

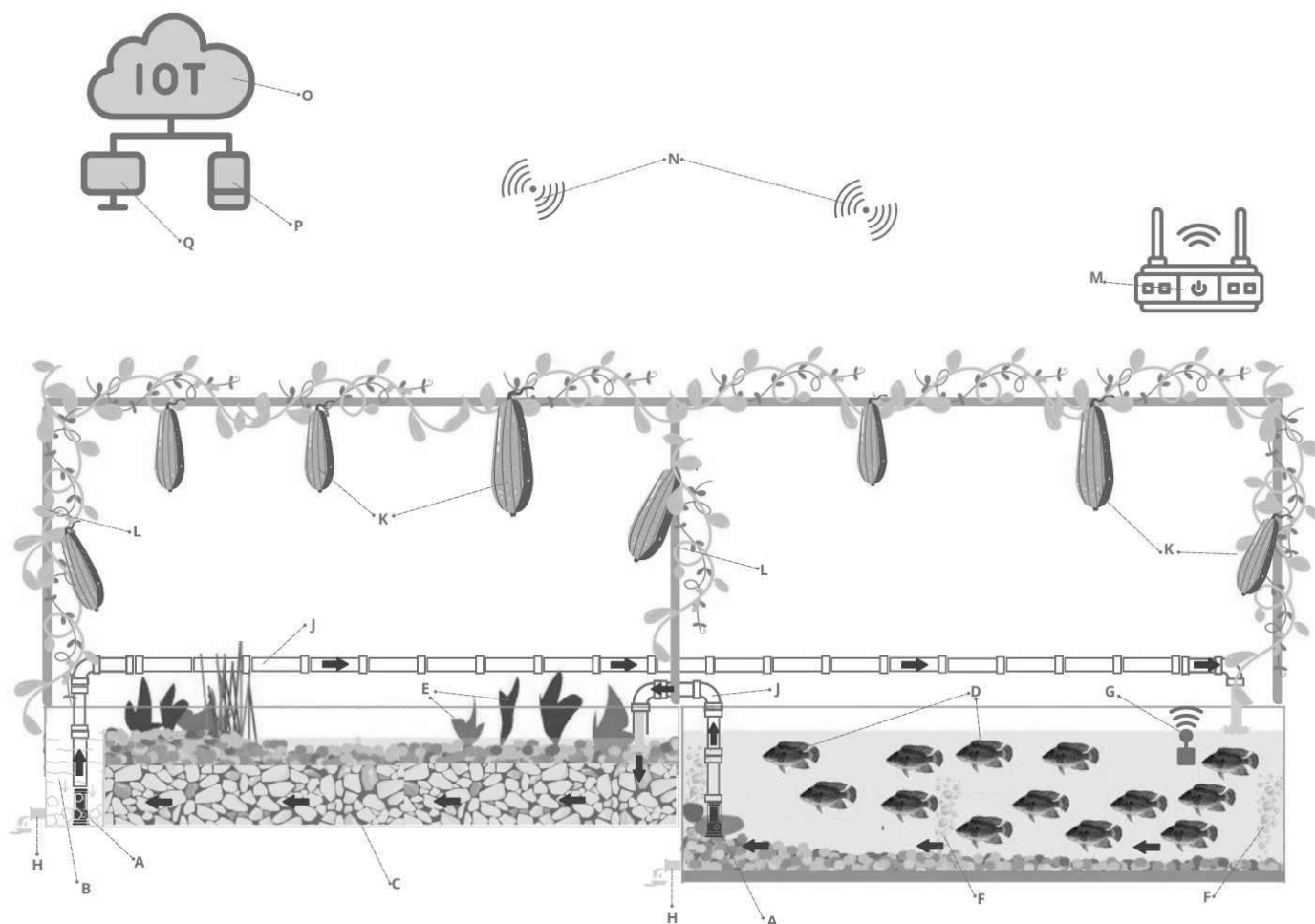


FIG 1 – Aquaponics System

Items Descriptions:

