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Implementation of Automatic Irrigation Controller

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Abstract: Agriculture and food production is a traditional technique; nevertheless, modern technologies were introduced, and it was only via the modernization of advanced technological equipment that Wireless Sensor Networks (WSN) were able to manage the sequence range of data. The sequence from the agricultural field is updated in real time by these automated irrigation controllers. The pH levels of the agricultural field are measured, and the selected crops of the observe framework are live adapted for optimal crop environment. The main goals are to control wastage of water, boost fertilization requirements, and enhance the performance in yield. The cloud server solution restores data oracle ingress and restricts without the need for human intervention.
Keywords: Automatic Irrigation, Internet of things, Water Control, Wireless Sensor Network (WSN), pH Level.

I. INTRODUCTION

Water is one of the most valuable resources available to humanity. The Earth has limited supply of freshwater and it is suitable only for consumption and agriculture [1]. Limited resources are required to keep human society afloat. Agriculture is one of the most neglected areas of research. The challenges are numerous in this sector, which require proper techniques and technologies to overcome [2], [3]. Farming's era would come to an end, if its conceptualization is being hampered by soil-water stress [4]. This unfavourable situation results in a low yield. A farmer has several challenges in maintaining their fields due to a lack of rainfall and different illnesses that might harm their crops [5]. This is where the notion of an IoT platform comes into play. Through an IoT device, the farmer can monitor and control their crops and their water quality, alleviating the farmer from carrying out manual tasks [6], [7], [8]. Ranchers may find a viable solution in the form of a sensor-based computerized water system. People nowadays utilize the internet on a regular basis [9]. Using the internet, a rancher considers the current state of the agricultural field water system. The goal of this article is to develop an intelligent fertilizer framework that monitors soil humidity and atmospheric temperature and assists in making decisions about whether to turn on or off the water delivery system [10].

This paper is structured into sections as follows: Section I, gives the introduction. Section II, elaborates the framework. Section III, describes the flow of operation. Section IV, discusses about results. Section V, concludes the paper.

II. SYSTEM OVERVIEW

The automatic irrigation controller is a technology for monitoring crop conditions and aesthetics, which is separate from supplying water to the agricultural area.

The supplied factors include soil and crop, which function in accordance with the yield's most important criterion. By using a feedback loop mechanism, the previous database activity can aid in calculating the future fertilization procedure. Climate data, Clay data, and Yield data are the three main insertation of databases. The changes in weather conditions might cause delay in yield information from the cloud database. The main fertilization strategy will execute a water-saving setup and preserve the water condition in the farmlands.

The concept proposes wireless sensor network device for automated farm irrigation in the agricultural sector. This IoT-based device is used to gather all data at various locations around the farm, which includes a web system app that functions as a frontend for examining the data acquired by the device and assist in improving usability. The IoT-based device is of low-cost, which can be used over a range of functions. Once this device is installed, it is utilized to communicate data to the server on a regular basis to analyse real-time data. The Arduino Uno is a microcontroller that has a wide range of functionality and is inexpensive for farmers. This facilitates the development of a system that uses a set of sensors to collect data on a variety of parameters in order to produce a more productive crop. Fig. 1, illustrates the block diagram of the proposed system.

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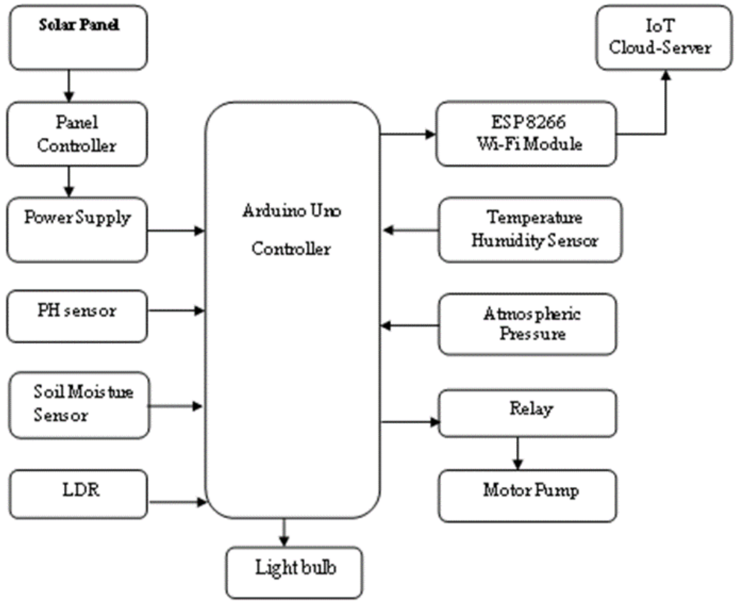

