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Solar Powered Water Purifier Using Solar Purification System

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Abstract: This project focuses on developing a sustainable and efficient solar- powered water purification system to provide clean and safe drinking water. The setup integrates solar energy technology with a multi-stage water filtration process to remove contaminants and pathogens. The system comprises three core components: a solar thermal collector, a filtration unit, and a storage tank. Solar radiation heats the water, promoting evaporation and condensation for effective distillation, while integrated filters enhance purification by removing particulates and harmful substances. The solar collector is designed with highly efficient photovoltaic panels to power auxiliary components, ensuring continuous operation even during low sunlight conditions. Key advantages include zero-carbon emissions, low operating costs, and minimal maintenance. This setup is particularly suited for remote and rural areas where access to electricity and clean water is limited. It demonstrates an innovative approach to addressing water scarcity and public health challenges, aligning with global sustainability goals. Future enhancements may incorporate automated monitoring systems and advanced filtration materials to further improve performance and scalability.

Keywords: Solar, Energy, Filtration, Water, Purify.

I.INTRODUCTION

This project is designed to create a smart, solar-powered water purification system that monitors and displays various water quality parameters using sensors and the Blynk platform. The system ensures that the water is clean and safe for consumption by passing it through multiple filtration stages, including sediment filter, activated carbon filter, and reverse osmosis (RO) membrane. The ESP32 microcontroller acts as the brain of the system, integrating several sensors and controlling the purification process.Access to clean and safe drinking water remains a critical issue in many parts of the world, especially in areas without reliable access to electricity.

Solar water purification technology is a sustainable, low-cost, and energy-efficient solution that harnesses the power of sunlight to purify water, making it an ideal choice for rural and remote areas. Solar water purifiers use solar energy, a renewable and widely available source, to disinfect and purify water. This technology typically involves heating water to kill pathogens or utilizing advanced filtering systems that leverage solar power. There are various methods, including solar distillation, solar UV purification, and solar-powered filtration systems, each with unique mechanisms for achieving safe drinking water.

Water is the most important substance on earth. Humans are fully dependent on water to survive and to live healthily. This makes water a very scarce resource since it is used daily. Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids as well as gases from water. Research shows that to maintain a healthy lifestyle, an average male/female consumes approximately 3.7 liters/2.7 liters of water per day (Sawka, Cheuvront & Carter, 2005). With many areas not connected to the electricity grid, particularly in developing countries, access to clean, decontaminated water is a critical problem. Therefore, it is necessary to develop a water purification system that disinfects and cleans biologically contaminated water through the utilisation of a readily available energy source, the sun. The development of a sustainable water purification system which is relatively easy to manufacture and maintain, while relying on a readily available power source (like solar energy) is necessary and important. Although it is not a permanent solution, such a system can assist in improving the quality of human life. Solar energy poses no polluting effect and may be used as a dependable energy source. A solar water purification system consists of a solar collector that absorbs sunlight to ensure boiling which is the first stage of purification; and a filter that removes contaminant

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II.SCOPE OF THE PROJECT

The future of solar-powered water purifiers is bright due to growing demand for clean water and sustainable solutions.

1. High Demand: Useful in remote areas, disaster relief, and industries.
2. Cost-Effective: Uses free solar energy, reducing electricity costs.
3. Eco-Friendly: No chemicals, low maintenance, and renewable energy-based.
4. Technological Growth: Advancements in solar distillation, IOT integration, and hybrid systems.
5. Government Support: Incentives for clean water and renewable energy projects.
6. This technology is a smart, sustainable solution for safe drinking water worldwide.

III.METHODOLOGY

The main goal of this project is to design a smart water purification system that monitors water quality in real-time using sensors. The system will be solar-powered, ensuring sustainability, and controlled by an ESP32 microcontroller. The key metrics of water quality, such as pH level, TDS (Total Dissolved Solids), water temperature, and water level, will be displayed on the Blynk app, allowing remote monitoring and control. The purification system will involve multiple filtration stages, including sediment filters, activated carbon filters, and a reverse osmosis (RO) membrane.

Step 1: Solar Energy Collection Install solar panels to capture sunlight and convert it into electricity. Use this energy to power UV purification lamps, pumps, and sensors.

Step 2: Pre-Filtration Raw water passes through a sand filter to remove large particles. Activated carbon filtration helps eliminate organic contaminants and odor

Step 3: Solar Distillation (Thermal Purification)Water is heated using a solar still or distillation unit. The water evaporates, leaving behind contaminants, and then condenses into a separate clean container.

Step 4: Solar UV Purification (Optional)If using a solar-powered UV lamp, it further disinfects water by killing bacteria and viruses

Step 5: Photo catalytic Purification (Optional)Water flows through a chamber containing photo catalytic materials (e.g., Titanium Dioxide).When exposed to sunlight, the catalyst accelerates breakdown of harmful contaminants.

Step 6: Storage and Distribution Purified water is stored in a clean, sealed storage tank. A gravity-based or solar-powered pump distributes the water for use.

EXPERIMENTAL SETUP (1)

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EXPERIMENTAL SETUP (2)

READING OF STANDARD DRINKING WATER

Parameter	Before purification	After Purification	Standard Drinking Water Limit
ph.	5.8	7.2	6.5-8.5
TDS (ppm)	500	50	<300
Temperature (c)	28	25	25-30
Turbidity (NTU)	10	0.5	<1.0

IV.CONCLUSION

A simple and efficient solar water purification system was successfully developed in this research. Experiments conducted with this system demonstrate a low cost option for obtaining clean potable water during emergencies. Solar system application provides a good alternative for the system to be used during times when electricity is unavailable. The compact size of the system makes it easy to deploy and install in places that have space constraint. This system shows a good platform for further research and optimization of portable solar water purification systems.

1.The setup of a water purifier using solar purification technology provides a sustainable, cost-effective, and eco-friendly solution for clean drinking water. By harnessing solar energy, the system can efficiently remove contaminants through filtration, distillation, and UV purification, making it ideal for off-grid or rural areas.

2.This method ensures safe and reliable water purification with minimal operational costs and maintenance. Additionally, integrating sensors and automation can further enhance efficiency and monitoring.

3. With continued advancements, solar water purification can play a crucial role in addressing global water scarcity and promoting environmental sustainability.

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