Journal of Science and Technology
ISSN: 2456-5660 Volume 06,Special Issue 01, August 2021,

www.jst.org.in *DOI: https://doi.org/10.46243/jst.2021.v6.i04.pp254-261*

Solar Powered Greenhouse Monitoring Using IoT

Abhinav Khedkar[1], Babasaheb Bhise[2], Dhanaji Shinde[3], Shantanu Hingane[4], Harshada Joshi[5]

[1](B.E. Electrical Student, N.B.N. School of Engineering Ambegaon (Bk.) Pune, India), abhinavkhedkar@gmail.com
[2](B.E. Electrical Student, N.B.N. School of Engineering Ambegaon (Bk.) Pune, India), bhisebabasaheb001@gmail.com
[3](B.E. Electrical Student, N.B.N. School of Engineering Ambegaon (Bk.) Pune, India), dgshinde8@gmail.com
[4](B.E. Electrical Student, N.B.N. School of Engineering Ambegaon (Bk.) Pune, India), shantanuhingane@gmail.com
[5](B.E. Electrical Assistant Professor, N.B.N. School of Engineering Ambegaon (Bk.) Pune, India), harshadajoshi93@gmail.com

To Cite this Article
Abhinav Khedkar, Babasaheb Bhise, Dhanaji Shinde, Shantanu Hingane, Harshada Joshi, "Solar Powered Greenhouse Monitoring Using IoT", Journal of Science and Technology Vol. 06, Special Issue 01, August 2021, pp254-261:.

Article Info
Received: 15.07.2021 Revised: 24.07.2021 Accepted:10.08.2021 Published: 16.08.2021

Abstract: *Greenhouses are climate controlled structures with walls and roof specially designed for off season growing of plants. Most greenhouse systems use manual systems for monitoring the temperature and humidity which may cause discomfort to the worker as they're sure to visit the greenhouse daily and manually control them. Also, tons of problems can occur because it affects the productivity rate because the temperature and humidity must be constantly monitored to make sure that yield of the plants increases. Internet of Things is among one of the newest advances in Information and Communication Technologies, providing global connectivity and management of sensors, devices, users with information. So the combination of IOT and embedded technology has helped in bringing solutions to several of the prevailing practical problems over the years. The sensors used here are YL69 moisture sensor and DHT11 (Temperature & Humidity sensor). From the info received, Microcontroller automatically controls Moisture, Temperature, Humidity efficiently inside the greenhouse by actuating an irrigating pipe, cooling fan, and sliding windows respectively consistent with the specified conditions of the crops to achieve good growth and yield. The recorded temperature and humidity are stored in a cloud database (Thing Speak), and the results are displayed in a web-page, from where the user can view them directly.*

Key Word*: Greenhouse, IoT, Solar Powered, Arduino.*

I. Introduction

A greenhouse is especially used to grow few types of crops throughout the year or crops that need continuous monitoring to get high quality and quantity yield. Presently most of the greenhouses are manually controlled and monitored. The current method of greenhouse monitoring is time consuming and requires intensive labour. The Internet of Things concept can be utilized in greenhouse to improve the productivity by using different sensors to sense the different environmental parameters. The Internet of Thinges include network comprised of various devices that are further connected via internet, and together with web services which communicate with each other. This paper proposes a system to monitor automatically also manually and further control the system in greenhouse using various sensors (ex. temperature sensor, humidity sensor, candle-power sensor and moisture sensor). If the sensed data crosses a predefined threshold value an alarm is going to trigger which will ring and alert the user.

A greenhouse are defined as a closed structure often made up of plastic sheets which is used to guard the plants from external climatic factors like excess cold, excess heat, pollution, excess rainfall etc. It offers a sustainable and

efficient development of the plants throughout the year. Basic factors affecting plant growth are humidity, sunlight, temperature, water content in soil, etc. Numerous works with water sprinkling and irrigation system have been already done. They chose various methods for finding the soil moisture content. An article based on "the automated water supply system for urban residential" have given that their system can be used in managing water resource effectively. The required physical factors are manually for disconnection or connection of supply. The embedded system and customers will be able to monitor the use of electrical power real time.

