PERSIVAL: View Segmentation and Static/Dynamic Summary Generation for Echocardiogram Videos

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1. INTRODUCTION

The demonstration described here is a part of the PERSIVAL system [1]. In PERSIVAL the user of the echocardiogram video archives is able to access, browse, search and interact with the echocardiogram videos efficiently and effectively. Video data is also integrated with other modalities of information and presented to the right users in the right context.

Echocardiography is the most common type of medical imaging modality in the field of cardiology. Each echocardiogram video shows the cardiac structure from a sequence of different angles and transducer positions. Unlike other types of videos addressed by existing work, echocardiogram video does not include speech, audio, or transcript information that can be used to index the video content. Information is predominantly contained in the visual form. There is usually predictable structure in the production of echo videos. In addition, there is associated information from other modalities, such as ECG and diagnosis reports, which can be used in analyzing the video content or providing useful annotations.

In the current presentation we will demonstrate parsing the echocardiogram videos at the syntactic level, and summarizing the videos based on the context and user needs.

For parsing the echocardiogram videos we exploit the spatio-temporal structure of the videos [2]. As a result of this process the echocardiogram video will be effectively segmented into its constituent views, where each view shows the cardiac structure from a different angle and position.

In order to generate the static summary each view of the echocardiogram video is represented by an image, which best captures the essence of that view. The extraction of such representative images is based on using the ECG information that is associated with each frame of the echocardiogram video [2]. The static summary is an efficient tool for browsing the content of the echocardiogram videos. The user will be able to randomly access the views of his/her interest. By selecting any of the representative images in the summary, the system will direct the user to a particular point in the echocardiogram video, where the user will be able to see the video of that view.

In the dynamic summary on the other hand, an entire view of the echocardiogram video is represented by one R-R cycle of the heart activity. An R-R cycle of the heart is the sequence of the frames in each view of the echocardiogram video that are between two consecutive representative frames. The advantage of this type of summary over the static summary is that it also conveys the dynamics of the heart, which is sometimes very useful to the users. There is also another level of the dynamic summary, in which, selected R-R sections from different views of the echocardiogram video are concatenated together to form a video skim of the echocardiograms [2].

Depending on the context and needs, users can choose to view the echocardiogram videos at different length by choosing between one of the three levels of summarization as described above.

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2. TECHNICAL SPECIFICATION

The demonstration will show an echocardiogram video playing and the processes of view segmentation and key-frame extraction applied to it. The user will be able to see in a separate window, the result of the tracking of the ECG signal. At the instances that R-wave peaks are detected, key-frames will be projected to the user interface.

As a result of the process, an HTML page will be generated. This page contains the static summary. There will be hyper-links from each representative image in the summary to the corresponding view of the echocardiogram. There will also be links to the dynamic summary of each view. Users will be able to use this page to browse through the echocardiogram video. The users can also experience the third level of the summary, which is in the form of a video skim of the entire echocardiogram.

In this demonstration the backend processes are implemented in C++ and the visual interface is in JAVA.

3. REFERENCES

[1] McKeown, K.R., Chang, S.F., Cimino, J., Feiner, S.K., Friedman, C., Gravano, L., Hatzivassiloglou, V., Johnson, S., Jordan, D.A., Klavans, J.L., and Teufel, S. PERSIVAL, a System for Personalized Search and Summarization Over Multimedia Healthcare Information. Accepted for publication in the proceedings of the JCDL'01 (June 24-28, 2001, Roanoke, Virginia), 2001.

[2] Ebadollahi, S., Chang, S.F., Wu, H., and Takoma, S. Echcoardiogram Video Indexing and Summarization. To appear in the proceedings of SPIE Medical Imaging (February 17-23, 2001, San Diego, California), 2001.