

DEVELOPMENT OF GREEN TECHNOLOGY SMART BUILDING USING ESP32 AND ARDUINO MCU WITH AUTOMATED MECHATRONICS PARKING

ABSTRACT

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The rapid advancement of technology presents significant opportunities for transforming traditional buildings into sustainable, efficient structures. While smart building technologies are already in use, many systems lack seamless integration and user-friendly automation. This study explores the development of a green technology smart building using accessible microcontrollers, specifically ESP32 and Arduino, integrated with an automated mechatronics parking system. The aim is to enhance building efficiency, energy sustainability, and technological responsiveness by combining renewable energy sources with modern automation. This project employs the Experimental Prototyping Methodology. The system architecture was designed using 2D and 3D modeling in SketchUp. Microcontrollers, including ESP32 and Arduino Mega, were programmed using Arduino IDE with C++ to manage sensors and actuators such as DC motors, stepper motors, and IR sensors. Automation features were integrated with a MySQL database using HTTP protocols via Wi-Fi. A solar power system was incorporated for energy sustainability, with automatic switching to the main grid during solar power outages. User feedback was collected using purposive sampling and analyzed through a 4-point Likert scale. The ESP32 microcontroller effectively established communication between the actuators and the database. Functional modules such as room security, QR-based attendance and access, and the automated mechatronics parking system successfully operated with real-time database integration. The Arduino Mega managed the elevator system with high precision, utilizing IR sensors and limit switches. A web server interface enabled QR code generation and system control. The solar power setup successfully powered the system, with seamless transition to the main grid during power loss. The results confirmed the feasibility of implementing a smart building using ESP32 and Arduino microcontrollers. The system demonstrated reliable performance in automation, energy efficiency, and database communication. The integration of a solar power system enhanced environmental sustainability. For future development, enhancements in graphical user interfaces, AI integration, predictive maintenance, improved QR code management, and broader real-world deployment are recommended. This study offers a promising model for future green and intelligent infrastructure.

RECOMMENDED CITATION

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