The University of Michigan NGI Visible Human Project

Quarterly Report
3Q Y1

September 30, 2000

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Overview

Project integration and focus was the over-arching theme of the 3QY1 of this project.

The deployment of version 2.0 of the Java browser for orthogonal male and female Visible Human slice retrieval, with CT and MRI has been demonstrated internally and a production implementation is planned for 4Q, in line with deliverable expectation. Mapping of the CT and MRI VH data corresponding to the cryosection data was performed using a volume to volume comparison. Warping of these volumes for a more precise fit will be explored with software based on Dr. Bookstein's thin spline algorithm in the 4^{th} Q.

From the User Interface Team UIT group, led by professor Berger, direction for the development of the user interface was funneled to the User Interface Design and Implementation group and then to the Knowledge Engineering group. This led to the development of two complementary software paths. The first being the Edgwarp browser with new flythrough capabilities, moving toward remote volume downloading as a 4QY1 demonstration. The other is Java-based, with robust database connectivity and an advanced user interface design.

Development of database logic has also been influenced by UIT findings. The raw material for populating the database has, in large part, been supplied by Dr. Gest. The use of his copyrighted anatomy tables has been included in the UM VH project. Integration of this raw material with other sources, including TA terminology, quiz materials, surface rendering and dissection movies will more appropriately reflect and enhance the learning process. This thesis will be evaluated when a pre-testbed of four Linux machines is placed in the medical school at the end of 4QY1.

Networking tests to be performed in the medical center in the month of October will determine the pre-testbed connectivity bandwidth. Assurances have been made by the Medical School Information Technology (MCIT) center staff that an upto 300 mbit connections to I-2 is available out through Merit Networks, Inc's I-2 gateway. This reduces the risk of bottlenecks owing to the College of Engineering gateway tested in the NREN demonstration in August.

Segmentation and labeling has continued unabated. Further refinements in technique, with the help of Dr. Bradley Smith, has produced several variations including the use of structure volume boundaries as a first step in decreasing the data viewed while defining contours.

Personnel: Dr. D. B.Karron has agreed to join our Knowledge Engineering team as a consultant, replacing Dr. Lee . His use of Digital Morse Theory (DMT) applied to segmentation is novel and should bring further advances to Dr. Bookstein's use of landmarks in defining and relating anatomic variation.

Knowledge Engineering: Third quarter progress report

Y1Q3 goals

From the technical proposal dated 6/28/99:
"Delivery of: script handler (for continuously varying views, i.e. 'movies') and interrupt script browser, provisional GUI for scripts [including] speed, parameter, and switch passing POINT TRAVERSE. Provisional LINE TRAVERSE that will work under ... specification by discrete point series. Provisional GUI for curves."

NOTE: what were called "scripts" in the proposal of 1999 are now called "filmstrips." That term will be used here. Likewise, what was "line traverse" is now "curve traverse."

Y1Q3 performance

On August 14, in San Jose at the NREN Demonstration a first release of the Edgewarp Navigator filmstrip handler promised for Y1Q3 was shown. This first version was demonstrated using five real-time filmstrips that had been loaded onto the UMVH project's web site (vhp.med.umich.edu). Real-time screen dumps of these five demonstrations will be sent to NLM under separate cover.

The new software, incorporated in release 3.2.4 of Edgewarp3D, runs on the SGI Indigo/Onyx family of machines at Michigan and PSC, and, just last week, was implemented for a specially equipped PC running Linux with an Nvideo graphics accelerator. All five demonstrations were in the form of filmstrip loops. The first, the simplest case, shows the smooth rotation of a plane around an anatomically meaningful axis (the central axis of Eve's lens). The other four demonstrate successively more complicated traverses of curves along which a section plane tumbles: the centerline of Eve's optic nerve, the centerline of her aorta, the symmetry curve of her corpus callosum, and (as a first experiment in the coming "surface traverse" mode) a coronal section of the third ventricle of her brain. User control of speed is by specification of interpolated frames between keyframes, via text window. User control of pose is by existing Edgewarp command functions in the left (worldview) window, where the sectioning plane can be viewed clearly as it creeps along the reference planes. Audiences have expressed great enthusiasm for these prototype filmstrips. The associated extensions of the Edgewarp kernel, which apply for both curve and surface traverses, consist of smooth linear interpolation of position and pose parameters jointly between keyframes of the script.

Two papers describing work under this contract have been published in volume 4121, "Mathematical Modeling, Estimation, and Imaging," of the familiar yellow SPIE Proceedings series. One of these papers, "Navigating solid medical images by pencils of sectioning planes," by Bookstein, Athey, Wetzel, and Green, is an overview of the mathematics of filmstrips. The other, "Inverting dedevelopment: geometric singularity theory in embryology," by Bookstein and new collaborator Bradley Smith, is an exploration in user interaction tools with an extension to change over time. Mr. Meixner will send these papers under separate cover.

Plans for the next two quarters:

The next deliverables from the Knowledge Engineering subgroup pertain to Y1Q4 (user control of the navigation interface) and Y2Q1 (provisional SURFACE TRAVERSE). Audiences for the current CURVE TRAVERSE demonstrations have emphasized the importance of the "left-hand window," which is freely rotatable during the playing of the filmstrip on the right. We will exploit this enthusiasm in the course of achieving these next two sets of goals. Rendered translucent segmented surfaces will be added to the left-hand (world-coordinate) view as soon as feasible, to improve the user's appreciation of the location/orientation of the moving section. At the same time, it will be added into the section image itself, in the form of a toggled one-bit graphics overlay. As for the August demonstrations, surface traverses for the Y2Q1 demonstrations will be produced by hand, using the kernel extensions that also drive the curve traverse; what differs are the graphical enhancements that the user must rely on to see where s/he really is. These same rendering enhancements will greatly improve the performance of the filmstrips' author, currently FLB.

