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IoT Based Aquaponics System

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ABSTRACT —

The incorporation of net of things (IoT) era into aquaponics has revolutionized sustainable farming practices by allowing precise monitoring, automation, and facts-pushed control. This paper highlights an IoT-enabled aquaponic system that integrates aquaculture (fish rearing) with hydroponics (soilless plant cultivation) in a closed-loop setup. the usage of IoT sensors, critical elements which includes water temperature, pH ranges, dissolved oxygen, ammonia attention, and humidity are monitored to preserve most suitable environments for fish and flowers.

Keywords – IoT, Aquaponics, Monitoring, NFT , Nutrients

I. INTRODUCTION

Aquaponics represents an eco-aware and present day farming technique that combines aquaculture, the elevating of fish, with hydroponics, the cultivation of plant life with out soil. This gadget is based on a symbiotic cycle wherein fish waste affords vitamins for plants, even as the plant life clear out and purify the water, returning it to the fish tanks. IoT generation enhances this method with the aid of using sensors, actuators, and cloud-based totally absolutely platforms for real-time records evaluation, computerized changes, and environmental tracking. This integration minimizes human intervention at the same time as ensuring unique, green, and scalable operations for aquaponics structures. Aquaponics structures are widely labeled into three number one designs: Media-based systems, Raft structures, and Nutrient movie technique (NFT) structures. moreover, advanced designs inclusive of Hybrid and Vertical Aquaponics systems have been evolved to maximise efficiency and cope with precise demanding situations.

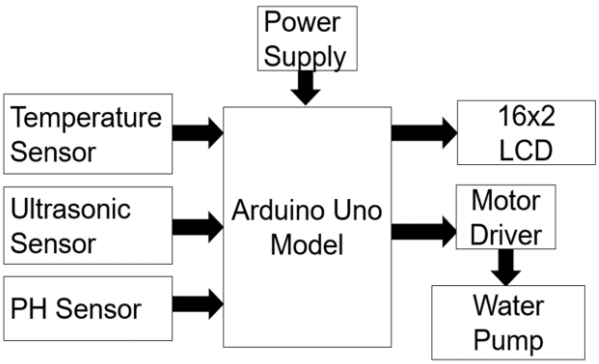

Fig. No.: 1 Block Diagram of System

1. Temperature Sensor: Measures the ambient temperature. Sends the temperature data to the Arduino UNO module for processing.

2. Ultrasonic sensor: Used measuring distance or liquid levels, possibly to monitor the water level in a tank. Provides distance data to the Arduino UNO module.

3. PH Sensor: Measures the pH degree of water or soil, indicating its acidity or alkalinity. Sends the pH statistics to the Arduino UNO module.

4. Arduino UNO Module: The central control unit of the system. Processes data from all connected sensors and decides the actions (e.g., turning on/off the water pump). Sends processed data to the 16×2 LCD Display for visualization.

6. Water Pump: Controlled by the Arduino UNO. Turns on or off based on sensor inputs (e.g., low soil moisture or low water level).

7. 16×2 LCD Display: Displays the sensor readings and system status (e.g., tempera ture, pH, moisture levels).

8. **Power Supply:** Provides power to all components, including the Arduino, sensors, water pump, and LCD display.

II. ALGORITHM

Step 1: Check water level by ultrasonic sensor.

Step 2: If water is out of range, then refill the fish tank through water pump.

Step 3: Detect the pH and display.

Step 4: The temperature sensor is used to detect the temperature of the surroundings for good health of fishes.

Step 5: Send all data on IOT through wi-fi.

Step 6: And display on LCD all the parameters respectively.

Step 7: Repeat the step 1 to 6.

