

# Intelligent Biometric Systems for Automated Border Control: A Comprehensive Literature Survey on Deep Learning-Based Identity Verification and Cross-Modal Data Integration

**S. R. Sheetal**

Department of Computer Science and Engineering, Jain Deemed to be University, Bengaluru, India

**Dr. P. Manikandan**

Department of Computer Science and Engineering, Jain Deemed to be University, Bengaluru, India

**Dr. S. Saravanakumar**

Department of Computer Science and Engineering, Jain Group of Institutions, Bengaluru, India

## Abstract:

The introduction of artificial intelligence (AI) and biometric technology has transformed border security and immigration control systems across the world. This detailed literature review looks at the current developments of AI-based biometric systems for automated border control, focusing on deep learning-based face recognition, iris recognition, and multi-modal data fusion. We discuss 45 peer-reviewed papers published between 2019 and 2025, considering advancements in algorithms, system architectures, evaluations of system performance, and barriers to implementations. Our review highlights that current automated border control (ABC) systems can reduce processing time by as much as 75% while staying compliant with accuracy rates usually above 95% in controlled conditions. However, there are a number of significant challenges to overcome related to deploying ABC systems in the natural environment. These challenges include environmental variations, presentation attacks, privacy issues, and ethical matters in machine learning. The review identifies essential research opportunities in cross-modal biometric data fusion, adversarial robustness, and trust and privacy-aware architectures. We conclude with suggestions for a way forward in order to develop more secure, efficient, and ethically aware border control systems.

## Keywords:

Automated Border Control, Biometric Recognition, Deep Learning, Facial Recognition, Iris Recognition, Multi-modal Fusion, Border Security.