Other curve traverses will be produced in collaboration with the Michigan Anatomy Testbed team (T. Gest, head).

Current filmstrip playback is limited to single 256x256x256 volumes of Eve as retrieved by the current EW-PSC retrieval interface. By Y2Q1 the handshake between EW sites and the PSC server will be strengthened to allow for client anticipation of additional volume requests as the current viewing frame approaches the edge of the currently retrieved volume.

User Interface Design and Implementation
Alex Ade

Description
With the completion of the UM Visible Human Java-enabled browser version 2.0 (v2.0), all goals for this quarter have been met. The browser features World-Wide-Web (WWW) delivery of cryosection, CT, and MRI Images at low, medium , or high resolution. Images may be viewed in one of three orthogonal planes, Transverse, Coronal, or Sagittal (Figures 1,2). The browser is multi-threaded, that is, tasks may be run simultaneously. Version 2.0 has full Relational Database Management System (RDBMS) connectivity, using Extensible Markup Language (XML) to transfer data, converted to HTML for display (Figure 3). The browser is also capable of displaying 3D, textured and shaded wireframe models embedded within the 3 orthogonal views. Currently, models may be rotated, translated, or scaled (Figure 4).

The Anatomy RDBMS set-up is complete. Oracle 8i Enterprise Edition software is installed and running on Sun hardware. Database design and table relations have been mapped. Populating the RDBMS has begun and is on-going. Also, server software is in place between the client and RDBMS to support a three-tier database architecture. Middle tier software delivers client requests to the RDBMS and returns XML data to the client. To optimize performance, the server software is multi-threaded.

The site's URL, vhp.med.umich.edu, will be available early November pending set-up of permanent server hardware.

Problems
Two problems were encountered this quarter; 1) many of the CT Female and Male, and Male cryosection images are out of register, and 2) the commercial-off-the-shelf RDBMS tools have been buggy, giving unpredictable results.

Resolution of Problems
Third quarter problems have been solved by 1), hand registering the CT Female and Male, and Male cryosection images, and 2) writing in-house software to populate the RDBMS.

Goals for Fourth Quarter
During the fourth Quarter, I plan to enhance the v2.0 browser by adding 1) the capability to play Quicktime movies of anatomy dissections, 2) reverse mapping of anatomical names to locations, and 3) arbitrary cutting. I will also add transparency and slicing capabilities to the 3D model viewer to mirror the native application I presented last quarter. I plan to continue supporting the RDBMS population effort by authoring in-house bridging software. Concurrently, I have begun developing a Java-based Volume Rendering engine which I will begin to integrate into the v2.0 browser.

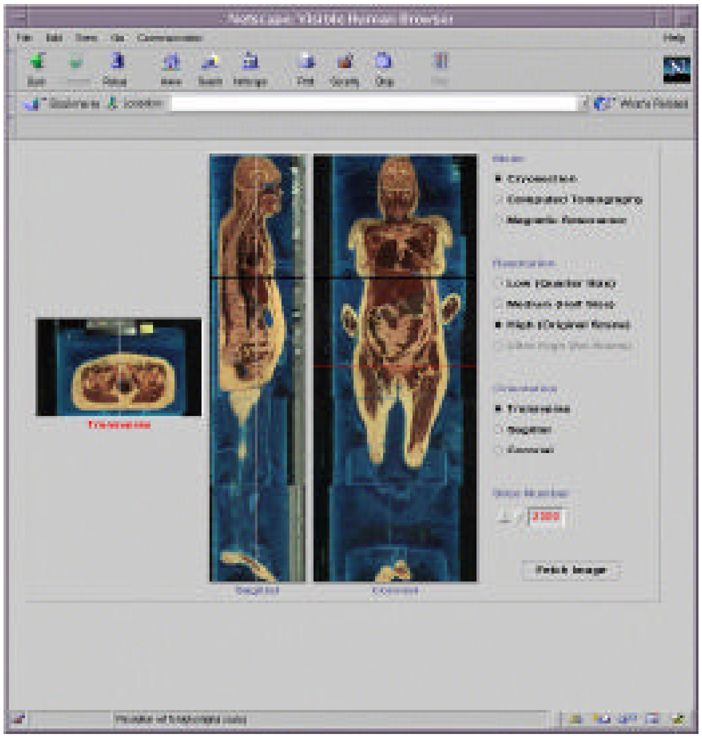

Figure 1: Main window for the version 2.0 UM Visible Human browser. From this page, one chooses image mode (cryosection, CT, or MRI), resolution (low, medium, or high), orientation (transverse, coronal, or sagittal), and slice number. Images are delivered via the WWW.

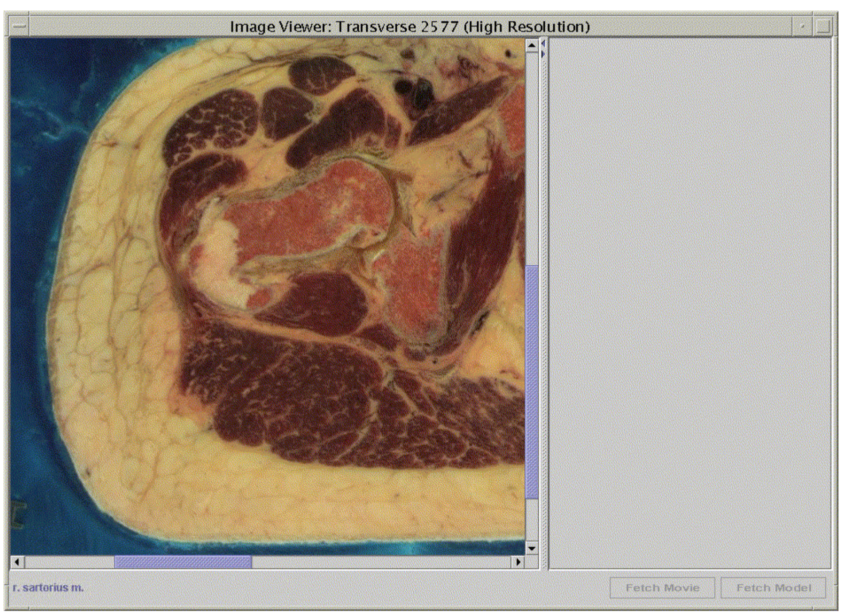

Figure 2: Image viewer window for the version 2.0 UM Visible Human browser. The image of choice is displayed in the left plane. The frame and pane can be resized. Control-clicking on the image will query the database and display the name of the feature present under the cursor.

