Hydroponics Based Cultivation Using IoT

Nivetha K[1], Jeya Chitra K[2], Dinesh Kumar S[3], Mr. Srinivasan K[4]
[1, 2, 3]Dept of Computer Science and Engineering
[4]Assistant Professor, Dept of Computer Science and Engineering
[1, 2, 3, 4] Dr. Mahalingam college of engineering and technology, Pollachi, Coimbatore, India

Abstract- *Hydroponics is a method of growing plants without using soil.In this study,we created a system that can grow common plants and vegetables and can operate without depending on the outside climate.We achieved this by using a technique called hydroponics.System parameters can be maintained and controlled by a sensor such as pH sensor,water temperature sensor and moisture sensor.For adequate management of water and nutrients in the hydroponics system,pH dissolved oxygen and temperature should be measured because ion concentrations in the nutrients solutions change with time,resulting in a nutrient imbalance.In closed hydroponic systems real time measurement of all nutrients are required but such measurements are not available due to technical problems.*

Keywords- PH Sensor, Moisture Sensor, Temperature sensor, Nutrients

I. INTRODUCTION

Hydroponics is a method of growing certain plants and vegetables without soil instead of plants are grown in solution composed of nutrients in water solvents. The purpose of the project is to expand and improve the utilization of hydroponics as well as to create an environmentally independent system for indoor plant growth. In a hydroponic system, a plant is placed in a solution composed of soluble nutrients and water as opposed to soil. In most conventional hydroponic systems, parameters such as EC and pH of the water solution are set to the desired value while setting up the system. In this project we built a system that grows plant without use of soil. In general, the process goes as follows: create a nutrient solution based on the plant being grown, apply this solution to a bed of water, and place a germinated plant into the water such that the exposed roots are touching the solution. Typically, hydroponic systems require human interactions when it comes to the regulation of certain elements that allow the plant to grow.

II.LITERATURE SURVEY

A.A technique for cultivation of vegetables and medicinal plant

A large number of vegetable crops [2] and medicinal plants are grown. Quality of produce, taste and nutritive value of end products is generally higher than natural based soil cultivation. Various experiments findings outline that leafy greens (lettuce, spinach) cannot be grown easily due to CO2 concentration. CO2 concentration is one of the major environmental factors. CO2 level is low in this experiment because of high yielding of plants in short duration of life time. The people nowadays used lots of chemical product that controls the carbon level of the plants without their sense and yields the plant mostly to died.

B. Nutrients Solutions and water quality for soilless cultures

It provides the information on a method for calculating nutrient solutions for soilless cultures on the basis of nutrient solutions. Using the standard nutrient solutions [1] and the composition for the plant growth. The compositions of standard nutrient solutions are expressed as molecalculations of the number of fertilizers can usually be divided into two parts. The first part involves calculating the major elements in the fertilizers used, which normally have two or more components to be considered. The recirculation solution is corrected for the element concentrations in the root environment, physiological stage of the crops and for the element concentration in the raw water. The solution is calculated as the amount added to the stream of the raw water only. This method can be used when the composition and the volume of the recirculating drain water are not known, e.g., in NFT systems.

C. Simulation study of nutrient uptake by plants from soilless cultures

The main focus is nutrient uptake by plants in soilless culture. Soilless plant growth systems are widely used as a means to save irrigation water and to reduce groundwater contamination. While nutrient concentrations in the growth medium are depleted due to uptake by the plants, salinity and toxic substances accumulate due to transpiration. A theoretical model is suggested, to simulate nutrient uptake by plants grown in hydroponics with recycled solutions. The model

accounts for salinity accumulation with time and plant growth, and its effects on uptake of the different nutrients by means of interaction.

D. *Equipment for hydroponic installations*

Soilless cultivation encompasses all the systems that provide plant production in soilless conditions in which the supply of water and of minerals is carried out in nutrient solutions with or without a growing medium (e.g., stone wool, peat, perlite, pumice, coconut fibre, etc.). Soilless culture systems, commonly known as hydroponic systems, can further be divided into open systems, where the surplus nutrient solution is not recycled, and closed systems, where the excess flow of nutrients from the roots is collected and recycled back into the system.

