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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# IoT Based Organic Farming by Using Aquaponics Method

Mr. S. Ismail Saheeb<sup>1</sup>, A.B. Kumara Swamy<sup>2</sup>, SKM.Khamar Taj<sup>3</sup>, P. Sada Siva Reddy<sup>4</sup>, P. Nagaraju<sup>5</sup>,  
K. Nagaveni<sup>6</sup>

Assistant Professor, Dept. of E.C.E., GATES Institute of Technology, Gooty, Anantapur, Andhra Pradesh, India <sup>1</sup>

UG Student, Dept. of E.C.E., GATES Institute of Technology, Gooty, Anantapur, Andhra Pradesh, India <sup>2,3,4,5,6</sup>

**ABSTRACT:** Agriculture is one of the important sectors in India. Food is a basic need of every person. But traditional farming has drawbacks of being dependent on soil quality, climate conditions, chemical fertilizers and pesticides water. To overcome the problems of traditional farming problem there is one technique called Aquaponics which is combination of aquaculture and hydroponics. Aquaculture deals with growing of fish and hydroponics deals with growing of soilless plants by providing with necessary nutrients.

Aquaponics system which will provide natural food for the country. It will provide fish as well as plants too for humans. As using this technique water is reused, it requires less space, user gets natural food. Aquaponics can be automatically managed and controlled by making use of IOT technology with the help of sensors like pH, temperature and humidity, dissolved solvents, water level sensors. Operating the sensors on microcontrollers like NodeMCU whose reading can be obtained on Thing Speak application for monitoring purpose. This technique can be built indoor as well as outdoor system. Sensors reading can be further used for research purpose.

**KEYWORDS:** ESP 32; DS18B20; pH Sensor; Water level sensor; LCD; Relay, AC pump

## I. INTRODUCTION

Aquaponics is an eco-friendly system for food production utilizing aquaculture and hydroponics to cultivate fish and crop without soil. In an aquaponics system, fish waste (ammonia) is fed into the plant bed which acts as a bio-filter and takes the nitrate which is essential to grow vegetation. The fresh new water is then returned to the fish enclosure to restart the cycle. Conservation of water is accomplished by recirculating water between the plant bed and the fish habitat continuously. Organic fertilization of plants using dissolved fish waste is the other benefit of Aquaponics. IOT in aquaponics system helps in better crop management, better resource management, cost efficient agriculture, improved quality and quantity and crop monitoring etc can be done.

The IOT sensors used in system are pH sensor, Temperature and Turbidity sensor etc. The given system is a simple architecture of IOT sensors that collect information and send it over the Wi-Fi network to the server, there server can take actions depending on the information. The systems uses Internet of things (IOT) technology to configure and deploy smart water-quality sensors that provide remote, continuous, and real-time information of indicators related to water quality, on a graphical user interface (GUI). Continuous monitoring of this data, and making necessary adjustments, will facilitate the maintenance of a healthy ecosystem that is conducive to the growth of fish and plants, while utilizing about 90 percent less water than traditional farming.

## II. LITERATURE SURVEY

N Hari Kumar et al. [1] stated that the hydroponic system is often implemented as a self-regulating system utilizing a wireless sensor network, which features a WSN open standard called 6LoWPAN. The system developed using the wireless sensor device are often wont to sense and collect the knowledge of the PH value of the waterand therefore the compatible data are repeatedly stored on a cloud database. Compared with the normal Aquaponics system, this technique requires almost no manual intervention.

Megumi U et al. [2] said that in a tiny area, we used hydroponics to grow plants. VEGILAB is used in an inside system for growing vegetables, which may solve some basic problems, like high-priced producing costs, finite growth, and food class.

Wang et al. [3] present an intelligent track system supported open WRT, and proposed pH value, water flow, sonar sensor, and digital temperature sensor, also as signal adjustment and feedback control. this is often an intelligent

interactive application during which the information collected by the webcam and certain sensors are going to be investigated and processed with a human-machine interface. The hardware contains Arduino Uno and the WRT node.

“Rodrigo S et al. [4] proposed a solar automatic hydroponic system, which is low-cost and more suitable for society. This system includes four modules:

- 1) Water circulation system
- 2) Fish and vegetable symbiosis control and tracking system, using Arduino microcontroller with sensor, actuator, GSM module, and NI LAB VIEW interface, the system allows plants and fishes an interdependently growing and reserved environment.
- 3) For system power solar energy is used.
- 4) The temperature maintains by using cooling systems like ac and heating system like heater of air and water, so it's very kind for the expansion of herbs and fish.

