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Water Management in Automated Aquaponics System Using LabVIEW

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Abstract: Maintaining the quality of the water quality is one of the important aspects that play a substantial effect on the aquaculture industry especially in the tilapia industry. The quality of the water needs to be continuously monitored as any deviation from the allowed critical parameters such as water temperature and potential of hydrogen (pH) can cause unwanted scenarios such as disease, stress, higher mortality rate and profit loss. Currently, the monitoring process adopted by most fish breeders is done manually by using a portable sensor. This approach is found to be very tedious, ineffective use of manpower and time consuming particularly for the large-scale aquaculture industry. Hence, this research focuses on developing a simple, low-cost automated water quality Aquaponics is a system which combines aquaculture and hydroponics the grows fish and plant together in one system. The fish excreta are rich in Ammonia, which is then biologically converted to Nitrates by good nitrifying bacteria. The nitrate-rich water is then supplied directly to the roots of the plants. Plants take up this nitrate as nutrients. Various sensors are calibrated for different measurements to provide accurate and reliable readings of land temperature, pH level, water level and humidity. Now lot of people are coming forward towards agriculture and hydroponics is a better method through which is less capital investment and huge production can be made possible. The fishery department is keen about the development of good projects by providing proper technical assistance and awareness to the farmers. So, in such a scenario improvising the current technology of water quality management through an automated window could soon contribute to a better production. Monitoring system for the industry via LABVIEW software.

Keywords: Aquaponics, Control, Monitoring, Automation, IoT, LABVIEW, Sensor, Pump, Motor, Farming

I.INTRODUCTION

This technique claims to have high water use efficiency, does not use pesticides and reduce the use of fertilizers, which make this technology green and sustainable. Since the interest in aquaponics is increasing, the major challenge is to do it feasible and reliable at commercial scale. The concept of precision farming usually applied in the traditional farming sense is now being introduced, leading to the need to adopt sensing, smart and IoT systems for monitoring and control of its automated processes. Lately, valuable contributions have been made towards the introduction of fully and semi-automated systems in small-scale Aquaponics systems by automation and manufacturing experts.

The system which is developed using this wireless sensor device can be used to sense and collect the information of the water pH level involved and the corresponding data can be stored in cloud data base. The autonomous indoor aquaponics cultivation technique 30percent protein produced by fish waste can provide almost all nutrients required for plant growth. The water filter system that available in the model will remove the unnecessary waste material from the water. To provide sustainability due to climatic changes in the system a set point is used to monitor the temperature in the tank using a temperature sensor.

II.PIC MICROCONTROLLER

The PIC microcontroller PIC16f877A is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A also have much application in digital electronic circuits.

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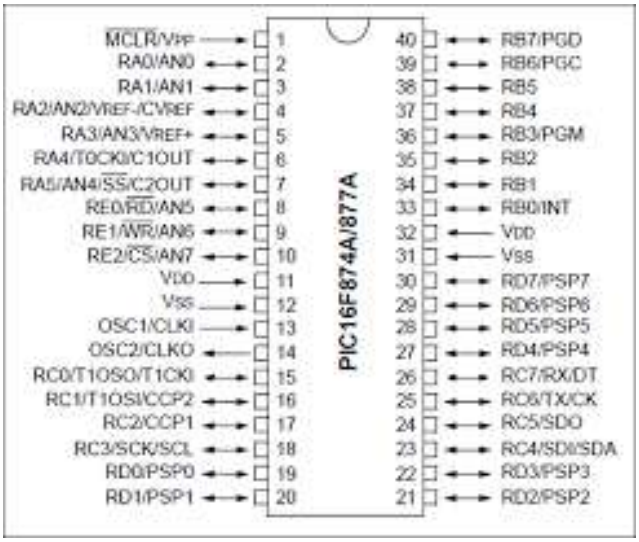
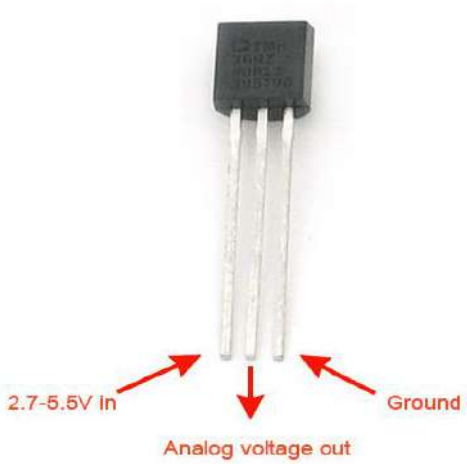


