ISSN: 2583-3286(Online)

IOT Based Smart Hydroponics System with Artificial Photosynthesis

Uma Sharma, Nelson Divyam Lobo, Abhilasha Mishra, Jyoti Singh
Department of Electronics & Communication Engineering, Inderprastha Engineering College, Ghaziabad, INDIA

***Abstract*—For more than 500 years the method of cultivating crops and herbs has been same with either none or a few subtle changes over years. It has always been time consuming, extremely dependent on the climate, expensive to grow, requiring a lot of human supervision, heavy use of chemical fertilizers, and making to prone to disease as well. Introducing Hydroponics, It is a concept made reality recently where the plants are grown without using soil as a medium instead the medium of nutrition is provided by a highly regulated pH liquid, this process can easily be applied to places where it environmentally unstable to grow certain plants or space and even in placeslike a green house where it is easy to control the factors like light, temperature and humidity. The main aim of this system is to have a better quality of crops, cultivating organic yield by avoiding the use of chemical fertilizers, saving precious fields for lands and most important efficiently using our water resource**

***Keywords*— Arduino , IOT, Irrigation, NFT , Photosynthesis**

I. INTRODUCTION

Internet of things (IoT) is a system that interrelates mechanical, electrical, electronics and network equipment such as computers, network switches etc… the data is transferred over the internet network without human intervention such as human to human or human to computer interaction. A network of objects, equipment, vehicles, buildings, and other devices connected to a series of electronic sensors which are integrated by a software connecting them to a network for exchanging information over the cloud. With IoT we can merge the physical world with the virtual world allowing the computer system to remotely control the physical attributes of the system over the internet to show results.

Hydroponics

Growing plants without soil is known as hydroponics. Hydroponics is a Latin word meaning "working water." Plants are grown in a soilless medium and come into contact with the nutrients in the water for their growth. Hydroponics operates on the principal as long as nutrients are providedto the plants, the plant will grow well. In other words Hydroponics is controlled growing environment by infusing nutrients in the water and keep the roots oxygenated. Nutrients have to be highly regulated to maintain the balance of pH factor, nutrients are added to the
water and moved through the plant roots at regular time intervals. The benefits of the technology it can feed the growing population by using just a fraction of the resources and capital.

Artificial Photosynthesis

The process of photosynthesis takes place during the day in presence of sunlight where the plant utilizes the pigment chlorophyll present in its leaves to convert carbon dioxide tooxygen to make its food allowing it to grow, But during the night sue to absence of sunlight the plants tend to show the opposite cycle which is converting oxygen to carbon dioxide.

Date of Submission: 01 June 2022, Accepted on 11 September 2022
Corresponding Author: Uma Sharma
(Email: uma.randev@ipec.org.in)

What if we could have the process of photosynthesis running 24x7 or for a major chunk of the day, this process is called photo morphogenesis where it is observed that the plants grow best under red and blue lights through careful nurturing. a combination of red and blue LED will be added which will be connected to the Arduino MCU allowing it to replicate the varying light intensity of the sun over a period of 24hrs, the strips are placed at a distance between 25cms to 35cms for optimum absorptionof light all while avoiding leaf burns [8]. The real time data of the transformer is acquired by using temperature sensor that will measure temperature T, potential transformer for measurement of V and one current transformer for measurement of T. Then the values of all the parameters sensed by sensors are sent to a Wi-Fi module under TCP/IP protocol to a dedicated IP that displays the real-time data in any web-connected PC / Laptop. The real- time data is also seen at the sending end LCD interfaced with the microcontroller.

II. METHODOLOGY

Nutrient Film Technique

First There are many ways to setup a hydroponic farm , But we are going to implement the NFT(Nutrient Film Technique).

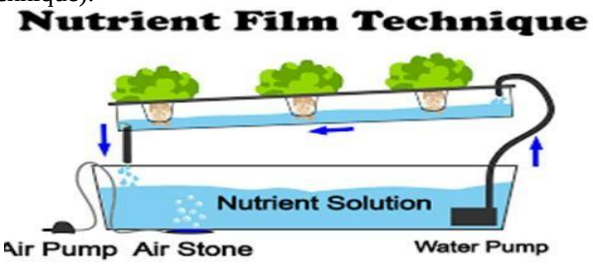

Figure. 1. Nutrient Film

The Nutrient Film Technique was created by Allen Cooper in 1965, He named the concept Nutrient film technique because the depth of recirculating pH liquid stream wasslightly shallow

ISSN: 2583-3286(Online)

so that the root of the plant has adequate amount of air exposure. The NFT also boasts a highly efficient yet simple design, A structure pipes are used and a series of plants are placed with respect to the length of the pipe , and a strictly regulated pH solution is passed through it , from one end to another and finally into the reservoir where it is re-circulated by the water pump back into the system , and by recirculating the water it displays a highly water efficient nature of this technique [6].

