SISTEM MONITORING KINERJA PLTB DENGAN WIND TRACKER BERBASIS MOTOR SERVO

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ABSTRAK

Pemanfaatan energi angin sebagai sumber energi terbarukan pada Pembangkit Listrik Tenaga Bayu (PLTB) skala mikro masih menghadapi kendala berupa penurunan efisiensi penangkapan angin akibat turbin yang tidak mampu menyesuaikan posisinya secara otomatis terhadap perubahan arah dan kecepatan angin. Penelitian ini bertujuan merancang dan membuat prototipe sistem monitoring kinerja PLTB yang dilengkapi dengan wind tracker berbasis motor servo MG966R 360° serta menganalisis daya output dan kinerja sistem secara keseluruhan. Metode yang digunakan adalah rancang bangun yang meliputi identifikasi masalah, studi literatur, perancangan perangkat keras dan lunak berbasis Arduino Uno R3, pengujian fungsional setiap komponen, serta pengambilan data kinerja sistem selama 12 jam di rooftop Fakultas Teknik UPN Veteran Jakarta. Sistem mengintegrasikan wind vane tracker, anemometer, sensor arus ACS758, sensor tegangan DC, generator PMSM 600 W/24 V, MPPT Wind Charge Controller, LCD display, dan baterai Lead Acid 24 V, dengan kinerja yang dibandingkan terhadap sistem PLTB statis. Hasil pengujian menunjukkan bahwa wind tracker mampu mendeteksi dan merespons perubahan arah angin dengan sudut servo pada rentang 109° hingga 252° pada kecepatan angin 1,9 hingga 3,9 m/s. Sistem dengan wind tracker menghasilkan arus maksimum 0,14 A dan daya maksimum 3,98 W, yang meningkat sekitar 39,16% dibandingkan sistem statis yang hanya menghasilkan 0,10 A dan 2,86 W. Kapasitas baterai pada sistem wind tracker juga meningkat lebih besar, dari 70,91% menjadi 80,20%, dibandingkan sistem statis yang meningkat dari 70,68% menjadi 77,56%. Hasil ini membuktikan bahwa penerapan wind tracker berbasis motor servo efektif meningkatkan pemanfaatan energi angin pada turbin angin horizontal skala mikro, terutama pada kondisi arah angin yang berubah-ubah.

Kata kunci: Arduino Uno R3, Motor Servo MG966R, PLTB, Turbin Angin Horizontal, Wind Tracker.

WIND TURBINE PERFORMANCE MONITORING SYSTEM WITH SERVO MOTOR BASED WIND TRACKER

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ABSTRACT

The utilization of wind energy as a renewable energy source in small-scale Wind Power Plants (PLTB) still faces challenges due to reduced wind absorption efficiency, as wind turbines are unable to automatically adjust their orientation to changes in wind direction and speed. This study aims to design and build a prototype PLTB performance monitoring system equipped with a 360° MG966R servo motor-based wind tracker, and to analyze the power output and overall system performance. The method applied is design and build, encompassing problem identification, literature review, hardware and software design based on Arduino Uno R3, functional testing of each component, and system performance data collection over 12 hours on the rooftop of the Faculty of Engineering, UPN Veteran Jakarta. The system integrates a wind vane tracker, an anemometer, an ACS758 current sensor, a DC voltage sensor, a 600 W/24 V PMSM generator, an MPPT Wind Charge Controller, an LCD display, and a 24 V Lead Acid battery, with its performance compared to a static turbine system. Test results show that the wind tracker was able to detect and respond to changes in wind direction with servo angles ranging from 109° to 252° at wind speeds of 1.9 to 3.9 m/s. The system equipped with the wind tracker produced a maximum current of 0.14 A and a maximum power of 3.98 W, an increase of approximately 39.16% compared to the static system, which produced only 0.10 A and 2.86 W. Battery capacity in the wind-tracker system also increased more significantly, from 70.91% to 80.20%, compared to the static system, which increased from 70.68% to 77.56%. These results demonstrate that the servo motor-based wind tracker effectively improves wind energy utilization in small-scale horizontal axis wind turbines, particularly under variable wind direction conditions.

Keywords: *Arduino Uno R3, Horizontal Axis Wind Turbine, MG966R Servo Motor, Wind Power Plant, Wind Tracker.*