

A MULTIMODAL BEHAVIORAL BIOMETRIC SCHEME FOR SMARTPHONE USER AUTHENTICATION (MBBS)

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PRESENTATION OVERVIEW

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- 1 Motivation and problem statement
- 2 Existing authentication solutions and their limitations
- 3 Behavioral biometrics for user authentication
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- **Smartphones are extremely popular**
 - Any-time any-where computing
 - Powerful processors, long-lasting batteries, GPS, Wi-Fi, etc.
 - Easy to use interface
- **Used in short but frequent sessions (upto 150 times a day (\approx 2 hours))**
- **Result**
 - **The UK is now a smartphone society¹**
 - **Computer usage falls as 20% of millennials go mobile-only²**

¹<https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2015/cmr-uk-2015>

²<https://www.extremetech.com/computing/226867-comscore-computer-usage-falls-as-20-of-millennials-go-mobile-only>

SMARTPHONES USAGE

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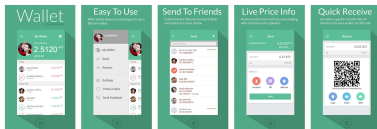
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EVALUATION

MBBS IN ACTION

CONCLUSIONS

- **Beyond just classical communication**
 - **Taking pictures & making movies and sharing with others**
 - **Social Networking**
 - **Facebook, Viber, WhatsApp, Skype, Twitter, etc.**
 - **Online Transactions**
 - **Google Wallet, Paypal, XOOM, etc.**



- **All of these apps generate and store very personal user information which needs to be protected**

AUTHENTICATION

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- *What is Authentication?*
 - *Being able to prove a user is who she claims to be?*
- **Authentication was introduced for**
 - **Protecting long term sessions**
 - **One-shot - TOCTOU problem**
 - **Binary decision**
- **Authentication is required for**
 - **Long, short & frequent sessions**
 - **Repeatable (as and when required)**
 - **Risk-based and adaptive**
 - **Continuous**

EXISTING APPROACHES

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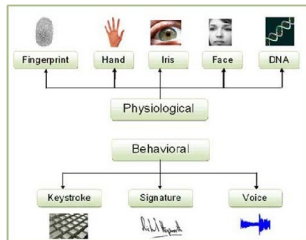
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EVALUATION

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CONCLUSIONS

- **Knowledge-Based**
 - PIN/Password
 - Graphical unlock patterns
- **Possession-Based**
 - Magnetic key card
 - Smart card
 - Token
- **Characteristic-Based**
 - **Physical**
 - Face, Fingerprint
 - IRIS, Lips, Ear
 - **Behavioral**
 - Key/Touch stroke
 - Voice, Signature
 - Motion-based



PROBLEMS WITH PINs/PASSWORD

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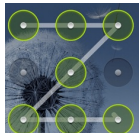
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- PINs/Passwords
 - Non Transparent
 - Shared/Forgotten
 - Attack Vulnerability



User consider them annoying^a and don't use them^b

^aJakobsson et al. "Implicit authentication for mobile devices." Proceedings of the 4th USENIX conference on Hot topics in security. USENIX Association, 2009.

^b<https://www.sophos.com/en-us/press-office/press-releases/2011/08/67-percent-of-consumers-do-not-have-password-protection-on-their-mobile-phones.aspx>

No	PIN	Freq
1	1234	10.713%
2	1111	6.016%
3	0000	1.881%
4	1212	1.197%
5	7777	0.745%

PROBLEMS WITH PHYSICAL BIOMETRICS

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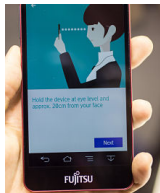
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EVALUATION

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CONCLUSIONS

- **Physical Biometrics**
 - **Non Transparent**
 - **Environmental Effects**
 - **Attacks Vulnerability**
- **Time Consuming (15-20s)^a**



- **Apple's iPhone 5S and iPhone 6 fingerprint sensors were hacked**

^a<http://www.ibtimes.co.uk/unlocking-phone-your-eyes-fujitsu-iris-recognition-tech-coming-smartphones-2015-1490297>

De Luca et al. "I Feel Like I'm Taking Selfies All Day!: Towards Understanding Biometric Authentication on Smartphones." Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. ACM, 2015.

