

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

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Abstract

The rapid advancement of technology offers opportunities to transform traditional construction toward greater sustainability. This research addresses the need for more integrated and efficient building systems. Although smart building technologies are available, seamless integration and user-friendly automation remain challenges. This study explores the development of a Green Technology Smart Building using accessible microcontrollers (ESP32/Arduino) with an Automated Mechatronics Parking system as a potential solution, aiming to enhance efficiency through the integration of modern technologies for more responsible and sustainable construction. The project followed an Experimental Prototyping Methodology. The system layout was visualized in both 2D and 3D using SketchUp. Microcontrollers, including ESP32 and Arduino MCU, were programmed in C++ using the Arduino IDE. Various sensors and actuators, such as DC motors and stepper motors, were integrated with the microcontrollers to create automated functions. These automations also communicated with a MySQL database through HTTP protocols via Wi-Fi. A solar power system was incorporated to harness green energy. User feedback was collected using a purposive sampling technique and evaluated using a 4-point Likert scale. The ESP32 successfully facilitated communication between the actuators and the database. The room security system, QR attendance system, QR security system, and automated mechatronics parking system all effectively interacted with the database via the ESP32 to control their respective actuations. The Arduino Mega enabled the creation of a fully functional elevator system, with IR sensors and limit switches ensuring precise operation. The HTML web server allowed comprehensive user management and generated QR codes for system use. Additionally, the solar power system was capable of powering the entire setup, with an automatic switch to the main grid in the event of a solar power outage. The findings confirm the feasibility of creating a smart building using ESP32 and Arduino microcontrollers. Renewable energy proved to be both feasible and efficient for the system. Future research should focus on real-world testing, GUI enhancement, predictive maintenance, improved security, optimized energy utilization, AI integration, refined QR code logging, and exploring commercialization potential. These findings suggest a promising direction for developing more efficient and environmentally responsible building designs.

Keywords: smart building, esp32, arduino, renewable energy, automated mechatronics parking, iot, sustainable construction