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Smart Hydroponics system

Adhila Unas[1], Amrutha Dilip[2], Ansal Sayeed[3], Ms Chaithanya G Nair[4]

[1,2,3] Electronics and Communication, Ilahia College of Engineering and Technology, Mulavoor, Kerala, India.
[4]Professor, Electronics and Communication, Ilahia College of Engineering and Technology, Mulavoor, Kerala, India

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Abstract - High yielding and high grade of crops are essential in modern day agriculture. This can only be achieved by smart farming technology which is used for making farms more intelligent in sensing its controlling parameters. Hydroponics is a type of horticulture and a subset of hydroculture which involves growing plants, usually crops, without soil, by using mineral nutrient solutions in an aqueous solvent. Hydroponics agriculture comes up as a solution to limited agricultural land that can lead to a decline in agricultural production capacity. These kinds of plants need a precise amount of nutrient every time to grow ideally. Hydroponics offers many advantages, notably a decrease in water usage in agriculture. Internet-of-Things (IoT) is a technology that enables regular monitoring of every aspect of human life. The emergence of IoT has allowed farmers to automate the hydroponic culture. IoT can be a solution to monitor the nutrition needs of the plants periodically. The application of solar powered system is also very necessary here due to current energy challenges facing by this new automated hydroponics system. If one such part gets fail, it compromises the working of entire system. So, it is necessary to detect that kind of failure. This paper proposes a solar powered automated hydroponics system for an energy efficient hydroponics precision agriculture based on the IoT concept.

Key Words: IoT, Horticulture, solar powered system, hydroponics, Agriculture

1. INTRODUCTION

Agricultural methods using hydroponics are one of the possible alternatives to be able to do agriculture even without extensive agricultural land. Hydroponics comes from Greece, hydro means water, and ponous means work. Hydroponics is a method of planting plants without using soil medium, but using a medium of water mixed with mineral nutrient solution. The advantage of hydroponic farming methods is that it does not require soil medium with vast land for agriculture, but agriculture can be done in a narrow area with water medium. Each hydroponic plant is also treated without using pesticides, so it is safer to consume.

Hydroponic farming methods need special treatment in controlling water temperature, water level, and acidity (pH) of nutrient solutions. To be able to produce plants that are good until the harvest period, they must carry out these treatments with regular checks every day. Examinations carried out include checking of water content in the installation, the nutrients, the size of the PH, the temperature and humidity of the air, which must be under the given quantity. If the quantity of one of the elements is excess or lacking, it can result in the inhibition of plant growth. This, of course, automatically impacts the selling price of hydroponic plants that are expensive. Therefore, although the method of hydroponics is the solution to the current problem of limited land, the complexity of treatment is an obstacle in its implementation. These problems can be overcome by combining hydroponic farming methods, the IoT technology, and a control system to make a smart controlling that can automatically control plants nutrition and water needs.

But this automated hydroponics require high energy due to motors and other current consuming components. Solar energy generation is an effective method for energy usage. Solar panels are now widely used for various applications both domestic and industrial alike. The decreasing price of solar panels inspires many companies and agencies to patronize its usage. Another problem facing by the hydroponics system is component failure especially after making the hydroponics system automated. Because the number of motors is more in automated hydroponics system. Failure in one of their operations compromise the entire working of system. This problem can be avoided by using current sensing resistor in the circuit. By utilizing internet of thing (IOT) technology, each sensor device can communicate or send data to a cloud server to be processed and monitored in real time. Each sensor is connected to ESP32 to control plant needs automatically.

Fig -1: Hydroponics

2 SYSTEM DESIGN

2.1 EXISTING METHOD

The existing method is automated hydroponics system. It consists of a monitoring system and controlling system. EC sensor and pH sensor along with microcontroller form monitoring system. These sensors take readings from nutritious solution where the root of plants is dipped. Every plant needs a specific amount of nutrition. And this nutritious solution has a specific electrical conductivity and pH value. By monitoring electrical conductivity and pH of the solution, amount of nutrient variation can be identified. Data collected from the sensors will be processed at microcontroller and check if the amount of nutrition is maintained. If at least any of the parameters (EC and pH) exceeding or lacking, a set of pumps provided for controlling the parameters. These pump pumps pH up solution, pH down solution, EC up solution and water from different tanks. These pumps are controlled by the microcontroller according to the data from the sensors, which form the controlling system. The monitoring and controlling values will be sent and saved to a server in Real time. The server used here is fire base, it's an open-source server provided by google.

