PLANT WATERING AND MONITORING SYSTEM USING IOT AND CLOUD COMPUTING

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***Abstract*: In a growing busy life of people, taking care of plants has become a tough task. In recent years the need for automation is increasing day by day. Also leads to water wastage in many cases. There are many automated solutions in the market which requires time dependent motor activation control for watering the plants. In this project, a smart plant watering mechanism is introduced using IOT sensors and cloud-based databases. The primary objective is to reduce human intervention and avoid water wastage by watering the plants as per the requirements. Output of the system will be satisfying the requirements of the plants by watering.**

***Keywords*: Cloud Computing, Controlling, GSM module, IOT, Soil Monitoring.**

I. INTRODUCTION

We live in a world where everything can be controlled and operated automatically. Plant monitoring is an important part of agriculture in our country as they used to grow plants under controlled climatic conditions for optimum produce. Automating a plant monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence they produce yields. Automation is a process for controlling industrial machinery and processes, thereby replacing human operations. In this paper, plant watering and monitoring system technology will provide feedback to the user through smart phones or laptops. The automated system will reduce the need of man power hence reducing the error. For large scale areas, it is quite impossible for a farmer to monitor the efficiency of the system by implementing this technology, the farmer can easily monitor the system using their smart devices.

In this system, we can water and monitor the plant using IoT (Internet of Things) and cloud computing. In this system we use different modules such as Arduino as controller, temperature sensor, moisture sensor, humidity sensor and PH sensor. By having knowledge of these entire scenarios, one can take action accordingly.

We set the water motor in the system. According to sensors values analyzed by different types of sensors automatically water Motor will get ON. And the sensor values are given to ADC (Analog and Digital Converter) to be processed by the controller.

II. RELATED WORK

We have studied many previous works done in this field by different researchers. Use of technology in the field of agriculture plays an important role in increasing the production as well as in reducing the manpower efforts. Research for improving agricultural production by utilizing different controllers like PIC microcontroller,8051 controller, ARM 7, also monitoring done by different communication technology like Zigbee, Wireless sensor network(WSN),even using GSM. In [1] , the paper demonstrates the integration of all the hardware parts related to agriculture. Soil moisture sensor is used for detecting dryness of soil and according to the value detected by sensor watering will be done to the plant. Efficient use of all the hardware whichever is used for developing the system. Paper [2] describes how to connect hardware devices to a third-party cloud service provider via processing language. Also the soil moisture is used here to detect dryness of soil. For storage purpose cloud is used so there is the issue of security. Real time data is used for further processing. In paper [3], the aim of the paper is to maintain the nature of plants by continuously monitoring the parameters leading to the increased life of plants. The system is designed by connecting different parameters of the soil like humidity, temperature, moisture to the cloud and it is successfully controlled remotely through a mobile application. The paper [4], deals with a simple, easy to install, microcontroller-based circuit to monitor and record the value of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield. The controller communicates with the various sensor modules in real-time in order to control the light and drainage process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops. Paper [5] based on a novel ZigBee based energy efficient environmental monitoring, alerting and controlling system for agriculture is designed and implemented. This system utilizes an ARM7 processor, various sensors and ZigBee communication module. Sensors gather various physical data from the field in real time and transmit it to the processor and to the end user via ZigBee communication. Then necessary actions are initiated to perform action on behalf of people to reduce or eliminate the need for human labor. The [6] the paper is an effective implementation of an intelligent remote monitoring system for solar Photovoltaic Power Conditioning Unit (PCU) which is used in a greenhouse environment.