II. Materials And Methods

A. Greenhouse System

A greenhouse (also called as hothouse with sufficient heating or a glasshouse) is a structure with roof and walls, often made up of transparent or translucent material such as, glass or green-cloth in which plants with regulated climatic conditions are grown. Range of these structures varies from size of industrial-sized buildings to small sheds. Cold-frame is another name for a miniature greenhouse. The interior of a greenhouse when exposed to sun rays or light becomes significantly warm as compared to the external temperature, protecting its contents in harsh cold weather.

Many commercial hothouses or greenhouses have high tech production facilities for fruits, vegetables, flowers, etc. The glass greenhouses are equipped with cooling, screening installations, lighting, heating, irrigation facilities, etc. for growth of plant. Various techniques are then often used to evaluate comfort ratio of greenhouses and optimality degrees, such as vapour-pressure deficit, air temperature and relative humidity in attempt to reduce production risk prior to cultivation of a specific crop.

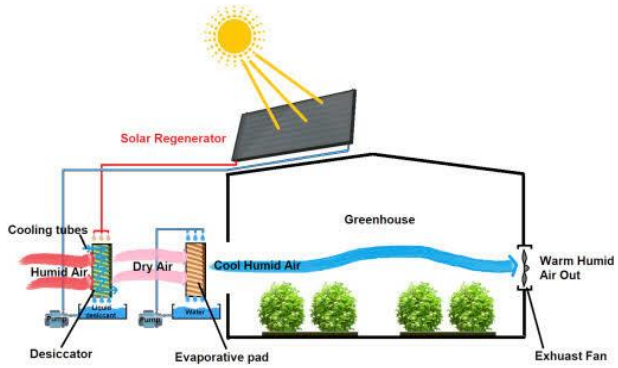

Figure no 1: Greenhouse System

Working Principle of Greenhouse

The greenhouse system depends upon the principle of green house effect, where the warm temperature within a greenhouse occurs because the incident solar radiation passes through the transparent walls and roof which gets absorbed by the floor, contents, and earth. As the structure is closed and not open to the atmosphere, the warmed air cannot escape through convection, resulting in the rise in temperature within the greenhouse. This is known as the "Greenhouse effect".

Greenhouse also manages various other factors inside like; Ventilation, Heating, Cooling, Lighting, Carbon dioxide enrichment, etc.

B. Solar Power System

Solar power is the conversion of energy from sunlight into electricity, either indirectly using concentrated solar power, directly using photo-voltaic (PV) or a combination of both. Concentrated systems of solar power basically use mirrors or lenses and solar tracking systems to make focus of sunlight from large area into a small beam. Photo-voltaic cells are used to convert light into an electric current using the principle of photo-voltaic effect.

Figure no 2: Solar panel used for greenhouse

IOT will be powered by solar power as solar energy would not be available during night period. So the solar energy produced during day period will be converted into DC and stored into batteries for further use.

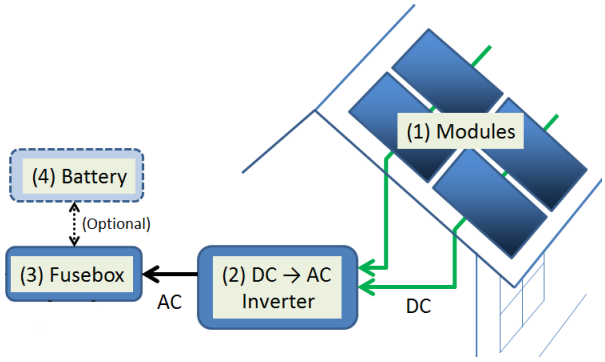

Figure no 3: PV system and storage of solar energy

C. Smart IoT

Internet of Things (IoT) is among one of the newest advances in Communication Technologies and Information Technologies (IT), giving access to global connectivity and management of devices, sensors, users with information. So the combination of IOT and embedded technology has helped a lot in giving solutions to many of the existing practical problems over the years.

