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IOT BASED AQUAPONICS MONITORING SYSTEM

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Abstract: **Aquaculture faces tremendous problems because water quality changes because of variation in environmental conditions. Estimate water characteristics such as pH, humidity, temperature and others, as fluctuations in these values are critical for aquatic life. At present, water parameters are detected by a chemical tester at the laboratories. As a result, it is a time-consuming manual method with a tiresome process. The quality of water should be monitored in real-time for that purpose Arduino based water quality monitoring has been proposed. The measured values from the sensors are processed by a microcontroller and various control signals are given to maintain the best water parameters for the fish life. Then the measured values are given to the user's mobile app through the cloud. This system ensures there is perfect living qualities in water for fishes and maintains it by controlling the water parameters.**

Index Terms - pH, Temperature, Internet of Things (IoT), GSM module, Humidity, Water level, Distance.

I. INTRODUCTION

Aquaponics is a system that is a combination of aquaculture (breeding, raising, and harvesting fish, shellfish, and aquatic plants) & hydroponics (a part of hydroculture that revolves around the cultivation of plants, usually crops, without the soil, making use of nutrient solution in an aqueous solvent) in one aquaponic system. The aquaponic model should consist of water filtration systems, water storage tanks, fish tanks, sensors for regulating various parameters, and an adequate piping system to facilitate the transfer of water from one section to the another. Aquaponics refers to the system that supports the dual combination of the aquaculture (fish rearing) and the hydroponics (production of the plants without soil). The excretions of the fish containing ammonia are converted by the nitrifying bacteria into nitrites and then to nitrates whichcan be used as nutrients for the plants. As compared to the traditional methods of farming, aquaponics is favorable for the place where there is no fertile soil, or lack of water or even lack offree land/soil. Sensors are the hardware components thatare used for acquiring information to and from Internet of Things technology.

With the applicationof Internet of Things in Aquaponics system, remarkable changes can be brought in the field of agriculture by simply monitoring and maintaining the system parameters for effective growth of the plants. The use of GSM with Arduino helped to connect the system to the web where in the data server stored the values of system parameters like pH value, temperature and humidity in thedatabase and provided the information to the web. With the application of Internet of Things in the Aquaponics Monitoring system, the values of the system parameters and information can be displayed on the web server continuously. It uses Fish's which contains nitrogen and minerals to provide important nutrients for the growth of the plants and in return, the plants will absorb the minerals, nutrients & nitrogen and purify the water, and give it back to the fishes.

The ultimate goal of this project is to monitor the parameters such pH, temperature, humidity, water level and distance on LCD using specific sensors and getting an alert messages to the operator through GSM module.

II. LITERATURE SURVEY

A. Important Water Quality Parameters in Aquaponics

The paper "Important Water Quality Parameters in Aquaponics", by Rossana Sallenave, discusses the importance of water quality in an aquaponics system. Maintaininga balance between water quality conditions that are optimal for fish, nitrifying bacteria, and plants is crucial to a healthy and productive aquaponics system. By monitoring key water quality parameters such as pH, temperature, dissolved oxygen, ammonia and nitrate on a regular basis, adjustments can be made in a timely manner to avoid problems and losses inproductivity.

B. Small-scale aquaponics food production Integrated fish and plant farming

'Small-scale aquaponics food production Integrated fish and plant farming' by Christopher Somerville and Moti, is a technical paper which provide a prescriptive approach to aquaponics; this is a resource paper and includes description and discussion ofthe major concepts needed for aquaponics. It discusses the main theoretical concepts of aquaponics, including the nitrogen cycle and the nitrification process, the role of bacteria, and the concept of balancing an aquaponics unit. The publication discusses in detail the three groups of living organisms (bacteria, plants and fish) that make up the aquaponics ecosystem. guidelines and considerations for establishing aquaponic units; a cost–benefit analysis of a small-scale, media bed aquaponic unit; a comprehensive guide to building small-scale versions of each of the three aquaponic methods. It also presents managementstrategies and troubleshooting practices, as well as related topics, specifically highlightinglocal and sustainable sources of aquaponics inputs.

C. IoT enabled Aquaponics with wireless sensor smart monitoring system

Praveen C Menon addressed some technical issues faced by the farmers using aqua- ponies and proposes the technical solution of an identified problem in traditional aquaponics using wireless sensors and a communication network with a GUI application in the paper IoT enabled Aquaponics with wireless sensor smart monitoring published in the year of 2020.

