Multidisciplinary Applied Research and Innovation Vol. 3 No. 2 (2022) 426-430

MARI

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/mari
e-ISSN :2773-4773

Smart Hydroponic System

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DOI: https://doi.org/10.30880/mari.2022.03.02.051
Received 31 March 2022; Accepted 31 May 2022; Available online 28 July 2022

Abstract: In today's world, soil deficiency causes a reduction in plant productivity and health quality. This due to shortage of water and the frequent use of chemical pesticides. Hydroponics is a method for growing crops without soil where water serves as the substrate for growing the plants with the addition of fertilizers to supply the plants' essential nutrients and promote its commercial success. The goal of this project is to create a working prototype of a hydroponics controller that will control the water level, temperature and light. An Arduino Mega-2560 will be integrated as main part of the project and connected with sensors such as temperature sensor, water sensor and light sensor, that maintain and manage the system parameter. The automated system has the advantage of operating the pumps, the fans and LED strip light for ensuring that the plant receives all the nutrients that requires at all times and increasing the plant's success rate. The advantage of the controller is that the plants be watered even if the user is not at home and the plant always get enough nutrient such as light, water and suitable temperature for a better growth. The water sensor will detect the water and the pump will pump the water to the plant. The temperature sensor will detect the surrounding temperature around plant and the fan will turn on if the temperature is above 30°C and the LED strip light will turn on when the light sensor detect that there are no presence of light. To produce a better hydroponic system, it is recommended to add a humidity function to ensure the plant can grow healthier. The application of smart hydroponic system will provide vast benefits to humans and the conservation of the environment.

Keywords: Hydroponics, Arduino Mega, Temperature Sensor, Water Sensor, Light Sensor.

1. Introduction

Nowadays, agriculture is heavily reliant on soil and its nutrient content. However, the availability of soil for agriculture is decreasing due to global warming and globalization, which hinders the production of various plants. Fertilizers and pesticides are also required to produce a better crop, which harms the environment. Hydroponics can be used in agriculture to solve problems [1]. As it is well known hydroponics does not require any soil, where root system is supported using inert medium such

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as clay pellets and gravels. The purpose behind this is to allow the plants roots to come in direct contact with nutrients solutions or water, while having access to light and normal temperature, which is essential for proper growth[2].

Absorption in hydroponic crops is usually proportional to the concentration of nutrients in the solutions near the roots, and it is greatly influenced by environmental factors such as oxygenation, temperature, light intensity, and water level[3]. This project is focusing on making a smart hydroponic controller. The significance of hydroponics is providing a way for the average person to grow their own plant without the need of soil. Sufficient amount of nutrient water, light and the right temperature are critically important in hydroponics for plant to grow[4]. In setting a controlled hydroponic system which is fully automatic with water level sensor, power controllers, that helps in circulation of water and nutrients, and also maintain the temperature with temperature sensors. When the temperature sensor detect the temperature above 30°C, so the fan will turn on[5]. This method is applied to help conclude that water circulation will be done by the turning on the pump in hydroponics based on the water level and the pump will generate the water. It also maintain the sources of light that helps the plant to grow by using light sensor based on the light presence in that area. If there is no light, light sensor will detect it and LED strip light will turn on.

For the farmers those have less fragmented land can perform hydroponic culture in greenhouse to increase crop productivity[6]. In cases of crop loss by natural disaster, they must have another option of farming to survive and grow organic, pesticides free vegetables which would further enhance economic growth of our country[7].

2. Methodology

Plants are grown in a nutrient-rich water solution in hydroponics. Plant roots come into direct contact with the nutrient water solution rather than needing dirt to grow the plants. The plants will also have plenty of oxygen, which will help them develop faster. The main benefit of growing with hydroponics is that it saves time and effort. The fundamental benefit of growing plants under hydroponics is that it allows for a considerably faster pace of growth.

