Machine Learning Models for Activity Recognition and Behavior-based Authentication of Smartphone Users

Sherif Rashad, Ph.D.
Director of the School of Information Technology
Full Professor of Computer Science
College of Applied Science and Technology
Illinois State University
Illinois, USA

Abstract:

Technological advancements have enabled smartphones to offer a wide array of applications, allowing users to perform numerous tasks with ease and convenience, at any time and from any location. Consequently, many users tend to store their private data on their smartphones. Conventional security methods for smartphones, such as passwords, Personal Identification Numbers (PINs), and pattern locks, are susceptible to various forms of attack, and some current security techniques provide limited reliability. For instance, Personal Identification Numbers can be easily guessed or hacked, fingerprint scans require specialized hardware, and facial recognition can be affected by lighting conditions, background distractions, or different user poses. Furthermore, these methods are suitable primarily for one-time security, typically employed during login to verify user identity. However, issues arise if there is a change of user during access or if an intruder gains access after login. To address this concern, continuous authentication has been developed, which unobtrusively and regularly verifies users through behavioral features such as keystroke dynamics, hand movements, and device orientation. The objective of this research is to design and implement a behavior-based security framework for continuous authentication using machine learning algorithms. This presentation discusses innovative methods for authenticating smartphone users based on activity recognition and behavioral biometrics derived from embedded sensor data. One of the proposed authentication schemes utilizes behavioral features such as hand movement, grasp, and orientation to continuously verify user identity. Inertial sensors embedded within smartphones, including accelerometers, gyroscopes, and magnetometers, are employed to unobtrusively capture micro-movements of the hand and orientation patterns during device access. Another approach involves constructing machine learning models to recognize users based on their daily activities. The research investigates datasets of smartphone users engaged in various interaction sessions. Different supervised machine learning algorithms are applied to these datasets to analyze user behaviors. Experimental results demonstrate the effectiveness of the proposed framework in activity recognition and in authenticating smartphone users.

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Biography:

Dr. Sherif Rashad is the Director of the School of Information Technology and a Full Professor of Computer Science in the College of Applied Science and Technology at Illinois State University, USA. He earned his Ph.D. in Computer Science and Engineering from the University of Louisville, USA, in 2006, along with M.Sc. and B.Sc. degrees (with honors) in Electrical Engineering from Zagazig University, Egypt, in 2001 and 1996, respectively. He is the inaugural recipient of the Rebecca L. and Henry P. Conn Endowed Fellowship from the Speed School of Engineering at the University of Louisville and was awarded the Graduate Dean's Citation Award from the Graduate School, as well as the Computer Science and Engineering Doctoral Award in 2006. Dr. Rashad has previously served as a Full Professor of Computer Science and the Program Coordinator in the School of Engineering and Computer Science at Morehead State University, and as an Associate Professor at both Florida Polytechnic University and the University of Southern Indiana. In his administrative capacity at Illinois State University, he is responsible for leading the strategic direction of the School of Information Technology, fostering excellence in research, teaching, and community engagement, and promoting program accreditation and growth initiatives. His leadership experience includes serving as an Academic Program Coordinator for the Computer Engineering program and a member of the Provost's Council of Coordinators at Florida Polytechnic University. His research interests include machine learning, artificial intelligence, human-computer interaction, cybersecurity, mobile security, and behavior-based security systems. Dr. Rashad has received several research awards and grants and has supervised numerous graduate students and undergraduate research fellows. He has served on the editorial boards of various international journals and has participated as a session chair and technical program committee member at several international and national conferences. His research work was recognized at IEEE conferences with best paper awards, and his accolades include receiving the 2023 Dean's Citation for Sustained Excellence Award, the 2021 Dean's Citation for Excellence in Research/Scholarship Award, and the 2020 Dean's Citation for Excellence in Teaching Award. Additionally, he has been a three-time recipient of the Outstanding Research Award (2012, 2014, and 2015) and received the Outstanding Teaching Award from the Department of Mathematics and Computer Science at Morehead State University in 2009. In August 2019, he was honored by the President of Morehead State University and the university's Board of Regents as an outstanding faculty member for his leadership, service, and dedication. Dr. Rashad is a senior member of IEEE and a member of the ACM.