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IoT Based Smart Agriculture Monitoring, Weather Control and Irrigation System

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A B S T R A C T

Agriculture plays vital role in the development of agricultural country like India. In India about 70% of population depends upon farming. Agriculture is done manually from ages. As the world is trending into new technologies and implementations it is a necessary goal to trend up with Agriculture also. due to migration of people from rural to urban there are difficulties in agriculture. In day today life, technology is updating and it is also necessary to trend up agriculture too. IoT can play a key role in smart agriculture.

Hence the paper aims at making agriculture smart using automation and IoT technologies. IOT based Agriculture monitoring system makes use of wireless sensor networks that collects data from different sensors deployed at various nodes and sends it through the wireless protocols. It includes the humidity sensor, temperature sensor, soil moisture sensor and water level sensor. The features of this project include an android application which shows the live information about the temperature, humidity, soil moisture, water level. Secondly it includes smart irrigation with smart control and intelligent decision making based on accurate real time field data. Thirdly an automatic weather control system which controls the humidity and temperature of the field (e.g. green house).

Keywords: Internet-of-Things (IoT), Smart Agriculture, Smart Irrigation, Weather Control, Automation

1. Introduction

As the world is trending into new technologies and implementations it is necessary goal to trend up in agriculture also. Agriculture is considered as the basis of life for the human species as it is the main source of food grains and raw materials. Basically, Agriculture production depends upon the seasonal situations, where the natural conditions like rain, temperature, humidity and plant diseases plays important role in farm yield. By considering and predicting environmental circumstances, farm yield can be increased. Crop quality is based on data collected from field such as soil moisture, ambient temperature and humidity etc. Advanced tools and technology can be used to increase farm production. The paper aims at making agriculture smart using automation and IoT technologies.

The real-time environmental parameters like soil moisture level, temperature, humidity and tank water level have continuous influence on the crop lifecycle. By forming sensor network, good monitoring of water regulation in the agriculture field can be achieved. The proper use of temperature and humidity sensor make operations and monitoring well maintained. This paper presents irrigation monitoring and controlling system. The system should be developed to monitor the environmental conditions such as temperature, soil moisture content, humidity of the air and water level of agriculture land for controlling the irrigation as well as controlled weather. The real time conditions sensed data is send to an android based application for monitoring and to be stored for future reference.

1.1 Problem Statement

- Monitoring of field parameters is important in order to analyze the situation.
- Due to heavy water consumption an automated irrigation system is needed to optimize the water uses.
- The traditional techniques can leads to under or over irrigation.
- Unsafe working conditions can potentially leads to accidents, wastage of man power, money, time etc.

1.2 Objectives

- The main objective of this paper is to design an IOT based agriculture monitoring system which can provide comfortable access to field information. This IOT server can be easily monitored from anywhere.
- To design a Smart irrigation system can optimize water levels based on things such as soil moisture and weather predictions.
- To design an automated regulation of water levels in the fields
- To provide a smart weather control on the in order to regulate the temperature and humidity.
- To save man power, time, money etc.

2. Literature Survey

Various researches have been carried out on how soil irrigation can be made more efficient .The researchers have used different ideas depending on the condition of the soil and quantity of water Different technologies used and the design of the system was discussed by the researchers.

An IOT Based Crop-field monitoring an irrigation automation system describes how to monitor a crop field. A system is developed by using sensors and according to the decision from a server based on sensed data, the irrigation system is automated. Through wireless transmission the sensed data is forwarded to web server database. If the irrigation is automated then the moisture and temperature fields are decreased below the potential range. The user can monitor and control the system remotely with the help of application which provides a web interface to user [1].

Prof. K.A.Patil and Prof. N.R.Kale propose a wise agricultural model in irrigation with ICT (Information Communication Technology).The complete real-time and historical environment is expected to help to achieve efficient management and utilization of resources. [2]

The system focuses on developing devices and tool to manage, display and alert the users using the advantages of a wireless sensor network system. It aims at making agriculture smart using automation and IoT technologies [3].

IOT Based Smart Agriculture Monitoring System develops various features like GPS based remote controlled monitoring, moisture and temperature sensing, intruders scaring, security, leaf wetness and proper irrigation facilities.[4]

Mahammad shareefMekala, Dr.P.Viswanathan demonstrated some typical application of Agriculture IOT Sensor Monitoring Network Technologies using Cloud computing as the backbone. [5]

By smart Agriculture monitoring system and one of the oldest ways in agriculture is the manual method of checking the parameters. In this method farmers by themselves verify all the parameter and calculate the reading [6].

The cloud computing devices are used at the end of the system that can create a whole computing system from sensors to tools that observe data from agriculture field. It proposes a novel methodology for smart farming by including a smart sensing system and smart irrigator system through wireless communication technology [7].

This system is cheap at cost for installation. Here one can access and also control the agriculture system in laptop, cell phone or a computer [8].

