International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 3 Volume No.7 May - June – 2023
DOI:10.46647/ijetms.2023.v07i03.078 ISSN: 2581-4621

SOLAR-POWERED SMART- IRRIGATION BY USING IOT

S. Premkumar[1] , G. Jeeva[2], B. Irulappan[3], Dr.V.Uma[4], Dr. B. Shridar[5]
[1]UG – Agriculture Engineering, SNS College of Technology, Coimbatore, Tamil Nadu
[2]UG – Agriculture Engineering, SNS College of Technology, Coimbatore, Tamil Nadu
[3]UG – Agriculture Engineering, SNS College of Technology, Coimbatore, Tamil Nadu
[4]Associate Professor, Agriculture Engineering, SNS College of Technology, Coimbatore, Tamil Nadu
[5]Professor, Agriculture Engineering, SNS College of Technology, Coimbatore, Tamil Nadu
Corresponding Author Orchid ID: 0000-0002-2400-8248

Abstract
Agriculture is the backbone of many of the world's leading economies. But in the face of rapidly progressing climate change, biodiversity loss, energy crisis, and water shortages, it is apparent that global agriculture must change significantly towards sustainability. This study deals with innovative technology considering the various ways to irrigate agricultural land using solar power. Since agriculture plays a vital role in boosting the country's economy, improvements should be implemented to increase production and expand crop quality. Additionally, the Internet of Things (IoT) is a network in which all physical objects are connected to the Internet through network devices or routers and exchange data. IoT allows objects to be controlled remotely across existing network infrastructure. IoT is a very good and intelligent technique that reduces human effort as well as easy access to physical devices. This project's scope is to automate the watering of plants according to the temperature, humidity, and moisture content of the soil. The user can use Wi-Fi to exchange data between devices. Hence the greatest sustainability challenge for agriculture may be replacing non-renewable resources with ecologically-skilled people, increasing productivity, employment, and value addition in food systems, and doing so in ways that create and support desirable rural livelihoods.
***Keywords*: Solar Energy, IoT, Smart Irrigation, ADA FRUIT, Google Assistant**

1. Introduction

The world's population is expected to increase by 9.6 billion in 2050 from 7 billion in 2012, food stocks must increase by 60% to meet the ever-increasing demand. India, an agriculturally dominant country, produced 51 MT of food grain in 1950-51, 250 MT in 2011-12, and plans to produce 298 MT in 2020-21 to meet population growth-based demand (FAO, 1951; GOI, 2016a). Promoting the use of contemporary information technology in agriculture will address a range of challenges that farmers encounter. The loss of output is caused by a lack of proper information and communication. Hari Ram et al. (2015) proposed a study aimed at addressing these difficulties. Based on the IoT, this regulator delivers an intelligent monitoring platform architecture and system structure for the facility's agricultural ecosystem. This will act as a catalyst for the shift from traditional to modern farming.

The project "Smart Irrigation System" is used for the optimization use of water in the garden as the soil moisture Sensor senses the moisture content of the soil and water the plant accordingly. The pins of the soil moisture sensor are connected to the ESP8266 board and the other end senses the moisture content in the soil. The Wi-Fi of the user is used to exchange data between various connected devices. The data collected by the soil moisture sensor is displayed on the chart developed in Adafruit and the user can log in to Adafruit using the credentials to analyse the moisture level in the soil. Once the event button that has been developed in the same Adafruit platform is clicked by the user the water pump gets switched on the plants get irrigated and after irrigating if the event button is switched off the water pump gets turned off. The water pump is connected to the single-channel relay module and

DOI:10.46647/ijetms.2023.v07i03.078 ISSN: 2581-4621

the power supply is given from the power supply board. The power adapter is used to resist the power according to the need of the water pump and supplies the power to the water pump. Apart from the soil moisture sensor the system also has a DHT11 sensor which is used to sense the temperature and humidity level in the environment. The chart is created similarly to the soil moisture sensor which indicates the temperature and humidity level to the user. When the humidity level in the environment gets low and dried up the water pump is turned on to water the plants and if it is rainy season or if the humidity level is high there is no need to irrigate the plants.

