Hydroponics Water Analysis and Crop Recommendation

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Abstract:

Soil based cultivation is now facing difficulties due to different man made reasons such as industrialization and urbanization. Also, sudden natural disasters, climate change and unrestricted utilization of chemicals for agriculture purposes cause the depletion of soil fertility and quality. That is why, scientists have developed a new alternative approach for cultivation system namely soil-less cultivation or hydroponics.

Hydroponics is a method of growing plants in a water based, nutrient rich solution. Through hydroponics a large number of plants and crops or vegetables can be grown. The quality of yield, taste and nutritive value of end products produced through hydroponically is generally higher than the natural soil based cultivation.

This cultivation is cost effective, disease free, ecofriendly and is gaining popularity all over the world, in both the developed and the developing countries. So, hydroponics would be a better technique to produce the different kinds of fruits, vegetables and fodder as well as meet the global nutrition demand with making advance future.

In the future, hydroponics could be emerging techniques for the supplying of food to the world wide population

Keywords: Hydroponics, Soil less agriculture, Water Analysis, Sensor Technology, Intelligent Algorithms, Nutrient rich solution, Eco-friendly, Real-time Monitoring.

1. Introduction:

Hydroponics is basically growing plants without soil. It is a more efficient way to provide food and water to your plants. Plants don't use soil – they use the food and water that are in the soil. Soil's function is to supply plants nutrients and to anchor the plants' roots. Hydroponic gardeners may use different types of inert media to support the plants, such as rockwool, coconut fibre, river rock, Styrofoam, or clay pellets.

The word hydroponics was coined by Professor William

Gericke in the early 1930s describe the growing of plants with their roots suspended in water containing mineral nutrients. Europe is considered the biggest market for hydroponics in which France, the Netherlands, and Spain are the

three top producers, followed by the United States of America and Asia-Pacific region. These systems are

becoming increasingly widespread over the world

Hydroponics is a Latin word meaning "working water." In the absence of soil, water goes to work providing nutrients, hydration, and oxygen to plant life. From watermelons to jalapeños to orchids, plants flourish under the careful regimen of hydroponics. Using minimal space, 90% less water than traditional agriculture, and ingenious design, hydroponic gardens grow beautiful fruits and flowers in half the time.

Hydroponic makes it easier to measure and fill the exact amounts of nutrients in the water solutions, since each plant requires different nutrients. This can be really a tedious job if you do it manually. Well, we are not a Hydroponics expert and we really don't know how much nutrients should be added in the water solution. But we can build and design our own Hydroponics system which we can use to measure and fill the exact amount of nutrients in the water using Solenoid valves which can be controlled as per the measured values.

Hydroponics is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution. This system helps to face the challenges of climate change and also helps in production system management for efficient utilization of natural resources and mitigating malnutrition.

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2. Literature Review:

This section discusses discoveries and discoveries related to this area of the system. The discussion begins with the development of surveillance systems, monitoring systems and wireless communications, as well as data entry and order submission.

All relevant research papers and journals providing ideas and ideas in this project have also been explained in simple words .[1]Cucumber is probably the first cereal crop to grow in the first century under the "For the Roman Emperor Tiberius". Technology has rarely been used in the last 100 years. An English scientist named John Woodward was born in the 17th century. [2] In 1699 in England, hydroponics was used to grow mint plants without soil. During the 1600's various methods were used to protect the horticultural crops from the cold. There are glass lanterns; bell rugs, cold frames and hot bed covered with glass are used.[3] In the thirteenth century, to warm for the plants they used portable wooden boxes covered with oil translucent paper.[4] Developers of this new technology, taking into account market profits, took the crops that appealed to the rich and privileged, the people who could afford the luxury of freshly harvested fruit in the greenhouse.

The agricultural sector must provide a solution to the current challenges regarding food security and ensure food of a high quality and sufficient quantity. In this review, conventional agriculture (soil cultivation) was compared to hydroponics (soilless cultivation).

Hydroponics is an emerging technology applied, among others, in agricultural production; it is well-known in the agricultural sector and could become established as the first choice among growers. Conventional agriculture, i.e., soil cultivation, demands the availability of arable land, agricultural areas for planting, the supply of chemicals, and water consumption for irrigation.

