Survey paper on aqua robotics urban farm system

Science, Biology

Aqua RUFS is a system which combines the aquaculture & hydroponics that grows fish and plants together in one system. There are 6 goals to achieve: 1st goal is to automate fish feeder this is done with the help of a servo motor. The timer is already set earlier in the program itself. So when the defined time is encountered the servo will rotate and thus food is fed to the fishes. 2nd goal is to supply excretion of fish to the plants through regular water supply. And this water contains all necessary nutrients that plant can need. 3rd goal is to use led grow lights instead of sunlight because this an indoor plant farming. 4th goal is to replace the dirty water in aquariums every 3 months automatically based on PH value. 5th goal is to upload the data acquired from the sensor system to Artik cloud, an IoT analytics platform service that provides real-time data visualization and analysis. 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. 6th goal is to maintain the temperature of water in the aquarium. Our responsibility in this project is achieving all these 6 goals.

Introduction

In our opinion, the practitioner’s primary purpose of an aquaponics systems is to grow plants to feed humans. The fish excretion is converted into plant fertilizer. Aquaponics is a simulated ecosystem, more precisely, a simulated freshwater ecosystem. Aquaponics is the combination of aquaculture and hydroponics. In these semi-closed systems, water flows between an aqua culture fish tank and a plant growing bed. The fish waste in the water is used to supply nutrients to the plants. The plants and micro-organisms clean the

water that is returned to the fish tank. This provides a mutually beneficial environment for both the fish and the plants, and results in two crops.

Aquaponics systems allow you to place plants closer to each other than normal which saves a lot of space. Aquaponics systems don’t encourage the growth of weeds because there is no soil used to grow plants. The fact that aquaponics systems constantly recycle or re-circulate water means that we don’t need to water the plants and plants have access to nutrients 24 hours makes them grow faster. The generic food and vegetables found in stores contain so many different chemicals which is hazardous to people’s health. Aquaponics is one of the best as we don’t use chemicals. In summary, aquaponics systems have numerous benefits. The systems make gardening more productive and economical. Anyone interested in a cost effective and healthy gardening at home should consider having an aquaponics system at home.

Related study

N Hari Kumar et al says how to build an efficient internet of things (IOT) application for aquaponics in order to create an autonomous, self-regulating system with the help of Wireless Sensor Network (WSN). An open standard of WSN called 6LoWPAN. The system which is designed using this sensor device can be used to sense and collect the information of the water quality involved and the corresponding data can be stored in the cloud database. This system requires very less human interaction when compared to the traditional technique.

Megumi U et al says that in small place we can grow the plants using the VEGILAB technique and Aquaponics system. The VEGILAB is an indoor system which grows vegetable in minimal spaces using LED lighting, to overcome the fundamental issues such as expensive manufacturing cost, limited grow and food quality.

M. F. Saaid et al studied that in Automated Indoor Aquaponics Cultivation Technique, 30% crude protein produced by fish waste can provide almost all nutrients required for the plant growth. Auto feeder is used in the system to provide food for the fish that helps to maintain the growth and survival rates of the fishes. Filter system that is available which removes the waste materials and breakdown products from the water. To provide sustainability due to climatical changes in the system, set point is used which gives desired value needed by user to monitor the desired water level, the monitored temperature in the fish tank. The sensed values will be received by the Arduino which responses by regulating the water temperature using a heater. Hence this setup works unaffected by the climatical issues.

Rodrigo S et al proposed an automated solar powered Aquaponics system that is designed and implemented in cost effective and more ideal for the society. The system designed consists of four modules:

1. Water recirculation system which circulates the water to aquaculture and hydroponic beds;
2. Aquaponics control and monitoring system using Arduino interfaced with sensors, actuators, GSM shield and NI LabVIEW that allows plants

and fish to grow together in an interdependent and controlled environment;

3. Solar energy conversion that powers the entire system using renewable energy source;
4. Cooling and heating system that maintain the air and water temperature, so it will be helpful for the plants and growth of the fishes.

N. R. Mohamed et al proposed an Aquaponics System using Solar Powered to Control the water and air Pump based on Peripheral Interface Controller (PIC) technology. It also involves a combination of the electrical, electronics and agricultural aspects into one system which consists of the water pump, air pump, inverter and solar panel. Solar panel will produce electricity. In this microcontroller is also used to control the operation of the aquaponics system for switching on/off water pump, battery charge and the discharge state.

Abel J Duarte et al aimed at mimicking the natural environment to successfully apply and enhance the natural cycle in the indoor aquaponics system. By having the knowledge on the natural cycle, it was possible to create a system with the support of the electronics to provide an artificial environment that is more like a natural environment. The authors have also mentioned the benefits it can bring to the society or to the current market. The team used CAD drawings for the prototype design and assembled all the components and tested the electronics comply with the budget.

M. N. Mamatha and S. N. Namratha proposed that the fish are feed with commercial pelleted feeds containing 30% crude protein which can provide almost all nutrients required for the plant growth. Auto feeder place major role in this system used to maintain the growth and survival rates. Filter systems used to remove the amount of waste materials and breakdown products from the water. The set point will be the desired water level, the monitored temperature in fish tank, at plant area and the desired amount of food. While arduino function as a brain that used to receive the information from the sensor and come out with an instruction in term of response as the feedback. Then the action will be based on the actuator that was reacted towards the act received.

