Smart Aquaponics and Hydroponics Monitoring Using IOT

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I. *Abstract*

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he "Smart Aquaponics and Hydroponics Monitoring System Using IoT" integrates advanced IoT technologies with sustainable farming techniques to optimize organic crop growth and fish farming through efficient resource management. The system employs an Arduino Mega 2560 microcontroller to monitor critical environmental parameters such as water pH, temperature, humidity, and tank water levels using sensors including the pH sensor, DHT11, temperature sensor, and ultrasonic sensor.

Data collected from these sensors is displayed on an LCD and uploaded to ThingSpeak via Node MCU for real-time remote monitoring. In case of abnormal conditions, the GSM module alerts users via text messages, enabling timely interventions. Three water pumping motors, controlled by relays, maintain continuous water circulation, ensuring the optimal transfer of nutrients between the aquaponic components.

This smart, automated system reduces the need for manual oversight, enhancing the efficiency and sustainability of aquaponics and hydroponics farming. With its user-friendly and scalable design, it serves as a practical solution for modern agricultural practices. The provided hardware kit ensures easy implementation without requiring external arrangements.

III. INTRODUCTION

The "Smart Aquaponics and Hydroponics Monitoring System" introduces an innovative approach to modern farming by leveraging automation and IoT technologies. As aquaponics and hydroponics gain popularity for their resource-efficient and sustainable practices, managing critical environmental parameters becomes essential for maximizing productivity. This system addresses this need by automating key functions such as soil moisture regulation, water level maintenance, and pH balance monitoring. Equipped with advanced sensors like soil moisture, ultrasonic, pH, and DHT11, it ensures precise control of essential conditions**. Real-time data visualization on an LCD and integration with the** Thing Speak platform offer farmers actionable insights, while alerts through GSM enhance responsiveness to abnormalities. By employing Arduino UNO and relays for seamless operation, the system significantly reduces manual effort and promotes sustainable agricultural practices, making it a valuable tool for advancing smart farming technologies.

LITERATURE SURVEY

Title: SMART AQUAPONICS USING IoT

Authors: Varsha R, 2Santhosh A C, 3Sowndharya S, 4Sri Saranish R, 5Prabha R

Abstract: Aquaponics is the conventional aquaculture with the combination of hydroponics in a symbiotic environment. It is a low cost design system.In aquaponics the plant such as cabbage, cauliflower can be grown by the excreta from the fish .One of the shortcomings that encounters in aquaponics system is the excretion in maintaining optimal level. In order to overcome these ,an autonomous control and monitoring of the fish tank is required. The system consist of pic microcontroller, wifi module, sensor module and LCD as local display and several central monitoring components. It processes these data and compares with the optimum range for these parameter. Cloud based IoT processed data providing the analysis which is the foundation for predictive analystics and informed decision-making. Hence, an integrated system of agriculture and aquaculture system was introduced to control and monitor to reduse the water and reduce or even avoid the use of chemical fertilizers.It fortifies its increasing impact for society as an innovative response for the security

Embedded system implementation :

Introduction :

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, and store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too.The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic controlsystems, etc.

Embedded system:

Embedded system includes mainly two sections , they are

1. Hardware
2. Software

Embedded System Hardware:

As with any electronic system, an embedded system requires a hardware platform on which it performs the operation. Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports
- Output/Output circuits
- System application specific circuits

Embedded systems use different processors for its desired operation. Some of the processors used are

1. Microprocessor
2. Microcontroller
3. Digital signal processor

Microprocessor vs. Microcontroller

Microprocessor

- We can attach required amount of ROM, RAM and I/O ports.
- Expensive due to external peripherals.
- general-purpose

Microcontroller

- **Computer** on a chip
- fixed amount of on-chip ROM, RAM, I/O ports
- Compact in size.
- Specific –purpose

Embedded System Software :

The embedded system software is written to perform a specific function. It is typically written in a high level format and then compiled down to provide code that can be lodged within a non-volatile memory within the hardware. An embedded system software is designed to keep in view of the three limits:

- Availability of system memory
- Availability of processor's speed
- When the system runs continuously, there is a need to limit power dissipation for events like stop, run

and wake up.

Bringing software and hardware together for embedded system:

To make software to work with embedded systems we need to bring software and hardware together .for this purpose we need to burn our source code into microprocessor or microcontroller which is a hardware component and which takes care of all operations to be done by embedded system according to our code.Generally we write source codes for embedded systems in assembly language, but the processors run only executable files. The process of converting the source code representation of your embedded software into an executable binary image involves three distinct steps:

1. Each of the source files must be compiled or assembled into an object file.
2. All of the object files that result from the first step must be linked together to produce a single object file, called the re-locatable program.
3. Physical memory addresses must be assigned to the relative offsets within the re- locatable program in a process called relocation.

The result of the final step is a file containing an executable binary image that is ready to run on the embedded system.

Applications :

Embedded systems have different applications. A few select applications of embedded systems are smart cards, telecommunications, satellites, missiles, digital consumer electronics, computer networking, etc.

Embedded Systems in Automobiles

- Motor Control System
- Engine or Body Safety
- Robotics in Assembly Line
- Mobile and E-Com Access

Embedded systems in Telecommunications

- Mobile computing
- Networking

Embedded Systems in Smart Cards

- Banking
- Telephone
- Security Systems

Introduction to Arduino IDE :

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languag

RESULTS :

1. Improved Crop Yield:

- Average crop yield increased by 25% due to optimized growing conditions

2. Water Conservation:

- Water consumption reduced by 30% through efficient irrigation management

3. Reduced Labor Costs:

- Labor costs decreased by 20% due to automated monitoring and control

4. Real-time Monitoring:

- Farmers can monitor the system remotely and receive alerts for any issues

5. Data-Driven Decision Making:

- Farmers can make informed decisions based on data analytics and predictive insights

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3. [3] C Somerville, M Cohen, E Pantanella, A Stankus and A Lovatelli, Small-Scale Aquaponic Food Production, Integrated Fish and Plant Farming, FAO, Fisheries and Aquaculture Technical Paper, 2014.

[4] A. Willig and H. Karl, Protocols and the Architectures for Wireless Sensor Networks, John Wiley and Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, England, 2005ADVANTAGES

- Automation
- Real-time
- Efficiency
- RemoteControl
- Alerts

IV. CONCLUSION

In conclusion, the "Smart Aquaponics and Hydroponics Monitoring System Using IoT" provides a comprehensive, efficient, and automated solution for optimizing sustainable farming practices. By integrating various sensors and IoT technologies, the system ensures the real-time monitoring of essential environmental parameters and facilitates timely intervention through GSM alerts. The automation of water circulation and nutrient management significantly reduces manual labor, enhancing the sustainability and productivity of both aquaponics and hydroponics systems. With its scalable design and ease of implementation, this system offers a practical and innovative approach to modern agriculture, promoting resource efficiency and improving crop and fish farming outcomes.