BEHAVIORAL BIOMETRICS

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CONCLUSIONS

- There are wide range of actions “**behaviors**” people perform by employing **different strategies, different styles**, and by applying their **unique skills**.
- Many of these behaviors are already used as **behavioral biometrics**, however they are new for smartphone user authentication.
 - **Unobtrusive data collection**
 - **No need of additional hardware**
 - **Arguably very secure**



Barack Obama



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DEMO: A Multimodal Behavioral Biometric Scheme for Smartphone User Authentication (*MBBS*)

MBBS INTRODUCTION

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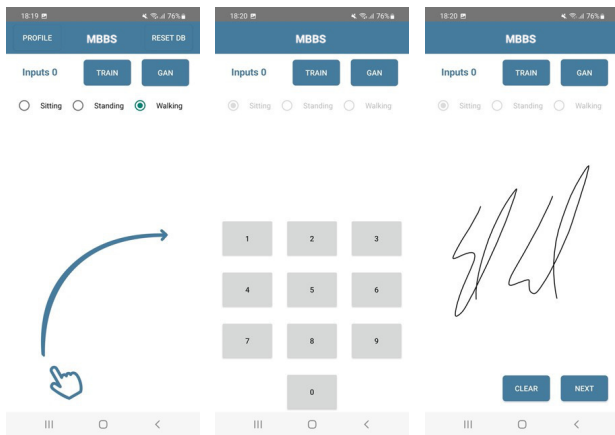
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- User Friendly
- No additional hardware required



MBBS APPROACH

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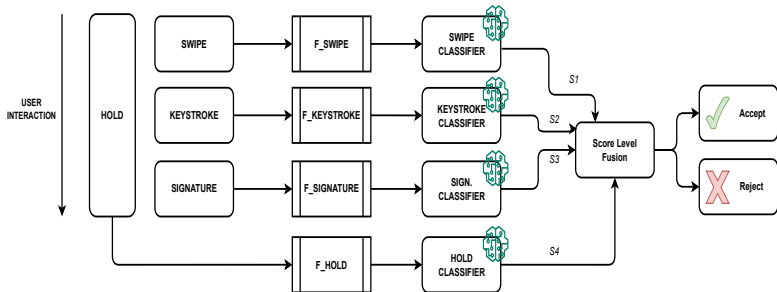
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- Statistical Features
- Score level fusion
- Random Forest classifier



MBBS GAN INTRODUCTION

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- **Keras Tuner for # of layers, neuron, and best learning rate**
- **We ended up in the development of a 4-hidden-layered generator comprising just 128, 16, 16, 8, respectively and 5-hidden layered discriminator comprising 32, 160, 192, 64, 256 neurons, respectively.**

MBBS EVALUATION STRATEGY

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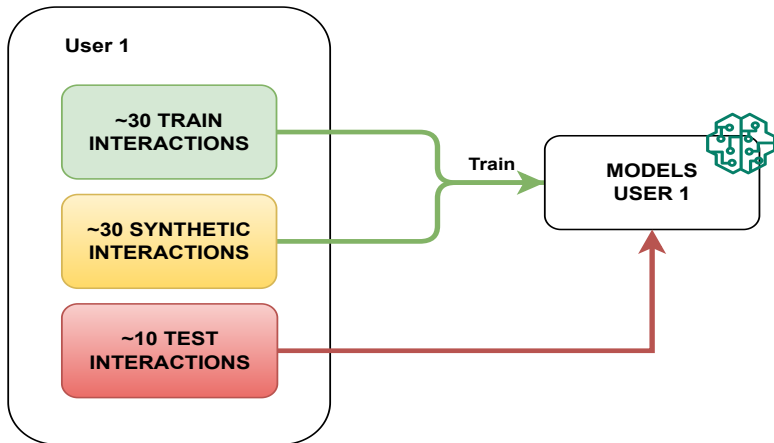
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MBBS: CONCLUSIONS & WAY FORWARD

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- **Conclusions**
 - We demonstrate a GAN-powered user-friendly, secure, and accurate smartphone user authentication scheme, namely *MBBS*
 - We show that user-provided 30 samples are enough
 - *MBBS* is hardware-friendly, is quick, and requires little time to generate synthetic samples
 - Final proof-of-the-concept implementation
 - Performance Analysis (computation, memory, testing time)
 - Security analysis (random, mimic, etc)
 - Usability analysis (SUS, etc.)