*As per UGC guidelines an electronic bar code is provided to seure your paper*

*International Journal for Modern Trends in Science and Technology*
*Volume 10, Issue 02*, pages 548-553.
ISSN: 2455-3778 online5Available online at: http://www.ijmtst.com/vol10issue02.html
DOI: https://doi.org/10.46501/IJMTST1002077

# Drip Irrigation System Using Wireless Control Valve Acutation with Solar Power

**Dr. Keerthipati Kumar[1] | D. Lavanya[2] | K. Nagendra Rao[3]**

[1]Department of Computer Science and Engineering, SV Collegeof Engineering, Karakambadi Road, Tirupati.
Kumar.k@svce.edu.in

[2]Department of Computer Science and Engineering, SV Collegeof Engineering, Karakambadi Road, Tirupati.
lavanya.d@svce.edu.in

[3]Department of Computer Science and Engineering, SV Collegeof Engineering, Karakambadi Road, Tirupati.
nagendrarao.k@svce.edu.in

**To Cite this Article**
Dr. Keerthipati Kumar, D. Lavanya and K. Nagendra Rao, Drip Irrigation System Using Wireless Control Valve Acutation with Solar Power, International Journal for Modern Trends in Science and Technology, 2024, 10(02), pages. 548-553. https://doi.org/10.46501/IJMTST1002077

**Article Info**
Received: 29 January 2024; Accepted: 21 February 2024; Published: 27 February 2024.

**Copyright** © Dr. Keerthipati Kumar et al;. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

*Water stands as a vital requirement in agriculture, playing a crucial role in fostering crop growth and facilitating abundant crop yields for farmers. The predominant challenge faced by farmers revolves around the irrigation systems employed on their farms. The increasing scarcity of water poses a significant obstacle to agricultural practices. Traditionally, expansive farms have relied on conventional flood-type irrigation systems, leading to substantial water consumption. This method proves highly inefficient, displaying low water productivity and failing to ensure sustainable, long-term food security.*

*In response to this challenge, researchers have endeavored to create a Solar Powered Wireless Auto Valve Actuation system for Drip Irrigation. This initiative aims to replace the conventional irrigation approach with a more efficient Drip Irrigation system. The Drip Irrigation system, automated through solar-powered auto valve actuation, represents an innovative solution. In this paper we proposed a stands out as an optimal strategy in mitigating water scarcity, as it directs water exclusively to the crop root zone, ensuring the most effective utilization. Through this approach, not only are water resources conserved, but efficient irrigation is also provided to nurture the crops effectively.*

*Keywords: Drip Irrigation, Solar Power, Wireless Auto Valve, Crop.*

## 1. INTRODUCTION

In the realm of agriculture, where water is a pivotal resource, technological innovations have become imperative for addressing the challenges posed by water scarcity and optimizing irrigation methods. One groundbreaking solution at the forefront of this transformation is the Solar Powered Wireless Auto Valve Actuation in Drip Irrigation System. This sophisticated system represents a paradigm shift in traditional irrigation practices, introducing a blend of renewable energy and automation to revolutionize crop cultivation.

At its core, this system is designed to enhance the efficiency and sustainability of drip irrigation, a method already renowned for its precision in delivering water directly to plant roots. By harnessing solar power, the system ensures a continuous and eco-friendly energy supply, mitigating the reliance on conventional power sources and reducing the carbon footprint associated with agricultural activities.

The wireless auto valve actuation aspect introduces a new level of automation, allowing for precise control and management of water flow through the irrigation network. This wireless functionality not only streamlines the operation of the system but also facilitates remote monitoring and control, empowering farmers with real-time data on soil moisture levels and environmental conditions. This level of automation not only optimizes water usage but also minimizes manual intervention, thereby increasing overall operational efficiency.

The integration of solar power and wireless technology addresses a longstanding challenge in large-scale agricultural operations, where conventional flood-type irrigation systems often lead to inefficient water use. The Solar Powered Wireless Auto Valve Actuation in Drip Irrigation System transcends these limitations, offering a sustainable alternative that ensures water is delivered precisely where and when it is needed most – at the crop root zone.

