Aquaponics cultivation with IoT monitoring

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Abstract- Aquaponics is a framework which joins the aquaculture and hydroponics that develops fish and plants together in one framework. It utilizes fish waste to give basic supplements to the plants and consequently the plants will sanitize the water and gives it back to the fishes. Agriculture innovation plan with aquaponics is likewise utilizing the idea of Internet of Things in light of the fact that the data from the sensor and control actuator esteems can be gotten to through applications introduced on the cell phone from anyplace with the Internet association. By making a robotized System with the assistance of sensors interfaced with the Arduino load up, it conceivable to operate fish feeding and water supply to the plants at intervals of time. Existing framework that joins these innovations must conquer the principal issues like cost, nourishment quality control and constrained develop. With innovation utilizing the idea of Internet of Things has more points of interest contrasted with ordinary cultivating.

Indexterms- IoT, agriculture, fish, sensors, Arduino

I. INTRODUCTION

Agriculture is one of the segments that has an imperative job in human life. Since agriculturists are fundamental suppliers of food, clothes, and shelter to address the issues of life that centers on individuals lives as a rule. As of late, the fuse of recycled fish with a vegetable hydroponic creation called Aquaponics has turned into a fascinating model for private division, aquaculture and natural researcher as a result of numerous points of interest that can be acquired. Fish excrete is broken down by bacteria to Nitrate which are absorbed by plants as nutrients, and plant roots act as a filter to clean the water for the fish. The water is circulating from fish tank to plant growing beads and back to fish tank. This is almost a closed circuit, you feed the fish and fish feed the plants and both feed you. This type of plant cultivation can be used anywhere (deserts, rooftops, houses...) and actually saves water as the same water is constantly recirculating (you just have to top up the tank when water evaporates), compared to traditional soil plant cultivation that needs to be watered constantly and most of the water is lost in soil. Also if all conditions are meet plants grow much faster than in soil because they don't have to develop extensive roots, nutrients are brought directly to them. As of climate changes in the surroundings won't have any effect on this framework and thus it can become any sort of vegetation. This framework gives negligible hazard and high benefit cultivating technique of course by the purchasers or individuals around the globe. Customary cultivating requires standard checking, though aquaponics framework is a mechanized framework which requires less observing. Overview says that aquaponics requires under 10 percent of new water as the framework itself reuses the water. In this paper, fundamental objective is to propose a mechanized aquaponics framework, which requests ostensible necessities furnishing best outcomes with the guide of the advance technologies.

II. LITERATURESURVEY

Since there is a constantly increasing world population, a decrease of farm land, climate changes and food safety concerns, many companies have gotten involved in plant factories that grow certain crops regardless of the weather or environment. Agricultural cultivation technology with indoor agricultural technology provides an alternative for those who are looking for farming and do not have land but they have a option such as aquaponics to conduct business activities that can be used as an adequate source of food or income. Aquaponics is a system in which the waste given out by fishes act as a nutrition to plants. With some light, temperature, and humidity manipulation of the plants the aquaculture is well suitable for plants and can be applied to indoor system. Agricultural technology design uses Internet of Things as we will require a connection to our smart phones so that we can get the information from the sensors and we can monitor our indoor system from anywhere with internet connection. Aquaponics farming systems are sustainable, environmentally-friendly and they are alternatives to conventional agriculture practices. They reduce the degree of pollution and allow for the conservation of gas, water, and land. For example, in traditional agriculture, the use of fertilizer is prevalent and results in toxic runoff that pollutes nearby rivers. On the other hand, aquaponics utilizes fish excrement as fertilizer, providing an organic alternative that is not harmful to the local ecosystem. But in traditional farms, which export produce to far-away markets, many aquaponics farms serve local businesses and restaurants which tends to be small scale. Aquaponics also reduces the usage of gas in transporting vegetables as it brings healthy and fresh foods to neighboring communities, since aquaponics is a closed system that recirculates water, the amount of water needed is significantly less than typical agricultural methods. This system also requires less land, aquaponics systems can come in a variety of sizes and are often more productive than regular farming methods. Many of these systems produce greater vegetable output in a shorter amount of time and in smaller spaces than conventional farms. Aquaponics requires a developed tool for continuous water monitoring techniques that are based on data acquisition, communication, and processing. This work mainly focuses on using IoT to configure and requires a water-quality sensors that provide remote, continuous, and real time information of indicators related to water quality on graphical user interface our aquaponics system can grow. We are using nutrient film technique in which plants have horizontal arrangements and always have contact with flow of fish water. The fish and plants that you select for aquaponics should have similar needs as temperature and ph. Fishes that can be raised on aquaponics with good result: tilapia, blue gill, koi, goldfish, catfish and plants that do well are: basil, mint, watercress, lettuce, tomatoes, cucumbers etc.