This system has another advantage that is if the user does not have time to log in to the Adafruit platform and switch on the event button to turn on the water pump then the user can control the water pump using google voice assistance. The commands for google voice assistance are created using the cloud-based platform IFTTT. Since the plants are irrigated according to the need there is less usage of water which is very helpful in saving water. This system of irrigation is also helpful in regions where there is water scarcity and improves sustainability.

The evolution of agriculture is trending towards precision agriculture, the use of IoT and analytics helps to generate higher economic efficiencies in the face of population growth and climate change (Baranwal et.al 2016). The conjunction of conventional approaches with cutting-edge technology such as the Internet of Things, machine learning and AI would result in agricultural innovations.

2. Proposed Methods

The system has three major parts; the humidity sensing part, the control section, and the output section. The soil humidity was detected using a soil moisture sensor. The control unit was achieved using the ESP8266 microcontroller based on the Node MCU platform. The output is an irrigation system that is controlled by the control unit by switching the water pump on and off depending on the soil moisture and temperature level. Two stages of design were undertaken: hardware and software.

The main working principle behind this system is connecting the soil moisture sensor, which is embedded into the plant, to the Node MCU microcontroller, which is also connected to other electronic components. Measurement of soil moisture is done by the sensor which forwards the information and parameters regarding the soil moisture to the microcontroller, which controls the pump. If the level of soil moisture drops below a certain value, the microcontroller sends the signal to the relay module which then runs a pump and a certain amount of water is delivered to the plant. Once enough water is delivered, the pump stops doing its work. Power supply has a task to power the complete system and the recommended voltage should be provided with respect to the input supply range for the microcontroller, that is, from 7V to 12V. The data of sensors will be displayed in graphical form on the Adafruit cloud page.

The advantages of these smart irrigation systems are wide-reaching. The smart irrigation system will help to have better control of landscape and irrigation needs as well as peace of mind that the smart system can make decisions independently if the user is away. The user can save a significant amount of money on water bills because through intelligent control and automation, the smart irrigation system will optimize resources so that everything gets what it needs without needless waste. Additionally, there are many places in the country that have experienced droughts and thus the water resources are precious. With smart irrigation systems, the resources are saved which is better for the environment.

The opportunity to save dramatically, have better control and be more eco-friendly while maintaining a lush and beautiful landscape are just a few of the advantages a smart irrigation system provides and would make a wonderful addition to any home. Smart Irrigation System uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers. Automating the irrigation allows the application of the right amount of water at the right time, regardless of the availability of labor to turn valves on and off.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 3 Volume No.7 May - June – 2023
DOI:10.46647/ijetms.2023.v07i03.078 ISSN: 2581-4621

This system proposes an irrigation system that describes the combination of the IoT communication technology and cloud server to accomplish the performance of the system and data storage. The proposed system provides remote monitoring and automated controlling of irrigation with the sensing of atmospheric and soil conditions like air temperature, humidity, and soil moisture. IoT-based irrigation improves production without any human interaction.

