EasyChair Preprint

№ 3728

Automated Aquaponic System for Indoor Gardening

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July 3, 2020

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ABSTRACT -Aquaponics is the eco-friendly system which is used for the production of food by utilizing certain concepts such as aquaculture and hydroponic. These methods ultimately help us to cultivate fish and crops without the vicinity of soil . The growth performance of a fish along with certain leafy vegetables will be tested and the result will be estimated during the recirculation of the system with respect to the temperature and the effective use of the fish excretion. Arduino usually acts as the brain of the system and that being used in aquaponic helps us to receive the information from the sensors and reciprocate as instructions with respect to feedback. Later, actions will be initiated based on the systems actuator. Aquaponics is an inexpensive symbiotic cycle between the living organism and the crop. In this system Fish excretion (ammonia) is incorporated into the plant bed which in turn acts as the biofilter and grasps the nitrate that is crucial for vegetation. Then the fresh water is returned to restart the cycle. The Fish is fed with pellets that contains 30% of the crude proteins that enhances almost all the nutrients that are required for efficient plant growth.

Keywords- Aquaponics,Aquaculture,Arduino,Internet-Of-Things,Indoor farming

I.INTRODUCTION : A system of aquaculture in which the waste produced by farmed fish or other aquatic creatures supplies the nutrients for plants grown hydroponically, which in turn purify the water. It is an symbiotic ecosystem for the living organism and the plant. Aquaponic system continuously detects and estimates the state of the symbiotic ecosystem and lay holes of the restorative activity to balance the abnormality based on the data given and diverge from the accumulated data to improve the circumstance and risks for the arrangement of the fish. The parameter in aquaponics include temperature , intensity of light , amount of food , etc. The light and the feeder for the fish are managed by the user.

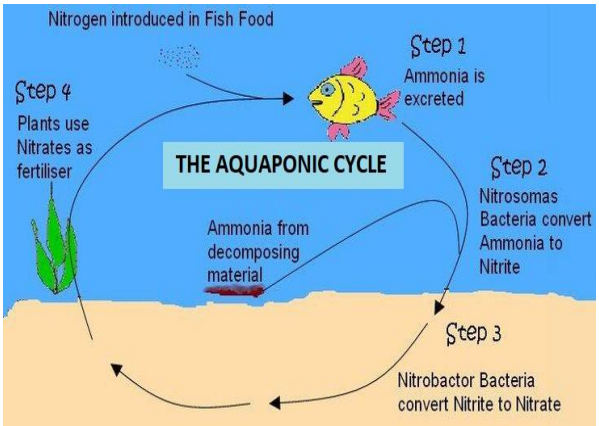


Fig 1. Aquaponic cycle

People have decided to cultivate by themselves and the equations given below are the once that happened during the cycle.

R-NH2 + H20 □ NH3 + R--OH + energy

2NH3 + 2O2 (in the presence of Nitrosomonas) □ 2N02- + 2H20 + 2H+

2NO2- + O2 (in the presence of Nitrobacter) □ 2NO3- + energy

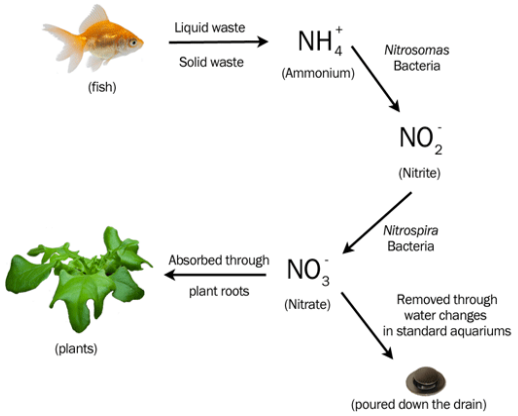


Fig 2. Aquaponic equation cycle

II.LITERATURE SURVEY :

The existing systems employ different techniques in aquaponic system .[1] With IoT, the system can be easily monitored and controlled from any remote location. In addition, the mobile application allows the user to either control the system by one self or to let it run automatically, as the system is both autonomous and semi-autonomous. The sensors placed in the Aquaponics system continuously monitor the system and the data is stored on Google Spreadsheets where it can be used for further analysis . [2] The proposed undertaking initially distinguishes the parameters of water utilizing different sensors and utilizing PIC 16F877A microcontroller the information will be contrasted and an ideal scope of the particular parameters, at that point if the characteristics are beneath or above ideal range the required tasks will be done in like manner. In this aquaponics observing framework, with the utilization of IoT the webserver persistently shows the estimations of the parameters and data. [3] Agricultural technology design with aquaponics is also using the concept of Internet of Things because the information from the sensor and control actuator values can be accessed through applications installed on the smartphone from anywhere with the Internet connection. Agricultural cultivation technology with indoor aquaponic agricultural technology provides an alternative for anyone who has no land for farming but can still conduct business activities [4] In this research, nutrients from crap fish farming are circulated as fertilizer to grow plants. pH is measured to protect the roots of plants from being rotted or damaged. From these data control of various environments by applying Internet Of Things (IOT) to turn off the lights, control humidity and develop web applications to control various factors and storing various data in cloud database.

