Smart Aquaponics Farming Using Internet of Things

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ABSTRACT

In agriculture and water-based business farmers and business owners face problems with the scarcity of fertile land, extreme weather impacting agricultural production insufficient supply of water high cost of maintenance due to excessive dependency on manual processes difficulty in monitoring farm operations 24/7 insufficient information regarding ideal conditions for agriculture aquaponics proposed system is introduced - an Internet of Things and big data-enabled aquaponics and water monitoring system that builds the symbiotic relationship between plants and fishes thus enabling sustainable farming aquaponics is of food production technology combining fish farming with hydroponics vegetable growing in practice fish release feces in the water beneficial bacteria transformed these excrements into fertilizers for plants by consuming these fertilizers plants purify the water and make it suitable again for the fish smart right but water-based agriculture is very sensitive to pH level water temperature oxygen to nutrient levels thus farm owners deploy human resources to take vital readings every six hours as failure to proactively capture issues can severely damage the cyclical system to address these challenges proposed a smart aquaponics and aquaculture system which is simple long-lasting and has persistent connectivity based on wireless technology allows 24/7 remote monitoring of chemical compositions through accurate IOT sensors temperature, pH, electrical conductivity automates fish feeding and dosages, control water and air pump systems, monitors ambient air condition, temperature, humidity, educates aquaculture practitioners through simulations has built-in intuitive reporting that can be integrated into existing agricultural and greenhouse systems our indigenous system stimulates local and sustainable production contributing to a circular you reduce smart aquaponics can also be used in other water-based businesses like swimming pool aquaculture and water quality monitoring.

Keywords: *Aquaponics system, hydroponics, fish farming, internet of Things, Machine Learning*

I. INTRODUCTION

The aquaponics system is the successful integration of aquaculture and hydroponics system. in aquaculture, the fish are fed fish arrays that either ponds or tanks or enclosures and the fish are fed and the fish, of course, produce waste and dealing with that waste becomes a real problem in aquaculture systems; very elaborate filtration systems are used to try and keep the water pure, but eventually, the water has to be discarded and the water is pumped out into dams or into rivers or local streams or some way have been disposed of which can become a problem. hydroponics has a similar problem in that hydroponics use uses nice clean water that they add nutrient chemicals to and as it is circulated and the plants are grown some of those nutrients become out of balance and eventually that water nutrient mixture has to be replaced and water has to be discarded and once again that nutrient rich water is discarded in creeks or rivers or dams or and some kind of implosion it becomes a problem for those kind of technologies but in aquaponics we don't have those problems because we can continuously never-ending and recirculate the work because the water has comes from the fish tank nutrient-rich those nutrients are converted by good bacteria to nutrients that the plants can use the plants consume the nutrients and the water is returned to the fish tank clean for the fish to use it again so it's a closed-loop system and that must be understood from day one and that's what makes aquaponics so absolutely wonderful especially in a dry thirsty land like Australia where water is at our absolute minimum we can produce to have a high density food production system that produces both plant matter and fish in the one system to the absolute minimum of water usage.

II. LITERATURE SURVEY

Hari Kumar et al [1] say the aquaponics system can be done as a self-regulating system with the help of a wireless sensor network with an open standard of WSN called 6LoWPAN. 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 the cloud database. This system requires very little human interaction when compared to the traditional aquaponics system. Megumi U et al [2], says that in a small place we can grow the plants using the idea of aquaponics. VEGILAB is mainly an indoor system that grows vegetables, to overcome fundamental issues such as expensive manufacturing cost, limited growth, and food quality. Wang et al [3] proposed the system for remote monitoring and remote controlling Based on OpenWRT, which Propose about pH, water flow, sonar sensor, and digital temperature sensors, as well as signal conditioning and closed-loop control. This is a smart interactive application, where the data that are gathered by webcam and some sensors are investigated and processed for human-machine interface. The hardware consists of Arduino UNO and WRTnod, and WRTnode is based on Wi-Fi Access Point, which is an open-source development board hardware. M.F. Saaid et al [4] studied that in Autonomous Indoor Aquaponics Cultivation Technique, 30% protein produced by fish waste can provide almost all nutrients required for plant growth. Auto fish food feeder is used in the system to provide automatic food for the fish that helps to maintain the growth rates of the fishes. The water filter system that is available in the model will remove the unnecessary waste material from the water. To provide sustainability due to climatically changes in the system, a setpoint is used to monitor the temperature in the tank using a temperature sensor. The sensed values will be received by the Arduino Uno which responses by regulating the water temperature using a heater coil. Hence this setup works unaffected by the climate change issues.