2.1 Materials

There are the list of materials and equipment needed for creating this hydroponic system :

- LM35DZ Temperature sensor LM35
- Arduino Mega 2560
- LDR Light sensor
- 12V Brushless DC Fan Blower
- 12V 2A Adapter
- Female DC jack
- LCD
- Water sensor
- Breadboard and wire connecter
- PVC pipe
- Netpot
- Bucket

2.2 Methods

Hydroponics is a method of cultivating plants in soil-free water using mineral nutrition solutions. Plants can be grown in this system with their roots immersed in a mineral nutrient solution. This project is controlled by an Arduino Mega-2560 to ensure that plant grow well. The Arduino Mega-2560 are set by the coding to control the component in this project such a water pump, motor fan and LED strip light based on sensor which is water sensor, light sensor and temperature sensor. In our project, this method

are used to ensure the crop get enough nutrient such as plants that grown on the ground. **Figure 1** shows the flowchart and **Figure 2** shows the block diagram of explanation of the project.

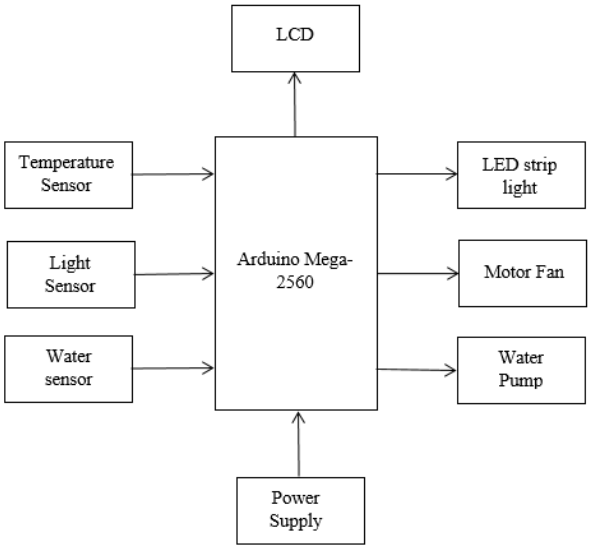

Figure 1: **Block diagram of smart hydroponic**

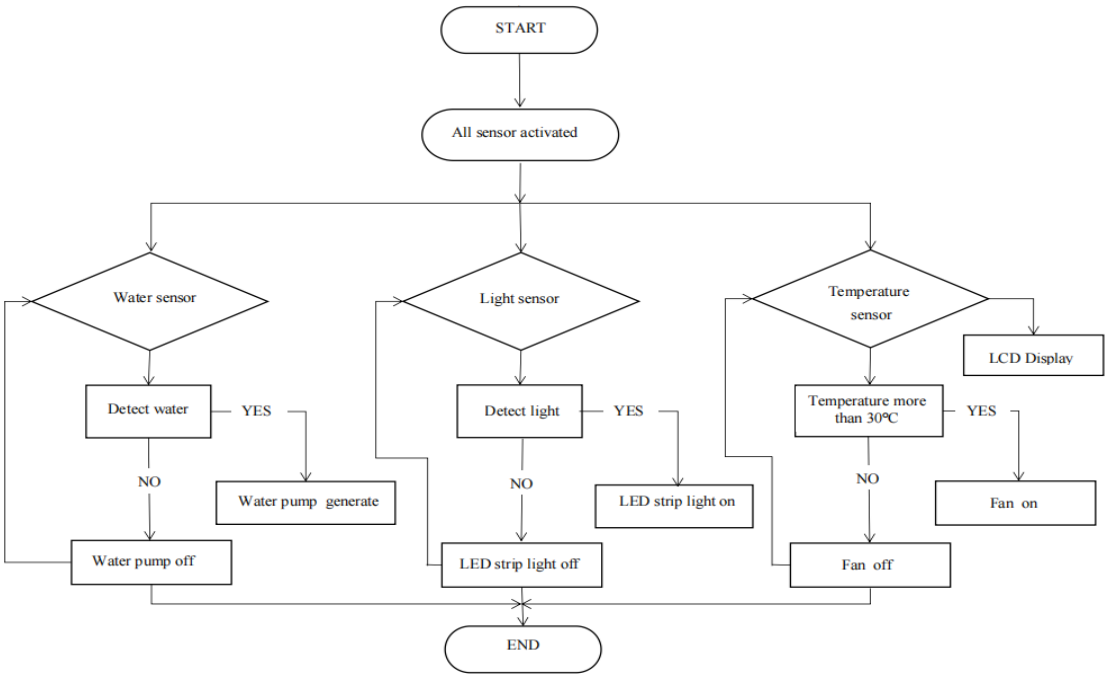

Figure 2: **Flowchart of smart hydroponic**

3. Results and Discussion

In a good hydroponic system, the water nutrient solution is automatically fed to the plants by the water pump into hydroponic circulation. This smart hydroponic system prototype, crops in hydroponic systems develop quicker because they are given an optimal quantity of nutrients and less environmental stress when grown indoors (like weather and pests). Hydroponics is the practise of growing plants in water without soil, with the proper nutrients added. The smart hydroponic system will have many features, such as the water pump turning on automatically when the sensor detects water, ensuring that