P. C. A De Silva introduces an Internet of Things (IoT) architecture for soil-less food production systems. The main objective of this paper is to design and introduce a frame work that automatically collects big data from distributed soil-less food production systems and perform background analytics to adaptively control the water quality of each food production system. In this work they have analyzed the requirement of fuzzy logic controllers for water quality control and streamline distributed soil-less food production systems. This architecture enables to deploy fail proof distributed smart farms that can be deployed in urban and/or rural areas to cater to growing food demands with minimum human intervention.

Fareed Ismail and Jasson Gryzagoridis says that It is a well-known fact that stand alone photovoltaic systems operate inefficiently due to overheating or once the batteries reach their charged capacity excess energy is dumped.

More efficient use of such systems is required to make this technology more affordable which led to the development of the Modular Solar Powered Aquaponics System (MSPAS). MSPAS makes use of solar energy such as photovoltaic to generate electricity and solar thermal energy to heat the environment of an aquaculture unit. The effluent from this unit is directed to a hydroponics unit (for the growth of vegetables). The prototype has already yielded good crop growth resulting in 30 % faster growth rate for some vegetables. A pilot prototype has been rolled out into an impoverished community resulting in trials and tribulations which are yielding good results. This paper seeks to address the possibilities of combining existing technology with new technologies to empower impoverished communities.

Ralf Biernatzki and Rolf Meinecke says that this paper focuses on the development of closed greenhouse concepts and application of that technology to aquaponics systems. At first, aquaponics systems and closed greenhouses with (thermal energy storage) TES are described. Then, TES in abandoned mines are discussed. Finally, ongoing research on aquaponics systems at the South Westphalian University of Applied Sciences, Soest Campus, will be presented. The aim is to develop a concept for a prototype aquaponics system in the Ruhr-district in North Rhine-Westphalia at an abandoned coal mine in order to use mine water for heating the aquaponics system, improving the energy balance significantly.

Wanda Vernandhes says with some light, temperature, and humidity manipulation of the plant is applied to indoor systems. The agricultural cultivation technology with indoor aquaponics provides an alternative for

anyone who has no land for framing with technology using the concept of Internet of Things has more advantages compared with conventional farming. Proposed system The main goal of this paper is to understand the existing aquaponics systems implemented using various techniques and to propose an analytical and automated based aquaponics system with all the necessary requirements and very less human intervention with the system. The main technology used is IOT by which the authors have automated fish feeding at a regular interval of time, automated water supply to the plants is done by using sensors. Nutrients are sent to plants which are the byproduct of fish waste and uneaten fish feed. We also use grow lights to enable plant growth and a backend tank or sump tank, the fish tank water is exchanged by having new water pumped in from the back-end tank every 3 months. The main task is analyzing the following:

1. Measurements made on water level
2. Change in plant length
3. Photographs taken during the experiment to monitor the progress of the cultures
4. Percentage change in the total measurements from the start to the end of the experiment.

In proposed aquaponics there are 5 modules namely

1. Automatic fish food feeder
2. Automatic water supply
3. Usage of grow lights
4. Collecting cloud information

5. To replace the dirty water in aquariums every 3 months automatically.

Automatic fish food feeder

The flow chart describes automated fish feeder. As a basic requirement of living beings, fish requires food for its all-round growth and development. Automatic fish feeder serves the above purpose with the help of the servo motor. The servo motor is connected to Arduino in which the two feed timings are set earlier in the program. When the defined time encounters the servo will rotate so, that the food is fed to the fish from the container which is attached to the servo.

Automatic water supply

The first module, automatic water supply that supply water to the plants and checks the water level in the aquarium. Plants require certain amount of specific nutrients for their growth, the supplied water contains all the necessary nutrients in required quantity. This water is fed to the plants at regular intervals of time. These nutrient values can be stored in the cloud database which will be helpful to check the number of days after which fresh water can be re-pumped to the tank.

Usage of grow lights

Grow light LEDs are plant lights that are widely implemented on indoor plantations. Grow light LEDs can replace the spectrum of sunlight so plants can photosynthesize well. Led Grow Light with Full Spectrum is designed to be optimal in stimulating plant growth.

Collecting cloud information

Samsung ARTIK is the integrated IoT platform that provides the fastest path to deliver secure, interoperable, and intelligent IoT products and services. Samsung ARTIK: Unifies hardware, software, cloud, security, and partner ecosystem in a single integrated offering. Hides the inherent complexity of IoT behind easy to use, open, and enterprise grade APIs, SDKs, and tools. Enables any device to interact with any 3rd party device, app, or service. The module is configured with AT commands and the microcontroller should be programmed to send the AT commands in a required sequence to configure the module in client mode. The module can be used in both client and server modes.

To replace the dirty water in aquariums

5th module is an automated pump which will fill the aquarium from backend tank. If the level of water is less than the threshold level, it will send that value to the Arduino. This in turn triggers the relay and as a result water will be pumped to the aquarium from backend tank.

Conclusion

Aquaponics is efficient sustainable and over all the best solution to feed the world. It is easy to run and uses much less water than traditional farming and genetically modified products and will allow us to see to the needs of food security at a faster rate than what a solution such as food waste management would. Food produced within Aquaponic systems are rich in nutrients, and unlike genetic modification have no potential risks to the health of both the environment and those consuming the produce.

Aquaponics currently have a small number of flaws although they are minor and with further research and investigation can be easily overcome.

In conclusion, it is vital that we as a society begin to look toward better food producing methods. If society continues to overlook our current situation and continues on using unsustainable and inefficient methods, the future of both our environment and agricultural industry may see a downfall. There are many different ways to fix the issue of food security, but realistically aquaponics is the most environmentally friendly and efficient way of farming, that could easily satisfy the needs of all people and suit all climates around the world.