III.TEMPERATURE SENSOR

LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor does not require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy



IV.HUMIDITY SENSOR

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc.., to measure humidity and temperature instantaneously. DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

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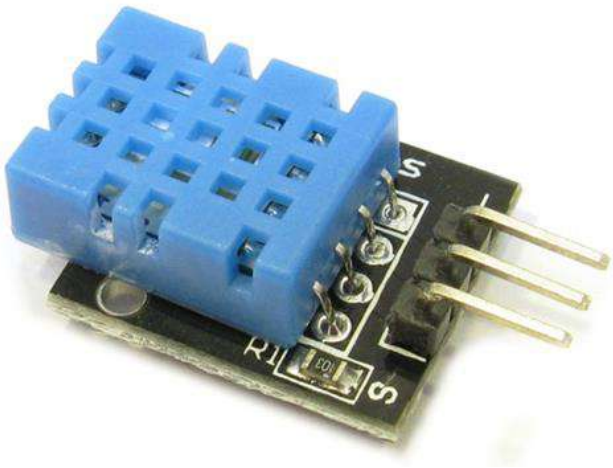
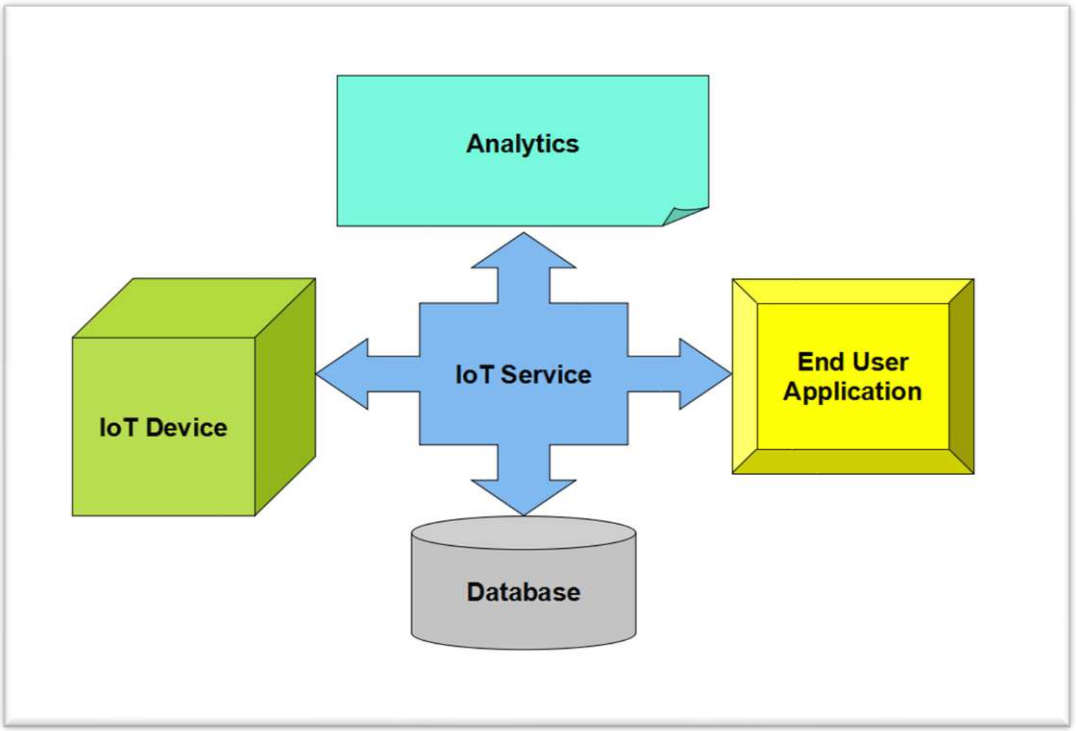


