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An Smart Aquaponic System Using IoT

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Abstract

According to some research institute in less than 5% of sea food is in the state of collapse and Now by 2050 it is expected that nearly 100% of all the sea food species may collapse. And as we know the fresh water resources are decline and the world population is increasing. So, to overcome this problem and to make the world better place we use aquaponics. Aquaponics is a system that deals with both aquaculture and hydroponics with this technique utilization of pesticides and water decreases by 90%. But this to work out properly we need very effective measures to take. So here we introduce IOT to aquaponics. This paper is based on a concept which plays a major role in food security and sustainability in many well-developed countries like Singapore, America. The problem of food scarcity arises due to modernization and less food production. This paper is an attempt to develop a smart aquaponics system than can help both fish and plant growing. This is to ensure a very good healthy environment for fish and plant growing. This project helps in meeting the food needs and decreasing land usage, manpower, time etc.

Keywords: Aquaculture, Hydroponics, Food security, IOT.

1.INTRODUCTION

Aquaponics is a system where fish and crops grow in a same frame simultaneously. Fishes release the required nitrates to plants and plants clean the water for fishes by this way only 5 to 10% of the clean water is used. Using Iot in aquaponics makes this process simple and effective way. The sensors we used here detect the unhealthy environment and send signals to rectifying authority so that necessary precautions can be taken.

Aquaponics is a combination of aquaculture and hydroponics. Aquaculture is called fish farming and hydroponics is growing plants without soil. This idea is to design an environment which combines fresh water system between fish and plant. In brief, the wastage generated by the fish becomes nutrients for plants after the nitrification process. The process which acts as a biofilters that cleans the water before recirculating it to the fish tank. This design requires many electronic items like sensors, actuators, Arduino, data acquisition systems, web applications, mobile applications, alarm unit etc. Therefore this paper is an attempt to design a smart aquaponics system that can help both fish farming and plant growing by continuously gathering information from various sensors, monitoring them and controlling them accordingly. This design also monitors all kinds of abnormalities that might happen in the system and intimate the user and can automatically rectify the problem immediately. However, this kind of operation can be challenging because constant monitoring is necessary.

2.Existing System

Present system (farming or aquaculture) requires a lot of human attention which is highly impossible. This is something that requires a lot of time, money and a perfect environment. However, this approach has been accepted by humans for years and got used to it. Sometimes, few things like high temperature, fertility, pH levels affect the system which may cause damage to the entire system. Plants can purify only certain amount of ammonia level based on the size of frame. For instance, if the ammonia levels in the

water exceeded beyond the purifying level the water need to be flushed out immediately. So, if the water is not flushed immediately the plants and fishes may die. The time taken for problem rectification in human absence is high and there is no medium to connect with the user. So, the process needs to be automatic to overcome all these problems.

Drawbacks

1.In the old design of aquaponic systems, continuous monitoring of the system is mandatory which requires a lot of human attention and energy, whereas the present design provides remote controlling also through internet or GSM.

2.The level of water in the fish tank has to be continuously checked and because of this someone has to be there always to keep checking it. But in the present design an ultrasonic sensor has been deployed such that it keeps tracking of the water level all the times. If the water level goes below the threshold level, a notification will be sent to the user so that he can supply water to it.

3.Proposed system

This system has got a lot of elements that can be highly effective in achieving the desired outputs. By this design, we can reduce human interference, cost of farming to a great extent [5]. In case of any abnormalities, the system automatically detects it do the necessary things and sends an alert or notification message to the user using a GSM module.