III. PROPOSED ARCHITECTURE

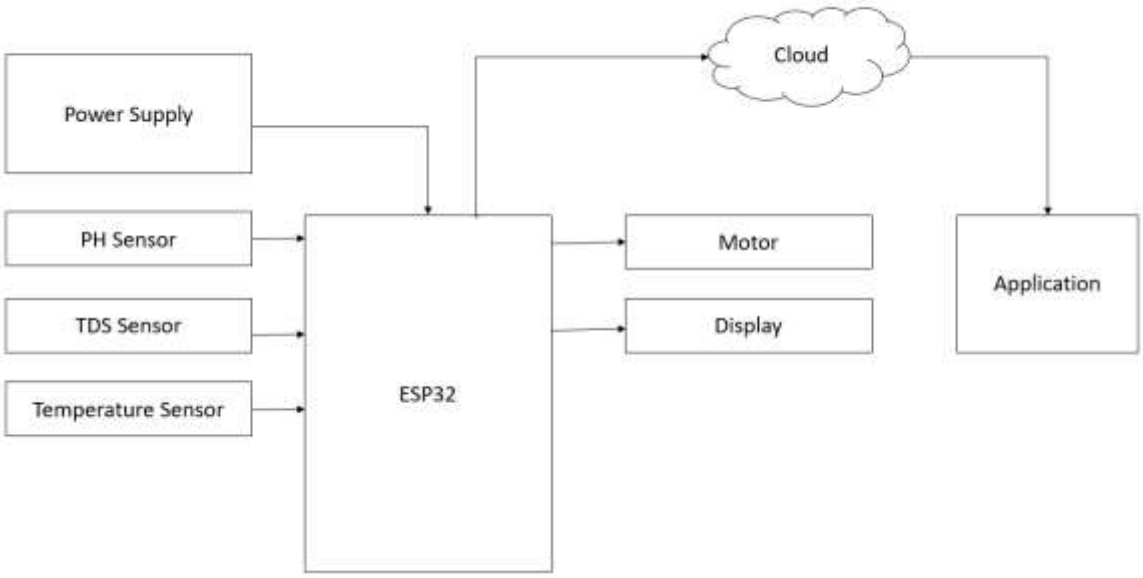

Figure 1 - System Architecture

The main goal of this system is to understand the existing available aquaponics systems implemented using various techniques and to propose a novel smart aquaponics system with all the requirements and very-less human intervention with the system.[7]The main technology used is the Internet of Things and machine learning by which the authors have automated fish feeding at a regular interval of time, automated water supply to the plants is done by using a connected system. Nutrients that plants use in this system are a byproduct of fish waste and uneaten fish feed.

In proposed aquaponics there are 2 modules namely 1) Automatic water supply, food feeding, and grow lights 2) cloud and application. The first module has three features out of which the first one includes supply water to the plants and checks the water level in the aquarium and turn on and off the pump, second is supplying food using food feeder and the third is control grow-lights. The second module use for connectivity, cloud storage, and mobile application for remote monitoring and controlling.

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In the proposed system, various services of Amazon AWS are utilized like Simple Storage service to store application data, datasets, Amazon DynamoDB is used as a database to store data, Amazon Elastic beanstalk to deploy python application. Mobile application for end user developed using Flutter framework and Dart programming language. Flutter is the latest framework developed by Google for building attractive, natively compiled mobile and web applications from a single codebase.

IV. CONCLUSION

In comparison to traditional agriculture, smart and connected agriculture uses about 40% less energy per unit crop yield. The proposed system promises economic strength for farmers to lead a superior quality of life. The concept of the smart and connected farm with aquaponics and vertical farming is soon to be a reality. A green, smart, user-friendly infrastructure that provides autonomous decision making and control is the need of the hour. The proposed Internet of Things and machine learning-based automated farming system using the wireless technique is a real-time feedback control system that monitors and controls all the activities of the farm efficiently.

V. REFERENCES

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