

# Aquaponic and Hydroponics using IOT

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## Introduction

Hydroponics is a type of hydroculture, which is a technique of cultivation of plants without soil by using mineral nutrient solutions in a solvent which is type of water. Terrestrial plants may be grown with only their roots exposed to the mineral solution, or the roots may be supported by a type of medium which help in the position of plants for their growth, such as perlite or gravel.

Growers of all plants all over the world are using hydroponic techniques due to the lack of a large amount of water supply or fertile farming area. Home growing gardeners have used the techniques hydroponics and Aquaponics on a medium scale to grow fresh vegetables year round and to grow plants in smaller spaces, such as an apartment or a balcony or backyard with a space to grow much more vegetables than a smaller hydroponic system in an apartment. Greenhouses and nurseries grow their plants in a without soil environment, peat- or bark-based growing mix. The nutrients obtained through the aquatic animals in the system then are applied to the growing mix through the water supply. Therefore, aquaponics is also a type of hydroponics.

Soilless gardening offers many advantages to the home gardener from a standard farmer of vegetables. Since a free from bacteria medium is used, there are no weeds to be removed, and pests with soil and diseases are minimized, if not eliminated completely. Properly grown hydroponic plants are also healthier and more vigorous because all of the necessary growth elements are readily available compared to traditional farming. The plants can mature faster, yielding an earlier harvest of vegetable and flower crops. Hydroponic and aquaponics gardens

use less space since the roots do not have to spread out in search of food and water just for the nutrients. This small space requirement makes hydroponics ideal for home gardeners, and it makes better use of greenhouse space. The big advantage to hydroponics is the ability to automate the entire system with just a timer. Automatic system reduces the possibility or probability of the exact time it takes to maintain plant growth requirements. Automatic system which can be operated through an app with the help of IOT technology, it also provides flexibility to the operator as the operator or the person looking after the system can be gone for hours or day without the worry of watering the plants. Aquaponics and Hydroponics using IOT is a feasible way to cultivate plants in an organic way. Planting the plants without soil in the structure removes the importance for big amount of land for farm and allows plants or crops to be produced in greenhouses or even in the desert scientifically. Aquaponic techniques allow the farmers for integrated water and nutrient application direct to the roots of every plant. Water used before in the aquaponics is reused in these systems and less amount of water is lost through evaporation most of the time and runoff because in most of the aquaponics system are built indoors rather outdoors. Therefore, arid lands, such as deserts, can be converted into productive lands for growing plants using the same amount of water as less as possible. Growing plants hydroponically is not as difficult if one understands the basic principles of aquaponics. As long as plant growth requirements are met in the aquaponics system, there are numerous aquaponics systems that can be used.

## Plant Requirements

### Growth Requirements

If a crop is grown in soil or a soilless part, there are lot of factors affecting crop growth and productivity. All crops require nutrients solution, water solvent, ample amount of light, and fresh air to grow. A crop grown in soil get it's complete nutrients and good water from the soil medium, when it is available. With Aquaponics, the water and nutrients are always completely available, the plant is never put in stressed. Fresh Sunlight and air are readily available in an outdoor aquaponic system. However, in an indoor system, one must provide an adequate light source and good complete air circulation. Metal halide lamps, rgb lamps, sodium powered vapor lamps, growth-lights, or fluorescent lights used in mix with everything incandescent light bulbs provide sufficient amount of light. Crop roots must have sufficient amount of oxygen in availability to keep them healthy and alive. Healthy visible roots (which are white in color and nature) is completely responsible for the care of all nutrients for the crops. If the roots do not live, it is impossible for the plant to even survive in nature, even if the plant grows. The nutrients used in aquaponics systems can come from an array list of different available sources, which can include the list, but are not only limited to a byproduct from fish waste which turns into manure, duck manure, or purchased chemical fertilisers or solvents and many other things.

