

WATCH-DICTAPHONE FOR AUTOMATIC MEDICAL CODIFICATION

S. Grassi⁽¹⁾, P. Heck⁽²⁾, P. Stadelmann⁽¹⁾, P. Cotofrei⁽³⁾, P. Dinnissen⁽²⁾, F. Meylan⁽²⁾, J.-P. Mignot⁽²⁾, J.-N. Pfeuti⁽²⁾, F. Piccini⁽²⁾, P. Geiser^(1,†), G. Biundo⁽¹⁾, P.-A. Farine⁽¹⁾, J. Grupp⁽²⁾ and K. Stoffel⁽³⁾

(1) Institute of Microtechnology / Electronics and Signal Processing Laboratory, University of Neuchâtel, sara.grassi@unine.ch, pierre-andre.farine@unine.ch, <http://www-imt.unine.ch/esplab> (†) Now with "Phonak Communications AG"

(2) ASULAB, Division of The Swatch Group, pheck@asulab.ch, jgrupp@asulab.ch, <http://www.asulab.ch>

(3) Information Management Institute, University of Neuchâtel, <http://www.unine.ch/imi>

We have developed a voice data recording watch and the accompanying software and hardware needed to build an integrated solution for medical data capture and automatic codification. The stand-alone watch is used to capture, either by voice recording or by form-filling, the relevant information on the healthcare service being provided. The captured information is stored locally and then downloaded to a PC, via a USB connection. In the PC, speech is translated first into text and then into medical codification, with minimum user-intervention. The resulting information is stored into local or centralized patient databases, to be sent later to 3rd-party SW for billing, reporting and statistics. The user controls the stand-alone watch either via a touch-screen based interface or via a voice-driven interface for hands-free operation. In both interfaces, user feedback is given using the LCD display and the watch hands.

The main components of the developed system are:

1) **The watch-dictaphone**, with the following characteristics:

- 47 mm diameter and 15.8 mm height.
- Rechargeable 150 mAh Li-Ion battery.
- Water resistant up to 30 m.
- Audio chain with AD/DA, piezoelectric speaker, low-power microphone and amplifier.
- User authentication for secure data access and support of several institutions for the same user.
- Three processors:
 - Proprietary CoolRISC microcontroller for controlling watch functions, LCD, push-buttons, touch screen, user interface and DSP communication.
 - USB controller to manage the USB communication between the PC and the DSP.
 - TI C55x DSP processor to manage audio acquisition, automatic speech recognition, speech coding, and storage in a FLASH-NAND based proprietary file system allowing audio edition (segment insertion and deletion). The DSP processor also implements communication with the CoolRISC and the USB controller.

2) **The watch cradle** is used for battery recharge and USB connection to the PC.

3) **The PC software application** is designed around a GUI from which the following functional modules are called: Authentication for PC / Watch users, Data Transfer from/to the watch, Automatic Speech-to-Text and Text Processing, Tarmed Explorer (a WEB interface to explore and choose among a selection of most-likely medical codes), Management of captured and processed data in Patient Databases, and Maintenance and Configuration operations.

To date thirty prototypes have been produced and tested during 10 weeks by medical personnel (10 persons), in different ambulatory services at a Swiss university hospital which uses forms to be filled with checkmarks for recording the services provided. There was a high level of acceptance of the product, and the quality of the sound recorded and played was judged excellent.

The power consumption of the stand-alone watch according to the working mode is: 20.5 mA in recording, 38.8 mA in playback (including the load of the loudspeaker), 17.5 mA in voice command, and 0.09 mA in watch mode (including LCD). The fully charged battery allows 2 hours of recording (50% in hands free), plus 1 hour of playback time, plus 2 hours of form filling (50% in hands free), plus 2 weeks in watch mode. This is typically sufficient for one workweek of the healthcare provider.

ACKNOWLEDGEMENTS

This work was partly supported by the Swiss Federal Office for Professional Education and Technology (OPET) through the Innovation Promotion Agency (CTI) under Grant CTI 6935.1 ENS-ES ("ATTra-Watch" project).

REFERENCES

- [1] S. Grassi et al., "Watch-dictaphone for Automatic Medical Codification", in *Proc. Eusipco 2008*, Lausanne, Switzerland, 25-29 August 2008.



Figure 1 - The watch-dictaphone and its cradle