III. SYSTEM ARCHITECTURE

The glass electrode pH sensor, temperature sensor, and the moisture sensor served as the inputs of the smart aquaponics system. Input data were then processed by the Arduino Yun microcontroller through the Android IoT Application that was also connected to the Temboo agent (an IoT gateway) for the Google mail irregularity notification. The Arduino Yun then controlled the relay drivers of the output loads (12V DC Feeder, Peristaltic Buffer Device, and Aerator). The Arduino Uno also processed acquired data and displayed it via LCD. The system was supplied by the 12V solar panels connected to the 12V solar batteries which supplied all outputs loads and regulators. The aquaponics is composed of four sections namely the water parameter detection, Arduino data analysis, water parameter correction, automated feeding.

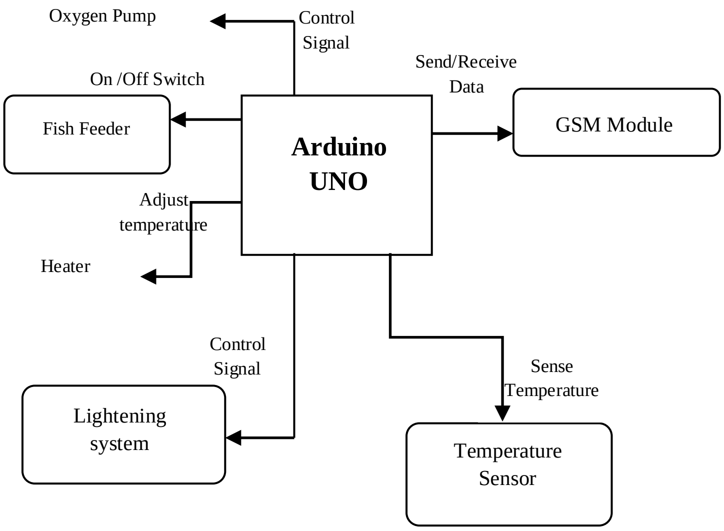
Water Parameter Detection

This section detects and monitors the pH and temperature parameter values of water using the sensors installed. The temperature sensor and the glass-electrode pH sensor, which were submerged in the sump tank, were sent to the analog and digital inputs, respectively, of the Arduino Yun for data acquisition and processing.

Arduino data analysis: The Arduino converts analog voltage output from the temperature as well as output from the ARC into digital form for the microcontroller to interpret the data.

Water correction parameter: For this section the data acquired from the Arduino data analysis is required for the decision support system in the microcontroller.

Automated Feeding: The automated feeding comprised of Arduino data analysis and the food dispenser. The Arduino is programmed with initialized default time settings of feeding wherein it would send a digital signal to the relay driver when the feeder would dispense food.



IV. IOT

IOT is an idea that intends to grow the advantages of constantly associated web availability. With respect to abilities, for example, information sharing, remote control, etc. For instance, food, gadgets, collectibles, any hardware, including living things that are altogether associated with neighborhood and worldwide systems through implanted and dependably on sensors. This likewise utilizes the idea of Internet Of Things in light of the fact that the data from the estimation of the sensor can be gotten to through cell mobile applications and sites from anyplace with the Internet association.

V. SENSORS:

1) TMP36 Temperature Sensor:

The TMP36 are low voltage, precision centigrade temperature sensors. They provide a voltage output that is linearly proportional to the Celsius (centigrade) temperature. The TMP36 do not require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range.

