

## **A Review on User Identification and Emotion Classification Using ECG**

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### **ABSTRACT**

*The aliveness of a person can be related with the heart beat rhythm. So the heart beat rhythm can be signalized into an ECG. Nowadays for the biometric authentication purpose we normally use the finger print, face & iris recognition etc. Among that ECG is more against forgeries and it is advanced technique than finger print & face recognition. This paper describes different methods used in identifying a person using Electrocardiogram signals. The same signal used for the classification of emotions also. User identification is the common method for identify a user in the business field and other organizations. User ID is one of the most common authentication system used within computing systems, networks, applications and over the Internet. Commonly used authentications are fingerprint, face recognition, iris recognition & RFID etc. Among ECG is universal, continuous & difficult to falsify. So the user identification using ECG is the new trend in biometric authentication. ECG is a periodical signal creates P, QRS, T through depolarization of atrium, repolarization & depolarization of ventricle. ECG is a bio signal & is unique because the variation in amplitude of R wave and the time duration of each wave is different for each individual. There are many different types of emotions that have an influence on how we live on earth and how we behave to others. The emotions are identified were happiness, sadness, disgust, fear, surprise, and anger. This paper describes the different method used to identify the person & classifies the emotion using ECG.*

**Keywords:** ECG, user identification, emotion classification, ANN classifier

### **INTRODUCTION**

Biometric technologies are fast-developing fields of information security, and it is applicable in many fields. Today only there are three biometric methods have proved their efficiency, namely, identification based on fingerprints, iris or retina, and face. Hand geometry, voice, writing and typing dynamics, etc. are also useful in many applications. The ECG signal is periodic signal which has higher security than fingerprint & face. For the identification of a person by using ECG normally follows the signal acquisition, preprocessing, feature extraction & classification.

These papers uses the ECG signal acquisition by different methods ,which include acquiring the signal in normal 12 lead ECG acquisition, ECG acquisition using cypress cortex M3 measurement device, measurement through the finger etc. Due to the physical condition of a person ECG signal effected by the noise. These noises can be eliminated by the pre - processing step. Different filters are used to remove the noise, *i.e.* Band pass, median filter, low pass, chebhychev ,Butterworth filter etc.& the filtered signal undergone by a segmentation process which normally carry the reference point & non reference point method .In reference point segmentation which sets the initial &

final point where in non-reference point segmentation it doesn't sets the initial & final point it just fix particular data size & apply section areas.

The feature extraction, the extracted feature could be either fiducial feature based or non-fiducial based. Fiducial features are based on peaks of ECG signal or the angle, amplitude & time interval (R-R peaks). The non fiducial features are based on detecting the QRS peaks or discrete wavelet transform & extracted the features corresponding to wavelet coefficient. Another type of feature includes statistical features which can be achieved with help of dower matrix, correlation matrix & covariance matrix. Sometimes time, frequency domain features are used. After extracting the features it classify the signal by using different classifier which include the SVM, KNN, ANN, CNN classifier etc. or the feature extraction & classification can be done with help of deep learning technique.

This paper also in cooperate the classification of emotion in accordance with the ECG signal. Emotion can be considered as the complex state of feeling that results in physical & physiological change that relates thoughts & behavior. The same step of user identification system is used in the classification of emotion. The main difference is in feature extractions which use the empirical mode decomposition, Genetic algorithm to classify the emotional states. Past research has shown that ECG is unique to each individual and thus could potentially be used for authentication. Current challenges include extracting exact features from ECG signals, designing correct models for pattern recognition, proving long stability of the biometric and protecting against attacks. This paper gives the overall view of user identification, emotion classification & about ECG with different

approaches.

The main objective of this paper is that to compare the different approach for biometric system based on ECG which has better identity security. Also classify the emotion with the changes in the ECG signal.

## TECHNIQUES

In this work, we describe the different methods of user identification & emotion classification using ECG. The normal methods for identification and emotion classification follow the signal acquisition, pre-processing, segmentation, feature extraction & classification. The pre-processing method includes different frequency filtering techniques or normalization. Segmentation uses reference & non reference point segmentation. Feature extraction can be classified according to the fiducial & non fiducial features. For the classification, different classifiers are used among some of them uses the deep learning techniques.

## The ECG

The ECG represents the electrical signal that forms from the contraction of the heart muscles, indirectly representing the blood flow inside the heart, and it is almost periodic.

