IOT BASED ORGANIC FARMING BY USING AQUAPONICS METHOD

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Abstract

As the population grows, the food production in India increases results in the use of high synthetic fertilizers and chemicals. In our project "IoT based organic farming by using aquaponics method" we proposed a solution of organic farming to reduce the use of pesticides. The main goal is to create plant growth by combining hydroponics with aquaculture. Aquaponics – Aquaculture and traditional hydroponics are combined in order to create an innovative and sustainable system to promote the growth of terrestrial plants as well as aquatic life. The correct implementation of aquaponics helps in providing organic foods with low consumption of water and pesticides. For better management we integrate IOT and smart sensing systems for monitoring and controlling the operations and also it helps to mitigate production times, reduce the need for labor to manage systems and improves product quality. The Node MCU used to connect over the internet to monitor the aquaponic environment. The DTH11 Module is used to measure the temperature and humidity and the water level is measured using ultrasonic water level sensors. The blynk app where we can see the conditions to monitor and control the operations of the plant bed.

Keywords— *Organic farming, Aquaculture, Smart Agriculture, IOT, Sensor Networks, Real Time Monitoring.*

I. Introduction

IoT-based organic farming using the aquaponics method represents a cutting-edge approach to sustainable agriculture. In this innovative system, the Internet of Things (IoT) technology is seamlessly integrated with aquaponics, a closed-loop ecosystem that blends soilless plant production with fish breeding (aquaculture). Aquaponics takes advantage of the fish and plant symbiosis, in which fish waste supplies vital nutrients for plant growth and the plants help to filter the fish's water. This system is improved by IoT technology, which uses real-time monitoring and control of a number of parameters, including temperature, fertilizer levels, water quality, and more. Through sensors and automation, IoT ensures optimal conditions for both fish and plants, maximizing yield and minimizing resource usage. Farmers can remotely monitor and adjust these parameters using smartphones or computers, enhancing efficiency and reducing the need for constant physical oversight. The benefits of IoT- based organic farming in aquaponics include increased crop yields, reduced water consumption, minimized chemical usage, and the ability to grow organic produce in a controlled and sustainable manner. This innovative approach holds great promise for addressing food security and environmental challenges in an increasingly urbanized world. It is the suitable platform for our aquaponics environment. Blynk is a versatile platform that makes it easier for IoT enthusiasts and developers to create mobile apps and connect them to their hardware projects, enabling remote control and monitoring of IoT devices. The third section outlines the hardware components of the aquaponics method. This includes the nodemcu acting as the central processing unit or a microcontroller, DC motors with encoders for motion control (pumping water in tank), ultrasonic sensors for measuring the distance of water in a tank, for measuring the temperature and humidity we use DHT11 sensor. Section four presents the software architecture of the aquaponics method. It is the suitable platform for our aquaponics environment. Blynk is a versatile platform that makes it easier for IoT enthusiasts and developers to create mobile apps and connect them to their hardware projects, enabling remote control and monitoring of IoT devices. IoT-based organic farming using the aquaponics method represents a promising and sustainable approach to modern agriculture. This innovative system integrates technology, automation, and real-time monitoring to optimize resource utilization and ensure the health and productivity of both plants and fish. By leveraging IoT devices and data analytics, farmers can achieve greater control over their operations;reduce resource wastage, and ultimately produce high-quality, organic crops in an environmentally friendly manner. As we look to the future, the continued development and adoption of IoT in organic aquaponics farming hold the potential to address food security challenges and contribute to a more sustainable and resilient agricultural system.

II. LITERATURE SURVEY

1. Michael Carl Straight and Jonathan Henry Beecher Cotton (2017) have studied the container with a greenhouse mounted above the tank. In the green house, plants are grown, and fish are raised in the tank. Water values, fish feeders, temperature, and water flow measurements are all customized by different sensors that are controlled by a processor. The sensors are powered by renewable energy sources like solar energy. Rainfall satisfies the system's water needs.

