Monitoring Parameters of Plants in Vertical Farming using Aeroponics Technique

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ABSTRACT– *India, our country, is second largest agriculture dominated country in the world. About seventy percent of people works are related to agriculture sector. Vertical framing is the new generation method of farming which help to maintain the food production chain without disturbing the agricultural misbalance. In our project, AEROPONICS TECHNIQUE IN VERTICAL FARMING, we are monitoring few basic parameters which help in growth of plant to achieve the fresh products using less space with (using coco peat or natural stone fibre in place of soil) soilless farming and maintaining the environmental parameters.*

Key Words: Aeroponics, Arduino, Artificial Environment, soilless production.

1. INTRODUCTION

We know, India is 2nd largest country in agricultural production. India is an agriculture dominated country in which 70% population depends on agriculture. According to Indian GDP, currently it contributes near about 16-17% of Indian GDP. Most of the farmers use conventional method for agricultural farming. Conventional agricultural farming that is the soil based agricultural farming and it is mainly requires 80% of soil and 65 to70% of global fresh water. Among this 65 to 70% of global fresh water 45 to 67% of global fresh water goes waste due to leakage and evaporation. Also India's dependency on weather and environment lead some time Conventional agricultural farming to unsustainable usage of resources. [3]

Now days a nutrition load values of food are very much important factor in day to day life of human. Due to huge increase of population, most of the farmers are using chemical fertilizers to grow the crops. For getting more and more production in less duration of time, farmers are compromising nutrition load values of products or crops.

Vertical Farming incorporates all planning and design of agricultural farms together in a high-rise building. In Vertical Farming different types of crops, fungi and plants are grown in vertical stacks. Recently, Vertical Farming is being implemented successfully in many countries. This agricultural farming technology helps to produce a lot of crops inside the city. [2]

The technique which is used in our project is an Aeroponics technique. Aeroponics is relatively new method for growing edible plants and was first developed in 1983 by Richard J. Stoner II. In this type of farming, the water which is to be provided is mixed with some compounds which are not hazardous for human anatomy as well as plant anatomy. Such water is circulated via pipes. Due to artificial environment creation and indoor implementation of agricultural farming project, we can avoid use of insecticides as well as pesticides.

2. METHODOLOGY

First we construct the structure of the vertical farming. In that structure we have to provide the pipe lines for supplying the water which is to be pumped from water tank. It contains the nutrients rich water.

For indoor farming we need to create or maintain few basic environmental conditions and control it.

i) Supply of Water,
ii) Moisture,
iii) Temperature,
iv) Light Intensity.

To achieve our goal here, we use ARDUINO UNO MICROCONTROLLER KIT and some sensors.By controlling factors mentioned above we develop require environment and can produce edible plants.

The connection block diagram of ARDUINO UNO MICROCONTROLLER is shown as below in figure (1).

Figure(1): Block Diagram

There are three techniques of vertical farming :

1. Aeroponics technique

2. Hydroponics technique

3. Aquaponics technique

Here, we adopted aeroponics technique. In Aeroponics farming technique a closed or semi-closed environment, spray of nutrient-rich water solution is done on the plant's dangling roots and lower stem.

In this technique, there is a water tank which contains mixture of water and nutrients. A submersible pump is placed into the water tank which pumps the water from tank through pipes and gets out through sprinkler nozzle. Mixture of Water and nutrients is sprinkled over the plant roots. Thus watering to the plants is done.

In the indoor place to create an artificial environmental, we need to monitor four basic parameters:

i)   Temperature
ii)   Humidity,
iii) Light,
iv)   pH value of water.

TEMPERATURE & HUMIDITY SENSOR (DHT-11): For simulation of temperature, heating elements and fan are used. According to the feedback of temperature sensor heating elements are operated ON when temperature drops beyond set T-LOW value; and remain OFF when temperature rises beyond set T-HIGH value. Above this set T-HIGH value cooling fan starts and make drop in temperature. These actions maintain inside temperature as per setting.

To sense the temperature of the atmosphere we used the Temperature Module that is DHT-11 temperature sensor which detects the temperature and the output of this sensor is in digital form. ARDUINO UNO MICROCONTROLLER KIT can accept analog as well as digital input because it has both types of I/O pins on the board. If the temperature is more than the set value, a fan will be turn on.

For simulation of humidity, a submersible pump is used. According to the feedback of humidity sensor submersible pump is operated ON or OFF and maintain inside humidity as per setting.

