution. As indicated in Figure 7, the web interface has been implemented. The web application includes a control interface as well as a live feed and historical data visualization. Always, it supports to updated sensor data and display the values in real-time. The user interface requests and visualizes data from the stored data. The graphic user interface for controlling the pump and the system's lighting is now presented on the website as an accessibility to the managing. Even if the soil moisture content material falls below the edge degree, the autonomous irrigation system can be activated. The irrigation system may now be activated, and the temperature threshold can be computed automatically. The farmer can receive the pump and use it to start or stop irrigation without having to be there at the time of the delivery. The farmer would be able to forecast the expense of the crop in advance, and the system could be turned off remotely or automatically.

IV. CONCLUSIONS

The system has been thoroughly designed from software to hardware for executing the regional control unit to the cloud end. It can perform basic agricultural care duties like watering, lighting, and monitoring based on the user's schedule. Various environmental sensors are connected, and data is constantly spread to the public cloud for real-time display and storage. An experimental deployment was used to test and verify the system. In terms of consistent implementation, real-time monitoring, fast response, and accessible remote control, the results show that a cloud and IoT-based remote monitoring and managing system can be a considerable benefit to agriculture. The method described above can be used to automate one of farming's most time-consuming processes: turning on and off the water pump in response to soil moisture levels. The tech- nology irrigates the soil using data from soil moisture sensors. Farm readings are also double-checked utilizing on-the-ground experience (Temperature, Moisture). This approach may be advantageous to farmers because it reduces the amount of work necessary. By developing a mechanism to monitor moisture levels in the soil, participants can put the winning structures to the test in terms of their functions and drawbacks. Farmers can use the technology to boost common crop yield ratings and grow spectacular crops by using smart farming techniques. The Smart farm monitoring system has the potential to become a major player in the agricultural industry in the future.

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