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AN ENHANCED MODEL FOR USING ELECTROCARDIOGRAM (ECG) SIGNALS AS HUMAN BIOMETRIC

THESIS

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بسم الله الرحمن الرحيم

﴿ الحمد لله الذي هدانا لهذا و ما كنا لنهتدي لولا أن هدانا الله ﴾

صدق الله العظيم

جزء من الآية (٤٣) – سورة الأعراف

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DEDICATION

I would like to dedicate this thesis to my mother, my father, my sisters and my brothers who provide me with love, care and support.

PUBLISHED WORK

1. Anwar E.Ibrahim, Salah Abdel-Mageid, Nadra Nada, Marwa A. Elshahed, " Human Identification Using Electrocardiogram Signal as a Biometric Trait ", International Conference on New Computer Science and Engineering (NCSET2020), Istanbul, Turkey, 1st - 2nd July 2020, (accepted).

2. Anwar E.Ibrahim, Salah Abdel-Mageid, Nadra Nada, Marwa A. Elshahed, " ECG Signals for Human Identification Based on Fiducial and Non-Fiducial Approaches ", International Journal of Advanced Computer Research (IJACR), (accepted).

ABSTRACT

Biometrics is an interesting study due to the amazing progress in security technology and defined as a method of recognizing humans based on a physiological characteristics (as face, fingerprints, DNA, ECG, etc…) or behavioral characteristics(as voice, gait, keystroke, signature, etc…). The term biometrics comes from the Greek words 'bio' (life) and 'metrics' (measurement), so biometrics means life measurement. Electrocardiogram (ECG) signal analysis is an active research area for diagnoses which is a method to measure the change in electrical potential of the heart over time. This work investigates in ECG signals as a biometric trait which based on uniqueness represented by physiological and geometrical of ECG signal. Biometric systems based ECG classified into two categories fiducial and non-fiducial approaches depend on the feature extraction methods.

In this work, a proposed non-fiducial identification system is presented with a comparative study using Radial Basis Function (RBF) neural network, Back Propagation (BP) neural network and Support Vector Machine (SVM) as classification methods. The Discrete Wavelet Transform method is applied to

extract features from the ECG signal. Two datasets are used in this work (ECG-ID and MIT-BIH) databases. The experimental results show that using RBF neural network gives higher identification rate than other used classifiers. Also, the system accuracy by using the neural network as a classifier is better than that using the support vector machine for the first and the second datasets. The obtained results show that decreasing the number of subjects the system performance using SVM is improved. Furthermore, integrating the two classifiers RBF and BP achieves a higher human identification rate.

Also, we present an ECG human identification system with different feature extraction methods as Daubechies wavelets ('db3', 'db8' and 'db10'), Symlets wavelet 'sym7' and Biorthogonal wavelet 'bior2.6'. A combination of RBF and BP neural network is used as a classifier compared with SVM. The experimental results show that using Daubechies wavelet 'db8' achieves the higher identification rate than the others used methods with the combined classifier. The proposed system performance is improved by adding fiducial features (R-R intervals) to the used non-fiducial features.

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LIST OF ABBREVIATION

ECG	Electrocardiogram
EEG	Electroencephalogram
PPG	phonocardiogram
BVP	Blood Volume Pressure
FAR	False Acceptance Rate
FRR	False Rejection Rate
RBF	Radial Basis Function neural network
BP	Back Propagation neural network
SVM	Support Vector Machine
DWT	Discrete Wavelet Transform
PCA	Principle Component Analysis
LDA	Linear Discriminant Analysis
WPD	Wavelet Packet Decomposition
LPC	Linear Predictive Coding
TM	Template Matching
FFT	Fast Fourier Transform
AC	Autocorrelation

Chapter One

INTRODUCTION