IoT Based Hydroponics System Using Machine Learning

Dr.Kavitha Devi.C.S.[1], Sonashree.T.R[2], Suprabha G[3],Vachanshree[4], Chaithra.A[5]
[1]*Asst. Professor, Dept of ECE, Dr.Ambedkar Institute of Technology, Bangalore, Karnataka, India*
[2,3,4,5]*UG Students, Dept of ECE, Dr.Ambedkar Institute of Technology, Bangalore, Karnataka, India*

Abstract: This project presents the development and implementation of an Internet of Things (IoT)-based 5 hydroponics system merged with machine learning algorithms. The apparatus point to optimize the growth conditions for plants by continuously monitoring and controlling various environmental requirements such as nutrient levels, pH, temperature, humidity, as well as light intensity Sensors deployed in the hydroponic setupcollect real-time details, which is then examined using machine learning models to predict the optimal conditions for different growth stages of the plants. Thesystem also features automated nutrient and water delivery mechanisms, give rise to found in contact with predictive insights to maintain ideal conditions. Additionally, the integration of IoT allows remote monitoring and control via a user-friendly interface, providing notifications and actionable insights to the user. This intelligent hydroponics system enhances crop yield, reduces resource wastage, and ensures sustainable agricultural practices, demonstrating a significantadvancement in precision agriculture.

Key Words: Hydroponics, IoT, ESP32,Machine Learning

I. INTRODUCTION

Soil is a determinate resource, meaning its loss and degradation cannot be recovered within a human lifespan. Soil is getting affected more and more due to land pollution and modern civilization which is keep on improving accommodation for their livelihood. According to United Nations Organization projects the population of the world will grow from a population of 7.7 billion in 2019 to 11.2 billion at the turn of the century. This population explosion will require humans to grow additional amount of food for survival. Degradation of soil quality, water scarcity, and increased air pollution will make our environment not suitable for traditional farming. We can overcome these environmental drawbacks by adopting hydroponics, which increases yield by consuming fewer amounts of resources. Hydroponics is widely accepted as the future of farming and is donecommercially in foreign countries. In India, Hydroponics is getting a great response, since hydroponics requires less space and uses tenfold less water than conventional soil-based farming. Hydroponics is broadly used in space research program.

II. OBJECTIVE OF THE STUDY

1. Main objective is to completely automate the process of rising plants in a system. All lightening, watering the plants to nutrient regulation is automated.As to make it simple for anybody to grow plants.
2. Hydroponic system can adjust and control important surrounding conditions that changes plant growth including Key Words: Hydroponics, IoT, ESP32,Machine Learning temperature, humidity, and water.
3. To provide real time access of the hydroponics system to user for monitoring and improving crop yield.

In this study work main focus is to plan and carry out hydroponics system by using IoT and Machine learning to completely automate the process for keep track of several conditions of crop.

III. LITERATURE SURVEY

Yamini. B, Sishnu. T and et al.,[1].An automated irrigation gadget based on microcontrollers connected to a cloud provider defined and its utility to a strawberry area is shown in comparison to its temperature, humidity, as well as light intensity. water needed for irrigation is regulated.
This was based on the water level decrease at a positive quantities of the time inside the evaporation pan utilization of choicest water amount .protects the

vegetation from now not the most effective drought pressure ,but also over – watering associates fungus and bacterial sickness. Including ,this device add android application when makes it remotely follow the current day gadget repute .with this technique possibilities of human related. Mistakes as well reversed hard work time for irrigation project are less,utilization of gadget associates statistic which has sensor values, general evaporation among successive irrigation ,irrigation date ,time & period are saved in cloud server.

