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Hydroponic Nutrient Solution for Crop Production using MATLAB

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Abstract:
Agriculture is considered as the basis of life for the human species as it is the main source of food grains and or raw materials. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops and fruits.The objective of this study is to prove that hydroponics method of growing crops is rich in nutrition. MATLAB is used to compare the nutrition of traditional method and hydroponics method. Wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield.

Keywords: Agriculture, Arduino, MATLAB.

I. INTRODUCTION

Humans require air, food, water, and living space in order to survive. These things are not endless in nature and thus humans are dependent upon the optimization of land area and the preservation of biodiversity. The human population is increasing and predicted to expand from 7.0 billion to 9.5 billion people within the next 40 years (Sahara Forest Project, 2009). An ever increasing demand for food species is implied, and it is estimated that food production will have to be doubled in order to compensate and provide availability to all.

The word “Hydroponic” defines as any means to grow plants via a medium that does not include the use of soil but involves inorganic nutrients or nutrient solution. Gericke who described methods of growing plants in liquid media (nutrient solution) introduced the term Hydroponics. Besides Gericke, many attempts were made to adopt the methods of soilless growing plants during thirties. Despite of all, countries like USA and others were keen to adopt this technology so that growing plants indoors without the favourable soil required as well as controlling the nutrient is possible. One of the basic principles for vegetable production, both in soil and in hydroponic systems, is to provide all the nutrients the plant needs. Several chemical elements are essential for growth and production of plants, in sixteen elements:

carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, manganese, iron, zinc, boron, copper, molybdenum and chlorine. Among the elements mentioned above, there is a division according to their origin: organic, C, H, O and minerals; broken down into macronutrients, N, P, K, Ca, Mg, S, and micronutrients, Mn, Fe, B, Zn, Cu, Mo, Ni, Cl. In hydroponic crops, absorption is usually proportional to the concentration of nutrients in the solution near the roots, being much influenced by environmental factors such as salinity, oxygenation, temperature, pH and conductivity of nutrient solution, light intensity, photoperiod and air humidity.

[4] Besides these facts, the progress of Hydroponics is being encouraged in India commercially. The performance of the system is compared with classical nutrient control unit designed using genetic algorithm using absolute error as fitness function. Food being the primary requirement worldwide for leading an energized and healthy life must be abundantly produced and made available. This production is carried over by the technique called cultivation. A number of vegetables, fruits, nuts and spices are all constantly being cultivated by various techniques. This project displays a programmed framework for hydroponics grub generation. The proposed framework was created for little and medium horticulture investigations empowering grub generation in six days.

II. EXISTING SYSTEM

In existing system, plants are grown in soil with spraying of pesticides and fertilizers. This deals with monitoring and controlling the environmental conditions like temperature, relative humidity, with sensors and sends the information to the web page and then plot the sensor data as graphical statistics. The data updated from the implemented system can be accessible in the internet from anywhere in the world. It requires excess amount of water.

III. PROPOSED SYSTEM

The proposed work deals with integrating the growing environment for individual crops on to a single system. This system is designed and built upon for growing three different types of crops which can be further extended to many a number of crops. A well-organized setup is built for the smooth functioning of the system. Appropriate nutrient solution is supplied to the crops, mixing them with the required quantity of water. Various sensors are used for monitoring the pH level of the nutrient solution and the water level.

The input obtained from these sensors will enable the controller to regulate the water and nutrient flow in correct Proportion. The controller is programmed with an efficient algorithm which will systematically regulate the flow. The system once built is tested upon for meeting an individual crop’s requirement and then all of which are integrated. This integrated system will improvise the growth of crops rapidly. The proposed system is shown in fig.1

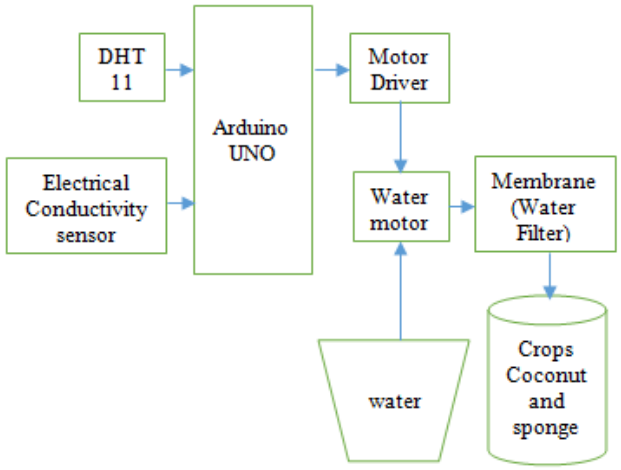

Figure.1. Block diagram

A. ARDUINO ARCHITECTURE

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. Arduino's processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories-Program memory and the data memory. The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the boot loader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz.The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware programmer to burn the program. This is done because of the presence of the 0.5KB of Boot loader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code.

