

INVESTIGATION ON SOLAR-POWERED AI BASED WATER PURIFIER**Dr. R. B. Ingle**Department of Mechanical Engineering, Mauli College of Engineering & Technology Shegaon Buldhana,
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<https://orcid.org/0000-0002-6072-8613>**ABSTRACT**

Purpose: The optimization of solar water purification systems is greatly aided by artificial intelligence (AI). Real-time monitoring of water quality metrics, including turbidity, pH, and bacterial levels, is made possible using AI algorithms.

Method: AI-driven solutions can provide optimal efficiency and efficacy by modifying treatment processes based on well-informed decisions made about data analysis. There are several benefits to solar water treatment. It provides a greener substitute by lowering the greenhouse gas emissions linked to traditional energy sources. It also offers a decentralized, sustainable alternative, which is very helpful for isolated or off-grid groups. By allowing wastewater to be treated and reused, solar water purification systems can help conserve water.

Result: This strategy has the ability to reduce water scarcity and enhance water quality by utilizing renewable solar power and AI-driven optimization, so promoting a more resilient and sustainable future.

Keywords: Water Purification, Solar Energy, Artificial Intelligence.

INTRODUCTION

The need for accessible and clean water supplies around the world has led to the confluence of cutting-edge technology to provide novel solutions. The combination of solar energy with artificial intelligence (AI) in water purification systems stands out among these as a game-changing strategy. The AI solar water purifier is a promising solution to water scarcity, contamination, and energy efficiency issues. It is a state-of-the-art combination of renewable solar electricity and AI-driven intelligence. An overview of the AI solar water purifier concept is given in this introduction, along with information on its significance, workings, and possible benefits for sustainable water management.

Water Scarcity and Contamination: The increasing global population puts more strain on the world's water resources by driving up demand for clean water. Significant health concerns are also associated with the contamination of water supplies by microbial diseases, agricultural runoff, and industrial pollutants. Even though they work well, traditional water treatment techniques are insufficient for remote or resource-constrained places since they sometimes involve high energy consumption and may be restricted by centralized infrastructure.

Need of AI base Solar System

The combination of solar energy and artificial intelligence presents a fresh method of purifying water. The capacity of artificial intelligence to process large volumes of data and arrive at well-informed judgments makes it a perfect fit for optimizing water treatment procedures. In addition, solar energy is the most suitable power source for decentralized water purification systems due to its sustainability, availability, and adaptability.

AI Solar Water Purifiers' Operating Principles: An artificial intelligence (AI) solar water purifier is a high-tech device that uses artificial intelligence (AI) algorithms to monitor and manage the water purification processes while utilizing solar energy as a sustainable power source. This cutting-edge technology is made up of several parts, such as sensors, AI-driven control units, water treatment modules, energy storage systems, and solar panels for energy production. Together, these elements form an independent and effective water filtration system.

LITERATURE SURVEY

Modeling, forecasting and prediction, operational management and decision support, and optimization are the four application categories that have been identified. Data scientists shouldn't be the only ones using AI techniques in the water sector; collaboration between data scientists and water experts is necessary, as is knowledge from the social sciences and humanities (1). The constraints of the water intake, water purification, and water purification processes as they currently operate were examined in this research. By utilizing artificial intelligence technology, it will be possible to lower production costs, advance the technology of the water treatment process, and create a tap water production system of the highest caliber. By developing and implementing artificial intelligence (AI) technology into waterworks, it is possible to establish a stable work environment while building a scientific system for producing high-quality tap water, forecasting demand based on advanced operating technologies, and predicting water quality (2). The wastewater treatment process could undergo a revolution thanks to artificial intelligence. The main AI tools used in water treatment for the uptake of different pollutants were compiled in this review. Notwithstanding these obstacles, the state of research indicates that artificial intelligence (AI) techniques have a promising future in water treatment applications (3). This brief discussed the overall trends in the deployment of cutting-edge technology and methods, particularly AI algorithms, in the field of water delivery. Water utilities can evaluate their technological capabilities and test the potential benefits of AI techniques by starting small-scale, low-risk pilot projects (4). Water resources may alter and be managed differently as artificial intelligence in water management advances. Water management is made easier with the application of artificial intelligence (AI) and cutting-edge technology including data analytics, regression models, and algorithms. Artificial intelligence (AI)-based systems will maximize water management solutions with the least amount of waste because they are sustainable, economical, and able to forecast possible damage (5). Water-related issues are predicted to worsen over the next few decades due to worldwide water scarcity brought on by rapidly expanding human populations, intense human activity, and climate variability (6). Smart IoT-based water management and monitoring system designs have been the subject of research for a variety of applications, including the residential, commercial, industrial, and crude oil exploration sectors (7). The advent of AI-driven smart water management technologies is revolutionary in an age where sustainable resource management is critical. Our approach to managing water resources is being revolutionized by these systems, which hold the promise of a more efficient and sustainable future (8).

