IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

AI Based Solar Powered Smart Irrigation System

Prof. S. S. Mandhare[1], Mr. Sai Satish Waghade[2], Mr. Pimparkar Pranil Santosh[3], Mr. Bhujbal Umesh Bapu[4]
[1]Prof. and [2,3,4]Students of Department of Electrical Engineering.
Dr. Vitthalrao Vikhe Patil College of Engineering, Ahilyanagar, Maharashtra
Savitribai Phule Pune University, Pune

Abstract: *Agriculture uses a lot of freshwater so we need to manage water in a way to make farming work well. This project is about an irrigation system that uses solar power and the Internet of Things. It has a lot of parts including a computer called NodeMCU ESP8266 a sensor that checks how wet the soil is, a sensor that checks the temperature and humidity a pump that can be turned on and off solar panels and a platform called Blynk that lets us check and control the system from afar. The system checks the soil all the time to see if it needs water. It turns the pump on and off automatically. We can also turn the pump on and manually if we need to. The system saves data on a card and we can check it from our smartphone. The smart irrigation system helps us save water. It means people do not have to go and check the pumps all the time. It also helps the irrigation system work better. This is good for farming and for the Earth because it helps us use water in a way and that is what we need for sustainable agriculture and smart farming practices. The smart irrigation system is really important for agriculture and it can help make farming more efficient and that is what this project is all about a smart irrigation system, for sustainable agriculture.*

Keywords: Smart Irrigation, IoT, Solar Energy, NodeMCU ESP8266, Blynk IoT, Soil Moisture Sensor, Agriculture Automation, Water Conservation, Artificial Intelligence, Smart Farming

I. INTRODUCTION

Agriculture is really important for producing food and helping the economy in countries. As more and more people are born we need to produce food from agriculture. At the time we are running out of freshwater because of climate change too many people and bad water management. Agriculture uses a lot of freshwater so we need to use water when we irrigate our farms.

Most farmers use methods to irrigate their farms. They turn on the water by hand. Follow a schedule. Farmers usually decide when to water their farms by looking at the soil, which can lead to much or too little water. Much water is bad because it wastes water hurts the soil and helps diseases grow. It also costs money to run the farm. Not enough water hurts the plants. Reduces the amount of food we get from them.

New technology like Internet of Things has helped us make irrigation systems. These systems can check the environment all the time. Turn the water on and off automatically. We can use computers like NodeMCU ESP8266 and wireless communication to make smart farming more affordable.

The AI Based Solar Powered Smart Irrigation System is a way to irrigate farms. It uses sensors to check the soil, temperature and humidity. It can talk to the internet. It also uses energy to power itself. The system shows us what is happening on the farm in time using the Blynk mobile application. By automating irrigation the system helps us save water use labor and grow more food. The Agriculture benefits from this system because it uses water wisely and helps the environment. The Agriculture is important, for our food production and economic development so we need to take care of it.

DOI: 10.48175/IJARSCT-37163

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

II. PROBLEM STATEMENT

Many farmers still use ways of watering their crops even though there are new technologies available. These old methods do not have real-time monitoring and automated decision-making. They depend on people to decide when to water, which can be inaccurate and different from one person to another. This can lead to much water or not enough water, both of which are bad for the crops.

Farmers also have a time keeping an eye on their fields from far away. They cannot be there all the time at night or when they have many fields to manage. This can cause delays in watering and waste of resources.

Another problem is that old irrigation systems do not keep track of what the weather was like in the past. Without this information it is hard to make decisions about watering and taking care of the farm. Also pumps are used much which wastes energy and costs more money.

So we need an irrigation system that can watch the environment all the time control watering based on the condition of the soil let farmers check on their fields from far away using internet technology and keep records for later use. The system we are talking about uses sensors, internet connection, automatic controls and solar energy to meet these needs. It is a system that can help farmers water their crops in a way.

The system is made up of parts that work together to make irrigation easier and more efficient.

* It has sensors to monitor the environment and the soil
* It has internet connectivity to let farmers check on their fields from away
* It has controls to make decisions about watering
* It uses energy to save energy and money.

This system is good, for farmers because it helps them take care of their crops and save money at the same time.

III. MATERIALS AND METHODS

This project is about making an irrigation system that uses solar energy. The smart irrigation system is part of the Internet of Things. It helps to manage water in a way for people who grow crops.

The system has an important parts. It can sense what is going on in the environment. It can also communicate with devices without using wires. The system can turn the water on and off by itself. It can also keep track of what's happening.

The whole system works together. Does not need people to do much to make it work. The smart irrigation system uses energy to work. The system is good, for people who grow crops because it helps to manage water in a way.

• Materials Used

The system uses hardware parts.