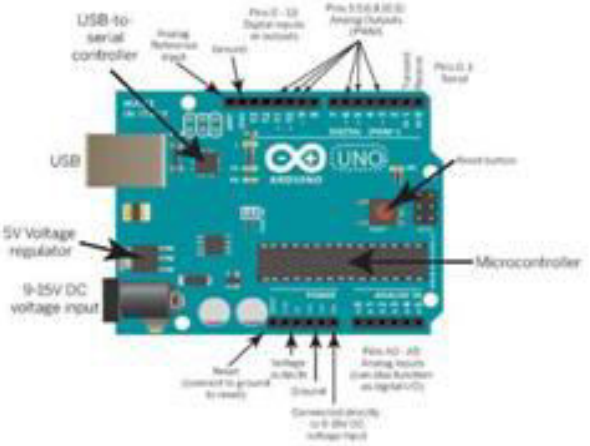

Figure.2. Arduino architecture

B. DHT 11 SENSOR

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive -type humidity measurement component and an NTC temperature measure ment component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

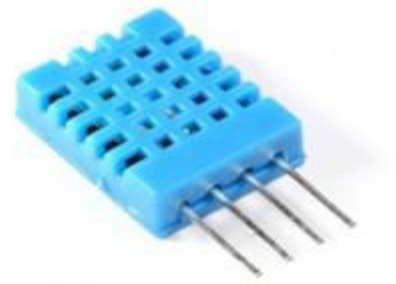

Figure.3. DHT 11 Sensor

C. ELECTRICAL CONDUCTIVITY SENSOR

EC or Electrical Conductivity of water is its ability to conduct an electric current. Salts or other chemicals that dissolve in water can break down into positively and negatively charged ions. These free ions in the water conduct electricity, so the water electrical conductivity depends on the concentration of ions. Salinity and total dissolved solids (TDS) are used to calculate the EC of water, which helps to indicate the water's purity. The purer the water the lower the conductivity. To give a real-life example, distilled water is almost an insulator, but saltwater is a very efficient electrical conductor.

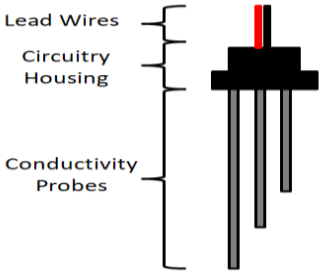

Figure.4. Electrical conductivity sensor

D.RELAY

Relays are switches that open and close circuits electro mechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit.

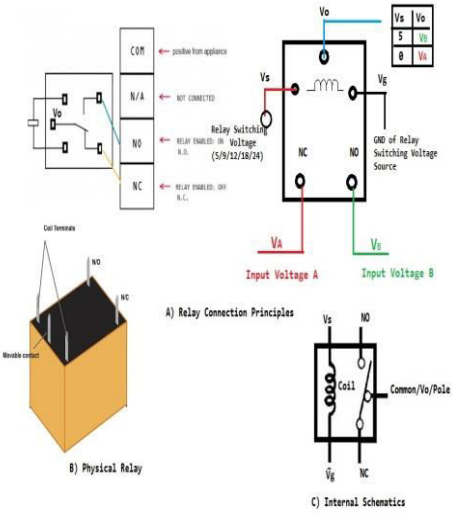

Figure.5. Relay

E. WATER MOTOR

DC 3-6V 120L/H Low Mini Submersible Motor Pump. Electronics Specification: DC Voltage: 2.5-6V, maximum lift: 40-110cm/15.75"-43.4", flow rate:80-120L/H, outside diameter of water outlet: 7.5mm / 0.3", driving mode: brushless dc design, magnetic driving continuous working life of 500 hours.

Figure.6. Bluetooth

F.MEMBRANE

Membrane is the sort that helps expel the undesirable waste items from water. For the dynamic test method two cubitainers were filled with tap water filtered over carbon and micro-filtration cartridges in order to ensure sterility of the test water.

Figure.7. Membrane

G. SPI PROTOCOL

The SerialPeripheral Interface (SPI) bus is a synchronous serial communication interface specification used for short distance communication, primarily in embedded systems. The interface was developed by Motorola has become a de facto standard. SPI devices communicate in full duplex mode using a master-slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave devices are supported through selection with individual slave select (SS) lines.

Figure.8. SPI Protocol

H. ETHERNET SHIELD

The Arduino Ethernet Shield R3 (assembled) allows an Arduino board to connect to the internet. It is based on the Wiz net W5100 Ethernet chip (datasheet). The Wiz net W5100 provides a network (IP) stack capable of both TCP and UDP. It supports up to four simultaneous socket connections. Use the Ethernet library to write sketches which connect to the internet using the shield. Ad fruit started shipping the R3 version on Feb. 3, 2012 at 3:30pm ET.

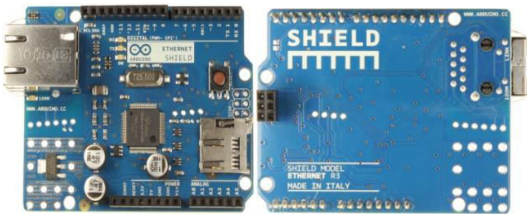

Figure.9. Ethernet shield

IV. CONCLUSION

Hydroponic agriculture farmers harvest more efficiently than conventional processes inputs provide the ability to implement. Without harming the environment, it provides greater quality crops, as well as saves time and money. This is a low-cost prototype model where the SD card using real-time environmental data storage and real time analysis of two methods of growing plant in coco and soil in MATLAB

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