Context-aware Fusion for Continuous Biometric Authentication

NUS National University of Singapore | School of Computing

A*STAR Institute for Infocomm Research

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To whom do I listen, and when?

Divya Sivasankaran, Mona Ragab Sayed, Terence Sim, Yair Zick

INTRODUCTION

Problem: With the rise of M-Commerce, there is a need for stronger authentication in mobile devices.

Traditional Authentication

- One-time authentication
- Vulnerable (spoofing, session-hijack)
- Not easy to use

Continuous Biometric Authentication

- Strong Authentication
- Secure
- Convenient

Challenges

- Modalities are not always available
- Quality of data acquired is not consistent

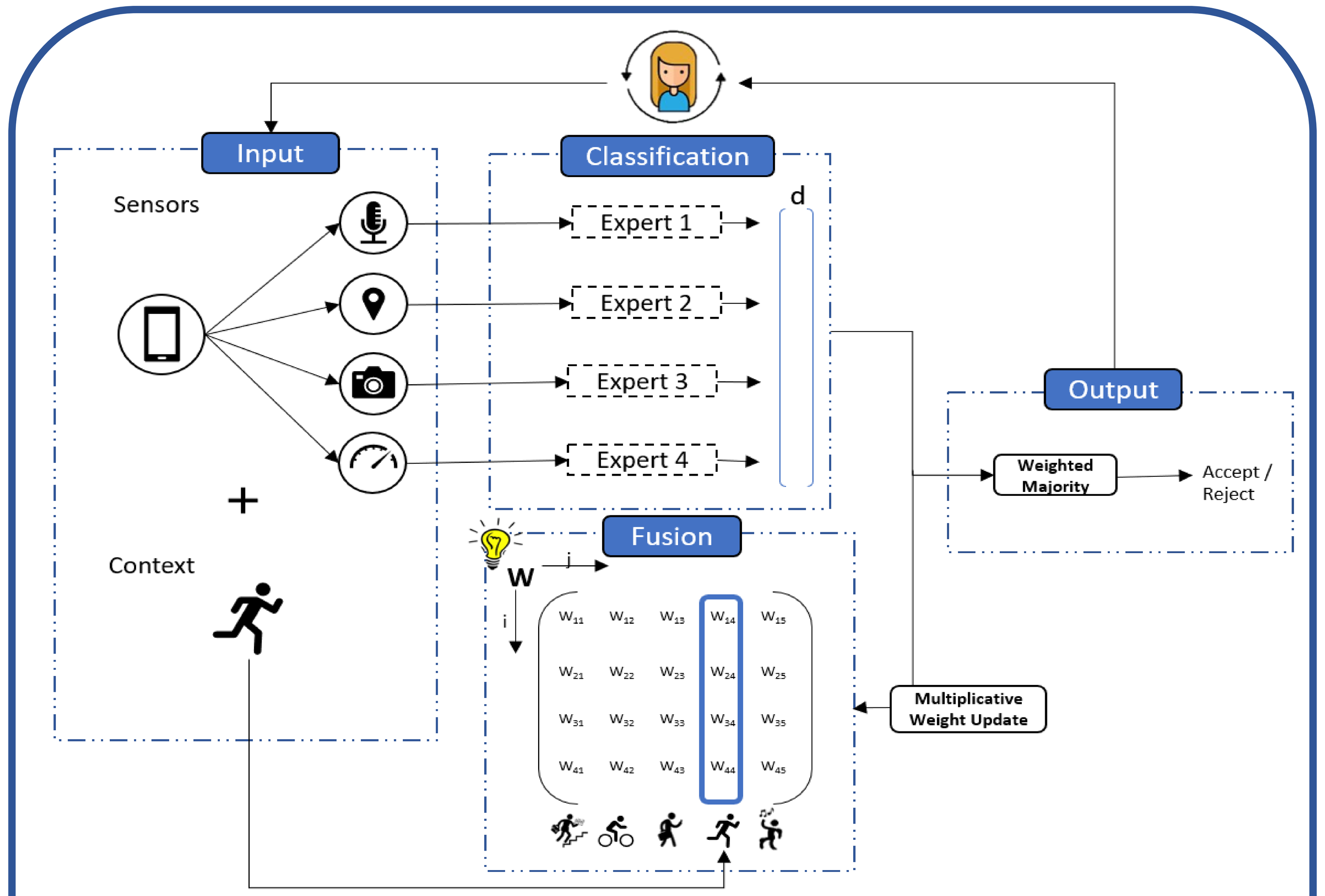
Different modalities are better in different situations (contexts)

Research Question: How can we exploit contextual information while fusing decisions made by various classifiers?

