REVIEW PAPER ON AUTOMATED HYDROPONICS

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ABSTRACT

The explosion in human population has left researchers scrambling for solutions on how to feed the world. Furthermore, rural-urban immigration has on the one hand left the farms in the rural areas devoid of farmers and on the other hand has left the urban areas over-populated. Hydroponics is a form of agriculture where crops are grown without soil. This technique allows the farms to follow the farmers to the urban area. In addition, the fact that no soil is needed, allows hydroponic system to be stacked vertically (also known as vertical farming) to save space. The final frontier in hydroponics is automation. It will allow one farmer to work more than one job and cultivate more than one farm simultaneously.

Growing certain plants and vegetables in remote areas such as deserts and the north and South Pole can be a challenge because of the extreme outside weather. very few species of plants thrive in such situations and are often not used as a food source. In this study, we created a system that can grow common plants and vegetables and can operate without depending on outside climate. we achieved this by using a technique called automated hydroponics. Hydroponics is a method of growing plants without using soil. The system was automated using microcontrollers and sensors to keep human intervention at a minimum. An internet of Things (IOT) network was created to improve reliability and allow remote monitoring and control if needed. The user is only required to plant a seeding and set initial parameters.

NTRODUCTION

The purpose of the project, is to expand and improve the utilization of hydroponics as well as to create an environmentally independent system for indoor plant growth. In a hydroponic system, a plant is placed in solution composed of soluble nutrients and water as opposed to soil. In most conventional hydroponic system parameters such as EC and Ph of the water solution are set to the desired value while setting up the system.
There are several other parameters such as air temperature and humidity, light, water temperature etc. which are not controlled or maintained. These parameters are important for healthy and faster plant growth. In this project, we built a system which monitors and controls all the parameters necessary for healthy indoor plant growth. In general, the process goes as follows: create a nutrient solution based on the plant being grown, apply this solution to a bed of water, place a germinated plant into water such that the exposed roots are touching the solution if the parameters are maintained within optimum levels, the plant should grow faster and healthier than its natural growth. The aim of the project is to make a system that is cost effective and most importantly, is completely automated and requires virtually no human interaction after placing the germination plant into system.

LITERATURE SURVEY

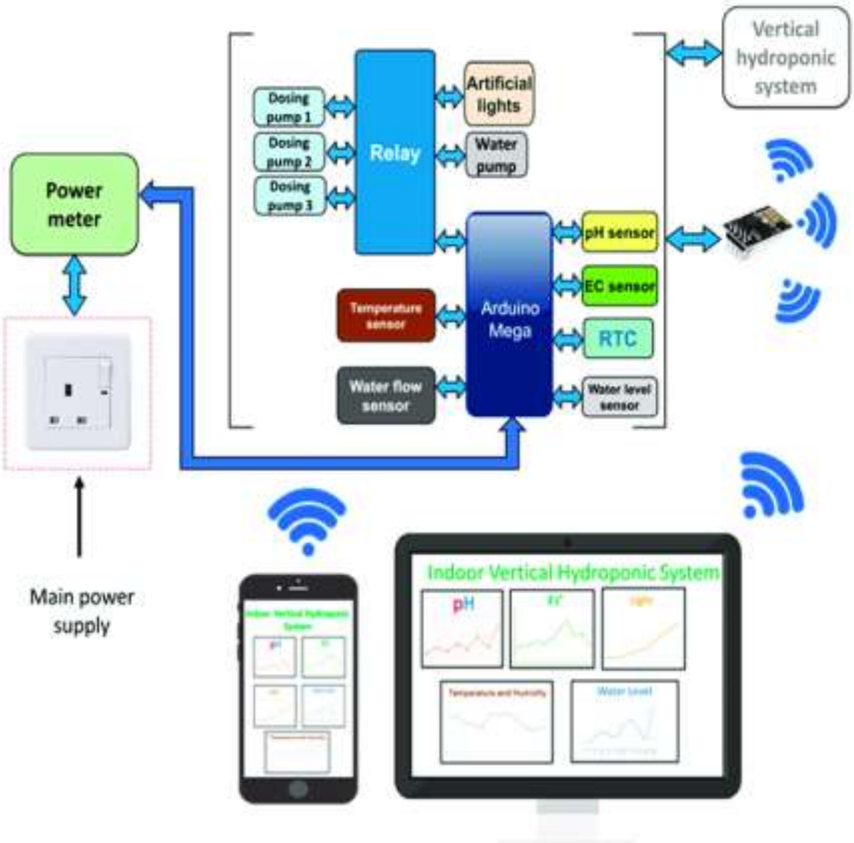
Conventional soil-based crop cultivation has various drawbacks, such as access to land, poor soil quality, erosion, low efficiency of water utilization, pests, and the multiple environmental limitations associated with climate change. These drawbacks are exacerbated by a growing human population and associated increase in demand for cereals, fruits, vegetables, and other food crops. Thus, interest has grown in soilless cultivation research in the last two decades. Hydroponics, a form of soilless cultivation, has become popular because it can produce higher yields than traditional soil-based agriculture, it is conducted in a controlled environment that is free from climate and other environmental constraints, and crops can be produced with significantly lower use of pesticides than those grown conventionally. This paper provides a literature review of recent research on hydroponic crop cultivation (HCC), including the historical context, classification, requirements for HCC, and the latest technologies employed in this field. The review closes with an analysis of the challenges ahead for the development of HCC.