As global concerns about water scarcity intensify, this innovative system emerges as a beacon of hope, showcasing the potential of technology to provide effective and sustainable solutions to age-old agricultural challenges. In this comprehensive introduction, we embark on a journey to explore the intricate details of this transformative technology, unraveling its capabilities and the positive impact it promises for the future of agriculture.

## 2. LITERATURE REVIEW

Applications for Wireless Sensor and Actuator Networks (WSANs) range widely, including smart cities, medical applications, agricultural, and military [3–4]. WSANs encounter difficulties in the context of garden irrigation because to limited financial resources and energy resources. On the other hand, new technology developments present chances to set up WSANs that are more efficient than before, getting over the earlier limitations.

The JN5139 low power wireless module was used by the authors of this work [5] to develop an energy-efficient wireless valve controller for drip irrigation systems. The JN5139 module's integrated radio transceiver and microprocessor provided the possibility of being inexpensive and small in size. It was intended to run on two alkaline batteries for three months while experiencing various synchronized sleep intervals. It was estimated that there will be four to five activations per week. The solenoid valve was intended to be precisely and correctly controlled by the valve controller, which was also intended to gather status data and promptly deliver feedback. The field test demonstrated the controller's ability to operate continuously for at least three months when fueled by two alkaline batteries.

A solar-powered insolent irrigation system with Wireless Sensor Nodes (WSN) and a Hub Controller was suggested in this study [6]. Every sensor node was connected to a hub concentrator via a ZigBee network set up in a star topology. The Xbee S1 modules and 1 Watt solar panels with 9V rechargeable batteries made up the planned wireless sensor nodes, which could interact with a hub within 300 square feet. In sensor nodes and hub coordinators, Arduino boards were used because of their simple edge to common USB, Wi-Fi shields, I2C, and power guideline. Every board has a SHT1x sensor attached to it in order to read, gather, and transmit temperature, humidity, and moisture data to the hub. Regularly putting sensor nodes in sleep mode and Six to nine months was estimated as the battery life duration. The data is sent to the cloud by the project's TI CC3300 Wi-Fi shield. In addition, a smartphone application was created to enable

This irrigation system [7] used a Zigbee wireless network for operation. Slave nodes and a master station made up the planned system. Temperature, soil moisture, water valve, microcontroller, and Zigbee transceiver sensors were all installed on each slave node. The slave microcontroller senses and records the soil moisture content as well as the ambient temperature of the trees and grass in the garden. After that, Zigbee is used to forward the frame to the master station. An incorporated fuzzy logic irrigation algorithm in the master station waters the trees and grass in accordance with a set of regulations. The master station was interfaced with a home web server so that it could be operated and monitored remotely. Since enabling internet and smartphone operation was the primary goal of the proposed system, the power consumption characteristics were not emphasized in depth.

An energy-efficient wireless sensor mote platform for low data rate applications was developed by the authors of this study [8]. This platform can be very helpful for drip irrigation since it doesn't require a high date rate. The new platform, which was dubbed DZ50, consists of ATmega328P microcontroller and RFM12b transceiver. This platform's power consumption was remarkably low, allowing for longer periods of energy efficiency when in sleep mode. Tests revealed that DZ50 outperformed TelosB and MicraZ in terms of performance. Energy tests have been conducted for various network operation states and settings. The findings show that, in comparison to MicaZ and TelosB motes, the suggested platform can increase battery lifespan by up to seven times in scenarios with a 10-second sampling period.

## 3. RESEARCH METHODOLOGY

ZigBee technology has been used to create autonomous irrigation systems driven by solar energy. ZigBee is a wireless communication system that can be used to connect nearby wireless nodes over short distances. Data connection offers excellent stability and high transfer rate because it operates at minimal power. Based on IEEE 802.15.4, the Low Rate Wireless Personal Area Network (LR-WPAN) standard, the ZigBee standard has been proposed as a means of connecting basic, low-rate, battery-powered wireless devices. The ZigBee network's implementation is anticipated to enable a wide range of applications, including home appliance networks, healthcare applications, medical monitoring, and environmental sensor networks[9].

In order to facilitate dependable and energy-efficient communication in Internet of Things systems, Zigbee technology is essential. It is a well-liked option for deploying industrial IoT systems, smart cities, and smart homes due to its broad variety of device and application support. Its resilience, low power consumption, and secure communication capabilities make it a crucial component that keeps the rapidly growing Internet of Things operating[10].

