International Journal of Innovative Science and Modern Engineering (IJISME)
ISSN: 2319-6386 (Online), Volume-12 Issue-9, September 2024

# Solar Based Water Purification System

**N. P. Mawale, Niranjan Devale, Aniruddha Goswami, Soham Borawake**

***Abstract:*** ***In this paper, we present a solar-powered water purifier based on the principle of reverse osmosis. Solar panels collect radiation, which is stored in a battery. The battery supplies power to the purification unit via an electromagnetic relay. The purification unit includes a high-pressure motor, a reverse osmosis system, and a water tank. The motor generates the pressure needed for reverse osmosis. A microcontroller monitors the water level in the tank to prevent overflow. This method results in purified water stored in the tank. Solar-powered water purification systems are considered a key solution for providing clean water. Solar energy is environmentally friendly and a reliable energy source.***

***Keywords: Water purification, Solar power, Battery***

## I. INTRODUCTION

The diminishing availability of potable water has prompted the search for new sources of drinking water. In many regions of the country, the available water is brackish, saline, or contaminated. Salinity is a significant issue in the coastal areas of Kutch and Gujarat. Access to clean drinking water is a major challenge in tribal and rural areas. Various methods exist for purifying drinking water, including chlorine tablets, well chlorination, slow and rapid sand filters, fluoride removal, and reverse osmosis plants. This project involves creating a solar-powered water purifier. The primary principle of this system is reverse osmosis. Solar energy, being a renewable, plentiful, and cost-effective resource, powers the purifier. It will continue to function during power outages by storing solar energy. This purifier is ideal for remote and rural areas lacking electricity and for locations affected by natural disasters. Additionally, it can reduce the salt content in seawater and operates without causing pollution. To address this urgent need, this project seeks to create a solar-powered water purifier that harnesses renewable energy to efficiently eliminate contaminants from water sources, ensuring clean and safe drinking water for diverse uses. This innovative approach aims to combat water scarcity while also fostering sustainable development and protecting the environment.

**Manuscript received on 27 May 2024 | Revised Manuscript received on 22 August 2024 | Manuscript Accepted on 15 September 2024 | Manuscript published on 30 September 2024.**

**Correspondence Author(s)*
**N. P. Mawale,** Department of Electronics & Telecommunication AISSMS College Of Engineering, Pune (M.H), India. E-mail ID: npmawale@aissmscoe.com
**Niranjan Devale,** Department of Electronics & Telecommunication AISSMS College Of Engineering, Pune (M.H), India. E-mail ID: niranjandevale999@gmail.com
**Aniruddha Goswami,** Department of Electronics & Telecommunication AISSMS College Of Engineering, Pune (M.H), India. E-mail ID: aniruddhagoswamir@gmail.com
**Soham Borawake*,** Department of Electronics & Telecommunication AISSMS College Of Engineering, Pune (M.H), India. E-mail ID: sdborawake5@gmail.com



Successfully implementing this project could significantly enhance global water security and sustainable development. By delivering access to clean and safe drinking water, the solar-powered water purifier can improve health, reduce waterborne diseases, and uplift the livelihoods of communities around the world. Moreover, utilizing solar energy for water purification supports environmental conservation and encourages sustainable practices.

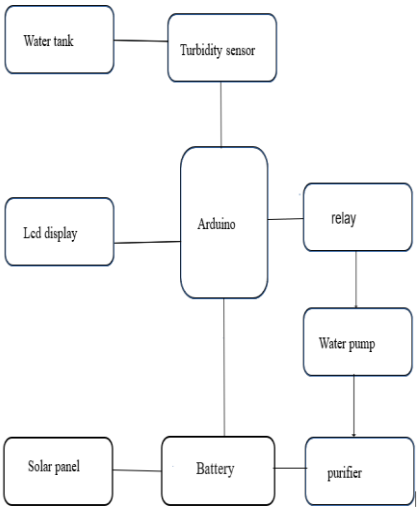


**Fig. 1: Block Diagram**

## II. METHODOLOGY

This project involves integrating various components to deliver clean drinking water using solar energy. The block diagram depicts the interactions between the following components:

### A. Solar Panel

Captures sunlight and converts it into electrical energy, which powers the entire system.

### B. Battery

Stores the electrical energy generated by the solar panel, ensuring the system can operate during periods without sunlight.