III. HARDWARE

ESP8266

NodeMCUESP8266 is a low-cost open source IOT platform. It initially included firmware which runs on the ESP8266 WI-FI SOC from Espress if Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32-bit MCU was added.

Node MCU was created shortly after the ESP8266 came out. On December 30, 2013, Espress if Systems began production

of the ESP8266. The firmware uses the Lua scripting language. The firmwareis based on the elua project and built on the espress if non- Oss dk for ESP8266. It uses many open-source projects, suchas lua-cjson

DHT – 11 (Digital humidity and temperature sensor*)*

Digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surroundingair and spits out a digital signal on the data pin. To provide us with real time atmospheric temperature and humidity, The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and±1%. So if anybody looking to measure in this range then this sensor might be the right choice for Application [10].

Light dependent resistor)

(LDR) is also known as light dependent resistors, are light sensitive devices most often used to indicate the presence or absence of light. In case of intrinsic LDR, these resistors are pure semiconductor devices like silicon or germanium. When the light falls on the LDR, then the electrons get excited from the valence band to the conduction band and number of charge carriers increases. In case of extrinsic LDR, these devices are doped with impurities and this impurity creates a new energy band above the valenceband. These bands are filled with electrons. Hence this decrease the band gap and small amount of energy is required in moving them. These resistors are mainly used for long wavelengths.

pH sensor

A pH sensor helps to measure the acidity or alkalinity of the water with a value between 0-14. When the pH value dips below 7, the water starts to become more acidic. And if the pH of the liquid exceeds 7 the water starts becoming basic in nature, this sensor uses a glass probe and requires and external 9volts of dc supply to operate. The pH element is a thin glass membrane that is permeable by H+ ions. The electrode is filled with a neutral solution, which by definition contains an equal number of H+ and OH- ions. When the probe is immersed in an H+ rich environment (acidic) the glass membrane is permeated by the H+ ions which exert a positive potential on the sensing electrode. This potential difference is measured by a pH meter and converted to a pH output. Likewise, when the probe is immersed in an alkaline environment there exists within the probe a higher H+ concentration than outside of the probe. This causes H+ ions within the probe to migrate outside of the probe which leaves an excess of OH- ions within the probe. A negative potential is thus sensed by the pH meter.

Moisture Sensor

Moisture Sensor uses capacitance to measure the water content of liquid (by measuring the dielectric permittivity of the liquid, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

Arduino mega

The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. In the system it is acting like the brain of the system controlling the functioning of all the components and

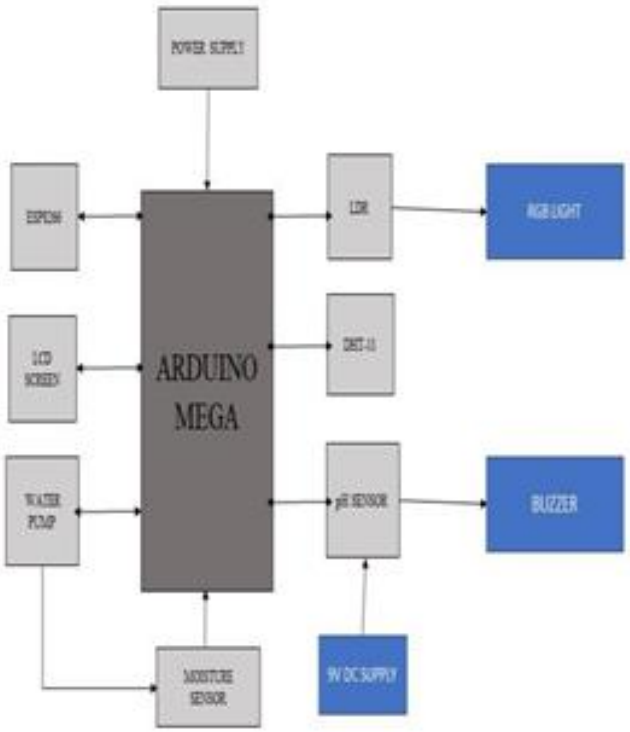

Figure. 2. Block Diagram

sensors present while sending all the real time time data recorded by the sensors to the ESP-8266 module for remote observation.

