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Optimization and Control of Hydroponics Indoor Farming System with Live Data Monitoring

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Abstract - *Hydroponics is a technique in which we grow the plant without using the soil. In This technique we ensure that plant gets all nutrients from the water solution. There are many types of hydroponics system. The Ebb & Flow is one of the hydroponics technique types. In this technique that grows the plant by supplying the nutrient direct to the root of the plant until the plants harvested. By using this technique, the plant roots will be always deeped into the water contains nutrient and oxygen. However, this technique manually controls the purity of water, which can effect to growing of plant. In this the purity level in water solution will be automatically maintained by microcontroller and measured by turbidity sensor. Lastly, this research also focuses on the ability of the system can adjust the purity in water solution for Ebb & Flow system. The water solution from the Ebb & Flow system container is transferred to the main tank to measure the purity level by turbidity sensor and make changes if needed and then transfer back to the system container to continue growing the plant. There are six stages in methodology for this project, which are details of study, hardware identification, software identification, hardware and software interfacing, analysis and troubleshooting, data and result collection.*

Key Words: DHT11, LDR, Water level sensor, Cloud, Ubidots

1. INTRODUCTION

The purpose of this project was to design, install and maintain hydroponic containing different types of varieties. The development and learning of how to properly grow hydroponic greens is important for future project ventures. Once growing quality on a smaller scale is achieved expansion can be easier. Designing and testing smaller systems will also allow you to test different techniques and decide which works the best. There have been large shifts toward locally grown fresh and healthy produce. Hydroponic systems can accomplish this by allowing crop production in urban environments not available for conventional farming. Hydroponic grow located in urban environments can help with maximization of crops per acre. Instead of expanding horizontally increasing the acreage of a farm a hydroponic can expand upwards and maximize the use of urban land. Included in this project will be the steps taken to design, , construct, and grow varieties in the hydroponic, the challenges I faced during the grow cycle, results, cost analysis, and recommendations for Future designs and growth cycles.

2. EXISTING SYSTEM

This part talks about the examination and finding that have been made with respect to this task field. GSM based portable notice was given in existing framework. All the related research papers and diaries that give thought and idea concerning this venture just execute by ground.

2.1 DISADVANTAGES

- Diseases & pests may spread quickly.
- System failure threats.
- Water and electricity risks.
- Organic debates.

3. PROPOSED SYSTEM

Hydrophonic systems can accomplish this by allowing crop production in urban environments not available for conventional farming. Hydrophonic grow located in urban environments can help with maximization of crops per acre.

4. BLOCK DIAGRAM

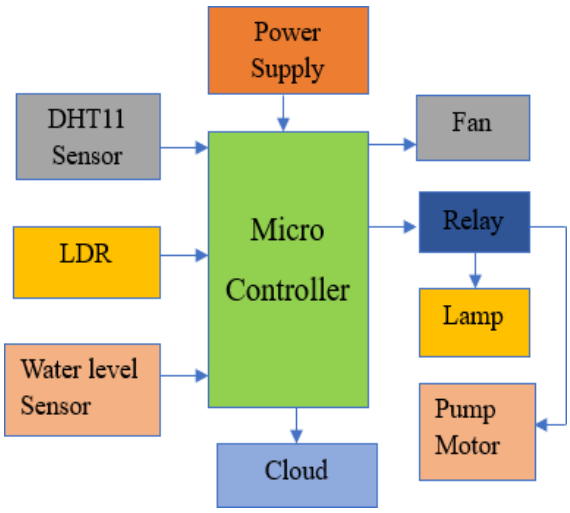

Fig -1: Block diagram of Proposed System

5. HARDRWARE DESCRIPTION

5.1 Node MCU

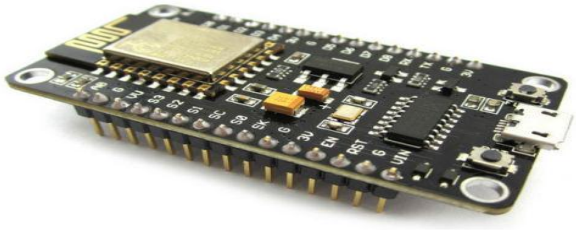

Fig-2 : Node MCU

The Node MCU (Node Micro Controller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for IoT projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You have to solder wires, with the appropriate analog voltage, to its PINs for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. And, you have to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

