Recent advances in mobile touch screen security authentication methods: A systematic literature review (Review)

Ibrahim, T.M.⁴, Abdulhamid, S.M.⁵, Alarood, A.A.⁵, Chiroma, H.⁴, Algaradi, M.A.⁶, Rana, N.⁷, Muhammad, A.N.⁸, Abubakar, A.⁹, Haruna, K.¹⁰, Gabralla, L.A.¹¹

⁴Department of Information Technology, National Open University of Nigeria, Nigeria
⁵Department of Cyber Security Science, Federal University of Technology, Minna, Nigeria
⁶Department of Computer Science, University of Jeddah, Saudi Arabia

Abstract

The security of the smartphone touch screen has attracted considerable attention from academics as well as industry and security experts. The maximum security of the mobile phone touch screen is necessary to protect the user's stored information in the event of loss. Previous reviews in this research domain have focused primarily on biometrics and graphical passwords while leaving out PIN, gesture/pattern and others. In this paper, we present a comprehensive literature review of the recent advances made in mobile touch screen authentication techniques covering PIN, pattern/gesture, biometrics, graphical password and others. A new comprehensive taxonomy of the various multiple class authentication techniques is presented in order to expand the existing taxonomies on single class authentication techniques. The review reveals that the most recent studies that propose new techniques for providing maximum security to smartphone touch screen reveal multi-objective optimization problems. In addition, open research problems and promising future research directions are presented in the paper. Expert researchers can benefit from the review by gaining new insights into touch screen cyber security, and novice researchers may use this paper as a starting point of their inquiry. © 2019

SciVal Topic Prominence

Topic: Authentication | Biometrics | Implicit authentication

Prominence percentile: 96.367

Author keywords

Biometric security | Graphical password | Mobile device security | Natural algorithms | PIN based authentication
Touchscreen gesture/pattern

Indexed keywords

Engineering controlled terms: Authentication | Biometrics | Mobile security | Multiobjective optimization
Smartphones | Taxonomies

Engineering uncontrolled terms: Authentication techniques | Biometric security | Future research directions
Graphical password | Mobile device security | Multi-objective optimization problem
Security authentication | Systematic literature review

Engineering main heading: Touch screens

Funding details
The authors will like to acknowledge TETFund Institutional Based Research Grant, Federal College of Education (Technical), Gombe. Tahir Musa Ibrahim is currently a logistics manager at Jos Electricity Distribution Plc, Bauchi Trading Zone, since 2014. He received his B.Sc. Computer Science degree in 2011, from a private university; Kwararafa University, Wukari, Taraba State, Nigeria. His current research topic is, recent advances on mobile touch screen security authentication methods: A systematic Literature Survey. He is also a member of International Project Management Professionals (IPMP). Shafi‘i Muhammad Abdulhamid received his Ph.D. in Computer Science from Universiti Teknologi Malaysia (UTM), MSc in Computer Science from Bayero University Kano (BUK), Nigeria and a Bachelor of Technology in Mathematics/Computer Science from the Federal University of Technology Minna, Nig... View all

References (67)


ISSN: 01674048 CODEN: CPSED Source Type: Journal Original language: English

DOI: 10.1016/j.cose.2019.04.008 Document Type: Review Publisher: Elsevier Ltd


Cited 31 times

Sensor-assisted facial recognition: An enhanced biometric authentication system for smartphones

ISBN: 978-145032793-0
doi: 10.1145/2594368.2594373

View at Publisher

Improving user authentication on mobile devices: A touchscreen graphical password

ISBN: 978-145032273-7
doi: 10.1145/2493190.2493213

View at Publisher

Mobile user identification through authentication using keystroke dynamics and accelerometer biometrics

ISBN: 978-145034178-3
doi: 10.1145/2897073.2897111

View at Publisher

A framework for continuous, transparent mobile device authentication

doi: 10.1016/j.cose.2013.05.005

View at Publisher

Toward the design of adaptive selection strategies for multi-factor authentication

doi: 10.1016/j.cose.2016.09.004

View at Publisher

Touch me once and i know it's you! Implicit authentication based on touch screen patterns

ISBN: 978-145031015-4
doi: 10.1145/2207676.2208544

View at Publisher

FIRME: Face and iris recognition for mobile engagement


View at Publisher
Continuous mobile authentication using touchscreen gestures

doi: 10.1109/TIFS.2012.2225048

Touchalytics: On the applicability of touchscreen input as a behavioral biometric for continuous authentication

doi: 10.1016/j.patrec.2015.09.009

Multimodal authentication on smartphones: Combining iris and sensor recognition for a double check of user identity

doi: 10.1016/j.procs.2016.07.977

 Forgery-resistant touch-based authentication on mobile devices

ISBN: 978-145034233-9
doi: 10.1145/2897845.2897908

The Shoulder Surfing Resistant Graphical Password Authentication Technique

(Open Access)

doi: 10.1007/s10207-015-0273-1

Gait authentication on mobile phone using biometric cryptosystem and fuzzy commitment scheme

doi: 10.1007/s10207-015-0273-1
Keystroke dynamics-based authentication for mobile devices