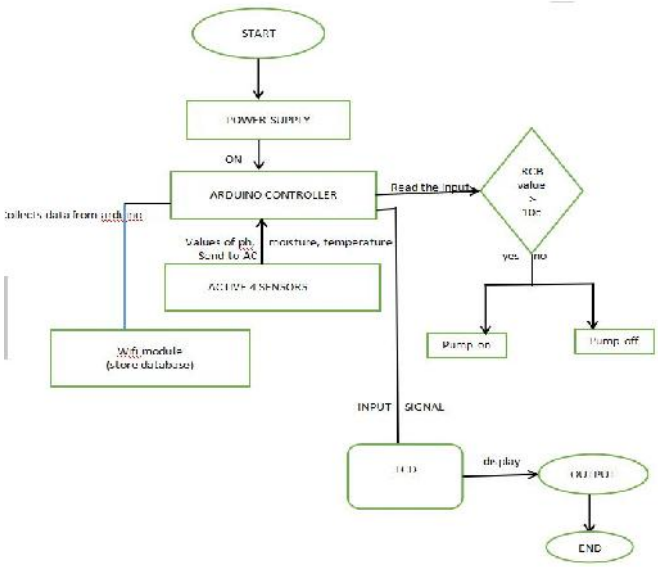
E. Hydroponics- Crop Production in liquid culture media

Thus, it is well established that production of certain crops without soil is practicable. The nutrient solution is changed either on a schedule, such as once per week, or when the concentration drops below a certain level as determined with a electrical conductivity meter. Whenever the solution is depleted below a certain level, either water or fresh nutrient solution is added. A bottle or a float valve, can be used to automatically maintain the solution level. In raft solution culture, plants are placed in a sheet of buoyant plastic that is floated on the surface of the nutrient solution. That way, the solution level never drops below the roots.

III. EXISTING SYSTEM

In the existing system, Arduino board plays a major role. It controls all part of the system. Several Sensors are installed like moisture sensor, nutrients etc. withArduino. The moisture sensor detects the level of moisture content in the hydroponic system and sends signal and moisture level to the LCD display. The pH sensor gives pH level, Nutrient level and temperature level in the display at several intervals of times. The wi-fi module collects all data of various sensors and stores it in the cloud storage. Python script also used to control the timing of the lights, using a rely module. It does not have analogue inputs like Arduino. By using Raspberry pi, it will automatically adjust the relay module's status accordingly.

IV. PROPOSED SYSTEM



Arduino is the heart for the whole Hydroponics system. It controls and watches over all components. The power button which is used to on all the system. There are four different sensors like pH, float, moisture; LDR sensors will be connected to the Arduino controller which is used to collect data from the four sensors. Then, the relay board is connected to the heart of the system to monitor the pump maintenance. If the RCB gets input less than the desired water level. It will initiate the pump to turn on. If the pH level is low, it sends data to ESP 8266 Wi-Fi to alert the person to observe it.

The Arduino sends the information to the LCD. LCD displays the warning alert to the user to observe. If there is correct level of pH, it will store the measurement of pH level in the cloud database. If the moisture level is reduced, it will directly send the data to Wi-Fi module and it turn the LCD gives warning output as a signal.

The float sensor which is connected to the Arduino controller board sends display to the LCD as an output. Finally, pH level, moisture content, water level and temperature can be implemented by using these processes.

V. MODULE DESCRIPTION

A Assemble the hydroponics system

This system consists of transistor, power supply board, motor, rely, Arduino board, Wi-Fi module, lcd display,7805 and 7812 regulators. This system contains four sensors namely pH sensor, moisture sensor, LDR sensor and

float sensor. The lcd display module used in our project is of type16 x 2. These components are assembled together and we need to give connections according to our project needs.

