Biometric Fingerprint-based Vehicle Ignition and Security System

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Abstract: *In the modern era of advanced technology, vehicle security has emerged as a critical concern due to increasing instances of vehicle theft and unauthorized access. Traditional security mechanisms such as mechanical keys and key fobs are often vulnerable to theft, loss, or duplication, thereby necessitating the development of more secure alternatives. This paper presents the design and implementation of a "Biometric Fingerprint-Based Vehicle Ignition and Security System," leveraging the NodeMCU ESP8266 microcontroller in conjunction with supporting hardware components, including a fingerprint sensor, keypad, LCD, DC motor, and buzzer.*

The system employs biometric fingerprint recognition as the primary authentication mode, offering a high level of security due to the uniqueness of individual fingerprints. Upon scanning, the fingerprint sensor transmits data to the NodeMCU, which verifies it against a pre-stored database of authorized users. Successful authentication triggers the vehicle ignition mechanism, represented by a DC motor, thereby granting access. In contrast, unrecognized attempts keep the system locked, denying unauthorized entry.

A keypad is incorporated as a secondary authentication method to enhance reliability. In cases where the fingerprint sensor fails to operate effectively due to environmental or technical factors, users may input a pre-set passcode. Real-time system status and prompts are displayed on an integrated LCD screen, ensuring a user-friendly interface and clear communication.

Additionally, a buzzer is used to alert users of security threats. Repeated failed authentication attempts activate the buzzer, serving as an audible alarm to indicate potential tampering or unauthorized access attempts. This multi-layered approach not only improves security but also increases the resilience and usability of the system.

The project demonstrates the practical advantages of integrating biometric technology into vehicle security systems. By replacing vulnerable traditional systems with biometric authentication, the proposed solution significantly elevates security standards. Future enhancements may include the incorporation of advanced biometric modalities such as facial or voice recognition, expanding the applicability of the system across various vehicle types and high-security domains.

Keywords: Fingerprint sensor, Vehicle security, Biometric ignition system, NodeMCU ESP8266