

Real Time Monitoring and Analysis for Plant Health and Production of Aquatic Culture using IoT

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Abstract: Hydroponics is the system of hardware and software designed to control and monitor hydroponic gardens. The goal of such a system is to create a precisely controlled automated hydroponic garden. The benefit of such a garden would be autonomous food production, self-sustainability, and conserve water as a resource. The system consists of custom electronics and software. The hardware consists of the Hydroponics modules. The Hydroponics modules are used for wireless plant and environmental sensing.

Keywords- IOT, Hydroponics, Sensors, Aquaponics, smart farming.

1. Introduction

Hydroponics monitoring system was started with the idea of creating an autonomous hydroponic garden. The purpose of such a garden would be for the autonomous and ultra-efficient production of healthy food produce. Modern human beings have busy schedules, may lack the expertise for agriculture, or be in a location that makes it difficult. Hydroponics monitoring system aims to be a complete open source autonomous hydroponics garden using real time operations for timely yields and conserve resources. Developing nations could possibly make use of such a system to maximize food production and save huge on fresh water, a scarce resource in some nations. Additionally, the basic components of the system are designed from parts easily source-able at hardware stores aside from the electronics. The need for such a system is a driving force behind the making of this system.

Another motivation is it will also help in spreading the awareness of how this technology can play an important part in helping conserve water and yet derive yields of unimaginable magnitudes.

2. Objectives

The main objective of this research project is to increase productivity and quality of crops and to simplify and improve agricultural practices by creating a healthy and automated system.

Some other objectives are to monitor all the parameters of crops and its environment, to provide a real time analysis & yield more production based on its statistics and make more efficient use of resources.

3. Survey and its outcomes

Focus on some problems faced by farmers:

- Drought conditions and unpredictability of climate and weather patterns.

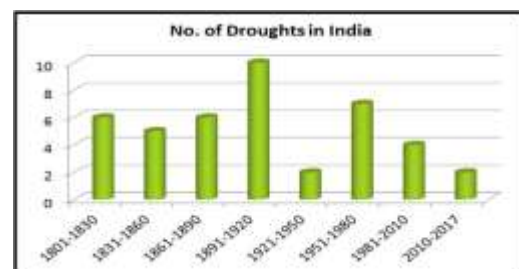
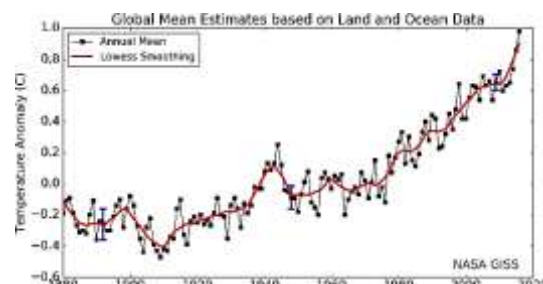


Fig 3.1:- Number of droughts per 30 years

- Rising temperatures and radical shifts from historic profiles.



- Pollution of rivers, means polluted water for agriculture.
 Water pollution is a major environmental issue in India. The largest source of water pollution in India is untreated sewage. Other sources of pollution include agricultural runoff and unregulated small scale industry. Drying up of water sources both in groundas well as on ground.
- Lack of cultivable space in major cities

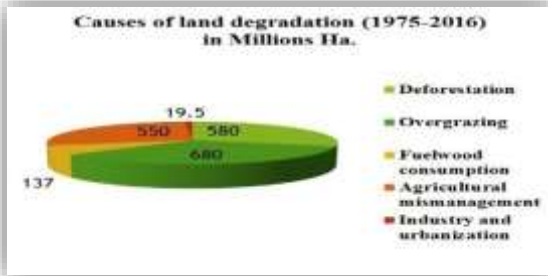


Figure 3.3:- Land degradation causes

- Effects of insecticides and pesticides



Figure 3.4:- Effects of insecticides

Pesticides are poisons and, unfortunately, they can harm more than just the “pests” at which they are targeted. They are toxic, and exposure to pesticides can not only cause a number of health effects, but is linked to a range of serious illnesses and diseases in humans, from respiratory problems to cancer.