**Step 1- System Architecture:**

Various elements employed within the system include:

- Solar Power Module: The utilized solar power setup comprises an 80 W PV module linked to a 20A charge controller, which in turn charges a 12 V 40 A battery serving as a power reservoir. This system furnishes DC power to the Zigbee Communication System (Transmitter/Receiver), as depicted in Figure 1.


**Fig. 1: illustrates the Integrated Solar Power System.**

- Sensor: A sensor is a piece of apparatus that recognizes and reacts to a signal upon stimulation. The sensor detects the water level when the system is in operation; if there is a deviation from the typical water level, the system will be shut off. Water waste will decrease as a result, and efficiency will rise. Digital temperature and humidity sensors (DHT 22) and soil moisture sensors (EC-5) were primarily used for this study project.

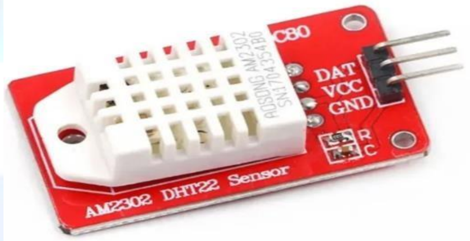


**Fig. 2: Digital temperature and Humidity sensor (DHT 22)**

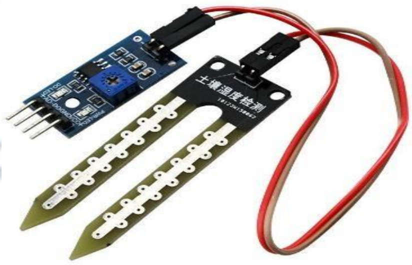

**Fig. 3 Soil moisture sensor (EC-5)**

- Zigbee Module: Using small, low-power digital radios as the building blocks of personal area networks, ZIGBEE is a specification for a set of high-level communication protocols. A cheap, low-power wireless mesh network is called ZIGBEE.


**Fig. 4: ZigBee Module**

- Irrigation control mechanisms: A signal is sent to a water pump connected to the farm using Zigbee technology in order to facilitate irrigation. Zigbee modules are attached to the transmitter side (control board) and receiving side (water pump) of this ZigBee technology. When water is being wasted, the Zigbee module alerts the control board to the excess water flow so that the farmer may monitor and manage the water pump from there.

**Step 2- Elements of a block diagram:**

A regulated power supply, sensors, microcontrollers, Zigbee modules, liquid crystal display (LCD), buzzer, relay drivers, relays, and DC pumps make up the ZigBee-based wirelessly controlled irrigation system

Operational Concept:

The Transmitter and Receiver are the two parts of the system that operate.

Design of Hardware (transmitter)

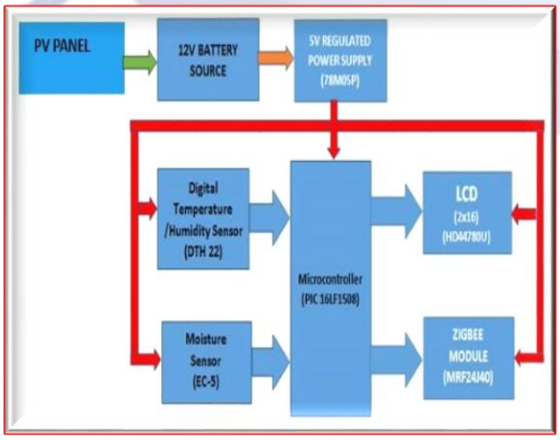


**Fig. 5: Block diagram of transmitter**

**Transmitter:**

All of the blocks are fed simultaneously by a 12V battery that is controlled to 5V on the transmitter side. Transducers attached to pins on the microcontroller set up as input are read. Various sensors, including those for soil moisture, temperature, and humidity, read the signals. Temperature, humidity, and moisture levels are the variables that are being watched. The temperature and humidity levels are likewise shown on the LCD, and these three (3) parameters are processed by the microcontroller and wirelessly transmitted to the receiver portion via a Zigbee module at 9600 baud rates. To minimize transmission error, the transmitter microcontroller does all of the intricate computations as needed.