III. FLOWCHART

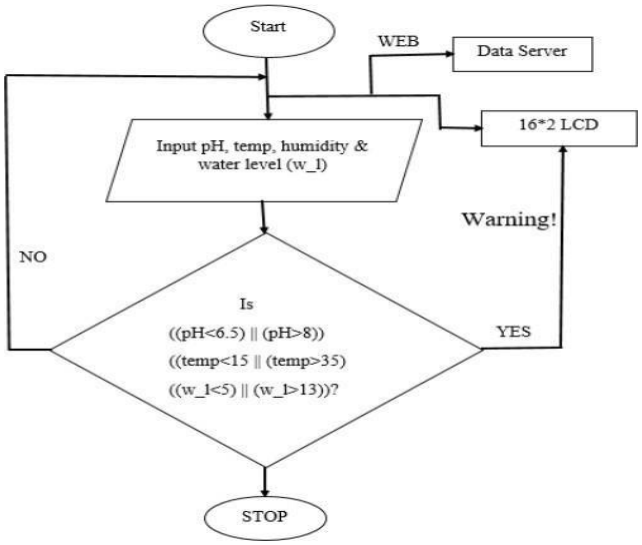

Fig. No. : 2 Flowchart Of System

III.1 COMPONENTS

- **Power Supply:** Provides the necessary electrical power to the entire system. Typically provides 5V or 12V regulated DC power to Arduino and sensors.
- **Arduino:** The central controller or brain of the system. An open-source microcontroller platform (like Arduino Uno or Mega) that reads data from sensors and controls actuators (e.g., LCD, motor driver). It processes sensor data, makes decisions (e.g., when to turn on/off pump), and displays readings on the LCD.
- **Temperature Sensor:** The temperature of the water is measure by temperature sensor. Common choices are DS18B20 (digital) or LM35 (analog). Ensures optimal water temperature for fish and plant health.
- **Ultrasonic Sensor:** Measures water level in the tank. Uses sound waves to detect distance (e.g., HC-SR04). Ensures the tank has adequate water level; helps automate refilling if needed.
- **pH Sensor:** On display shows the acidity or alkalinity of the water. Typically provides an analog signal representing pH value. Maintains optimal pH levels for both aquatic animals and plants, crucial in aquaponics.
- **16x2 LCD Display:** Displays real-time sensed data. It can show temperature, pH, water level, etc.
- **Motor Driver:** Acts as an interface between the Arduino and the water pump. Amplifies control signals to operate the pump (e.g., L298N or L293D). Controls the water pump based on sensor inputs (like water level or nutrient needs).

- **Water Pump:** Circulates water inside the aquaponics device. moves water between the fish tank and plant grow beds, permitting nutrient.

IV. RESULTS

Fig. No. : 3 Model OF Project

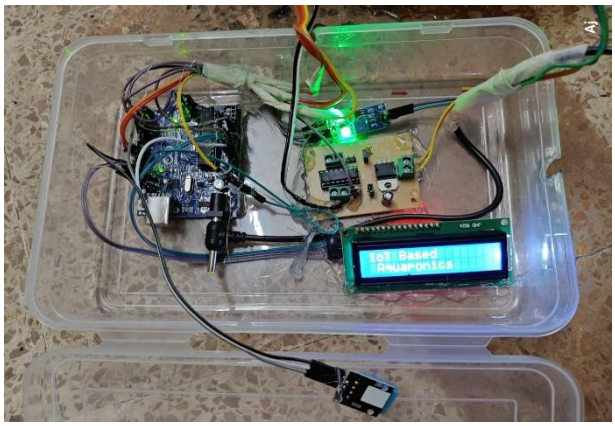

Fig. No. : 4 Interfacing Of Components

This system works as following:

Water from the water container (bucket) is pumped into the fish tank, if ultrasonic sensor detects the water level of fish tank is low than setted value.

Then fish waste (in a complete system) or nutrients in the water enrich to plants manually.

After releasing the water cock it flows to the plant grow bed, providing moisture and nutrients.

The plants absorb nutrients, helping purify the water.

For detecting acidity and alkalinity of water for good health of fishes' pH sensor is used in system.

Sensors monitor water and plant health, feeding data to the controller.

The system shows water level, pH level, or automate cycles.

The extra water can be recircuit back to the forming a closed loop.

V. PROS AND CONS

PROS:

1] Control Plant Growth: The system allows for precise control over nutrients and growing conditions, leading to faster and more consistent plant growth.

2]Monitor Fish Health: Regular observation of fish and water quality ensures that the aquatic environment remains healthy and productive.

3] Maximize Agricultural Yield: With optimized water and nutrient cycles, plant life grows quicker and bring higher yields in comparison to traditional farming.

4]Nutrient Recycling: Fish waste is converted via beneficial micro-organism into vitamins that plants can soak up, minimizing waste and developing a closed-loop atmosphere.

CONS:

1]Time-Consuming Monitoring: The system requires continuous monitoring of water quality, temperature, pH, and fish health to maintain balance.

2]High Initial Setup Cost: Equipment such as tanks, pumps, grow beds, and monitoring systems can be expensive to install and maintain initially.

VI. CONCLUSION

Selecting the right system is crucial to the success of your aquaponics projects. If you're a new grower or an experienced one looking to build your business, there are aquaponics systems to fit every budget, skill level, and space. Regardless of your level of experience, success depends on choosing a system that meets your needs and goals. To begin aquaponics right now, look into the options mentioned above. Transform your space into a thriving aquaponics habitat to begin growing your own organic, sustainable food at home.

VII. FUTURE SCOPE

1]Reduce manual effort: Modern aquaponic systems are evolving with the integration of automation and data-driven technologies, which significantly reduce manual effort and enhance system efficiency.

2]Data Integration and Anomaly Detecton: Further research could lead to the development of intelligent systems that integrate data from multiple sources—such as: Water chemistry sensors, Video or motion tracking for fish behaviour, Plant growth imaging and analytics

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