Fig.1. Block diagram of Automatic Irrigation Controller

The Automatic Irrigation Controller consists of a set of sensors they are: soil moisture sensor, pH sensor, Temperature and Humidity sensor, LDR, Atmospheric Pressure sensor, and Wi-Fi modules (ESP8266). This device is powered up by a solar panel with a battery, allowing it to function autonomously. The Soil moisture sensor calculates the moisture level by measuring the volumetric content of water in the soil. A pH sensor is a precision tool that measures the movement of hydrogen ions in water-based solutions in the soil and displays the acidity or alkalinity as pH. The Temperature and humidity sensor provides the weather reports to the controller. When there is a high intensity of light, the LDR enables greater voltages to flow through it (low resistance), and when there is no light, it passes a low voltage (high resistance). LDR controls the light bulb. Motor Pump act as an actuator for the supply of water. The controller determines the precise amount of water to be delivered to the crops by moving the actuator based on sensor characteristics and cloud database information.

III. ALGORITHMS FOR AUTOMATIC IRRIGATION CONTROLLER

This section describes the algorithm of operation lucidly. The water supply at the farm or target site is regulated by the WSN system. The WSN's function is to detect, measure, and record data, which is then transferred to an IoT server. The data processing system then makes the required judgments about when and how much water to deliver. The WSN controller sets up a closed loop feedback system to control pH levels. Water supply levels are monitored on a regular basis and works over liming water quality to keep the desired pH levels. Thus, the irrigation controller offers great flexibility to the user for consideration of the specific type of need. Fig. 2, depicts the flow diagram of algorithm.

The algorithm of operation are as follows:

A. The WSN is a base system on farm land, which collects the all connected sensors data.
B. The WSN establishes a link to the IoT cloud server for data transmission and data reception.
C. The ThingSpeak is the selected cloud server, which formulates the decision on control over the water requirements of the soil-crop growth level.
D. The received data will be collated with the priorly fetched data for every 15 seconds for decision making. The system will come to a standstill if the comparison or connection fails.
E. If a sufficient amount of rain compensates for the need of water, then no measure is required. Otherwise, the WSN controller directs the actuator to cover the need of water.
F. The pH sensor monitors the pH values in the water and soil on a continuous basis. If the pH level exceeds the desired level, the system stops the operation and displays the pH level status.
G. The procedure is repeated in a feedback loop, ensuring that the optimal water level on agricultural land is maintained.

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By adhering to this algorithm, agricultural area gets ideal water levels, resulting in a predicted rise in yield.