B. Add plants to the growing tube

In this stage, we have to remove all the soils from the root. To wash the dirt off from the roots, submerge the root ball in a bucket of lukewarm to cold water. Water that is too warm or too cold can make the plant into shocking state. Generally, separate the roots to get the soil out.

C. Monitor the system via sensors

We need to turn on the pump to check the water level daily or twice a day depending on water loss due to excessive heat and evaporation. Then, check the nutrient levels every few days. Because the pump runs full time, you don't need a timer, but make sure the tank doesn't dry out or the pump will burn up. If the pump will burn up, it leads to the plant died and check that accordingly by using sensors.

D. Monitor plant growth via think speak

A few weeks after planting, the plants will grow little bit, because they'll have all the water and nutrients they need to grow quickly. It's important to keep a close eye on plant growth and tie or clip the plant stalks every few days. While monitoring the plants we can monitor the pH level, moisture level, presence of light and temperature of the plants by using pH sensor, moisture sensor, LDR sensor and float sensor.
These are all connected to the Arduino board.

VI. HARDWARE COMPONENTS

A. Arduino

Arduino is a micro controller board based on the mega328P (data sheet). It has 14 digital input/output pins (of which can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro controller. The operating voltage is 5V. DC current or I/O pins is 40mA. DC current for 3.3V Pin is 50mA. It is named as Arduino Uno as "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0, the Uno board and version of Arduino. The Uno board is the first in a series of USB Arduino boards, reference model for the Arduino platform.

B. pH Sensor

A pH sensor is one of the most essential tools that's typically used for water measurements. This type of sensor is able to measure the amount of alkalinity and acidity in water and other solutions.

C. Float Sensor

A float switch is a type of level sensor, a device used to detect the level of liquid within a tank. The switch may be used to control a pump, as an indicator, an alarm, or to control other devices. One type of float switch uses a mercury switch inside a hinged float.

D. LDR Sensor

These devices are used where there is a need to sense the presence and absence of light is necessary. These resistors are used as light sensors and the applications of LDR mainly include alarm clocks, street lights, light intensity meters, burglar alarm circuits

E. Moisture Sensor

The Soil Moisture sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soilscience, agricultural science, environmental science, horticulture, botany, and biology. It uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil.

F. ESP 8266 WI-FI Module

The ESP8266 is a really useful, cheap Wi-Fi module for controlling devices over the Internet. It can work with a micro-controller like the Arduino or it can be programmed to work on its own. The Internet of Things (iot) has just been made a whole lot cheaper and easier. It is a self-contained SOC with integrated TCP/IP protocol stack that can give any micro controller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

G. LCD

Liquid -crystal display known as LCD is a flat-panel display or electronically modulated optical device that uses the light modulating properties of liquid crystals, liquid crystals do not emit light directly, instead using a backlight or reflector

to produce images in colour or monochrome. LCDs are available to display arbitrary or fixed images with low information content, which can be displayed or hidden, such as present words, digits and 7-segment displays, as in a digital clock. LCD displays available in various sizes 8×1, 16×1, 16×2, 16×4, 20 Char x 4 Lines. We mainly focus on 16×2 display. It is commonly used.

H. Bridge Rectifier Circuit

Bridge rectifiers as a type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (AC) current to a direct (DC) current.

I. Regulators

The purpose of a voltage regulator is to keep the voltage in a circuit relatively close to a desired value. Voltage regulators are one of the most common electronic components, since a power supply frequently produces raw current that would otherwise damage one of the components in the circuit.

J. Relay Control Board

RCB is used for controlling higher current loads from your microcontroller development board, PC parallel port or Arduino Uno. ... Relays terminals (C, NC, NO) are accessible through screw terminals which makes wiring up the board very easy. These are computer boards with an array of relays and switches. They have input and output terminals and are designed to control the voltage supply. It provides independently programmable, real-time control for each of several onboard relay channels.