Some disease occurred are-- (1.)Skin Irritation, (2.)Alzimer’s disease, (3.)Parkinson’s disease, (4.)Neurotoxicity, (5.)Carcinogenic effects, (6.)Weight Loss in Fetus, (7.)Childhood Leukemia, (8.)Bladder & Colon Cancer

4. System Development

The system shown in following figure consists of various sensors, Output of these sensors are shown on the wireless display and sent over server through Wi-Fi.



Figure 4.1:- System Block Diagram

Description:

A] Temperature Sensor

This sensor is used for minimizing the Cold Junction Compensation. The sensor output temperature (in digital form) and this temperature is given to the microcontroller.



Figure 4.2:- Temperature Sensor B] Ultrasonic sensor

Ultrasonic Distance Sensor provides range from 2cm to 5mtr for applications in detection and ranging. The sensor provides precise and stable measurement of a crop from seedling to a grownup plant with very high accuracy.



Figure 4.3:- Ultrasonic Sensor

C] Power Supply

Power supply required depends upon the sensors used and outputs required, hence I designed a variable power supply as per application and requirements.

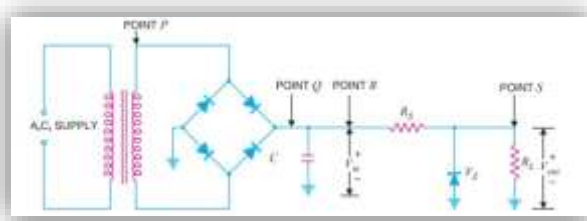


Figure 4.4:- Power supply circuit D]

Microcontroller

The microcontroller is used to do all the logical operations needed and acts as a communication medium between input and output components.



Figure 4.5:- Micro-controller IC circuit

6. These LEDs are controlled by microcontroller.
7. The RTC provides with the date and time update to ensure proper ordered set of readings.
8. Further all of these results can be transmitted on a web server through a Wi-Fi module.
9. Finally, monitoring and analysis of these results can be done.

6. Schematic Description

The schematic design shown in following figure is made with the PROTEUS 8 software. I made use of the built-in available components. While doing so, we used the datasheets of the respective components and made the connections accordingly.

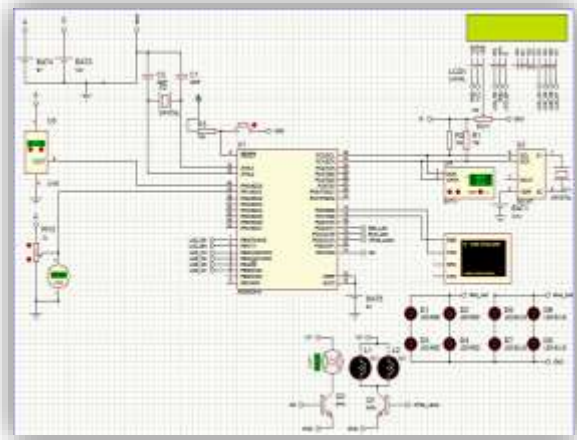
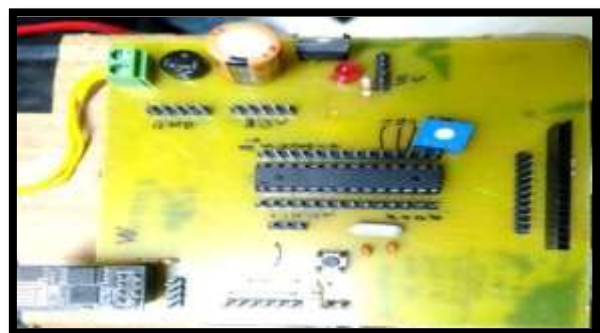


Figure 6.1:- Schematic circuit diagram

The PCB Layout module is automatically given connectivity information in the form of a net list from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. PCB's of up to 16 copper layers can be produced with design size limited by product configuration.