ECG is a graphical representation of heartbeat rhythm. There are three main components of an ECG- The P wave, which describe the depolarization of the atrium; the QRS complex, which describe the depolarization of the ventricles; and the T wave, which described the repolarization of the ventricles. In normal 12-lead ECG, ten electrodes are placed on the patient's limbs and on the surface of the chest. The overall magnitude of the heart's electrical potential is then measured from twelve different angles and is recorded over a period of time which is fixed. In most of the research lead 1 ECG is used for the authentication purpose. ECG can be

altering due to the patient movements, position of heart & condition of the individual. ECG is universal & unique which is used as a biometric mean for authentication

### **User Identification**

Authentication is applied throughout the world, like in electronic finance, social welfare, administration etc. In computer science, verifying an identity of a person is often required to allow access to confidential data or systems. The first type of authentication is the identity proof given by a credible person who has first-hand evidence that his or her identity is genuine. Even though authentication is required in many fields and the proof this is related with our friends, family members etc. Credential based authentication are not well suited for some places. Among all biometric authentication like fingerprint, face recognition & iris, ECG is more robust against forgeries and it is an alteration than fingerprint and face recognition. so ECG is universal, difficult to falsify.

### **Emotion Classification**

Emotion classification, the means by which one may distinguish from other by emotion. Researchers have approached the classification of emotions according to two points, they are

- They are discrete and are of different construct.
- Emotion can be classified according to dimension.

six basic emotions are classified as anger, disgust, fear, happiness, sadness, and surprise. Emotion is different for every person. Emotion can be classified according to the facial expression, audio signal, gestures etc. Emotion can be altering with mood, temperature, personality. The emotion in ECG can be detected by using different techniques in feature extraction, classification step which uses different methods.

### **LITERATURE REVIEW**

GYU-HOP CHOI, EUN-SANGBAK, SUNG-BUM PAN [1] proposes a user-recognition system which extracts multi-dimensional features of ECG through 2D resizing based on bi cubic interpolation. The proposed system contains ECG acquisition step, an ECG signal processing step, a segmentation step, a feature extraction step, and a classification step. For ECG signals, the signals are acquired as lead 1 signal. In this paper they convert the corresponding 1D ECG signal to a 2D image after the process of segmentation. This corresponding image is undergone by a bi-cubic interpolation to reduce the data size & compare the given data with the enrolled data. If the match found user can be clearly identified. Classification is done with the help of deep learning techniques which is more advanced than other techniques. The performance can be evaluated by means of shuffled classes and normal CU ECG dataset. The paper shows a 93% of accuracy. So it is an advanced technique model of identification of a person by using ECG.

Mohamad O. Diab, Alaa Seif, Mohamad El-Abed, Maher Sabbah [2] has proposed comparative study between fiducial and non-fiducial features used for identification of user. ECG signals are confidential for each individual. Advantages of using non-fiducial feature over fiducial one is that less computational time. In this paper they use the third order butter worth low pass filter for the removal of noise. In feature extraction 13 fiducial features are calculated. Pan Tompkins algorithm is used for the R peak detection. Whereas non fiducial features are calculated by using discrete wavelet transform. The classification is done with the help of neural network classifiers. Among that artificial neural network is used. Here the data is analyzed with the help of statistical calculation of wavelet coefficient.

Meenakshi Nawal, G.N Purohit [3] presented a review report based on biometric authentication using ECG. This paper mainly concentrated in the area of remote health monitoring of a patient with aid of ECG. Credential based authentication is not well suited for remote health care. The main step involve in the study are pre-processing, feature extraction, and classification. The pre-processing is done with the help of frequency filters, and then also there are different types of outliers. So to remove those outliers we use the thresholding which uses the Butterworth bandpass filters. The feature extraction can be extracted as statistical and wavelet features. Classification is done with the help of KNN,SVM,Neural networks etc.

Lena Biel, Ola Pettersson; L. Philipson, P. Wide[4] proposes a new approach in human identification. Here they use the 12 lead ECG for the identification purpose. Multivariate analysis is used for the identification. It is risky method for capturing the ECG signal compared to lead 1 signal acquisition. This method is suited for the hospitalization purpose. The equipment used for the measurement is a Siemen megacart.360 features of each person is identified and is reduced to 12 features with the help of correlation matrix. For the classification purpose uses the principle component analysis is used. But the experiment is conducted with the single lead ECG to identify a person which makes the method applicable without too much effort.