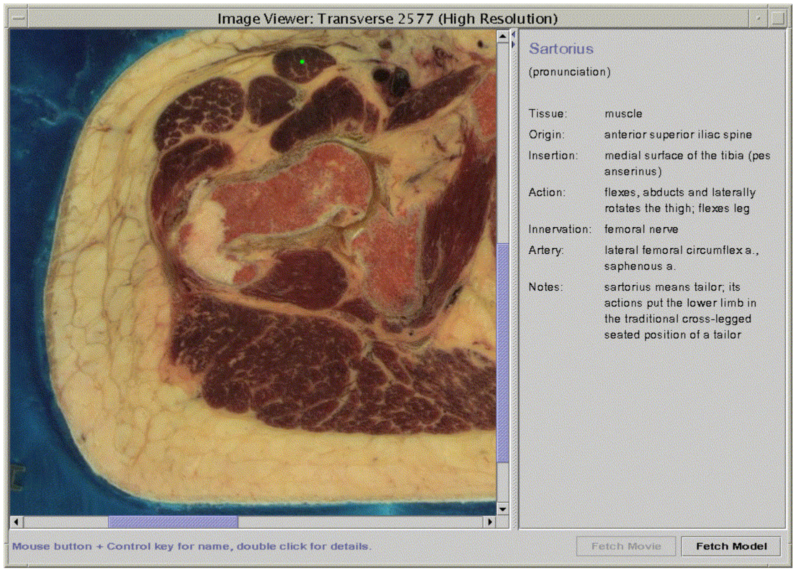

Figure 3: Image viewer window for the version 2.0 UM Visible Human browser. Double-clicking the image queries the database and displays detailed anatomical information in the right pane. Information is transferred as XML, converted, and displayed as HTML. The database also contains information about other datatypes, such as 3-D models and Quicktime movies. If available, buttons are enabled along the bottom of the window.

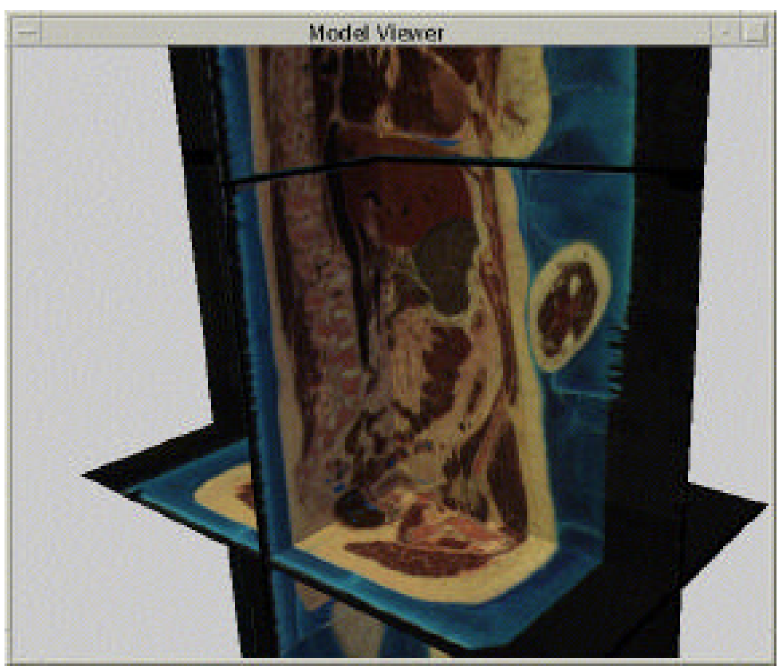

Figure 4: Model viewer window for the version 2.0 UM Visible Human browser. Displays 3D models embedded with the orthogonal views. Scene is textured and shaded.

Third Quarter PSC Visible Human Subcontract Status Report

1) Description of progress towards/completion of quarterly milestones & deliverables.

The major areas of progress this quarter are preparation for transmission of compressed volumetric data from the new ES-40 server platform, development of the mechanisms for efficient server based computation from compressed volume data representations, use of normal mesh methods for compressed surface representations, extension of anatomist supplied manual contours to intermediate layers and network tuning efforts leveraging the Web100 project.

We have been working with the Compaq ES-40 platform at PSC which is currently being shared between the Visible Human work and testing for the PSC Terascale project. In selecting the ES-40 we are taking advantage of the research that has gone into the PSC Terascale, which will contain nearly 800 ES-40 systems, and also the strategy for implementing its visualization nodes. (See Compaq's web page http://www5.compaq.com/alphaserver/es40/es40.html) The ES-40 is located in the Westinghouse Energy Center location where PSC maintains its large machine room. This site gives us access to the improved network connectivity and other services in place for the Terascale and other large PSC machines. Until this server is completely turned over to the VH project in early October it is running Tru64 UNIX rather than Linux. Nevertheless, the hardware is in place and, within the limits of shared use, is being used to complete most parts of the compressed in memory volumetric data service. A slighly larger ES-40, with faster processors and 2Gbytes of memory per processor rather than 1Gbyte each, is being ordered for delivery to the University of Michigan.