2. Masaharu Hori (2019) studied that the rearing and cultivation of plants are being done, as well as the rearing of fish and shellfish. In this, a plant can be grown in The cultivation bed and fish and shellfish can be raised in the rearing tank. Here, water is moved from the tank to the cultivation bed.

3.Kwangjin Kim (2021), studies that relate to a hydroponics system that uses aquaponics. Here,fish are raised in a bowl, and plants are grown on a cultivation plate that is located on the upper side of the fish bowl. The fish waste in the fish bowl provides the nutrients for the plants. The fish waste is broken down and pounded into the cultivation plate. The pipe's water level is managed.

4.Lee Jung-ho(2021) has studied the aquaponics cultivation system discussed in this paper relies on bio floc technology and a small filter. Using this technology, we can create a pesticide- and antibiotic-free aquaculture system that can grow fish and plants simultaneously without the use of artificial nutrients or water exchanges.

5.Lee Dong-hun(2021) studied a low pH aquaponics system that uses microorganisms to combine independent and heterotrophic nutrients when growing plants and marine life. By simultaneously increasing ammonia and nitrate, this system lowers facility costs while maintaining plant productivity without affecting the productivity of marine organisms.

6.N Hari Kumar et al (2019), It has been discovered that aquaponics systems can function as self-regulating systems with the aid of wireless sensor networks that use the 6LoWPAN open-source WSN protocol. This sensor-based system can be used to sense and gather data on the water quality in question, and the corresponding information can be saved in a cloud database. When compared to the conventional method, this technology requires a lot less human engagement.

7. Megumi U et al (2018) have found that using the aquaponics concept, we can grow plants in small spaces. Vegetables are grown primarily indoors in the VEGALAB system, which helps to solve certain fundamental problems like high production costs, constrained growth, and poor food quality.

8.Wang et al (2021), the Smart Monitoring and Control System Based on OpenWrt was proposed, and it makes assumptions regarding flow meters, pH, ultrasonic range finders, and digital temperature sensors, as well as the fundamentals of signal conditioning and closed loop control. The data that are gathered by a webcam and a few smart sensors are examined and processed for the man-machine interface in this intelligently interactive application. Users can also remotely monitor and manage the smart aquaponics using a mobile terminal in the meantime. The hardware comprises an Arduino board and a WRTnode device, the latter of which is based on the open source development board hardware known as the Wi-Fi AP. In Automated Indoor Aquaponics Cultivation Technique, 30% crude protein created by fish waste can offer nearly all of the nutrients needed for plant growth, according to research by M.F. Saaid et al. To maintain the development and survival rates of the fish, the system uses an auto feeder to deliver food to the fish. The system's built-in filter will take out the waste and broken-down elements from the water.

9.Rodrigo S et al (2020), developed a cost-effective and more perfect for society automated solar-powered aquaponics system. There are four modules in the system that was created: Two systems: a water recirculation system and an aquaponics control and monitoring system that uses an Arduino microcontroller coupled with sensors, actuators, a GSM shield, and NI LabVIEW to enable the coexistence of fish and plants in a managed environment. The system is entirely powered by solar energy. HVAC systems that regulate air and water temperatures for the benefit of plants and the development of fish.

10. N.R. Mohamad et al (2021), It was discovered that the aquaponics system uses a solar-powered control pump, which is made up of a solar panel that produces energy from the sun and is utilized to operate an air and water pump utilizing a peripheral interface control system. The system, which consists of the water pump, air pump, inverter, and solar panel, also integrates the electrical, electronic, and agricultural components. Electricity will be produced using solar panels. The aquaponic system's microcontroller is also utilized to regulate the water pump's on/off switch, battery charging, and discharge status.

ii. Theory Of Problem

A. Problem Definition

As the population grows the food production increases, For greater food output results in use of more pesticides, In this project we propose an IOT based organic farming by using aquaponics method. The main aim is to create plant growth by integrating aquaculture with hydroponics to limit the use of pesticides.