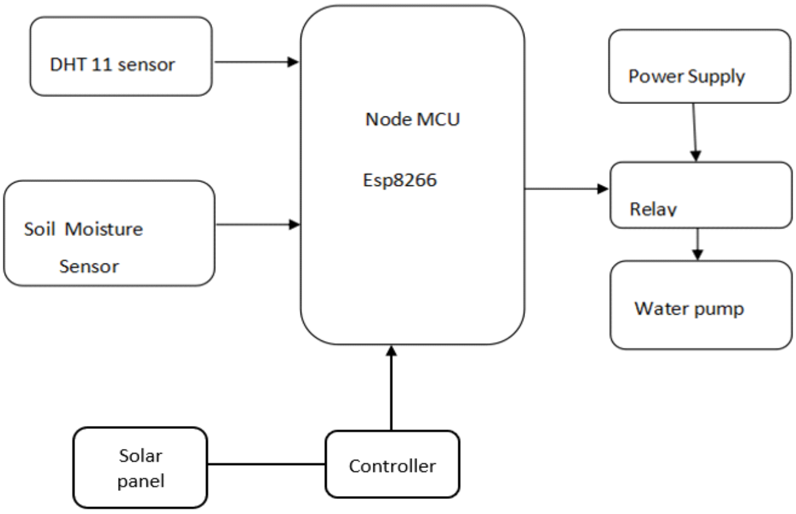
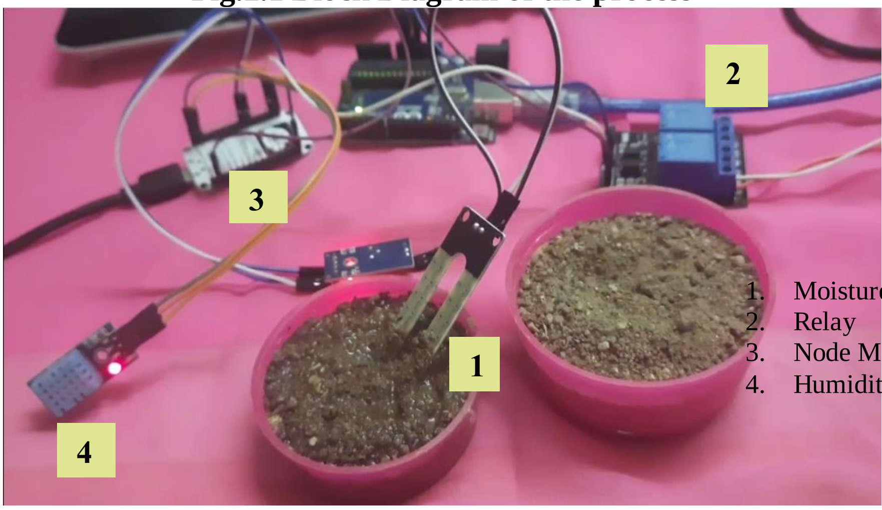


Fig.2.1 Block Diagram of the process



1. Moisture sensor
2. Relay
3. Node MCU
4. Humidity sensor

Fig. 2 Smart Irrigation System using Solar

3. Result & Discussion

3.1 ADA FRUIT

In the Adafruit account which we signed in by using the same mail ID we used in Google Assistant and IFTTT, we have to create our dashboard by giving a suitable name. Here, we have created a dashboard as "HOME AUTOMATION". Now the feeds are to be created. The feeds are toggle (relay), Sensor (we use it for Humidity-temperature measurements), PWM (Speed control of motor) etc. The feeds are selected and created as :

- From the window "Create a new block" we have to select a block according to the purpose we have. Like if we want to create a switch (Relay), we have to select the first block 'Toggle'.
- After this, the block will ask us to label it by a name, to give relative ON feed and OFF feed as 1 and 0 or ON and OFF which we can give as per our wish.

Website: ijetms.in Issue: 3 Volume No.7 May - June – 2023
DOI:10.46647/ijetms.2023.v07i03.078 ISSN: 2581-4621