Volumetric data service is based on several layers of representation. Although the purpose of this service is to deliver most client data requests directly from main memory, there is also an original disk copy of the data which migrates into memory as the system begins operation. This disk layer uses 64^3 cube as the basic storage unit. In the memory representation this is broken down into smaller subcubes which are connected by a 3D matrix of pointers and tags which indicate the location and state of each of the subcubes in memory. The 3D matrix replaces the highest layers of an octree representation so that the server can directly jump to a small subtree which contains information about the contents of each cube.

In operation the server accesses the data structure to retrieve and deliver small compressed 16^3 "microcubes" to the client on demand. The PSC group will deliver a copy of the decompression code to be used in client software so the original data volume can be reconstructed their. For most client applications, the client will then use the delivered voxel data to produce Edgewarp views etc. In the case of potential clients which are not able to do their own decompression and view generation there is also the capability for the client to produce viewable slices. This mechanism of course shifts more load back to the server end and reduces that ability to take advantage of the rapidly increasing capabilities of client machines to offload this level of processing. Therefore, the preferred mechanism in actual multiuser operation is to deliver compressed microcubes so the collection of clients can act on them as parallel processors. We expect to go thru a tuning process during the next quarter using tools from the Web100 effort to adjust parameters related to prefetch and delivery of large sets of microcubes from a single client request determine the best settings for multiuser operation.

We have also been developing the API for server based computation using the same in memory data representation that is the basis for client services. The purpose of this work is to allow convenient use of the server machines for processing the datasets for continuing segmentation and similar work. It also provides for the generation of additional viewing mechanisms that do not completely fit the slice generation model. For example, the following images of the Visible Female spinal column used a spline curve from manually selected points to generate a warped coronal view that follows the curve of the spine.
See, http://www.psc.edu/~awetzel/vhimages.html and particularly
http://www.psc.edu/~awetzel/spinepath.jpg (Fig 1.) and
http://www.psc.edu/~awetzel/spine.jpg (Fig 2.)

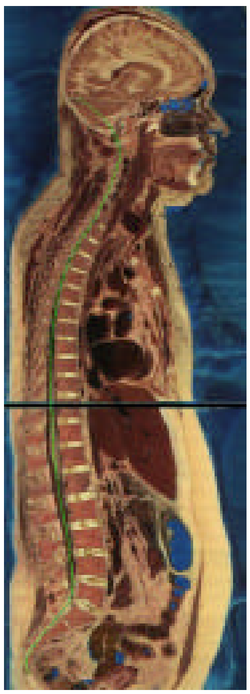

Fig 1.

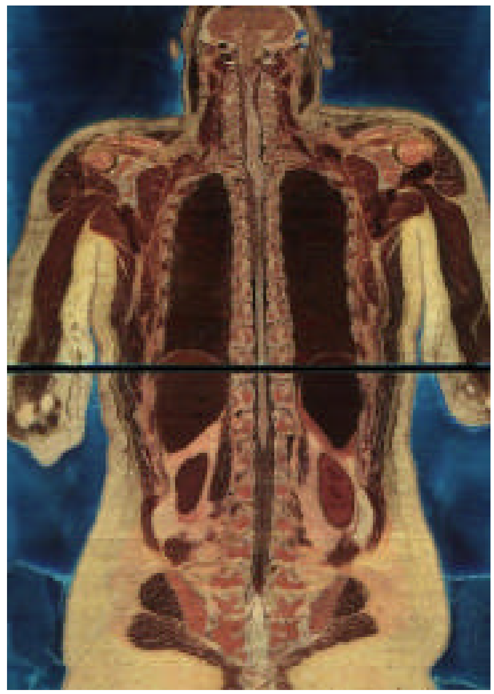

Fig. 2.

In most respects this server computation API is the same as needed for delivery of finished slice views to unprogrammed web client viewers. The initial version of this API is by a small set of routines to locate and decompress requested parts of the VH data volumes. We have also continued work on producing a device driver interface to achieve seamless memory mapped access to the data. Since this facility is not in the direct timeline for compressed volumetric delivery to clients and since it requires additional Linux kernel work this will not be released until the rest of the ES-40 data delivery is complete.

Although the volumetric data has the greatest need for compression techniques, we are also working on compression for improved delivery of surface representations. The explicit mesh representations needed for display by available hardware is unfortunately very inefficient in terms of compactness of representation. This greatly reduces the speed of access from servers and delivery of data across the network to clients. The method is based on the work of Wim Sweldens at Bell Laboratories and Peter Schröder at CalTech in multiresolution wavelets for modeling applications. The particular method, called normal mesh representation, takes advantage of the fact that most of the information carried in explicit mesh representations is redundant except for the displacement along the local normal direction. This is part of the technique that will be presented at October Visible Human conference.

Initial production of the normal mesh representation is by using the anatomist supplied hand segmentions of selected layers as seed contours. The work currently underway but not yet in production uses the statistics of pixels on both sides of the anatomists segmentation curves to guide the fill in of intermediate layer contours. Using the normal mesh method appropriate points on the surface are selected as the vertices of the normal mesh. Within the normal mesh each surface displacement is described as a single number (rather than 3) and the distribution of these normal displacements becomes very narrow and high sampling resolutions. This provides the basis for entropy compression and compact data delivery. The essential missing step which will be produced during the next quarter is to generate an explicit mesh from the compact normal mesh representation to allow rendered surface viewing.

Finally, the networking effort has been taking advantage of the autotuning and related performance monitoring work from the Web100 project and Matt Mathis' participation with the Visible Human project. The kernel portions of the network code are in place based on the Linux 2.2.14 kernel from the RedHat 6.2 distribution and have been undergoing tests on both Intel and single processor Alpha based machines. This provides fast user code access to read and modify critical parameters in the kernel networking system. The networking work as also been able to identify additional bottlenecks in the connection from the "vhserv.psc.edu" machine to remote sites. Part of this relates to some of the older routers which have been adequate for most daily uses but are not able to sustain the needs for VH data delivery. We are working with the networking group to produce the network interface code for the VH volumetric delivery module.