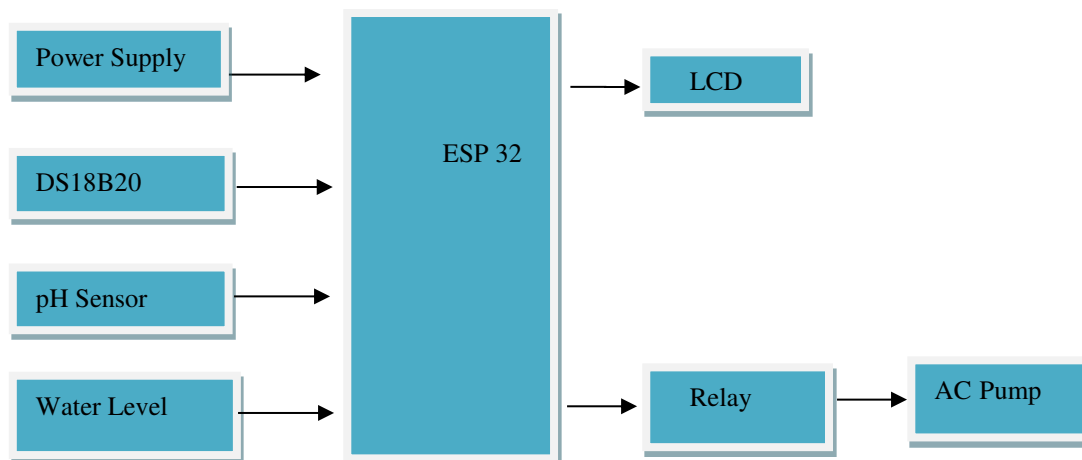
### III. EXISTING SYSTEM

In today’s time the world has faced many health issues because of unavailability of natural food. Also, the artificial fertilizers and chemicals are used for the fast growth of plants due to which the soil loses its original nature and it takes years to regain that back. Farmers have no alternative than to grow plants artificially with the help of chemicals and fertilizers available.

### IV. PROPOSED SYSTEM

In the proposed system design, the quality of water in aquaponics system is monitored by monitoring the parameters such as temperature, pH value& Turbidity. These parameters are measured using the respective sensors. The values are measured in a particular interval and the measured values are sent to the ESP32 Microcontroller. The core processor processes the parameters received and if the parameters are exceeding the threshold values it activates the corresponding relay and start motor. All values are sent on Google cloud and stored in Real-time database. These values are monitored by authorized person using mobile application. The main objective of this system to know the prevailing available Aquaponics system executed using several technologies as well as presents a unique and intelligent Aquaponics system that has all the requirements and doesn’t require human intervention. The most technology used is that Internet authors use machine learning and machine learning (automatically feed fish at regular intervals) to automatically supply water to plants by employing a connected system. The nutrients employed by plants during this technique are by-products of fish poop and leftover food of fish.

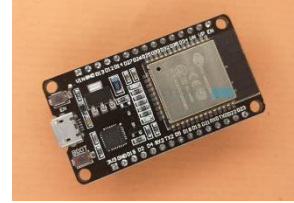
#### BLOCK DIAGRAM





### ESP 32

ESP32 based boards come in a variety of shapes and sizes and pinout of each board is different to other. Also, not all pins of the ESP32 Microcontroller SoC will be available on a development board as some pins might be permanently tied to a dedicated function. One such case is the Flash Memory. We know that all ESP32 boards come with 4 MB of Flash Memory to store the programs. So



### DS18B20

This is a pre-wired and waterproofed (with heat shrink) version of a 1 Wire DS18B20 sensor. Handy for when you need to measure something far away, or in wet conditions. While the sensor is good up to 125°C the cable is jacketed in PVC so we suggest keeping it under 100°C. Because they are digital, you don't get any signal degradation even over long distances! These 1-wire digital temperature sensors are fairly precise ( $\pm 0.5^\circ\text{C}$  over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them. Usable with 3.0-5.0V systems.

The only downside is they use the Dallas 1-Wire protocol, which is somewhat complex, and requires a bunch of code to parse out the communication. If you want something really simple, and you have an analog input pin, the going. We toss in a 4.7k resistor, which is required as a pullup from the DATA to VCC line when using the sensor. We don't have a detailed tutorial up yet but you can get started by using the Dallas Temperature Control Arduino library which requires also the One Wire Library.



### pH Sensor

Analog PH Sensor Kit with PH Electrode Probe is Compatible for Arduino. The pH stands for the power of hydrogen, which is a measurement of the hydrogen ion concentration in the body. This is used in Water quality testing and Aquaculture. The total pH scale ranges from 1 to 14, with 7 considered to be neutral. A pH less than 7 is said to be acidic and solutions with a pH greater than 7 are basic or alkaline. The PH electrode has a single cylinder that allows direct connection to the input terminal of a pH meter, controller, or any pH device which has a BNC input terminal. The pH electrode probe is accurate and reliable that can give almost instantaneous readings. This Kit is specially designed for Arduino controllers and has a built-in simple, convenient and practical connection and features. It has an LED which works as the Power Indicator, a BNC connector and PH2.0 sensor interface. To use it, just connect the pH sensor with BND connector, and plug the PH2.0 interface into the analog input port of any Arduino controller. If pre-programmed, you will get the pH value easily.

