A PRAGMATIC AUTHENTICATION SYSTEM USING ELECTROENCEPHALOGRAPHY SIGNALS

Ayman Khalafallah, Aly Ibrahim, Bahieeldeen Shehab, Hisham Raslan, Omar Eltobgy, Shady Elbaroudy

Computer and Systems Engineering Department, Alexandria University

The authors contributed equally to this work

MOTIVATION

Build a biometric authentication system that:

- is secure
- is seamless to use
- is cheap relative to other biometrics
- combines the best of knowledge and possession factors.
- can used by everyone
- unamenable to force
- cannot be lost
- cannot be forgotten

EmotivMindwave128Hz512Hz14 channels1 channel10 users29 users3 sessions4 sessions50 second sessions

PIPELINE Feature Extraction Filtering AutoRegressive Coefficients Forward and Reverse Filtering Power Spectral Density [STFT, FFT, Welch] using 4-order Elliptic Band-Pass SIGN UP Interhemispheric Power Difference from 2Hz to 100Hz Interhemispheric Channel Linear Complexity Model Classification Feature Reduction Support Vector Machine Linear Discriminant Analysis Regularized Logistic Regression Principal Component Analysis Linear Discriminant Analysis Naive Bayes Classifier (Gaussian & Bernoulli)

RESULTS Day Test One session of data is used, each Day (session) segment in that session is binary classified, and a single +1 authorizes the user. **Block Test** One block of data is used, each segment in that block is binary Block classified, and majority voting 10 secs) between segments is used. **Shuffled Cross Validation** Shuffle all the data blocks for each user before partitioning the Segment (1, 2, 5, 10 secs)

Day Cross Validation

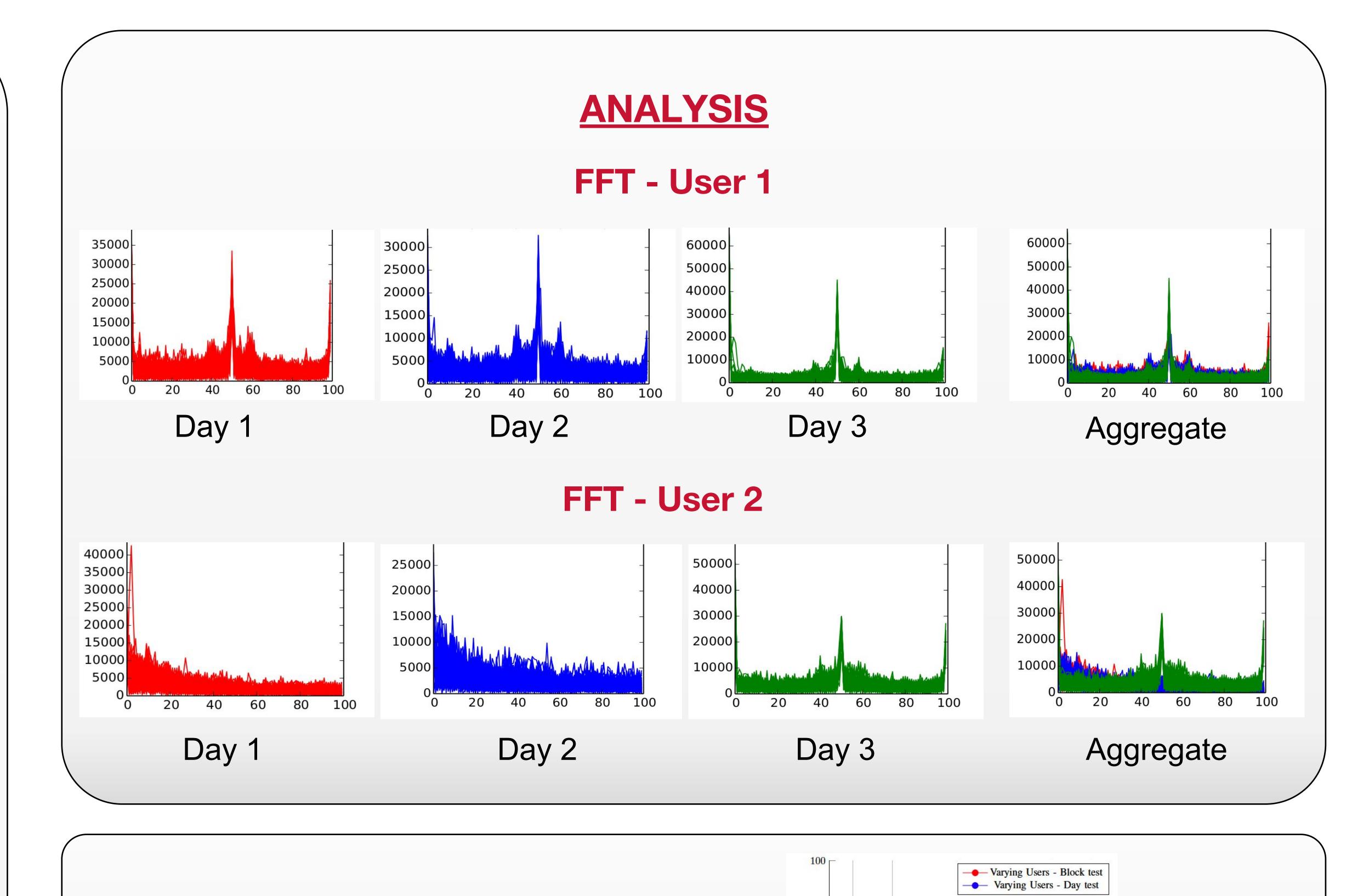
each user

Partitioning the folds according

to data from different days used for

<u>Cross</u>	BLOCK TEST			DAY TEST		
<u>Validation</u>	FA	FR	Accuracy	FA	FR	Accuracy
Shuffle	0.38	15.72	91.95	3.93	0.75	97.66
Day	1.54	48.00	75.23	10.92	28.75	80.16

Number of	Best Channel Combination	Accuracy			
<u>Channels</u>		FA	FR	Accuracy	
4	AF3 P8 T7 T8	1.43	5.00	96.76	
3	AF3 P8 T7	2.14	2.50	97.68	
2	AF3 P8	1.79	17.50	90.36	
1	P8	0.71	35.00	82.14	



CONCLUSION

- Shuffle Cross Validation Accuracy 90+% [~literature].
- Day Cross Validation Accuracy 80% Mindwave, and 90% Emotiv [more realistic].
- Training data needs to span different days to capture variations in EEG signals.
- The rate of decline in accuracy as we increased the number of users decreases.

FUTURE WORK

- Figure out what constitutes bad user data and circumvent it.
- Sampling a "good" subset from all users for each user to authenticate.
- Find minimum interval between sessions.

EFFECT OF REDUCING # USERS:

Investigate identification and matching.



More information: http://www.alexu.edu.eg/