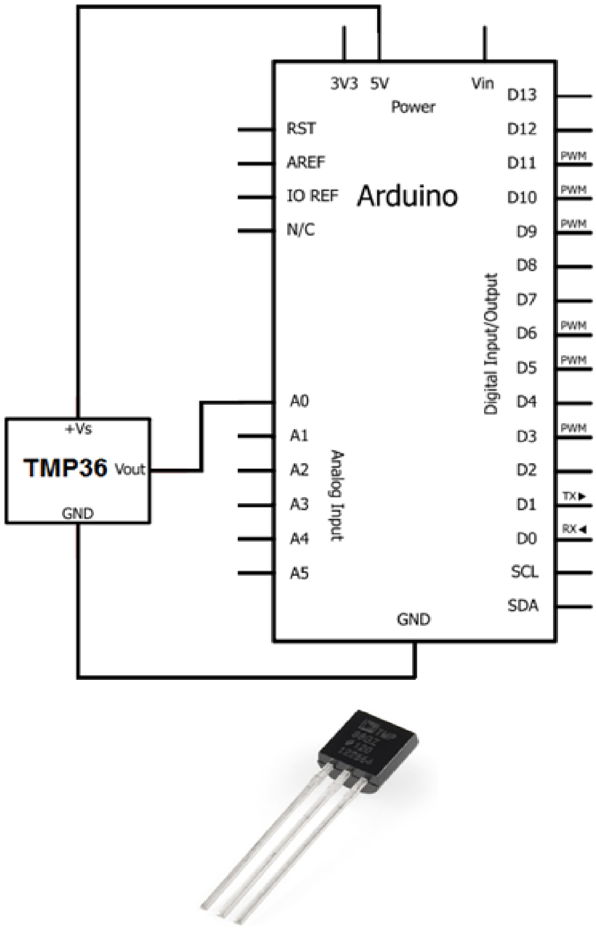


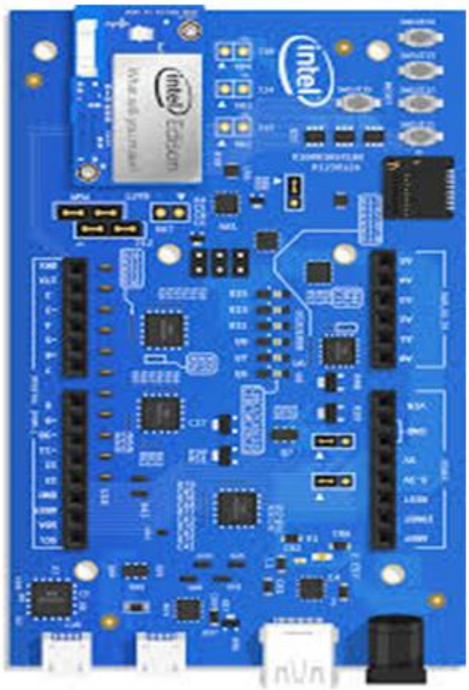
Fig.1: TMP36

2) Photoresistor sensor

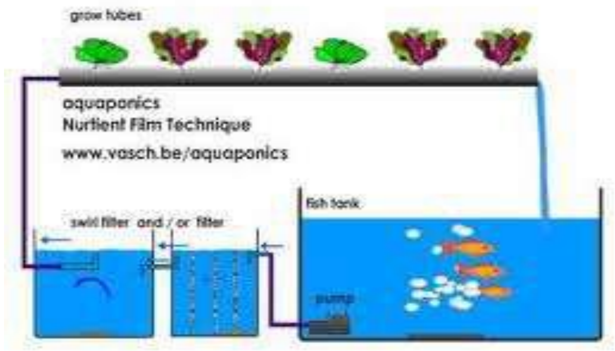
Photo resistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to 1MΩ, but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity.

3) Intel Edison Arduino Breakout Board:

The Intel® Edison is an ultra-small computing platform that will change the way you look at embedded electronics. Each Edison is packed with a huge amount of tech goodies into a tiny package while still providing the same robust strength of your go-to single board computer. Powered by the Intel® Atom™ SoC dual-core CPU and including an integrated WiFi, Bluetooth LE, and a 70-pin connector to attach a veritable slew of shield-like “Blocks” which can be stacked on top of each other. This kit also includes an Arduino Breakout, which essentially gives your Edison the ability to interface with Arduino shields or any board with the Arduino footprint. Digital pins 0 to 13 (and the adjacent AREF and GND pins), analog inputs 0 to 5, the power header, ICSP header, and the UART port pins (0 and 1) are all in the same locations as on the Arduino Uno R3 (Arduino 1.0 pinout). Additionally, the Intel® Edison Arduino Breakout includes a micro SD card connector, a micro USB device port connected to UART2, and a combination micro USB device connector and dedicated standard size USB 2.0 host Type-A connector (selectable via a mechanical micro switch). Though this kit won’t turn your Edison into an Arduino itself, you will, however, gain access to the Arduino’s shield library and resources



4) 4 Channel 5V Relay Module with Optocoupler Isolation



This is a 5V 4-Channel Relay interface module, for controlling various appliances, and other equipment’s with large current. It can be controlled directly by microcontroller (Raspberry Pi, Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430) TTL logic.

Description:

- 5V 4-Channel Relay interface board, and each one needs 15-20mA driver current.
- Optical isolation on each channel.

- Equipped with high-current relay: AC240V 10A / DC28V 10A.
- Indication LEDs for relay output status.
- Equipped with screw holes for easy installation.

5) LED grow lights:

Plants don't successfully utilize the whole range of light. Actually, inner structures that ingest light inside plants such a chlorophyll and carotene ingest light in the scope of two specific wavelengths. Most LED Grow Lights convey vitality that plants require in the correct range that are best to incite sound and steady plant development

- It can provide all the light a plant needs to grow, to help plant grow quicker a better, increase yield.
- It's simple, high yields, low heat and less electricity.
- Supplement sunlight, especially in winter months when daylight hours are short. .