V.INTERNET OF THINGS

The Internet of Things (IoT) is a system of connected things. The things generally comprise of an embedded operating system and an ability to communicate with the internet or with the neighbouring things. One of the key elements of a generic IoT system that bridges the various 'things' is an IoT service. An interesting implication from the 'things' comprising the IoT systems is that the things by themselves cannot do anything. At a bare minimum, they should have an ability to connect to other 'things. But the real power of IoT is harnessed when the things connect to a 'service' either directly or via other 'things. In such systems, the service plays the role of an invisible manager by providing capabilities ranging from simple data collection and monitoring to complex data analytics. The below diagram illustrates where an IoT service fits in an IoT eco-system: One such IoT application platform that offers a wide variety of analysis, monitoring and counter-action capabilities is 'ThingSpeak'.



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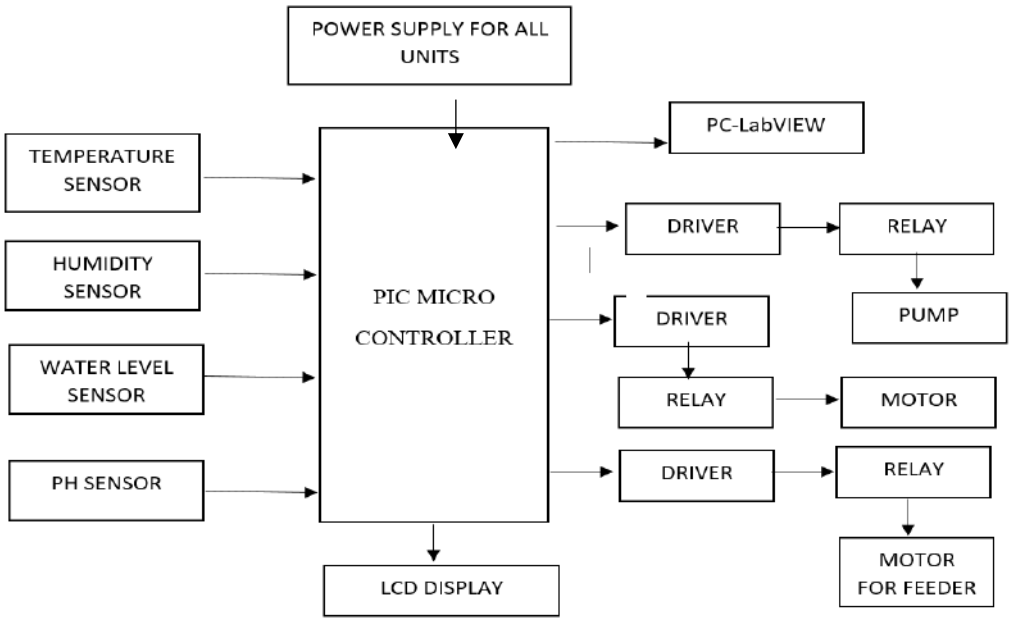
VI.BLOCK DIAGRAM OF THE SYSTEM



VII.HARDWARE PROTOTYPE

- Microcontroller-PIC16F877A
- Temperature sensor-LM35
- Humidity sensor-DHT11
- Water level sensor-Potentiometer
- pH sensor
- 12V-Water pump
- Electromagnetic Relay
- 16*2-LCD Module
- 12V DC Motor
- USB to TTL Converter-CP2102

This are the components we used to develop the aquaponics. The below figure depicts the hardware prototype that has been developed to realize the proposed methodology. The tests were conducted using the below experimental setup.