A	Submersible Pumps	B	Sump
C	Gravel Media Bed / Bio-filter Media	D	Fishes in Fish Unit
E	Vegetables in Vegetable Plot	F	Aeration from Air Compressor
G	Multi-Parameters Sensor with Wifi	H	Discharge Valves
J	Pipes for water flow	K	Vine Growing Plant on 1 Vertical
L	Vine Growing Plant Fruit - Luffa	M	Gateway for Transmission
N	Transmission via Wifi or 5G SIM Card	O	IOT Cloud Storage
P	Mobile App to Monitor Alerts	Q	Desktop Software to Monitor Alerts

Note: "I" is intentionally not used

Aquaponics System

Images: (1)

Fig 1 – The Invention System Design for Aquaponics

Patent for:

A technical and process improvement on an existing invention for Aquaponics.

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Description:

Background of the Present Invention

The present invention relates to Aquaponics, a food production system that combine aquaculture which is farming of fish and hydroponics which is growing of crop in a soil-less medium.

Aquaponics uses these two systems in a symbiotic combination where the nutrient-rich water from the fish unit is pump into the grow bed to be used as a fertiliser for the hydroponically grown crops. In return the crops and the grow bed which also function as a bio-filter bed, help to filter the water that goes back to the fish unit after absorbing the nutrients from the fertiliser for the crop's growth. The water filtered by the grow bed also contains other nutrients that are beneficial for the fish. Furthermore the CO₂ exhaled by the fish is also absorbed by the plants – thus greatly increasing the crop productivity.

This present invention relates to an outdoor system that relies on the natural resources – the sunlight and rainfalls. This system has to work in pairs with the fish unit pairing besides the grow bed to achieve the maximum yield for the fish and the crop.

The present invention relates on the high stocking density for the fish farming in 1 fish unit, up to 4,000 fishes of harvest-able size of 500gm to 600gm, and the high crop planting density in the grow bed. An orderly planting method to achieve high crop planting density is to use a fishing net which is laid on top of the grow bed as a guide for the orderly planting. The mesh size of the net is dependent on the type of crop being planted.

With this recirculating system, it significantly reduces the sewage of the fish unit and the usage of water for crops in the grow bed by up to 95%.

No synthetic fertilisers or chemicals are used in the present invention.

A multi-parameter sensor(s) is placed in the fish unit for monitoring the parameters in the water that are crucial to the success of the system.. The parameters are:

1. Water PH level
2. Water DO, Dissolved Oxygen level
3. Water EC, Electrical Conductivity
4. Water Temperature
5. Water TDS, Total Dissolved Solids
6. Water Turbidity
7. Water Ammonia Level &
8. Water Nitrate Level

These sensors can be integrated as 1 unit or as individual sensors depending on the availability and viability of the sensors to be integrated with the wifi module or 5G sim card. They are placed in the water to monitor the various parameter's level. This unit is hooked up via a wireless module and is connected to a host gateway via WIFI or 5G sim card to a cloud storage server.

The data capture are in real time. With any abnormality from the sensor(s), an alert will be triggered via desktop software or mobile app. By using this technology, automation of the system is ensured for the quality of the water for the fish unit, and thereby the quality of the crop produce in the grow bed. This automation also ensure the better deployment of manpower, especially in labor-crunch country like Singapore.

The present invention also employs the Vertical concept to produce another crop yield by Growing Up instead of just Growing Horizontal. Only 1 vertical is adopted.

The Vertical concept is to farm vine growing plants, like the luffa. The luffa is planted at the extreme end row in the grow bed to ensure the proper climbing of the vines and that they do not obstruct the other crop in the grow bed.

The Vertical concept also serves other benefits to the present invention, the fully grown luffa will provide a shade for the fish units and the grow bed, thereby lowering the ambient temperature and also mitigates the production of algae in the water.

The present invention allows a near zero-emission, contributes to solving the issue of sustainable food security, water security and land scarcity especially for a country like Singapore.

The present invention is adaptable to local conditions.

This present invention is a Scalable, Sustainable, Automated and EcoFarm using AI technology to provide Wholesome Fish & Crop produces.

Brief Description of the Figure

The present invention will be described with reference to the figure where:

Fig 1 – depicts the full View of the Fish Unit, Grow Bed and 1 Vertical Concept.