5. Working

1. First, the temperature and moisture sensor provide the mV readings corresponding to the temperature and moisture in the system.
2. These readings are given as an input to the ADC. The ADC generates the count which is sent to the microcontroller.
3. Further, the temperature values are displayed on the LCD.
4. If the temperature is above threshold value, then cooling fan which is connected to the microcontroller will start rotating. It will stop when temperature drops below threshold.
5. Array of blue and red LEDs are used along with white fluorescent light source to provide photosynthesis required for plants growth.

7. Hardware Requirements

A] INPUTS AND OUTPUTS

- Inputs - ADC, RTC, temperature sensor, oxygen Sensor, humidity sensor, ultrasonic sensor, keypad etc.
- Output - Voltage in mV, LED, LCD. B] PROGRAMMING

- Conversion of ADC output to corresponding counts.
- Coding related to different communication protocols.

C] COMMUNICATION

- I2C
- UART
- GSM
- WI-FI

D] DEVELOPMENT TOOLS:

- AvrStudio for ATMEGA328 programming
- Tinker Cad for coding and simulation
- PROTEUS for Schematic E]

POWER SUPPLY

- 12V power supply
- 05V power supply
- 3.3V power supply

F] PRODUCT SPECIFICATION

- pH value: 5.5-6.
- Temperature :24-30 `C
- Relative Humidity: 50-70%
- Dissolved Oxygen: 7 mg/L

8.1 Performance Evaluation

LED Source	Image	Stated Wattage	Actual Wattage	Colour Spectrum
CFL White		26W	21.5W	650K
LED Blue		12W	14.1W	450-460nm
LED Red/Blue		12W	10.1W	630nm
LED Red		12W	10W	620nm

Figure 8.1.1:- Comparative Study of artificial light system

8.2 Observations

Following are the observations that are found out after testing the artificial light on crops: - **Effects of artificial light on Vegetation: -**

- CFL White - As shown growth is good but due to high intensity of white light, temperature rises and burns can be observed.
- Blue LED - Growth comparatively is good enough but root development is weak and elongation is less. It has Good mass
- Red-Blue LED (Violet) - Although root development is good, growth of the plant is not as good as other one in blue light.
- Red LED - Growth is good but excess elongation also leads to weak structure and leaf bleaching, yet it has a good root structure.



Figure 8.2.1:- Effects of artificial light on plants

8.3 Lab Prototype



Figure 8.3.1:- Prototype for the plant cultivation

8.4 LCD Display Outputs



Figure 8.4.1:- LCD Display photos showing different outputs.

8.5 Real time Implementation at a Farm



Figure 8.5.1:- Real time system implied in field.

9.1 Conclusion

Thus Real time data of any plant with its essential environmental conditions can be monitored, saved and controlled for greater yield of plants in agriculture.

9.2 Advantages

- 1) Irrigation water usage reduced by 70-90%
- 2) Fungal disease can be significantly reduced through controlled humidity.
- 3) Gives effective control over environment.
- 4) The product has macro-micro nutrients needed by human body.
- 5) The amount of nutrients needed by plants can be automated as they grow.
- 6) Root zone temperatures are maintained as is ideal to ensure good growth of the plant.

9.3 Disadvantages

- 1) The initial investment in a commercial hydroponic system is high.

9.4 Applications

- 1) At different market segments for cultivation at extreme conditions.
- 2) For production of a large quantity of biomass.
- 3) At deserted and snow affected areas.
- 4) For production of medicinal plants that rely on its roots.
- 5) At terrace farming (best option to get organic vegetables in cities)

9.5 Future Scope

- 1) Due to deforestation and scarcity of cultivable land in major cities, this system can be implemented within less space in the house.
- 2) Deserted areas that are low on resources and water can make the most use of Hydroponic Control System for better and timely yields.
- 3) Areas affected by harsh climatic conditions will have no effect on yields cultivated by the system.
- 4) Hydroponics Control System will evolve into a solar powered system.

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Biography



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