VII. EVALUATION METRICS

S.NO	Existing System 1	Existing System 2	Proposed System
Nutrients Container	5 plants	10 plants	15 plants
Water Pump	1.3 m	1.5 m	1.8 m
PH sensor	5.6 - 6.2 (lettuce)	4.5 (aloe Vera)	6.5 – 7.5 (Coriander)
Wi-fi module	8266 modules	8266 modules	8266 modules

VIII. RESULTS AND DISCUSSION

Arduino board is used to all the hardware components. Sensors are used to detect the presence of the moisture, pH level and nutrient level in the plant. Sensors are also used to detect the water level. LCD display displays the attributes like level of water, nutrient level in the plant tank. Wi-Fi module is the software used in our system. The main purpose of cultivating plants in water is because population scale increased so that the vast area (agricultural land) become construction land. So, cultivate plants with the help of a Hydroponics Verti-culture Technique to increase daily need products like fruits, vegetables, etc.,). To design and develop an algorithm for humidity detection and to improve cultivation in large scale. To design an IOT architecture with suitable sensors for automated watering, and monitoring of crops by using Wi-Fi module like ESP. By using Arduino, we implement the system and collect the database in cloud and display the input/output in suitable devices.

IX. EXPERIMENTAL RESULTS

Fig 1 – Hydroponic system

The hardware connection of hydroponic system contains Arduino which is the heart of the system, transformer which converts high voltage power supply into low voltage, relay board which is used to give pure current to the board and motor to control the water level of the system.

FIG – 2 Lcd display and Think speak output

The moisture level phases of the project which contain moisture sensor and it also contain LCD display which shows the moisture level in that display. The pH level sensor display shows the level of temperature, pH in detail.

X. CONCLUSION

With the success of IOT, it is now easy to implement a Hydroponic system (soilless agriculture). Hydroponics isbasically growing plants without soil. It is a moreefficient way to provide food and water to the plants. In a hydroponics garden, it provides the plants with a complete nutrient formula and an inert growing medium to anchor the plant's roots so they have easier access to the food and water. The major problems in the developed cities are the management of cultivable areas or lands. To chase these problems, hydroponic system provides a best solution by choosing the right hydroponic system.

REFERENCES

[1] Alfredo Aires, (2019 July) Centre for the research and technology for agri-environmental and biological sciences, International Journal of Computer and Research, University of Portugal, Hydroponics production systems: impact on nutrition status and bioactive components of fresh vegetables. 12-16.

[2] Barbosa, G.; Gadelha, F.; Kudlik, N.; Proctor, A.; Reichel, L.; Weissinger, E.; Wohlleb, G.; Halden, R.; Barbosa, G. L. (2015). Philosophy degree, International Journal of Science, Mumbai, India, Nutrient's solutions and water quality for soilless cultures, pp. 11-15.

[3] Cindy Rae, (2017 March) Research Director, Canada, Hydroponics offers a healthy alternative, Journal of Science Technology, pp.15-19.

[4] Douglas, James Shallot, Dr. Ambedkar, (2015 May) Science research director, Chairman, Santa college, India, Journal of Physics, Equipment for hydroponic installations, New Delhi: Oxford University Press, Edition 5, pp. 17-23.

[5] D.S. Domingues, H.W. Takahashi, C.A. Camara and S.L. Nixdorf, (2012). Hydroponics- A technique for cultivation of vegetables and medicinal plants, InternationalJournal of Computers and electronics in agriculture, pp. 12-14.

[6] Hirofumi Ibayash, Yukimasa Kaneda, Jungo Imahara, Naoki Oishi, Masahiro Kuroda and Hiroshi Mineno, (2016 May) Hydroponics- crop production in liquid culture media, Journal of Physics, MDPI, pp. 33-37.

[7] Ikra Rahman Maiden, (2019 January) Science Lecture, Department of CSE, CDK Institute of IT, Mumbai, how hydroponics works, International Journal of Advances in Computer Science Engineering, Volume 2, pp. 8-19.

