SMART HYDROPONICS MANAGEMENT SYSTEM

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Abstract:

The purpose of this research to develop a Internet of Things (IOT) based Smart hydroponics system. Hydroponics is a system in which plants are grown without soil by providing water based nutrient solutions. We employ IT to monitor and take care of the factors on which plants depend such as: pH, TDS, Light, Temperature and Humidity. We have designed a network of sensors to collect data according to the requirement of the Plants. As a result of this our system enhances plant care and production while minimizing resources usage. In this paper we research in designs, Implementations and Performance of the system.

Keywords—internet of things; hydroponics;

1. Introduction:

The primary objective of this project is to design a portable "chamber" that facilitates the growth of various shallow-rooted plants like tomatoes, capsicums, cucumbers, spinach, lettuce, mint, coriander, strawberries, and others. The chamber is equipped to automatically regulate crucial factors such as temperature, humidity, light, and water pH, essential for optimal plant growth. In conventional hydroponic systems, parameters like EC and water pH are manually set during system setup.

This chamber utilizes hydroponics, a soil-less cultivation method where plants are grown with their roots submerged in water. Unlike traditional soil-based gardening, hydroponically grown plants receive their nutrients directly in water, resulting in faster and healthier growth by avoiding soil-borne diseases. The project aims to enhance the adoption of hydroponics and establish an environmentally self-sufficient system for indoor plant cultivation. The automation is achieved through microcontrollers, sensors, and IoT technology for remote monitoring and control. The system collects data from sensors and adjusts actions to maintain optimal conditions for plant growth.

Existing automated hydroponic systems in the market are either prohibitively expensive or lack comprehensive control over all necessary parameters for robust plant development. This study introduces a smart hydroponics system for home cultivation that offers full automation, including monitoring and control of all essential growth parameters like Light, pH, TDS, Temperature and Humidity.

2. OBJECTIVE OF OUR STUDY:

- How hydroponics technique (NFT) work
- How to design the system and how to implement IOT for monitoring various parameters such as: pH, TDS, Temperature and Humidity.
- How to automated water supply, DC Fans in case of high temperature and Lights.

3. LITERATURE SURVEY:

To study about the installation and implementation of NFT Technique, paper [1] has discussed about different hydroponic systems such an Ebb and flow system, Water culture, aeroponics, wick system and Nutrient film technique. In this project Nutrient film technique (NFT) is been implemented.

To study about IOT based monitoring of the various parameters such as: pH, TDS, Temperature and Humidity, paper [2] has discussed about the hydroponic system is also sensitive to environmental changes; timely adjustments are necessary to ensure plant health. The major component used for this proposed work are the ESP32 microcontroller, BH1750 sensor, DHT11 sensor module, TDS sensor, pH sensor, LED Light, Water pump, DC fan, and ultrasonic atomizer. The essential parameter like light intensity, environment temperature, humidity, TDS level, and pH value has been monitored.

In paper [3] calibration methods and formulae of different sensors like pH and TDS which help us to give accuracy of the system. It shows the main application window presenting five essential parameters of the nutrient water in hydroponic system. It also describes the human interfacing web application which use to monitor the important parameters of Plants.

In paper [4] discussion on the solar system proto type is shown to ensure that the prototype function successfully. The component used for the solar system is 10W of solar panel, a solar charger controller and 12V of lead acid rechargeable battery. Solar system reduces the electricity bills of our system.

In paper [5] analysis about water pump consumption, based on tests carried out using a 220-volt AC / 50 Hz / 125-watt water pump, and a 250-liter nutrient storage tank. An AC water pump has a flow rate of 18.2 liters per minute and can fill a 250-liter storage tank for 13.7 minutes. Hydroponic system automation using nutrient storage tanks can save electricity consumption by 70%.

In paper [6] analysis about the temperature effect on plants like lettuce. Lettuce grown at 21.1 °C chilled water was greater in terms of shoot fresh and dry weight as well as root fresh and dry weight compared to 18.3 °C and ambient water treatments

In Paper [7] analysis about role of artificial LEDs. In this study, five (5) sets of lettuce were grown hydroponically under the same ratio of the red-blue LED light. The power intensity and the number of LED light used in the hydroponic system

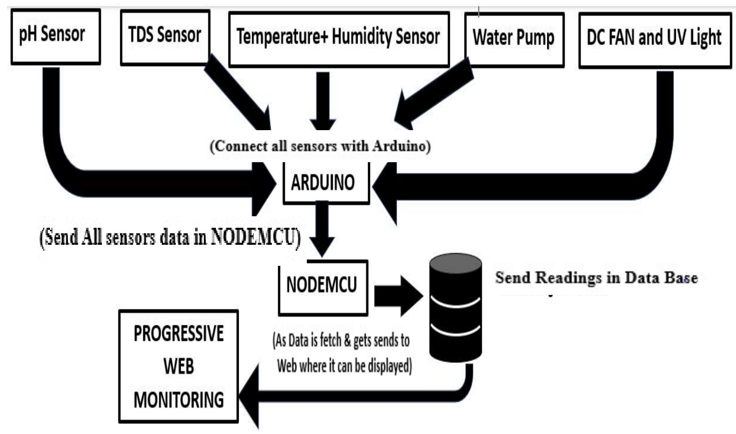
5. Advantages of Project:

- Soil less plantation
- Reduce water usage
- Reduce needs for pesticides
- Plant can grow all over the year
- No need for weeding
- Plants grow quicker and organic.