Nivesh Patil, Shubham Patil et al,.[2]. Three sensorsare utilized namely pH sensor for pH level of water, DHTH for temperature & humidity &circuit meter the conductivity of water quantity. Every sensors are interfaced to Node-MCV E(SP12) which is microcontroller. This microcontroller interfaced with 3.3V power supply. Valve, pumps& dispense and being regulated by Node-N+MCU for effective functioning of technique .All this data is transmitted toa mobile app .The regulation of whole system is automated using Node MCV along with IOT, There is a manual operating permitted by mobile app by use of LAN communication in case of lost of the internet connection outcome was got by getting all informationrelated functioning system so that can be designed technique regulated

Ravi Lakshmanan, Mohamed Djama et al,.[3].The working methodology implemented described. Smart Hydroponic system include three components :Input data, cloud server and output data. Initialising by input information, IOT basically collection of things more particularly the sensors interact with each other via a network ,so a group of sensors is needed to construct IOT system ,the smart hydroponics technique made of type of sensors that gets data given below :room temperature ,room humidity ,water temperature and pH level and fertilizer quantity

Huu Cuong Nguyen ,Bich Thuy Vo Thi et al,.[4].The introduced system perform on process sensors sense data of the environment and hydroponic nutrients solution. This data is converted into digital information then processed in the signal pre-processing unit. The iot gate way has the operator of for warding these information. To cloud a webserver is implemented on a virtual server machine that gives the user interface along stores information in database. The information collected in database can be retrieved for later utilisation so like analysis, user can perform formation of pumps, fans through a mobile device to alter these criteria the control information are given to the control signal the controller well start the related actuator to on/off this regulation and signal and then the normalized data to the IoT gets commands from IoT gateways along regulate actuators.

IV. BLOCK DIAGRAM OF SYSTEM

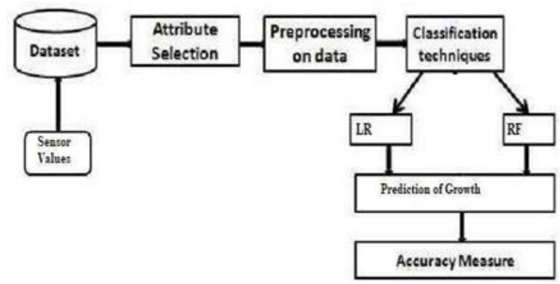

Fig 4.1: Block Diagram of Hydroponics system

Fig 4.1 Says that Hydroponics is a soil-free method of growing plants using nutrient-enriched water. In the Continuous-Flow Solution Culture, nutrients flow past the roots like a gentle stream, ensuring consistent nourishment. Automation is a breeze think of it as a high-tech cafeteria for thousands of plants! Another technique, the Nutrient Film Technique (NFT), involves a thin water channel where roots hang out. They stay moist but exposed to air, receiving a constant oxygen supply. NFT works well for fast-growing crops like herbs and lettuce. Another nifty method is the Nutrient Film Technique (NFT). Picture a super-thin water channel where plant roots hang out. This channel contains all the essential nutrients. The roots are like sunbathers they're moist but exposed to the air.

System Diagram shown below in Fig 4.2 says that, flow rates for each gully should be1litre per minute. Atplanning rates may be half this and the upper limit of 2L/min appears about the maximum. Flow rates beyond these extremes are often associated with nutritional problems. Depressed growth rates of many crops have been observed when channels exceed 12 meters in length. According to studies while oxygen level has been remaining adequate, nitrogen may be depleted over the length of the gully. When it comesto hydroponics, channel length matters. Here's the deal: Don't make your channels too long (over 12 meters). Why? Because trouble brews when they stretch too far. Instead, aim for a sweet spot—between 10 to 15 meters. Short, simple, and plant friendly! way along the gully and having the flowrates through each outlet.