3. Features of the project :

3.1 Interfacing various sensors

- TDS sensor

Hydroponic growing is more popular than ever. Since the plants are growing in a nutrient solution, TDS is an indicator if the nutrient solution needs to be adjusted. If the TDS creeps out of range, it indicates the nutrients are out of balance. The recommended TDS range is dependent of the type of plant being grown. Monitoring the TDS is essential in order to have a successful hydroponic garden or growing operation

The total dissolved solids (TDS) sensor in a hydroponic system is used to gage the concentration of soluble solids in the nutrient solution and expressed as electrical conductivity (EC). It can estimate how much salt dissolves in a liter of water in milligrams by the value of total part per million (PPM), which reflects how pure the water is to a particular level with an accuracy of ± 2% of 999 ppm TDS. Measurements during prolonged submersion in water are possible because the probe is waterproof

- pH Sensor

As pH is an indicator of the nutrient availability, the measurement can therefore be useful for the early identification of deficiencies (which can then be corrected before crops become permanently damaged).

As the plants grow, consuming nutrients and changing their concentrations, the pH of the water will fluctuate due to the low buffering capabilities of these systems. Therefore, the pH needs to be continuously monitored and kept at the correct level, to ensure the plants are able to absorb the essential nutrients for growth. This sensor identifies whether a substance or solution is basic, acidic, or neutral. The sensor can detect pH levels between 0 and 14, with an accuracy of approximately 0.1 pH. Plants require water with a pH between 6.5 and 7; thus, the nutrient solution's pH was maintained in this range

- DSB18B20

Can measure temperatures from −55 °C to 125 °C with an accuracy of ±0.5 °C. ESP32 determines and record records specific signals to a particular protocol on its data pin to read the temperature from the sensor. This sensor is extensively used to calculate temperature within rigid environments which includes mines, chemical solutions, otherwise soil, etc.

This sensor is used to measure the liquid temperature.

- Display_0.96

Display 0.96 will be used in Hydroponics system to display information such as temperature, pH, humidity etc on the display

- ADS1115

ADS115 is an ADS1115 is a 16-bit analog-to-digital converter (ADC) that can measure up to four analog signals and communicate with a microcontroller via I2C protocol1. It is useful for applications that require high-precision and low-power ADCs, such as sensors, instrumentation, and battery monitoring.
Hydroponics is a method of growing plants without soil, using water and nutrients as the medium2. Hydroponics systems often need to monitor various parameters, such as pH, temperature, dissolved oxygen, and electrical conductivity, to ensure optimal plant growth and health2.One way to use ADS1115 in hydroponics is to connect it to a microcontroller, such as ESP8266, and use it to read the analog signals from different sensors, such as pH probes, temperature sensors, and dissolved oxygen sensors3. The microcontroller can then process the data, display it on a screen, send it to a cloud service, or control other devices, such as pumps, valves.

- ESP32 Micro-controller

An ESP32 microcontroller with 38 pins, digital analog convertor (DAC), analog digital convertor (ADC), and built-in Wi-Fi connectivity was used. It is designed to focus on IoT applications. The ESP32 microcontroller was used as the monitoring device for the hydroponics process and controls the water, salt, pH, temperature, and humidity levels. All the data collected by the sensors are processed inside the ESP32 microcontroller before being sent through Wi-Fi to a database to be saved for further use.

- Better growth rate

If you give a plant exactly what it needs and when it needs, the plant is likely to grow as healthy as genetically possible. In hydroponics, this is exactly the case as it is very much possible to create an artificial environment with the addition of a light or air conditioning in an area enclosed between four walls. As the environment created will be suited best according to the different plant's needs, they will give better results in terms of turning out to be fresher, greener and tastier to eat

- Crop Water Management:

Since this project is based on Water Crops cultivation, but this uses way too less water compared to traditional technique of crop cultivation with soil. More efficient use of water because the water is filtered and recycled instead of getting leached into the soil.

3.2 Data Analysis and Optimization:
Automation in hydroponic water management often includes advanced software and data analysis capabilities. These systems can collect and analyze data from multiple sensors, helping you gain insights into the performance of your hydroponic system. By utilizing this information, you can make data-driven decisions, optimize water usage, and fine-tune nutrient solutions for improved efficiency and crop yields. Automation offers numerous benefits to hydroponic water management, making the process more precise, efficient, and reliable.