- Increase the length of the "day" in order to trigger specific growth and flowering and help plants grow quicker, decrease growth circle.

VI. NUTRIENT FILM TECHNIQUE

- As with DWC the water is filtered prior to going to the plants, but in this case the plants are rooted through holes in pipes.
- The tip of the root touches the bottom surface of the pipe and absorbs nutrients from a thin film of water trickling down the length of the pipe.

VII. IoT KIT ARCHITECTURE

All sensors are outside the Arduino board, connected by wires to breadboard.

- Make two groups with 4 wires each
- On first group connect the temperature sensor and photo resistor, they can share the +5V wire.
- First group will collect ambient data so it's best to attach those sensors somewhere above the system light, so it doesn't pick up the system light.
- On second group connect water flow sensor and photo resistor, they also can share +5V wire.
- Photo resistor from the second group should be placed somewhere inside the system so it can catch its artificial light, possibly somewhere it won't be covered with plant leaves.
- On the breadboard photo resistors use 10-kilohm resistor connected to the ground, and water flow sensor uses 10-kilohm resistor connected to +5V
- Solder some wires to LED's to connect them to the breadboard, connect the cathodes (short leg) to ground through 220-ohm resistors, and anodes to edison pins 10, 11, 12.
- Solder some wires to piezo buzzer, connect one wire to pin 9, and other to gnd.
- Connect Edison pins 4, 5, 6, 7 to relay module pins, and +5V from edison to vcc on relay module board.

VIII. CONCLUSION

Aquaponics framework beats the disservices like Increase in labor costs, Dependence on place, overall high costs, and reliance on climate by giving a powerful framework to supply water to the plants and feed nourishment to the fishes.As indicated by the above proposed paper, the framework utilizes a computerized fish feeder and a water cleaning framework which makes the whole procedure practical and free of synthetic substances. The products developed by utilizing this framework are profoundly wealthy in the required supplements and are free of synthetics. This framework turns out to be extremely helpful as it requires less measure of room for the development and furthermore delivers a cost-effective at the end. Plants become naturally disposing of the considerable number of harms and misfortunes caused by the bugs and infections. This framework can be utilized in two modes, programmed mode can work most extreme without mediation or control from client and the gadget can work appropriately if the manual mode is running on the application android-based that support as IoT. Thinking about all the above benefits, we can presume that aquaponics is the best technique to develop plants and harvests naturally.

IX. REFERENCES

[1]. Automated Indoor Aquaponic Cultivation Technique, M.F. Saaid, N. S. M. Fadhil, M.S.A. Megat Ali, M.Z.H. Noor Faculty of Electrical Engineering, UniversitiTeknology MARA Shah Alam, Malaysia

[2]. Survey On IoT based Automated Aquaponics Gardening Approaches, Aishwarya K S, Dept of CSE, BMS College of Engineering, Bangalore, Karnataka, India, Prathibhashree S, Dept of CSE, BMS College of Engineering, Bangalore, Harish M, Dept of CSE, BMS College of Engineering, Bangalore, K Panimozhi, Dept of CSE, BMS College of Engineering, Bangalore

[3]. Smart Aquaponic with Monitoring and Control System Based On IoT, Wanda Vernandhes, N.S Salahuddin, A. Kowanda, Sri Poernomo Sari, Computer System, Faculty of Computer Science and Information Technology, Faculty of Industrial Technology, GunadarmaUniversity,Jakarta, Indonesia

[4]. IoT NFT Aquaponic System ControlerWithWebApp (Intel Edison & Node.js), Marjanovic_davor in Technology.

[5]. AQUADROID: AN APP FOR AQUAPONICS CONTROL AND MONITORING, Lean Karlo Tolentino, Technological University of the Philippines, Kyle Tristan Lapuz, Rubie Jayne Corvera, Allen De Guzman.

[6]. Pratomo, M, 1983. AlatdanMesinPertanian, DepartemenPendidikandanKebudayaan, Jakarta

[7]. Donald S. Bailey, James E. Rakocy, William M. Cole and Kurt A. "Economic Analysis Of A Commercial-Scale Aquaponic System For The Production Of Tilapia And Lettuce", Shultz University of the Virgin Islands, Agriculture Experiment Station St. Croix, U.S. Virgin Islands.

[8]. Andreas Graber, RankaJunge. Aquaponic Systems: Nutrient recycling from fish wastewater by vegetable production. Desalination, vol.246, pp. 147-1566, 2009.