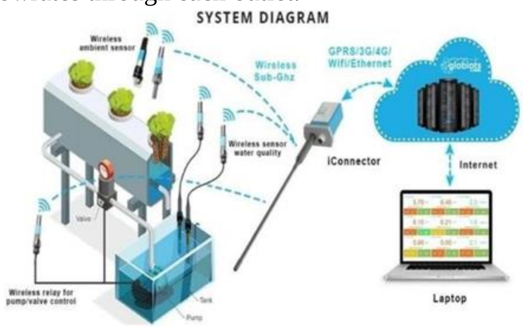

Fig 4.2:System diagram of hydroponics system

V.RESULTS

By this system we come to know that that hydroponics plants grew much faster than traditional method of growing them in potted soil, Giving them access to sunlight and watering them by hand because all nutrients solution and water in hydroponic we are adding directly to roots. The crops are pesticide free. The nutrients we use in our project are food grade and are healthy to consume. Plants grown hydroponically will mature on average 25% faster and deliver up to 30% greater yield than plants grown in soil.

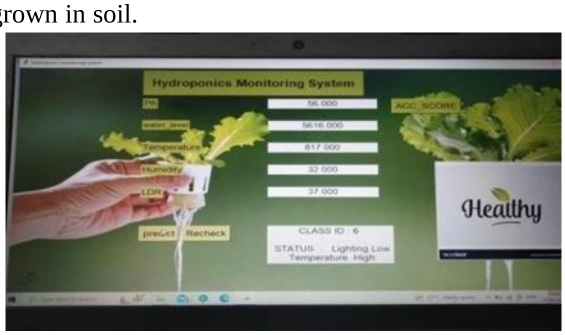

Fig 5.1:Showing plant growth parameters along with plant healthy status

Above Fig 5.1 Says that In an IoT-based hydroponics system, machine learning can analyze parameterslike pH, water level, temperature, humidity, and light intensity (LDR) to ensure optimal plant health. By continuously monitoring and adjusting these factors, the system maintains ideal growing conditions, preventing stress and promoting robust growth. This results in healthier plants, increased yield, and more efficient resource usage.

VI. FUTURE SCOPE

1. Enhanced Crop Management Disease and Pest Detection: Use image recognition and sensor data to detect diseases or pest infestations early.
2. Phenotyping: Analyze plant traits and growth responses to different conditions to select optimal varieties and growth strategies.
3. Machine learning can identify anomalies in plant growth or system performance, allowing for quick intervention.
4. Educational and Research Opportunities Research: Facilitate research into optimal growing conditions.

REFERENCES

[1]. Yamini. B, Sishnu. T, Vikash. V " Machine Learning System On Plant Growth Using Aquaculture" Volume: 06 Issue: 03 | Mar 2019, e-ISSN: 2395-0056

[2].Nivesh Patil, Shubham Patil, Animesh Uttekar, A.R. Suryawanshi "Monitoring of Hydroponics System using IoT Technology" Volume: 07 Issue: 06 | June 2020 e-ISSN: 2395- 0056.

[3].Ravi Lakshmanan, Mohamed Djama, Sathish Kumar Selvaperumal, Raed Abdulla "Automated smart hydroponics system using internet of things" Vol. 10, No. 6, December 2020, pp. 6389~6398.

[4].Huu Cuong Nguyen , Bich Thuy Vo Thi, Quang Hieu Ngo "Automatic Monitoring System for Hydroponic Farming :IOT Based Design and Development" Volume 12,Issue 3(2022):210- 219.

[5].Vibhu Sharma, Dr. V.K Srivastav " Iot & Artificial Intelligence Based Automated Smart Hydroponics System" | Volume 11, Issue 1 January 2023 | ISSN: 2320-2882.

[6].Anirban Jyoti Hati , And Rajiv Ranjan Singh "AI-Driven Pheno-Parenting: A Deep Learning Based Plant Phenotyping Trait Analysis Model on a Novel Soilless Farming Dataset" Volume 11, 2023,doi:10.1109/ACCESS.2023.3265195.

[7]. Sonali Jadhav, Prof. S. D. Jawale "A Review On Hydroponic Plant Without Soil"| Volume 11, Issue 4April 2023 | ISSN: 2320-2882.

