INTELLIGENT PLANT CARE AEROPONIC USING IOT

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Abstract— *Aeroponics is the recent advancement in the modern organic plant culture. In this process of culture nutrient rich air or mist is used as the growing medium. Plants are grown on a solid cloth or equivalent membrane like holding medium and which takes the nutrients from the spray or mist given to the roots. A minimum support of the plant to the holding medium is ensured in order to avoid pathogen and other cosmopolitan microbe growth. Aeroponics provide fast and efficient food production. In this phase, design has been shown through a proteus software.*

Keywords: *Aeroponics, Hydroponics.*

I. INTRODUCTION

Implementation of modern organic plant culture in an air or mist environment without the use of soil or an aggregate medium (Aeroponics). Aeroponic culture differs from both conventional hydroponics, aquaponics, and in-vitro (plant tissue culture) growing. Unlike hydroponics, which uses a liquid nutrient solution as a growing medium and essential minerals to sustain plant growth; or aquaponics which uses water and fish waste, aeroponics is conducted without a growing medium. It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients.

II. AEROPONICS (AIR CULTURE)

Aeroponics is a form of hydroponics where plants roots are suspended in a chamber and nutrient solution is sprayed from below. The main difference of air culture is that it does not require a growing medium like in other hydroponic systems (except for NFT). This method of spraying nutrient solution allows roots to absorb more oxygen than it is in the soil (geoponic) system. It has been reported that, in air culture, plant growth and metabolism rate increased ten times than that of soil. Through aeroponic systems, root growth, nutrient, water, and environment conditions around the roots can be monitored and controlled than other hydroponics or geoponic.

A. Benefits

Air cultures optimize access to air for successful plant growth. Materials and devices which hold and support the aeroponic grown plants must be devoid of disease or pathogens. A distinction of a true aeroponic culture and apparatus is that it provides plant support features that are minimal. Minimal contact between a plant and support structure allows for 100% of the plant to be entirely in air. Long-term aeroponic cultivation requires the root systems to be free of constraints surrounding the stem and root systems. Physical contact is minimized so that it does not hinder natural growth and root expansion or access to pure water, air exchange and disease-free conditions.

B. Existing system

An Intelligent Plant Care Hydroponic Box (IPCH-Box) that exercises environment driven control methods through an Internet-of-Things (IoT) management tool called IoT talk. IoT talk provides a scalable and configurable software for users to easily and quickly add/remove/exchange the sensors and actuators, and program their interactions. From the experimental measurement results of IPCH-Box, the developed environment driven control methods include LED lighting, water spray and water pump which can effectively lower the CO2 concentration, the temperature and increase water level, respectively. Specifically, the time of CO2 concentration reduction in IPCH-Box is 38.54% faster than that with the plant system without our mechanism.

III. PROPOSED SYSTEM

The principles of Aeroponics are based on the possibility of cultivating vegetables whose roots are not inserted in a substratum (the case with hydroponics) or soil, but in containers filled with flowing plant nutrition. In these containers roots can find the best condition regarding oxygenation and moisture. These conditions allow for better plant nutrition assimilation in a more balanced way, with consequential faster development of the cultivated plants.

A. *Cultivation scenario*

Plant containers can be mounted on top of one another and because they are light and handy, they can be easily moved according to agricultural needs. Numerous plants are mounted in vertical columns within a greenhouse or shade house space. Nutrients are allowed to trickle down through the growth columns.

Most agricultural plants need a direct exposure to the sun during the first vegetative development. Afterwards this direct exposure is no longer relevant. Based on this observation, plant containers are periodically displaced. Young plants are placed at the highest level of the growth column. Afterwards they are progressively lowered utilizing a rotational mechanical system. With the rotation periodically repeated, this permits constant production without any interruption. The Aeroponic system is agriculture with a non-stop production cycle.

