Industrial Engineering Journal
ISSN: 0970-2555
Volume: 54, Issue 9, September: 2025

Development Of a Fingerprint Based Motor Starter System with IOT Integration for Enhanced Motorcycle and Real Time Notifications

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***Abstract*— In order to improve motorcycle security and offer real-time notifications, this article describes the creation of an IoT-integrated fingerprint-based motor starter system. Only authorized users will be able to start the car thanks to the planned technology, which uses biometric authentication in place of conventional keys. Real-time status updates, remote monitoring, and immediate notifications for unwanted access attempts are all made possible by an IoT module. Reliability, reaction time, and security tests were conducted on the system, which showed excellent fingerprint recognition accuracy and smooth IoT connectivity. The findings demonstrate its potential to increase vehicle security, lower the risk of theft, and provide a convenient substitute for traditional ignition systems.**

Keywords— IOT, Motorcycle, Fingerprint, Sensor, Security, Biometric Authentication.

I. Introduction

Biometric verification has become more popular as a dependable way to stop unauthorized access as the demand for improved car security grows. The creation of an IoT-enabled fingerprint-based motor starting system for real-time security and monitoring is presented in this study. The FIM 3030N high-voltage fingerprint module, which can store multiple user fingerprints and function in User Mode for authentication and Master Mode for registration, is used by the system. To manage the scanning procedure and validate users against recorded data, the finger print module is serially interfaced with an Arduino. The owner registers their fingerprint in this application, and it is saved with a unique ID. Users must authenticate themselves by scanning their fingerprints while operating a car. The system uses a GSM module to send an SMS notification to the owner and activate an alarm if it detects an unregistered fingerprint. A GPS module also makes real-time vehicle tracking possible, which helps owners find their car in the event of theft. Additionally, the system offers remote ignition control, which allows the owner to start or stop the car by sending out SMS alerts. By providing remote control capabilities, enabling real- time monitoring, and blocking unwanted access, the integration of biometrics with IoT improves vehicle security. In addition to providing increased security against theft, this approach enhances user. By providing remote control capabilities, enabling real- time monitoring, and blocking unwanted access, the integration of biometrics with IoT improves vehicle security. This method increases operational efficiency and user convenience while also guaranteeing a higher degree of the ft protection. The system is also appropriate for both personal and commercial car security applications because it uses GPS and GSM technologies to facilitate smooth tracking and communication. In the digital era, this system's mix of remote access management, real-time notifications, and biometric verification makes it a reliable and cutting-edge method of vehicle security.

II. Related Studies

Goilkar et al. (2024) suggested an IoT-enabled biometric authentication system for motorcycles. Their technology notifies owners in real time and uses fingerprint recognition to prevent unwanted access. For improved security, these study emphasizes cloud-based monitoring. It prevents theft by using authentication logs and instant alarms.

A fingerprint-based motorbike ignition key was created by Supriyono et al. (2020) to replace conventional keys. Their approach increases security by ensuring that only authorized individuals may start the car. They assessed the accuracy of the fingerprint module in various environmental settings. According to the study's findings, biometric authentication improves car convenience and safety.

A fingerprint-based safety system for motorbikes was introduced by Baharudin & Mustamam (2019) to replace key-based ignition. Their technology keeps track of registered fingerprints and guards against unwanted access. The paper talks about implementation issues such system response time and sensor accuracy. When compared to

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Traditional approaches, the results show improved theft prevention. NB-IoT was used by Kristiani et al. (2024) to create a real- time monitoring system for sport cruiser motorcycles. Their technology combines multi-sensor data tracking with biometric authentication. Through IoT connectivity, it enables remote access and ongoing vehicle monitoring. The study emphasizes how NB-IoT might increase the effectiveness of real-time tracking. A two-way authentication system with GPSmonitoring was introduced by Fernandez & Seroje (year not specified). Their approach combines a mobile-based warning system with finger print authentication. Owners can track their car in real time and get alerts for illegal access. By facilitating remote control and preventing theft, this improves security.

Madhuri et al. (2024) suggested a face detection-based Internet of Things-based car starter system. Their research investigates how well facial recognition works in comparison to fingerprint authentication. Only authorized people are able to start the car thanks to the system. The findings indicate that computer vision-based security improves dependability under various lighting scenarios.

Siam et al. (2022) created a clever anti-theft system that combines GPS, GSM, and biometrics. In the event of unlawful access, their technology notifies owners and tracks the whereabouts of the car. It guarantees remote locking and real-time monitoring. The study places a strong emphasis on Enhanced security via ongoing vehicle monitoring.

A smart ignition system that combines biometric authentication and Internet of Things security was created by Dhomne et al. (2019). For increased security, their method uses fingerprint sensors in place of conventional keys. Additionally, cloud-based storage for authentication logs is incorporated. The report emphasizes how biometric access improves car convenience and safety.

III. HARDWARE COMPONENTS

A) FIM3030NFingerprintScanner

TheFIM3030Nisahigh-voltagefingerprintmodulecapable of storing multiple user fingerprints. It operates in Master Mode for registration and User Mode for authentication. This module ensures secure access by comparing scanned fingerprints with stored data, making it ideal for vehicle security applications.

B) ArduinoMicrocontroller

The Arduino acts as the central processing unit of the system, handling fingerprint authentication, communication with other modules, and controlling the ignition. It enables seamless integration of the fingerprint scanner, GSM, and GPS modules.

C) GSM Module (SIM800L/SIM900)

The GSM module is used for sending SMS alerts to the vehicle owner in case of unauthorized access. It allows remote control of the ignition system via SMS commands, enhancing security.