Hwang, S.-s., Cho, S., Park, S.
View at Publisher

Secure smartphone unlocking using NFC

Jambusaria, U., Katwala, N., Mistry, D.
http://www.sciencedirect.com/science/journal/18770509
doi: 10.1016/j.procs.2015.03.081
View at Publisher

Two-factor face authentication using matrix permutation transformation and a user password

Kang, J., Nyang, D., Lee, K.
doi: 10.1016/j.ins.2014.02.011
View at Publisher

Keystroke dynamics-based user authentication using long and free text strings from various input devices

Kang, P., Cho, S.
http://www.journals.elsevier.com/information-sciences/
doi: 10.1016/j.ins.2014.08.070
View at Publisher

Secure biometric template generation for multi-factor authentication

Khan, S.H., Ali Akbar, M., Shahzad, F., Farooq, M., Khan, Z.
www.elsevier.com/inca/publications/store/3/2/8/
doi: 10.1016/j.patcog.2014.08.024
View at Publisher

A bio-signal based framework to secure mobile devices

Kumar, P., Saini, R., Pratim Roy, P., Prosad Dogra, D.
View at Publisher

Secure bimodal PIN-entry method using audio signals

Lee, M.-K., Nam, H., Kim, D.K.
doi: 10.1016/j.cose.2015.06.006
View at Publisher

A study of biometric feature for a recall-based behavioral graphical mobile authentication

Liou, J.-C., Scaduto, A.
35 Liu, C.-L., Tsai, C.-J., Chang, T.-Y., Tsai, W.-J., Zhong, P.-K.
Implementing multiple biometric features for a recall-based graphical keystroke dynamics authentication system on a smart phone
http://www.elsevier.com/locate/jnca.2015.03.006
doi: 10.1016/j.jnca.2015.03.006
View at Publisher

36 Liu, H., Lu, J., Feng, J., Zhou, J.
Group-aware deep feature learning for facial age estimation
www.elsevier.com/locate/patcog.2016.10.026
doi: 10.1016/j.patcog.2016.10.026
View at Publisher

37 Mahfouz, A., Muslukhov, I., Beznosov, K.
Android users in the wild: Their authentication and usage behavior
http://www.elsevier.com/locate/pmcj.2016.06.017
doi: 10.1016/j.pmcj.2016.06.017
View at Publisher

38 Meng, W., Li, W., Kwok, L.-F., Choo, K.-K.R.
Towards enhancing click-draw based graphical passwords using multi-touch behaviours on smartphones
doi: 10.1016/j.cose.2016.11.010
View at Publisher

39 Meng, W., Wong, D.S., Furnell, S., Zhou, J.
Surveying the development of biometric user authentication on mobile phones
doi: 10.1109/COMST.2014.2386915
View at Publisher

40 Meng, Y., Wong, D.S., Kwok, L.-F.
Design of touch dynamics based user authentication with an adaptive mechanism on mobile phones
ISBN: 978-1-4503-2469-4
doi: 10.1145/2554850.2554931
View at Publisher

41 Micallef, N., Just, M., Baillie, L., Halvey, M., Kayacik, H.G.
Why aren't users using protection? Investigating the usability of smartphone locking
ISBN: 978-1-4503-3652-9
doi: 10.1145/2785830.2785835
View at Publisher
42 Miguel-Hurtado, O., Stevenage, S.V., Bevan, C., Guest, R.

Predicting sex as a soft-biometrics from device interaction swipe gestures  
(Open Access)

http://www.journals.elsevier.com/pattern-recognition-letters/
doi: 10.1016/j.patrec.2016.04.024
View at Publisher

43 Murao, K., Tobise, H., Terada, T., Iso, T., Tsukamoto, M., Horikoshi, T.

Mobile phone user authentication with grip gestures using pressure sensors

http://www.emeraldinsight.com/products/journals/journals.htm?id=ijpcc
doi: 10.1108/IJPCC-03-2015-0017
View at Publisher

44 Nader, J., Alsadoon, A., Prasad, P.W.C., Singh, A.K., Elchouemi, A.

Designing Touch-Based Hybrid Authentication Method for Smartphones  
(Open Access)

http://www.sciencedirect.com/science/journal/18770509
doi: 10.1016/j.procs.2015.10.072
View at Publisher