5.2 Water level Sensor

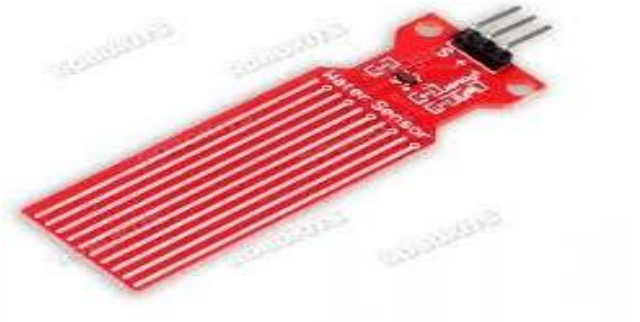

Fig-3: Water level sensor

Water level sensors are used to detect the level of water that can flow. Such measurements can be used to determine the amount of the flow of water in open channels.

5.3 DHT11 Sensor

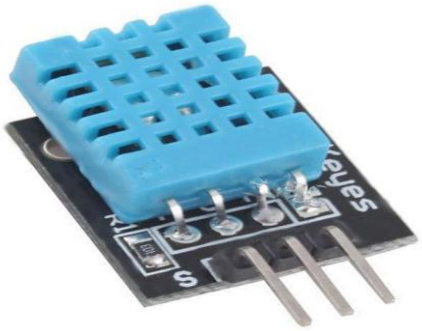

Fig-4: DHT11 Sensor

DHT11's power supply is 3-5.5V DC. When power is supplied to the sensor, do not send any instruction to the sensor in within one second in order to pass the unstable status. One capacitor valued 100nF can be added between VDD and GND for power filtering.

Once DHT detects the start signal, it will send out a low-voltage-level response signal, which lasts 80us. Then the program of DHT sets Data Single-bus voltage level from low to high and keeps it for 80us for DHT's preparation for sending data. When DATA Single-Bus is at the low voltage level, this means that DHT is sending the response signal. Once DHT sent out the response signal, it pulls up voltage and keeps it for 80us and prepares for data transmission. When DHT is sending data to MCU, every bit of data begins with the 50us low-voltage-level and the length of the high-voltage-level signal determines whether data bit is "0" or "1".

5.4 Light Dependent Resistor

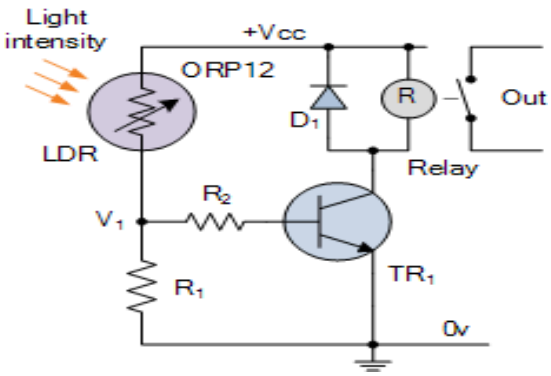

Fig-5 Light Dependent Resistor

This basic light sensor circuit is of a relay output light activated switch. A potential divider circuit is formed between the photoresistor, LDR and the resistor R1. When no light is present in darkness, the resistance of the LDR is very high in the Megaohms (MΩ) range so zero base bias is applied to the transistor TR1 and the relay is "OFF".

As the light level increases the resistance of the LDR starts to decrease causing the base bias voltage at V1 to rise. At some point determined by the potential divider network

formed with resistor R1, the base bias voltage is high enough to turn the transistor TR1 "ON" and thus activate the relay which in turn is used to control some external circuitry. As the light level falls back to darkness again the resistance of the LDR increases causing the base voltage of the transistor to decrease, turning the transistor and relay "OFF" at a fixed light level determined again by the potential divider network.

