

**RANCANG BANGUN ANTARMUKA PENGGUNA GRAFIS
DASHBOARD SISTEM PEMANTAUAN BANGUNAN ZERO ENERGY DI
DTNTF UGM**

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INTISARI

Sektor bangunan menyumbang lebih dari sepertiga konsumsi energi dan emisi karbon global, termasuk 36% emisi gas rumah kaca di Indonesia. Konsep *Zero Energy Building (ZEB)* menawarkan solusi dengan menyeimbangkan konsumsi energi dan produksi energi terbarukan tanpa mengorbankan kualitas lingkungan dalam ruang (*Indoor Environment Quality/IEQ*). Di DTNTF UGM, konsep ini diimplementasikan melalui pengembangan *dashboard Nearly Zero Energy Building Monitoring System (nZEBMS)*.

Sistem nZEBMS memvisualisasikan data dari sensor lingkungan dan energi yang tersimpan di server lokal melalui antarmuka berbasis *React JS*. Evaluasinya mencakup dua aspek: (1) Kompatibilitas dengan mengukur *Fully Loaded Time (FLT)* dan *Largest Contentful Paint (LCP)* pada *browser* (Chrome, Edge, dan Firefox) dengan variasi RAM (1GB, 2GB dan 4GB) menggunakan DevTools; dan (2) Fungsionalitas melalui *black box testing* dengan wawancara dengan ahli fisika bangunan.

Berdasarkan hasil pengujian fungsionalitas nZEBMS berhasil menampilkan informasi IEQ, konsumsi energi, produksi energi terbarukan, dan ketercapaian menuju ZEB secara *real-time* sesuai dengan standar yang berlaku di Indonesia dan konsep ZEB menurut ahli fisika bangunan. Pengujian kinerja menunjukkan performa optimal tercapai dengan RAM di atas 4GB untuk semua variasi *browser* dengan rerata FLT tercatat di bawah 3,2 detik, dan LCP di bawah 2,42 detik.

Kata kunci: bangunan nol energi, antarmuka pengguna grafis, sistem pemantauan, kualitas lingkungan dalam ruang.

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ABSTRACT

DESIGN AND DEVELOPMENT OF A GRAPHICAL USER INTERFACE (GUI) DASHBOARD FOR ZERO ENERGY BUILDING MONITORING SYSTEM AT DTNTF UGM

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ABSTRACT

The building sector accounts for more than one-third of global energy consumption and carbon emissions, including 36% of greenhouse gas emissions in Indonesia. The concept of Zero Energy Building (ZEB) offers a solution by balancing energy consumption with renewable energy production without compromising Indoor Environmental Quality (IEQ). At DTNTF UGM, this concept is implemented through the development of the Nearly Zero Energy Building Monitoring System (nZEBMS) dashboard.

The nZEBMS system visualizes data from environmental and energy sensors stored on a local server via a React.js-based interface. Its evaluation covers two aspects: (1) Compatibility, by measuring Fully Loaded Time (FLT) and Largest Contentful Paint (LCP) across browsers (Chrome, Edge, and Firefox) and RAM variations (1GB, 2GB, and 4GB) using DevTools; and (2) Functionality, through black box testing and expert interviews with building physics specialists.

Based on the functionality tests, nZEBMS successfully displays real-time information on IEQ, energy consumption, renewable energy production, and progress toward achieving ZEB under applicable standards in Indonesia and expert-defined ZEB criteria. Performance testing showed that optimal results were achieved with devices using more than 4GB RAM across all browser variations, with average FLT recorded below 3.20 s and LCP below 2.42 s.

Keywords: zero energy building, graphical user interface, monitoring system, indoor environmental quality.

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