Automation of Hydroponics System using Android Application and Ubidots Platform

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Abstract-- **Hydroponics is an ancient technique that dates back approximately 2600 years. The first application of hydroponics in recorded history was the hanging gardens of Babylon that was built by KING NEBUCHADNEZZAR. Growing greenhouse vegetables is one of the most exacting and intense forms of all agricultural enterprises. In combination with greenhouses, hydroponics is becoming increasingly popular, especially in the United States, Canada, Western Europe, and Japan. It is high technology and capital intensive. It is highly productive, conservative of water and land and protective of the environment. For production of leafy vegetables and herbs, deep flow hydroponics is common for growing row crops such as tomato, cucumber and pepper. The two most popular artificial growing media are rockwool and pertile. Computing devices today operate hundreds of devices within a greenhouse by utilizing dozens of input parameters, to maintain the most desired growing environment. The technology of greenhouse food production is changing rapidly with systems today producing yields never before realized. The future for hydroponic/soilless cultured systems appears more positive today than any time over the last 50 years.**

Keywords-- Recovery system, pH, NPK ratio, Android application, Ubidots.

I.INTRODUCTION

Hydroponics **hy'dropon'ics**(from the Greek words *hydro* water and *ponos* labor) means cultivation of plants in nutrient solution rather than in soil. Hydroponics is the science of growing healthy plants in a medium, other than soil, using mixtures of the essential plant nutrient elements, dissolved in water, as plant food. Utilizing this technology, the roots absorb a balanced nutrient solution dissolved in water that meets all the plants developmental requirements. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as pertile, gravel, mineral wool etc that plants absorb essential mineral nutrients as inorganic ions in water. This technology can be used to grow healthy indoor plants and premium grade vegetables, fruits and herbs. Hydroponics may also be called 'controlled environmental agriculture'.

Hydroponics can be adapted to many situations from outdoor farming to greenhouse and now in-home gardening. The main objective of hydroponics is to supply the ideal nutritional environment for optimum plant performance. Plant performance may be further optimized by controlling the climate and lighting. Advances in technology in lighting, nutrient delivery, and environmental control, will further improve plant productivity and performance. Since hydroponic systems reduce water and nutrient stress to the plants, they grow faster and can be grown closer together without starving each other. Healthier plants also produce higher yields.

II.OBJECTIVE

The main objective of the project is to completely automate the process of growing plants in a system designed to t within one's home. Useful feedback is given to the user about the condition of the plants via an Android application. It utilizes hydroponics, a more efficient method for growing plants than traditional potted soil. Everything from lighting and watering cycles to nutrient and pH regulation is automated, as to make it simple for anybody to grow plants.

III.LITERATURE SURVEY

In this paper a two electrode sensor for measuring water conductivity for the hydroponics system is presented. The sensor is designed to measure the conductivity of nutrient solution which is in the range of millisiemens(mS). These electrodes are used to regulate the nutrient in hydroponics solution according to the plant's requirement. The automatic hydroponic system is based on low cost ARM processor that monitors and control the need of hydroponics plants. Automatic hydroponics system will boost the production by controlling the different parameters. [1]

Hydroponics is a technique that ensures that the plant gets all nutrients needed from the water solution. There are many types of hydroponics technique. The Deep Water Culture (DWC) is one of the hydroponics technique types. DWC is a technique that grows the plant by supplying the nutrient direct to the root of the plant until the plant can be harvested. However, this technique manually controlled the pH water, which can give bad effect to growing of plant. In this research, the pH level in water solution will be automatically maintained by microcontroller and measured by sensor. Lastly, this research also focuses on the ability of the system can adjust the pH value in water solution for DWC. The water solution from the DWC container is transferred to the main tank to measure the pH level by sensor and make adjustment if needed and then transfer back to the deep water culture container to continue growing the plant. [2]

This paper presents an efficient hydroponic nutrient solution control system whose system parameters are optimized using genetic algorithm. The FIS evaluation function has been designed using expert opinion from researchers at Murugappa Chettiar Research Centre, India. To evaluate the performance of the proposed algorithm, a virtual hydroponic nutrient control system with a solution monitoring unit was designed using LabView. The designed algorithm demonstrated better convergence efficiency and resource utilization compared to conventional error function based nutrient solution control systems. [3]

