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Nutrient Film Technique Hydroponics Vertical Farming of Lettuce Plants using Dissolved Nutrient solution

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ABSTRACT

Automation has intervened in all our day to day activities and we humans, nowadays, have become so used to it that we expect everything in our day to day life to be automated. Yet there are some fields that still require developments in various levels and one such field is Agriculture. Agriculture is an essential field which is in dire need for advancements. With the ever growing population and racing industrialization it is high time that we concentrate on smart farming techniques like hydroponics, aquaponics, etc. These techniques can be adopted so that it is easy to manage and regulate the vegetation under a more controlled environment with the proper application of concentrated nutrient solution to the plants. This paper describes about the automatic control system with latest electronic technology using microcontroller. The plants are well grown in the automated environment in the absence of soil with all the essential nutrients supplied artificially to the plants. The monitoring parameters are temperature, light, humidity, and soil moisture.

KEY WORDS: VERTICAL FARMING, RO WATER, HORTICULTURE

INTRODUCTION

Agriculture is one of the essential occupations of man since early civic establishments and even today manual intercessions in cultivating are inescapable. It is the foremost and indispensable component, (Rajeswari et al. 2018) of any nation. Computerizing a nursery incorporates checking and controlling of the climatic parameters which straightforward or by implication administer the plant development. With the utilization of nurseries, horticulture should be possible on all the places of the earth. To farm the plants in a hydroponic framework it is critical to keep up the conditions required for the plants needed for its growth.

Hydroponics implies the development of plants utilizing a supplement advanced water source without the

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utilization of soil. Water is more important for growing plants because it gets its nutrients, (Luechai et al. 2018) from water and not from soil. Plants are developed regularly, however they have their foundations submerged in water, (Castelo et al. 2010). Soil gives structure, not simply the genuine sustenance, for plant roots, (Balraj et al. 2018). The sustenance originates from different materials blended in the dirt, for example, compost, separated plant waste or manures. These mediums don't supply any supplements to the plants however much like soil they supply the plants with a place to grapple. While giving the supplement advanced water, pH levels are essential in hydroponic frameworks.

A supplement advanced water source is basically water doped with mineral supplements called micronutrients or follows components. The portability of the supplements is dictated by the pH in the arrangement. At the point when these micronutrients turn out to be more portable, consumed by the plants quickly and in overabundance what the plant completely needs.

The overabundance of the nutrients to the plant results in toxic condition for the plant. At the point when the micronutrients are less versatile the plant experiences difficulty retaining the supplements, which at that point prompts the lack in the plant growth. Thus adjusting the pH in hydroponics framework is amazingly imperative to the wellbeing and essentialness of yield of the plants, (Qiang Wang et al. 2010).

The mechanized pH checking framework is utilized as a part of this system; undertaking will precisely decide the pH levels of the supplement enhanced arrangement and keep up these levels inside a range for ideal plant growth. Likewise the temperature of a supplement arrangement in a repository is a standout amongst the most vital elements influencing the broke up oxygen substance of the arrangement. Actually, water's capacity to hold oxygen is straightforwardly identified with its temperature. On the off chance that the temperature gets excessively icy, a radical new arrangement of issues is made. Temperatures that are excessively frosty will make the plant's development moderate and inevitably stop out. For this purpose the temperature detecting framework has been received.

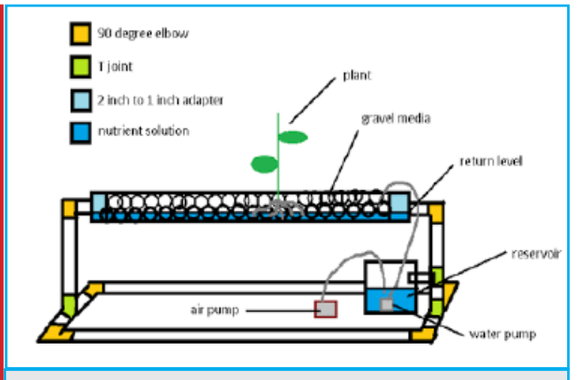

Figure 1. Nutrient Film Technology

MATERIALS AND METHODS

In this project the set up is implemented with a smart sensors and controllers, (Kulkarni et al. 2017) which are used to sense and control the physical parameters like temperature, humidity, moisture and water level and also monitor the major factors that affect the crop yield. We have implemented a vertical farm module based on hydroponics technology that is soilless farming method, (Kiruthika et al. 2018).