METHOD

Context-weighted Majority Algorithm (CWMA)

- Game-theoretic approach to decision & score level fusion
- Extension of Weighted Majority Algorithm[1]:(WMA)
- A set of weights is learnt per expert per context

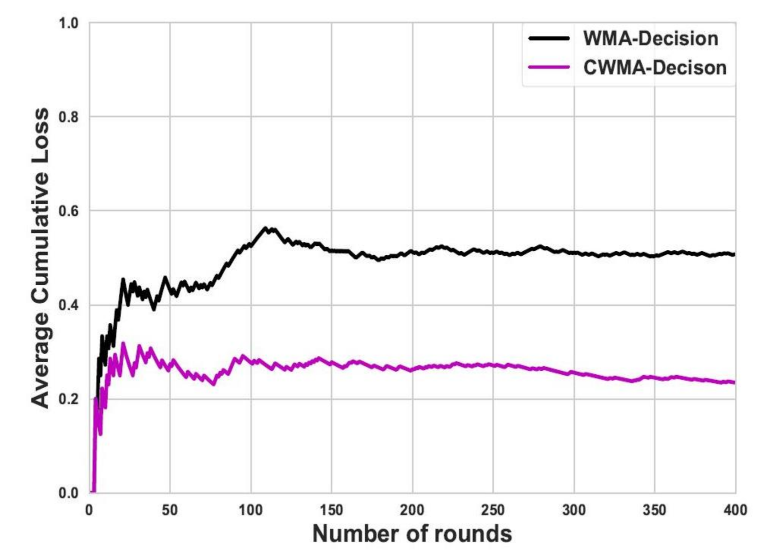


Properties:

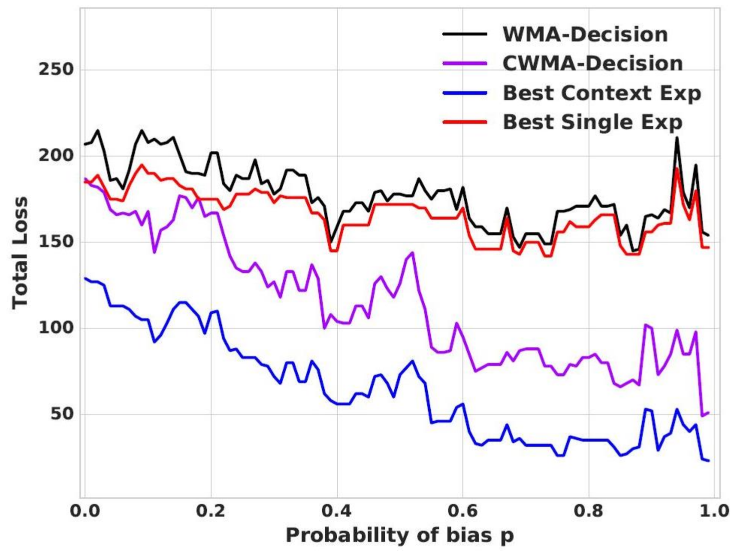
- low computational overhead: O(#classiers)
- guaranteed to perform better than WMA when context affects experts' performance; otherwise same as WMA
- guaranteed to have 0-regret after convergence

EXPERIMENTS

Synthetic Dataset:
Test data to compare the performance of CWMA against WMA.