LIGHT DEPENDENT RESISTOR (LDR): For simulation of indoor light, TRI-COLOUR LEDs are used which are controlled according to the feedback of "Light Dependent Resistor" known as LDR. With the combination of three colours RED, GREEN and BLUE any coloured light can be produced.

For plants to produce good yield, plants need a good amount of light for the processes of photosynthesis. In order to maintain the intensity levels of light we use a Light emitting diode (LED) module. Intensity of LED module is depend on the light fallen on LDR sensor. More light on LDR, low brightness of LED module and vice versa.

Here a LDR an analog passive device, whose output is used to control the intensity of LED light module. Light Sensor which senses the intensity of the surrounding light and if it is beyond the setted values, it causes to change the intensity of LED module. We use series of Red and Blue LED strips as plants mainly absorb these intensity of lights for the better yield of the crops.

Blue LED has wavelength in mid of 350-400 nm range that's why it prefer for vegetative growth. Similarly red LED has wavelength in the range of 600-650 nm so it is used for fruits and flowers.

pH SENSOR:A pH value (i.e. acidic or alkaline value) of water mixture is monitored by pH sensor. According to the feedback of pH sensor an audio-able alarm is triggered ON or OFF. [3]

The flowchart of our project is as below in Figure (2)
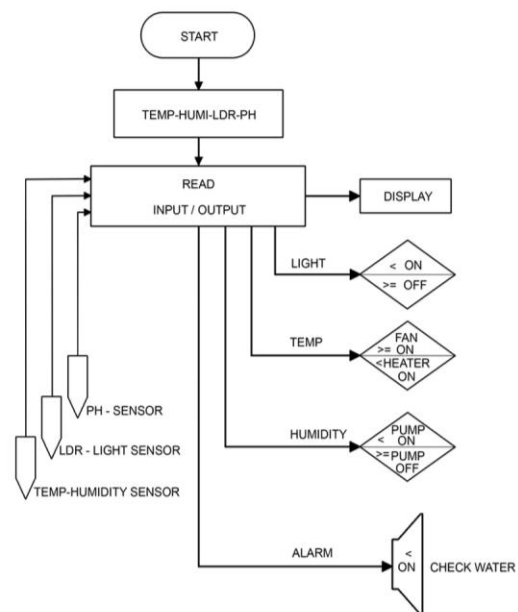
Figure(2): Flowchart

- **Components used in our project :**
1. Arduino UNO: Arduino UNO is an open source microcontroller board which is based on the microchip ATmega328P microcontroller. It contains digital as well as analog pins which are helps us to reduce the complexity of our project. It is used to sense the various inputs from variety of sensors and acts as main controlling element.

2. Temperature/humidity sensor: We choose DHT 11 as temperature and humidity sensor. DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. It can immensely affect the growth of plants and keeps the track of temperature and humidity for field. We use this sensor for proper growth of plants/vegetables. We can maintain the temperature and humidity range as per the plants/vegetables.

3. pH sensor : It is uses to find the concentration of hydrogen ions using electric current in water based solution. We used pH sensor to check the acidic/alkaline values of water for exchanging that water from the tank.

4. LDR: A Light Dependent Resistor is also called a photoresistor or cadmium sulphide (CdS) cell. It is also called a photoconductor. It works on the photoconductivity principle.LDR is used to monitor the surrounding temperature and light intensity respectively.

5. LED grow light : Lighting is an important factor that governs a growth of the crop in vertical farming. We used red, blue, green LEDs for artificial photosynthesis purpose. It impact on root formation, plant growth, and flowering during growth.

6. Fan : Fan is used for cooling purpose of the system. If the temperature of the system increases the fan will turn on to cool down work.

7. Submersible Water pump : A submersible pump is a device which has a motor close joined to the pump body. The whole structure is submerged in the fluid to be pumped. We used pump for circulating the water to sprinklers throughout the structure.

8. 16X2 LCD Display: Liquid Crystal Display screen is an electronic display module. A 16x2 LCD display is very basic part and is very normally used in various devices and circuits. It can show 16 characters per line and there are 2 such lines. We used it to see the final result that is temperature, humidity, pH etc on the display.

3. CONCLUSION

In aeroponics technique, we can grow different types of plants or vegetables throughout the year by maintaining the respective parameters like temperature, humidity, pH, LED light for photosynthesis purpose. Due to indoor structure and monitored environment, there is less chances of becoming diseased plants and need very less of pesticides and insecticides. It requires about 70-90 percent less water due to circular chain supply of water during over all the process. At the end, we can get fresh, clean and healthy food production.

4. REFERENCES

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