III.PROPOSED SYSTEM :

The primary agenda is to successfully design an aquaponics system with monitoring and controlling capabilities of the parameters which will be more enhanced with Arduino nano implementation in the system .

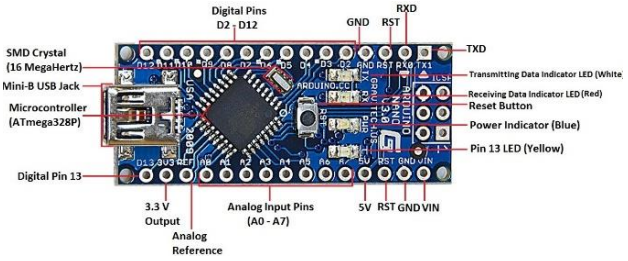
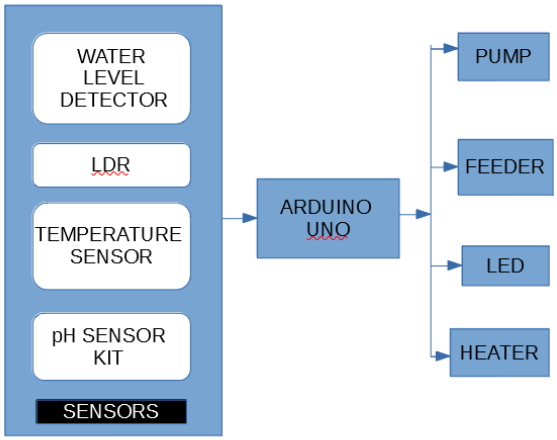


Fig 3. Arduino Nano

The system includes parameters like the water quantity , the pH level of the water along with the Temperature of the water and the intensity of the light inside the aquarium.

Fig 4. Aquaponic system using arduino

IV.SYSTEM ARCHITECTURE :



The model hardware is developed on an arduino uno board consisting of the following sensors [1] water level detector [2] LDR [3] Temperature sensor [4] pH sensor kit [5] Along side of the following hardware components that are controlled by the sensor [6] Pump—To check water level [7] Feeder—Automatic fish food feeder [8] Led Light – To control light intensity [9] Heater—To control temperature .

V.HARDWARE IMPLEMENTATION :

Hardware implementation involves the design of the model , Temperature sensor , LDR , water level detector , pH sensor , fish feeder , water heater and hydroponic water pump .

TEMPERATURE SENSOR

This sensor is a water proof and pre wired DS18B20 sensor. This sensor is handy when measurement, for wet conditions is required. The sensor can be good up to 125°C, the cable is covered in PVC hence it is suggested under 100°C the reason being they are digital.1-wire digital temperature sensors precise (±0.5°C over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter.

LDR

A photo resistor or the light-dependent resistor, LDR, or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing light intensity, it exhibits photoconductivity. A photo resistor can be useful in light-sensitive detector circuits, and dark and light activated switching circuits. The resistance ranges and sensitivity of a photo resistor can significantly differ among different devices. Moreover, exclusive photo resistors may respond significantly differently to photons in certain wavelength bands.

WATER LEVEL DETECTOR

The water level in the aquaponics set up is monitored and controlled in order to prevent the overflow of the water. The water level sensor has three probes in total. The first probe is completely immersed in water the second probe is semi immersed and the third probe is not immersed. The probes are marked as low, medium and up. When the water is in the low and medium level, the water does not pump from the aquarium to the plant bed but when the level of water reaches the up level the pumping of the water begins from the aquarium to the plant bed.

pH SENSOR KIT

A pH Meter sensor kit is a scientific instrument that will measure the hydrogen-ion concentration i.e. the pH in a solution, indicating its acidity or alkaline nature. The pH meter measures the variation in electrical potential, between a reference electrode and a pH electrode.

FISH FEEDER

Fish feeder is normally clamped to the walls of the tank just over the water. Fish feeder consists of a container that is loaded with a variety of dry food. The dc motor that rotates the container at regular intervals, dispensing food in the process and method of setting the interval between feeding and the amount of food dispensed.

