جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Centre des Etudes Doctorales Sciences et Techniques
&
Sciences Médicales

THESIS DEFENSE

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CANDIDATE FOR DOCTOR SCIENCES AND TECHNIQUES

Towards an Automatic System for ECG-based Biometric Identification and Cardiovascular Diseases Detection using Wavelet Transform and Capsule Network

Date :	**Saturday, December 30th, 2023**
Time :	**10.00 am**
Location :	**Conference Room, ENSA - Tangier**

Committe Members		
Pr. Yassin LAAZIZ	ENSA - Tangier	Chair & Examiner
Pr. Mohammed BOUHORMA	FST - Tangier	Reviewer
Pr. Mohammed MESTARI	ENSET - Mohammedia	Reviewer
Pr. Abdelhak EZZINE	ENSA - Tangier	Reviewer
Pr. Abdelkader Jalil EL HANGOUCHE	FMP -Tangier	Examiner
Pr. Abdelouahid LYHYAOUI	ENSA - Tangier	Examiner
Pr. Said RACHAFI	FST - Tangier	Guest
Pr. Abdelhak TALI	FSJES - iTangier	Supervisor

ABSTRACT

Electrocardiogram (ECG) is a widely used non-invasive tool to capture the electrical activitygenerated by the heart on the body surface. In this thesis, the ECG pattern is derived from recorded ECG signals to perform two distinct tasks namely biometric identification and cardiovascular disease classification.

The recent expansive evolution of science and technology in this millennium resulted in a substantial increase in security standards. However, privacy threats and risks are increasing due to security attacks. Hence, in this thesis we propose a novel ECG-based biometric identification system that can potentially strengthen the security of monitoring systems.

According to the World Health Organization, cardiovascular disease (CVD) has become the major cause of death imposing a significant societal and economic burden. In this regard we designed a well-designed computer-aided system to enable early and accurate detection of CVDs, and thereby increasing the chances of timely treatment and potentially saving patients' lives.

In both of the aforementioned aspects, we used a combination of wavelet transform coefficient features to extract relevant features from the transformed domain of ECG signals along with a novel form of deep learning classifier called Capsule Network that can achieve prominent results using a limited number of training samples. Specifically, the Continuous Wavelet Transform (CWT) is employed to transform heartbeat characteristics into the time-frequency analysis domain. Next, the Discrete Wavelet Transform is applied to extract spectral information of two-dimensional frequency time scalograms to further improve the identification accuracy. Subsequently, the discrete wavelet coefficients obtained through (DWT) are inputted into the capsule network.

Experimental results demonstrate that our proposed methods in both of the aforementioned aspects were able to achieve high performance and outperforming other state-of-the-art methods using only a limited number of training ECG segments of short duration.

Mots clés : Electrocardiogram, Biometric Identification, Cardiovascular Diseases, Wavelet Transform, Capsule Network, Focal loss.