In **Fig 1**, the present invention is depicted in accordance to the full view of the paired design. The fish unit and the grow bed is built with concrete to reach a volume of 20 sqm and at a depth of 1m. The ratio of the fish unit and the grow media bed is 1:1.

The fish unit is coated with epoxy to improve the unit's surface smoothness to mitigate abrasion to the fishes and for easy cleaning. The base of the fish unit is lined in such a way that the level is sloping towards the centre of the paired-units. While the grow bed is sloped towards the far side of the paired-unit.

A discharge drain is constructed below the paired-units for discharge of the water with a Discharge Valve each at the fish unit and the grow bed. The water is discharged in the event the water in with the fish unit or the grow bed is breached. By breach, it means the water is contaminated and need to be discharged and replaced with clean water.

The grow bed uses gravels as the grow media. The choice of using gravel is such that it helps easy planting of crops, while the crop roots can take hold on the gravels for growth stability. The gravel makes a superb filtering medium to ensure the water is cleaned before returning to the fish unit and it also acts as a bio-filter to help break down the ammonia into nitrates which the plants need for growth.

A discharge valve is fixed at the lower portion of the fish unit and grow media bed to discharge contaminated water either at the fish unit or the grow bed.

Submersible pumps are used each at the fish unit and the grow bed. At the fish unit the pump is placed at the low space near the discharge Valve to pump the ammonia rich waste into the grow bed. At the grow bed the pump is housed at the far end of the paired unit near to the Discharge Valve to pump the filtered clean water back to the fish unit.

The fish unit is for housing 1 type of aquatic fish species, such as Tilapia. While the grow bed is for farming up to 2 types of leafy vegetable species, such as Brazil Spinach and Luffa, a vine growing plant.

Water aeration is provide for with air pumps to the fish unit, a process of increasing or maintaining the oxygen saturation of water in the fish unit.

The blue arrows depicted in Fig 1, gave a better perspectives of the re-circulating system in the present invention. This system can also be addressed as Recirculating Aquaculture System or RAS.

Only 1 vertical for the present invention is built, this is to ensure adequate sunlight for all the crops in the grow bed as well as on the Vertical.

The Vertical is to farm vine growing plants, like the luffa. The luffa is planted at the extreme end row in the grow bed to ensure the proper climbing of the vines and they do not obstruct the other crop in the grow bed.

The present invention employs the Vertical concept to produce another crop yield by Growing Up instead of just Growing Horizontal.

The Vertical also serves other benefits to the present invention, the fully grown luffa will provide a shade for the fish units and the grow bed, thereby lowering the ambient temperature and also mitigates the production of algae in the water.

Claims

1. An Aquaponics system comprising:

- a paired-unit of 1 fish tank and 1 grow bed;
- the fish unit is for housing one type of aquatic species;
- the grow bed is for housing up to two types of plant species growing in an aqueous environment;
- the grow bed uses two types of media - gravels (up to 0.4m) and clay pebbles (up to 0.15m) layered at the top;
- the grow bed media acts as the bio-filter module for receiving the nutrient-rich waste from the fish unit;
- a natural occurring biological waste digesting unit formed by bacterial, helps digest and produce the nutrients for the plants farm in the grow bed;
- the filtered water entered the sump in the grow bed and the clean water is pump back into the fish unit;
- one pump is used in the fish unit and one pump is housed in the sump area of the grow bed;
- the pump in the fish is for pumping the nutrient-rich water from the fish unit into the grow bed;
- the pump in the sump area of the grow bed is for pumping the filtered clean water back into the fish unit;
- aeration or air jets are provided for in the fish unit to ensure sufficient dissolved oxygen and flow;

2. An Aquaponics system according to claim 1, wherein the surface area ratio of the paired-unit is 1:1; if the area of the fish unit is 20 sqm, the grow bed area will also be 20 sqm.

3. An Aquaponics system according to claims 1 to 2, wherein the the depth of the fish unit is 1m and holding 20 cbm of water.