This paper discuss automation of hydroponics using sensors to determine how to water, give light to and fertilize the plants through hydroponics, while requiring no action from the user. The android application makes it easy to monitor the status of the plants and sensor readings. Being a closed loop system, we are able to reuse the hydroponic solution over and over again as it runs through the plants, until it is depleted. Everything from lighting and watering cycles to nutrient and pH regulation is automated, as to make it simple for anybody to grow plants. [4]

IV.METHODS AND PROCEDURES

A) Methodology used

Drip irrigation system pumps the nutrient solution through the tube and drops onto plant roots via a network of drip lines. The action is often made automatic by a moisture sensor. Drip irrigation systems can be active recovery or non-recovery type system. A moisture sensor is used to schedule the submerged pump. When the moisture value is above threshold, the nutrient solution is pumped and dripped onto plants' base through a small drip line. And with this line emitter for each plant, gardeners can adjust the amount of solution per plant they want. In a recovery drip system, the nutrient solution is sent back to the reservoir via the drip tray. However, the recovery one can be more efficient, and cost-effective. With recovery system, hydroponic gardeners need to check pH regularly. Since this is a drip system, slow draining medium is often used like Rockwool, coconut coir, or peat moss.

B) Procedure

The existing system techniques are discussed in the literature survey. The new technology that we are implementing in our project is as shown in the block diagram (Figure.1)

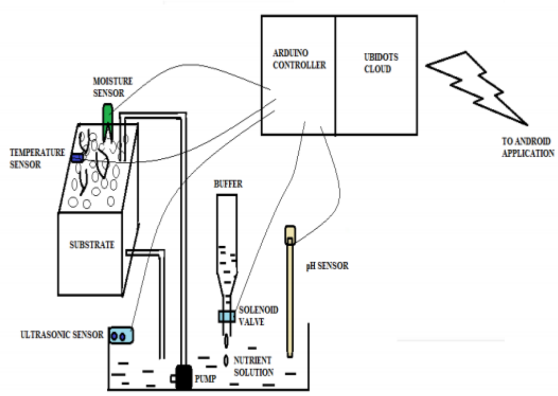

Figure.1 Block Diagram of the proposed system

Nutrient solution will be present in the Reservoir (as shown in the Figure.1) which is mixed in proper proportions to meet the pH requirements of the crop. pH and NPK ratios(for different plants are as shown in Table.1) are used during initial mixing procedure to meet the crop requirement. The nutrient solution level is recorded using ultrasonic sensor. A fresh nutrient solution is replaced once the nutrient solution level goes beyond the threshold level and this is intimated to the user through android application. The crop is planted into a substrate like coco peat which is placed inside a casing. The pipes consisting of holes are laid above the substrate to wash the roots with nutrient solution thus forming a Drip Irrigation System.

TABLE I. PK RATIOS FOR DIFFERENT PLANTS

CROP	N	P	K
Mint	100	50	50
Tomato	190	40	310
Pepper	190	45	285
Strawberry	50	25	150
Melon	200	45	285
Cucumber	200	40	280

ISSN: 2278-0181
NCESC - 2018 Conference Proceedings

A submersible DC/AC Pump will be placed inside the reservoir to circulate nutrient solution to the roots of the plants using Drip Irrigation system. This Pump is controlled by the moisture content of the coco peat substrate which drives the pump periodically. For Ex.: If the moisture content of the substrate is above 500, it means there is lack of nutrient solution and then the pump starts pumping the solution until the moisture value is below 500. The remaining nutrient solution is collected back to the reservoir after circulation and is re- circulated again and again using the pump. This method is known as 'Recovery Drip Irrigation System'. As the plant absorbs the nutrients from the solution, the pH value of the solution goes high. In order to bring down the pH value to the optimum level, pH down buffer solution (like dilute phosphoric or nitric acid) is used. The flow of such a buffer solution is controlled by Opening and Closing of the solenoid valve. The Ethernet shield is interfaced with Arduino UNO to establish internet connection which is used to send data to ubidots colud.

Figure.2 Android Application

The Automated System allows the grower to stay away from the Hydroponics System by updating him about the onsite happenings. This is made possible by using android application. Data is sent to the grower's mobile phone (shown in Figure.2). Thus the system works continuously resulting in High crop yields even in the absence of grower, hence making the system automatic.