2) Problems encountered during this quarter.

The largest problem this quarter was the temporary diversion of so many people's time to aspects of the Terascale project. Additionally we had delays in getting ES-40 equipment and the posting of the new job position. Network performance has continued to be a problem from the PSC graphics lab to locations outside of Mellon Institute. We also have a number of work items in process that are not yet complete for delivery to the rest of the project.

3) Resolution of problems.

The posting for a new staff programmer that will be assigned 100% to the Visible Human project is now complete. We expect to fill that position within two weeks. Specific skills that are in the posting include OpenGl programming, network programming and data structures. Addition of this person will take care of the largest manpower gap in the implementation process. Additionally, one of our team members Anjana Kar, who has been working at the 30% level with our project has had part of her other work effort assigned to the Web100 project with Matt Mathis. Because we are using the Web100 results as a central part of our network implementation strategy this will bring both Anjana and Matt into a higher effective percent effort on the Visible Human deployment and we will also be taking advantage of other people on that project to assist with network setup and tuning on the ES-40 servers.

Despite the fact that Compaq has had shipment delays the existing ES-40 at Pittsburgh will be completely turned over to our use by Oct 15 and the additional machine for Michigan will come in shortly after that. The location of the PSC ES-40 will avoid most of the network problems because of its location in the WEC machine room where the high performance network connections are located. We are continuing to make improvements to the network infastructure at the Mellon Institute building but not all of that will be complete before the end of the year.

4) Goals for the next quarter & action plan for their completion

The first goal for the next quarter is reconfigure the PSC ES-40 for exclusive use by the Visible Human project. This work which will take place in mid October will replace the disks and install the RedHat 6.2 release. The networking codes will be installed and tested for correct operation in the 4 processor configuration.

Compressed volumetric data delivery from the memory based data structure will be the first service from the ES-40. We will provide the associated decompression routines and network interface code to the other members of the team. At that time we will begin a new set of network performance tests with particular attention to multi-user access.

The next major priority for the 4th quarter is to release server support for surface data delivery using both compressed and explicit mesh representations. This will also require insertion of landmark and surface tags into the tree structure along with a starting set of texture maps derived from the volumetric data.

By the end of the quarter we expect to be delivering both volumetric and surface data to intelligent clients. Generation of finished image views for non-intelligent web browser clients will be in place for part of the data. This capability will be tied to release of the central routines for the server data access API.

5) Next quarter needs

We have disk storage for the ES-40 to allow us to bring up the initial volumetric data service but not enough to duplicate all of the exising "vhserv.psc.edu" data. We need to examine which parts of that service to move onto the ES-40 and possibly transfer some of that disk to the new machine. However, it appears that we will need some additional storage as we work with the CT, MRI and 70mm data.

Also, the PSC ES-40 will have 1Gbyte of memory per processor (4 Gbytes total between the 4 processors) and we will evaluate whether that needs to be upgraded to match the configuration of the Michigan ES-40 based on actual test results.

Third Quart Report for the User Interaction Team of the NGIVH Project

The third quarter for the User Interaction Team was extremely busy. We were able to carry out almost all of our goals and deliverables. Our goals and deliverables for the third quarter were to:

1. Finish focus group sessions,
2. Use User Requirement Rubric to determine target groups and crucial interface tools,
3. Use user requirements to inform user interfaces,
4. Provide initial specs for modules,
5. Develop prototype navigation maps,
6. Develop criteria for feed back development,
7. Develop integrated data gathering from interfaces.

The third quarter accomplishments were:

1. Finished focus group session for all but Kinesiology, and Radiation Oncology which must wait till fall term for students to return.
2. Used User Requirement Rubric (URR) to determine target groups and crucial interface tools:
   User requirements identified from focus sessions
   User requirements categorized by UIT team
   Target groups identified.

These are shown in chart 1.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		VHP Test Beds --> User Requirements (problems and wishes)	Dental-1 Students	Dental-2 Students	Anatomy Faculty	Medical-1 Students	Medical-2 Students	Medical-4 Students	Nursing Faculty	Nursing Students	Surgery Faculty	Surgical Students	Ki[illegible]siology Faculty	Kinesiology Students	Radiation Oncology
2	change	anatomic variations													
3	change	changes due to disease													
4	change	changes due to gestation													
5	change	changes due to maturation and age													
6	change	dynamic visualization													
7	curriculum	connection to other coursework													
8	curriculum	identify what is important to know													
9	curriculum	features													
10	curriculum	need to know for exam													
11	curriculum	macro <-> micro (large <-> small)													
12	curriculum	learning assessment/grading													
13	learning process	collaboration													
14	learning process	connection to clinical practice													
15	learning process	interactions													
16	Learning tools	concept maps (knowledge organization)													
17	Learning tools	fun/enjoyable													
18	Learning tools	hyperlinked text													
19	Learning tools	knowledge integration													
20	Learning tools	flip between different representations (labels <-> organ)													
21	Learning tools	learning how to study/how to learn													
22	Learning tools	mnemonic devices													
23	Learning tools	motivation													
24	Learning tools	multiple levels & forms of user support													
25	Learning tools	navigation maps													
26	Learning tools	pronunciation													
27	Learning tools	self testing/review ("quiz cards")													
28	Logistics	greasy mices/computer location													
29	part-context	feel overwhelmed by detail													
30	part-context	feel that everything is equally important													
31	part-context	blood supply													

Chart 1. User Requirement Rubric (URR) Carl Berger 12/21/00showing target groups and themes

