Vox4Health: Preliminary Results of a Pilot Study for the Evaluation of a Mobile Voice Screening Application

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Abstract Mobile devices are rapidly becoming a part of everyday life as both communication and information tools. The use of m-health systems may be helpful for the collection of a set of data and information that can enable the individual to be proactive in the management of his/her own health, focusing on wellness and preventive behaviors, and so improving quality of life. We have realized an app, called Vox4Health, able to perform a fast, portable and simple voice screening test, due to the rapid increase in the incidence of voice disorders. The voice screening test is especially useful for teachers, singers, actors and other professional voice users who use their voice in their own activities, this vocal abuse possibly increasing the risk of suffering from dysphonia. Vox4Health analyzes vocal signals in real time, allowing users to self monitor the state of their own vocal health, thanks to an appropriate methodology. In this paper we present a pilot study conducted in two regions of Italy. The aim of the study is to evaluate the accuracy, in terms of classification capability, the usability and the degree of satisfaction with the developed app. The preliminary results show an average score of 81.3 for usability and average values ranging from 1.48 for dependability to 2.12 for perspicuity calculated in accordance with the User Experience Questionnaire.

Keywords mHealth application · Fundamental frequency estimation · Pilot study · Usability · Voice screening test

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1 Background

Dysphonia is a disorder that alters the voice quality. The symptoms of this disorder can be characterized by objective signs, either acoustic (alterations in intensity, frequency, timbre or texture), clinical (morphological or dynamic), physical (pharyngeal-laryngeal paresthesia), or psychological (a feeling of unpleasantness or inadequacy of one's own voice), occasionally or constantly present, in all or in particular communicative situations. The incidence of voice disorders is increasing rapidly, such problems now affecting nearly one-third of the population [1]. Professional voice users (singers, actors or teachers) represent the most affected category [2]. Unfortunately, too few people know about dysphonia and the causes of this disorder, and for these reasons only a few sufferers consult a speech specialist.

Speech therapists evaluate the presence of dysphonia by performing several tests including an acoustic analysis, in accordance with the SIFEL protocol [3] released by the Italian Society of Logopedics and Phoniatrics, agree with the instructions of the Committee for Phoniatrics of the European Society of Laryngology. The acoustic analysis is useful to quantify the voice features through estimations of specific parameters like the Fundamental Frequency (F_0), or jitter and shimmer. The parameters are calculated from a recording of the vowel 'a' of five seconds in length. Each of these parameters represents a particular feature of the human voice. For example, the F_0 indicates the oscillations of the vocal folds, and its alteration possibly indicating the presence of voice disorders.

We have realized a mobile health (m-Health) application [4], that we have called "Vox4Health", that is able to estimate the F_0 of the voice signal and to classify it as healthy or pathological through a methodology, opportunely implemented for a smartphone or a tablet. This would be a simple and fast instrument to perform a real-time voice screening able to support people for the self-monitoring of the state of their voice, and to suggest healthy behaviors to prevent or reduce voice health problems. The objective of the study detailed in this paper is to test Vox4Health, evaluating the performance of the embedded methodology for the F_0 estimation, the usability, and the user's satisfaction with the realized app. We have drawn up an appropriate trial protocol, a detailed document in which we have described the complete execution plan, focusing on organizational and ethical aspects. Based on this analysis of the literature, we have built a trial protocol in accordance with the SPIRIT 2013 Statement [5], which provides some guidelines on the performance of a clinical study.

2 Vox4Health

The system realized is able to estimate the F_0 from the speech signal and to classify the analyzed voice as healthy or pathological. In the following subsections, descriptions of the F_0 estimation and the functionalities provided by the app are presented.