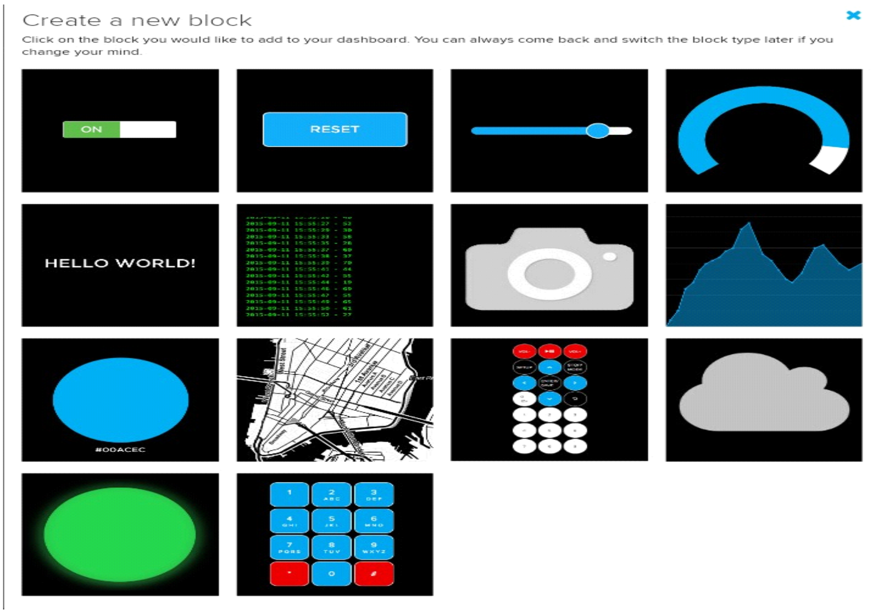


Fig. 3.1 Dashboard creation in ADAFRUIT

After creation our dashboard, we have to click the key icon on the right top corner of our dashboard.it will generate a URL and a key for our account. This URL and key will be used in the program to make the Node MCU monitor the feeds in our account.

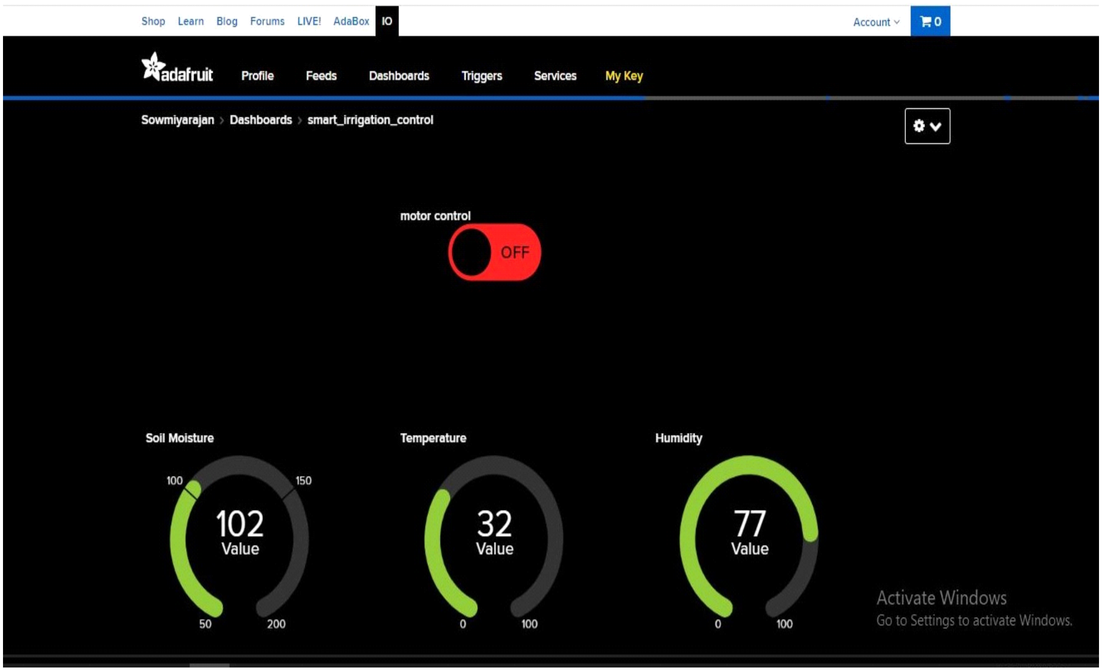


Fig.3.2. ADA FRUIT

3.2 Relay Module

In this system a single channel relay is used. Relay module is a simple circuit consisting of a single transistor, several resistors, diodes, a relay and it is controlled digitally by microcontroller. Since the complete system should be embedded in a small box, Node MCU is a perfect microcontroller for this purpose because of its dimensions and its work performance. The soil moisture module is used to detect the moisture content in the soil. The other module uses the DHT11 sensor that is used to detect the temperature level in the environment. Analog output gives the real time information regarding the moisture in the plant and this output is used in the system. Water pump is connected to the relay module and it only works when the relay module gets a command from the microcontroller. The command is given by the user either by clicking the event or by using Google voice assistance. The commands for Google voice assistance are given on IFTTT cloud page.