This paper shows idea of wireless sensors can be used in agriculture. This paper simplifies plant monitoring process and reduced human effort drastically. User can create customized environment for the plants, thus providing them with optimal growth conditions. Also shares idea about the interfacing with android software [9]

The sensors and microcontrollers of all three Nodes are successfully interfaced with raspberry pi and wireless communication is achieved between various Nodes.[10]

This paper provides basic guidelines for deploying Wireless Sensor Networks (WSNs) in Agriculture, and more specifically in applications requiring crop monitoring. Firstly, it reviews the main components that existing WSN applications use, namely node platforms, operating systems (OSs), power supply, etc. Based on these data, a generic guide is proposed discussing basic considerations for deploying WSNs in applications relevant to agriculture. [11]

In this paper, authors have proposed a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. System focuses on the measurement of physical parameters such as soil moisture content, nutrient content, and pH of the soil that plays a vital role in farming activities.[12]

The implemented framework comprises of different sensors and de-vices and they are interconnected by means of remote correspondence modules. The sensor data is been sent and received from client end utilizing Internet connectivity which was enabled in the Node MCU module- an open source IOT platform.[13]

This project uses IOT technology in agriculture, gathering crops growth environmental parameters in a fixed place to help farmers find problems in time. [14]

This project shows IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management and control of insecticides and pesticides. [15]

This paper considered all aspects and highlighted the role of various technologies, especially IoT, in order to make the agriculture smarter and more efficient to meet future expectations. For this purpose, wireless sensors, UAVs, Cloud-computing, communication technologies are discussed thoroughly. [16]

3. Proposed System

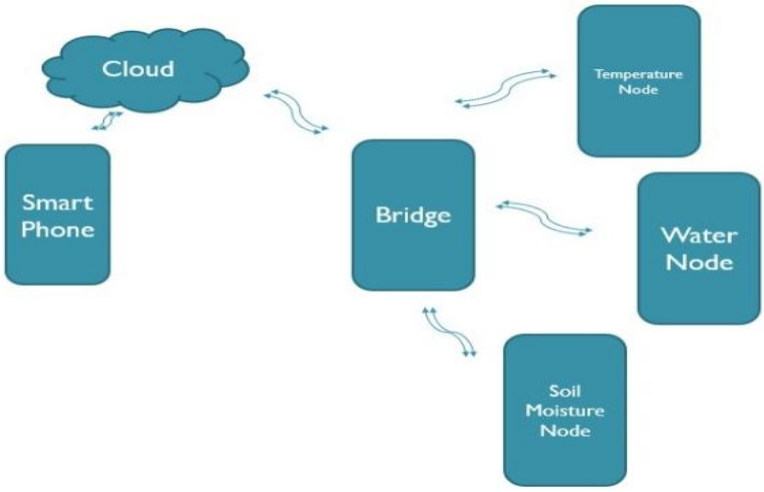

Fig.1 - Block Diagram of the proposed work

This system is a combination of hardware and software components. The hardware part consists of different sensors like soil moisture sensor, water level sensor, temperature& humidity sensor etc. whereas the software part consists of an android based application connected to the bridge ESP(32) board and other hardware components using Internet of Things (IOT). The android based application consists of signals and a database in which readings are displayed from sensors i.e. temperature, humidity, soil moisture & water level. The improvement in irrigation system using wireless network is a solution to achieve water conservation as well as improvement in irrigation process. By using water level sensor an automated regulation of the water level can be achieved in the field. With temperature and humidity data, weather regulation can be done.

Figure shows the block diagram of all above mentioned materials in the system. The main working principle behind this system is in connecting the soil moisture sensor, which was previously embedded into the plant, to the soil moisture node (ESP8266) which is also connected to other electronic components listed above as shown in Figure 1. Measurement of soil moisture is done by the sensor which forwards the information and parameters regarding the soil moisture to the bridge(ESP32) and water node(8266), which controls the pump. If the level of soil moisture drops below a certain value, the water node (ESP8266) sends the signal to the relay module which then runs a pump and certain amount of water is delivered to the plant. Once the enough water is delivered, the pump stops doing its work. To maintain the appropriate water level in the water tank, the water level sensors are used. If the water level falls below the certain level the sensor will send data to the water node(ESP8266), based on data received from sensor water node sends signals to the motor driver and motor will start accordingly and once the desired water level is achieved the water node will send data to motor driver to stop the motor.

For temperature regulation if the temperature and humidity values are above the reference value (calculated according to. the crop) to maintain them to be within threshold levels fan will switched ON. If the temperature value is below the reference value the heater lamp will start to maintain the threshold levels.

All three nodes (ESP8266) water node, temperature node & soil moisture node are connected to the bridge (ESP32) to form a local network. The bridge will have the Wi-Fi connectivity to share the data over internet. All the sensor data will be stored in the form of spread sheet in the Google cloud account. An android based application is required to monitor the real time data from the field.

