ABSTRACT

This project centers on the creation of a solar-powered embedded system built around the Arduino Uno microcontroller. Its primary aim is to develop a sustainable and energy-efficient solution capable of operating without reliance on the conventional electrical grid. Utilizing solar energy as the main power source, the system incorporates a rechargeable lithium-ion battery to provide consistent backup. In response to the growing need for autonomous, off-grid technologies—particularly in rural and underserved regions—this project presents a functional prototype integrating key components such as a 12V solar panel, TP4056 lithium battery charger module, buck converter for voltage control, and a digital voltmeter for real-time monitoring The system is engineered to accept dual charging inputs (solar and external DC), with manual switching capabilities to manage power sources and maintain operational flexibility. Voltage levels can be observed via the voltmeter, ensuring users can track battery status and energy input effectively.

Initial testing was conducted on a breadboard setup, followed by final deployment on a custom PCB design, ensuring both reliability and practical usability. By addressing the challenges of conventional power infrastructure, this embedded system demonstrates how microcontroller-based projects can be optimized for sustainability and reliability. The design highlights the relevance of integrating renewable energy with electronic hardware, supporting future applications in automation and IoT. Ultimately, the system offers valuable insights into solar energy utilization, embedded hardware design, and power management strategies, making it a strong candidate for use in educational environments, remote monitoring devices, or low-power IoT solutions.