45 Patra, K., Nemade, B., Mishra, D.P., Satapathy, P.P.

Cued-Click Point Graphical Password Using Circular Tolerance to Increase Password Space and Persuasive Features  
(Open Access)

http://www.sciencedirect.com/science/journal/18770509
doi: 10.1016/j.procs.2016.03.071
View at Publisher

46 Rzecki, K., Pławiak, P., Niedźwiecki, M., Sośnicki, T., Leśkow, J., Ciesielski, M.

Person recognition based on touch screen gestures using computational intelligence methods

http://www.journals.elsevier.com/information-sciences/
doi: 10.1016/j.ins.2017.05.041
View at Publisher

47 Saevanee, H., Clarke, N.L., Furnell, S.M.

Multi-modal behavioural biometric authentication for mobile devices  
(Open Access)

ISBN: 978-364230435-4
doi: 10.1007/978-3-642-30436-1_38
View at Publisher

48 Samangouei, P., Patel, V.M., Chellappa, R.

Facial attributes for active authentication on mobile devices

doi: 10.1016/j.imavis.2016.05.004
View at Publisher
49 Seetharaman, K., Ragupathy, R.
LDPC and SHA based iris recognition for image authentication  (Open Access)
doi: 10.1016/j.eij.2012.10.001
View at Publisher

50 Serwadda, A., Phoha, V.V.
When kids’ toys breach mobile phone security
ISBN: 978-145032477-9
doi: 10.1145/2508859.2516659
View at Publisher

51 Shahzad, M., Liu, A.X., Samuel, A.
Secure unlocking of mobile touch screen devices by simple gestures - You can see it but you can not do it
ISBN: 978-145031999-7
doi: 10.1145/2500423.2500434
View at Publisher

52 Shankar, V., Singh, K., Kumar, A.
IPCT: a scheme for mobile authentication

53 Staneková, L., Stanek, M.
Analysis of dictionary methods for PIN selection
doi: 10.1016/j.cose.2013.08.006
View at Publisher

54 Xiaoyuan, S., Ying, Z., Owen, G.S.
Graphical passwords: A survey
ISBN: 0769524613; 978-076952461-0
doi: 10.1109/CSAC.2005.27
View at Publisher

55 Teh, P.S., Teoh, A.B.J., Yue, S.
A survey of keystroke dynamics biometrics

56 Teh, P.S., Zhang, N., Teoh, A.B.J., Chen, K.
TDAS: a touch dynamics based multi-factor authentication solution for mobile devices
http://www.emeraldinsight.com/products/journals/journals.htm?id=ijpcc
doi: 10.1108/IJPCC-01-2016-0005
View at Publisher
57 Nguyen, T.V., Sae-Bae, N., Memon, N.
doi: 10.1016/j.cose.2017.01.008
View at Publisher

58 Von Zezschwitz, E., Koslow, A., De Luca, A., Hussmann, H.
Making graphic-based authentication secure against smudge attacks

Zipf's Law in Passwords
doi: 10.1109/TIFS.2017.2721359
View at Publisher

60 Wang, D., Gu, Q., Huang, X., Wang, P.
Understanding human-chosen PINs: Characteristics, distribution and security
ISBN: 978-145034494-4
doi: 10.1145/3052973.3053031
View at Publisher

61 Wang, D., Wang, P.
The emperor's new password creation policies
(2015) Proceedings of the European symposium on research in computer security

62 Wang, D., Zhang, Z., Wang, P., Yan, J., Huang, X.
Targeted online password guessing: An underestimated threat
ISBN: 978-145034139-4
doi: 10.1145/2976749.2978339
View at Publisher

63 Watanabe, Y., Houryu, T.F.
Toward introduction of immunity-based model to continuous behavior-based user authentication on smart phone (Open Access)
http://www.sciencedirect.com/science/journal/18770509
View at Publisher

64 Yan, Q., Han, J., Li, Y., Zhou, J., Deng, R.H.
Designing leakage-resilient password entry on touchscreen mobile devices
doi: 10.1145/2484313.2484318
View at Publisher
Cracking android pattern lock in five attempts

Yuan, W., Xu, Y., Liu, H., Wang, D.F.
Developing Biometric Passive Recognition Sensor Applicable to Wearable Devices: Part i - A Novel Structural Design for Achieving Three Dimensional Images  (Open Access)
http://www.sciencedirect.com/science/journal/18777058
doi: 10.1016/j.proeng.2016.11.505
View at Publisher

Zhou, L., Kang, Y., Zhang, D., Lai, J.
Harmonized authentication based on ThumbStroke dynamics on touch screen mobile phones
doi: 10.1016/j.dss.2016.09.007
View at Publisher

Chiroma, H.; Department of Computer Science, Federal College of Education (Technical), Gombe, Nigeria;
email:freedonchi@yahoo.com
© Copyright 2019 Elsevier B.V., All rights reserved.