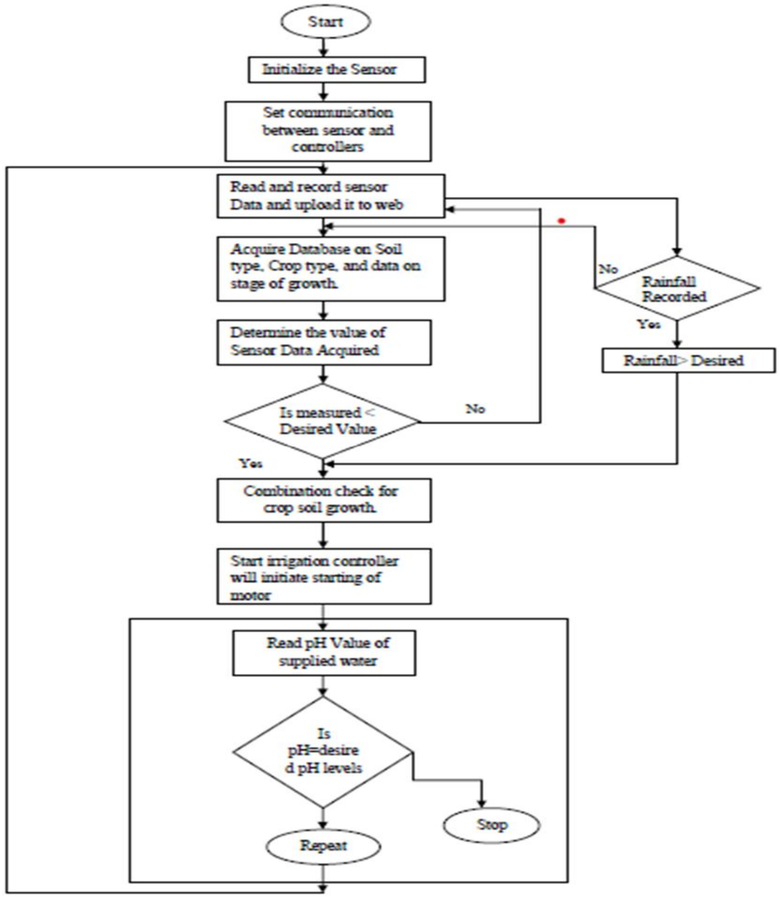

Fig.2. Design flow of the system

IV. RESULTS AND DISCUSSIONS

This section provides the operational outputs of the proposed system. The operation was carried out using the Arduino application and ThingSpeak cloud server. The relevant graphs of sensors were modulated in the ThingSpeak cloud server according to the detected, measured and recorded data.

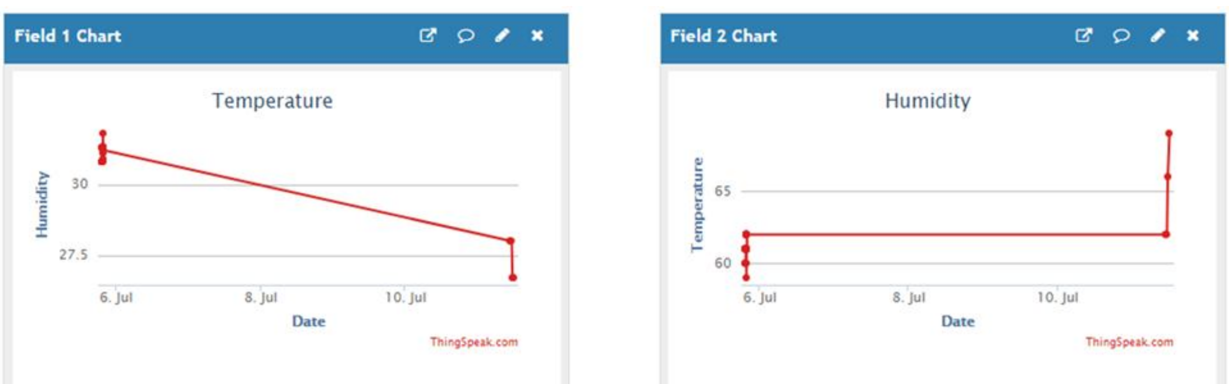

Fig.3. Monitoring DHT 11 Temperature and Humidity Sensor.

Fig. 3, shows the DHT 11 sensor result. As indicated in the graph above, the detected humidity and temperature parameters were transferred to the cloud server through wi-fi module, and results were created after collation with previously recorded data on the ThingSpeak server.

Fig.4. Monitoring Atmospheric Pressure and Soil Moisture Sensor.

Fig. 4, shows BMP180 barometric pressure sensor and Soil Moisture sensor output, it displays the pressure parameters in ThingSpeak IoT cloud server. Soil moisture sensor with Wi-Fi module uploads the observed soil condition, whether wet or dry, using a percentage parameter.

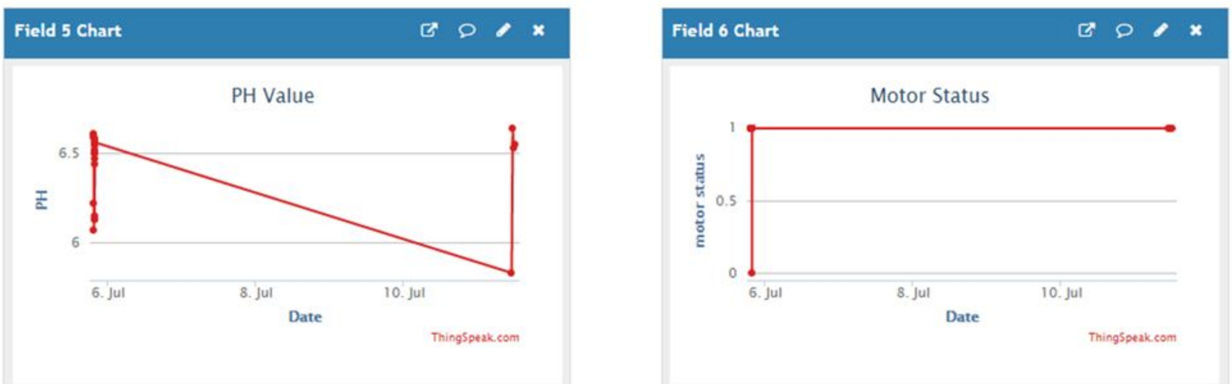

Fig.5. Monitoring pH Sensor and Motor status.