3.3 Cost-effectiveness and Practicality :
When designing a device, it is necessary that device should be cost-effective and it should be practically used. Our device is a will analysis the water nutrients, which will help in growing the best crops. Because, in Hydroponics the crops are grown using Water and by adding additional water nutrients in the solution. Generally the water analysis device are expensive to purchase as they are not made in huge amount because, Hydroponics is not yet boomed the field of agriculture, it will sooner gain the attention. Our device will give the readings of water and nutrients that are required to be added which will help in crop cultivation in water, also it will predict the crops on the obtained data
3.4 Integration and Compatibility :
When the sensors and hardware components are integrated with software algorithms it will be most compatible device to use amongst normal people too. Due to such integration it has several advantages that it helps in various fields for reducing costs and betterment in crop cultivation and growing. Some of them are:
Farming at heights:
Farming at heights means that less space is used to generate a high amount of outputs. This is possible via the fact that hydro farms extended vertically in even places such as marginal lands, inside warehouses, water scarce areas.
Conservation of water:
It requires just 2- 3 litres of water to produce one kg of lush green fodder, as compared to 60-80 litres to conventional system of fodder production.
Reduced labour requirement:
Continuous intense labour for cultivation of fodder is required in conventional fodder production, but in hydroponics labour required is 2- 3 hours / day only.
Crop Prediction:
This system will produce the better result of growing crops

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based on obtained data and conditions to grow good and better crops to earn good profits.

4. Block Diagram

All the hardware, software and sensors working together to analyze the water for hydroponics, fetches data, stores and uses later for crop prediction . The different components work together effectively

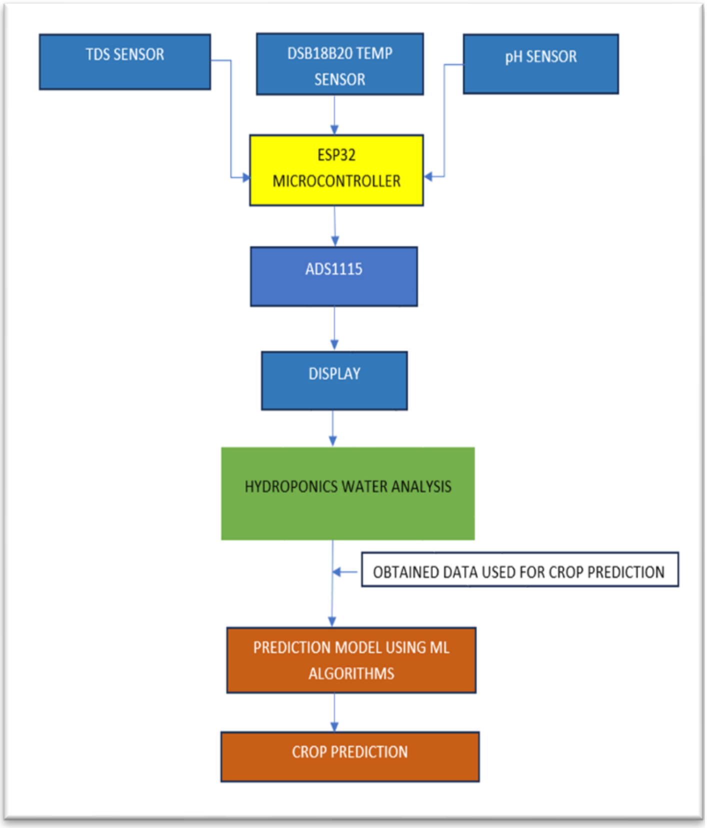

Fig 4.1

5. Flow chart

Following flow chart improve understanding, communication, and decision-making. It offers a visual representation of complex processes, making them accessible and actionable for project