These include:

* NodeMCU ESP8266
* Soil Moisture Sensor
* DHT11 Temperature and Humidity Sensor
* Relay Module
* BC547 NPN Transistor
* DC Water Pump
* Solar Panel
* Rechargeable Battery
* SD Card Module
* Wi-Fi

The software tools used are:

* Arduino IDE
* Blynk IoT Platform

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 9, June 2026 Impact Factor: 8.2

* ESP8266 Libraries
* Network Time Protocol (NTP) services

The NodeMCU ESP8266 is like the brain of the system. It collects data processes it communicates with the cloud and controls parts.
The Soil Moisture Sensor checks how wet the soil is.
The DHT11 sensor measures temperature and humidity levels.
The Relay Module helps the NodeMCU ESP8266 control the irrigation pump. This makes the system turn the pump on or off automatically.
The Solar Panel provides energy to the system. This makes it suitable for use, in agricultural areas.
The NodeMCU ESP8266 uses the Solar Panel for power. The system relies on the ESP8266 for its operations.

• Methods Followed

The system is always checking the soil moisture, temperature and humidity using sensors that are connected to it. These sensor readings are looked at by the ESP8266 and then sent to the Blynk cloud platform using Wi-Fi. All the information that is collected is shown on a dashboard so people can see what is going on in real time.
The controller looks at the soil moisture level that is measured and compares it to the threshold values that were decided on ahead of time. When the moisture level gets too low and goes below the threshold the controller turns on the relay module, which makes the irrigation pump start working. When the soil has moisture the pump is turned off automatically. The system has a mechanism called hysteresis that stops the relay from switching on and off too much.
The system also has an override feature that lets people control the pump from afar using the Blynk application. The system saves all the information about the environment, the status of the pump the mode it is operating in the date and the time, on an SD card module. The system uses NTP synchronization to get the time right so it does not need a separate Real-Time Clock module.

IV. RESULTS

The Solar Powered Smart Irrigation System that uses Artificial Intelligence was put in place. Tested in many different situations. What we found out from the tests was that all the main parts of the system worked well including the parts that sense things communicate, control things and keep track of data.
The sensor that checks the moisture in the soil did a job of finding out when the soil was dry and starting the irrigation system when the moisture got too low. The water pump that is controlled by a relay worked correctly when it got commands from the NodeMCU so the irrigation system worked automatically without anyone having to do anything.
We got readings for temperature and humidity from the DHT11 sensor. Sent them to the Blynk Internet of Things platform, where they could be seen in real time on a mobile phone. This meant that people could check on the conditions of the environment from away and turn the irrigation pump on and off whenever they needed to.
The system that logs data to an SD card worked well keeping track of what the sensors were reading whether the pump was on or off and what mode the system was in all with the time, from the NTP synchronization. The Solar Powered Smart Irrigation System used energy, which meant it could keep working all the time without needing to use traditional electricity. The Solar Powered Smart Irrigation System is a way to water plants automatically.

Key Results

• Successful real-time monitoring of soil moisture, temperature, and humidity.
• Successful SD card-based data logging.
• Real-time remote monitoring & controlling through Blynk IoT platform.
• Reduction in water wastage through automated irrigation.
• Effective utilization of solar energy for system operation.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

V. DISCUSSION

The proposed system shows how IoT technology, sensing and renewable energy can work together to improve irrigation in farming.

It combines monitoring, automation, communication and data storage into one platform thats afford-able and practical for medium-sized farms.

* The NodeMCU ESP8266 is a controller for agricultural IoT applications because it has built-in Wi-Fi uses low power and is easy to program.

* The Blynk IoT platform provides a user- interface for real-time monitoring and remote control without needing extensive software expertise.

Using soil moisture sensing makes irrigation more efficient than timer-based systems. The system irrigates based on soil conditions, not fixed schedules.

This approach reduces water waste. Prevents crop stress from overwatering or underwatering. The SD card-based data logging adds an analytical part to the system.

Historical records help users study patterns, irrigation cycles and resource use over time.

This data can support use of machine learning algorithms for predictive irrigation management with soil moisture sensing.

The solar energy integration makes the system more sustainable.

Using energy reduces operational costs and allows deployment in remote agricultural areas where grid electricity may be unreliable or unavailable.

Overall the system addresses limitations of traditional irrigation methods, including lack of automation no real-time monitoring, inefficient water use and high labor dependency by utilizing IoT technology, environmental sensing and renewable energy.

The proposed system is a solution, for small and medium-scale farms. It helps farmers manage irrigation efficiently with IoT technology.