They designed a smart remote monitoring system based on the internet of things for monitoring Solar PV PCU. This system had incorporated remote monitoring for solar PV PCU through internet using host, network GPRS (Global Positioning Radio Service), embedded system gateway and other components. The paper [7] aims to provide controllable environment for measuring and supporting plant growth by applying the Internet of Things technology and scientific experimental process together in order to improve farmers' performance of growing plants. In [8] the Data collected is visualised using graphs charts to give better understanding with the help of node js application. They are using graphs and charts for better understanding. They are storing data in Dynamodb to maintain security. In paper [9], the automatic water enduring method described in these papers can ensure a systematic and scientific approach in taking care of plants. The whole system is controlled by raspberry pi 3, which will take actions particularly when water is needed. FC-28 is used for sensing soil moisture which is less costly. In [10] the Zigbee technology is used for communication between sensor nodes and base stations and real time data is handled using java based graphical user interface. Mobile application also provides alerts to the user for application of fertilizers and pesticides depending upon crop selection. In paper [11] , the main objective of this project is to control the water supply and monitor the plants through a smartphone sends SMS to farmers and engineers to make aware of water requirements. The system proposes low cost moisture sensor based acquisition system.Blue term application is used for writing codes to main controller. In paper [12] the proposed work is to develop an Embedded System for Plant Watering and Monitoring System using IoT, Raspberry pi as processor and sensors for sensing environmental conditions. The system can also be accessed with an IP address. In paper [13], the purpose of the smart water irrigation system is to provide a water delivery schedule to the crops to ensure all the crops have enough water for their healthy growth, to reduce the amount of water wasted in irrigation. In paper [14], the System based on IOT, which uses GSM,Wifi technology and sensors especially luminous sensor.Can monitor plants remotely through Wi-Fi and Bluetooth module.Parameters like temperature and moisture are considered. In [15] , the System is designed to replace conventional chilli sprinkler to automatic one using moisture sensor and pH Sensor to capture current moisture and pH respectively.This paper focuses on optimize use of water as needed for chilli plant and IOT can be used for data analysis and for managing and controlling in detail and precisely by the sensors. The paper [16] demonstrates the integration of all the hardware Soil. a moisture sensor is used for detecting dryness of soil and according to the value detected by sensor watering will be done to the plant. In paper [17] , the main idea of Vertical Farming is to use a controlled environment agriculture technology, where all the environmental factors can be controlled.The system is developed based on a web server to monitor and control the soil moisture of vertical farming.

III. IOT FOR SMART IRRIGATION

In the agriculture field, sensors are used like soil moisture, temperature, humidity, pH meter. The information received from the sensors is sent to the cloud and database folder through the device.
Also, this system is automatically activated when the soil moisture is low, the pump is switched ON based on the moisture content. Sensors and actuators are connected to local wireless network the other side is connected to wireless actuator network and can be accessed from Cloud systems.

IV. NECESSITY TO USE CLOUD

Cloud computing facilitates the access of applications and data from any location worldwide and from any device with an internet connection. Cost savings; Cloud computing offers businesses with scalable computing resources hence saving them on the cost of acquiring and maintaining them. cloud storage provides various advantages as follows :

1) Data can be accessed from anywhere.
2) Hardware requirement and cost reduces.
3) Security of data increases.

V. PROPOSED SYSTEM

The automated system includes different sensors which senses humidity, temperature and soil moisture, and then uploads the sensed information to the databases on Cloud. Soil Moisture Sensor can be used to detect the moisture of soil or judge if there is water around the sensor. Users can access the system remotely.

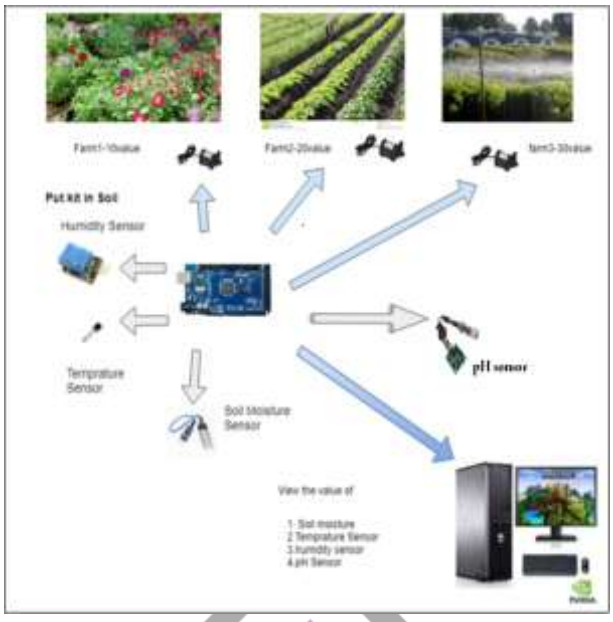

Figure1. Proposed System Overview

According to sensors values analyzed by different types of sensors automatically water Motor will get ON. And the sensor values are given to ADC (Analog and Digital Converter) to be processed by the controller.