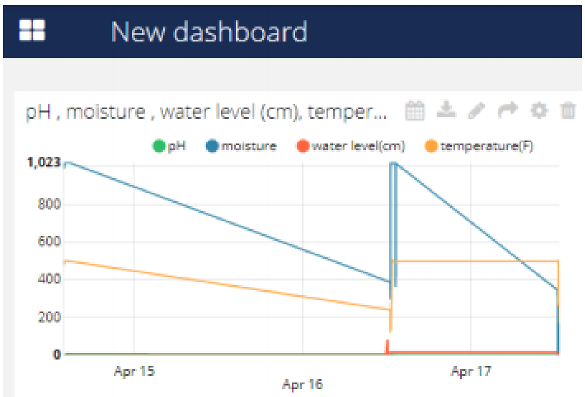

Figure.3 Sensor readings in ubidots cloud

The smart greenhouse is connected to an android application through the ubidots clouds hosting a web server. The sensor information is provided to the user so that the plants can be monitored from anywhere. This is done through a button showing the live readings (as shown in Figure 3) of the plants and through graphs plotting the values for the past week or so. This means that a user will be able to see if something has gone wrong with the system. o the bloom cycle (once per plant cycle). Currently the android application is an HTML webpage, that if connected to the proper internet connection could be available anywhere.

V.ADVANTAGES

Hydroponics is a far more economical and profitable technique than traditional agricultural cultivation. Some of the advantages:

- After the initial start up costs, hydroponic gardening is around 20 per cent cheaper to run and maintain.
- We can plant more hydroponic plants in a smaller area. This is because the roots will not grow as large as they have a readier access to nutrients. This is despite the actual plants growing larger too.
- Maintenance time is greatly reduced in hydroponic indoor gardening. Weeding doesn't exist without soil and of course there is no need to water them.
- The yield is year round and permanent as we have full control over growing conditions and we will have made them optimum for whatever we are growing. This is great for when it's off season as we can sell them for higher prices.
- We can grow our hydroponic indoor gardening plants anywhere; rooftop, window ledge, corridor, garage, bedroom, living room, cellar or attic.
- As we will not be watering them, there is no danger of them being over or under watered. This is a common mistake with many novice gardeners.
- For the reasons listed above, the plants will grow up to 50 per cent faster! This is ideal if we are feeding a large family or are planning on making money out of it.
- As soil is not used, we can take part in hydroponic indoor gardening in the desert or snow covered regions like Antarctica.
- Highly palatable.
- Nutritious fodder.

VI.DISADVANTAGES

- Commercial Scale requires technical knowledge as well as a good grasp of the principles.
- On a commercial scale the initial investment is relatively high.
- Great care and attention to detail is required, particularly in the preparation of formulas, mixing procedures and plant health control.

VII. APPLICATIONS

1. *House gardening*
   Hydroponically grown foods not only taste better and are more nutritional, we can change the properties of our food, monitor what goes into our food and pollutes less. One can also grow more in less space. This is especially great for those of us that do not have a backyard to grow in. With the right plant selection, we can also keep pests away.

2. *Research*
   Hydroponic systems have been utilized as one of the standard methods for plant biology research and are also used in commercial production for several crops, including lettuce and tomato. Within the plant research community, numerous hydroponic systems have been designed to study plant responses to biotic and abiotic stresses.
3. *Growing medicinal plants*
   Medicinal plants are increasingly cultivated on a commercial scale to satisfy the large demand for natural remedies. These species are generally grown in open field, which results in large year-to-year variability in both biomass production and content of active principles. Hydroponic technology may be applied to produce high-standard plant material all year-round in consideration of the possibility to control growing conditions and to stimulate secondary metabolism by appropriate manipulation of mineral nutrition.
4. *Plant nursery*
   Plant nursery can be made using hydroponics system. Greenhouses and nurseries grow their plants in a soil less, peat- or bark-based growing mix. The nutrients then are applied to the growing mix through the water supply.

VIII. CONCLUSION

Our system aims at maintaining pH at optimum levels and hence no nutritional problems will be observed in plants cultivated in our re-circulating system. Hydroponics growth and productivity are considerably affected by prolonged recycling of nutrient solutions where adjustments are based solely on pH measurements. This system can play an important part in helping conserve water and electricity and yet derive yields of higher magnitudes. Initial Investment stands as one time investment and same system setup can be used to grow variety of crops.

IX. REFERENCES

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