ISSN: 2583-3286(Online)

IV. SOFTWARE

1. ARDUINO IDE

Arduino IDE is a platform for syncing the code within the arduino mega where it can control and observe the various parameters from the sensor and display them, they have a collection of libraries preinstalled and the user can also install new libraries according to their sensor requirement, it is a very versatile as it can be used to code many other logic boards as long as they require embedded C to operate.

2. BLYNK(CLOUD PLATFORM)

Blynk is a versatile application used in modern day IoT projects it can be synced through a node MCU via an Arduino IDE platform , It has various predefined switches and gauges , notification bars which can be set according to the requirement of the sensor , It can be connected to various virtual pins present on a arduino where it interacts with the system via a ESP-8266 module , It is a great application as it is a free application on Google play store, app store and has predefined structure which saves valuable time in a DIY project [9].

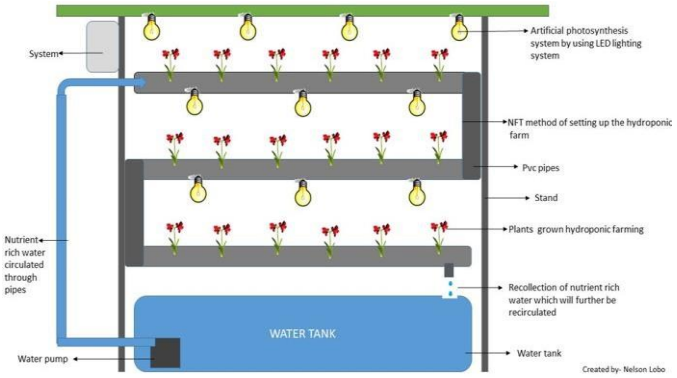

Figure. 3. Framework

created in levels the nutrient fortified water is pumped descending from the top layers to layers below as the water and nutrients are provided to the roots is passed as it flows through the various levels, the water is then collected in the water tank and re-circulated.

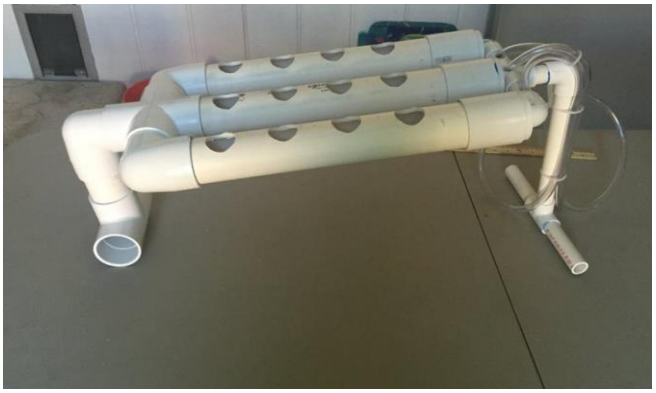

Figure. 4. Frame Hardware

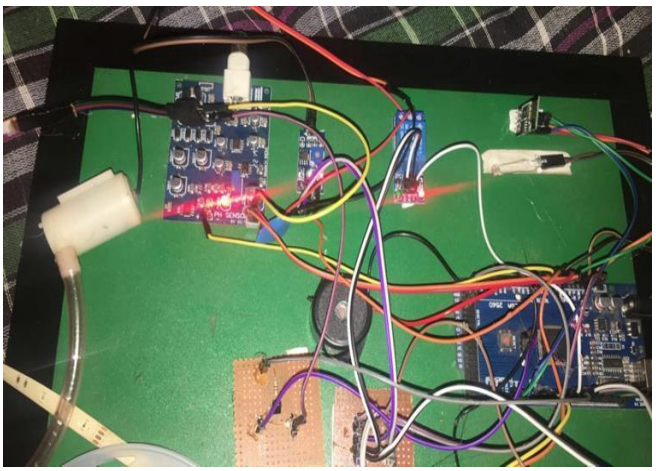

Figure. 5. Implemented Hardware

ISSN: 2583-3286(Online)

V. SYSTEM FRAMEWORK

As the Hydroponics model illustrated is the NFT, the brains of the system (Arduino) on receiving data from the sensors, creates variable program for preparing an optimum environment. The program considers the water level with quantity of nutrients considering the CO2 factor.And the hydroponics farm