4. An Aquaponics system according to claims 1 to 3, wherein the depth of the grow bed is at least 0.6m, housing gravels up to 0.4m depth and clay pebbles of at least 0.15m layer at the top.

- to achieve the orderly planting for crops, a fishing net is used. The net with the specific mesh size for the crop is lay over the entire grow bed. The grids facilitate the orderly planting for the crop.

5. An Aquaponics system according to claims 1 to 4, wherein a vertical concept is oriented to the paired-units in Aquaponics system comprising:

- 1 vertical is adapted to the paired-unit with building materials strong enough to take
- the weight of a fully grown vine growing plant, like the luffa;
- the vertical structure is constructed at least 2m in height to behave like a trellis over the paired-unit;
- the vertical is for housing and supporting the vine growing plants like the luffa;
- the vertical will provide a shade when the luffa has fully grown;

6. An Aquaponics system according to claims 1 to 5, wherein the quality of the water in the fish unit is critical to the successful operations of the Aquaponics system. Sensors are used to monitor the eight parameters comprising:

- Water pH level - pH is a way of measuring whether the water in the fish unit is acidic or basic (alkaline). Maintaining the right pH in the fish is important to fishes, but it is especially vital if they were collected in the wild, like the empurau. Sudden changes in pH can be harmful, or even fatal, if the change is too drastic or happens suddenly. Most freshwater farmed fish do best between 6.8 and 7.8;
- Water DO, Dissolved Oxygen level - All life needs oxygen, including the life present in the water in an aquaponic system. The concentration of DO in water is important for

optimal fish and plant growth, as well as for beneficial bacteria that convert toxic ammonia to usable nitrate for plant growth.

- Water EC, Electrical Conductivity - The electrical conductivity of water provides an assessment of the total concentration of dissolved ions in water, and is an important property of water frequently measured in aquaculture systems.
- Water Temperature - Water temperature in aquaponics systems will influence not only what type of fish can be reared but also plant growth and the performance of the bio filter. The key is to find a temperature that falls within the acceptable range for all three components of the aquaponics system.
- Water TDS, Total Dissolved Solids - Dissolved solids are different minerals dissolved in water, higher levels of total dissolved solids often harm aquatic species.
- Water Turbidity - Turbidity is a measure of how clear the water is. Unlike 'hardness', the greater the total dissolved solids' content is, the lower the turbidity of the water.
- Water Ammonia Level - Ammonia is excreted as the primary waste product of protein metabolism by fish from the gills and in urine. Ammonia in an aquatic system is in a constant state of fluctuation between toxic, unionized ammonia (NH_3) and non-toxic, ionized ammonium (NH_4^+) based on changing pH and temperature of the water. Unionized ammonia is difficult to measure on its own. Therefore, total ammonia nitrogen (TAN) is measured, and then the concentration of unionized ammonia is calculated using the pH and temperature of the water.
- Water Nitrate Level - Fish will feel the impact of nitrate by the time levels reach 100 ppm, particularly if these levels persist. The resulting stress leaves fish more susceptible to disease and inhibits their ability to reproduce. High nitrate levels are especially harmful to fry and young fish and will negatively affect their growth.

7. An Aquaponics system according to claims 1 to 6, wherein to maintain the stability and quality of the water in the fish unit, regular partial water exchanges should be done to remove pollutants and replenish minerals that naturally buffer pH and keep it stable.

8. An Aquaponics system according to claims 1 to 7, wherein the sensors can be an integrated one unit of multi-parameters sensors or eight individual sensors capable of:

- the sensors must be able to adapt to a WiFi or a 5G sim card module;
- the signals from the sensors are transmitted via WiFi or 5G sim card gateway;
- the data from the signals are collected and stored in a cloud storage environment;
- a software adapted in a desktop can be used to monitor the levels or via a mobile

app;

- any abnormality from the signals will trigger an alert either to the desktop or via the mobile app.

9. An Aquaponics system according to claims 1 to 8, wherein discharge drains are built to carry the discharged water from the discharge valves. Discharge water can be regular partial water exchanges or in the event when the water in the fish unit is 'breached'. By breach, it means the water has been contaminated.