D. Water quality monitoring for rural areas-a sensor cloud based economical project

This paper highlights the whole water quality monitoring methods, sensors, embedded design, and knowledge dissipation procedure, role of state, network operator and villagers in ensuring proper information dissipation. It can explore the Sensor Cloud-domain. While automatic water quality improvement is not yet possible, smart use of technology and cost-effective approaches can help enhance water quality and public awareness.

E. Smart and Sustainable Home Aquaponics System with Feature-Rich Internet of Things Mobile Application

This paper is concerned with the fact that generation of fishes & plants by every household will reduce the overall food demand. Food security has been a recurring issue for many countries in the world including Singapore. This issue is exacerbated by growing world population and climate change, which inevitably leads to an increased demand for food. In recent years, large scale aquaponics has shown efficient production of edible fish and plants. This paper further exploits the design and development of an aquaponics system for home environment, with the notion that if every household within a country can generate its own fish and plants, the overall food demand of the country will be reduced. The proposed smart and sustainable home aquaponics system consists of various sensors, actuators, and microcontroller with internet connectivity to continuously monitor, control, and record fish tank water and ambient air quality.

III. PROPOSED METHOD

The proposed system consists of 3 major stages. Sensing stage, Computing and controlling and Communication stage

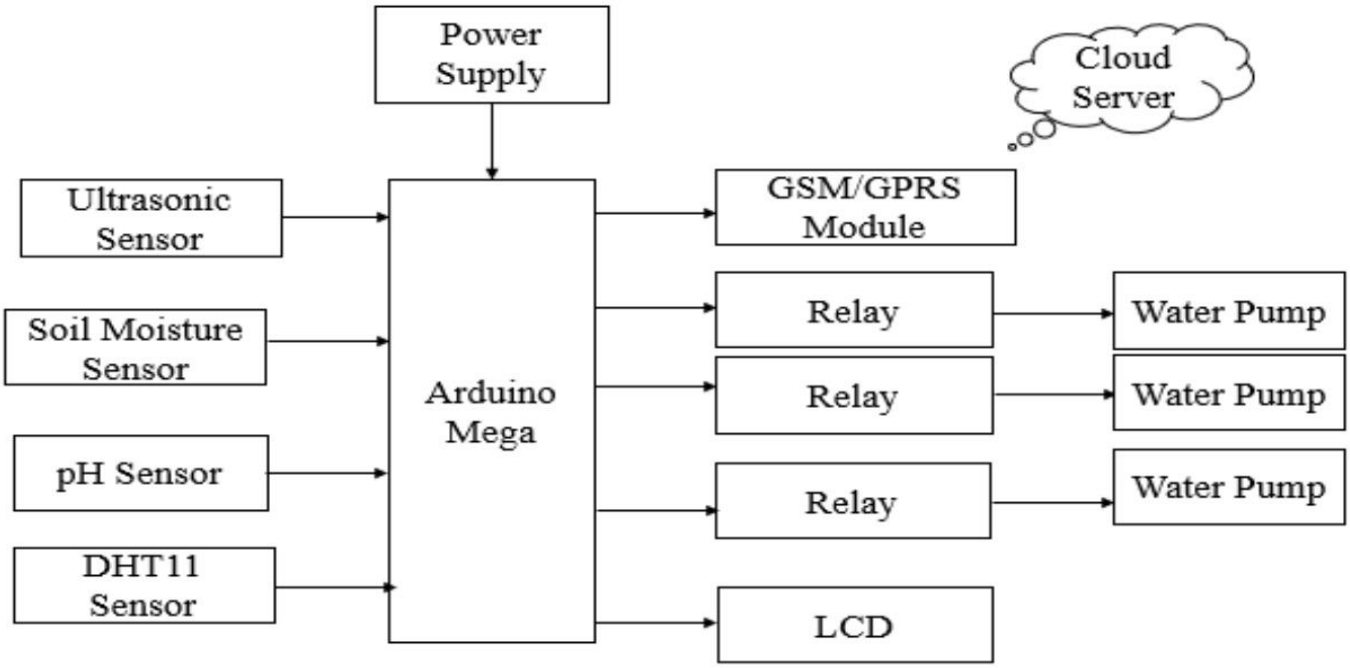


Fig.1 System Architecture

The Sensing stage consists of following sensors.

1. Arduino mega: The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet).It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, apower jack, an ICSP header, and a reset button.