Figure 2. Hydroponics in vertical farming

Inside this casing, three layers of PVC channels were stacked evenly to frame vertical layers. Gaps between settled widths were penetrated at equidistant places focuses on each pipe push where the lettuce plant seeds are made to be planted. The funnels were associated utilizing submersible pump to direct the water stream between the channels. Over the casing, a focal water tank was set and a gap was made at its base to enable spill out of tank to the underneath PVC pipe layer. Two separate tanks of little limit contrasted with the principle tank were put on either side of the primary tank that stores basic and acidic solutions.LED pieces of blue and red light were stuck on the side dividers of the edge to where a pink light glows represents the intake of photo-

synthesis by the lettuce plant. On top surface two gaps were penetrated to put a fumes fan and a globule individually.

MEDIUM USED

The supplements to the lettuce plants required are given by the supplement arrangement, and the developing media for the plant sapling is watered and saturated. Probably the most broadly utilized developing media is incorporated with Rockwool, Coconut coir, growing slab and Perlite or Vermiculite. A great developing medium guarantees that plant attaches have a place to stay and holds dampness in the meantime. A few sorts of develop medium, for example, preparing blends and soil, come pre-accused of supplements and alterations as a rule. The medium provides the nutrients and minerals to the plants by which they can go grow well.The growth of the plant is monitored every day.

Figure 3. Germinating using rock wool

Figure 4. (a) Coconut coir. (b) Net Pot

TEMPERATURE SENSOR

In this venture we utilize LM 35 as temperature sensor. LM35 is exceptionally exact and great sensor to demonstrate the temperature in Celsius. LM35 is a direct temperature sensor. To change over this yield for the contribution of the ADC we utilize operation amp current intensifier to change over the flag into 0-5volt dc. LM 35 is associated with the stick no 3 of the operation amp through 2.2kohm resistor, (Sarkar et al. 2015). Stick no 2 which is – ve contribution of the operation amp is set to the reference voltage by 1 kilo ohm variable resistor. Focus purpose of 1 k ohm resistor is associated with the stick no 2 by means of 10 k ohm resistor. Positive voltage is additionally connected to the one shaft of the preset by means of 3.3kilo ohm resistor. 4.7kilo ohm resistor is additionally grounded from the 1 kilo ohm variable resistor. Stick no 7 of the IC is associated with the positive 5 volt. Stick no 4 is associated with the shared belief point. One criticism resistor is associated from yield stick to the stick no 2 which is 50 k ohm resistor. So by along these lines we set the pick-up of 5 by this operation amp. We set the base reference voltage by preset (variable resistor) and when temperature rises at that point yield is likewise increments with the pick-up of 5 and associated with the IN0 contribution of the ADC.

MOISTURE SENSOR (HIH4000)

Water vapour is measured by the estimation of dampness estimation. Water vapor introduced in a gas is blend, for example, air, or unadulterated gas. Dampness sensors depending on this guideline comprise of a hygroscopic dielectric material sandwiched between a couples of anodes framing a little capacitor. Most capacitive sensors utilize a plastic or polymer as the dielectric material, with a run of the mill dielectric consistent going from 2 to 15, (Tanaka et al. 2009). Without dampness, the dielectric consistent of the hygroscopic dielectric material and the sensor geometry decide the estimation of capacitance.

pH SENSOR

One of the essential prerequisite of this automated hydroponics framework is to quantify and change the pH of the hydroponics store. It is imperative that the pH esteem remains adjusted for a given plant that is developing in the plant supply. The plant will continually influence the pH, so the framework should have the capacity to change the pH of the supply utilizing a compound pH adjusting arrangement. The ideal pH extend for hydroponics is inside the scope of 5.5-6.8. Keeping in mind the end goal the pH synthetic should be added to the hydroponics store, a sensor senses the pH ceaselessly, (Jegadeesh et al. 2014). The most straightforward condition of a pH sensor comprises of a glass terminal test that is delicate to the hydrogen particle fixation, which gives a voltage perusing that relates directly with pH. At 25°C, anode affectability is 59.16mV/pH and the

yield of the cathode will swing from 7pH x -59.16 mV/pH = +414.12 mV (pH 0 strong acid) to +7 pH x -59.16 mV/pH = -414.12 mV (pH 14 strong base).

PLANNING OF THE NUTRIENT SOLUTION

It is critical to utilize RO water or water with Total Dissolved Solids under 250ppm to guarantee that there are no undesirable impacts on plants having the capacity to inject supplements, (Kalantari et al. 2017). An eggplant was developed with 250ppm the capacity to inject supplement arrangement made with hard water with 650ppm of Total Dissolved Solids.