4.SYSTEM IMPLEMENTATION

Technical Specifications:

Software Requirement:

- Arduino ide
- Embedded c

Hardware Requirement:

- Arduino uno
- Temperature sensor
- Ph sensor
- Ammonia sensor
- Relay
- Cooling fan
- Water pump
- GSM module
- Ultrasonic sensor

4.1Block diagram

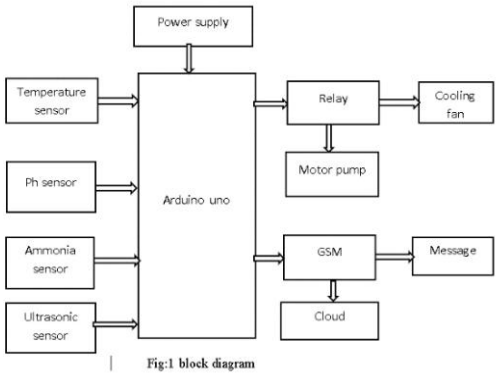


Fig:1 block diagram

Fig:1 block diagram

4.2WORKING

The working of this model creates a combination of both aquaculture and plant farming

- The sensors present in its architecture performs a specific duty to create a healthy environment to both fish and plants
- All the information from the sensors is stored in data acquisition unit through GSM
- An alarm system has been employed to detect and overcome abnormalities and alert the user

.4.3HARDWARE COMPONENTS

Arduino Uno: Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB

connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Fig: 2 Arduino uno

DTH-11

Fig: 3 DHT11 sensor

This Sensor is for finding temperature and humidity of the system continuously. This sensor measures the humidity and temperature of its environment, monitors the changes in them and also signals the temperature changes.

pH sensor:

pH is a measure of acidity or alkalinity of a solution; the pH scale ranges from 0 to 14. This sensor is placed in the water which detects the nature of water (acidic or alkaline). We know that acidic or alkaline nature of water is not suitable for farming environment. So, in order to maintain an equilibrium nature of water we use a pH sensor. This sensor detects and monitors the changes in water and displays the changes or abnormalities on LCD.

Fig: 4 pH sensor

Ammonia sensor:

Ammonia is a major provider of nitrogen to plants. This sensor is used to measure the ammonia levels in the soil. This ammonia sensor detects whether sufficient amount of ammonia is present in soil or not and sends alert message using a reliable medium

.

Fig: 5 Ammonia sensor

Relay module:
A relay module is a switch which is operated by an electromagnet. A separate low-power signal from a microcontroller activates the electromagnet. The electromagnet pulls to open or close an electrical circuit when energised
.

Fig: 6 relay module

Dc Water Pump:
Based on the values given by pH sensor and temperature sensor this DC water pump will turn on and turn off automatically without any man power. An engine's main task is to guarantee that water from a fish tank flows properly onto the bed for cultivation
.

Fig: 7 Motor pump

Cooling fan:
When temperature is high, cooling fan will automatically go on and maintain moderate temperature in the system environment.

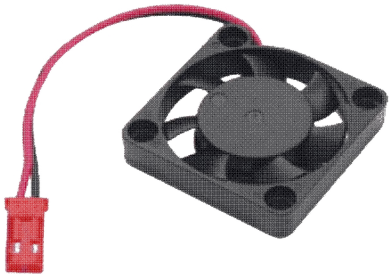


Fig: 8 cooling fan

GSM:
GSM is a device that acts as an intermediate device that sends the information from sensors to the cloud and It also signals alert messages to user in case of abnormalities.

Fig: 9 GSM module

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

Fig: 10 Ultrasonic sensor

4.4Design

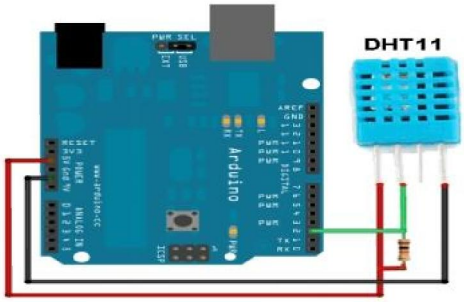


Fig:11 The above schematic design depicts an Arduino uno with a DHT11 sensor DTH-11 connected to a microcontroller.