Hardware Design (receiver)

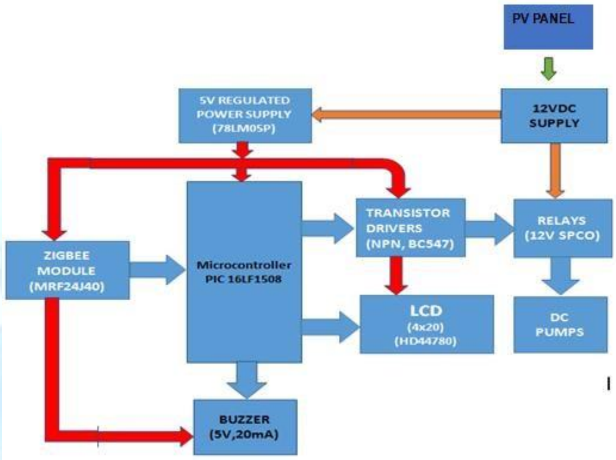


**Fig. 6: Block diagram of receiver**

The moisture data pertains to the circumstances of dry, moist, or wet soil on the farm. When the soil is dry, the sprinkler pump is turned on by the relay driver, provided that the reservoir tank has adequate water and a constant power source. When the soil is wet or damp, the sprinkler pump is turned off. Additionally, a bell is activated to draw attention to the situation and the sprinkler pump is turned off if the temperature data is above a specific maximum threshold level. This is a precautionary approach to save water and steer clear of watering plants in very hot weather.

## 4. RESULTS AND DISCUSSIONS

The outcomes are explained as follows: temperature and humidity readings at the transmitter were displayed.

| TRANSMITTER | | RECEIVER | |
|---|---|---|---|
| **Temperature** | **Humidity** | **Soil State** | **Sprinkler State** |
| 34.9 | 43.6 | Dry | ON |
| 25.9 | 51.7 | Moist | OFF |
| 15.9 | 63.3 | Wet | OFF |

**Table 1. Summary of results displayed by both transmitter and receiver.**

Figure 7 depicted the transmitter part, which used a liquid crystal display (LCD) to show the measured temperature and humidity values. It displayed 34.90 C as the temperature and 43.6% as the humidity.


**Fig. 7: Displayed values of temperature and humidity**

**Displayed values for dry soil condition at the receiver**

Fig. 8 showed the receiver section which displayed the monitored parameters of soil state, temperature and humidity values. The status of the sprinkler pump is also displayed on the Liquid crystal display (LCD). It showed the soil state as dry, the temperature value at 34.90 C and the humidity value at 43.6%. The temperature range is from 0-34.90C while the humidity range is from 38-48% at this soil condition.

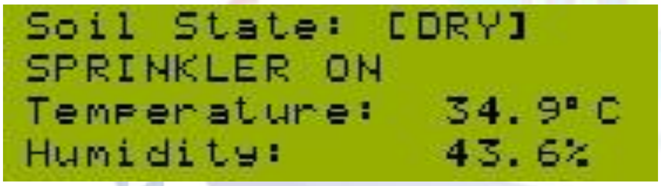


**Fig. 8: Displayed values of soil state, temperature, humidity and the status of the sprinkler pump**

**Displayed values for dry soil condition showing low reservoir**

The receiver section, depicted in Fig. 9, indicated the temperature, humidity, and soil condition parameters that were being monitored. The liquid crystal display (LCD) additionally shows the reservoir pump's status as LOW. It displayed the temperature as 34.90 C, the humidity as 43.6%, and the soil condition as dry. In this soil condition, the temperature ranges from 0-34.90C and the humidity ranges from 38-48%.

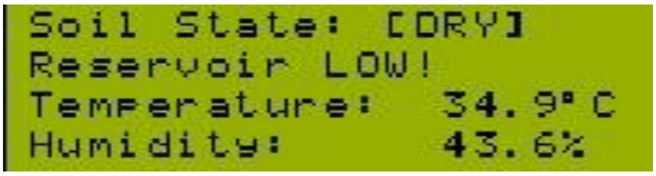


**Fig. 9: The soil condition, temperature, humidity, and reservoir pump status**

**values for the receiver's moist soil condition were displayed.**

The receiver section, depicted in Fig. 10, indicated the temperature, humidity, and soil condition parameters that were being monitored. The Liquid Crystal Display (LCD) also shows the sprinkler pump's status as OFF. It displayed the temperature as 25.90 C, the humidity as 51.7%, and the soil condition as moist. In this soil condition, the temperature ranges from 16 to 25.90C, and the humidity ranges from 50 to 63%.