2.2. PROPOSED METHOD

In this automated hydroponics system, a solar system and motor failure detection system is added. The microcontroller used here is ESP32. Since the existing model is automated system, it will be facing a problem of higher energy consumption and hardware failure. Controlling system consist of motors. It needs high amount of energy for its working. High electricity cost makes the farming more expensive. So solar system is required. A solar panel of 10-watt power is used here to generate electricity. A diode is connected to the positive terminal of panel to ensure that the current pass only in one direction. The varied voltage from the output of the panel is regulated using a buck converter and supplied to the circuit. Because of the installation of solar system availability of light for plants may be reduced. So, grow lights are required. LED strips are provided for that. Since automated system require more components for automation like motors, it increase the possibility of operational failure of system due to component failure. Even failure of one component can compromise the working of entire system. So, it is necessary to detect component failure. Here motor failure detection is implemented. This is done by using a current sensing resistor. The positive terminal of the motor is connected to relay and the negative terminal is connected to the resistor to ground. The resistor is of 4.7 ohm. When the relay is on, current passing through the motor to ground. Current will flow through resistor produce a small voltage drop. That voltage drop is measured by the microcontroller and indicate that the motor is functional and if the motor stopped working there will be no voltage drop and it is detected by microcontroller. It indicates that the motor is not functioning. This is also displayed in LCD. This project is mainly for farmers, for make the farming more easily and economically. This proposed method solves the problems in the automated hydroponics system and making it more efficient.

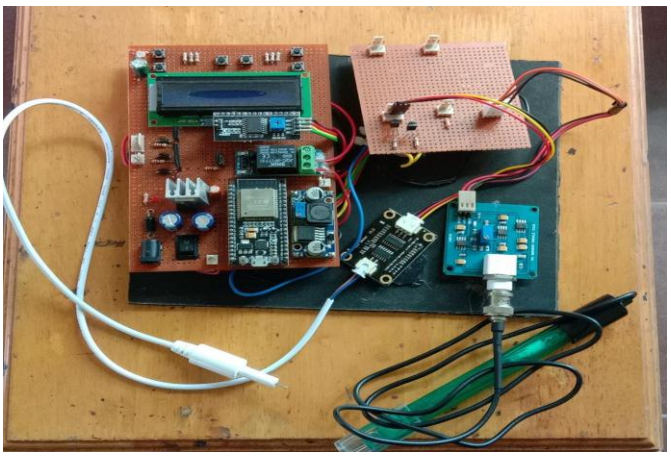

Fig -2: Connection Setup

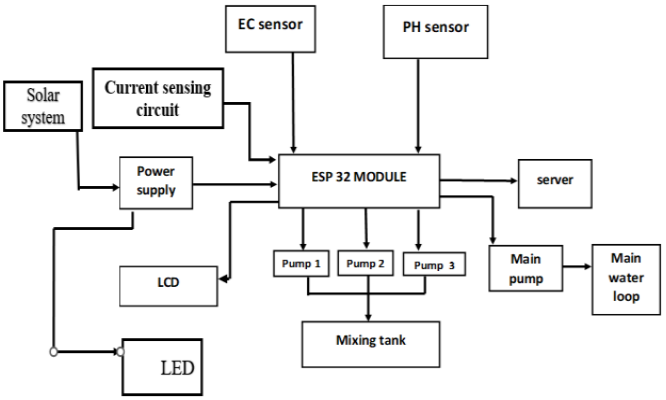

Fig -3: Block Diagram of Proposed Method

Fig -4: System Setup

3 SOFTWARE REQUIREMENTS

3.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. ion. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

4. CONCLUSIONS

This paper has proposed a solar powered automated hydroponics system. The crops in hydroponics are grown without the use of soil, instead the nutrients from the soil are directly given to the crops by water reservoir. Nutrients that are required by the plants are measured and added to the water reservoir so that the crops get enough nutrients from the water as equal as from the soil. The IoT technology is used to monitor the nutrition needs of the plants, while a control system is designed to control the supply of nutrition precisely. The nutritional needs are identified with the help of EC sensor and pH sensor. The microcontroller will read each value that will be sent by the sensor to be then analyzed, and a decision will be made to hold the nutrition to a required level. All the sensor parameters are continuously monitored. The microcontroller will connect to the server via an existing internet connection to store measurement data. Solar system is an efficient way for providing power supply in hydroponics. Since the main advantage hydroponics is less usage of water and land, solar system can be a best choice. Because it can be installed in small areas and areas with less availability of water may have higher availability of sunlight. Since the integral part of the controlling system is motors, motor failure can compromise the entire operation so, it is essential to detect motor failure. An LCD is provided to display the monitored values and error messages.

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