Glimpses of Precision Agriculture Using Hydroponics

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Abstract

Due to huge demand on water resources and subsequently food supply, many new trends in the farming innovative methods which include a complex agricultural production system have been evolved. The technology Hydroponics plays very crucial role in this modern era. Plants will grow under optimal conditions like nutrient, temperature, and ph. In this technique oxygen is influenced into the nutrient solution, allowing the roots to absorb nutrients quicker and more easily. This facilitates stimulating the rapid growth, preventing algae formation and resulting high yields. Different kinds of sensors capture the information in real time and send to the Blockchain and update the relevant data that they have captured. Using the innovative technologies, it helps the farmers to increase their agricultural production with minimum environmental footprint. In this paper we discuss the process of precision agriculture using Internet of Things with the Blockchain concepts and monitoring the growth of the plants via web application.

Introduction

Hydroponics was method of growing plants using mineral nutrients solutions instead of soil. Hydroponics plays very important role for the commercial food production. Hydroponics grown plants will get perfectly balanced diet. The farmers face many problems due to soil erosion and biodiversity loss. A little knowledge of farmers about the agriculture new technology will lead loss.

Lettuce is one of the best crops for soilless systems because it can be produced in a short period. Hence the pest pressure is relatively low. Unlike tomato and cucumber, a high proportion of the harvested biomass is edible. With lettuce, income per unit area per unit time is very high. Other fast growing and high-income generating crops are herbs such as basil and chive, which are being grown commercially in soilless systems. In plants, some general diseases are brown and yellow, late scorch and other fungal viral and bacterial diseases. Hydroponic Nutrient measurement are EC, PPM, PH & TDS. PH measures the acidity or basicity of a solution. EC measures how much dissolved material is in a solution. TDS measured in PPM or Parts per Million.

The pH of the nutrient solution indicates whether it is alkaline, acidic or neutral. If the pH > 7, it is alkaline; if the pH < 7, it is acidic. A pH of 7 indicates that the solution is neutral. The plant's ability in a

hydroponic to absorb nutrient solution depends on the pH of the nutrient solution. When the nutrient solution is above or below the optimal pH level, the plant may not receive enough nutrients. Nutrient solution concentration can be monitored and controlled using electrical conductivity measurements. Electrical conductivity is measure of the ionic strength of a solution. When a solution is too acidic, over absorption of hydrogen, aluminum and manganese can be toxic to the plant. Conversely, at low pH, calcium and magnesium are less readily absorbed. This can lead to deficiencies of these nutrients.

Nutrient Deficiency identification-

In hydroponics, keep the nutrient solution in the recommended concentration range or ppm level. Nutrients in fertilizers are typically divided into 2 categories Macro Nutrients and Micro nutrients.

Macro nutrients are Nitrogen, Phosphorus, Potassium, Calcium, Sulfur, Magnesium, Carbon, Oxygen, Hydrogen. Micro nutrients are Iron, Boron, Chlorine, Manganese, Zinc, Copper, Molybdenum, Nickel.

Sl.No	Nutrient Components	Deficiency symptom
1	**Nitrogen**	It brings yellowing of the leaves.
2	**Phosphorus**	Purplish color of older leaves.
3	**Potassium**	Yellowing and browning of the margins.
4	**Calcium**	Drooping, collapsed petioles and a whitish coloured cigar leaf (the youngest leaf at the top of the plant).
5	**Iron**	Interveinal chlorosis on youngest leaves
6	**Magnesium**	Interveinal chlorosis (yellowing) on older, lower leaves.
7	**Sulphur**	The deficient plants show growth depression, and appear pale and yellow due to general chlorosis of the leaf edge, with a greater degree of chlorosis in the young leaves. Control plants on left.
8	**Manganese**	Manganese deficiency symptoms include dark green veins.
9	**Molybdenum**	The molybdenum-deficient plants show a limp stature and a slightly paler color. Molybdenum deficiency symptoms depend to some degree on the nitrogen status of the plant, with leaves being much paler green at high levels of applied nitrogen

10	**Boron**	Stunted growth, dieback of the terminal bud, and brown cracks on stems and fruits can be a sign of a boron deficiency. Also, leaves may develop brown irregular spots and become brittle and curled, and witches' brooms may form.
11	**Zinc**	Plants deficient in zinc will exhibit chlorosis between the leaf veins, appearing as yellowish or whitish stripes between the midrib and margin. Leaves also can be stunted and misshapen. Yellowing between the leaf veins is the first sign.
12	**Copper**	Plants with a copper deficiency show yellowing in young leaves, and slow growth. Eventually, the leaves turn brownish.
13	**Chlorine**	Yellowish leaves that have rounded dead spots that are sharply delineated from the rest of the leaf. Roots may exhibit excessive branching, and leaves may be wilted along the margins.