IV. BLOCK DIAGRAM

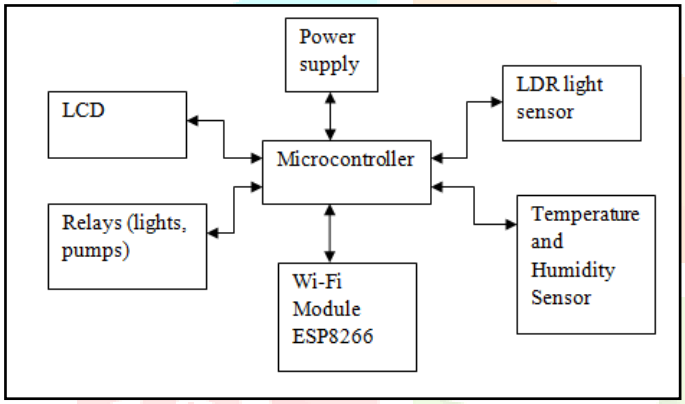


Fig 1: Block diagram of aeroponics

V. TYPES OF CROPS

A. *Lettuce (Lactuca sativa)*

Lettuce is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled. One variety, the *woju* , or asparagus lettuce (celtuce), is grown for its stems, which are eaten either raw or cooked. In addition to its main use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption. Europe and North America originally dominated the market for lettuce, but by the late 20th century the consumption of lettuce had spread throughout the world. World production of lettuce and chicory for calendar year 2013 was 24.9 million tonnes, over half of which came from China.

B. *Fenugreek*

Fenugreek (Trigonella foenum-graecum) is an annual plant in the family Fabaceae, with leaves consisting of three small obovate to oblong leaflets. It is cultivated worldwide as a semiarid crop, and its seeds are a common ingredient in dishes from South Asia. Fenugreek is believed to have been brought into cultivation in the Near East. While Zohary and Hopf are uncertain which wild strain of the genus Trigonella gave rise to domesticated fenugreek, charred fenugreek seeds have been recovered from Tell Halal, Iraq, (carbon dated to 4000 BC) and Bronze Age levels of Lachish and desiccated seeds from the tomb of Tutankhamen. Cato the Elder lists fenugreek with clover and vetch as crops grown to feed cattle. In one first-century A.D. recipe, the Romans flavored wine with fenugreek. In the 1st century AD, in Galilee, it was grown as a food staple, as Josephus mentions it in his book, the Wars of the Jews.

C. *Spinach*

Spinach (Spinacia oleracea) is an edible flowering plant in the family Amaranthaceae native to central and western Asia. Its leaves are eaten as a vegetable. It is an annual plant (rarely biennial) growing to 30 cm (12 in) tall. Spinach may survive over winter in temperate regions. The leaves are alternate, simple, ovate to triangular, and very variable in size from about 2–30 cm (1–12 in) long and 1–15 cm (0.4–5.9 in) broad, with larger leaves at the base of the plant and small leaves higher on the flowering stem. The flowers are inconspicuous, yellow-green, 3–4 mm (0.1–0.2 in) in diameter, maturing into a small, hard, dry, lumpy fruit cluster 5–10 mm (0.2–0.4 in) across containing several seeds.

D. *Plant growth in aeroponics*

Fig 2: Plant growth in aeroponics

E. *Plant farming*

Plant nutrition is supplied into a closed circuit. Consumption is consequently limited to only the quantities absorbed by the plants, allowing for substantial water savings. For example: to produce a kilogram of tomatoes using traditional land cultivation requires 200 to 400 litres of water, hydroponics requires about 70 litres, aeroponics utilizes only about 20 litres.

Because the aeroponic system is a continuous-cycle in an enclosed space it reduces the agricultural labour into a series of mechanical routine operational tasks which are carried out daily and throughout the year. This enables workers to acquire considerable skill within a short period of time a few months. In traditional agriculture commercial production is obtained only with skilled workers qualified by many years of experience.

The aeroponic equipment is sheltered within greenhouses or anti hail-storm coverings according to the latitude. Climate controls within the greenhouse ensure optimal growing conditions, assuring high yields.

