

Abstract

The increasing demand for sustainable and energy-efficient solutions in the heating and cooling sector highlights the importance of this project. Integrating geothermal heat pumps with solar panels, controlled by an Arduino and enhanced with a MOSFET for efficient pump regulation, represents a cutting-edge approach to leveraging renewable energy resources for reducing carbon footprints and operational costs in residential and commercial buildings. This project stands out due to its innovative blend of technologies that harness the Earth's natural thermal energy and solar power, demonstrating a forward-thinking solution to climate change and energy consumption challenges.

The project is significant as it encapsulates the intersection of renewable energy technology and smart automation to create a highly efficient, sustainable heating and cooling system. Its significance lies in its potential to significantly reduce reliance on fossil fuels, lower electricity costs, and provide a scalable model for future green infrastructure projects. By employing an Arduino-based control system with integrated temperature, current, and voltage sensors, it enables precise real-time monitoring and energy optimization.

Key aspects include system integration for sustainability, Arduino-based smart control, efficient pump management using MOSFETs, environmental impact analysis, and economic viability assessment. The objectives are to design an integrated sustainable system, develop intelligent control algorithms, demonstrate environmental benefits, and assess cost-effectiveness. The methodology involves system design, Arduino programming, prototype testing under real-world conditions in Arrabeh, Palestine, and performance analysis. This project is the first of its kind to combine these technologies, making the solution more sustainable, energy-efficient, and impactful