VI. SYSTEM IMPLEMENTATION AND RESULT

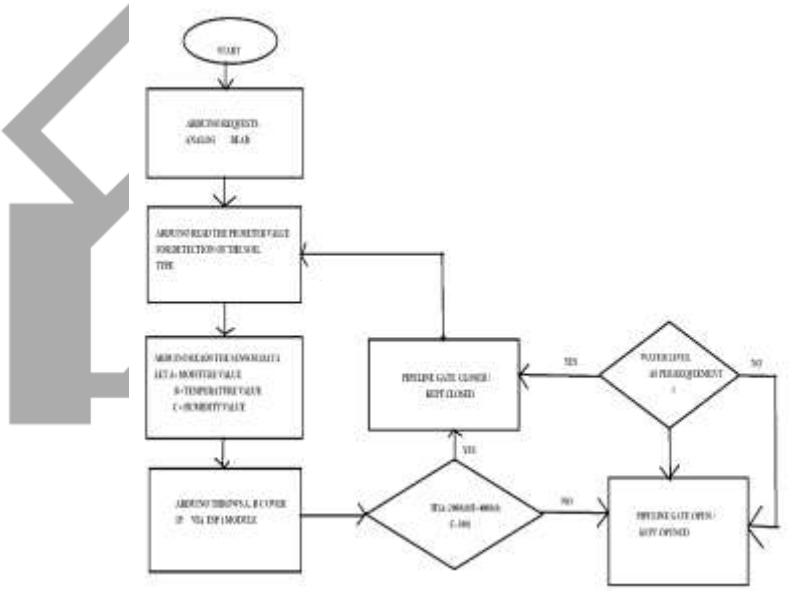

Figure 2. Flow Chart

1. Firstly, the pH sensor will detect the soil fertility. And according to fertility of soil, categorization of plants will be done.
2. .Sensors like Temperature, Humidity, Moisture are used for detecting the soil condition. According to threshold value the comparison will be done on obtained values of sensors.
3. If the condition is not satisfied then the water quantity requirement of the plant will be satisfied via switching ON through the motor pump.
4. Pump will switch OFF when watering will be done upto the requirement.
5. User need to login for observing the whole scenario.

Observation table consists of some fields like the sensor readings that are sensed by sensors used in the proposed system.The sensed values will vary based on their category.
(Refer Table 1 : Observation table)

Table 1: Observation table

category	PH sensor	Temperature sensor	Humidity sensor	Moisture sensor
Shrubs (Aloe Vera)	7.0-8.5	26.19	53.00	62.95
Medicinal plant(Tulsi)	6.0-7.5	26.53	55.22	55.73
Flower plant(Rose)	6.0-6.9	26.06	52.09	65.55

Here, the Result table shows the water requirement for a particular category of plant. The readings are having their unit as Gallon of water per week. (Refer Table 2: Result Table)

Table 2: Result Table

Category	Water Requirement		
	Summer	Rainy	Winter
Shrubs(Aloe Vera)	2 - 4	1 - 2	2 - 4
Medicinal plant(Tulsi)	6 - 9	3 - 4	4 - 6
Flower Plant(Rose)	7 - 8	3 - 5	5 - 7

There are four sensors used in the system.

1. pH Sensor
2. Moisture Sensor
3. Temperature sensor
4. Humidity Sensor

1. pH Sensor:

A **pH meter** is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity expressed as pH.

Figure 3. pH Sensor

2. Moisture Sensor :

Soil moisture sensors used to measure the water content in soil.

Figure 4. Soil Moisture Sensor

3. Temperature Sensor:

A **temperature sensor** is a device, typically, a thermocouple or RTD, that provides for **temperature** measurement through an electrical signal.

Figure5. Temperature Sensor

4. Humidity Sensor:

A **humidity sensor** senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity.

Figure 6. Humidity Sensor

VIII. CONCLUSION

The proposed system can reduce the efforts of daily watering of plants. It also conserves water for irrigation by locating the sensor at the right position above the soil level. The plants can still sustain at low moisture levels when the temperature is moderate. The system is used to switch on/off the water pump according to the sensor readings there by automating the process of irrigation, which is one of the time-consuming activities. The system uses information from the sensors to irrigate soil which helps to prevent over irrigation (water wastage). Users can monitor the process online through a website. From this system it can be concluded that there can be considerable development in farming with the use of the Internet of Things.

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