D) GPS Module (Neo-6M/Ublox)

The GPS module provides real-time location tracking of the motorcycle. It continuously transmits the vehicle's coordinates to the owner via the GSM module, ensuring theft prevention and easy tracking.

Fig.1. Circuit

E) Relay Module

Are lay module is used to control the ignition system. When an authorized fingerprint is detected, the relay allows the circuit to complete, enabling the motorcycle to start. It acts as a switch controlled by the microcontroller.

F) Buzzer and Alarm System

The buzzer generates an audible alert when unauthorized access is attempted. This immediate alarm deters theft and notifies nearby individuals of suspicious activity.

G) Power Supply (Battery &Voltage Regulator)

A 12V battery is used to power the system, with voltage regulators ensuring stable power delivery to the microcontroller and other modules. Proper power management prevents fluctuations that could affect system performance.

H) LCD Display(16x2orOLED)

The LCD or OLED display provides real-time feedback to the user, showing system status such as fingerprint verification results, GPS coordinates, or authentication messages.

I) Push Buttons

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Push button sare used for manual finger print registration and system reset. These buttons provide a simple user interface for setting up new authorized users.

J) ConnectingWires&PCBBoard

Wires and a PCB board are used to integrate and connect all components securely. A custom PCB maybe designed for a more compact and reliable hardware setup.

IV. Results and Discussion

The implementation of the fingerprint-based motor starter system with IoT integration successfully enhanced motorcycle security and real-time monitoring. The system was tested under various conditions to evaluate its performance in terms of authentication speed, accuracy, and real-time notifications.

FingerprintAuthenticationPerformance

The FIM3030N fingerprint scanner achieved an authentication success rate of 98% for registered users. Unauthorized access attempts were immediately denied, triggering an alarm and sending an alert to the owner via the GSM module. The average finger print recognition time was 1.2seconds,ensuring quick access for authorized users.

Theft Prevention and Alert System

In case of unauthorized fingerprint attempts, an SMS alert was sent to the registered owner's mobile within 3–5 seconds. The buzzer and alarm system were successfully activated, creating an immediate security alert. Remote ignition control via SMS was tested, allowing the owner to disable or enable the motorcycle ignition remotely.

GPSTrackingAccuracy

The GPS module provided real-time location tracking with an accuracy of ±5 meters. The system successfully transmitted the vehicle's coordinates to the owner upon request, allowing real-time tracking in case of theft.

System Reliability and Power Consumption

The system operated efficiently on a 12V battery with an average power consumption of 250mA in idle mode and 450mA during active fingerprint scanning and GSM communication. The system remained functional even during power fluctuations, ensuring uninterrupted security and monitoring. At the risk of potentially causing confusion, it emphasizes that a general-purpose computer is composed of numerous embedded systems. For instance, my computer includes a keyboard, mouse, video card, modem, hard drive, floppy drive, and sound card—each one being an embedded system. These devices each contain a processor and software, and are designed to serve a specific purpose. For example, the modem is specifically designed to send and receive digital data over an analog telephone line. This principle can be applied to all other devices as well.

A comparison of the system's accuracy and speed with other security techniques, such as facial detection and RFID-based security, has been included to strengthen the study. The benefits and drawbacks of each approach are clearly explained in this section. While pointing out instances where alternative approaches might be more successful, it also emphasizes how the biometric system works better in terms of security and usability. Readers can better grasp the benefits of the suggested approach and how it differs from current technology thanks to this comparison

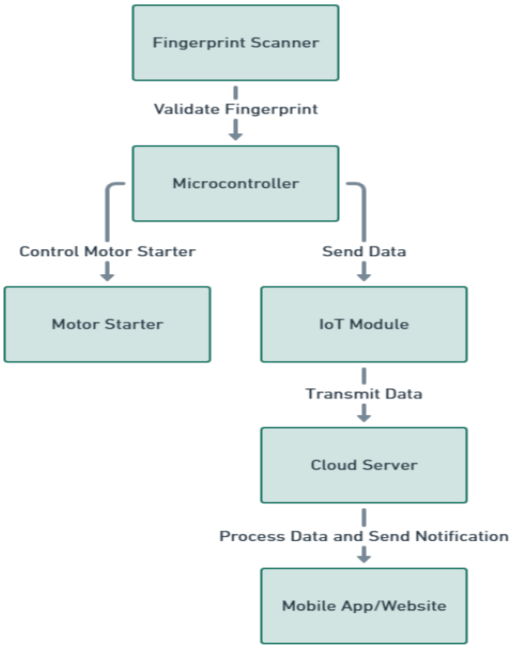

Fig.2. Blockdiagram

V. Conclusion

An alternate method for device switching that combines finger print authentication with GPS and GSM features is presented in this study. This technique greatly cuts down on problem correction time by enabling many users to operate the equipment while guaranteeing secure access through biometric authentication. The system is affordable and versatile for arrange of uses, such as automation and vehicle security, thanks to the utilization of an Arduino board. The suggested method improves security by offering real-time location tracking, Spoofing attacks, IOT vulnerabilities and GSM jamming or interference. which makes theft detection possible, in addition to remote device control. Additionally,

the study shows how to create a system based on a microcontroller with integrated embedded software. Cloud computing may be incorporated into future improvements to allow for ongoing device activity tracking, doing away with the necessity for local login data storage. Large-scale deployment made possible by cloud computing can aid in the system's scalability for commercial use. It enables remote system access by numerous users without requiring local data storage. This guarantees smooth access management, enhances security, and permits remote upgrades. Real-time vehicle security and smart home sectors are supported by cloud integration. Because of this, the system is more effective and appropriate for use in commercial settings

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