IoT based Green House Automation System with Power Conservation using Biofuel Cell

[1]Shahana Saba
Department of ECE
GSSSIETW
Mysuru, India

[2]Smita Ramakrishna Shetty
Department of ECE
GSSSIETW
Mysuru, India

[3]Umme Kulsum
Department of ECE
GSSSIETW
Mysuru, India

[4]Vinutha M
Department of ECE
GSSSIETW
Mysuru, India

Abstract- Greenhouse Environment, used to grow plants under controlled climatic conditions for efficient production, forms an important part of the agriculture and horticulture sector. In this paper, an experimental setup for automated greenhouse system is presented, with an aim to improve the crop productivity under a controlled environment. For this purpose, temperature, light and soil moisture sensors are used to collect data. It also focuses on the Generic Architecture which can be applied for many other Automation Application. Nowadays due to urbanization and lack of land availability there is a great need to construct the Greenhouses which will be reserved mainly for growing crops. With the advancement of technology, we can control and monitor the multiple Greenhouses using IOT from the central location wirelessly. For the power supply we have used bio battery and solar energy. Bio-Battery generates electricity from renewable fuels (glucose, sucrose, fructose, etc) providing a sustained, on-demand portable power source, which reduces the impact of the chemicals and reduces the harm to the environment which gives a great advantage to humans.

1. INTRODUCTION

A greenhouse is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. These structures range in size from small sheds to industrial-sized buildings. A miniature greenhouse is known as a cold frame. The interior of a greenhouse exposed to sunlight b ecomes significantly warmer than the external ambient temperature, protecting its contents in cold weather. Many commercial glass greenhouses or hot houses are high tech production facilities for vegetables or flowers. The glass greenhouses are filled with equipment including screening installations, heating, cooling, lighting, and may be controlled by a computer to optimize conditions for plant growth. Different techniques are then used to evaluate optimality-degrees and comfort ratio of greenhouse micro-climate (i.e., air temperature, relative humidity and vapor pressure deficit) in order to reduce production risk prior to cultivation of a specific crop. A battery is an electrical device which is used to alter the chemical energy to electrical energy. Batteries are classified into different types based on the application, and these are used in several electrical as well as electronic devices. An electrical battery includes certain chemicals like compounds of mercury, lead etc. and the lead of a battery is extremely dangerous in nature and are not environment-friendly. Apart from these, there is a chance for chemical leakage as well as the explosion of the battery in certain cases. To overcome this problem researchers have invented Bio-battery which reduced the impact of these chemicals and reduces the harm to the environment which gives a great advantage to human.

2.RELATED WORK

Since 1990's for greenhouse and environment monitoring various kinds of system have been developed but due to lack of awareness ,cost and implementation factors ,these systems were left behind. Introducing this system can help in increasing the cultivation in a controlled environment. Required environmental conditions like Respiration for plants are necessary for optimum plant growth, improved crop yields, and efficient use of water and other resources. Low soil temperatures can inhibit water absorption in plants. Lack of sunlight can affect plant growth. When RH is low, transpiration increases resulting in water deficiency in plants. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected with less labor requirements. .Automatically controlling all the factors that affect plant growth is also a difficult task as it is expensive and some physical factors are interrelated , for example, temperature and humidity are related in a way when temperature raises humidity reduces therefore controlling both together is difficult. Because the temperature and humidity of greenhouse must be constantly monitored to ensure optimal conditions, wireless sensor network can be used to gather the data from point to point. The data from the greenhouse will be measured by the sensor and the data that are collected will be sending to the receiver. As the day goes on development of green house monitoring system increases. By using this system, the process of monitoring is easier and it is also cheaper for installation and maintenance process.

The Bio Battery, based on the work of different universities is a type of battery that uses energy sources such as

carbohydrates, amino acids and enzymes from a variety of sources. Anode consists of sugar-digesting enzymes and mediator, and the cathode composes of oxygen reducing enzymes and mediator. These batteries can be used as energy sources in green house monitoring system.

3.Methodology

3.1 Design of Green House System

This project demonstrates the design and implementation of a wireless sensor networks for greenhouse environment monitoring and controlling. This greenhouse control system is powered by Arduino and it consists of temperature sensor, soil moisture sensor, LDR sensor, smart phone, DC fan, Bulb and pump.

