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# Smart Vertical Farming

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**Abstract -** Hydroponics is a method of planting or cultivating plants without using soil but uses water, nutrients, and oxygen. It has advantages such as higher quantity and quality of production, cleaner, more efficient use of fertilizers and water, and also easier in pest and disease control. The goal of this project is to develop a system for maintaining a hydroponic growing environment, which simplifies the process of growing plants hydroponically by abstracting the details from the user. The system monitors the parameters needed by the plant to grow healthily and efficiently and adjusts those parameters accordingly. It also provides the user with a mobile application that helps the user monitor the conditions their plants is growing.

***Key Words***: Vertical Farming, Hydroponic, Agriculture

## 1.INTRODUCTION

Agricultural lands are already declining in the world due to the conversion of agricultural land into industry and settlement purpose. This happens because of economic and social phenomena, the limitation of land resources, population growth and economic growth . Currently, agricultural technology developed rapidly in urban areas, it is often called Hydroponics or urban agriculture . Hydroponics or urban agriculture is one powerful solution to cope the dwindling agricultural land. Hydroponic is an efficient way of cultivating crops in a soilless manner with increased productivity per area, reduced water and fertilizer usage. Hydroponics can be used to produce variety of crops in compact spaces such as the backyard, terrace, or in offices, by using a nutrient rich water solution. The areas of the world with poor or infertile soils can completely rely on hydroponics system. This gives people in these areas access to healthy and fresh produce. Other advantage of this method is that it enriches the crops with full flavor and delicious taste with higher nutrients values . Hydroponics is derived from Greek, hydro meaning water and ponic means work . In hydroponic farming system, the water is used continuously and just diminishes because of evaporation by the Sun or by the photosynthesis process of plants. If it is compared to conventional agriculture, water is used once at the time of irrigation, the conventional agriculture method be said to be very wasteful in the use of water . There are many factors that are critically important for crops production and quality in hydroponics such as correct pH level, air temperature, relative humidity, nutrient level in the water, and correct irrigation of water. Therefore, the help of a management system that monitors these factors is valuable and will ensure higher success and efficiency rates of the grower. The project proposed in this document, The HYPO project enables users to monitor the pH level, nutrient concentration and water level through a mobile application. HYPO is based on IOT.

## 2. LITERATURE REVIEW

1) Hydroponics as an advanced technique for vegetable production
Authored by Nisha Sharma, Somen Acharya, Kaushal Kumar, Narendra Singh and
O.P. Chaurasia, in the Journal of Soil and Water Conservation 17(4): 364-371,
October-December 2018 ISSN: 022-457X , This article discuss various hydroponic structures viz. wick, ebb and flow, drip, deep water culture and Nutrient Film Technique (NFT) system; their operations; benefit and limitations; performance of different crops and water conservation by this technique.

2) A review on plant without soil- Hydroponics
Authored by Ms. Mamta D. Sardare, Ms. Shraddha V. Admane, Assistant Professor, MIT Academy of Engineering, Alandi Pune, Maharashtra, India. ISSN: 2319- 1163, Vol 2 Issue 3, This article discusses various technologies available for Soilless farming and comparison of the performance of arious crop in soil and soilless cultivation.

3) Soilless farming- the next generation Green evolution
Authored by Bikram Pradhan and Bandita Deo, published in Current Science, Vol. 116, No. 5, this paper discusses about the origin of soil less farming and it's present form throughout the world. Also, discusses all the important parameters of soilless farming and its large-scale implementation.

4) Challenges and possibilities in Hydroponics: an Indian perspective Authored by Shailesh Solanki, Nitish Gaurav, Geetha Bhawani and Abhinav Kumar, published in International Journal of Advanced Research (IJAR), this paper focus on the challenges and possibilities to bring soil less farming in India, to ensure its stability so that it may prove more beneficial for growing crops which are 100% organic, toxic free and of better quality.