Fig. 5, shows the results of pH sensor and motor operational status. The detected parameters of all sensors were uploaded to the cloud server, and the data on the ThingSpeak server was collated to prior data every 15 seconds in order to make a better decision on how to regulate the motor for efficient watering.

V. CONCLUSION

In this paper, we have proposed an automatic irrigation control system which has been implemented to control the water supply. The method reduces the burden of human irrigation control while also saving the available water supply. IoT enabled this system on a farm to collect and collate a variety of data remotely and delivered in real time. The farm land was irrigated with the appropriate amount of water based on the soil moisture and pH values successfully. Overall, the system worked satisfactorily according to specifications.

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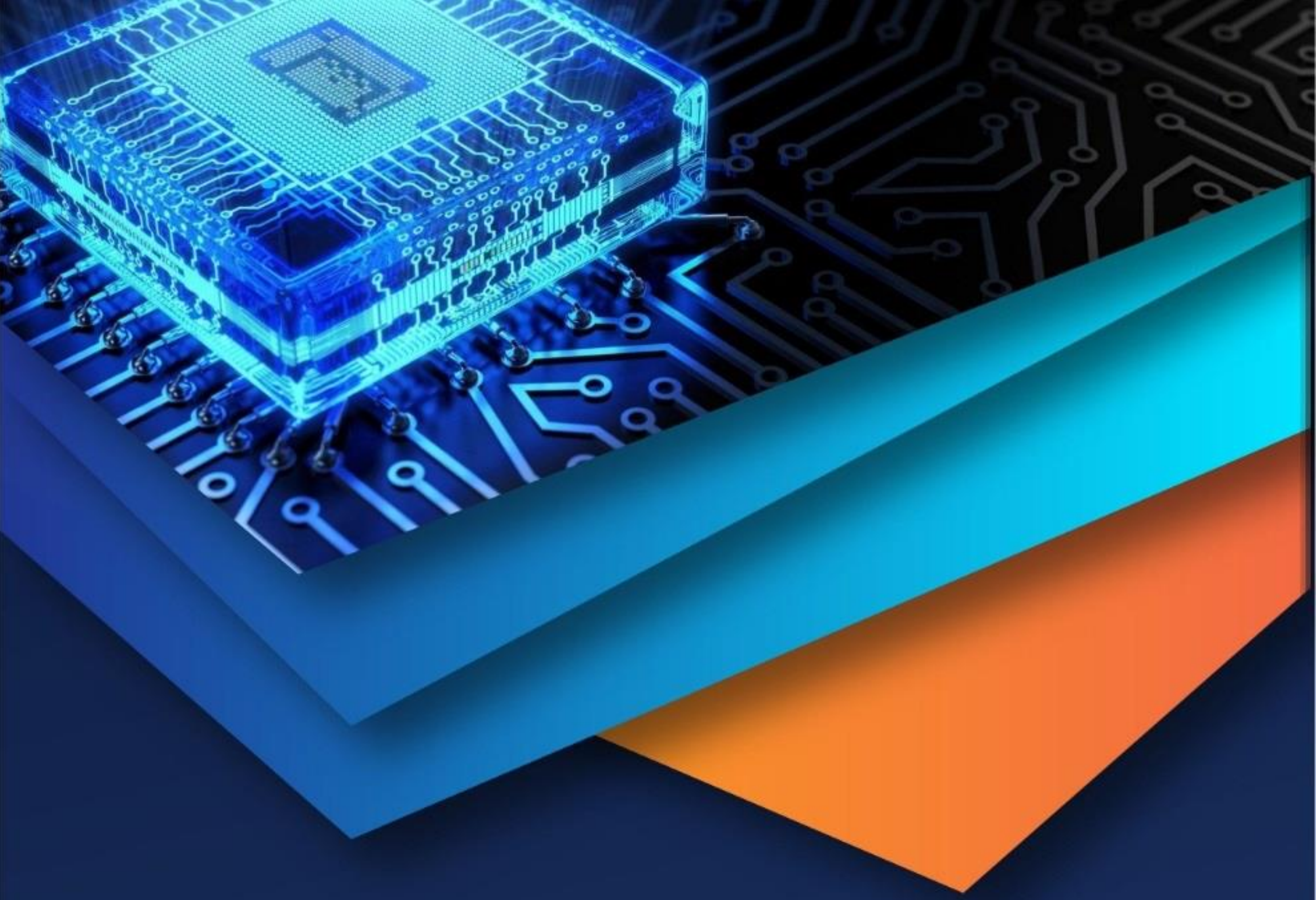

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