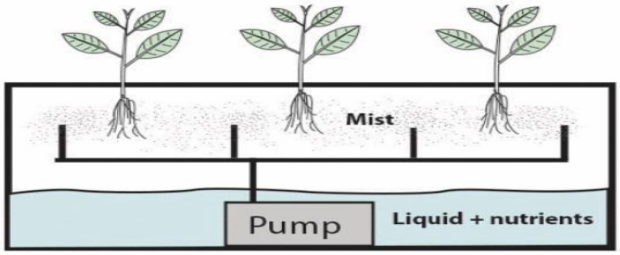


Fig 3: Hydrofluid for plants

VI. SOFTWARE SIMULATION

A. *Proteus*

The Proteus Design Suite is wholly unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode SPICE circuit simulation. With this Virtual System Modelling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development. If one person designs both the hardware and the software then that person benefits as the hardware design may be changed just as easily as the software design. In larger organisations where the two roles are separated, the software designers can begin work as soon as the schematic is completed; there is no need for them to wait until a physical prototype exists. In short, Proteus VSM improves efficiency, quality and flexibility throughout the design process. Proteus Virtual System Modelling (VSM) combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs. For the first time ever, it is possible to develop and test such designs before a physical prototype is constructed. This is possible because you can interact with the design using on screen indicators such as LED and LCD displays and actuators such as switches and buttons. The simulation takes place in real time (or near enough to it): a 1GMHz Pentium III can simulate a basic 8051 system clocking at over 12MHz. Proteus VSM also provides extensive debugging facilities including breakpoints, single stepping and variable display for both assembly code and high level language source.

B. *Circuit simulation*

At the heart of Proteus VSM is ProSPICE. This is an established product that combines uses a SPICE3f5 analogue simulator kernel with a fast event-driven digital simulator to provide seamless mixed-mode simulation. The use of a SPICE kernel lets you utilise any of the numerous manufacturer-supplied SPICE models now available and around 6000 of these are included with the package.

Proteus VSM includes a number of virtual instruments including an Oscilloscope, Logic Analyser, Function Generator, Pattern Generator, Counter Timer and Virtual Terminal as well as simple voltmeters and ammeters. In addition, we provide dedicated Master/Slave/Monitor mode protocol analysers for SPI and I2C - simply wire them onto the serial lines and monitor or interact with the data live during simulation. A truly invaluable (and inexpensive!) way to get your communication software right prior to hardware prototyping.

C. *Basic proteus design*

If you wish to take detailed measurements on graphs, or perform other analysis types such as frequency, distortion, noise or sweep analyses of analogue circuits, you can purchase the Advanced Simulation Option. This option also includes Conformance Analysis - a unique and powerful tool for Software Quality Assurance.

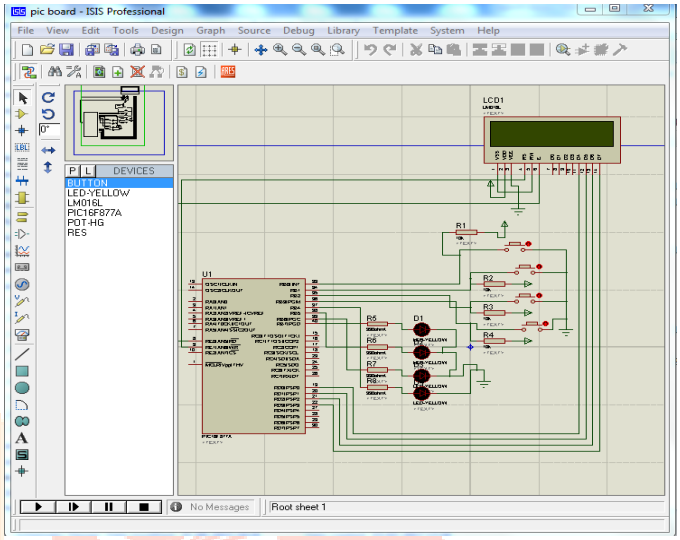


Fig 4: Basic Proteus design

D. *Proteus design for sensor value reading*

The behaviour of the model under variations to the transition rules was observed. The step increment amounts of the transition rules were found to have a large impact on the resulting simulated leaf shape and rates of growth, as was expected.

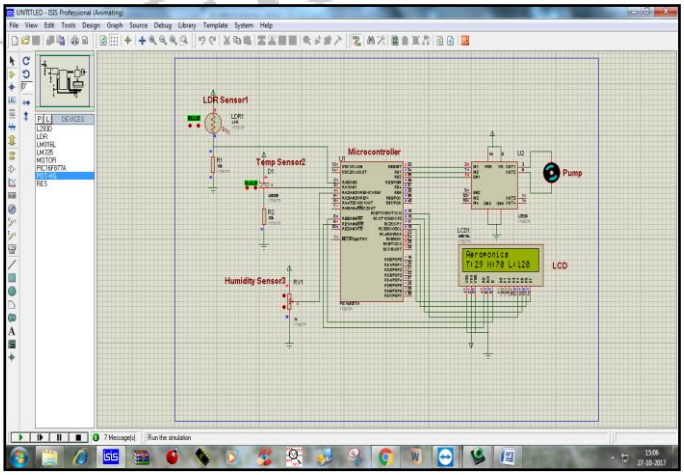


Fig 5: Aeroponics simulation

E. *Benefits of aeroponics*

Energy saving technology for plant factory using artificial light source. By controlling the LED using photo sensor, 260 PPFD (Photosynthesis Photon Flux Density), are maintained. The optimum growth efficiency of the crop is decided by the percentage of LED by its colours. The percentage of the

energy saving between the plant cultivation by the artificial light source and by sunlight is compared, and about 43 % of the saving effect is acknowledged.