5) Integration of Vertical Farming and Hydroponics:
Authored by Awadhesh Kumar, published in Acta Scientific Agriculture (ISSN: 2581-365X) Volume 3, Issue 2, 2019 this paper talks about the inclusion of Vertical farming with Hydroponics farming and its impact on the agricultural yield.

## 3. HARDWARE AND SOFTWARE USED

**Hardware :**

- Arduino Uno
- DHT11 Humidity and Temperature Sensor Module
- DHT11
- Water pump
- 5V Relay Module
- LCD Display

**Software :**

- Arduino IDE

## 4. METHODOLOGY

### 4.1 Working :

. Hydroponics is a method of growing plants without soil and instead. using mineral nutrient solutions in a water solvent. The word “Hydroponics” it- self is an amalgamation of two Greek words: “Hydro” meaning water and “Ponics” meaning to work. Using hydroponics, terrestrial plants can be grown with only their roots exposed to the nutritious liquid, or the roots may be physically supported by an inert medium such as perlite or gravel . The nutrients used in hydroponic systems can come from an array of different sources, including (but not limited to) byproduct from fish excrement, duck manure, or purchased chemical fertilizers.
Through careful manipulation and management of the plant growing environment which includes the amount of water, the pH levels and the combination of specific nutrients, plants can be encouraged to grow faster. Hydroponics is a less wasteful approach including reduced waste, preservation of water stocks and a diminished reliance on pesticides, fertilizers and other potentially harmful materials. The net impact is an expanded surrender and progressed utilize of assets. Plants commonly developed hydroponically incorporate tomatoes, peppers, cucumbers, lettuces, and cannabis. The web of things, or IOT, could be a framework of interrelated computing gadgets, mechanical and advanced machines, objects, creatures or individuals that are given with interesting identifiers and the capacity to exchange information over an organization without requiring human-to-human or human-to- computer interaction. Im- planted with gadgets, web network, and other shapes of equipment such as sensors, these gadgets can communicate and connected with others over the web, and they can be remotely checked and controlled.
These advantages of IOT have in- spired scientists to use the technology in different aspects of our day to day life. Due to limited resources, farmers need to produce more with less resource and without hampering environment. So, more people are trying to set up hydroponics farm, since it does not require a large area and there is a very minimal need of water in the cultivation process. Using hydroponics with IOT can be an efficient way to produce maximum crops with reduced environmental impact and resources. Horticulture IOT arrangements permit agriculturists to use sensors, shrewd doors, and observing frameworks to gather and analyze data and make more educated choices. The rise of IOT has permitted ranchers to computerize the hydroponic horticulture handle to a certain degree. From keeping up the water temperature to a certain level to robotizing the supplement blending, each single handle can be done by means of this imaginative innovation.
Hardware There are several hardware components we used for this project. We used Arduino UNO, an artificial light panel, a pump to pump water throughout the pipes, a light sensor that helps to detect when the time is for light and therefore will turn on the light. We used a sensor to measure humidity in our greenhouse. Another sensor needed to measure temperature as well. We also need a sensor to measure pH levels as well as another sensor to measure the levels of nutrients in the water for which we used a dp-4 dispenser. We will need a filter to keep the water clean running through the pipes. We will use the artificial light panel in our system instead of using the actual sunlight as this will give us full control over the environment of the greenhouse hydroponics system.

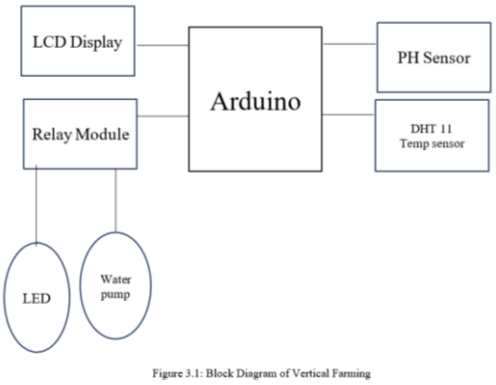


Fig.4.1.1 Block Diagram of Vertical Farming

- The DHT11 sensor and pH sensor are connected to the Arduino Uno. The DHT11 sensor provides digital output, which is read by the Arduino Uno using a digital input pin. The pH sensor provides analog output, which is read using one of the Arduino Uno's analog input pins.

