

Biometric system based on electroencephalogram analysis YACHAY TECH Dustin Carrión-Ojeda¹, Héctor Mejía-Vallejo¹, Rigoberto Fonseca-Delgado¹, Pilar Gómez-Gil², Manuel Ramírez-Cortés³

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Introduction

Electroencephalography is a noninvasive electro-physiological monitoring method that records the electrical activity of the brain.



Pre-processing

1. Downsampling (512 to 128 Hz).



- 2. Electrooculographic removal.
- 3. Discrete wavelet transform.

Feature Extraction

Relative wavelet energy (RWE) was chosen as a feature because it has been shown to be very useful in classification tasks. The energy of each sub-band was computed using the following equations:

 $E_{D_{i}} = \sum_{j=1}^{N} |D_{ij}|^{2}, i = 1, 2, 3, \cdots, L$ $E_{A_{L}} = \sum_{j=1}^{N} |A_{Lj}|^{2}$

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where N is the length of the coefficient vector and L is the maximum level of decomposition. Using the previous equations, the total and relative energy are defined as:

 $E_T = \left(\sum_{i=1}^L E_{D_i}\right) + E_{A_L}$

 $E_R = E_i / E_T$ where $E_i = E_{D_{j=1,\cdots,L}}$ or $E_{A_{j=L}}$.

Time (Sec)					
	$\mathbf{S}\mathbf{V}\mathbf{W}\mathbf{I}(\mathbf{\%})$	RF (%)	KNN (%)	AB (%)	ANN (%)
0,25	$59,88{\pm}2,55$	$53,25\pm2,23$	$37,00\pm 2,40$	$52,69\pm 2,69$	$61,97{\pm}2,40$
0,5	$70,25\pm 2,13$	$59,09\pm 2,24$	$45,19\pm 3,49$	$59,84\pm 2,77$	$73,78\pm1,79$
1	$79,34\pm 2,79$	70,91±1,58	58,81±1,60	$70,38\pm1,94$	83,63±1,31
2	88,31±1,66	$79,69\pm 2,42$	$72,38\pm2,23$	$78,84{\pm}2,16$	92,25±1,92
4	93,75±1,41	$87,72\pm1,77$	82,91±1,88	87,31±1,63	96,47±1,37
6	95,44±0,81	90,31±1,55	86,25±1,56	90,59±1,33	97,81±0,93
8	96,69±1,00	91,81±1,56	89,13±0,92	92,31±1,06	98,47±0,45
10	97,66±0,82	93,16±1,12	89,97±1,85	$92,44{\pm}1,28$	98,56±0,37
20	98,94±0,61	95,25±1,10	95,53±0,84	95,06±1,55	99,72±0,23
30	$98,88{\pm}0,40$	96,47±1,04	95,97±1,01	$96,22{\pm}0,88$	99,53±0,37
40	99,31±0,48	96,81±0,94	96,81±0,52	$96,84{\pm}0,71$	99,75±0,25
50	99,47±0,42	97,66±0,68	97,75±0,56	$97,\!88{\pm}0,\!87$	$100,00\pm0,00$
60	99,47±0,28	98,00±1,17	98,31±0,83	$97,94{\pm}1,05$	$100,00{\pm}0,00$
	$\begin{array}{c} 0,5\\ 1\\ 2\\ 4\\ 6\\ 8\\ 10\\ 20\\ 30\\ 40\\ 50\\ 60\\ \end{array}$	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

User Identification





Conclusions

- > Our main contribution is the comparison and analysis between different times of EEG recordings.
- > A viable biometric system based on EEG could be developed using only 2 seconds of recording, but if we increase the recoding duration the

References:

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system becomes extremely secure.

The implementation of multimodal biometrics systems using signals of other sources could increase the accuracy with short times. For this reason, we propose it as future work.

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