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Automated Hydroponics System using Mobile Application

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ABSTRACT

In the fast spaced world human beings require everything to be automated. Hydroponics has become popular to grow plant without soil and many studies were shown that plants grown with hydro-culture are high quality and consume fewer resources than traditional growing methods. This paper aims to develop a control tool for the flow of nutrients of hydroponic plants automatically using Arduino micro-controller and controlled by smart-phones.The purpose of the research are to design and develop the automation controlling and monitoring plant growth hydroponics system and evaluate the effect of using this prototype. Hence to make life simpler and convenient, we are making ***"Automated hydroponic system using mobile application ".***

1. INTRODUCTION

According to research, We found that the total world population could reach 9.15 billion in 2050 so, It would be difficult to fulfill the need of human being in future. Hydroponic gardening is a great way to grow plants to their full potential. Plants are given as much nutrients and water as they can absorb. In the past, setting up a hydroponic system required research, many installation steps, and daily monitoring to ensure proper growing conditions and Now, implementing a hydroponic system requires research and knowledge about the type of plants to be grown.

A deep-water hydroponic design requires daily maintainence of PH level, nutrient level, water level, temperature, and conductivity testing. Nowadays, agriculture has become more and more effective in sustainable development.

Hydroponics has long been accepted in foreign countries and it is cultivated as a commercial product, such as the United States, Netherlands and Japan. Hydroponics has a number of innovative techniques and it is not limited to plant with water culture like nutrient film technique, deep flow technique, dynamic root floating technique and etc. Internet of Things is currently a novel trend of technology that connects and communicates electronic devices and tools such as computers, cell phones, cars, refrigerators, televisions and so on with each other through the Internet. In the future, consumers will be more familiar with the technology that makes it possible to control things from anywhere, such as home temperature control, turn on the lights, and order watering the plants. Therefore, the automated hydroponics system based on mobile application and IOT The emergence of Internet of Things (IoT) has allowed people to automate the hydroponic culture . Monitoring of water level, pH, temperature, flow and light intensity can be regulated using IoT, Which allows for M2M interaction and controlling the hydroponic system autonomously and intelligently.

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In the treatment of plants, Hydroponics is very important to consider the timing of when the water should be added and replaced nutrients, and it would be very inconvenient. To accomplish with this, hydroponic systems must collect a lot of information, since this allows a better diagnosis of the problems and better understand the development of hydroponic crops. Automatic sensors not only have the ones that can be read at predefined intervals, but also the readings of these sensors are stored so that higher results can be obtained for analysis and diagnosis resulting in higher crop yields with the environment.

2. CLASSIFICATION OF AUTOMATED HYDROPONIC SYSTEM.

There are six main types of hydroponic systems to consider for your garden:

1. Wicking ;- In a wick system, the nutrients and water are transported to the plants' roots using a wick, like a rope or a piece of felt. The plants are suspended in some sort of growing medium, like coconut coir or perlite. Wick systems are "passive hydroponics" because they don't require air or water pumps. This makes them low-cost and easy to maintain, especially for beginner growers.Read: How To Build An At-Home Hydroponics Garden

Pros:

1.The wick system is great for smaller plants.

2. Once implemented, it's an easy and hands-off growing process.

3. Wick is one of the lowest cost systems to implement.

Cons:

1. Wicking is not effective for larger plants or extensive gardens.
2. Failure to set up properly or maintain the integrity of the wick can kill the plants.

You need:

- Reservoir
- Growing medium
- Wick
- Monitor systems
- Nutrient solutions
- Distilled water

3. Deep water culture (DWC) :-

A DWC consists of a reservoir filled with water and nutrient solution. The plants are suspended over the reservoir using a net pot and growing media. The roots themselves are submerged in the reservoir, so they have a constant supply of water and nutrients. Plant roots need oxygen or they can "drown." Thus, you need to use an air pump with air stone to pump bubbles in the reservoir to continuously oxygenate the water and deliver necessary oxygen to the roots.

Pros:

1. DWC is inexpensive and low-cost to maintain.
2. Upkeep is low and only requires a reservoir, suspension system, and basic air pumps.
3. It's a recirculating process, which means less waste and greater cost savings.