water is always thought into the plant. The water pump will off when sensor not detect water. The hydroponic system also has temperature control system which the fan will automatically switch on when temperature sensor reading the temperature of environment is over 30 degrees Celsius and will display it to Liquid-crystal display (LCD). The smart hydroponic also provided automatically light which led will switch on in night time. The system will provided plant the amount of light every time and plant will in healthy condition. The LED strip are use because compatible and not consume many energy and light sensor act as switch. The system use 2 DC with 12 DC volt which suitable for project which easy to install in circuit will switch ON or OFF automatically based on sensor. The Arduino Mega-2560 is controller off all system in smart hydroponic which all features already coding and install in it and system will work based on the coding. All the features in smart hydroponic system will ensure the plant will provide all it need to grow automatically without human energy involvement.

An irrigation system for hydroponic plants based on the Arduino Mega-2560. The system is adapted to recycle and reuse the solution of nutrient water. Water is generated by a water sensor in this nutritional water flow system. The water level in the hydroponic tube can be adjusted to fit the hydroponic system's needs, and this has be used as a general guideline for watering or not watering. The Arduino Mega-2560 receives the data from the sensors and it will transmit to other component such as water pump, LED strip light and motor fan to work. The surrounding temperature of the crops will detect and it will be displayed on the LCD. In our project, a hydroponic prototype delivered a blend of water and nutrients to plant roots automatically. If there are no presence of light, the LED strip light will light up to supply the crop enough light. All of the plants in the hydroponic systems germinated and grew because they were given enough nutrients, light, and a warm environment.

Table 1: The result of water sensor

Water Sensor	High	Low
Water Pump	ON	OFF

Table 1 displays the project's results; in this project, a water sensor is used to detect the water level, and a water pump is used to generate the water. When the water sensor detects a high water level, the water pump turns on and generates then supplies water to the crops. The water pump will turn off if the water sensor does not detect water or low water level.

Table 2: The result of light sensor

Light Sensor	High	Low
LED Strip Light	OFF	ON

Table 2 shown the result based on this project, in this project light sensor are used to detect the presence of light and the LED strip light are used to supply light. When the light sensor detect the presence of light is low or light sensor doesn't detect the light, then the LED strip light will turn on and it will supply the light to the crops. If the presence of light is high, the LED strip light will not light up.

Table 3 displays the project's results. In this project, a temperature sensor is used to detect the temperature surrounding the crop, and a motor fan is used to maintain the temperature around the crop. When the temperature sensor detects that the temperature around the crops is above 30°C, the motor fan turns on and works to keep the temperature from becoming too high. The motor fan will turn off if

the temperature falls below 30°C. The temperature of the environment around the crops will be display on a LCD panel.

Table 3: The result of temperature sensor

Temperature Sensor	>30°C	< 30°C
Motor Fan	ON	OFF

4. Conclusion

In conclusion, the hydroponic system is a better towards the growth of plants. This study further showed that the application of Arduino Mega-2560 that control the sensor in this hydroponics prototype based on the coding that install. Based on the experiment, the hydroponic system can build by using Arduino Mega-2560 which all system will work automatically without human involvement. The sensor that used in this prototype such as a water sensor, temperature sensor and light sensor to ensure that the plants get enough nutrient. The performance growth of plants depending on a few factors which are water, temperature and light. Proper understanding of the hydroponic is essential for efficient plant cultivation even in artificial conditions because these systems are very precise with temperature, light and water usage. Due to the constant supply of water, light and temperature, the hydroponic plants in this project have grown better than the plants growing in normal soil. The application of experimentally verified the application of hydroponic will provide good benefits to humans and also for the crops.

Acknowledgement

The authors would like to thank the Centre of Diploma Studies, Universiti of Tun Hussein Onn Malaysia (UTHM) for its support.

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