2. pH sensor: If chemical effluents from the industries are let into water bodies the pH value of the water changes counting on sort of chemical i.e. Acidic or basic. The pH sensor measures the extent of pH in water by measuring the activity of hydrogen ions in water. Normally, the fishes can live in a pH range of 6 to 8. If the value of the pH goes below 6, the solution becomes acidic and opens the base valve. If the value of pH goes above 8, the water becomes basic and therefore the acidity valve are going to be open and make it to the range which is suitable for aquatic life.

3. Temperature sensor: Microbial activities can cause the temperature of water to rise, which is one of the factors that determines cleanliness. The water temperature is measured by the temperature sensor. Fishes survive within the temperature range of 21°C to 33°C. If temperature goes beyond threshold range, motor gets activated and pumps the water.

4. Ultrasonic sensor: This sensor used to find a water level in the system. When water level low, automatically turn the motor.

5. Water level sensor: It determines the extent of water. If water level is low, motor gets activated to pump the water to the specified level.

6. DHT11 sensor: This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems.

7. LCD: LCD 16x2 is a 16-pin device that has 2 rows that can accommodate 16 characters each. LCD which is used to display the parameters such as pH, temperature, humidity, water level and distance.

8. GSM module: This module is used to get the alert messages to the operator. The GSM module is designed to enable wireless communication for radiation monitoring instrument intended for continuous data monitoring and emergency alert.

9. Relay: This is used as pump controlling feature in the system.

The signal received by these sensors is applied to Arduino board which is that the controlling and computing a part of the system. The computing stage entails comparing the sensor's sensed data to a predetermined threshold value. When the sensed

value differs from the edge value, the communication stage sends a message to the authorised person. Communication stage involves GSM module.