UIT team members rated requirements for each target group (Chart 2).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Deb Walker UIT	VHP Test Beds --> User Requirements (problems and wishes)	Dental-1 Students	Dental-2 Students	Anatomy Faculty	Medical-1 Students	Medical-2 Students	Medical-4 Students	Nursing Faculty	Nursing Students	Surgery Faculty	Surgical Students	Kinesiology Faculty	Kinesiology Students	Radiation Oncology
26	Learning tools	pronunciation	5	5	5	5	5	4	5	5	4	4	5	5	3
27	Learning tools	self testing/review ("quiz cards")	6	5	4	5	5	4	4	5	3	3	5	5	3
28	Logistics	greasy mices/computer location	2	5	5	5	5	4	5	5	3	3	4	4	3
29	part-context	feel overwhelmed by detail	5	5	4	5	5	4	5	5	3	3	5	5	3
30	part-context	feel that everything is equally important	5	3	3	5	4	4	4	4	3	3	4	4	3
31	part-context	blood supply	4	5	5	5	5	5	4	5	5	5	4	4	5
32	part-context	innervation	4	5	5	5	5	5	5	5	5	5	5	5	3
33	part-context	layers (pull back skin then fascia then...)	5	4	5	5	5	5	5	4	5	5	4	4	3
34	part-context	model stresses	3	3	5	5	5	4	4	4	4	4	3	3	3
35	part-context	relationships among parts	4	4	5	5	5	5	5	5	5	5	5	5	5
36	part-context	content features unique to test bed group	4	5	5	5	5	5	5	5	5	5	5	5	5
37	part-context	where things are located (not details) - normal anatomy	5	5	5	5	5	5	5	5	5	5	5	5	3
38	part-context	whole-part integration by location (an organ in its anatomic, spatial context)	4	5	5	5	5	5	5	5	5	5	5	5	4
39	part-context	whole-part integration by scale (from cellular level through tissue, organ, system, and entire organism)	4	5	5	5	5	5	5	5	5	5	5	5	5
40	processes	haptic interaction with data	4	5	5	3	3	4	4	5	5	5	3	3	2
41	processes	simulate surgical procedure	3	5	3	2	2	3	3	3	5	5	3	3	2
42	skills	dissection process information (how do I get there?)	5	4	3	4	4	5	3	3	5	5	3	3	2
43	skills	dissecting skills	5	4	3	5	5	5	3	3	5	5	3	3	3
44	skills	generate surgical prothesis	2	2	2	2	2	2	2	2	5	5	3	3	2
45	skills	processes unique to test bed group	4	5	5	5	5	5	5	5	5	5	5	5	5
46	skills	tactile feedback	4	5	5	5	5	5	5	5	5	5	3	3	3
47	spacial/3d vis	2d to 3d mapping (X-ray image or textbook drawing to anatomical	5	5	5	5	5	5	5	5	5	5	3	3	2
48	spacial/3d vis	3d models of parts (include "hands on")	5	5	5	5	5	5	5	5	5	5	5	5	5
49	spacial/3d vis	3d visualization - spatial reasoning	5	5	5	5	5	5	5	5	5	5	3	3	3
50	spacial/3d vis	logistical anatomy (following a structure from hither to yon)	4	5	5	5	5	5	5	5	5	5	5	5	4

Chart 2. Sample UIT member rating of requirements and target groups.

Each member of the UIT will b a beta tester for each target group. Ratings ranged from 1-not usable to 6 essential. The ratings were averaged and an overall rating rubric created.

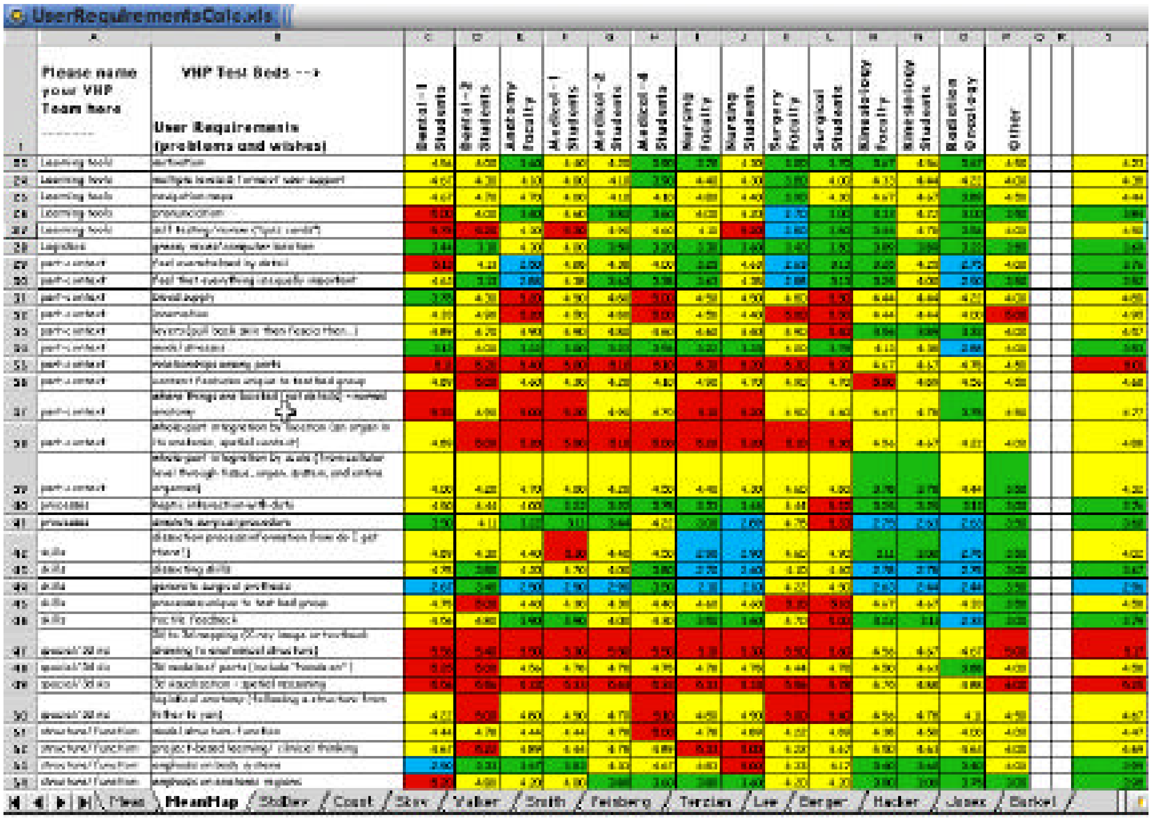

Chart 3. Average ratings color coded for low, ratings-blue to high ratings-red.