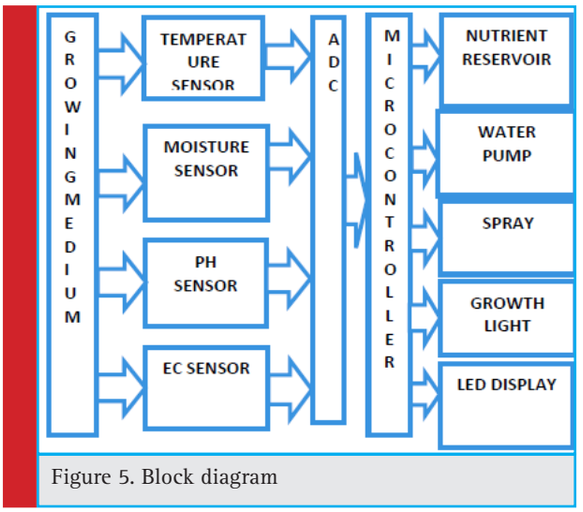

Figure 5. Block diagram

This had prompted decolorization of plant leaves and roots and the pH began floating quickly. At that point when the eggplant was developed with Reverse Osmosis water, the decolorization of plant leaves would not have happened. Similarly it is required to distinguish the ideal level of supplement focus needed for the plant of that size and for the atmosphere. Settlements of 15 lettuce plants were developed with 2500ppm of Total Dissolved Solids Nutrient course of action which was well finished the required levels. It was recognized that the Total Dissolved Solids levels started climbing as the plants started taking in water and the pH level started drifting, (Safikhani et al. 2014). Exactly when a common customized structure which draws destructive into the supplement game plan when the pH goes more than 6.3 was used, over the top destructive (H3PO4) was incorporated into the system. This changed the union of the structure and made the plants to dry changed out in water within two days.

E.LIGHT SOURCE

Plants require radiation with wavelength of the UV range, noticeable light range and infrared range. The plant responds diversely to various shades of light. Driven lights are utilized for the actualized framework.

ATMEGA328

Atmega328 utilizes a 16MHz precious stone oscillator. The water level sensors LS1-LS5 and the transfer pins S1S6, temperature sensor, ultrasonic separation sensor are associated with the computerized pins of the microcontroller, (Aswathand et al. 2016). The EC meter and pH meter are associated with the ADC of the microcontroller. The equipment serial ports tx and rx are associated with the serial ports of the ESP8266, (Anirudh et al. 2014).

The pH and electrical conductivity of the arrangement is estimated once at regular intervals of time. In this event the pH is over 6.3 pH down arrangement or weakened phosphoric corrosive is added to the supplement arrangement. If the electrical conductivity is less, then the supplements are added in the framework to a required extent. At whatever point the ultrasonic separation sensor identifies that the water level has dropped, water is drawn into the framework. Simultaneously when the supply of pH down arrangement and supplement arrangement is exhausted an alarm message is given, (Specht et al. 2015). An alarm message is additionally given to a man when unusual practices are recognized and when the temperature of the arrangement ascends to a point where broken up oxygen is denied. The plant develops with the pH meter and electrical conductivity meter serving to keeping up ideal parameters for the plant development. The framework distinguishes if the adjustment in pH esteem is too quick and alarms the client to change the supplement arrangement. It can also be controlled by the programmable logic controllers, (Gruda et al. 2015) and the molasses can be used as a germinating medium instead of coconut coir.

RESULTS AND DISCUSSION

The automated hydroponic system with pH sensor, EC sensor and temperature sensor shows good result. The growing light is used to fulfill the process of photosynthesis. So turn ON the light at least 17 hours/day. In order to avoid climatic barriers and fast production we used LED. Our growing test shows that the plant (lettuce) grows well within one week. Currently pH needs 10 minutes to stabilize data sensor reading. Automated system in recirculation of water, the hydroponic shows the growth rate of about 40-50% faster than the soil. The outcomes got from the gadget have shown that the execution is well, particularly in gathering, logging and dissecting the sporadic information from the sensors that is exchanged to focal hub for agriculturists' utilize. Additionally work is required on shield packaging of hubs

under extreme climate conditions. Power supply from inexhaustible sources or a battery or some other continuous source requires examination, (Rosa et al. 2014).

CONCLUSION

In summary, the soilless farming system guaranteed the development of agriculture. The plants grown in the hydroponics system is developing at a faster rate as the plants grow fast in water than the soil. Continuous monitoring of plants should be implemented for this system; otherwise the outcome won't be satisfactory. This system finds a gateway to the cultivation of plants in areas like deserts, sterile lands and building as all the nutrients like oxygen, nitrogen, phosphorus, etc are supplied manually to the plants.

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