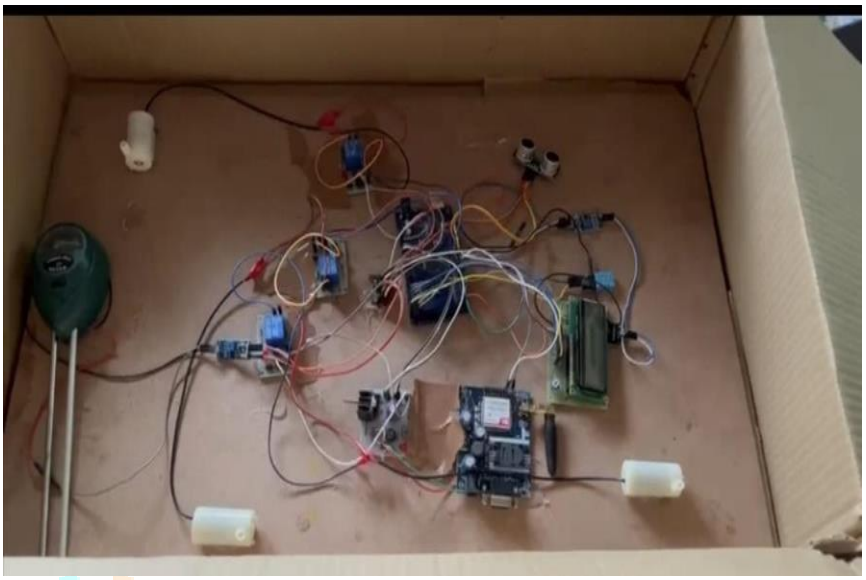


Fig 2 Hardware set up

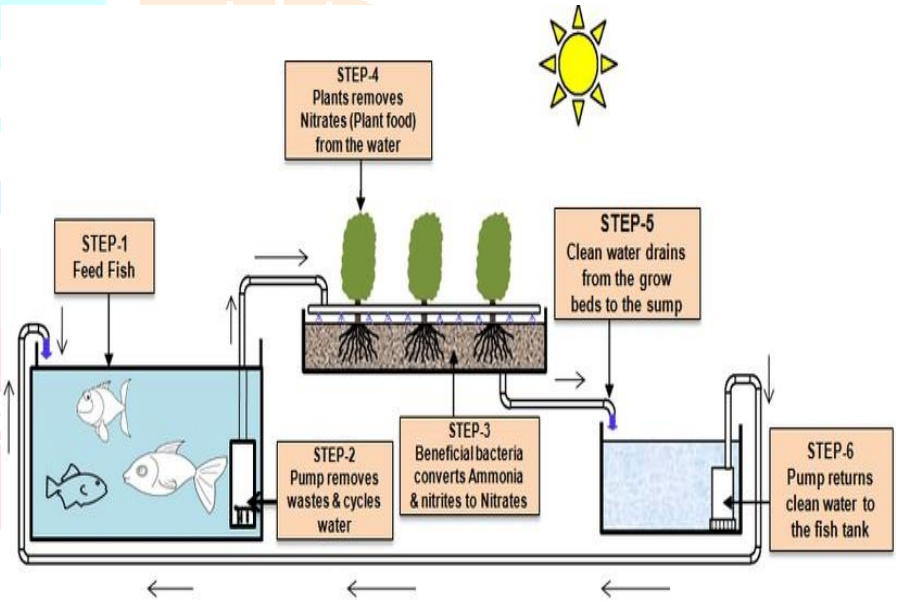


Fig 3 Representation of Aquaponics system

Step 1: Includes the feeding of fishes.

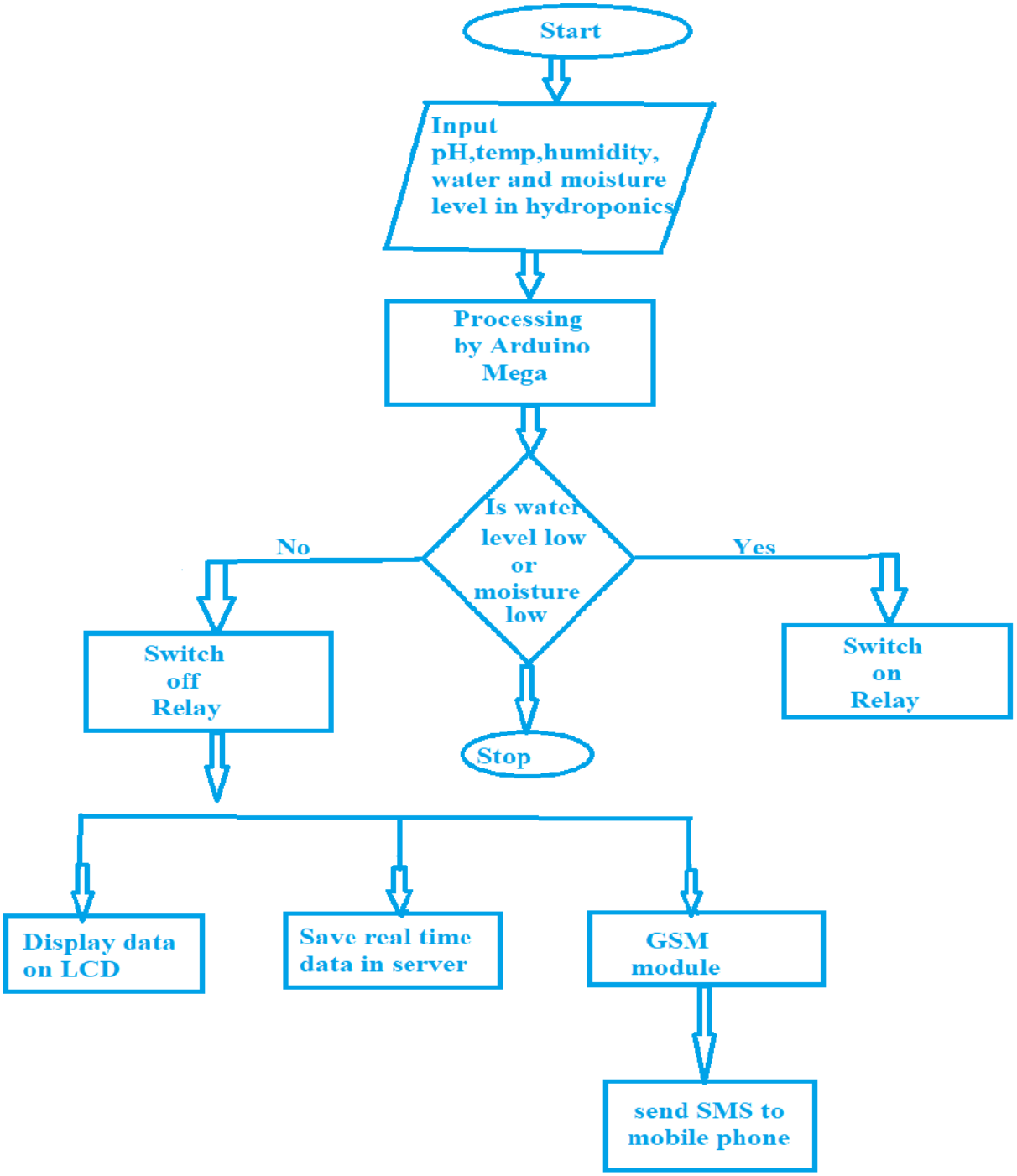
Step 2: The excreta of fishes which is removed through the pump.