### C. Arduino

Functions as the central control unit, managing all connected components based on pre-programmed instructions.

### D. Turbidity Sensor

Measures the water's clarity and sends this data to the Arduino, which decides if purification is needed.

### E. Relay

Acts as a switch controlled by the Arduino, regulating the power supply to the water pump and purifier based on the sensor data.

### F. Water Pump

Moves water from the tank to the purifier when activated by the relay.

### G. Purifier

Removes contaminants from the water using methods such as reverse osmosis, and directs the clean water back to the tank.

### H. Water Tank

Stores the raw water and the purified water output by the system, serving as both the source and reservoir.

### I. LCD Display

Connected to the Arduino, it provides real-time system status, including water quality, battery level, and operational status

## III. OPERATION PROCESS

### A. Energy Collection and Storage

Solar Panel: The solar panel captures sunlight and converts it into direct current (DC) electrical energy. This renewable energy source is crucial for powering the entire system, making it sustainable and eco-friendly. Battery: The DC electrical energy generated by the solar panel is stored in a battery. This storage ensures that the system can operate continuously, even during periods without sunlight, such as nighttime or cloudy days.

### B. System Monitoring and Control

Arduino: The Arduino microcontroller serves as the system's brain. It is programmed to manage the operations of all connected components based on inputs from various sensors. The Arduino ensures the system runs efficiently and responds to real-time data. Turbidity Sensor: This sensor measures the clarity of the water by detecting the amount of particulate matter present. It sends real-time data to the Arduino, which processes this information to determine if the water needs purification.

### C. Water Quality Assessment

Data Analysis: When the turbidity sensor detects that the water clarity is below a predefined threshold (indicating contamination), it sends a signal to the Arduino. Decision Making: The Arduino processes this data and decides whether to initiate the purification process based on the turbidity levels.

### D. Activation of Purification Process

Relay Activation: Upon receiving the signal from the turbidity sensor, the Arduino activates the relay. The relay acts as an electrically operated switch that controls the power supply to the water pump and purifier. Water Pump Operation: Once the relay is activated, it powers the water pump. The pump moves water from the water tank to the purification unit.

### E. Water Purification

Purification Unit: The purifier, which may use reverse osmosis or other methods, removes contaminants from the water. This process includes:

High-Pressure Pump: Creates the necessary pressure for the reverse osmosis process, forcing water through a semipermeable membrane to remove impurities. Reverse Osmosis Membrane: Filters out contaminants, including salts, bacteria, and other impurities, allowing only clean water to pass through. Clean Water Storage: The purified water is directed back to the water tank, ensuring a continuous supply of clean water.

### F. Continuous Monitoring and Display

LCD Display: The LCD display, connected to the Arduino, provides real-time information about the system's status. It displays:

Water Quality Readings: Current turbidity levels and whether the water is being purified. Battery Level: The remaining charge in the battery to ensure the system has sufficient power. Operational Status: Status of the water pump, purifier, and any other relevant components. Feedback Loop: The Arduino continuously monitors the system, ensuring all components are functioning correctly. It adjusts operations as needed, providing a feedback loop that maintains optimal performance.

## IV. RESULT AND EVALUATION

In our project, we implemented a solar based water purification system using Arduino to control all connected components. The primary goal was to develop an efficient and accurate system for water purification using solar power, which are crucial for access clean and safe drinking water. The turbidity sensor's efficiency to identify various degrees of contamination was initial examined verifying its accuracy. The turbidity of post-purification samples decreased significantly, indicating that the reverse osmosis system were effective at removing bacteria, dissolved salts, and other impurities. The purifier's outstanding efficiency has been shown through the system's regular generation of water that met all safe drinking demands. The system's regular operation and reliable use of energy demonstrated its efficiency. The whole thing was fueled by solar panels that generated sufficient power to run it, and batteries maintained the system running whenever there wasn't no sunlight, like at night or on cloudy days. This highlighted the system's ability to function continuously for extended periods of time and also demonstrated how trustworthy the energy setup is. The Arduino microcontroller successfully connected all of the components, responding quickly to variations in the turbidity of the water and modifying the operation as necessary. Effective relay control of the water pump provided constant supply of water to the purifier, which ran effectively and constantly provided clean water.

