ABSTRAK

Tugas akhir ini dibuat untuk mengatasi masalah pemadaman listrik di sektor rumah tangga, khususnya untuk beban penerangan dengan memanfaatkan energi surya sebagai sumber daya alternatif. Percobaan menggunakan *Photovoltaic Solar Cell* sebagai sumber daya listrik dan *Synchronous Buck Converter* sebagai pengisi baterai menunjukkan hasil positif. *Photovoltaic Solar Cell* terbukti efektif untuk penerangan rumah, sedangkan *Synchronous Buck Converter* memberikan akurasi dan kestabilan tegangan output. Penggunaan kontrol *PID* dalam *Synchronous Buck Converter* melalui mikrokontroler juga terbukti efektif dalam menstabilkan tegangan untuk metode pengisian baterai *Constant Voltage (CV)* yang cocok dengan baterai *Valve Regulated Lead Acid (VRLA)*. Baterai VRLA dipilih karena karakteristik *deep cycle*-nya yang optimal untuk penggunaan daya.

Kesimpulannya, energi surya yang dikonversi menjadi energi listrik oleh Solar Cell dengan tegangan maksimum bisa mencapai 17 Volt, bisa diturunkan tegangannya dengan *Synchronous Buck Converter* dan kontrol *PID* menjadi stabil di rentang 13,6 Volt sesuai dengan kebutuhan tegangan pengisian baterai. Sehingga alat ini menjadi solusi untuk pemadaman listrik di rumah tangga.

Pengembangan lebih lanjut direkomendasikan, termasuk penyesuaian kapasitas *photovoltaic solar cell* dan baterai, penggunaan *Buck-Boost Converter*, dan metode pengisian baterai *Constant Current (CC) - Constant Voltage (CV)* untuk baterai jenis lithium dengan metode *fast charging* yang aman. Proteksi tambahan seperti modul *relay* juga disarankan untuk mencegah risiko *overcharging, overload*, dan *power loss*.

Kata kunci: Baterai, *Constant Voltage*, Kontrol PID, Panel Surya, *Synchronous Buck Converter, Valve Regulated Lead Acid.*

ABSTRACT

The scientific objective of this research is to address power outage issues in the household sector by utilizing solar energy as an alternative power source. The experiments involve the use of Photovoltaic Solar Cells as the power source and the Synchronous Buck Converter as the battery charger, yielding positive results. Photovoltaic Solar Cells have been proven effective for household lighting, while the Synchronous Buck Converter provides accurate and stable output voltage. The utilization of PID control in the Synchronous Buck Converter through a microcontroller has also been found to effectively stabilize the voltage during the Constant Voltage (CV) battery charging method, which is suitable for Valve Regulated Lead Acid (VRLA) batteries. VRLA batteries were chosen due to their optimal deep cycle characteristics for power usage.

In conclusion, the conversion of solar energy to electrical energy using the Solar Cell with maximum voltage until 17 Volt can be decrease the voltage using Synchronous Buck Converter and PID control to be about 13.6 Volt, according to the required battery charging voltage. So this equipment offers a solution to household power outages.

Further developments are recommended, including adjusting the capacities of the photovoltaic solar cells and batteries, exploring the use of Buck-Boost Converters, and implementing the Constant Current (CC) - Constant Voltage (CV) battery charging method for lithium batteries with a safe fast charging capability. Additional protection, such as relay modules, is also advised to prevent overcharging, overload, and power loss risks.

Keywords: Battery, Constant Voltage, PID Control, Solar Cells, Synchronous Buck Converter, Valve Regulated Lead Acid.