Step 3: Nitrifying bacteria converts Ammonia and nitrites to nitrates.

Step 4: Plants removes nitrates from water.

Step 5: Clean water drains from the grow beds to the sump.

Step 6: Finally Pump returns clean water to the fish tank.



- The system is initialized. All the sensors start their functioning andthen send their values.
- After that the conditions defined for the growth of plants and fishes are checked.
- Real time values for each system parameter is displayed on the LCD and webserver.
- In case of mismatch in defined range for each sensor, the warning message isdisplayed in the web server through Internet of Things, resulting the pumps are switched off. The data stored in the server(via gateway, local server) is displayed on LCD.

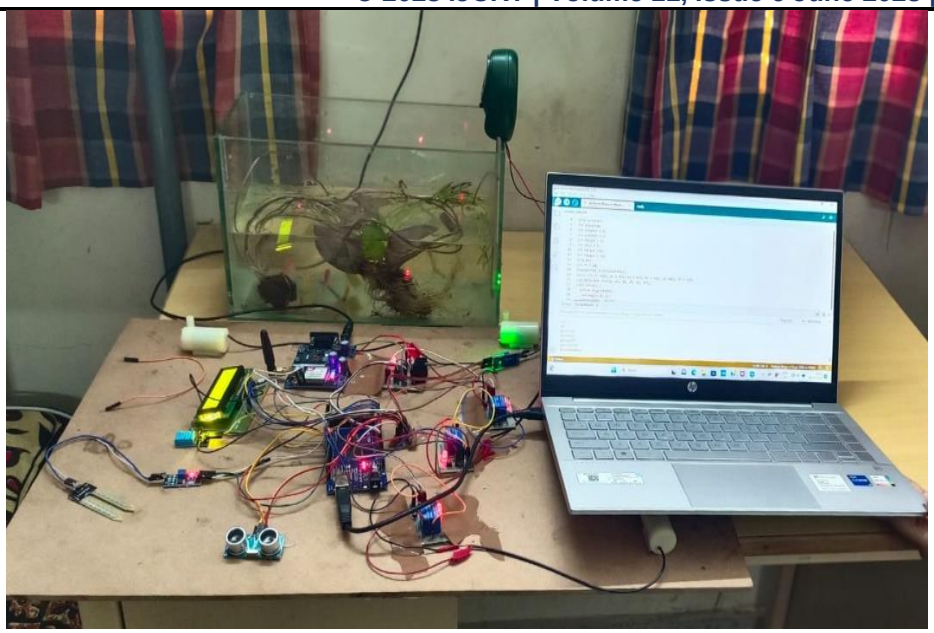


Fig 4 Final representation of aquaponics system

III. RESULT

We've found a good implementation model that includes a variety of sensor devices and other modules, as well as their functionalities. During this implementation model we used ATMEGA 2560 with GSM module. Sensors are attached to an Arduino UNO board for monitoring; After sensing the info from different sensor devices, which are placed especially area of interest. When a proper connection with the server device is established, the sensed data will be automatically delivered to the online server.

Fig 5 pH value

Fig 6 Temperature and humidity value

Fig 7 Distance(Water level)

V. CONCLUSION

The existing problems seen in the traditional aquaponics system can be detached by the introduction of electronic approach in the system. And this can encourage people to produceorganic and healthy plants for daily use or consumption in their own household. By the application of Internet of Things in this system, it has been possible to view the readings from anywhere in the world and also it provided the graphical and analytical view of the system parameters which define the IoT Based Aquaponics Monitoring System. A low cost aquaponics system using Arduino microcontroller is successfully designed. The program of Arduino IDE is developed to monitor and control the water parameters. The technology is extremely adaptable and cost-effective. It's a real-time system that measures numerous parameters concerning the water and makes sure the water maintains the standard for the lives of fishes. The system gives the knowledge of the standard parameters measured to user through cloud.

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