Andre Lourenco, Hugo Silva and Ana Fred[5] proposed the ECG signal has been shown to contain relevant information for human identification. Even though results validate the degree of these signals, data acquisition methods and apparatus explored and compromise the user acceptability, requiring the acquisition of ECG at the chest. In this paper finger-

based biometric authentication system by acquiring the ECG signal, that uses signals collected from the fingers, through a minimally intrusive 1-lead ECG setup recurring to Ag/AgCl electrodes and it has no contact with the skin. The ECG acquired at the finger is noisier than the ECG acquired at the chest. at the motivating the application of feature extraction and signal processing techniques to the problem. Time domain signal processing of ECG is performed, which contain the different steps i.e. filtering, normalization etc. Through the distance between the test data and enrolled data should be minimum which results have revealed this to be a promising technique for biometric applications.

Baby Shalini T., Vanitha L.[6] proposed emotion is differ from one person to another with the activity of each individual and which differ from one another by the thoughts and physical condition. Emotion modelling and recognition has great attention towards the fields like psychology, cognitive science and engineering. The aim of the proposed work is to identify the state of emotions by using ECG signals, which could well suited for in medicine, entertainment, education, safety, etc. Empirical mode decomposition is well suited for identifying the patterns of emotion. Certain features of classification are based on the instantaneous frequency and the local oscillation. The proposed system uses the fast Fourier transform to remove the noise to identify the states of emotion.

Supriya Londhe1 and Rushikesh Borse[7] proposed that the emotion recognition is the major challenges in human-human and human-computer interaction. There are different approaches to identify emotions like facial expression, audio signals, body poses, and gestures etc. Physiological signals play important role in emotion recognition as they are not controllable. In



this paper, they discuss the research done on emotion recognition using skin conductance, skin temperature, electrocardiogram (ECG), electromyography (EMG), and electroencephalogram (EEG) signals. Even though the same methodology has been adopted for emotion recognition techniques based upon various physiological signals. After survey it is found that none of these methods are fully efficient standalone but the efficiency can be improved by using combination of physiological signals. The study of this paper comprises an insight on the current state of research and challenges faced during emotion recognition using physiological signals. In feature extraction, genetic algorithm is used. Which contain higher performance? Classification using KNN shows the accuracy of about 67%.

Jing Cai, Guangyuan Liu and Min Hao[8] proposed that the emotion recognition is the one of the major research area of interest. This paper contain the states like sad, happiness are classified by using electrocardiogram (ECG) signal acquisition obtained from 391 subjects through stimulation of film clips. The location of P-QRS-T wave can be analyzed using discrete wavelet transform (DWT), which was crucial for ECG feature extraction by the computer. Through tabu search algorithm (TS), is used for the extraction of feature. Atlast fisher-KNN proposed to classify the test data. So a better recognition and classification of emotion is done with the help of above method. By using TS and fisher-KNN classifier emotions can be classified efficiently.

Lin He, Wensheng Hou, Xiaolin Zhen & Chenglin Peng[9] has proposed that the ANN is we suited for the identification of human. There are four different methods of ECG pattern recognition were chosen from the MIT-BIH database, including

premature ventricular contraction, sinus rhythm, atrial premature beat and left bundle branch block beat. R-R interval features and ECG morphological features were performed as the characteristic representation of the original ECG signals to be fed into the neural network models. There are three types of artificial neural network models like SOM, BP and LVQ networks were separately trained and tested for ECG pattern recognition and the experimental results of the different models have been compared.

K. Zhu; P.D. Noakes; A.D.P. Green[10] proposed that artificial neural networks are used for the detection of abnormalities in an ECG monitoring scheme. The authors investigate the use of artificial neural networks for ECG abnormality detection in an ECG monitoring scheme. Simulations are performed with the neural networks which is of a short learning phase. The method aims to conduct a system which will perform well practically. For the detection of each individual it uses the waveform slope method to locate the QRS complex for each ECG cycle which allows a small training data set .

## CONCLUSION

This paper gives the review of user identification system using ECG& the emotion can be classified according to the same step which is used for the identification purpose .The most of the paper has accuracy problem ,by comparing the different approaches we could increase the accuracy . First, the main effort has been spent in feature selection and classifier design, it is not yet clear what is the best features and classification scheme for ECG biometrics. Non-fiducial based techniques reduce the computational error as well as the error rate due to the ECG wave's recognition. Therefore, new techniques are developed will use fiducials and non-fiducial based features in order to

catch the best of the above two. Neural network classifiers show the better performance regardless of other methods of classification. In case of population size, the majority of the studies have been conducted on a small population. Therefore; the applicability of ECG biometric recognition is not yet proven in most of the organizations. The research is going on. So this system will be so advanced biometric authentication for public use.

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