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Cons:

4. 1.DWC doesn't usually work for larger plants or those with a longer growing period.
5. 2.If not properly managed, plant roots can suffocate in solution.

You need:

- Reservoir
- Net pots
- Growing medium
- Air pump & air stone
- Nutrient solution
- Distilled water

3.Nutrient film technique (NFT) :-

The nutrient film technique (NFT) supplies the plans' roots with a thin film of nutrients.

The water and nutrient solution is held in a large reservoir, which has an air pump and air stone to stay oxygenated (like a DWC system).

Pros:

1. NFT is a low-waste recirculating system.
2. There is minimal to no growing media needed.

Cons:

1. A malfunction in the pumps can ruin the crop.
2. Roots can overgrow and intertwine along the channel.
3. The recirculating system can clog the pipes and channels if the water isn't properly balanced.

You need:

- Reservoir
- Air pump & air stone
- Plant channel
- Water pump
- Timer
- Net pots
- Nutrient solution
- Distilled water

6. **Ebb and flow** :-

An ebb and flow system, also called "flood and drain," floods your plants with nutrients on a cycle. You fill a tray with a growing medium to house the plants. A timed pump will "flood" the tray with nutrient solution on a cyclic schedule. After flooding the tray, gravity drains the solution back into the reservoir to be reused. An air pump should oxygenate the water in the reservoir as it waits for the next flood cycle.

Pros:

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1. An ebb and flow system doesn't expose your plants to constant water. This can help improve growth and yield if appropriately cycled.

2. Ebb and flow are recirculating systems that are an efficient use of water and energy.

Cons:

1. If not balanced or timed properly, the system may over-saturate your plants or dry them out.

2. Ebb and flow requires consistent monitoring, especially of environmental factors like water pH.

You Need:

- Reservoir
- Tray
- Growing medium
- Water pump
- Timer
- Air pump
- Nutrient solution
- Distilled water

5. **Aeroponics :-**

Aeroponic systems are the most high-tech and usually more expensive, but they're also one of the most effective systems. In an aeroponic system, the plants and roots are suspended in air. The reservoir (with oxygenating air pump) has misters, which spray a fine spray over the plant roots.

Some growers will use a nonstop, fine mist while others will mist on a cycle. The cycle of misting is shorter than the flood and drain model with only a few minutes between each cycle. This allows the roots to continuously have nutrients without oversaturation or submersion. It also naturally allows the roots greater exposure to oxygen, which is critical for growth and development.

Pros:

1. The roots are exposed to more oxygen.

2. There is less likelihood of oversaturation or under-saturation of roots.

3. Aeroponic systems are generally the easiest to maintain and monitor.

Cons:

1. This is one of the more expensive systems.

2. A failure of a pump or mist nozzle can have dire effects on plants.

You Need:

- Reservoir
- Air pump
- Timer
- Suspension pots
- Mist nozzles
- Timer
- Nutrient solution
- Distilled water

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7. Drip systems: -

Drip systems are similar to NFT systems, where the plants are held in a separate channel. The plants are suspended in net pots over a thin layer of water and nutrient solution. A pump continuously moves the water throughout the channel to improve oxygenation and nutrient uptake. Leftover solution flows back into the reservoir to be reused.

Pros:

1. Drip systems offer greater control over the schedule of feeding.
2. For commercial spaces, these can be inexpensive and highly effective.

Cons:

1. These systems require a lot of moving parts, which could be overkill for home gardens.
2. You have to be highly aware of monitoring pH and nutrient levels.
3. These don't recirculate all solution, which can lead to high level of waste.