For researchers and practitioners working with drinking water, this study offers numerous important takeaways. As water systems expand and take into account additional operational variables, water utility operations are getting more complicated (9). The paradigm proposed here offers a foundation for proactive and critical risk management techniques, guided by participatory methodologies that involve and educate end users, that may be developed by multidisciplinary academics and practitioners in the water and AI industries (10). Water- and wastewater-treatment plants, natural systems, and water-based agriculture are some of the most important applications in water-based industries and operations that ML models and AI techniques have effectively optimized, forecasted, modeled, and automated (11). Solar energy is freely available which convert into Electrical Energy as per requirement. (12)

METHODOLOGY

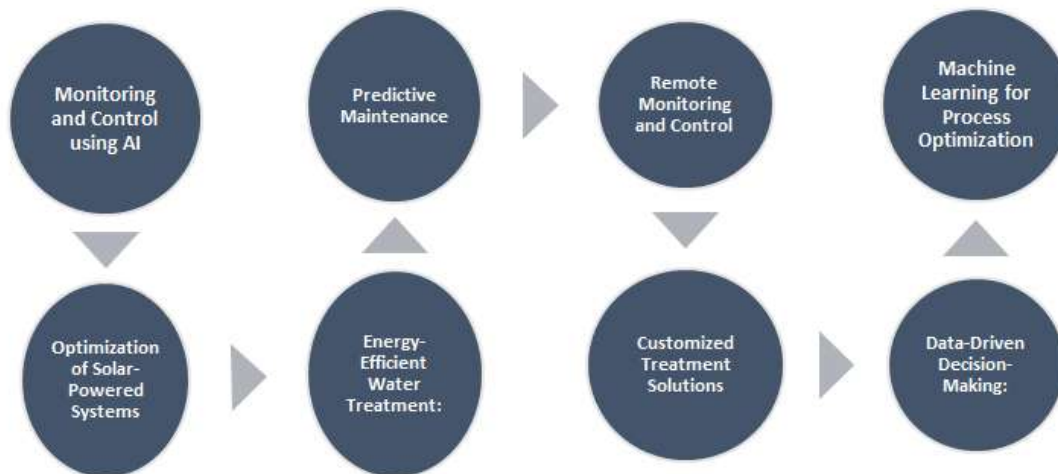


Chart1. Flow process chart for Water Purification

Monitoring and Control using AI: Water quality metrics including pH, turbidity, chemical make-up, and bacterial contamination may all be tracked with the use of AI. Artificial intelligence algorithms can optimize water purification by evaluating sensor data in real-time and making judgments about chemical dosage, filtration rates, and UV disinfection intensity, among other aspects. By predicting when equipment will need maintenance, AI can cut down on downtime and boost system efficiency.

Optimization of Solar-Powered Systems: Water purification devices that use solar energy can lessen the load on fossil fuels and the power grid. By taking into account variables such as weather, time of day, and energy storage capacity, AI algorithms can maximize the use of solar electricity. So even when the sun isn't shining, the water purification process can continue as usual.

Energy-Efficient Water Treatment: Artificial intelligence can optimize energy use in water treatment systems. By assessing historical data and current inputs, AI systems may determine the most efficient times to conduct power-intensive processes such as ion exchange, membrane filtration, and reverse osmosis, hence minimizing electricity use. This reduces the impact on both the operational budget and the environment.

Predictive Maintenance: Artificial intelligence can foresee when solar water purification systems' parts will break down and when repairs will be necessary. Artificial intelligence (AI) can analyze data from different sensors to find trends that could mean problems, so maintenance workers can fix them before they even happen. Continuous water treatment is guaranteed with this predictive approach, which minimizes downtime.

Remote Monitoring and Control: Particularly useful for decentralized or rural settings, water purification systems enabled by AI may be remotely monitored and managed. Operators can improve system reliability and reduce travel expenses via remote control, which allows them to make adjustments and resolve issues without physically being there.

Customized Treatment Solutions: Artificial intelligence can evaluate data on water quality and provide tailored treatment plans for various water sources. This personalization improves treatment efficiency and guarantees water safety by adapting the purification process to the specifics of each water source.

