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Automated Irrigation System in Vertical Farming using Internet of Things and Android

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ABSTRACT: In recent times, a revolution has sprung in the field of agriculture in the name of Vertical Farming. Vertical Farming is practicing agricultural in a storied building with least usage of resources. Vertical Farming canbe made automated using Internet of Things[IoT]. IoT stretches its hand for the connection between physical objects and help us to connect and fetch details. With help of IoT, connections are made between varied sensors and the information is fetched and it is analyzed using an operating system. Arduino provides an interface for various sensors like DHT, Soil moisture and LDR. These sensor values are collected and then transmitted using Bluetooth module to the android device. The valuesfrom the sensors are fetched and read. Depending upon the parameters the motor and LEDS are turned on using the android application. This farming can be effected to bring more output than routine farming and in a limited span of time. Implementing this can help the demands in food industry and can improve the country's economic growth.

KEYWORDS: Internet of Things, VerticalFarming, Sensors, Android.

I.INTRODUCTION

Vertical farming is a technology of growingplants in a vertical orientation. This type of agriculture is very well suited for urban culture where we can use storied buildings for agriculture.

The simple concept of vertical farming uses less land,less water and promotes great yield. Vertical farming consumes 70 percent less water compared to conventional farming method. As per the report, by 2050,around 80 percent of world population is expected to live in urban areas, and the growing population will lead to an increasing demand for food. The efficient use of vertical farming may perhaps play a significant role in preparing for such a challenge.

A minor disadvantage of vertical farming is the high labor cost and maintaining the crops without getting affected. Vertical farming needs to be taken care properly with adequate amount of water, lighting and temperature. Therefore, comes the technology which will help the crops to grow with minimal human intervention. Internet of things (IoT) is the one the fast growing technology.It is necessary to control and manage many factors in the process (Like watering and maintaining the plants).IoT is the technology where we can connect n number of devices remotely using networks. Each devices has its own IP address and gets connected with server using the IP address.addresses used in IoT. The sensorsconnected to an Arduino UNO will sense the moisture level in the soil, temperature and lighting. When the water level is low the Arduino will sense it and will send it to the server and the server will initiate the automation process for irrigation. The system also provides basic remote function where the users could turn on/ off the watering system. This controls the usage of water.

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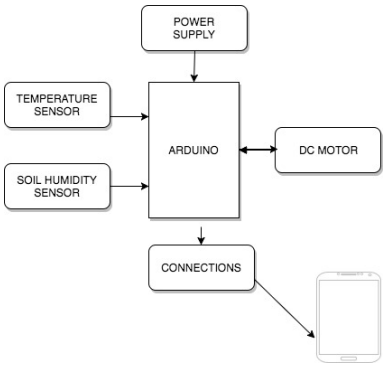

Fig 1. Architecture - Flow diagram

II.LITERATURE REVIEW

In [1] the author suggests that the labor cost for running the Vertical Farming is a bit higher. In [2] the author suggests that internet of things can be used to monitor the internal parameters of the farm. In [3,4] the author states how Vertical Farming will satisfy the needs of the upcoming urban culture. Vertical Farming uses the least amount of water than any other farming technologies. In [6] gives the list of sensors that are available which can be used to make an automated Vertical Farm system. In [9] is the survey of the technologies that are used in Vertical Farming. So these all gave rise to the concept of installing an automated irrigation system for Vertical Farming. This can help saving a lot of water and can improve the farming.

III.CONNECTION

The sensor components are connected in the bread board as shown in the figure (red wires - power; black wire - ground). The main voltage supply for the bread board is provided from the analog VCC of Arduino UNO. The digital pin 8 is the input supply for DC motor pump. A 5V supply is given. The pins A0,A3,A5[green wire] are connected to the input of soil moisture, DHT and LDR. The TX, RX of the Arduino are connected to the RX and TX of the Bluetooth module respectively [yellow and orange wires]. The current supply for Arduino can be given through any power source that consists of a USB 2.0 input port.