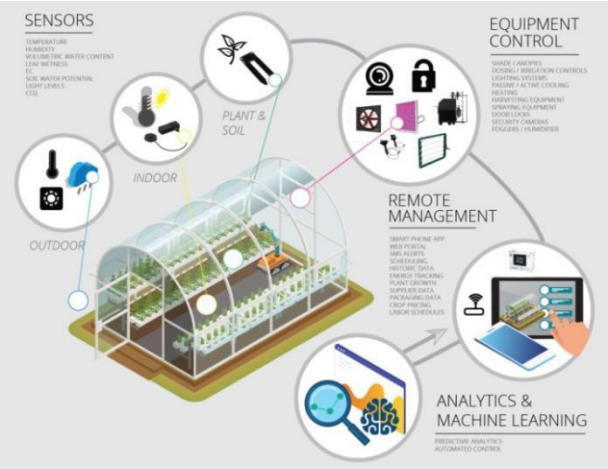

Figure no 4: Greenhouse controlled using IOT

Working Principle of IoT in Greenhouse

As we all know the harmful effects of the greenhouse over human labour it is very essential to control various equipments inside the greenhouse using IOT. In greenhouse the Internet of Things concept can be used to increase the productivity, with the help of various sensors environmental parameters can be sensed. The Internet of Things include network comprised of various devices that are further connected via internet, and together with web services which communicate with each other. The system monitor automatically also manually and further control the system in greenhouse using various sensors (ex. temperature sensor, humidity sensor, candle-power sensor and moisture sensor). If the sensed data crosses a predefined threshold value an alarm is going to trigger which will ring and alert the user. Basic factors affecting plant growth are humidity, sunlight, temperature, water content in soil, etc. Using this system water resource can be effectively manage. The required physical factors are manually for disconnection or connection of supply. The embedded system and customers will be able to monitor the use of electrical power real time.

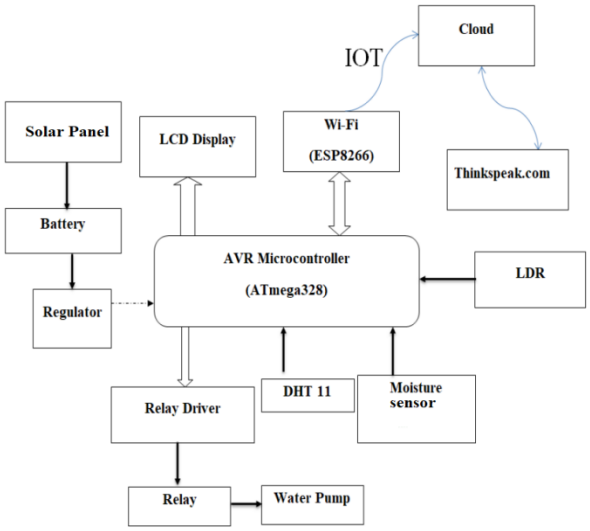

Figure no 5: Working principle of IOT in greenhouse

The sensors in use are DHT11 (Temperature & Humidity sensor), photo sensors and YL69 moisture sensor. From the data received, Microcontroller automatically controls Temperature, Moisture, Light, Humidity, etc. efficiently within the greenhouse by activating a cooling fan, an irrigating pipe, and sliding windows respectively

depending on the required conditions to achieve maximum growth and yield from the crops. The recorded parameters of humidity and temperature gets stored in a cloud database (Thing Speak), also the results are displayed in a web page from where the user can view them directly. These result can also be used for future references.