WATER HEATER

The main purpose of using the heater in the aquaponics system is to maintain a suitable temperature for the fishes to survive. Heater is a device that is used to increase the temperature. Heater is alternating current. The sole purpose of using the heater in the aquaponics system is to maintain a suitable temperature for the fishes to survive. If the temperature in the system drops down below 31 degrees then the heater heats till the temperature is 31 again.

HYDROPHONIC WATER PUMP

Pump is a device that moves fluids like liquids, gases or sometimes slurries, by the mechanical action. Pumps are classified into three groups according to the method, they use to move the liquids, and they are direct lift, displacement, and gravity pumps.

VI. WORKING:

Aquaponics is a catchall term used for farming on a large scale, The proposed work simplifies the system to be used for indoor farming with less human involvement.
The plant body is submerged in water rather than in soil.
The aquaculture system helps the fishes to grow. Nitrifying bacteria helps to break down the nitrogen in fish poop to be absorbed by plants, thus purifying the water to be sent back to the aquaculture system. Hence, fishes, plants, bacteria, and water are the critical components of the aquaponics system. Tilapia, trout, hybrid striped bass, carp, mosquito fish, tetras, guppies, catfish, cichlids, crappie, bluegill, sunfish, perch, koi, and goldfish are the common types of fishes used. A standpipe is used in the center of the plant bed as a fixation pipe. The standpipe is for the sole purpose of preventing the intervention of pebbles in the drainage. The fish pond is supported beneath the plant bed. Pipes are set for the transmission of water between the plant bed and the fish pond. The impure water is carried from the fish pond to the plant bed in one pipe and the filtered water is brought from the plant bed to the fish pond in the other pipe.

VII.ALGORITHM:

STEP 1: The aquaponics system is well understood using the system architecture

STEP 2: Firstly, the Water level detector is used to check whether there is any overflow of water and it is used to control the overflow of water in our setup.

STEP 3: A LDR or an Light Dependent resistor, is used for the Photoconductivity process to take place.

STEP 4: The Temperature sensor as the name suggests, is used to detect the temperature of the aquaponic system. Normally it can be used till 125 degree Celsius, but since they are made by PVC wires, it is suggested to keep the temperature below 100 degree Celsius.

STEP 5: The pH sensor kit is used to detect the hydrogen-ion concentration i.e, the ph in a solution.

STEP 6: The ARDUINO UNO acts as an interface between the sensors and the pump,feeder,led and heater.

STEP 7: Now the pump is used to move the fluids like liquids, gases or sometimes as slurries by mechanical action.

STEP 8: Next, the Fish Feeder is normally clamped and present in the corners , just above the water. By the use of DC motor when it is rotating at regular intervals, food is dispensed to the water so that the fish present inside gets enough food to live.

STEP 9: Next, the Led is used to give artificial light to the system when natural light is not present in the surroundings.

STEP 10: Finally, the Heater is used in the system so that a suitable temperature around the aquaponics system is kept for the fishes to survive. If the temperature is below 31 degrees Celsius, then the heater is used to bring back again to 31degrees because this is the right temperature for the fishes to survive in the aquaponics system.

VIII.CONCLUSION AND FUTURE WORKS:

Aquaponics unit has provided a good vegetable yield. It favors the growth of basic house plants .In the future, aquaponics will continue to gain increased attention as a bio-integrated food production system, an urban-friendly technology and a sustainable farming technique. It is usually implemented on a large scale industry level

But out proposal makes it possible to implement it efficiently in even a square foot width area under urban settings.

The proposed system uses arduino uno to control the automatic flow of the system with less human intervention.

The future work will include an IOT system to control the working of the system remotely.

The IOT system is integrated with almost every blooming technology and used Machine Learning algorithms alongside.

IX.REFERENCE:

1. Vegilab and aquaponics indoor growing system by megumi u Leatherbury, IEEE, 2014.

2. Automated indoor aquaponics cultivation technique by M.F.Saaid, N.S.M. Fadhil, M.S.A Megat Ali, M.Z.H. Noor, IEEE, 2015.

3. Integrating thermal energy storage (TES) closed greenhouse concept applied to aquaponics systems by Ralf Biernatzki, Rolf Meinecke IEEE, 2014.

4. Sustainable development using renewable energy to boost aquaponics food production in needy communities by Fareed Ismail, Jasson Gryzagoridis- International Conference on the Industrial and Commercial Use of Energy (ICUE), 2016.

5. https://tushev.org/articles/ardino/10/how-it-worksds18b20-and-arduino.

6. The Indoor farm by harry Goldstein, IEEE Spectrum, 2013.

7. http://www.theaquaponicsource.com/rules-ofthumb/aquaponics-ph/

8. http://www.arduino.cc/

9. http://en.wikipedia.org/wiki/aquaponics