### Nutrient Solution

The nutrient solvent is a very important and good factor in the success or failure of a aquaponic system. Most chemical fertilizers which are very readily available in all garden centers which do not contain all of the 13 required elements necessary in need for plant growth because their growing part of medium which usually provides many of them in question. Aquaponic plants receive complete set of nutrients from a different source in need, so it is not necessary to use a chemical fertilizer formulated for aquaponics systems. Aquaponics fertilizers are available in great source from many type of mail order companies and a few specialty owned garden centers. It is very

important to hold the dilution in rate to recommended on the very label and to test the solution to be sure that the pH is between 5 and 6 which is very important to keep in track. Simple to use pH available test kits and pH modifiers are available wherever there are fish supplies are sold.

Depending on the stage of crop development, some of the types of elements in the nutrient solution will be depleted or evaporated more quickly than others elements in the system. Because of this, it is important to change the nutrient solution every two weeks. The old solution can be used to water other houseplants or out- door plants. Also, make sure that the nutrient solution is kept at the original volume. As water evaporates from the nutrient solution, the fertilizer becomes more con- centrated and can burn plant roots. Add water only and not more fertilizer to raise the nutrient solution back to its original volume.

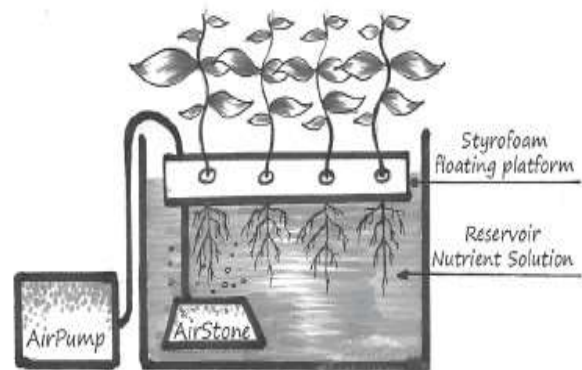


Fig 1. Nutrient Solution

## Types of Systems

### Water Culture Systems

Water culture systems include the nutrient film technique, aeroponics, aquaponics and the aeration method which is a very unique idea to use.

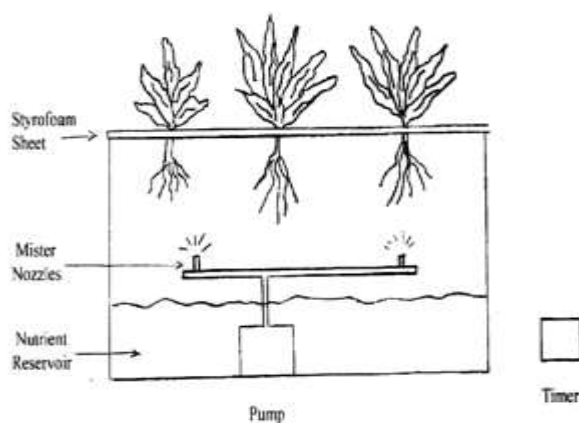


Fig.2. Aeroponics

The trough is gently sloped so gravity pulls the solution back to the nutrient reservoir. There are many variations of this system, making it the most popular for the home gardener or the equipment used outside in aquaponics system.

Aeroponics (Figure 1) is the growing of plants in a container in which the roots are suspended in a nutrient mist rather than in a solution. The most popular container for aeroponics is an enclosed A-frame constructed of styrofoam boards. The plants are placed in holes along the sloped sides of the frame. The nutrient mist is delivered to the roots by a vaporizer or by special attachments available with drip irrigation kits. The mist clings to the roots. Any excess runs down the inside of the frame, is collected at the bottom, and is recycled back to the nutrient reservoir in the aquaponic system.

The aeration method (Figure 2), is one of the first and very important systems to be developed in aquaponics, uses an aquarium air pump to bubble oxygen to the roots of plants immersed in completely the nutrient solution. Plants are suspended 1 inch above the solution by a 2-inch-deep into the mesh tray that is set into the placing the lip of the tray over the container's edge. A layer of inert material, such as gravel, clay pebbles, or vermiculite, is placed in such a way in the tray to provide complete stability for the plants while allowing the underground roots to grow into the nutrient solution.

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