Ratings were sorted both horizontally and vertically yielding chart 4.

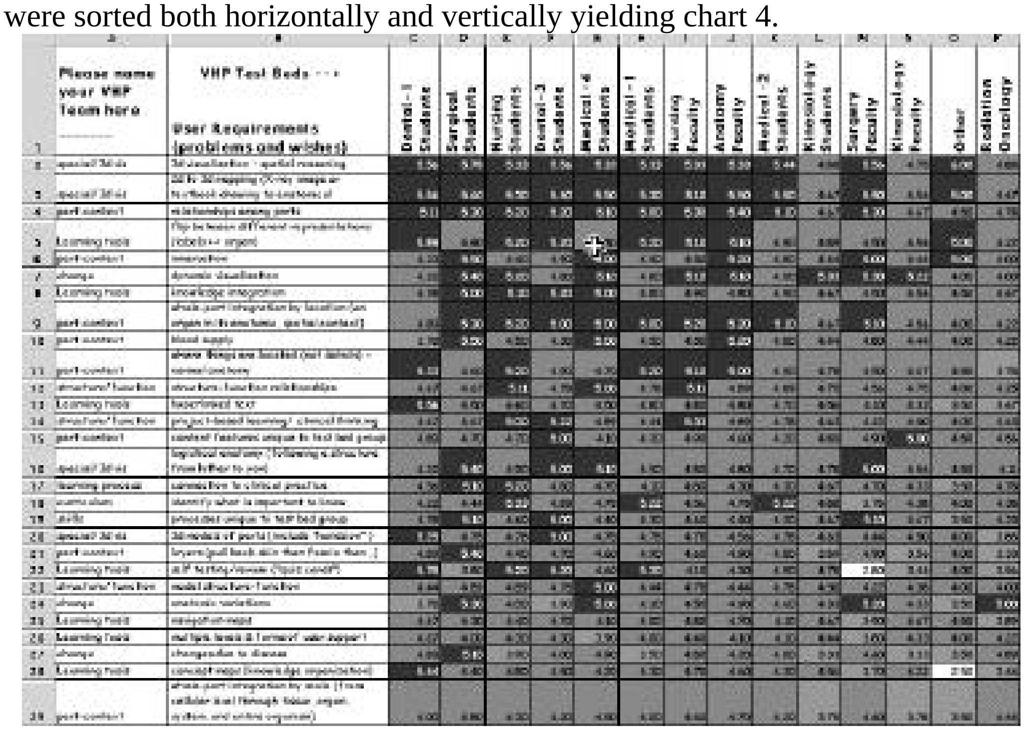

Chart 4, Average ratings sorted from most to least important both horizontally and vertically.

As a first, crude analysis, most important requirements for target groups gave an indication of similar target groups and similar user requirements. A more rigorous analysis included a hierarchical clustering of the target groups shown in Chart 5.

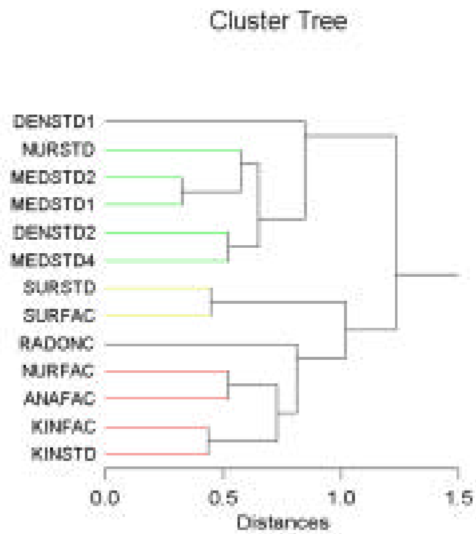

Chart 5. Hierarchical cluster analysis (complete, Euclidean) of target groups

In this clustering, dental nursing and medical students form a cluster with faculty, and surgical students formed another cluster. Conclusions of kinesiology should be withheld until focus group sessions are completed this fall.

The same cluster analysis was applied to the user requirements with the following results.

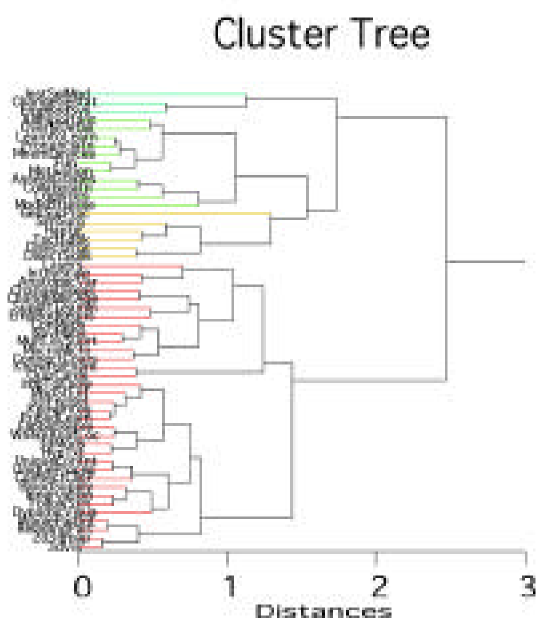

Chart 6. Hierarchical cluster analysis (complete, Euclidean) of user requirements.