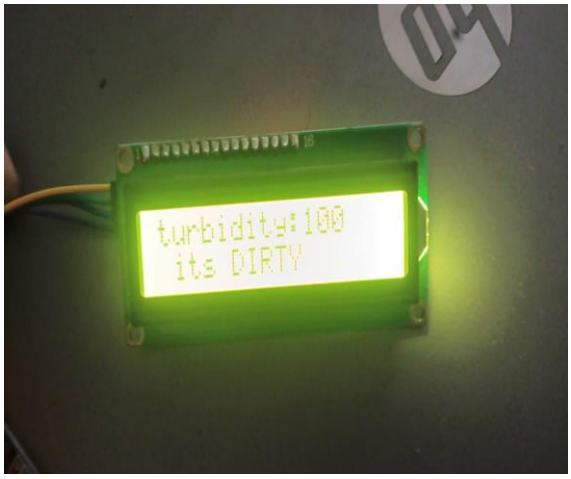


**Fig. 2: Water's Turbudity**

## V. DISCUSSION

The implementation of the solar-based water purification system reveals several significant insights and considerations, highlighting both the strengths and areas needing improvement for future developments. The project's success in delivering clean and safe drinking water using renewable energy sources underscores its potential impact on global water security and sustainability. The system's main advantage is that it uses solar energy, which is plentiful and safe for the environment. Using this renewable energy source instead of traditional fossil fuel-based techniques of purifying water results in a significant reduction of carbon footprint. Because the system is battery-operated, it can continue to function even when there isn't any sunshine. This is essential for keeping the water clean in a variety of weather situations even at night. In isolated and rural places, where access to energy can be irregular or nonexistent, this reliability is especially advantageous. It turned out that the Arduino microcontroller worked incredibly well for controlling the system's functions. The turbidity sensor's real-time data processing capacity combined with the Arduino's ability to react quickly to changes in water quality guarantees that the purification process is effective and responsive. Because of this automatic control, there is no longer a requirement for constant human intervention, which makes the system viable for wider deployment and easy to operate. In conclusion, the solar-based water purification system stands for a promising solution to the hitting issue of water shortages and contamination. It is a viable and sustainable option for a range of applications due to its automated control systems, scalability, and dependence on renewable energy sources. Maximizing the system's potential and guaranteeing its successful implementation on a larger scale will require addressing the issues of maintenance, changing water quality, and initial costs. This innovative approach has the potential to significantly enhance global water safety and promote sustainable development through ongoing adaptation and improvement.

## VI. APPLICATOION AND FUTURE WORK

There are many applications for the solar-powered water purification system, particularly for areas with limited access to safe drinking water. It is especially well-suited for remote and rural locations where traditional water infrastructure and reliable power may be limited, due to its self-sufficient design and dependence on renewable energy sources. These systems can offer a consistent supply of clean water to isolated and rural people in areas with poor or nonexistent infrastructure for energy and water. Through the use of solar energy, the system keeps running even when off the grid, guaranteeing constant access to clean drinking water.

Hospitals and schools earn many advantages from this technology as well. For the purpose of maintaining health and hygiene standards, clean water has to be supplied at educational and health organizations. By establishing these systems, hospitals and schools can significantly improve the health of their patients and children while reducing the number of diseases caused on by polluted water. These devices may be helpful even in areas with irregular water supplies. In times of dryness or shortages of water, they can serve as an additional source of clean water, lowering dependency on municipal water supplies. Though there's lots of potential for the present setup, there are still certain areas where additional research and development could enhance its effectiveness, scalability, and ease of use. Researching innovative filtration technologies is one important field. Future research endeavors could look into the integration of advanced filtration technologies, including ultraviolet (UV) purification or advanced oxidation processes (AOPs), to improve water quality and expand the scope of pollutants that may be efficiently removed. The water purifying system can also be remotely controlled and monitored by using Internet of Things (IoT) technologies. Proactive management and decreased downtime can be accomplished by the use of smart sensors and IoT connectivity which provides real-time data on water quality, system performance, and maintenance demands. Eventually, the implementation of such technologies can be accelerated by promoting policy support and obtaining funding through both governmental and non-governmental organizations. In order to pay for the initial investment and continuous maintenance, future efforts should focus on establishing partnerships and creating sources of funding. In conclusion, the solar-powered water purifying system is an achievable solution to deal with the global issues associated with shortages of water and pollution. These systems can be enhanced and broadened to provide clean, safe drinking water to people in need, supporting durability, sustainability, and health via ongoing research, development, and partnership.