6. Where to use:

- Terrace Gardening
- Indoor Farms
- Nasa is trying to use it for farming in space [8]

4. System Diagram:



In this diagram we can see that different types of sensors are usually named as pH sensor to measure the pH level of water Reservoir, DHT11 sensor for monitoring Temperature and Humidity of Chamber where whole system installed, TDS sensor use to maintain the nutrients level in reservoir, LED lights are used to maintain the intensity level of the plants in a chamber especially in afternoon time. Fans are maintaining the temperature when temperature gone above 30^0C fans on automatically to slow down the temperature. DC pump maintain the circulation of water level.

All these sensors are interfaced to an open-source Node-MCU which will act as a microcontroller. We can retrieve the sensors data into database through NODEMCU and which help to display data on Web application.
The reservoir (water containing nutrients) is passed to the pipes with help of DC pump.

7. Methodology:

The intent of this project is to grow any type of shallow roots plants by using hydroponic farming technique. For this purpose, a closed chamber is constructed, the NFT hydroponic technique is used in this chamber to grow plants. The structure of NFT technique is built from PVC pipes which are all connected together. The nutrition flows into the roots of plants which are placed in net cups in the pipes facilitated by small holes created using drill machine where one end of the pipe is connected to the reservoir, allowing nutrient-enriched water to flow through using a water pump at 10-minute intervals. The other end of the pipe is also connected to the reservoir, preventing wastage of excess nutrient rich water and directing it back into the reservoir. Iron rods have been used to construct the chamber and the structure is covered with green fiber sheets to protect plants from direct sunlight which contains ultraviolet rays (UV), which can severely affect the plant's growth and damage them. This sheet blocks the ultraviolet rays and passes the filtered light from it, necessary for the photosynthesis process. The chamber can be kept indoors or outdoors. Plants also require sunlight for photosynthesis, so for this purpose growing LEDs are used in blue and red colors. DC fans have been used to keep the chamber temperature balance and whenever the indoor temperature raises by 30C, DC fans will automatically activate to stabilize the temperature and tyres have been added to facilitate the easy movement of the chamber from one place to other.

8. Hardware Installation:

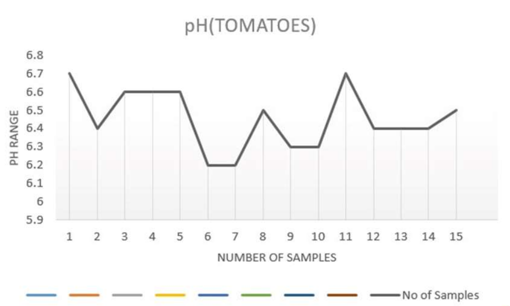
9. Uniqueness of the project:

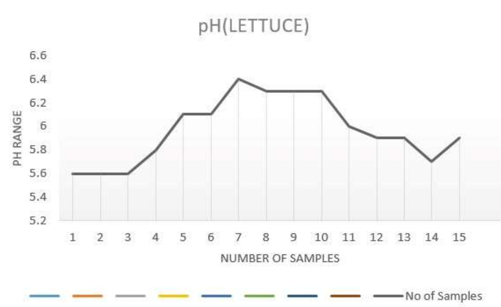
Our Project is less expensive as compare to others due to the following reasons:

1. We use DC Fans to maintain the temperature in the replacement of Cooling Pads.
2. We make our own lights combination in the replacement of UV Lights.
3. We make a chargeable circuit in replacement of Battery for power supply.

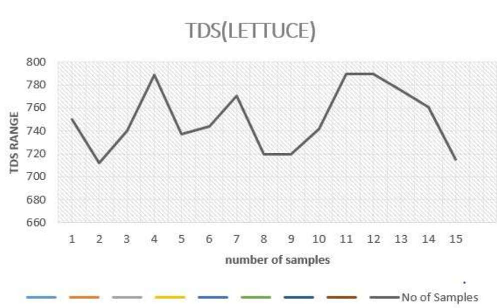
10. Observations and Readings:

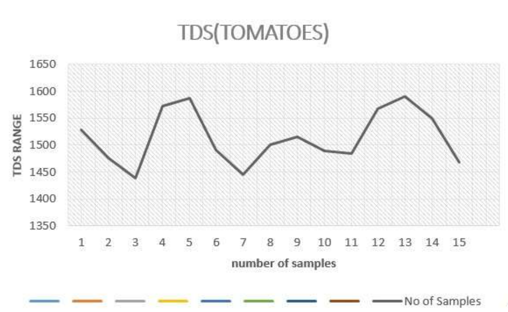
pH value:



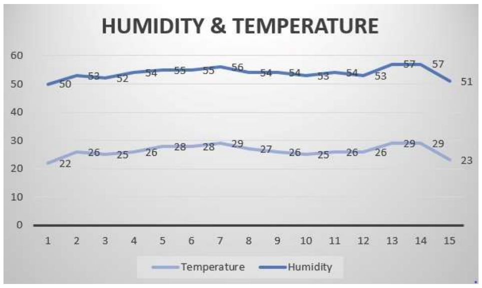


TDS Value:





Humidity and Temperature:



Conclusion:

In this paper, we aimed to revolutionize indoor plant cultivation. The system meets the need to control important growth parameters such as: pH, TDS, Temperature, Humidity and light intensity to ensure Plant health and productivity.

By implement IOT in our system, it helps user to access Real time data of growth parameters which helps in productivity of the plants.

The Nutrient Film Technique (NFT) in our system provides a sustainable method for plant growth, offering Advantages such as: Reduced water usage and minimize needs for Pesticide.

Our system interfaced with microcontroller, facilitating data collection and transmit the data to a web application for user interface.

Our Project lies in its cost-effectiveness achieved through Using DC fans for temperature control, custom LED light combinations and a rechargeable circuit for power supply. Our system step towards sustainable agriculture.

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