While not easily readable in this report, the analysis was used by the UIT to start grouping user requirements into meaningful set interface design. (Chart 7)

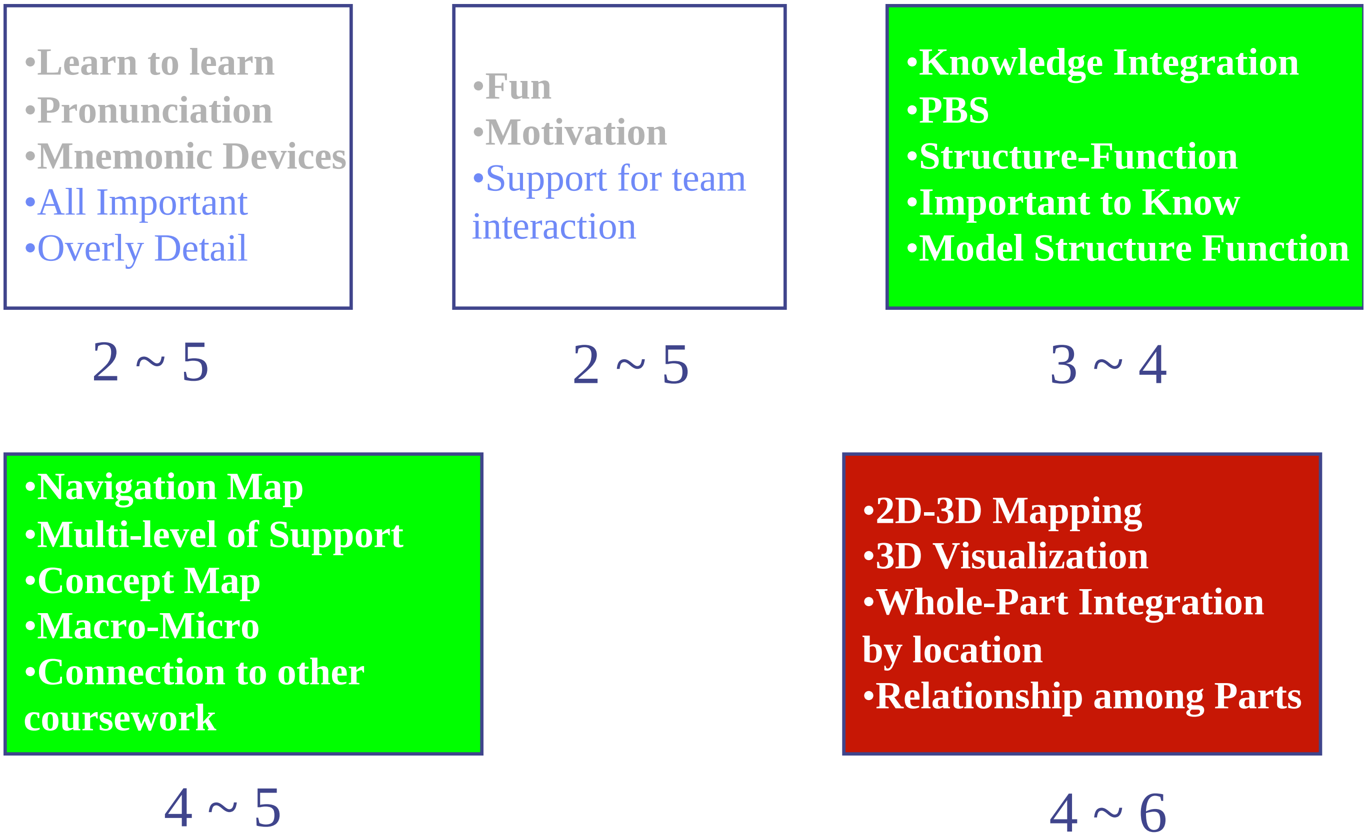

Chart 7. Initial grouping and importance.

From the analysis we determined that different interface designs will be needed for different groups.

In the fourth quarter we expect to further analyze the data to help set up prototype interfaces for student and faculty testing.

In addition to the above direct analysis we also:
1. formalized the relation with application team
2. started UMVH Web interface
3. started exploration of interface tools
4. initiated integration of Edgewarp with interface
5. initiated discussions with Apple for QuickTime development
6. reviewed literature on “Problem Based Learning in health care”
7. determined that a simple interface is needed for Edgewarp.

Third quarter problems

The following problems were identified in the third quarter.
1. strengthen interaction and relationship with other project teams
2. develop better in-project communication tools
3. develop early prototypes using tools from the application team (ex. Edgewarp)

Action Plan

1. Obtain Human Subjects approval for next testing phase
2. Select target groups from matrices analyses
3. Develop differing prototype interfaces for several target groups
4. Integrate tools from application team
5. Test tools and prototype interfaces

Goals for the fourth quarter

1. Finish focus group sessions with Kinesiology and Radiation Oncology
2. Continue analysis of User Requirement Matrices
3. Develop interface from user requirements
4. Test current user interfaces
5. Determine modules
6. Finish prototype navigation maps
7. Develop criteria for question development
8. Develop integrated data gathering from interfaces
9. Develop measure of learning to use with prototypes
10. Test 256x256 QuickTime movies to assess students ability to relate labels and structures
11. Gather Student background data gathered to benchmark learning outcomes assessment
12. Start User testing of tool use and analysis
13. Develop Questionnaires after tool use for impact assessment

In conclusion, the UIT has produced more than anticipated in the third quarter and we look forward to doing the same in the fourth quarter.

The User Interaction Team

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