

# Design and Evaluation of an ECG Holter Analysis System

Alberto Rodríguez\*, Gemma Rodríguez, Raúl Almeida, Nelvy Pina and Gisela Montes de Oca

Medical Equipment, Central Institute for Digital Research, Habana, Cuba

The aim of this paper is to discuss the design and evaluation process of a software for the analysis of ECG signal in a Holter system. The software was developed with RAD Studio 2009 using the Object Pascal language. The complete design and programming process was oriented to obtain different classes that encapsulate the needed functionality and combine them to obtain the final application.

The analysis process was organized in different steps: acquisition of the 3 channels of ECG and other recording information from the record device (up to 72 hours of ECG), filtration of ECG signal to remove movement and electrodes noises, detection and classification of QRS, detection of rhythm events and pacemaker malfunction, search of ST deviation episodes, HRV and spatial QT dispersion studies. All the processes were executed in this order and finalized with the compression and storage of the results.

Due to the large amount of data to be analyzed, all the algorithms were optimized to run fast. It was implemented a transparent buffering mechanism to manage the large ECG data files, performing reading and writing operations as if they were in memory. The rhythm events detection process was implemented using a pattern recognition algorithm that combines accuracy and faster processing. The average times to analyze recording of 24, 48 and 72 hours were 10, 30 and 70 seconds respectively.

The QRS detection and classification process was evaluated with 40 thirty-minute strips from the PhysioNet database. The 99.12% of the complexes were detected and 98.40% of complexes were well-classified. The user interface, entire system operation and analysis results were also tested and validated by specialists from the National Institute of Cardiology during a period of 4 months and 160 patients were studied. Nowadays there are 50 systems, working with good results in many hospitals.