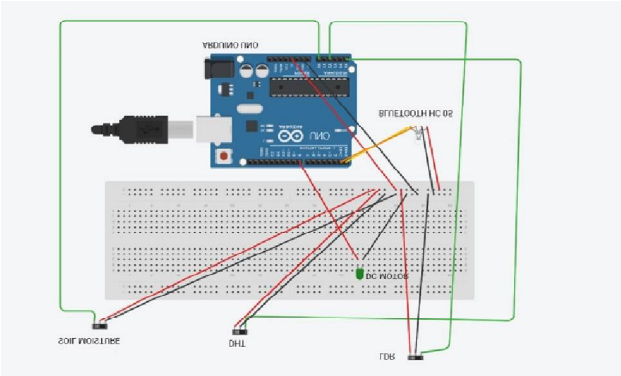

Fig 2. Circuit diagrammatic representation

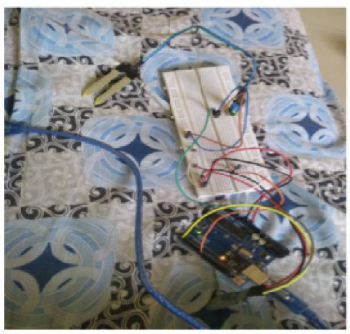

Fig 3. Real time circuit connection

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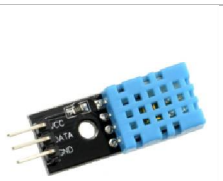
IV.COMPONENTS

Device	Description
	**Arduino UNO** The Arduino Uno (Fig 4.2) is a micro-controller board based on the AT-mega328. It has 14 digital Input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.
	**DHT Sensor** This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output.
	**Soil moisture sensor** Soil moisture sensors measure the volumetric water content in soil. This is a fork shaped sensor and is inserted into the medium of soil
	**LDR Sensor** An LDR or light dependent resistor is also known as photo resistor, photocell, photo- conductor.
	**DC Motor** Mini motor immersive DC motor pump is to pump water and pass it to the drip irrigation system. This is of 3 to 5V.This is for the purpose of demo and for the purpose of real time implication, use high voltage motors. This has a inlet and outlet.

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	**Bluetooth HC 05** HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication.

V.IMPLEMENTATION

A. SOFTWARE IMPLEMENTATION

There are list of option provided in the android application to control over the Vertical farms, they are as follows:

Crop feature:

This feature helps the people to know about the type of crops that can be grown in the area with and the parameters that are needed for the growth of the particular crop. Parameters include the soil moisture, pH and the growth period.

Irrigation :

This button takes into the activity where the motor control is present. Automatic and Manual settings are provided.

Motor On and Off - Manual mode :

Make sure the Bluetooth connection indication is displayed. There is a button provided for the motor turn on and off. Whenever the button is clicked it takes to the activity where there is option for Automatic and Manual. Manual is for the manual control of the button. Separate buttons are provided for on and off.

Automatic mode:

This button helps the motor to run automatically. This is based upon the value of the soil moisture. The Arduino code has set to run such that for every one second the soil moisture sensor checks for the value.

Fetching parameters:

This button helps to fetch the soil moisture, humidity and temperature instantly. This helps the person outside the farmhouse to knew what the condition is like inside with a single click.

B. HARDWARE IMPLEMENTATION

SoilMoisture:

Connections are made for soil moisture. A power of 5V is supplied. The soil moisture is inserted into the medium where the crop is planted. Values are sent through the output port and it is processed later.

DHT Sensor :

Digital Humidity and Temperature sensor is connected to the bread board. This also requires a 5V supply. This sensor reads the current temperature and humidity at that particular surrounding.

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LDR Sensor:

Light Dependent Resistor is again connected adjacent to the bread board. A 5V supply is needed. A red light on the sensor notifies the sensor's life. This sensor reads the light intensity.

Bluetooth Module:

The Bluetooth model used here is HC-05. The Bluetooth module consists of TX(Transmitter),RX(Receiver), Input and ground points. The TX of the module is connected to the RX of the Arduino and the RX of the module to TX. Once connected the communication is done through these ports. This module provides an interface of communication between the android and Arduino.

VI.WORKING

The connections are made and the hardware components are interfaced with the crop medium. Check for the repeated blinking of the Bluetooth module. Then launch the android application. Then navigate to the motor on and off option. Set the automatic mode on. Now whenever the soil moisture falls below a required level, the motor turns on and when it reaches the acquired level the motor stops pumping in the water. There is also the fetch button which fetches the parameters such as temperature, humidity, light intensity and soil moisture is fetched. Fig.4 shows the screenshot of the manual motor control. On and Off buttons are provided for the turning motor. Connect and Close are for the Bluetooth connectivity. The fetch button thereby prints the parameters.

Fig.4 Screenshot of Ager app (Manual controlling of motor) and Fetching data

VII.CONCLUSION AND FUTURE ENHANCEMENTS

The main objective of this project is to establish an automated irrigation system for the vertical farming. This system also helps to fetch information of the required parameters. All these operations are done with a single click using an android operating system.

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The Future work of the project is very essential in order to make the design system more advanced and effective. Features to convert the water from transpiration by the process called dehumidification can help save a lot of water. Dehumidification devices can be developed. And also, the data fetched are stored in cloud and is processed to produce a dataanalysis. This data can be helpful for seeding the next crop.

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