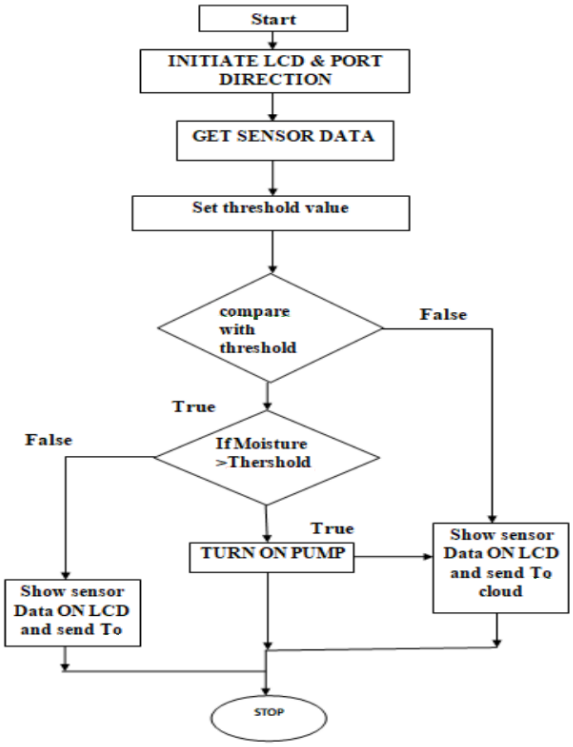

Figure no 6: Flowchart of working of greenhouse using IOT

i. Microcontroller (Arduino) for Controlling Greenhouse

To design the greenhouse monitoring system the Microcontroller used is Arduino UNO R3. The microcontroller board is based on the ATmega328P (data sheet). It has 14 pins of digital input/output of which 6 can be used as analog inputs, 6 as PWM outputs, a USB connection, an ICSP header, a power jack, a 16 MHz quartz crystal and a reset button. It has everything needed to support the microcontroller. For use simply connect it with a USB cable to a computer or power it with a battery or AC-to-DC adapter to get started.

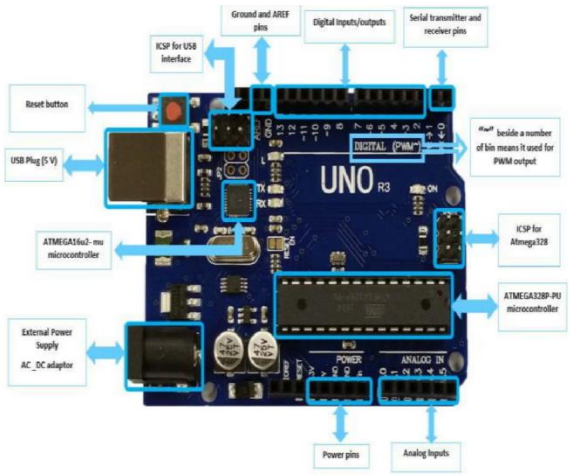

Figure no 7: Microcontroller (Arduino) used for controlling

ii. Wi-Fi Module

The Wi-Fi module used to connect the internet with greenhouse monitoring system is ESP8266, A low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. It is produced by Shanghai-based Chinese manufacturer, Express if Systems. It is the most popular Wi-Fi module used for Internet of Things projects, due to its low price.

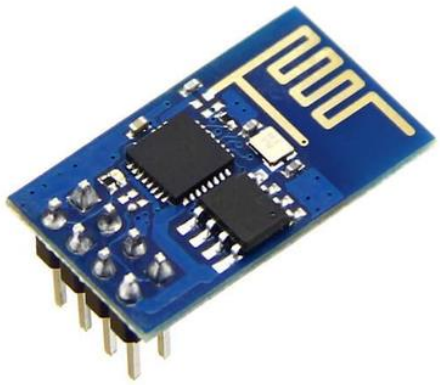

Figure no 8: ESP8266 Wi-Fi module

iii. DHT 11 Sensor

The DHT11 can give its output directly to data pin instead of ADC due to its basic, low digital value . It capacitive sensor measures humidity. It can only get new data from it only after every 2 seconds.

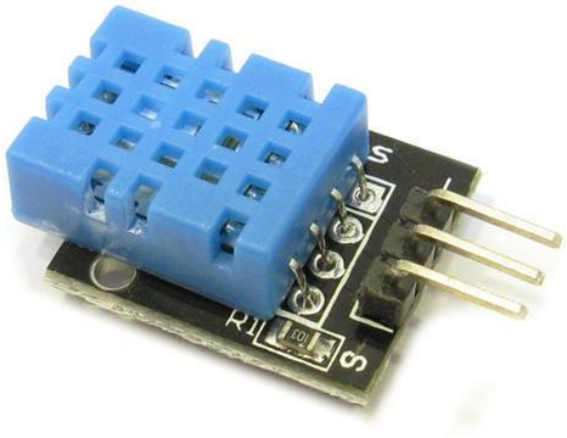

Figure no 9: DHT 11 sensor

iv. Soil Moisture sensor

To measure soil water content the soil moisture sensor are used. The property of the electrical resistance is used where the soil moisture is calibrated which varies depending upon environmental factors such as temperature, electric conductivity, or soil type. It is used here, to sense the moisture of the field and transfer it to raspberry pi which will help taking controlling action of switching water pump ON/OFF.

v. Relay

An electrically operated switch is called as relay. Many to operate a switch mechanically use an electromagnet, but other operating principles such as relays are also used. Relays are used where several circuits must be controlled by one signal or when it is necessary to control a circuit by a separate low signal, low-cost digital humidity and temperature sensors.