4. Hardware Requirements

4.1 IOT (WI-FI module ESP32)

ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth SoC (System On a Chip). ESP32 is designed for mobile, wearable electronics, andInternet-of-Things (IoT) applications. It supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps & Classic Bluetooth v4.2 and BLE specifications. It supports 34 GIPOs. It has 512kB of SRAM &upto 16MB external flash memory can be added. It also supports up to 8 MB of external SRAM memory. ESP-MESH is a networking protocol built atop the Wi-Fi protocol. ESP-MESH allows numerous devices (referred to as nodes) spread over a large physical area (both indoors and outdoors) to be interconnected under a single WLAN (Wireless Local-Area Network).

Figure: ESP32 Module

4.2 IoT (WI-FI module ESP8266)

The NodeMCU (ESP8266) shown is a microcontroller with an inbuilt Wi-Fi module. The total pins on this device are 30 out of which 17 are GPIO (General Purpose Input/Output) pins which are connected to various sensors to receive data from the sensors and send output data to the connected devices. The NodeMCU has 128KB of RAM and 4MB flash memory storage to store programs and data. The code is dumped into the NodeMCU through USB and is stored in it. Whenever the NodeMCU receives input data from the sensors, it crosschecks the data received and stores the received data. The Wi-Fi module presents in the NodeMCU range from 46 (indoors) to 92 (Outdoors) Meters.

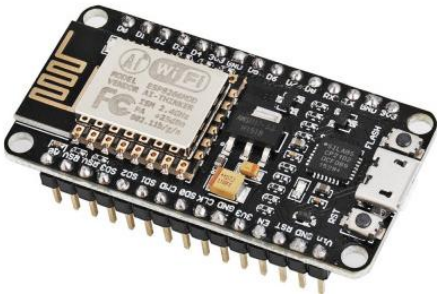

Figure: ESP8266 Module

4.3 Soil moisture sensor

A device which is used to sense the moisture level in the soil is called soil moisture sensor and is shown in Figure. When the sensor senses the water shortage in the field, the module output is at high level else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening.

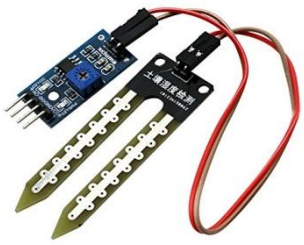

Figure: Soil Moisture Sensor

4.4 Temperature Sensor (DHT11)

Temperature Sensor (DHT-11) is used to monitor temperature and humidity of the atmosphere. The DHT-11 shown in Figure. It is a basic ultra-low cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and split out a digital signal on the data pin. The DHT-11 calculates relative humidity by measuring the electrical resistance between two electrodes.

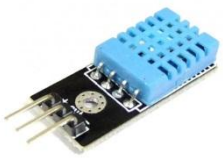

Figure: Humidity & Temperature Sensor

4.5 Water level Sensor

The water level sensor is used to determine the water level of the stored water tank. The power and sense traces form a variable resistor (much like a potentiometer) whose resistance varies based on how much they are exposed to water. This resistance varies inversely with the depth of immersion of the sensor in water: The more water the sensor is immersed in, the better the conductivity and the lower the resistance. The less water the sensor is immersed in, the poorer the conductivity and the higher the resistance. The sensor generates an output voltage proportional to the resistance; by measuring this voltage, the water level can be determined.

Figure: Water Level Sensor

4.6 Water pump

The DC 3-6V Mini Micro Submersible Water Pump shown in Figure 5 is a low cost, small size Submersible Pump Motor. It operates with a 2.5 to 6V power supply. It can pump up to 120 litres per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it.

Figure: Water Pump

4.7 Relay

A relay is used as electrically operated switch which is shown in Figure. It has a set of input terminals for a single or multiple control signals and a set of operating contact terminals. The switch may contain number of contacts in multiple contact forms which make contacts or break contacts. Relay is used to turn on the water pump in order to maintain the moisture level of the crop.

Figure: Relay

4.8 Power Supply

Power supply is an electrical device which supplies electric power to an electrical load. The first function of a power supply is to convert electric current from a source to the correct voltage, current and frequency to power up the load. As a result, power supplies are alsoreferred to as electric power converters. Some power supplies are separate standalone pieces of equipment while others are built into the load appliances that they power.

5. Benefits of the Proposed System

Smart Farming with the help of IoT technology, benefits in the following ways:

- Water usage optimization
- Energy resources optimization
- Better crop yield & plant quality
- Time & energy saving
- Workload reduction

5. Conclusion

In this Paper, Smart Farming Enabled IoT Based Farming for Live Monitoring of Temperature, Soil Moisture, climate status, water level, motor status, fan & heater lamp has been proposed. Farmers may know the state of their crop at any time and from any location. Wireless sensor networks, on the other hand, provide for control the farm's environment, as well as automate certain processes. This paper demonstrates the design and implementation of a smart irrigation system in the agriculture field as well as an automated water level management & smart weather control.

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