Classification of heart rate data using artificial neural network and fuzzy equivalence relation

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Abstract

The electrocardiogram is a representative signal containing information about the condition of the heart. The shape and size of the P-QRS-T wave, the time intervals between its various peaks, etc. may contain useful information about the nature of disease afflicting the heart. However, these subtle details cannot be directly monitored by the human observer. Besides, since bio-signals are highly subjective, the symptoms may appear at random in the time scale. Therefore, the signal parameters, extracted and analysed using computers, are highly useful in diagnostics. This paper deals with the classification of certain diseases using artificial neural network (ANN) and fuzzy equivalence relations. The heart rate variability is used as the base signal from which certain parameters are extracted and presented to the ANN for classification. The same data is also used for fuzzy equivalence classifier. The feedforward architecture ANN classifier is seen to be correct in about 85% of the test cases, and the fuzzy classifier yields correct classification in over 90% of the cases. © 2002 Pattern Recognition Society. Published by Elsevier Science Ltd. All rights reserved.

Keywords: Heart rate; Pattern recognition; ECG; Neural network; Fuzzy equivalence; Disease classification

1. Introduction

Electrocardiography deals with the electrical activity of the heart. Monitored by placing sensors at the limb extremities of the subject, electrocardiogram (ECG) is a record of the origin and propagation of the electric potential through cardiac muscles. It is considered a representative signal of cardiac physiology, useful in diagnosing cardiac disorders.

The state of cardiac health is generally reflected in the shape of ECG waveform and heart rate. It may contain important pointers to the nature of diseases afflicting the heart. However, bio-signals being non-stationary signals, this reflection may occur at random in the time scale. (That is,

the disease symptoms may not show up all the time, but would manifest at certain irregular intervals during the day.) Therefore, for effective diagnostics, the study of ECG pattern and heart rate variability signal (instantaneous heart rate against time axis) may have to be carried out over several hours. Thus, the volume of the data being enormous, the study is tedious and time consuming. Naturally, the possibility of the analyst missing (or misreading) vital information is high. Therefore, computer-based analysis and classification of diseases can be very helpful in diagnostics.

The present paper makes use of heart rate variability (HRV) as the base signal for analysis and classification of diseases. The heart rate is evaluated by measuring the time interval between the successive R-peaks (R–R interval) of the ECG waveform. It is known that almost all the useful frequency components in ECG signal falls below 40 Hz [1], and therefore sampled at the rate of 200 samples/s. The heart rate, plotted against the time scale provides the HRV signal.

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David Baud

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Machine Learning in Bio-Signal Analysis and Diagnostic Imaging Nilanjan Dey,Surekha Borra,Amira S. Ashour,Fuqian Shi,2018-11-30 Machine Learning in Bio Signal Analysis and Diagnostic Imaging presents original research on the advanced analysis and classification techniques of biomedical signals and images that cover both supervised and unsupervised machine learning models standards algorithms and their applications along with the difficulties and challenges faced by healthcare professionals in analyzing biomedical signals and diagnostic images These intelligent recommender systems are designed based on machine learning soft computing computer vision artificial intelligence and data mining techniques Classification and clustering techniques such as PCA SVM techniques Naive Bayes Neural Network Decision trees and Association Rule Mining are among the approaches presented The design of high accuracy decision support systems assists and eases the job of healthcare practitioners and suits a variety of applications Integrating Machine Learning ML technology with human visual psychometrics helps to meet the demands of radiologists in improving the efficiency and quality of diagnosis in dealing with unique and complex diseases in real time by reducing human errors and allowing fast and rigorous analysis The book s target audience includes professors and students in biomedical engineering and medical schools researchers and engineers Examines a variety of machine learning techniques applied to bio signal analysis and diagnostic imaging Discusses various methods of using intelligent systems based on machine learning soft computing computer vision artificial intelligence and data mining Covers the most recent research on machine learning in imaging analysis and includes applications to a number of domains **Biomedical Sensors and Smart Sensing** Ayan Kumar Panja,Amartya Mukherjee,Nilanjan Dey,2022-06-02 Biomedical Sensors and Smart Sensing A Beginner s Guide a book in the 10 volume Primers in Biomedical Imaging Devices and Systems series covers a wide range of interdisciplinary applications in imaging modalities nuclear medicine computed tomographic systems x ray systems magnetic resonance imaging ultrasound and virtual reality The series explores the essential fundamental techniques required to analyze and process signals and images for diagnosis scientific discovery and medical applications Volumes in this series cover a wide range of interdisciplinary areas combining foundational content with practical case studies to demonstrate the applications of these technologies in real world situations In addition the 10 volume series considers various medical devices electronics circuits sensors and algorithms Several applications ranging from basic biological science to clinical practice are included to facilitate ongoing research Covers a variety of sensing and signal processing techniques Introduces different approaches relating to communication and intelligent data processing for early detection and prediction of diseases Includes practical case studies *Encyclopedia of Information Science and Technology* Mehdi Khosrow-Pour,Mehdi Khosrowpour,2009 This set of books represents a detailed compendium of authoritative research based entries that define the contemporary state of knowledge on technology Provided by publisher **Information, Technology in Bio- and Medical Informatics, ITBAM 2010** Sami