You Need:

- Reservoir
- Water pump
- Timer
- Net pots
- Growing medium
- Channel
- Pump system
- Nutrient solution
- Pump system
- Distilled water

Hardware used:

1. PH Sensor
2. TDS Sensor
3. Arduino Uno
4. 16*2 LCD Display
5. Battery(12V)
6. Relay Module
7. Water Pump
8. Float Sensor
9. Transistor / Diode
10. Temperature and Humidity Sensor
11. HC – 05 Bluetooth Module
12. ESP 12F WI-FI Module

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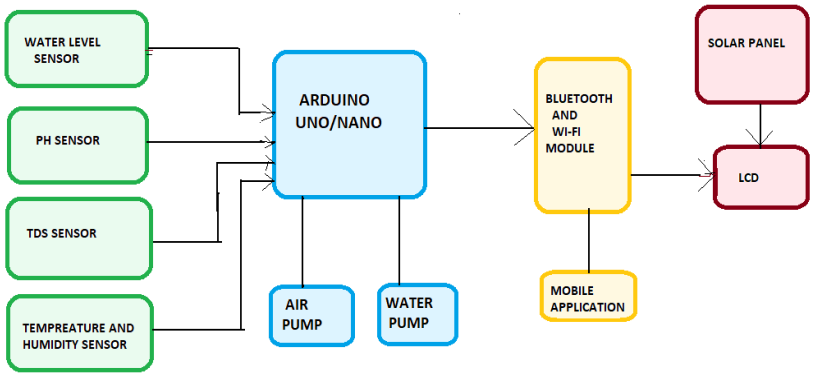
PROCEDURE



Fig(a). Block diagram of Automated Hydroponics system

This research is implement the automated hydroponics system based on IOT and smart phone to support planting hydroponic vegetables. The system can be measured and displayed information through mobile phone to manage and control over the related sensor devices like temperature, pressure of water supply system. The experimental set is allowed on the acquisition of land by setting temperature 30-35 degrees, soil moisture 50-60 percent, and the intensity of light at 2–5. The application will record data received from the related sensors every 10 minutes. Furthermore, the prototype gets information from the database every 1 minute and plants grown in normal conditions. The system includes 4 sections to control and manage the automatic hydroponics application.

Arduino boards are used to control the various functions of the system, including temperature and humidity sensors, light sensors, the pH sensor, and the water level sensor. The proposed system covers the process from sending data measured sensor devices, receiving data from an intermediary data storage and sending data to the host computer. Then, the system will analyze the sent value and relay module acts as a switch to turn on-turn off the related module

Section 1: To control the discharge of water, when system gets the value from the temperature and humidity sensors, the spayed water will be released in case of the temperature higher than the indicated value.

Section 2: To control light level, the turn on - turn off the LED from the board received the value from the light sensor and when the intensity of light is lower than the set value, the system will operate relay module to turn on the LED until the intensity is equal or greater than the set value.

Fig(b). Hardware Components

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Section 3: the pH control is started when the pH value is higher than the set value and the system will release the pH solution until the pH value is lower than the set value.

Section 4: to control the water level, the water level sensor will notify the vale to the system and when the water level is lower than the indicated value , the application will release water into the vegetable plot until the water level is equal or higher a set value. The system gets the sensor data and records every hour, collected from 07.00 to 18.00. Also, the prototype can access and control through both mobile and web based application.

RESULT :-

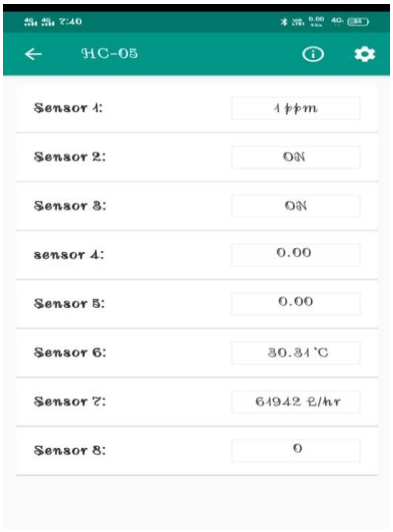

Fig (c). Ardutooth mobile application

Fig(d). Working Video

Fig(e). completed hardware

FUTURE SCOPE

1. This system can be extended by introducing cooling fans and Infrared lights which can be used to maintain required temperature for Indoor Hydroponics, which can be achieved by using Temperature Sensor.
2. Develop Android application to control actuators.
3. Design solar panel for the power supply instead of DC battery to conserve energy.
4. Connect device directly or indirectly to the internet through Internet of Things (IoT).

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