[8] J K.P. Ferentinos and L.D. Albright, (2003). Scientific publications on hydroponic lettuce production, Journal of biomedical, Biosystems Engineering, pp. 43-47.

[9] Mia Godfrey, (2018) Department of Growing Science, The Quick Reference Guide for Hydroponics Farmers, in Journal of Physics: Conference Series, IOP Publishing, pp.14-19.

[10] Dr. Hillel Soffer, (2017 June). senior researcher at the VoIcani Institute at Ein Gedi, Aero Hydroponicsthe Way of the Future, University of California at Davis, InternationalConference.

[11] Dr. Lynette Morgan (2019 April) Director of Research at SUNTECH International, Hydroponics Foiler Fertilization, International Conference.

[12] I Mohan raj, Ashokumar Kritika and J Naren, (2016 September) Changes of ph. across the rhizosphere induced by roots, Science Direct 6th international conference on advances in computing & communications ICACC 2016, pp 6–8.

[13] Dania Eridani, Olivia Wardhani and Eko Didik Widianto, (2017) Simulation study of nutrient uptake by plants from soilless cultures, InformationTechnology Computer and Electrical Engineering (ICITACEE)2017 4th International conference.

[14] Larry Brooke, (2015 May) Asst ProfessorAmerica, Water Should Taste Good to Plants, InternationalConference, OxfordUniversity, Vol 1.pg 2-5.

[15] L.A.Velázquez,M.A.Hernández,M.León,R.B.Dominguez and J.M.Gutiérrez, (2013 October) Hydroponic production of vegetables and ornamental,10th International Conference on Electrical Engineering Computing Science and Automatic Control(CCE) Mexico City, pp.34-36.

[16] Dr. Lynette Morgan, (2015 June) Director of Research at SUNTECHInternational, London, Hydro Humates,2019.

[17] M.F. Saad, N.A.M. Yahya, M.Z.H. Noor and M.S.A. Megat Ali, (2015 March) Hydroponics: A versatile system to study nutrient allocation and plant responses to nutrient availability, IEEE 9th International Conference on Signal Processing and its Applications, pp. 8–10.

[18] Om Prakash Yadav, Dr.R.P. Singh, Asst.Professor, (2016 Feb) Research director, vicechancellor, comparison of land, water and energy requirements of lettuce grown using hydroponic vs conventional agricultural methods, conference of science technology, pp.9-11.

[19] Paolo Sambo, (2018 March) Department of Agronomy, Food, Natural Resources, University of Padova, Hydroponic Solutions for Soilless Production Systems: issues and opportunities in a smart agriculture perspective, International conference.

[20] Pitakphongmetha,N. Boonnam,S. Wong Koon, T. HoranontD.Somkiadcharoen and J. Prapakornpilai, (2016), Farming for the future, Computer Science and Engineering Conference (ICSEC).

[21] P. Shimming, N.A. Karina, J.T. Tariana and M. I. Saraf, (2018) Nitrate uptake kinetics in lettuce as influenced by light and nitrate nutrition in conference of Physics: Conference Series, IOP Publishing, pp.13-16.

[22] Treftz, C. Kretsch, Moyes, (2015 September) University of Nevada, Reno, Hydroponics: A brief Guide to Growing Food Without Soil, International Conference.

[23] Vikas Verma, Malempati Subhash Sri Sanjay, (2017 May) Department of Genetics and Plant Breeding, Department of Plant Pathology, Jabalpur, Madhya PradeshHydroponics: A step towards Food Security, World Congress on Food Security.

[24] Gagnon, G. Malaise-Landry, Jugnauth, F. Chazarenc and Brisson, (2010) An intro into sand culture hydroponics, Water Air & Soil Pollution, pp. 11-19.

[25] Yang Chenzhong, Huang Yinchuan and Zheng Weihong, (2018 June) Shoot and root temperature effects on lettuce growth in a floating hydroponic system, 5" World Congress on Intelligent Control and Automation, vol. 1, pp. 15-19.