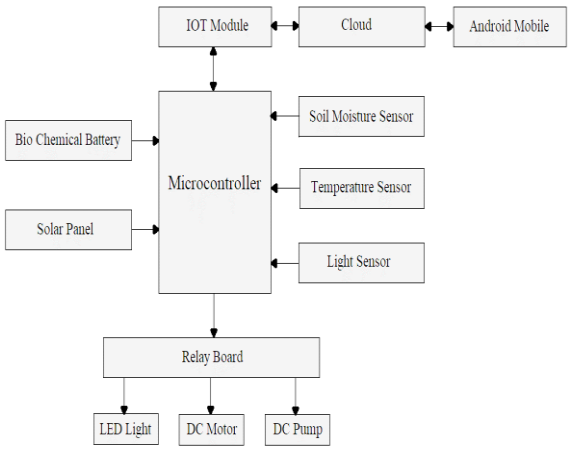


Fig. Green House Automation System

In Greenhouse System, the different parameters like temperature, soil moisture and light intensity is continuously monitored by the respective sensors. At every moment readings from the sensors is sent to the Arduino. These received values are compared with the threshold values which has been programmed in the Arduino. If the received value from the sensor is above or below threshold value, the Arduino would send signals to the user's mobile application to turn on the particular relay.

The user should then give a command through his mobile application to turn on the respective relay as per the requirement. If the user does not respond to the message sent by the Arduino within a certain interval of time, which has been already set in the Arduino during its programming, the Arduino would then automatically turn on the relay as per the requirement. If the temperature increases above the threshold value, the dc fan will be turned on to cool down the temperature inside the greenhouse and if moisture level decreases the pump level will be turned on to allow the flow of water.

Similarly, if intensity of light inside the greenhouse decreases the bulb will be turned on to increase its intensity. The sensors will be continuously sensing the greenhouse parameters and after the parameters reaches the threshold value; the Arduino would send signals to the user's mobile application to turn off the relay.

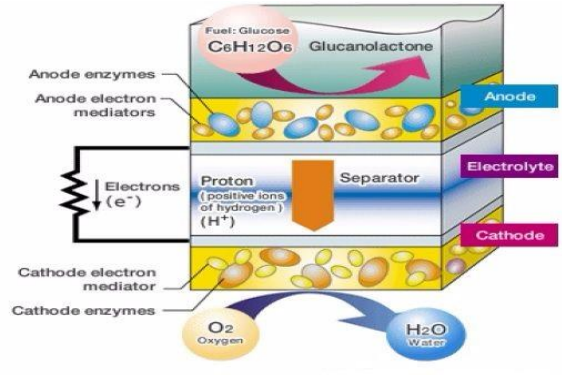
The user should then give a command to turn off the relay. If the user does not respond to the message sent by the Arduino within a particular interval of time in the Arduino would automatically turn off the relay. The device used in our system that is dc fan, pump and bulb is operated by using renewable sources of energy that is either by biochemical process or solar energy which makes a system complete sustainable model.

The electricity from biochemical process is generated by the decomposition of animal and plant waste. In this system solar panel is also used for the generation of electricity to operate the device. During rainy seasons as there will be less availability of solar energy, we are using electricity generated by the biochemical process. The chemical energy generated by this process is stored in an evacuated battery using electrodes. Use of these two methods makes a system complete sustainable model.

3.2 Design of Biofuel Cell

The bio-battery construction can be done by using four components such as anode, cathode, electrolyte, and separator.

All these four components are coated on each other so they stack up jointly. Similar to other batteries, in these batteries, the anode is negatively charged as well as the cathode is charged positively. The main difference between the anode & cathode permits the flow of electrons inside and away from them. In bio- battery construction, the anode terminal is placed at the top of the battery whereas the cathode terminal is placed at the bottom of the battery. In between these two terminals electrolyte is placed which includes a separator.



In the above figure, glucose is used at the anode side whereas enzyme is used at the cathode side. Glucose gets broken down into electrons and protons.

$$C6H12O6 \rightarrow C6H10O6+2H+ +2e-$$

The flow of protons can be travel to cathode side via a separator and the flow electrons can be travel to cathode side via a mediator. Enzymes are utilized at cathode side which generates water by both protons as well as electrons travelled from the anode side. Here, the reaction of Oxygen reduction is being used here.

$$O2 +4H+ +4e- \rightarrow 2H2O +e-$$

The proton movement can be occurred due to the moving force which is known as current. The electrons flow can be from anode to cathode whereas current flow can be from cathode to anode.

3.3 Blynk Software

Three major components in the platform:

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smartphone and hardware.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