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Data-Driven Decision-Making: Operators can benefit from data-driven decisions made possible by AI algorithms processing massive volumes of data collected from sensors, weather predictions, and past performance. As a result, methods for treating water become more precise and effective.

Machine Learning for Process Optimization: Algorithms trained with past data can gradually improve water purifying procedures. Continuous improvements in system efficiency and performance can be achieved by their ability to detect patterns and correlations that human operators might overlook.

RESULT

Permeate flow rate -10 liters per hour Recovery rate-5%

Salt rejection-98%

Operating pressure-110 psi

Feed water temperature- 25°C Feed water TDS-500 ppm Permeate TDS <10 ppm

Feed water Ph- 7.5

Permeate pH- 7.0

Sr No	Feed Water TDS	Permeate Water TDS
1	652	55
2	540	45
3	460	35
4	365	32

Table1.TDS of Feed Water

Working Model of Soar Water Purifie.



Fig 2. Water Purifier Solar Base System

BENEFIT:

- 1) **Improved Water Quality:** Solar water purifiers that incorporate AI can track the water's condition in real-time and make adjustments to the treatment process accordingly. By efficiently eliminating impurities and germs, this process improves water quality and guarantees that the treated water is up to par in terms of safety.
- 2) **Energy Efficiency:** One sustainable and renewable source of energy is solar electricity. Improved energy efficiency and reduced carbon footprint are outcomes of powering water purification operations with solar energy and optimizing energy consumption with AI algorithms.
- 3) **Decentralized Access to Clean Water:** Remote or rural locations with limited access to clean water can benefit from the deployment of AI solar water purifiers. Their solar power and modular construction make them ideal for areas without regular grid connections, ensuring that people in those areas always have access to clean water.
- 4) **Real-time Monitoring and Remote Management:** Remote management and monitoring of water purification systems are now possible because to AI-driven real-time control and monitoring. Improved operational efficiency, less onsite maintenance required, and the capacity to respond quickly to changing water conditions are all benefits of this capability.
- 5) **Customization and Adaptability:** Algorithms powered by artificial intelligence can study past data and modify treatment procedures to fit various water sources and environments. Because of its flexibility, the system can adapt to different situations and continue to function well.
- 6) **Reduced Operating Costs:** Operating expenses are reduced over time due to solar energy's reduction in reliance on costly fossil fuels or grid power. Furthermore, AI-powered predictive maintenance can cut down on maintenance costs and downtime.
- 7) **Environmental Benefits:** There is less of an effect on the environment and less greenhouse gas emissions when water purification is powered by sustainable solar energy instead of fossil fuels. Sustainable activities are encouraged and this helps achieve those aims.
- 8) **Technological Advancement:** Artificial intelligence (AI) solar water purifiers are a step forward in renewable energy and water treatment technology. More research and innovation in these fields is encouraged by this.
- 9) **Emergency Response:** In places where conventional water purification systems could be damaged or destroyed, artificial intelligence solar water purifiers could be quickly set up to supply safe drinking water..
- 10) **Data Insights for Water Management:** Information about water consumption trends, pollution origins, and treatment efficacy can be found in the data gathered by monitoring systems powered by artificial intelligence. Strategies and policies for water management can be informed by these insights.
- 11) **Energy Efficiency:** The use of solar power reduces operational expenses and carbon emissions by eliminating the requirement for grid electricity. By continuously modifying purification operations in response to real-time data, AI maximizes energy efficiency.
- 12) **Decentralization:** People in places without consistent infrastructure can now have access to clean water thanks to this system, which can be easily installed because to its modular design.
- 13) **Real-time Monitoring and Control:** In order to continuously evaluate water quality metrics, AI systems examine data collected from sensors. Proactive responses to changing conditions are made possible by this real-time monitoring, which ensures successful purification.
- 14) **Customization and Adaptability:** The device can modify its treatment parameters and function at its best when fed water from different sources because to AI's learning capabilities.

- 15) **Reliability and Sustainability:** Integrating AI with solar power results in an autonomous system that can function with minimal interference from outside sources.

CONCLUSION

Sustainable water purification solutions have taken a giant leap forward with the advent of the artificial intelligence solar water purifier. This device improves energy efficiency, increases access to clean water for marginalized communities, and tackles important water concerns by utilizing solar energy and artificial intelligence. With the further advancements in this area of study, the AI solar water purifier has the ability to completely transform our methods of water treatment, leading us towards a future where safe drinking water is easily available without compromising the environment.

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