**Fig. 10: Temperature, humidity, soil condition, and sprinkler pump status are all displayed**.

**values for the receiver's wet soil condition were displayed.**

The receiver section's liquid crystal display (LCD), which displayed the temperature, humidity, and soil condition metrics that were being monitored, was depicted in Figure 11. The LCD additionally shows the sprinkler pump's state as OFF. It displayed the temperature as 15 90 C, the humidity as 63.3%, and the soil condition as damp. In this soil condition, the temperature ranges from 10 to 15.90C, and the humidity ranges from 63% to 100%.

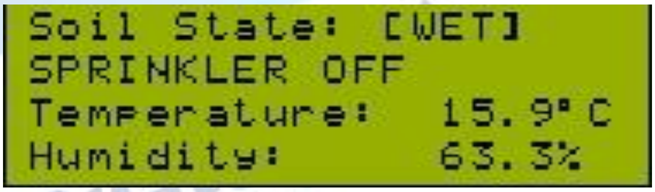


**Fig. 11: Values for temperature, humidity, soil condition, and sprinkler pump status**

## 5. CONCLUSIONS

It has been discovered that the ZigBee wireless communication technology-powered, solar-powered, low-cost irrigation system that was constructed is a feasible and cost-effective way to improve the management of water resources in agricultural production. It can be tailored to different types of crops, which improves upkeep procedures.

## Conflict of interest statement

Authors declare that they do not have any conflict of interest.

## REFERENCES


[1] K. S. Abhishek, L. C. K. Qubeley and D. Ho, "Glove-based hand gesture recognition sign language translator using capacitive touch sensor," 2016 IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC), Hong Kong, 2016, pp. 334-337.

[2] Sunitha K. A, Anitha Saraswathi.P, Aarthi.M, Jayapriya. K, Lingam Sunny, "Deaf Mute Communication Interpreter- A Review", International Journal of Applied Engineering Research, Volume 11, pp 290-296, 2016.

[3] C. Llas, D. Rosner, R. Tataroiu, and A. Surpateanu, "Wireless sensors and actuators networks: Localization for medical and robotics applications, vol. 7, no. 5, pp. 565–574, 2018.

[4] Haijiang Tai, Nannan Wen and Daoliang Li. "A Wireless Low Power Valve Controller for Drip Irrigation Control Systems." Sensors & Transducers, Vol.26, Special Issue, March 2014

[5] Esther Ososanya, Sasan Haghani, Wagdy H Mahmoud and Samuel Lakeou."Design and Implementation of a Solar-Powered Smart Irrigation System." 122nd ASEE Annual Conference & Exposition, (June, 2015) Seattle, WA.

[6] AbdelRahman Al-Ali, Murad Qasaimeh, Mamoun AI-Mardinia, Suresh Radder and I. A. Zualkernan. "ZigBee-Based Irrigation System for Home Gardens." 2015 International Conference on Communications, Signal Processing, and their Applications (ICCSPA'15), Sharjah, 2015, pp. 1-5

[7] Jayasuriya, M., Hong, C. S., & Karim, M. A. (2017). A review on low-power wireless communication technologies for industrial IoT applications. IEEE Access, 5, 26544-26561.

[8] Jayasuriya, M., Hong, C. S., & Karim, M. A. (2017). A review on low-power wireless communication technologies for industrial IoT applications. IEEE Access, 5, 26544-26561.

[9] Tiwari, G. N., Tiwari, S., & Biswas, W. (2018). Design and development of solar water pumping system for irrigation. Renewable Energy, 126, 773-787.

[10] Yogesh, G. G., Chaudhari, D. S., & Hitendra, C. C. (2016). A Review on Automated Irrigation System using Wireless Sensor Network. International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) 5 (6), 2. , 65, 1-12. Wiley, 1994.

[11] Sugeno-Takagi, Kamyar Mehran, Fuzzy Modeling for Process Control, Industrial Automation, Robotics and Artificial Intelligence (EEE8005), 2008