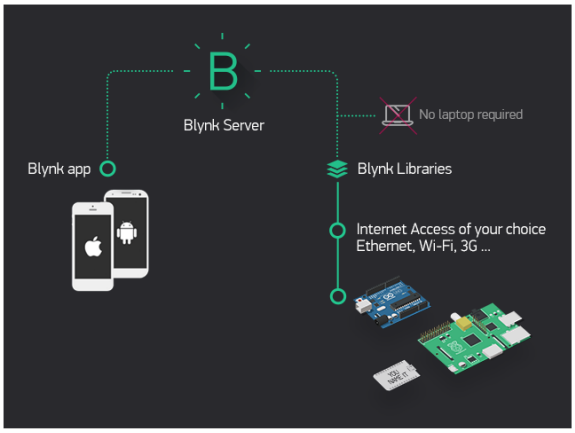
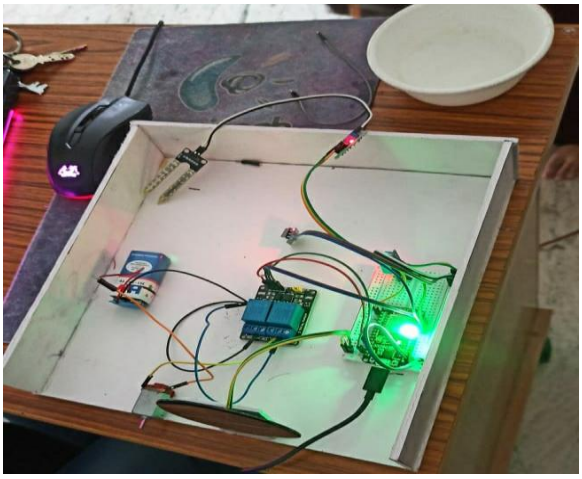


Fig. Blynk Architecture

Blynk is not an app that works only with a particular shield. Instead, it's been designed to support the boards and shields you are already using. And it works on iOs and Android.

4. PERFORMANCE

This project presents the system that collects and controls conditions of greenhouse environment manually or automatically by



using different sensors through mobile application.

The system can generate electrical energy by using bio chemicals(bio-battery) which are eco-friendly and available in common household. Addition to this solar panels are used as energy source.

5. CONCLUSION

Our proposed system monitors the temperature, soil moisture and light intensity inside the greenhouse system. The system do not need human interaction. This System is very suitable at places where people live but plants does not grow due to weather condition. The person will only need to monitor about the condition of the green-houses and fix something that cannot fixed by the proposed system such as cutting off any infected leaves of the plants, uprooting any infected trees and so on. Also, IoT will enable a person to monitor from remote distances and efficiently utilize the time and energy using blynk application.

For the supply of energy this system is using biofuel cell and solar energy. System can generate electrical energy by using biochemical process which are eco-friendly.

6. FUTURE SCOPE

The circuit can be improved in many ways and can be used in wide applications. It can be placed and operated in any of the environmental conditions. Non-conventional energy sources such as solar panels, wind mills are used to supply power to the automatic greenhouse equipment. The energy produced can be used for automation purpose like in home to control light and fan. In our project we have made a prototype taking only three sensor for light, temperature and soil moisrure into consideration. We can use this system for many sensors as a future use of this project. And in the future by using limited number of sensors we can maintain

the greenhouse at specific environmental conditions. Also we can use a 360 degree camera module to click pictures of leaves from various angles so that we can detect health of a plant and distinguish between healthy and infected plant and detect the exact disease which a plant can have by this proposed project in the future.

7. REFERENCES

[1] Aadil Imam, Deepak Gaur, "Smart Greenhouse Monitoring using Internet of Things", International Journal of Advanced Research in Electronics and Communication Engineering : Volume 7, Issue 5, May 2018.

[2] Anuradha A. Pandit, Avinash V. Mancharkar, "Greenhouse Environment Monitoring and Control System", International Journal of Scientific & Engineering Research, Volume 7, Issue 8, August 2016.

[3] Zaidon Faisal Shenan, Ali Fadhil Marhoon, Abbas A. Jasim. IOT Based intelligent greenhouse monitoring and control system. Volume 17, no. 1,2017.

[4] S.U. Zagade, R.S. Kawitkar (2012). Wireless Sensor Network for Greenhouse. International Journal of Science and Technology, Volume 2 No.3, ISSN 2224-3577

[5] Kiran Sahu, Susmita Mazumdar (2012). Digitally Greenhouse Monitoring and Controlling of System based on Embedded System. International Journal of Scientific & Engineering Research, Volume 3, Issue 1, ISSN 2229-5518.

[6] Alausa Dele W.S, Keshinro Kazeem Kolawole. Microcontroller based green house control device, Volume 2,Issue 11,ISSN(p):2319-1805

[7] Arduino Based Automatic Plant Watering System - Devika Et Al., International Journal Of Advanced Research In Computer Science And Software Engineering 4(10),October – 2014

[8] Data Acquisition Of Greenhouse Using Arduino - Journal Of Babylon University/Pure And Applied Sciences/ No.(7)/ Vol.(22): 2014

[9] Remote Sensing In Greenhouse Monitoring System - SSRG International Journal Of Electronics And Communication Engineering (SSRG-IJECE) – EFES April 2015

[10] Greenhouse Automation System Using Psoc 3 - Journal Of Information, Knowledge And Research In Electronics And Communication Engineering

[11] Dan, Liu, et al. "Intelligent Agriculture Greenhouse Environment Monitoring System Based on IOT Technology." Intelligent Transportation, Big Data and Smart City (ICITBS), 2015 International Conference on. IEEE, 2015.