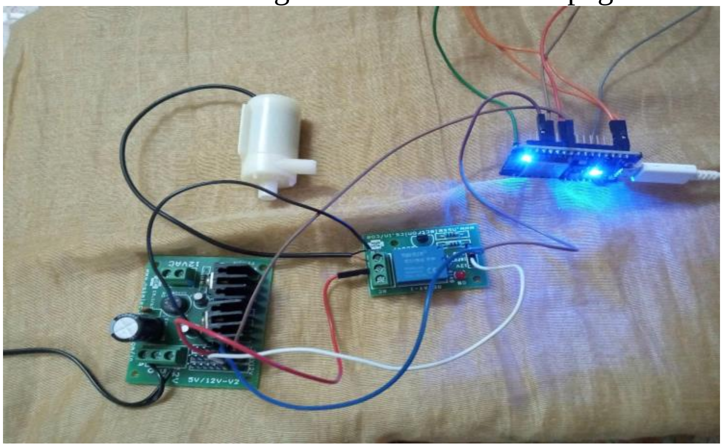


Fig.3.3 Relay Module

3.3 Testing

Testing is done for each module. After testing all the modules, the modules are integrated and testing of the final system is done with the test data. In this application, each module is unit tested and the modules are integrated into whole system. In the temperature sensing module the system is switched on with DHT11 sensor and the measured values are displayed in the dashboard ensuring that the module works successfully.

Similarly, soil moisture sensing module and relay module are tested individually and all the modules are integrated into a single whole system and the complete system is tested to ensure that it works according to the condition. After integrating the entire system is tested and it is noticed that the values of moisture content and temperature values are displayed in the dashboard by clicking the event button the water pump gets turned and some amount of water is poured to plant, the water pump is also controlled using Google voice assistance and this feature is also tested. Thus, integration testing is performed successfully.

4. Conclusion

The entire project "Smart Irrigation System" an attempt is made in all its earnest towards the successful completion of the project. This system was verified with valid as well as invalid data. This system is user-friendly. The System is developed to enable controlling various electrical devices via Wi-Fi and Bluetooth.

This development helps the users to look after the fields as well as the garden by reducing the manual work of switching on the motor and precious time by allowing the user to turn on the water pump from any place rather than traveling a long way to switch on the water pump. This also helps to conserve water resources as only a very small amount of water is required to irrigate all the plants. Any suggestions for future development of the system are welcome upgrading the system it can be done without affecting the proper functioning of the system.

5. References

1. Wood, G., Dylan, T., Durrant, A., Torres, P. E., Ulrich, P., Carr, A., ... & Lawson, S. (2019, May). Designing for digital playing out. In *Proceedings of the 2019 CHI conference on human factors in computing systems* (pp. 1-15).

2. Pfister, C. (2011). *Getting started with the Internet of things: connecting sensors and microcontrollers to the cloud*. " O'Reilly Media, Inc.".

3. Chou, T. (2016). *Precision: Principles, Practices and Solutions for the Internet of Things*. Lulu Press, Inc.

DOI:10.46647/ijetms.2023.v07i03.078 ISSN: 2581-4621

4. Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. WW Norton & Company.
5. Kellmereit, D., & Obodovski, D. (2013). *The silent intelligence: the internet of things*. DnD Ventures.
6. Wimer Hazenberg, Menno Huisman and Sara Cordoba "Meta Products: Building the Internet of Things
7. Adam Greenfield" Everyware: The dawning age of ubiquitous computing" Greenfield, A. (2010). *Everyware: The dawning age of ubiquitous computing*. New Riders.
8. Claire Rowland, Elizabeth goodman, Martin Charlier and Alfred Lui "Designing Connected Products"
9. Rowland, C., Goodman, E., Charlier, M., Light, A., & Lui, A. (2015). *Designing connected products: UX for the consumer Internet of Things*. " O'Reilly Media, Inc.".
10 Waher, P. (2015). *Learning Internet of Things: Explore and learn about Internet of Things with the help of engaging and enlightening tutorials designed for Raspberry Pi*. Packet publishing.
11. Baranwal, T., & Pateriya, P. K. (2016, January). Development of IoT based smart security and monitoring devices for agriculture. In *2016 6th International Conference-Cloud System and Big Data Engineering (Confluence)* (pp. 597-602). IEEE.