Multimodal Biometric Border Control System

Team: Abdelrahman Khaled, Abdelrahman Sohsah, Moamen Mahmoud, Nour Bahgat, Salma Abdelmonem, Ziad Mahmoud
Supervisors: Dr. Hanan Hindy , T.A. Beshoy Victor
Cybersecurity Program, Faculty of Computer and Information Sciences, Ain Shams University

Introduction

This project aims to revolutionize border security by integrating multimodal biometrics, specifically combining **face** and **fingerprint** recognition, to address the significant limitations inherent in traditional manual and unimodal identification systems.

Driven by the escalating global challenge of illegal border crossings and the persistent threat of security breaches, the initiative seeks to establish a robust framework that enhances accuracy and reliability in identity verification. Key objectives include the implementation of advanced liveness detection techniques to effectively prevent spoofing attempts, the application of AES encryption to safeguard sensitive biometric data, the development of real-time processing capabilities to manage high volumes of travelers efficiently, and strict adherence to GDPR regulations to ensure privacy and data protection.

Methods

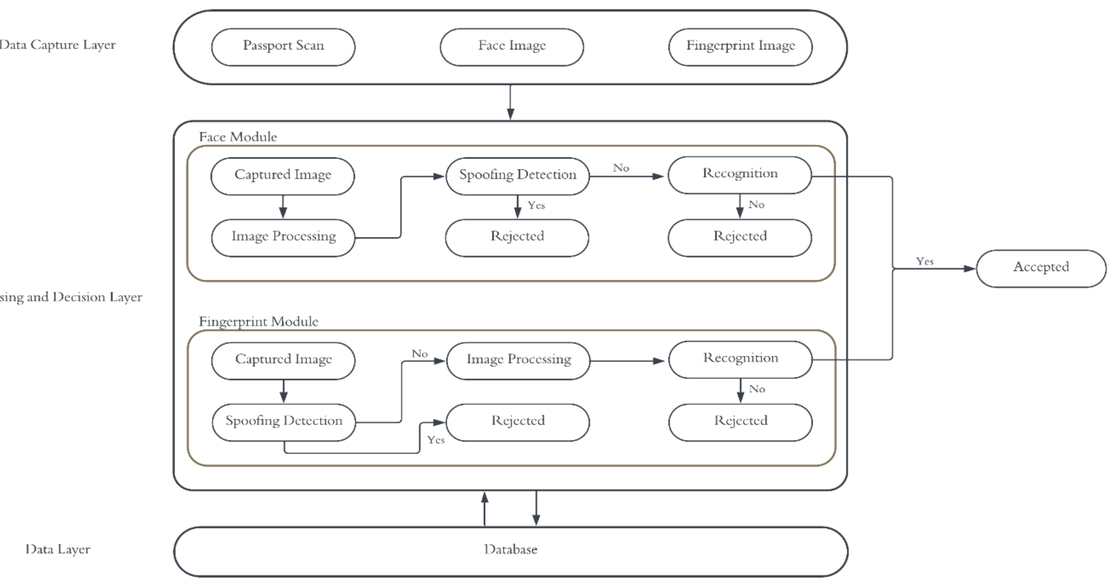

Figure 1 - Three-tier System Architecture

Figure 1 shows the project Three-Tier architecture. The Data Capture Layer collects data via OCR passport scans, fingerprint sensors, and webcams. The Processing and Decision Layer processes face and fingerprint images with spoofing detection and recognition, comparing features to database IDs for verification, with enrolment for new users. The Data Layer maintains a secure database for data storage.

Results

The table presents the identification and spoofing accuracy rates for fingerprint and face recognition.

Table 1 - Performance Metrics

	Identification Accuracy	Spoofing Accuracy
Finger	90.40%	99.82%
Face	99.60%	100.00%

Figure 2 shows an example for face spoofing detection, where the traveler attempted to spoof the system by scanning the face picture on an ID card.

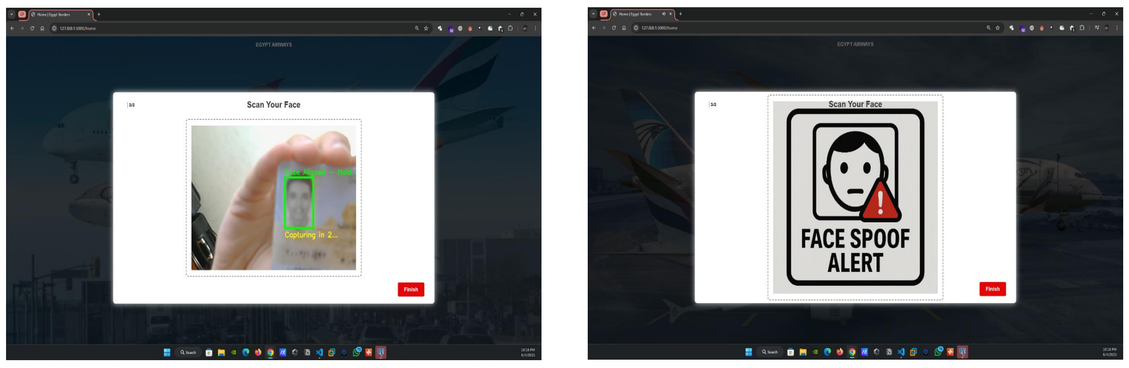

Figure 2 - face spoofing attempt using an ID detected

Conclusions

Our project creates a multimodal biometric system integrating face and fingerprint recognition with high accuracy and spoof detection, supported by GDPR-compliant encryption and liveness detection using a custom dataset. Future work aims to enhance the system through dataset expansion and accuracy improvements.

References

[1] S. S. Thenuwara, C. Premachandra, and H. Kawanaka, “A multi-agent based enhancement for multimodal biometric system at border control,” in *Array*, vol. 14, 2022, p.100171. doi:10.1016/j.array.2022.100171.

[2] P. Chatzis and E. Stavrou, “Cyber-threat landscape of border control infrastructures,” *International Journal of Critical Infrastructure Protection*, vol. 36, p. 100503, Dec. 2021, doi:10.1016/j.ijcip.2021.100503.

[3] D. White, R. Kemp, R. Jenkins, M. Matheson, and A. M. Burton, “Passport officers’ errors in face matching,” *PLOS ONE*, 2014, [Online].