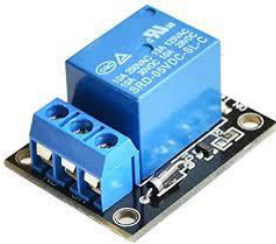


### Water Level Sensor

Level sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. Fluids and fluidized solids flow to become essentially level in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak. The substance to be measured can be inside a container or can be in its natural form (e.g., a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally, the latter detect levels that are excessively high or low.



There are many physical and application variables that affect the selection of the optimal level monitoring method for industrial and commercial processes. The selection criteria include the physical: phase (liquid, solid or slurry), temperature, pressure or vacuum, chemistry, dielectric constant of medium, density (specific gravity) of medium, agitation (action), acoustical or electrical noise, vibration, mechanical shock, tank or bin size and shape. Also important are the application constraints: price, accuracy, appearance, response rate, ease of calibration or programming, physical size and mounting of the instrument, monitoring or control of continuous or discrete (point) levels.

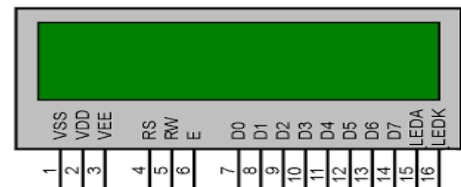


### Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations

### LCD

To display any character on LCD micro controller has to send its ASCII value to the data bus of LCD. For e.g., to display 'AB' microcontroller has to send two hex bytes 41h and 42h respectively. LCD display used here is having 16x2 size. It means 2 lines each with 16 characters.



### AC Pump



We know that the main function of an electric motor is to convert the energy from electrical to mechanical. There are different types of electric motors available in the market like ac motor and dc motor where its classification can be done based on different parameters like type of power source, output motion type, construction & application. These motors operate through the interaction among the magnetic field of the motor & the flow of current within the winding of a wire to produce force in the torque form that is applied on the shaft of the motor.

These motors can be power-driven through AC (alternating current) sources or DC (direct current) sources, where ac sources are inverters, power grids, generators, and dc sources are rectifiers, batteries. Electric motors are more efficient as compared to other prime movers utilized in transportation, industry & the ICE (internal combustion engine). This article discusses an overview of one of the types of electric motor like AC motor and its working.

An electric motor like an AC motor works with an alternating current to generate mechanical energy through magnetism blended with AC. The AC motor structure includes coils to generate a rotary magnetic field within an attached rotor toward an output shaft so that a second magnetic field can be generated.

## V. EXPERIMENTAL RESULT

The values of ph, temperature and motor is shown in Google cloud platform i.e. Google Firebase as shown in fig 3. We use the service Realtime Database of Google firebase to store data. This data is remotely accessible thus keeping the users aware about the current status at any instants of time. In order to make this data available a software routine is written and flashed on ESP32 microcontroller. This software routine enables the microcontroller to establish a wi-fi connection.

## VI. ADVANTAGES AND APPLICATIONS

1. It can be implemented in gardens or nurseries even in balconies with minimum cost and resources. Also helps in proper utilization of the available resources and helps in avoiding wastage of electricity and water.
2. Can be easily configured and scaled up to work on larger fields.
3. Provides a user-friendly interface hence will have a greater acceptance by the technologically unskilled workers. The system is more compact compared to the existing ones, hence is easily portable and low cost. Advancements in sensor technology and control systems allow for optimal use of resources. Our aim is to design and develop newer techniques

that will allow garden automation to flourish and deliver to its full potential. Thus it can be concluded that the proposed project will lessen labour, conserve water, increase crop yield, provide maximum automation and benefit the society by adopting the fast-growing IoT (Internet of Things) to implement newer and sustainable ways of farming.

## VII. CONCLUSION AND FUTURE SCOPE

This paper shows the result of our proposed system for monitoring the water quality in the aquaponics system using technology. It is important to have a good water quality in the aquaculture for producing good yield of fish. If the water quality is not maintained properly the fishes will die. Hence, in this work a system has been designed using ESP32 Microcontroller and different sensors like Temperature sensor, pH sensor. These sensors measure the corresponding value in the water and the values are sent to the microcontroller for processing. If the values measured are not in the desired level, then corresponding relay is activated to turn on motor. Also, the measured values are sent to the Google firebase cloud and display on application to inform the present situation. The measured values are continuously monitored through IOT.

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