

Linking Human Anatomy to Knowledgebases: A Visual Front End for Electronic Medical Records*

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Problem

The Defense Advanced Research Projects Agency Virtual Soldier Project (VSP) is investigating methods to predict outcomes from wounding that will revolutionize medical care for the soldier, and in turn for civilian medical care. Prediction of outcomes of penetrating wounds will be made based on comparison of results from complex mathematical models, with experimental data, and (ultimately for the soldier) with clinical data including baseline X-ray CT and post wound imaging. The problem is to display this information in such a way as to capture the three-dimensional (3D) nature of the human body and to correlate that with extensive information about both the anatomy and the physiology of the wounded soldier.

Method

To address this problem, VSP has developed a holographic medical representation (or Holomer) to be used to connect a 3D model of the soldier's body, based on X-ray CT, with anatomical and physiological information for purposes of improving medical diagnosis and treatment both on and off the battlefield. The Holomer coupled with predictive modeling software will facilitate a new level of integration in medical procedures and create a prototype for a truly interactive visual electronic medical record.

To demonstrate the Holomer concept, a 3D model was created from segmented and annotated NLM Visible Human male photographic data [1]. The 3D model is displayed in SCIRun [2] using existing volume visualization techniques, and is linked to knowledgebases using a specially developed module, referred to as the HotBox. The HotBox interacts with the model via a 3D widget which is user controlled such that it can be moved to any location in the model. This provides the user input as to the location of interest. Given the location from the user controlled 3D widget, the HotBox implements the linkage to the 3D anatomy and the many levels of information provided in the knowledgebases. This provides a unique visual-based electronic medical record which the medic or physician can utilize for purposes of diagnosis and treatment. The specific focus of the VSP of this unique visual approach is for penetrating wounds to the heart.

Results

A prototype of the HotBox has been developed within SCIRun. The HotBox, which comes from animation software [3], is a menu activated by placing the cursor at a particular point in the 3D space (anatomy). The menu provides the user with a multitude of options based on retrieving the anatomical structure at the spatial point from the "Master Anatomy" list created from segmenting

and labeling the Visible Human data. For example, a menu item can be selected to invoke a connection, by Web services, to the Foundational Model of Anatomy [4], to provide the anatomical structures adjacent to the structure at the cursor location. Physiological information from measured vital signs will also be available via the Web service from the HotBox menu. In addition, we have also developed an alternative approach for connecting to knowledgebases that is independent of SCIRun and can be run on PC platforms. In this approach the 3D images are created using the VTK [5].

Conclusion

We describe the prototype concept of the HotBox, which can be integrated into the SCIRun problem-solving environment to link between 3D anatomy and knowledgebases of anatomical information, physiological response (vital signs) data and other medical records. This design can serve as a prototype for a new type of electronic medical record, one based on a 3D representation of the individual soldier or patient, providing unique visual access to the condition, be it a wound or a disease, afflicting the individual.

Discussion

The prototype Holomer is a unique demonstration of the concept of a "Visual Electronic Medical Record", improving the ease and use of medical records data by the physician in an interactive setting. Using the Holomer, physician or medic will have access, at the touch of a button, to all available information about a patient or wounded soldier, greatly facilitating accurate and efficient diagnosis of medical conditions.

References

- 1) See: <http://www.nlm.nih.gov/research/visible/>.
- 2) "SCIRun: A Scientific Computing Problem Solving Environment. Scientific Computing and Imaging Institute (SCI), 2002 (software.sci.utah.edu/scirun.html)
- 3) Pouchard, LC, Dickson, SP (2004) "Ontology based three-dimensional Modeling for Human Anatomy" ORNL Technical Report ORNL/TM-2004/139
- 4) Rosse, C. and Mejino, JLV. (2003) "Ontology for Bioinformatics: The Foundational Model of Anatomy". *Journal of Biomedical Informatics* 36:478-500.
- 5) See: <http://www.kitware.com/vtk.html>

*This work was supported by a grant from the DARPA, executed by the U.S. Army Medical Research and Materiel Command/TATRC Cooperative Agreement, Contract # W81XWH-04-2-0012.

The submitted manuscript has been authored by the U.S. Department of Energy, Office of Science of the Oak Ridge National Laboratory, managed for the U.S. DOE by UT-Battelle, LLC, under contract No. DE-AC05-00OR22725. Accordingly, the U.S. Government retains a non-exclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purpose.