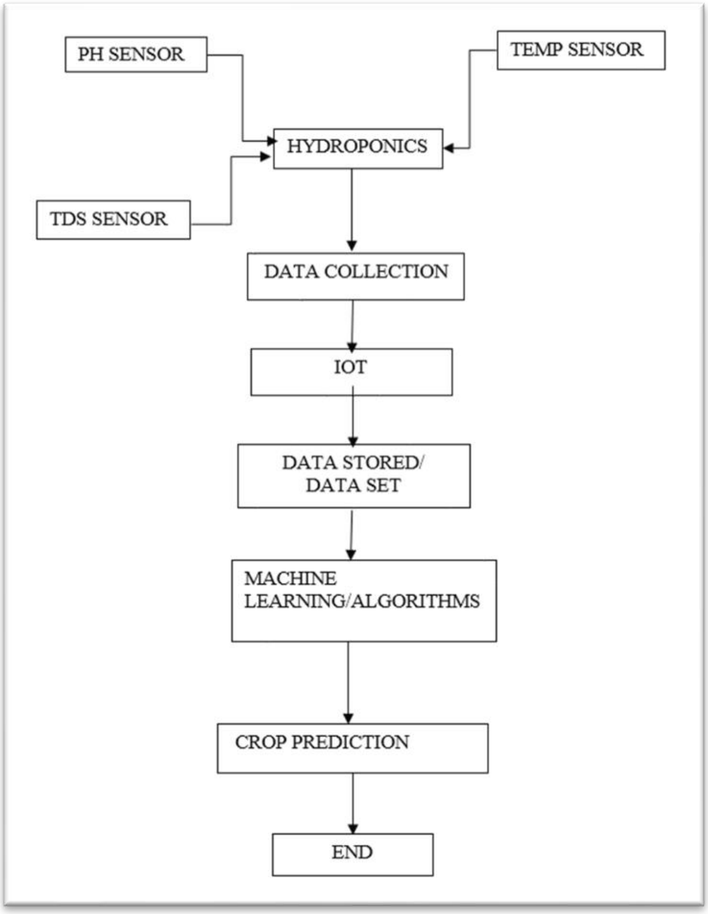

Fig4.2

1) The Project will be majorly focusing on detecting the available nutrients in water through which we could get idea of nutrients required to grow certain crop
2) The IOT device through which we will obtain the data, it will collect Temperature of water, pH of water, TDS(Total Dissolved solids involved in water)
3) Later, after collecting the data we will use those data to predict the best crop to be grown with the available data and conditions using ML.
4) We will also try to build a prototype by growing the crop mostly Lettuce, because it can be grown in almost all types of conditions.

6. Result and Output

The result and output section contains the results obtained from integrating hardware devices and training model for crop recommendation system.

As we can see the Hardware prototype shows the readings taken by the devices and based on the same readings the Software i.e. Machine Learning model recommends the crop. Following are the results of both Hardware prototype and Crop recommendation model.

Crop recommendation is shown on a web page, where we can enter the inputs and directly get the output of Crops that can be grown.