III.AIM OF THE PROJECT

In this project we propose an IOT based organic farming by using aquaponics methods. The main aim is to create plant growth by integrating aquaculture with hydroponics to limit the use of pesticides. Aquaponics – Aquaculture and traditional hydroponics are combined in order to create an innovative and sustainable system to promote the growth of terrestrial plants as well as aquatic life. The correct implementation of aquaponics helps in providing organic foods with low consumption of water and pesticides. For better management we integrate IOT and smart sensing systems for monitoring and controlling the operations and also it helps to mitigate production times, reduce the need for labor to manage systems and improve product quality.

Hardware And Software Required:

- Node MCU
- DHT11 Module
- Ultrasonic water level sensor
- DC Pumping motor
- Relay
- OLED display

IV. IMPLEMENTATION AND WORK

A. Hardware Architecture:

This theme demands certain devices such as ESP node mcu, DTH11 sensor, Ultrasonic sensor, DC pumping motor,Relay, Arduino software, IoT Cloud Technology. An ESP8266 based microcontroller called Node MCU has Wi-Fi and Bluetooth builtin. It enables us to program the ESP8266 Wi-Fi module using the Arduino IDE.DC Pumping Motor Utilizing power from a motor, battery, or solar panel, direct current pumps can move fluid in a variety of ways. It is used to move water back and forth from a plant to a fish tank. Relay It is an electrical switch that uses an electromagnet for operation. The microcontroller's independent low power source turns on the electromagnet. For controlling the DC pumping motor.Output Devices Here, an OLED display and the Blynk App are the two output kinds being employed. When using NodeMCU, output is displayed in the Blynk App, which is utilized to handle things as needed. DTH11 Module The temperature and humidity of the aquaponics environment are sensed and measured using it. 0 to 50 degrees Celsius is the temperature range. range of humidity: 20% to 90% Ultrasonic Sensor An ultrasonic sensor is a piece of equipment that measures the distance to a target item with ultrasonic sound waves and converts the sound that is reflected back into an electrical signal. It is used to determine the water level in the fish tank.

B. Software Architecture :

The Software Architecture of the aquaponics is Presented In Section Microcontroller programming:The microcontroller we use here in ESP8266 which is programmed in Embedded C programming language. Arduino IDE is used for programming and uploading the code. Arduino Software-Connect to a device over the internet and exchange data with it using the Arduino software. Our system's measurements and current status are communicated to the Blynk App, where the local server gets it and transmits it to our phone so the user can make any necessary adjustments.

Step-By-Step Process:

1. System Design and Setup: The first step in implementing IoT-based organic farming using aquaponics is designing and setting up the system. This involves constructing the aquaponic grow beds, fish tanks, and plumbing infrastructure. IoT sensors and actuators are strategically placed to monitor and control key parameters.

2. Sensor Integration: IoT sensors are integrated into the aquaponic system to collect data on various parameters. These sensors measure water temperature, pH levels, dissolved oxygen, ammonia levels, and nutrient concentrations. The data is transmitted wirelessly to a central control system.

3. Central Control Hub: A central control hub serves as the brain of the IoT-based aquaponics system. It receives data from the sensors and processes it in real-time. Based on predefined thresholds and algorithms, the control hub can trigger actions such as adjusting water flow rates, activating aerators, or sending alerts to farmers.

4. Data Storage and Analytics: All collected data is stored in a centralized database for historical analysis. IoT-based aquaponic systems generate large volumes of data, which can be leveraged for insights. Data analytics tools are used to identify patterns, trends, and correlations that can inform decision-making.

5. Smartphone App and Web Interface: To facilitate remote management and monitoring, a smartphone app and web interface are developed. These user-friendly platforms allow farmers to access real-time data, receive notifications, and control system parameters from their mobile devices or computers.

6. Automated Nutrient Management: Nutrient management is critical in aquaponics. IoT technology is used to automate the dosing of nutrients into the system based on plant requirements. This ensures that plants receive the necessary nutrients for optimal growth.

7. Sustainability Practices: To align with organic farming principles, sustainable practices are integrated into the methodology. These include using organic fish feed, minimizing water wastage, and adopting energy-efficient components in the IoT system.