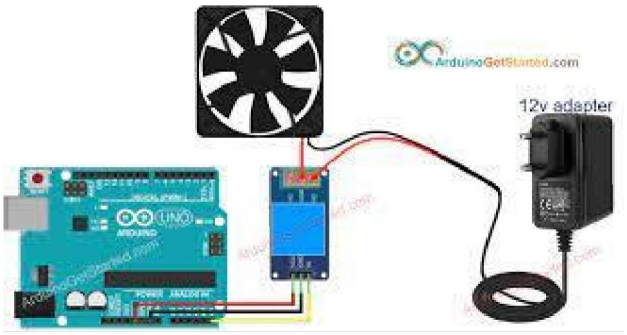


Fig: 12 Arduino uno with cooling fan

Cooling fan connection with microcontroller is show in above Schematic diagram

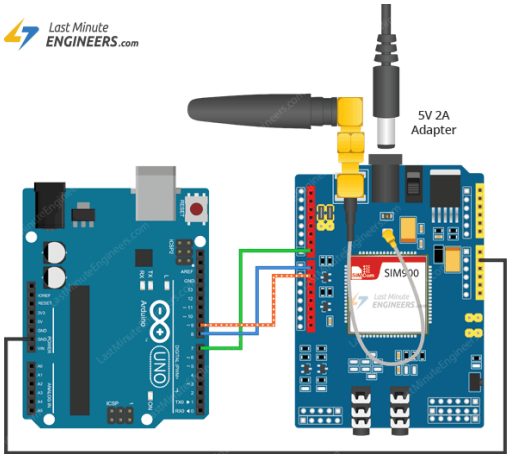


Fig: 13 GSM module Arduino One

The above schematic diagram depicts the GSM connection with the microcontroller.

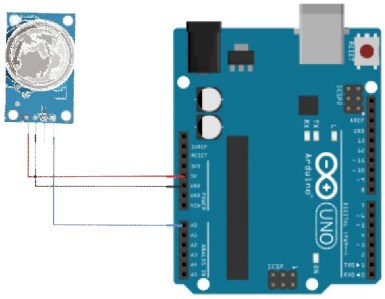


Fig:14 Uno with a sensor of ammonia

Ammonia (MQ135) microcontroller connection is displayed in the schematic graph above.

Fig:15 Motor pump Arduino.

The connection between the motor pump and the microcontroller is shown in the Scheme above

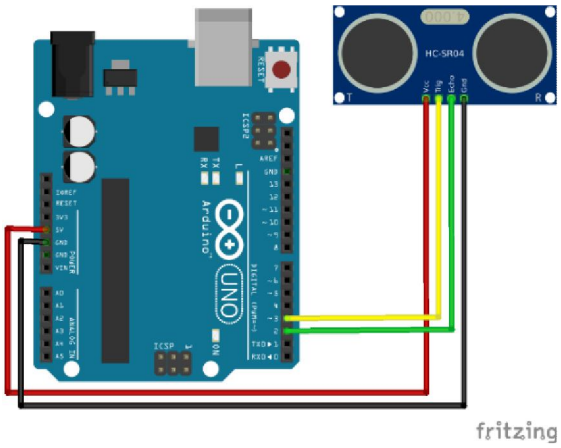
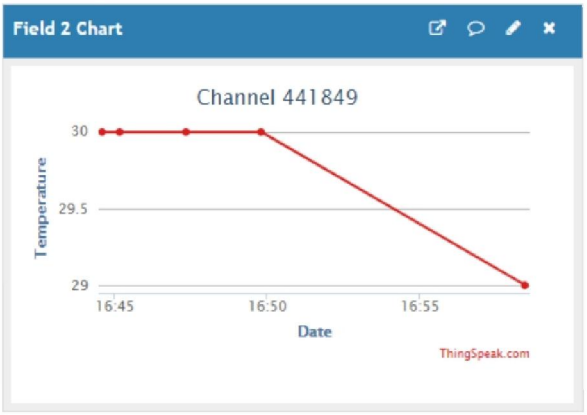