[8]Shrestha Sanchaya ,Ms Saritha S R , Mr Bhaskar A, Tesfaye Leul , Thapa Anushri , Agrawal Subham , Jaju Anish "Research On Hydroponics Farming " Vol4, no 4, pp 825-832 April 2023.

[9].Nurten Buluta, Mehmet Hacibeyoglub

“Hydroponic Agriculture with Machine Learning and Deep Learning Methods” vol. 9, no. 3, pp.508-519, doi:10.30855/gmbd.0705083.October 2023.

[10] Ms. Ingole Preeti , Ms. Wayal Sayali , Ms. Nanaware Paya , Ms. Snehal Sabale “Hydroponic Monitoring System Using Iot” Vol 5, no 4, pp 7884-7891 April 2024.

[11]N. C. Eli-Chukwu, "Applications of Artificial Intelligence in Agriculture: A Review," Engineering, Technology & Applied Science Research, vol. 9, no.4, pp. 4377–4383, Aug. 2019.

[12]Y. Jiang and C. Li, ‘‘Convolutional neural networks for image-based high- throughput plant phenotyping: A review,’’ Plant Phenomics, vol. 2020,Jan. 2020,Art. no. 4152816.

[13]N. S. Pezol, R. Adnan, and M. Tajjudin, "Designof an Internet of Things (Iot) Based Smart Irrigation and Fertilization System Using Fuzzy Logic for Chili Plant," in 2020 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Shah Alam, Malaysia, Jun. 2020, pp. 69–73.

[14].Z. Li, R. Guo, M. Li, Y. Chen, and G. Li, ‘‘A review of computer vision technologies for plant phenotyping,’’ Comput. Electron. Agricult., vol. 176,Sep. 2020, Art. no. 105672.

[15] A. H. Blasi, M. A. Abbadi, and R. Al-Huweimel, "Machine Learning Approach for an Automatic Irrigation System in Southern Jordan Valley," Engineering, Technology & Applied Science Research, vol. 11, no. 1, pp. 6609 6613, Feb.2021.

[16]X. Jin, P. J. Zarco-Tejada, U. Schmidhalter, M.P. Reynolds, M. J. Hawkesford, R. K. Varshney, T. Yang,C. Nie, Z. Li, B. Ming,Y. Xiao, Y. Xie, and S. Li, ‘‘High- throughput estimation of crop traits: A review of ground and aerial phenotyping platforms,’’ IEEE Geosci.Remote Sens. Mag., vol. 9, no. 1, pp. 200–231, Mar. 2021.

[17] A. J. Hati and R. R. Singh, ‘‘Smart indoor farms: Leveraging technological advancements to power a sustainable agricultural revolution,’’ Agri Engineering, vol. 3, no. 4, pp. 728–767, Oct. 2021.

[18] S. A. B. Anas, R. S. S. Singh, and N. A. B. Kamarudin, "Designing an IoT Agriculture Monitoring System for Improving Farmer’s Acceptance of Using IoT Technology," Engineering, Technology & Applied Science Research, vol. 12, no. 1,pp. 8157–8163, Feb. 2022.

[19]G. Kaur, P. Upadhyaya, and P. Chawla, "IoT Based Mobile Application for Monitoring of Hydroponic Vertical Farming," in 2022 10th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), Noida, India, Jul. 2022, pp. 1–4.

[20] T. Diwan, G. Anirudh, and J. V. Tembhurne, ‘‘Object detection using YOLO: Challenges, architectural successors, datasets and applications,’Multimedia Tools Appl., vol. 82, no. 6, pp. 9243– 9275, Mar. 2023.

[21] A. Shrivastava, C. K. Nayak, R. Dilip, S. R. Samal, S. Rout, and S. M. Ashfaque, "Automatic robotic system design and development for vertical hydroponic farming using IoT and big data analysis," Materials Today: Proceedings, vol. 80, pp. 3546–3553, Jan. 2023