5 Experts, 10 Contexts over 400 rounds

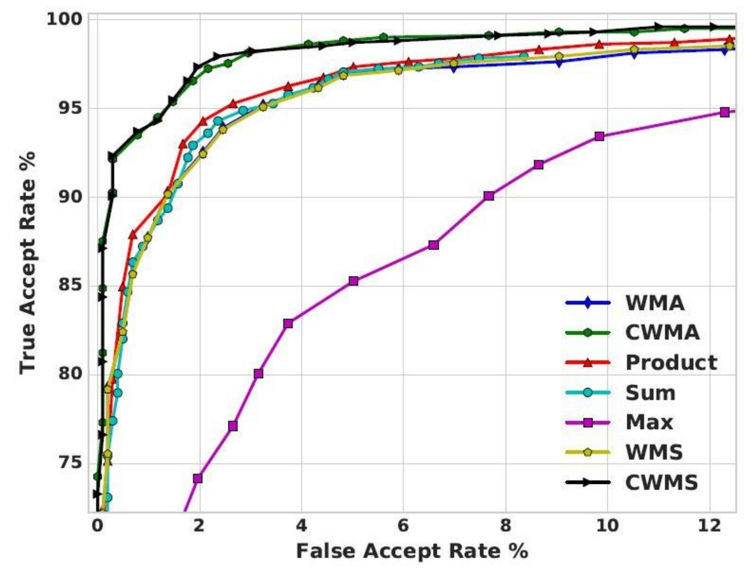


10 Experts, 20 Contexts, 400 rounds

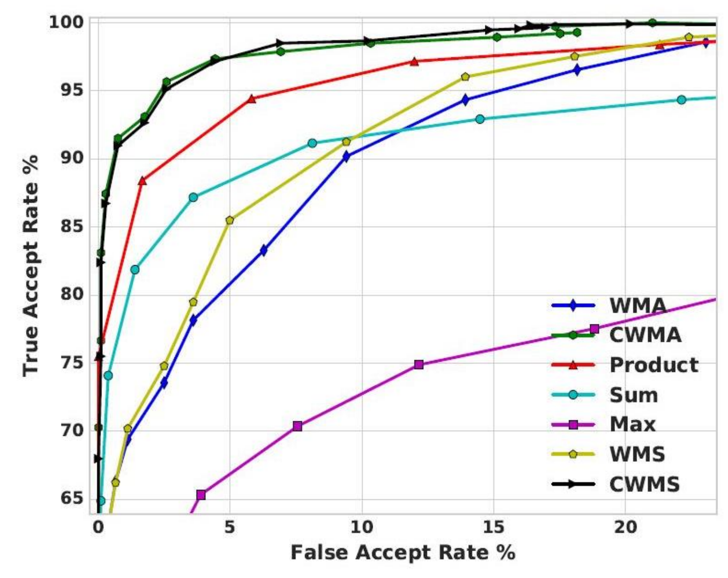
CWMA outperforms WMA. It exploits contextual information when possible.

Real Dataset:
Two modalities – Face (MultiPIE[2]), Voice (SITW[3])

Type	No.
Chimeric Users	64
Samples per user	~40-70
Gallery	2238
Genuine Probes	1017
Imposter Probes	1017



Unimodal Scenario: Face



Multimodal Scenario: Face & Voice

Feature Extraction: VGGFace [4] (Face), MFCC[5] (Voice)

CWMA outperforms all other fusion methods. CWMA-Decision performs on par with score level fusion methods!

CONCLUSION

- CWMA is an online, generic, and context-aware fusion method
- It has proven theoretical guarantees
- Extensive experiments with synthetic and real data showcases the power of contextual learning.

[1] Littlestone, N., & Warmuth, M. K. (1994). The weighted majority algorithm. *Information and computation*, *108*(2), 212-261.
[2] Gross, R., Matthews, I., Cohn, J., Kanade, T., & Baker, S. (2010). Multi-pie. *Image and Vision Computing*, *28*(5), 807-813.
[3] McLaren, M., Ferrer, L., Castan, D., & Lawson, A. (2016, March). The Speakers in the Wild (SITW) Speaker Recognition Database. In *INTERSPEECH* (pp. 818-822).
[4] Parkhi, O. M., Vedaldi, A., & Zisserman, A. (2015, September). Deep Face Recognition. In *British Machine Vision Conference* (Vol. 1, No. 3, p. 6).
[5] Hasan, M. R., Jamil, M., Rabbani, M. G., & Rahman, M. S. (2004). Speaker identification using mel frequency cepstral coefficients. *variations*, *1*(4).