IoT and MPPT Based Charge Converter for PV System

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Abstract: *Maximum Power Point Tracking plays a vital role in extracting the highest possible energy from photovoltaic systems under varying environmental conditions. This project presents a practical implementation of an IoT-enabled MPPT-based charge controller that enhances the efficiency of solar energy harvesting. The system uses real-time monitoring and control, where the ESP32 microcontroller adjusts the duty cycle of a custom-designed boost converter to track the maximum power point. Input and output parameters are measured using dual INA219 sensors, and live data is visualized through an OLED display. The MPPT logic is implemented through a perturb and observe algorithm. The controller ensures optimized battery charging, making it suitable for small-scale off-grid renewable applications. The integration of cloud-based data logging adds an intelligent edge for performance analysis and diagnostics.*

Keywords: Maximum Power Point Tracking (MPPT), Photovoltaic System, Boost Converter, IoT-enabled Controller, ESP32 Microcontroller, Perturb and Observe Algorithm, Real-time Monitoring