By replacing the fixed resistor R1 with a potentiometer VR1, the point at which the relay turns "ON" or "OFF" can be pre-set to a particular light level. This type of simple circuit shown above has a fairly low sensitivity and its switching point may not be consistent due to variations in either temperature or the supply voltage. A more sensitive precision light activated circuit can be easily made by incorporating the LDR into a "Wheatstone Bridge" arrangement and replacing the transistor with an Operational Amplifier as shown.

6. SYSTEM DESIGN

This research is implemented the automated hydroponics system based on IOT and smart phone to measured and displayed information through mobile phone to manage and control over the related sensor devices like temperature, humidity, water level and light of the system. The experimental set is allowed on the acquisition of system by setting temperature 30-35 degrees, water level 50-60 percent, and the intensity of light at 2–5. The application will record data received from the related sensors every 10 minutes. Furthermore, the prototype gets information from the database every 1 minute and plants grown in normal conditions. The system includes 3 sections to control and manage the automatic hydroponics application. Node MCU boards are used to control the various functions of the system, including temperature and humidity sensors, light sensors, the, and the water level sensor. The proposed system covers the process from sending data measured sensor devices, receiving data from an intermediary data storage and sending data to the host computer. Then, the system will analyse the sent value and relay module acts as a switch to turn on-turn off the related module.

Section 1: To control the temperature, when system gets the value from the temperature and humidity sensors, the cooling fan will be released in case of the temperature higher than the indicated value.

Section 2: To control light level, the turn on - turn off the light from the board received the value from the light sensor and when the intensity of light is lower than the set value, the system will operate relay module to turn on the light until the intensity is equal or greater than the set value.

Section 3: To control the water level, the water level sensor will notify the value to the system and when the water level is lower than the indicated value , the application will release water into the plant plot until the water level is equal or higher a set value. The system gets the sensor data and records every hour, collected from 07.00 to 18.00. Also, the prototype can access and control through both mobile and web based application.

7. MODULAR IMPLEMENTATION

7.1 Temperature Sensor

The controller must be able to measure the air temperature. For this a DHT11 sensor will be used. This was chosen as its temperature range falls well into the range required for growing food, which is 0-50°C It also has a temperature accuracy of ±2°C. However, this can be improved by using an offset in the SW to configure it to the actual temperature using a mercury based thermometer. The sensor can only get new data once every 2 seconds. This should not be a problem though for hydroponics. The chances of a big fluctuation in air temperature within two seconds are not very likely.

7.2 IoT

The Internet of things is the extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware, these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled.

7.3 Wi-Fi Module

IRJET sample template format ,Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. The ESP8266(ESP-01) Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266is capable of either hosting an application or off loading all Wi-Fi networking functions from another application processor.

7.4 Light Level

Lights can be controlled and customized to any temperature for nurturing the plants that are grown using hydroponics. Environmental ambience can be replicated by the use of a light grow system. When the green house that the plant is placed in is too dark, the lights get switched on automatically as per the requirement of the plant. This enables the plant to grow faster and better.

7.5 Pump Motor

A water pump is used here to control the rate of flow of the water through the roots of the plant. The water pump can be programmed to turn on and off according to the requirements of the plant so that it grows faster and more

effectively, this is done using a relay switch. In case the water content is less, the pump can be switched on so that water is circulated and the moisture content increases.

7.6 Notification System

A notification system is used which alerts the user when required. Since it is an automated system, most of the requirements are under control, but for some specifications of the system which need manual attention, we use the notification system to alert the user of a problem. Other than that, notifications are received whenever changes are made to the system to achieve optimal conditions.

8. CONCLUSION

Today, hydroponics is an established branch of farming. Progress has been on large scale and results obtained in various countries in the world have proved that this technology is thoroughly practical and has very definite advantages over conventional methods of crop production. The two main advantages of this type of system soil-less cultivation and hydroponics can be used in places where the gardening is not possible. Thus not only is it a profitable undertaking, but one which has proved of great benefit to humanity. People living in crowded city streets, without gardens, can grow fresh vegetables and fruits in household gardens or in small discarded containers. By means of hydroponics, a regular and abundant supply of fresh greens vegetables, fruits can be produced in poor production areas and clean areas can be made productive at relatively low cost.

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