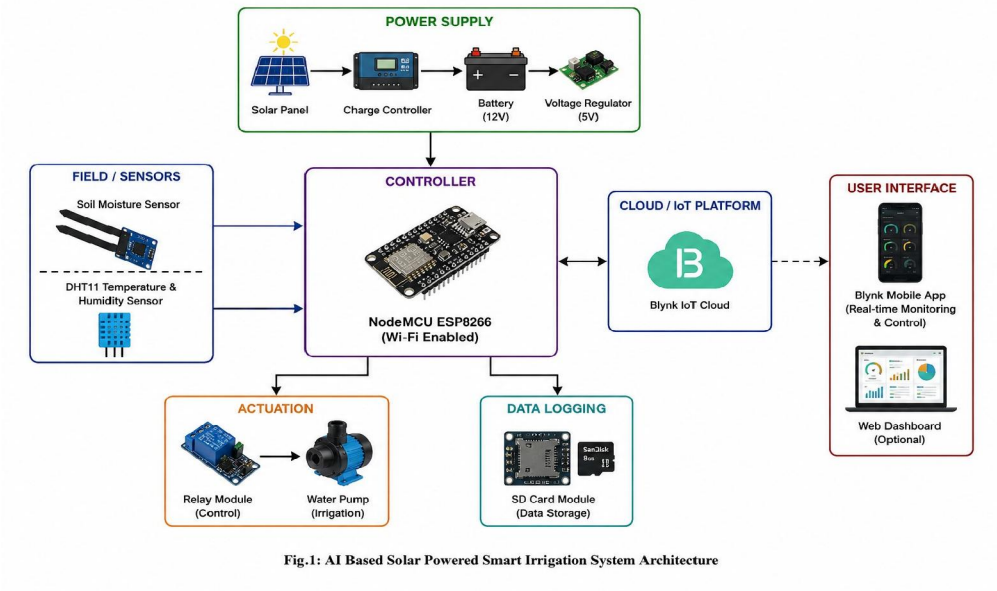

Fig.1: AI Based Solar Powered Smart Irrigation System Architecture

Fig.1: AI Based Solar Powered Smart Irrigation System Architecture

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

VI. CONCLUSION

This project was able to develop and show off a Solar Powered Smart Irrigation System that uses Artificial Intelligence. This system can watch the environment. Automatically turn the water on and off using Internet of Things technology. The Solar Powered Smart Irrigation System has a lot of features like checking the moisture in the soil checking the temperature and humidity sending messages through the cloud controlling the water pump using energy from the sun and storing data locally all in one place.

We did some tests. They showed that all the parts of the system both the physical parts and the software parts worked well together. The Solar Powered Smart Irrigation System was able to save water by turning it on when the crops needed it. It also let people watch what was going on and control it from away using the Blynk app on their phone.

The Solar Powered Smart Irrigation System is a solution because it is practical does not cost too much and can be used on a large scale. It helps farmers use water and energy in a way by using automation, energy, from the sun and making decisions based on data. This makes farming more sustainable. Helps the environment. The Solar Powered Smart Irrigation System is a way to make farming smarter and more efficient.

ACKNOWLEDGEMENT

We want to say thank you to Prof. S. S. Mandhare for helping us and supporting us all the time while we were working on this project. He gave us good advice and encouraged us to keep going.

We also want to thank the Department of Electrical Engineering Dr. Vithalrao Vikhe Patil College of Engineering, Ahilyanagar for giving us the things we needed to finish this project.

We are really thankful to our classmates and the teachers at the college and, to everyone who helped us with this project in any way.

REFERENCES

[1] J. Gutierrez, J. F. Villa-Medina, A. Nieto-Garibay, and M. A. Porta-Gandara, "Automated irrigation system using a wireless sensor network and GPRS module," IEEE. Transactions on Instrumentation and Measurement, vol. 63, no. 1, pp. 166–176, 2013.

[2] P. Rajalakshmi and S. Mahalakshmi, "IoT based crop-field monitoring and irrigation automation," Interna-tional Journal of Computer Applications, vol. 138, no. 6, pp. 7–12, 2016.

[3] A. Goap, D. Sharma, A. K. Shukla, and C. R. Krishna, "An IoT based smart irrigation management system using machine learning," International Conference on Smart Computing and Communications, pp. 1–5, 2018.

[4] N. Nawandar and V. Satpute, "Low cost IoT based smart irrigation system using NodeMCU," International Journal of Engineering Research & Technology, vol. 8, no. 5, pp. 458–462, 2019.

[5] S. Patil and P. Kumbhar, "Smart irrigation system using Raspberry Pi and Android application," International Journal of Innovative Technology and Exploring Engineering, vol. 9, no. 6, pp. 1221–1225, 2020.

[6] A. Vij, A. Jain, P. Bajaj, S. Bassi, and A. Sharma, "IoT and machine learning approaches for smart agriculture," Journal of Cleaner Production, vol. 271, 2020.

[7] P. Rao, S. Kulkarni, and A. Patil, "Blynk based IoT monitoring system for agricultural applications," International Journal of Advanced Research in Computer Science, vol. 12, no. 2, pp. 45–50, 2021.

[8] A. Khanna and S. Kaur, "Evolution of Internet of Things for smart agriculture applications," Journal of Ambient Intelligence and Humanized Computing, vol. 10, no. 2, pp. 817–828, 2019.

[9] D. Sharma, R. Verma, and P. Singh, "NTP-based synchronization techniques for IoT-enabled agricultural monitoring systems," International Journal of Electronics and Communication Engineering, vol. 11, no. 3, pp. 98–104, 2022.

[10] J. M. Talavera et al., "Review of IoT applications in smart agriculture," Computers and Electronics in Agriculture, vol. 142, pp. 369–381, 2017