VII. HARDWARE IMPLEMENTATION

A. *PIC16F877AMicrocontroller*

PIC stands for Peripheral Interface Controller. It encodes and decodes the data. It has flash memory so we can rewrite up to 100,000 times. It is a 28 pin DIP package. The architecture of the PIC is HARVARD. It has three ports for the input/output operation. The analog signal can be directly given to the PIC hence there is no need for external analog to digital converter.

B. *Positive voltage regulators ICs*

The L78xx series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3, D²PAK and DPAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

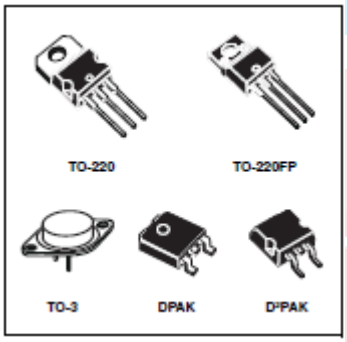
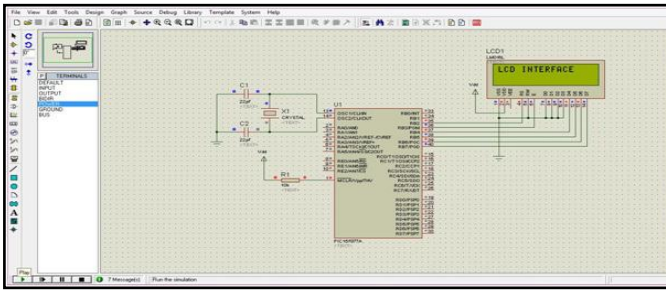


Fig 6: Voltage Regulator

C. *LCD interfacing with microcontroller*

LCD (Liquid Crystal Display) provides user interface and can be very useful for S purpose. To interface LCD with PIC16F877A and display the text 'LCD INTERFACE' on it. LCDs comes in different sizes and shapes. For this project, we have selected a 16×2 character, alphanumeric LCD. It contains 2 rows of 16 character.



D. *Light Dependent Resistor*

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material.

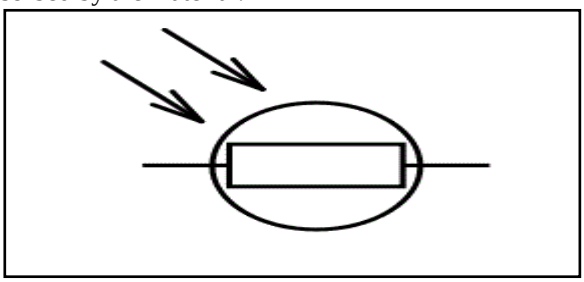


Fig 7: Light Dependent Resistor

E. *Power supply Unit*

The AC mains are fed to the transformer, which steps down the 230 Volts to the desired voltage. The bridge rectifier follows the transformer thus converting AC voltage into a DC output and through a filtering capacitor feeds it directly into the input (Pin 1) of the voltage regulator. The common pin (Pin 2) of the voltage regulator is grounded. The output (Pin 3) of the voltage regulator is first filtered by a capacitor, and then the output is taken.

An important thing to note is that you will need to take care of the polarities, while using this supply, as most of the devices you will power up will only work on forward bias, and will not have an inbuilt rectifier to correct wrong polarities. Almost all of the devices will need positive on the tip, and ground on the sleeve, except a few, for example, in the music industry, almost all the devices will need ground on the tip, and positive on the sleeve.

F. *Thermistor*

A thermistor is a temperature sensor constructed of semiconductor material that exhibits a large modification in resistance in proportion to a tiny low modification in temperature. When temperature changes, the resistance of the thermistor changes in a predictable way.

Fig 8: Thermistor

G. *Humidity sensor*

The humidity sensor used in this project is called HSM-20G.

Relative humidity is converted to standard voltage output. The relative humidity should monitor an ideal environment.