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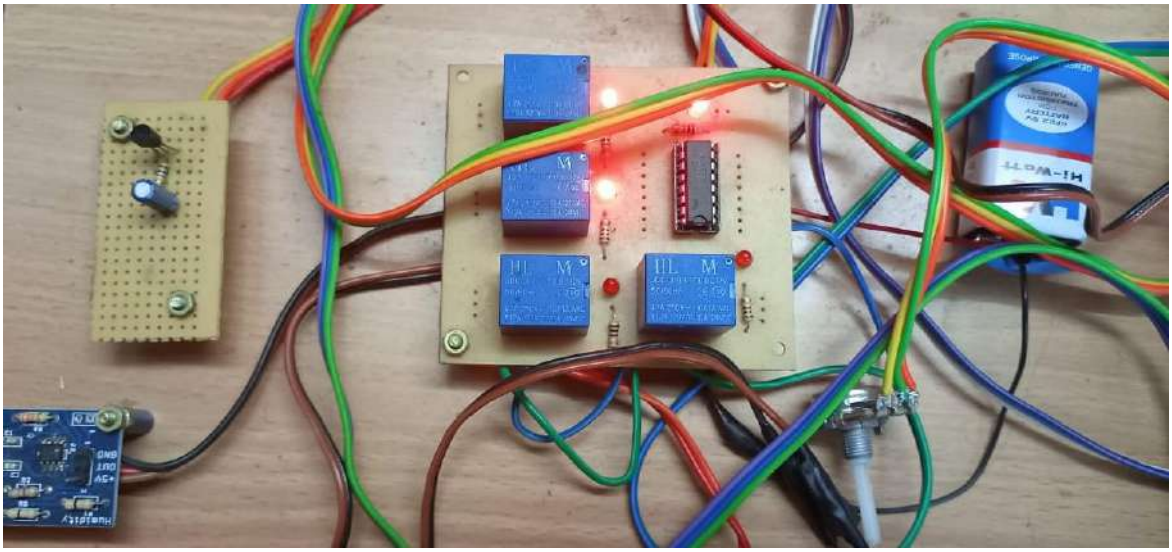

VIII.OPERATION

The main objective of an automated aquaponics system is to maintain and control various parameters of an aquaponics system by interconnecting various sensors and actuators to increase productivity. Automatic aquaponics that supervises the pH level of the water, temperature and humidity of the land and also the water level. This technique claims to have water efficiency, does not use pesticides and reduce the use of fertilizers, which make these technology green and sustainable. Water is conserved, and the nutrients are refused. Enables continuous and sustainable production. The system is simple, reliable and robust.

In our project we use temperature and humidity sensor to monitor the lands parameter in LABVIEW. Water level sensor is used to check the level of water in the land, if the level is decreased then the motor turned on automatically. In case of high-level water then using water pump the water is pumped out automatically. We use PH sensor to know the PH level of the water, if the water in the land is more Acidic or base then the water is pumped out automatically. These all-sensor Parameters will be displayed in the LCD and can be monitored.

IX.RESULT

The output of the Automated Aquaponics System:

- Using Microcontroller,Humidity,pH,Water level in the fish tank and Temperature in the atomosphere are measured using sensors and displayed in the LCD.
- Daily changes in the Humidity,pH,Water level and Temperature will save in the Labview for future reference
- If pH level in water is change to acidic the pump starts automatically and pumps out the acidic water to the agriculture land.
- If Water level in a tank decreases motor will start.Due natural calimities water tank may be increases beyond the water level pumps starts automatically and pumps out the water to the agriculture land.
- Using IOT, we can control and monitor the aquaculture at everywhere.
- Feeder mechanism is used to feed the food for fish in every 5 minutes.