The proposed crops through hydroponics are

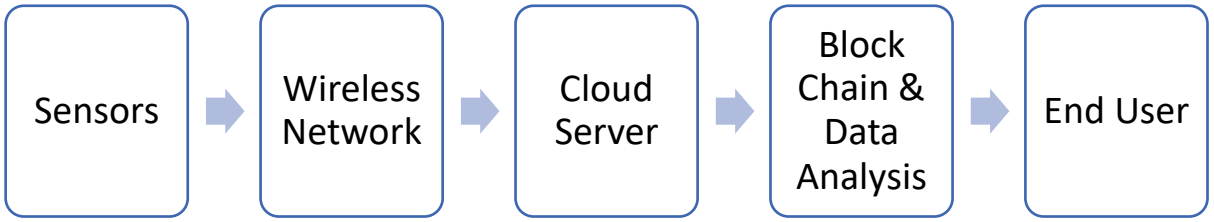
Sl.No	Plans Name	pH level	Grow& Harvesting Time	Remarks
1	Lettuce	6 to 7	Within 30 days or less	Cool temperatures
2	Strawberries	5.5 to 6.2	Two months or 60 days	Cool temperatures
3	Cucumbers	5.5 to 6.0	50- 70 days	Supply it with ample light and high temperatures.
4	Spinach/ Sweet Spinach	6.0 to 7.5	Within one month or 40 days	The temperature is duly regulated. 65 Degrees to 72 Degrees F
5	Beans	6.0 to 6.3	6-8 weeks. Once you're done with harvest, you can continue growing the crop for another three to four months	Warm temperatures

6	Bell Peppers	6.0 to 6.5	Take around 90 days	Make sure they get plenty of full light.
7	Tomatoes	5.5 to 6.5	Within two months you will be harvesting	Ample light and hot temperatures. The air temperature should be 65 to 75 degrees Fahrenheit (18 to 24 C). At night it should be 55 to 65 °F (12.8 to 18.3 °C).
8	Basil	5.5 to 6.5	28 days	11 hours of uninterrupted lighting at a warm temperature
9	Potatoes	6	70-90 days	water temps of approximately 70°F to 75°F, and 6 to 12 hours of light.
10	Brinjal	5.5-6.5	90-120 days	Temperature 70 – 80 degrees / Warm Temperature, nitrogen, potassium, and phosphorous needed

Web Application for monitoring the hydroponic system

Web Application for an IoT-based hydroponic monitoring systems has been developed. This application provides very user-friendly interface for monitoring. It displays the temperature, PH and TDS values in real time basis. This will help the farmers to monitoring the growth of the plants. The report of the web application data includes the date, time, temperature (nutrient temperature), and PH. The sensors such as temperature PH and TDS senses the data and send the data to cloud server through a Wi-Fi communication, after the data analysis, the result will be displays in the web application. The data are saved in the server and can be accessed by users. The users access the data from their devices such as PCs, laptops, or smartphones. These devices communicate to the cloud server through internet connection using Wi-Fi or wired connection.

Block Diagram



Using IOT and Block chain

The sensors help to collect the data from the hydroponic farm and then send to the Cloud Server. Once the information is collected from the sensors, it passed on the wireless network and shared to the Cloud Server. It processes the data that is collected from sensor nodes and after using the block chain technology and the data analysis the end user can view and access the data processed in the cloud server. The sensors could gather data on the water, temperature, PH, Nutrient, etc. use and send it to the blockchain.

The block chain receives the information from the sensors that are connected to the data involves in the agriculture monitoring process. Each node maintains the local copy of the block chain with all the approved transactions. The transactions that are involved in each node are accessing, storing and monitoring the sensor data. The Blockchain technology involves the highly secured and transparent network where each users having its own block of data which contain hash code, consensus algorithm, cryptographic signature that is used in the agricultural data inputs in the intelligence agriculture sector.

This innovative and intelligent precision agriculture monitoring system use the digital technology to stay connected with farmers, consumers and the land. Hence it builds trust between farmers & consumers for improving brand reputation and operational efficiencies and open a new market trend.

Conclusion

Hydroponics growing allows plants and crops to grow without the use of pesticide and thus it will be disease free. The crops will grow in a natural healthy manner as a Hydroponic system is very similar to nature environmental conditions. The system is also likely to be profitable producing high value crops. The main advantage of the modern cultivation system is the conservation of water and increase productivity per unit area. Hydroponic system reduces water loss and increase water use efficiency compared to the conventional agriculture. The web application will display the sensors result in real time. Hence the user knows the growth of the plant and the requirements of the plant's growth. the results are displays in numerically and graphically via this web application.

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