Abstract

In the ears of an experienced physician, a stethoscope yields important clinical information which can help an initial assessment of a patient's clinical condition and guide the subsequent need for more specialized exams. This is particularly true in chest Medicine, i.e. Cardiology and Pneumology, which is the reason why the stethoscope still maintains a key position in Medicine in the modern era. Auscultation, however, is a hard skill to master. The heart sounds are of low frequency and the intervals between events are in the order of milliseconds, requiring significant practice for a human ear to distinguish the subtle changes between a normal and a pathological heart sound.

The use of a digitally enhanced stethoscope, adequate for training physicians to improve their basic skills in diagnosing and treating heart conditions, or as a stronger tool for world-wide screening of specific heart pathologies are some examples of how state of the art technology can be used horizontally to benefit people at different economical, political or geographical levels.

In this thesis, following contributions are reported:

The publication of a survey on the state-of-the-art in audio processing in cardiology, we have loosely adopted some concepts of clinical systematic reviews. In this survey, we realized that despite the great interest on this research area, some major problems are preventing the adoption of computer-assisted tools on this area, some of them are the poorly described data which lack of additional clinical information.

A data collection system, for the storage and transmission of clinical records and patient exams from the remote hospital and the data server, located at the university of Porto was designed. 59 patient records regarding to patients with ages between 7 days and 15 years were transmitted to our server. The experience of the development and use of this tool showed that the adopion of technologies kown to clinicians helps to lower the time clinicians take to learn how to operate the system. It also increased the system acceptance from the user perspective.

The last contribution of this thesis is the improvement of one of the most

cited algorithm for heart sound segmentation. With the implementation of the state-of-the-art algorithm, we could realized that it is still sensitive to noise and to auscultations with periods of silece: events far common in an uncontrolled clinical environment. The proposed algorithm has a better tolerance to noise and is capable of handling auscultations with periods of silence.