H. Hardware view

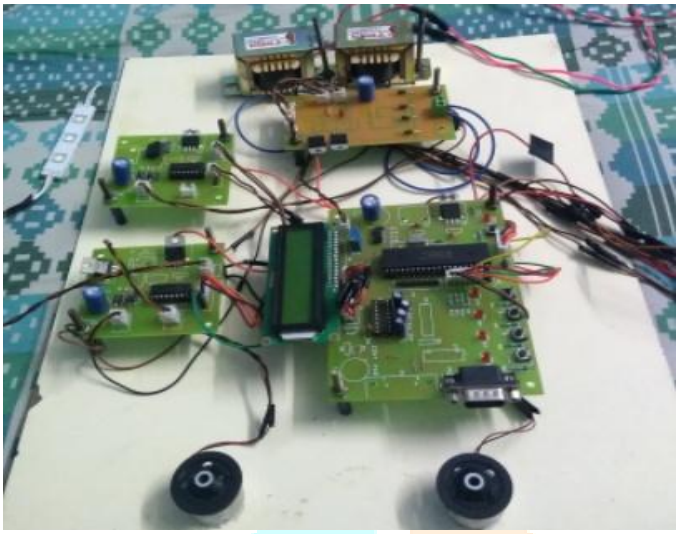


Fig 9: Hardware Output Implementation

VIII. CONCLUSION

A major breakthrough is required in the organic farming practices. Pesticide and modern fertilizer usages are bringing various health hazards. Plant and food quality is being in a state of degradation day by day. Personal or home farming practices are to be rejuvenated and supported in various manners. Aeroponic systems are pointing to success of the technology adoption in the organic farming culture. Possibilities in assisted large farmlands also need to be confronted through agricultural technologies. The main advantages of this type of system Limited water consumption, independent of land and soil quality, and aeroponic can be used in places where the gardening is not possible. Thus not only is it a profitable undertaking, but one which has proved of great benefit to humanity. People living in crowded city streets, without gardens, can grow fresh vegetables and fruits in household gardens or in small discarded containers. By means of hydroponics, a regular and abundant supply of fresh greens vegetables, fruits can be produced in poor production areas and clean areas can be made productive at relatively low cost.

REFERENCES

[1] L. A. Velázquez, M. A. Hernández, M. León, First Advances on the Development of a Hydroponic System for Cherry Tomato Culture, in 2013 10th International Conference on Electrical Engineering, Computing Science and Automatic Control (CCE) Mexico City.

[2] M.F. Saaid, N. S. M. Fadhil, M.S.A. Megat Ali, M.Z.H. Noor , Automated Indoor Aquaponic Cultivation Technique, in 2013 IEEE 3rd International Conference on System Engineering and Technology.

[3] E. U.Iniyan, L.Padmanaban,"Fusion of Medical Images using Wavelet Transform and Second generation curvelet Transfor",International Journal of Creative Research and Thoughts,Vol 6,Issue 1,pp 437-442,2018.

[4] Monica Rozenfeld, Indoor farms could revolutionize agriculture, The institute – IEEE tech news resource online magazine, 23May2016 [5] Students boost food production with simple technologies, The institute - IEEE tech news resource online magazine, 23May2016.

[5] S. Lee, S. Park, "Energy savings of home growing plants by using daylight and LED," *IEEE Sensors Applications Symposium* (SAS), pp. 202-204, Feb. 2013.

[6] Ms. M. D. Dafny Lydia Ms. V. Savitha M.E. , Mr. E. U. Iniyan M.E.," Small Data Dissipation Using Se-Drip –An Enhanced Version of Drip," International Journal of Engineering Trends and Technology,Vol 18, pp.276-278,2014.

[7] A. N. Harun, R. Ahmad, N. Mohamed, "WSN application in LED plant factory using continuous lighting (CL) method," *IEEE Open Systems* (ICOS), pp. 56-61, Aug. 2015.

[8] Y. B. Lin, Y. W. Lin, C. Y. Chih, T. Y. Li, C. C. Tai, Y. C. Wang, F. J. Lin, H. C. Kuo, C. C. Huang, and S. C. Hsu, "EasyConnect: A management system for IoT devices and its applications for interactive design and art," *IEEE Internet of Things Journal*, vol. 2, no. 6, pp. 551-561, Dec. 2015.

[9] KS Sunitha, E U Iniyan, M Moorthi, "Reversible Encrypted Data Concealment in Encrypted Images by Reserving Room approach for Data Protection System," International Journal of Research in Engineering & Advanced Technology,Vol 1, pp:1-5,2013.