Continuous Behavioral Biometric Authentication Using Multi-Modal Interaction Analysis

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Abstract

This paper presents a comprehensive design and implementation approach for a continuous behavioral biometric authentication system that leverages multi-modal user interaction data collected from web and mobile platforms. The system integrates keystroke dynamics, mouse dynamics, scroll behavior, and touchscreen gestures to create a robust behavioral profile for each user. Using a combination of anomaly detection algorithms (One-Class SVM, Isolation Forest, and Autoencoders) and an adaptive decision engine, the system monitors active sessions in real-time and responds to deviations based on configurable risk thresholds. We discuss feature extraction, 10-second time-windowing, incremental profile updates, cloud-based scalable deployment (Docker, Kubernetes, Kafka), and privacy-preserving measures (AES-256 encryption, anonymization) to ensure GDPR/CCPA compliance. We also describe an evaluation methodology and recommended metrics, and provide implementation guidelines to achieve low-latency (<100 ms) detection with high accuracy (>95%).

Keywords

Behavioral Biometrics, Continuous Authentication, Multi-Modal Interaction, Anomaly Detection, Privacy Compliance, Real-time Monitoring.