The AIL Automated Interface Layout System

Simon Lok and Steven K. Feiner
Dept. of Computer Science, Columbia University
500 W 120th St., 450 CS Building
New York, NY 10027 USA
+1 212 939 7000
{lok, feiner}@cs.columbia.edu

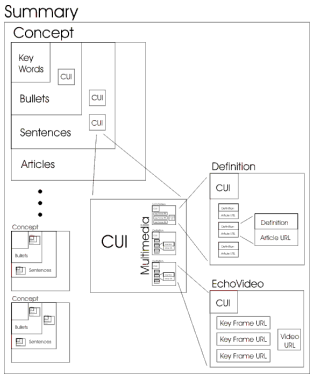
ABSTRACT
We describe an automated layout system called AIL that generates the user interface for the PERSIVAL digital library project. AIL creates a layout based on a variety of content components and associated meta-data information provided by the PERSIVAL generation and retrieval modules. By leveraging semantic links between the content components, the layout that AIL provides is both context and user-model aware. In addition, AIL is capable of interacting intelligently with the natural language generation components of PERSIVAL to tailor the length of the text content for a given layout.

Keywords
Automated layout, natural language generation.

INTRODUCTION
PERSIVAL [7] is a digital library project whose goal is to assist patients and caregivers in searching online medical resources by automatically generating presentations that summarize search results and suggesting relevant new queries. We are developing AIL (Automated Interface Layout) to manage the screen layout of PERSIVAL's presentations. We use many different automated layout techniques [6] to address the problem of needing to rely on manual design of a large number of output presentations. In this paper, we focus on the ability of AIL to modify the length of the content to create more effective layouts.

INTEGRATION WITH CONTENT GENERATION
An automated layout system requires knowledge about the relationships between the input components of the content in addition to the content itself. Unlike other automated layout systems [6], AIL receives input exclusively from automated content generation systems: CENTRIFUSER, DEFINDER, and EVS. CENTRIFUSER [4] generates textual summaries of articles that have been selected as being relevant to the user's query. DEFINDER [5] extracts explanations of medical terms by searching for blocks of texts that fit patterns of definitions. EVS (Echocardiogram Video Summarization) [1] retrieves video clips relevant to the user query and returns both the video itself and key frames from the video that EVS determines to be of particular interest. Over the course of the project, PERSIVAL's content generation systems have been augmented with the capability to generate meta-data and abstract constraints that specify the relationships among the components.

The output of the CENTRIFUSER system is a Summary that forms the foundation of the content to be displayed. This summary has been augmented to contain tags for UMLS (Unified Medical Lan-guage System) [3] terms (called CUIs) in the output. Both DEFINDER and EVS produce multimedia explanation elements for UMLS terms. The data model is shown and an example of the input received by AIL is shown below:



<Summary><synopsisTopic string="angina"> According to Halcomb, complete control of <concept>angina pectoris </concept> with 60-mg zinc tablets 3 … </synopsisTopic> <echoVideo><concept>aorticvalve</concept><frame>atf90.gif</frame></echoVideo><textGlossary> <concept>angina></concept>the chest pain that occurs when the heart is deprived of oxygen due to diminished blood flow </textGlossary></Summary>

CONTENT LENGTH ALTERATION
Both DEFINDER and CENTRIFUSER can generate output of varying lengths. AIL leverages this capability by requesting the appropriate textual length for the available screen real estate.

The output of CENTRIFUSER is a list of synopsis topics. Each synopsis topic can be generated at different levels of detail (currently "short," "medium," and "long"), where additional length is used to provide more information about a given topic. The actual number of characters generated by CENTRIFUSER for a particular level of detail is not known to AIL until it receives the content.

AIL takes advantage of this flexibility in two ways. First, AIL can proactively request a synopsis topic of a given length

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in order to constrain the final presentation to fit within the bounds of the screen size for a given set of typographic constraints. Second, if the user wishes to focus on a particular topic, AIL will send a request to CENTRIFUSER for a longer version of that synopsis topic and shorter versions of the other topics. This results in a semantic fisheye display [2], where the change in focus actually changes the content rather than the appearance of the content.

DEFINDER extracts multiple definitions for each UMLS term as it searches across a set of documents. These definitions range in length from just a few words to many sentences. An example of DEFINDER output is shown below:

```
<concept conString="ischemia"> <source url="anger.htm">a
reduction of blood flow to the heart</source> <source
url="15.htm">an area of heart muscle that has a poor blood
supply</source></concept>
```

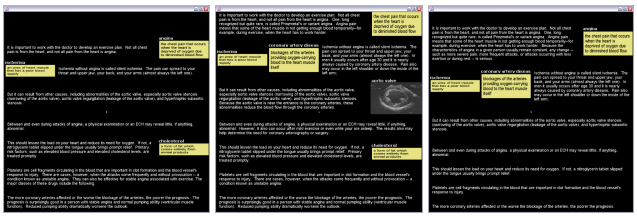
AIL leverages this in the same way it leverages the varying output lengths of the CENTRIFUSER synopsis topics. A definition of an appropriate length is chosen for display based on the amount of screen real estate available. If sufficient space is available, then the system can display more than one definition at the same time. In addition, if a user wishes to focus on a particular definition, a longer definition can be displayed.

AIL also interacts with the videos and key frames retrieved by EVS in a similar manner. Since the content consists of raster images, we can simply scale them in the traditional way to suit our display. We leverage the flexibility of being able to scale images at pixel granularity by allocating space for echocardiograms after we have allocated space for the variable the blocks of text and making the echocardiograms fit in the remaining space.

LAYOUT METHODOLOGY

AIL produces a layout in two passes. First, the synopsis topics are allocated vertical space in a top-to-bottom manner. Each synopsis topic is given enough space to display its content at "medium" length. The system will automatically scroll vertically if insufficient screen real estate is present. If the user wishes to focus on a particular synopsis topic, then AIL informs CENTRIFUSER that a longer synopsis topic is desired. The synopsis topics immediately above and below the topic in focus remain the same length, while the other synopsis topics are reduced in length.

In the second pass, horizontal screen space is allocated by assigning a space for the text of the synopsis topic as well as each multimedia explanation element in strict left-to-right order. The layout's balance as a whole is currently accounted for by alternating between having the multimedia explanation elements come first and last. Screen shots of the results are shown below:



ONGOING AND FUTURE WORK

AIL is a work in progress that will continue to evolve over the next few years. The images included here are snapshots of the system in its early development. In the near term, we are building navigation and display tools for the source articles used in synopsis generation and definition extraction. We will also be creating navigation and search refinement tools that will interact with the video component.

In the medium term, we will be adding more powerful constraint management systems to better manage the components of the layout. In addition, we will be expanding the balance component of the layout generator into a full knowledge-based system to create more visually appealing and effective layouts. In the long term, we also hope to take advantage of additional user-model data from medical records, which will be available once a secure platform for obtaining patient data has been established for PERSIVAL.

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