8.Continuous Monitoring and Maintenance:

Regular monitoring and maintenance are essential for the smooth operation of the aquaponic system. IoT-based sensors continuously monitor parameters, while automated alerts prompt farmers to take corrective actions when needed.

IoT-based organic farming using the aquaponics method offers a promising path towards sustainable and efficient agriculture. The objectives of this approach include sustainable food production, real-time monitoring and control, resource efficiency, data-driven decision-making, and remote management. The methodology involves system design, sensor integration, central control, data storage and analytics, user-friendly interfaces, automated nutrient management, sustainable practices, and ongoing monitoring and maintenance. By embracing this innovative approach, we can harness the power of IoT to revolutionize organic farming and contribute to a more sustainable and food-secure future.

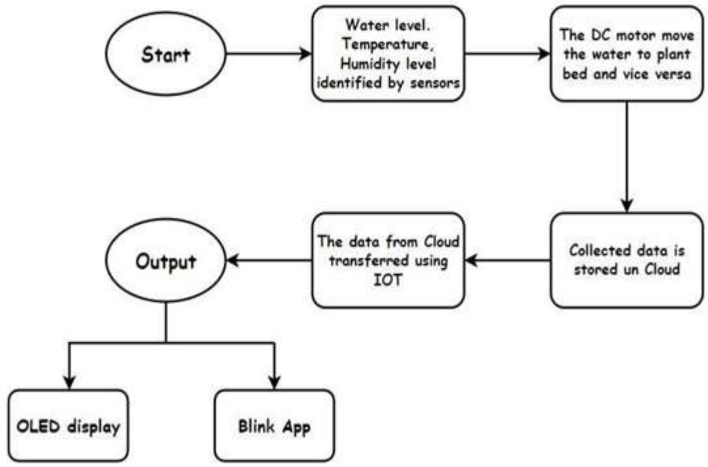

Figure 1.block diagram of aquaponics method.

V.RESULT AND DISCUSSION

Workflow :

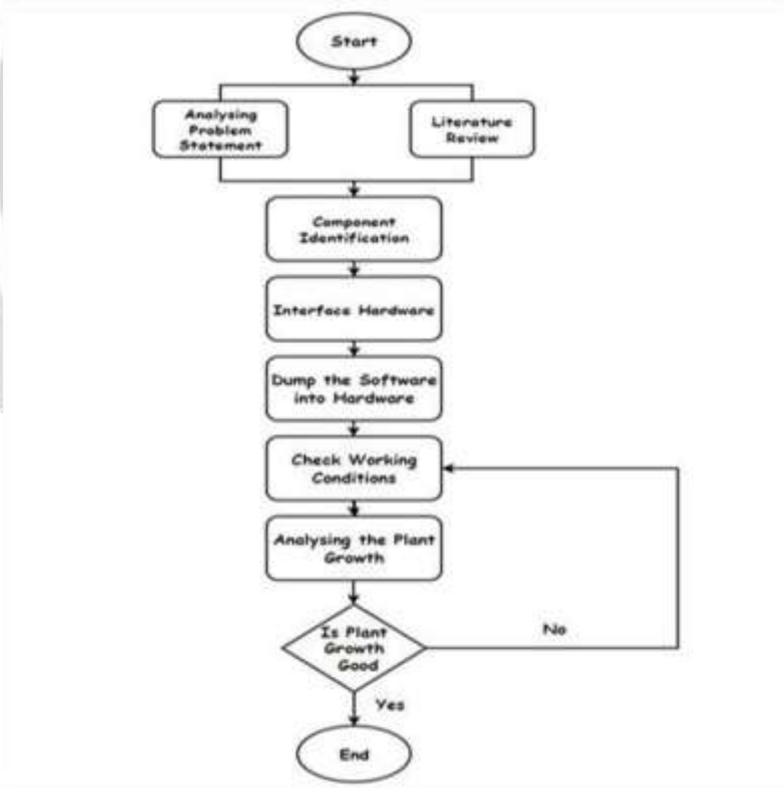

Figure 2.flow chart

Dashboard:

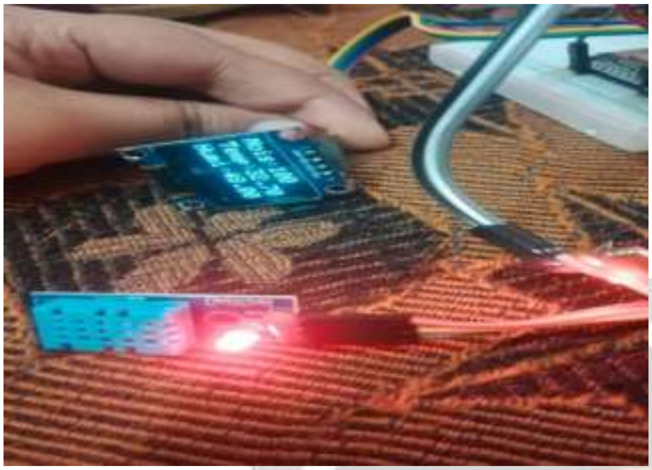

Figure 3.output of the hardware

Figure 4. Output of the software

BENEFITS OF AQUAPONICS

In recent years, there has been a growing interest in sustainable agriculture practices, with a particular focus on organic farming methods. Among these methods, aquaponics stands out as a promising approach that combines aquaculture and hydroponics, enabling the cultivation of both fish and plants in a symbiotic environment. To further enhance the efficiency and sustainability of aquaponics, the integration of Internet of Things (IoT) technology has gained traction. This article explores the objectives and methodology of implementing IoT-based organic farming using the aquaponics method, aiming to maximize productivity while minimizing environmental impact.

1. Sustainable Food Production:
The primary objective of implementing IoT-based aquaponics is to achieve sustainable food production. By creating a closed-loop ecosystem that efficiently utilizes water and nutrients, we can grow organic vegetables and raise fish with minimal waste. This approach reduces the environmental footprint of agriculture and ensures a consistent supply of fresh, healthy produce.

2. Real-Time Monitoring and Control:

IoT technology allows for real-time monitoring and control of various parameters within the aquaponic system. This includes water quality, temperature, pH levels, and nutrient concentrations. By maintaining optimal conditions, we aim to maximize plant and fish growth, leading to higher yields and healthier produce.

3. Resource Efficiency:
Efficient resource utilization is a key objective in IoT-based aquaponics. By closely monitoring resource inputs such as water and energy, we can minimize waste and reduce operational costs. Additionally, optimizing nutrient cycling within the system reduces the need for external fertilizers.

4. Data-Driven Decision-Making:
IoT sensors and data analytics enable data-driven decision-making. The collected data can be used to identify trends, detect anomalies, and make timely adjustments to the aquaponic system. This ensures that the farm operates at peak efficiency and can adapt to changing environmental conditions.

5. Remote Management:
IoT-based aquaponics systems can be remotely managed and controlled through smartphone apps or web interfaces. This objective aims to provide farmers with flexibility and convenience in managing their farms, allowing them to respond to system issues or make adjustments from anywhere.

VI.CONCLUSION

The combination of hydroponics and aquaculture, supported by IoT technology, results in organic farming and eco-friendly agricultural practices. IoT enabled systems allow farmers to remotely monitor and manage their aquaponics setups. Sothe wastage of resources will be reduced. We can create organic foods in the house itself without using any kind of fertilizers. It doesn't need more water because we haven't used much more soil. It will be more useful to save the water also. After raising the fish, you can sell it and make money and use this money to upgrade the garden. Overall this system enables efficient resource management and optimization, leading to reduced waste and better crop yields.In conclusion, IoT-based organic farming using the aquaponics method represents a promising and sustainable approach to modern agriculture. This innovative system integrates technology, automation, and real-time monitoring to optimize resource utilization and ensure the health and productivity of both plants and fish. By leveraging IoT devices and data analytics, farmers can achieve greater control over their operations; reduce resource wastage, and ultimately produce high-quality, organic crops in an environmentally friendly manner. As we look to the future, the continued development and adoption of IoT in organic aquaponics farming hold the potential to address food security challenges and contribute to a more sustainable and resilient agricultural system.

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