

Speech Recognition for Dental Electronic Health Record

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Abstract. This paper describes the application of universal automatic speech recognition (ASR) system in the area of dental medicine. Short motivation in the introduction consists of analysis of reasons why it is a good idea to use speech controlled electronic health record in dentistry. After that we deal with EHR system present at the background of the solution. The user acceptance was achieved via developing of a graphical component called

DentCross integrated with the MUDRLite EHR. The thorough description of the ASR server includes decomposition to its components, statistical approach to the recognition task, training of the acoustic model and its evaluation. Finally, the text concludes with the evaluation of the solution and first experiences gained during the testing process, in which students of dentistry as well as dentists themselves participated.

Introduction

The patients' health data in the electronic form are an integral part of the dental office health documentation and they are constantly becoming more important. Besides, the reports for insurance companies and the information about patient's health status are practically used to improve the quality of health care and decision making. However, there are still some obstacles that have to be surpassed.

One of them is the lack of rich structured data in dental medicine. Data structuring is on a relatively low level, mostly limited to simple tables. The main disadvantage of using such a system is the loss of detailed information on the localization, the size and the character of hard dental tissues defects. Further information on an oral cavity such as periodontitis, orthodontic anomalies, preventive oncological examinations, etc. is described in the form of a free text.

Entering data into a computer during the examination of a patient requires either frequent change

of sterile gloves, which is time-consuming and expensive, or the participation of a nurse, who is entering the dictated data into a computer.

Conclusion

Our solution improves the quality of the data stored in a structured form in dental EHR. The usage of ASR showed one of possible ways how to integrate the dental EHR into routine practical dentistry. The ASR server is designed in a way that remains independent on the target domain and makes its usage in other domains possible (e.g. cardiology). The universality of our setting is supported by the MUDRLite EHR as well.

MUDR

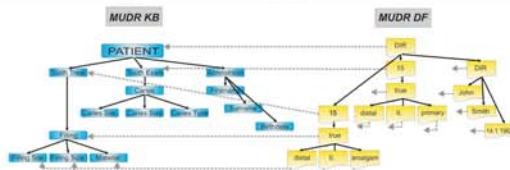


Figure 1.

MUDR EHR architecture [1] - Knowledge Base with Data Files. An example of dental knowledge base which served as a conceptual basis for further systems' development. On the right side a data files tree is depicted representing examination and treatment of an upper left second premolar tooth of patient John Smith.

MUDRLite

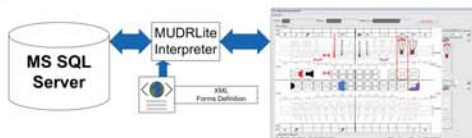


Figure 2.

MUDRLite [2] architecture and DentCross component preview.

DentCross Component

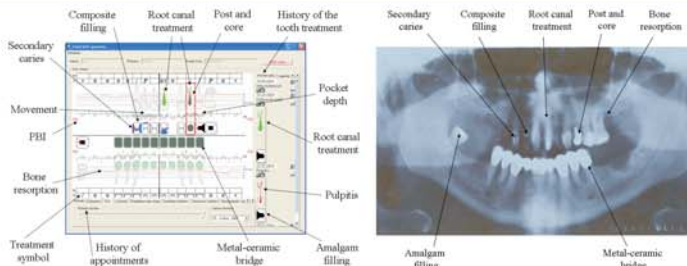


Figure 3.

An example of dental arch formalized in a form of electronic dental record stored in DentCross component and a corresponding tomograph picture.

Automatic Speech Recognition

The ASR system [3], [4] is speaker-independent and is based on the HMM (Hidden Markov Model) approach. It comprises of a front-end, an acoustic model, and a decoding block (see Fig 4).

Features of the ASR Module:

- Speaker independent
- Based on a statistical approach
- Configurable by a text file
- Recognized phrases defined in a form of a textual grammar
- Featuring high accuracy and yet operating very fast

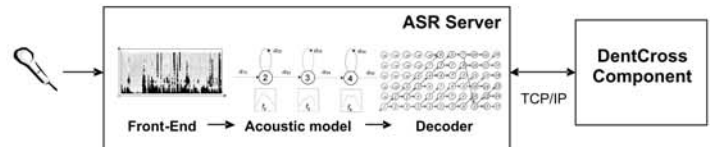


Figure 4.

Internals of ASR Server and its connection to DentCross component. Together they form the DentVoice application.

DentVoice application

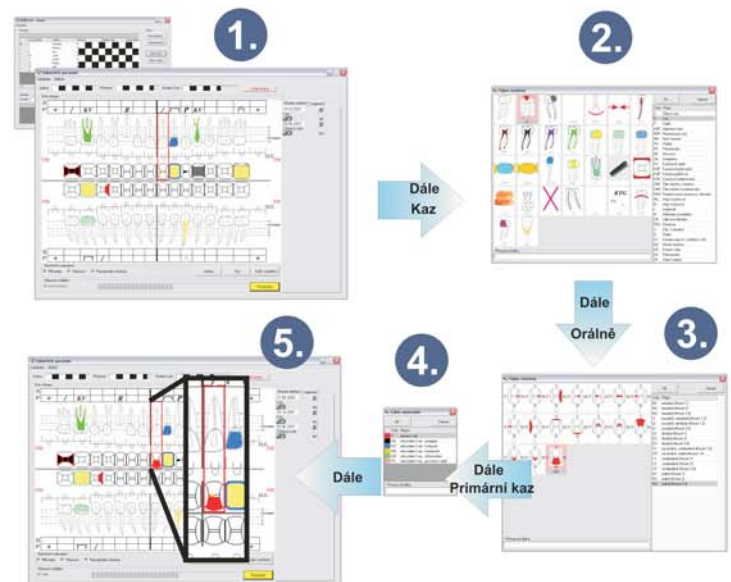


Figure 5.

An example session between user and DentVoice application. Texts inside arrows represent voice commands which realize state transitions inside the DentCross component. The starting position is depicted on the upper left screenshot and the dental record containing new information about an orally placed primary caries on an incisor tooth is located at the bottom on the left.

References:

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 [3] Müller L, Psutka J, Šmidl L. Design of Speech Recognition Engine. TSD 2000, Lecture Notes in Artificial Intelligence, Heidelberg: Springer; 2000.
 [4] Psutka J, Müller L, Matousek J, Radova V. Mluvíme s počítačem česky. Praha, Academia, 2006. (752 p. ISBN 80-200-1309-1)

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