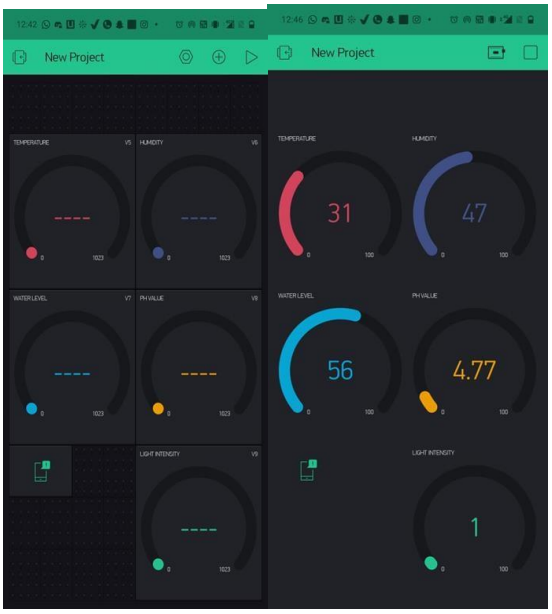

Figure. 6. Sensor Readings

The circuit diagram represents the instrument panel of the system with all the sensors attached to the Arduino and relaying data to the ESP-8266 module in real time, where the ESP-8266 module is synced with the Bylnk application displaying the values and data in the real time and notifying the user whenever there is a change in the pH level of the water that is being used for irrigation of plants Various gauges represent the various sensor readings of the BLYNK application connected via ESP-8266.

VI. CONCLUSION

One of the main research objectives was to explore the possibility of independent farming that too in a soil-less medium which had been achieved (post a picture of plants in the PVC tube in the system) Second objective was to that all the sensors were functioning accurately including the ESP-8266 module whose role was to transmit the data accurately .and the functioning of the circuit in offline modeincase the online system fails and a manual override is required. .

VII. FUTURE SCOPE

We can cultivate many green vegetable and herb using this technique making irrigation easier for the farmers. All they need to do is to monitor the crops on the regular basis on their smartphone. In future if the population increases, the requirement of food will also increase simultaneously and at that time we will have to increase the production of crops and vegetables but according to some studies more than 80 percent of cultivated land is already in use due to urbanization. on that period this IoT based hydroponic system will work as a life savior for all as ‘vertical farming’ is also possible in this technique by stacking the crops one above the other. It will help in increasing the crops yield thatcomes with smaller unit area of land requirement.

Also, in future, we can modify it at better level by syncing the artificial intelligence systems like Amazon Alexa and Google homes, which can further expand the development of this project by overseeing the the growth and make changes accordingly in the system with respect to crop requirements giving it an optimum environment for growth with a completely natural yield.

REFERENCE

[1] Resh, Howard (2004). Hydroponic Food Production. CRC Press. p. 157. ISBN 0-931231-99-X.

[2] "Archived copy". Archived from the original on 2010-11-30.
Retrieved 2010-11-30., Hydroneeds.com.au

[3] "Index of /NFT". Archived from the original on 2013-11-03.
Retrieved 2013-10-30., GVHI.co.nz

[4] Frost, Groves, and Charkowski . (2013). "Integrated Control of Potato Pajthogens Through Seed Potato Certification and Provision of Clean Seed Potatoes". Plant Disease. 97. pp. 1268–1280.

[5] Cooper, Allen (1979). The ABC of NFT. London: Grower Books. ISBN 0958673500.

[6] Merle H. Jensen, Hydroponics, Department of plant science, University of Arizona, Tuscon, AZ85721.

[7] J. Benton Jones Jr., Hydroponics, it’s a history and use in plant nutrition, Department of Hotriculutre, University of Georgia, USA,21 Nov, 2008.

[8] A review on plant without soil- Hydroponics Mamta D. Sardare1 , Shraddha V. Admane2 1, 2 Assistant Professor, MIT Academy of Engineering Alandi Pune, Maharashtra, India, March 2013.

[9] Arduino Board in the Automation of Agriculture, Jaime Cuauhtemoc Negrete1,Eugenio Romantchik Kriuskova2 International Journal of Horticulture, 2018, Vol. 8, No. 6 doi: 10.5376/ijh.2018.08.0006, March, 2018.