## VII. CONCLUSION

The challenge of providing clean and safe drinking water to every individual on the planet is effectively addressed by the solar-powered water purification system.

This project demonstrates the potential to greatly improve the safety of water, particularly for remote, rural, and devastated regions, through the use of modern filtration technologies, automated control systems, and renewable solar energy. Areas with limited availability of conventional water and electrical infrastructure might find the system to offer an appealing option because of its independence from traditional power sources, which ensures its reliability under a variety of conditions. By reducing the incidence of illnesses caused by water, the successful implementation of this system not only solves current health issues but also advances wider environmentally friendly goals. The technology offers an environmentally friendly approach to water purification by minimizing its environmental impact by the use of renewable energy. Also, the system's scalability and cost-effectiveness enable it to be adapted to different community sizes and water demands, ensuring its use in a range of geographical and economic settings.

In conclusion, the solar-based water purification system represents a significant advancement towards fighting water shortages and contamination. This innovative strategy has the potential to significantly enhance public health, improve sustainable development, and boost global water security with sustained research, development, and cooperation.

## DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

## REFERENCES


1. Design and Development of a Dual Solar Water Purifier S. O. Ismail1*, S. J. Ojolo1 , J. I. Orisaleye2 , A. O. Alogbo1 1Department of Mechanical Engineering, University of Lagos, Lagos, Nigeria 2Department of Mechanical Engineering, Lagos State University, Epe Campus, Lagos, Nigeria.
2. Design and Construction of Solar Water Purifier, Gazi Nazia Nur, Mohammad Ahnaf Sadat International Conference on Mechanical, Industrial and Materials Engineering 2017.
3. Solar Energy Based Water Purification System Dr.S.Prakash, DEEPAK TOPPO International Journal of Pure and Applied Mathematics 2018.
4. Overview on solar based water purifier Ganesh D Shingade, Yogita V.Gaikwad, PoojaV.Gavande, Smital A.Akolkar, havan N.Nikita International Journal of Engineering Development and Research 2020.
5. Solar Based Smart Water Pump Control with Turbidity and Measuring System Sudipta Karmarker Department of Electrical and Electronic Engineering American International UniversityBangladesh Dhaka-1229, Dhaka, Bangladesh sudiptoaiubeee@gmail.com Shobhasish Halder Shovo Department of Electrical and Electronic Engineering American International UniversityBangladesh Dhaka-1229, Dhaka, Bangladesh shovo.halder@gmail.com
6. Water Purification and Disinfection by using Solar Energy Md. Z. H. Khan1, Md. R. Al-Mamun , Suvash C. Majumder , Md. Kamruzzaman Aceh International Journal of Science and Technology 2015.
7. Kumar, C., Sinha, A. R., Prakash, S., Singh, K., & Kumar, S. (2020). Water Purification by Activation Plasma Technology. In International Journal of Innovative Science and Modern Engineering (Vol. 6, Issue 8, pp. 15–23). https://doi.org/10.35940/ijisme.h1251.076820
8. Bharathi, Dr. V. V. P., & Krishnaiah, Dr. T. (2019). EXONERATION OF WASTE WATER WITH SOLAR ENERGY. In International Journal of Innovative Technology and Exploring Engineering (Vol. 8, Issue 10, pp. 1551–1553). https://doi.org/10.35940/ijitee.a1033.0881019
9. Behera, D. D. (2019). Development And Performance Testing Of Solar Operated Insecticide And Pesticide Agro Spraying System. In International Journal of Engineering and Advanced Technology (Vol. 9, Issue 1, pp. 573–578). https://doi.org/10.35940/ijeat.a9694.109119 [3]
10. Dewalkar, S. V., & Shastri, S. S. (2020). Provision of Staged Onsite Wastewater Treatment Units at Environmental Floors of Multi-storeyed Building with Hydraulic and Structural Feasibility. In International Journal of Recent Technology and Engineering (IJRTE) (Vol. 8, Issue 5, pp. 4488–4493). https://doi.org/10.35940/ijrte.e6741.018520
11. Singh, H. P. (2022). Scope of Solar Energy and Wind Energy in District Raebareli (Uttar Pradesh). In Indian Journal of Energy and Energy Resources (Vol. 1, Issue 3, pp. 7–8). https://doi.org/10.54105/ijeer.c1004.051322