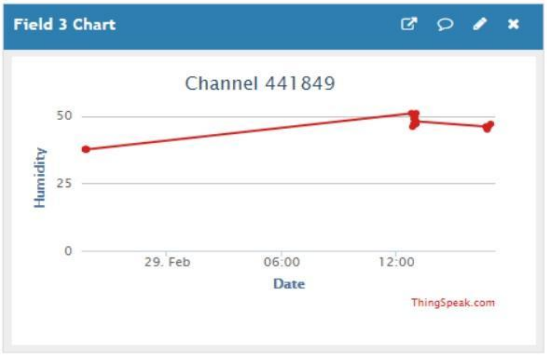
Fig:16 Ultrasonic sensor Arduino Uno

Ultrasonic microcontroller connection is seen in the scheme above

IoT page out Put values

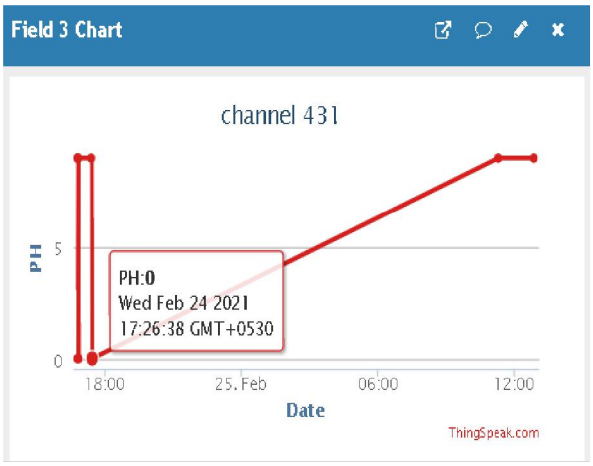


Temperature values transmitted to the iot server from our aquaponic system's DTH-11 sensor will be

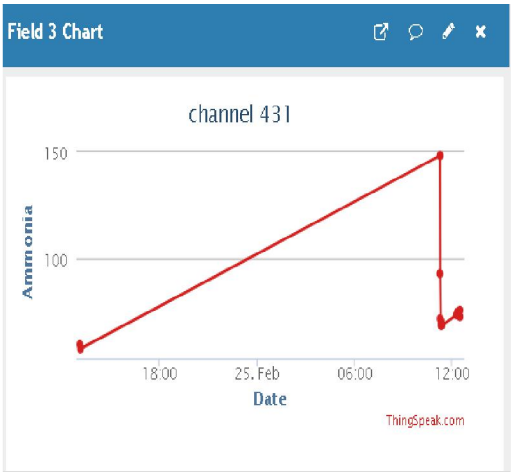


shown in a graph, as illustrated in the upper screen.

The humidity values posted to the iot server by our Aquaponic system's DTH-11 sensor will be displayed in the graph shown in the above screen.



The pH readings that have been placed in the iot server are exhibited in graph as above by means of



our Aquaponic system employing the pH sensor.
The pH values from our Aquaponic system are displayed in graphs, as shown on the screen, using the pH sensor.

Results and discussion

Any current decorative tank may readily be converted into an independent herbal producing facility. The cost of such a system is inexpensive and there is no need for particular expertise or tools.
Furthermore, an aquarium may be constructed using low-cost components. It is not necessary to have any specific expertise or tools. This is a method for city dwellers to come closer to nature, to enjoy the serene view of some lovely fish, and to have fresh herbs direct from the grow bed in their kitchen all year with absolutely no production costs.

Hardware output

(when our hardware kit ready. It will be replaced with our kit)

Conclusion

The proposed system is able to continuously monitor and control water quality, light intensity and pH levels. This system helps in sending early messages in the form of email, short message services and rectify abnormalities. With a large scale, this system can reduce labor, operating costs and increase the production and profits.

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