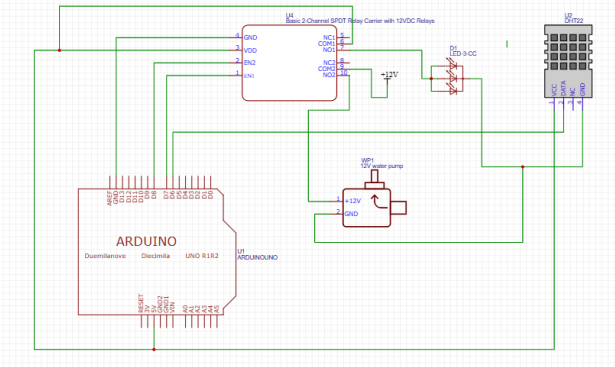


Figure 5.1: Circuit Diagram of Vertical Farming.

- The Arduino Uno continuously reads data from the sensors to monitor temperature, humidity, and pH levels in the hydroponic system.

- Based on predefined thresholds or conditions programmed into the Arduino Uno, such as optimal temperature and humidity ranges or desired pH levels, the Arduino Uno controls the relay module to turn the water pump on or off.
- The relay module acts as a switch, receiving commands from the Arduino Uno to control the water pump's operation. When the water pump is turned on, it **circulates the nutrient solution to the plants in the hydroponic system, maintaining optimal growing conditions.**

- The Arduino Uno also sends data to the LCD display for visualization. The LCD display provides real-time information on temperature, humidity, pH level, and system status, allowing users to monitor the hydroponic system's operation at a glance.
- Proper calibration of the sensors and accurate programming of the Arduino Uno are essential for the hydroponic system to function effectively. Additionally, safety precautions should be observed when working with electrical components and water pumps

## 5. RESULT & DISCUSSION

Results • The aim of HYPO is to automate the monitoring process of hydroponics system that is capable of fulfilling the following objectives and monitor nutrients and PH levels and concentration also provide statistics on PH level and plant growth and regulate water and finally allow user to access growing environment data anytime through application
• All goals were achieved
• Project methodology :The incremental model has been chosen for the methodology of this project because the project can be neatly divided into two well defined system : the growing environment system ,which is comprised of the hardware component (sensors , microcontroller and actuators) the mobile application and the server (the mobile application is for both android and iOS platforms). Each one of these systems is developed in its own increment respectively. It is better to develop each system in its own iteration rather than develop both of them simultaneously.

## 6. CONCLUSION & FUTURE SCOPE

### 6.1 Conclusion :

In conclusion, an audio signal denoising project aims to develop a system that can effectively remove or reduce unwanted noise from audio signals, improving their quality and intelligibility using python. In this project we used Tkinter, OS, Numpy, Scipy, Sound device, Soundfile, Matplotiob.pyplot, wave and noisereduce for developing the algorithm of filters. Throughout the project, various techniques and algorithms are employed to analyze thefrequency content of the audio signal, estimate the noise profile, and suppress or eliminate thenoise components.
The outcome of the project is a denoising system that can effectively reduce or remove noise from audio signals, resulting in clearer, more intelligible audio. The system may be capable of real-time denoising, batch processing of audio files. Also, we concluded that the Kaiser filter gives the best denoised audio as compared to another two filters.

### 6.2 Future Scope :

Vertical farming holds significant potential for the future of agriculture. By utilizing vertical space in controlled indoor environments, it addresses key challenges such as land scarcity, climate change, and water conservation. With advancements in technology like hydroponics, aeroponics, and LED lighting, vertical farms can grow crops efficiently and sustainably. This method reduces reliance on traditional farming practices, mitigates transportation costs, and enables year-round production of fresh produce. As urbanization continues and food demand rises, vertical farming is poised to play a vital role in ensuring food security and environmental sustainability.

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