The term IoT refers to a system in which numerous sensors, controllers and actuators are connected with *things* using the Internet and a cloud server. IoT can be used to monitor and control many aspects of crop life without human intervention, making farming smart. Hence the term *Smart Farming* to indicate IoT technologies applied to the agrifood sector. As for hydroponic agriculture, the integration of the IoT into the system could add other advantages to this methodology, such as efficiency and simplicity, which will make it appreciated even more. In addition, the sensors can collect data and automatically send it to a cloud server that can be accessed remotely via a web application or a mobile application. This means that farmers can monitor plants even if they are far away or not constantly present on the farm. Therefore, resources can be easily optimized with a fully automated and independent system.

In this project, we propose an implementation of a smart hydroponic greenhouse which makes use of some sensors to monitor the temperature, humidity, light and water level of the greenhouse. All the data collected by the sensor are sent to a cloud server by using Wi-Fi and it is then displayed in real-time in a dashboard with the additional possibility, for the final user, to control remotely the power on/off of some components.

IMPLEMENTATION

3.1 BLOCK DIAGRAM: -



METHODOLOGY

The system uses Arduino board for the analysis of received data and control. The system also uses a mobile app to enable monitoring and control from iOS or Android devices. Because the system is relatively small it can fit into a small office space or nook in the home. this accomplishes the second goal of the project. The complete automation and size are what make this project different from the other hydroponic system.

The block diagram of the automated vertical hydroponic system consists of six parts main power supply, power supply, power meter, sensing and control system, vertical hydroponic structure, wi-fi module, and online database. The overall block diagram is shown above. All the sensors connected to the vertical hydroponic system can be monitored from the IOT platform on any smart device. There is a power meter module for continuous monitoring the power consumption of the system in order to make the system power efficient and possible for large scale expansion. In any hydroponic system, there are several parameters that should be maintained within certain range, such as pH, electric conductivity (EC), temperature of the surroundings, and water level of the container. An automatic hydroponic system should adjust and maintain these parameters within its suitable value automatically and independently without the requirement of user intervention. Different sensors are connected to the microcontroller to monitor the different parameters of the hydroponic system. A panel electromechanical relay was used to control artificial lights, water pumps and the dosing pumps that were used to add pH and nutrient to the water. Pumps and the dosing pumps that were used to add pH and nutrient to the water. Finally, all the acquired data from the central microcontroller circuit was sent wirelessly to other area online database through an ESP 8266 Wi-Fi module.

System could be divided into the below subsections:

1. NFT structure and essential components
2. Water flow path
3. Nutrition and pH controlling system
4. Internet of Things (IoT) platform

The hydroponic system was chosen to be a vertical NFT hydroponic system since it has the greatest benefits compared to the other systems

Typical hydroponic system consists of the hydroponic pipes, nutrient container, water pump, artificial lights, nutrient, and pH adjustments' solutions. The nutrient container, water pump, and artificial lights is selected carefully to assure the highest efficiency of the hydroponic system.

1. Hardware:

The system was designed to get the data from the sensors and collected in a central microcontroller and send it to IoT platform IoT platform is capable to store, analyze and preview the data to the user in private or public web-interface and also in a mobile application. The web-interface can be visualized anytime from smart phone or computer and the mobile application is also simple and easily accessible solution. The LED's provide light to the growing plant. The lights are set to a 14 hour ON cycle to simulate daytime. A Real Time Clock (RTC) is used to keep track of the time. The lights, along with a small exhaust fan, are controlled using a relay module. The state of the system is monitored by using various sensors. An air pump is used to infuse the water with oxygen for the plant to absorb through its roots. The system contains four sensors: an electrical conductivity probe, a pH sensor, a water temperature sensor, and an air temperature/humidity sensor. The electrical conductivity probe allows us to estimate an amount of salts or nutrients in the water. The pH probe must be calibrated using calibration liquids [8]. Measuring the pH allows us to properly adjust the pH of the water before putting the young plant into the system. The EC and pH probes are connected to a transmitter to convert the information received by the sensors into pH and EC values. Measuring the pH of the water at consistent temperatures is vital since the pH is dependent on temperature .The water was heated up to 25°C and then the pH was adjusted using acidic and basic solutions. A water heater heats up the water and automatically maintains the water at a temperature of 24°C and 25°C which is optimum for healthy root growth [2]. Carbon dioxide is supplied to the system by a carbon dioxide releasing pad

2. Software:

The system uses Arduinos which are programmed using the Arduino IDE. It is a modified version of the C++ programming language. This software is responsible for operating the sensors and lights. The system was configured as a sensor network in Internet of Things by using an open source API called My Sensors.

Future Scope & conclusion

Hydroponics is a relatively new technology, evolving rapidly since its inception 70 years ago. From its origins in academic research, to its utilization in industry and government, hydroponics has found many new applications. It is a versatile technology, appropriate for both developing countries and high-tech space stations. Hydroponic technology can efficiently generate food crops from barren desert sand and desalinated ocean water, in mountainous regions too steep to farm, on city rooftops and concrete schoolyards and in arctic communities. In highly populated tourist areas where skyrocketing land prices have driven out traditional agriculture, hydroponics can provide locally grown high-value specialty crops such as fresh salad greens, herbs and cut flowers.

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