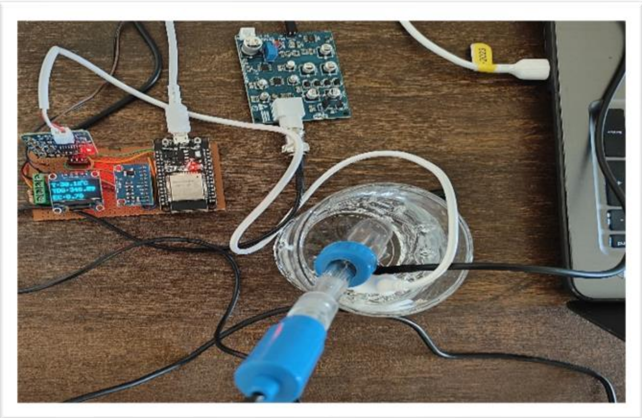

Fig 6.1 Hardware Prototype

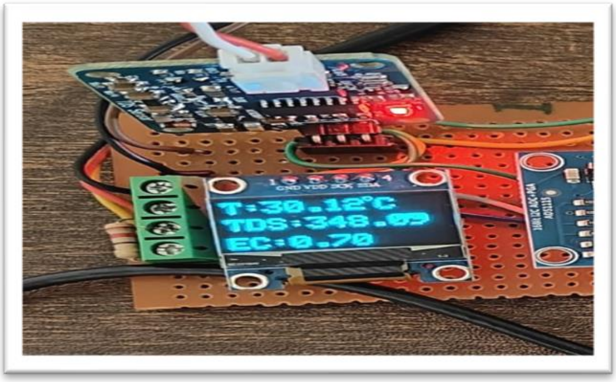

Fig 6.2 Readings displayed on screen

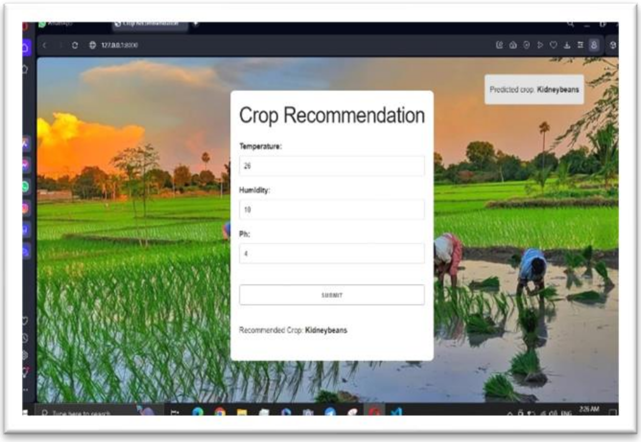

Fig 6.3 Crop Recommendation Model

7. Conclusion

The industry is expected to grow exponentially also in future, as conditions of soil growing is becoming difficult. Specially, in a country like India , where urban concrete conglomerate is growing each day , there is no option but adopting soil-less culture to help improve the yield and quality of the produce so that we can ensure food security of our country

In conclusion the hydroponics is extending worldwide and such systems offer many new opportunities for growers and consumers to have productions with high quality, including vegetables enhanced with bioactive compounds

It is possible to cultivate soilless culture in very low spaces with low labour and short time, so hydroponics can play a great contribution for the poorer and landless people.

The industry is expected to grow exponentially also in future, as conditions of soil growing is becoming difficult. Specially, in a country like India , where urban concrete conglomerate is growing each day , there is no option but adopting soil-less culture to help improve the yield and quality of the produce so that we can ensure food security of our country. However, Government intervention and Research Institute interest can propel the use of this technology.

8. Reference

[1]Ellis, N.K., Jensen, M., Larsen, J. and Oebker, N., ―Nutriculture Systems—Growing Plants Without Soil‖. Station Bulletin No. 44. Purdue University, Lafayette, Indiana.(1974)

[2] Beibel, J.P. , ―Hydroponics -The Science of Growing Crops Without Soil‖. Florida Department of Agric. Bull. p. 180,(1960.)

[3]Butler, J.D. and Oebker, N.F. ,―Hydroponics as a Hobby— Growing Plants Without Soil‖. Circular 844. Information Office, College of Agriculture, University of Illinois, Urbana, IL 61801.(2006.)

[4]Jensen, M.H and Collins, W.L. 1985. Hydroponic vegetable production. Horticultural Reviews, 7: 483-558.

[5] Sardare, M.D. and Shraddha, V.A. 2013. A Review on Plant without Soil – Hydroponics. International Journal of Research in Engineering and Technology, 2(3): 299-304.

[6]. De Kreij C; Voogt W; Baas R (1999). Nutrient solutions and water quality for soilless cultures. Research Station for Floriculture and Glasshouse Vegetables (PBG), Naaldwijk, The Netherlands, Brochure 196

[7]. Raviv M; Krasnovsky A; Medina S; Reuveni R (1998). Assessment of various control strategies for recirculation of greenhouse effluents under semi-arid conditions. Journal of Horticultural Science and Biotechnology, 73(4), 485–491

[8]. Savvas D (2002). Nutrient solution recycling in hydroponics. In: HydroponicProduc tion of Vegetables and Ornamentals (Savvas D; Passam H C, eds), pp 299–343. Embryo Publications, Athens, Greece

[9]. Silberbush M; Ben-Asher J (2001). Simulation study of nutrient uptake by plants from soilless cultures as affected by salinity buildup and transpiration. Plant and Soil, 233, 59–69 [10]. Sonneveld C (2000). Effects of salinity on substrate grown vegetables and ornamentals in greenhouse horticulture. PhD Thesis, University of Wageningen, The Netherlands