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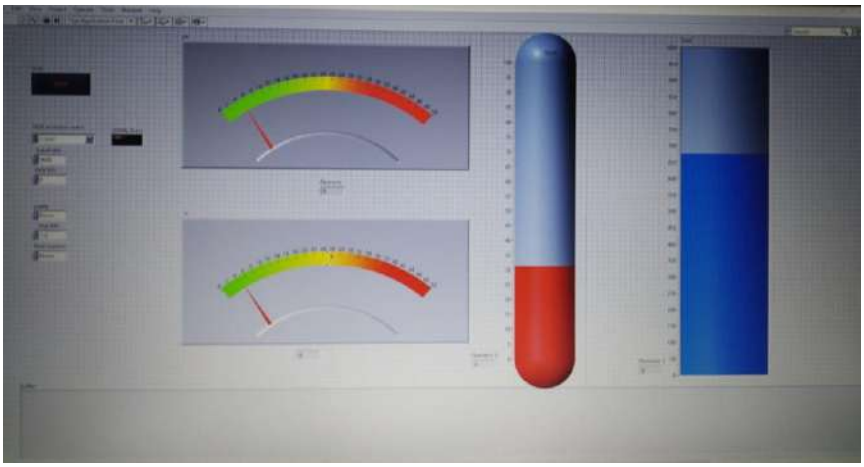
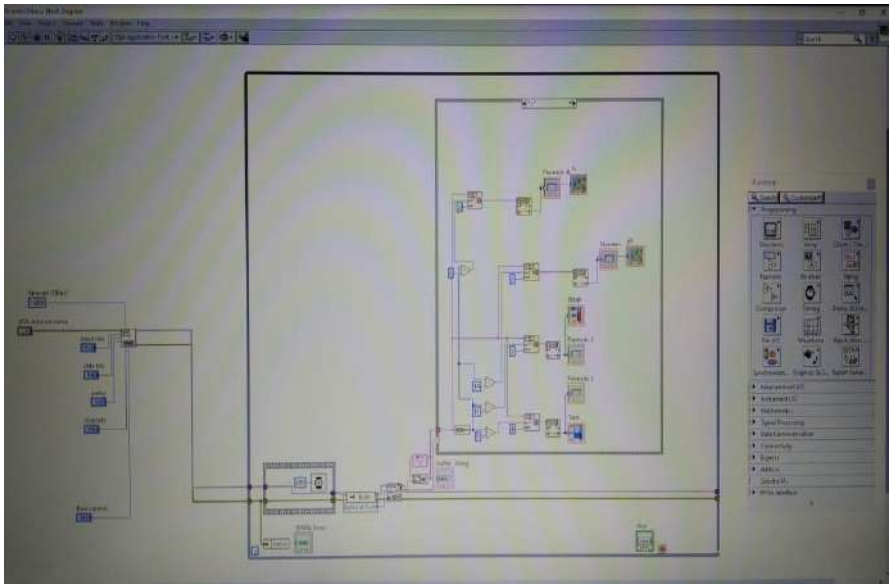
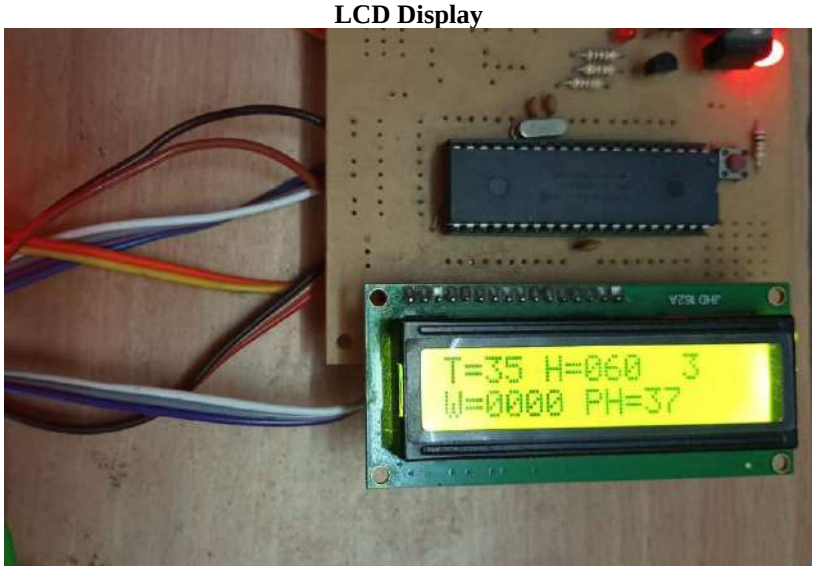
Front Panel



LabVIEW Block Diagram



LCD Display



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X.CONCLUSION

The techniques which are going to use in automation include those in agriculture as well as the small- and large-scale industries. After studying and understanding literature survey and other existing works, we proposed a technique that will gives us better understanding of the Environmental conditions. We also provide notification to the user about any error occurs in the devices. In this paper we are planning to eliminate most of the human interaction by providing intelligent system. Development of such system by using Internet of Things technology. By using this system, we can actually manage to make low cost, flexible smart homes to adjust its environmental conditions and resolve its errors with energy saving.

XI.FUTURE WORK

- There are many alternative species that can used in aquaponics besides fish. Crayfish,ducks,turtles,shrimp and many more provide the nutrients for plants to grow in.
- Fixing aquarium heaters in fish tank for ornamental fish. A tank temperature of 78^0 F temperature need to be maintained for ornamental fish.
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XII.REFERENCE

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