Khuri,Lenka Lhotská,Nadia Pisanti,2010-09-09 Biomedical engineering and medical informatics are challenging and rapidly growing areas Applications of information technology in these areas are of paramount imp tance The aim of the first ITBAM conference was to bring together scientists searchers and practitioners from different disciplines mathematics bioinformatics biology medicine biomedical engineering and computer science having such c mon interests We hope that ITBAM conferences will provide opportunities for fru ful discussions between all attendees and provide a platform where participants can exchange their most recent results identify future directions and challenges initiate possible collaborative research and system development and develop common l guages for solving problems in the realm of biomedical engineering bioinformatics and medical informatics The importance of computer aided diagnosis and therapy has drawn more and more attention worldwide and laid the foundation for modern medicine with excellent potential for promising applications such as telemedicine Web based healthcare and analysis of genetic information For this conference after a peer review process we finally selected 13 long papers and 8 short papers that are now published in this volume They are divided in to the following groups workflow management and database decision support and data management in biomedicine medical data modelling and information retrieval data mining in bioinformatics knowledge representation and data management in bio formatics biological data and signal processing The papers show how broad the spectrum of topics in applications of information technology to biomedical engine ing and medical informatics is **Information Technology in Bio- and Medical Informatics** Christian Böhm,Sami Khuri,Lenka Lhotská,Nadia Pisanti,2011-08-19 This book constitutes the thoroughly refereed proceedings of the Second International Conference on Information Technology in Bio and Medical Informatics ITBAM 2011 held in Toulouse France in August September 2011 in conjunction with DEXA 2011 The 13 long papers and 5 short papers were carefully selected and address the following topics decision support and data management in biomedicine medical data mining and information retrieval workflow management and decision support in medicine and classification in bioinformatics The papers show how broad the spectrum of topics in applications of information technology to biomedical engineering and medical informatics is **Advanced Intelligent Computing Technology and Applications** De-Shuang Huang,Prashan Premaratne,Baohua Jin,Boyang Qu,Kang-Hyun Jo,Abir Hussain,2023-07-30 This three volume set of LNCS 14086 LNCS 14087 and LNCS 14088 constitutes in conjunction with the double volume set LNAI 14089 14090 the refereed proceedings of the 19th International Conference on Intelligent Computing ICIC 2023 held in Zhengzhou China in August 2023 The 337 full papers of the three proceedings volumes were carefully reviewed and selected from 828 submissions This year the conference concentrated mainly on the theories and methodologies as well as the emerging applications of intelligent computing Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications Therefore the theme for this conference was Advanced Intelligent Computing Technology and Applications Papers that

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