III. Result

The various factors and machinery which has to be controlled by manual labour can be controlled using phone or computer. Various factors like temperature, moisture, can be easily be detected using sensors which will further inform about the increase and decrease of various factor on device and with this switching on off of various machinery can be controlled. The data collected from various sensors can stored into cloud and can be used anytime afterwards for future reference. Production through greenhouse using IOT has been increased and minimal wastage of water and other resources has been reduced.

IV. Discussion

Greenhouse system are very common in countries having colder climate like countries in subtropical, temperate and frigid zones. In UK and other Northern European countries have started using IOT controlled in their dutch light greenhouses. Even India is being working on it. India has a huge mountainous border across Himalaya which needs to be protected and hence Indian army has a huge mountainous warfare trained army. During harsh climate leads to blockades of land routes till these regions and lack of connectivity occurs leading to lack of food supply. Hence greenhouse is very important in places like ladakh and to maintain it in harsh climate and yield the production of vegetables, greenhouse controlled using IOT is necessary. On 20th August 2020 Lieutenant Governor R.K. Mathur has sanctioned the Ladakh greenhouse project under which 2000-2500 greenhouses will be set up in Leh and Kargil each, where vegetables can be grown during the winter season and would be controlled automatically.

V. Conclusion

The project's prime applications are farmers and gardeners who cannot give enough time to their crops or plants. Also further covering those farmers who waste water during irrigation. The project can be very well extended to such greenhouses where manual supervision is few and far in between. It can be extended to create fully automated nursery, farmlands and gardens. If applied in the right manner in dry and Sub-tropical areas the project can be combined with the principle of rain water harvesting, leading to water savings. In agricultural lands this model can be successfully applied to test soil content and achieve great results with various types of soil. Desired conditions are implemented for greenhouse parameter control system The sensor devices when integrated with Microcontroller board is very useful. A series of observations and study for inter dependency of various parameters such as humidity, temperature and sun light intensity is needed in setting. The microcontroller (Arduino) board makes it easy for system's easy installation and maintenance. In test greenhouse the system deployment is studied and it implies simply controlling given parameters is not enough there is a need of inside, outside environment study, poly house structures study, crop needs, etc. The user awareness of how to check system operation is a basic need to be fulfilled. DC supply can be given in the form of a battery bank easy to charge with solar system. There are limitation in terms of seasonal measurements and crop needs.

References

[1]. M. Danita, Blessy Mathew, Nithila Shereen, Namrata Sharon, J. John Paul, " IoT based Automated Greenhouse Monitoring System" of Electrical Sciences, Karunya Institute of Technology and sciences, Coimbatore, India.

[2]. Yan Liu" The Design of Greenhouse Monitoring System based on ZigBee WSNs"College of Information Engineering Qingdao Binhai University Qingdao, China lybhxy@126.com.

[3]. Vimal P V "IOT Based Greenhouse Environment Monitoring and Controlling System using Arduino Platform" PG Student, Dept. of ECE NMAMIT, Nitte Karnataka, India vimalpv00@gmail.com.

[4]. Rangan K. and T. Vigneswaran, "An Embedded systems approach to monitor greenhouse", IEEE Conference on Recent Advances in Space Technology Services and Climate Change (RSTSCC), 2010, pp. 61-65.

[5]. Cui Wenshun, Cui Shuo, Yuan Lizhe, Shang Jiancheng, "Design and implementation of sunlight greenhouse service platform based on IOT and cloudcomputing", 2nd International Conference on Measurement, Information and Control (ICMIC), August 2013, Vol. 01, pp. 141-144