

Full Integration of AquariusNET into the Radiological Workflow – A Technical Paper

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Introduction

In the recent past, three-dimensional images were primarily used as embellishments in books and publications. The clinical value of these attractive images was insignificant. The only possible application of 3D images was in the areas of education and illustration. However, with the introduction of new scanners, especially Multi Detector Computed Tomography scanners, the data production has increased dramatically¹ (Figure 1). Increased data production has made patient evaluation based entirely on the source images (axial slices) virtually impossible. Therefore, the use of advanced visualization and evaluation techniques became necessary.

Traditionally, advanced visualization and evaluation techniques were only available at customized, expensive, and dedicated workstations. There has been a recent trend of using mainstream personal computers to perform functions similar to dedicated workstations. However, these personal computers are not well integrated into the workflow of the radiologist.

The answer to this problem is the AquariusNET system from TeraRecon, Inc. TeraRecon is based in San Mateo, California. We purchased the AquariusNET system over a year ago and integrated it fully into our working environment.

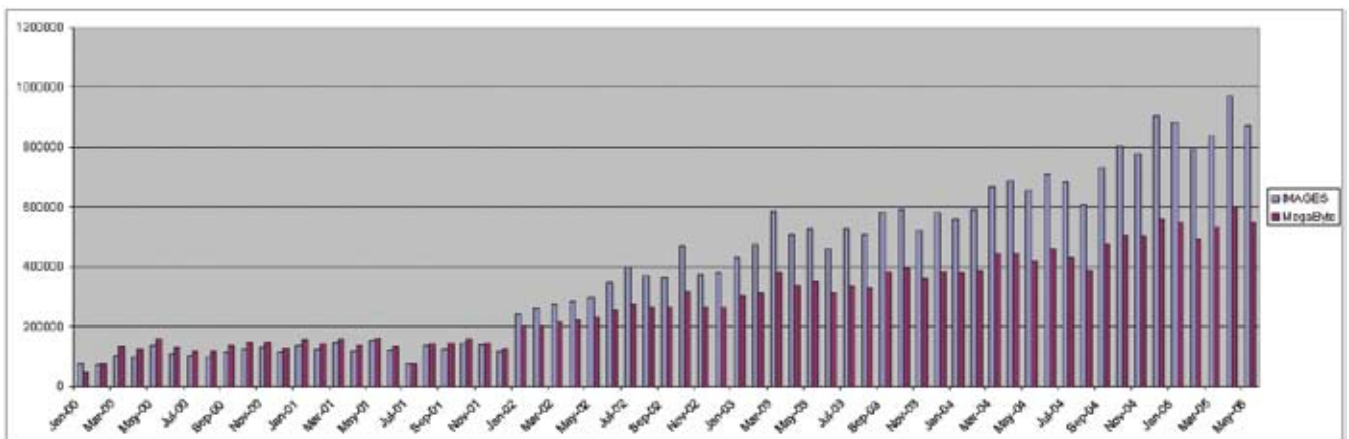


Figure 1 Data production per month expressed both in the number of images stored and the computed number of MegaBytes stored.

Technical setup

PACS

Our PACS was installed in 2000. (It is based on fast availability of all images within the archive and a high level of redundancy)^{1,2}. All workstations are connected through copper wiring (Cat5E cabling) to a dedicated radiology network using 1Gb/s connections. The radiology network, subnet of the hospital network, provides more bandwidth and a higher level of security. The uplink between the radiology network and the hospital network uses 1Gb/s fiber optic cabling. The images are provided to the radiological viewing stations through four identical (MASS) servers using load balancing. Using four servers increases retrieval speed and also ensures continued operation when a component fails. In addition, this concept allows for easy increase of capacity by simply placing another MASS server into the network. Three servers are connected into the PACS network as a speech cluster that handles the batch and on-line speech recognition, speech database management, and communication with the radiological information system (RIS).

The AquariusNET server has been added to the PACS setup to view 3D and 4D images. This server is connected to other parts of the system using a 1Gb/s Ethernet connection. Radiologists often tend to load CT data into the AquariusNET viewer directly after the CT scan, not allowing for the router to actively send the data into the AquariusNET server. This results in the AquariusNET server actively retrieving CT data even before it was routed. In order to avoid this problem, the auto-routing to the AquariusNET server has been switched off and the server actively queries the PACS for the requested series on demand.

Workstation Setup

The workstations used at our department run several software packages from different vendors to perform specific tasks. First, the HyperView software provides easy and fast access to all images stored on the archive. Next, the AquariusNET application provides easy and fast access to advanced three-dimensional images. Other software packages used are - ISP for both on-line and batch speech recognition, PoliPlus for access to the Electronic Patient File, and webmail.

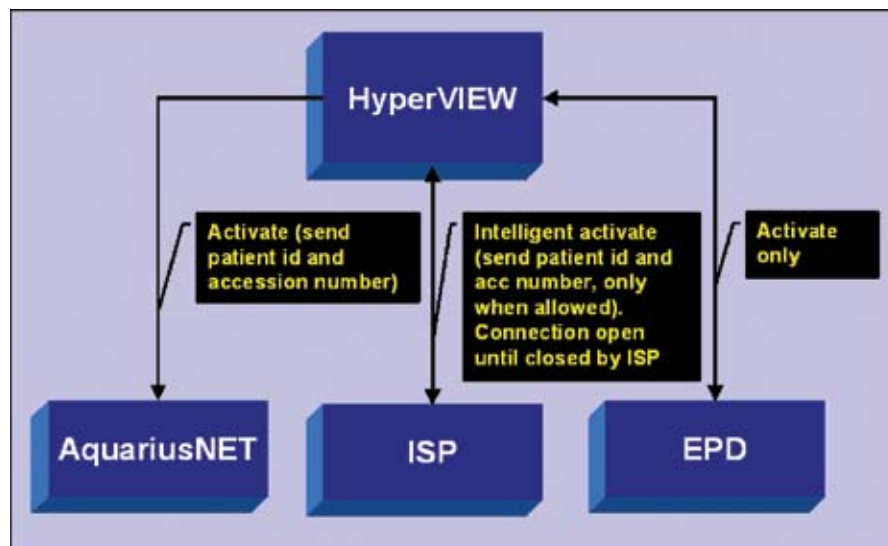


Figure 2 Schematic drawing of the different software packages and their respective current integration level



Figure 3. Our two-screen setup showing the HyperVIEW application on the computer screen on the left (black and white) and the AquariusNET viewer on the computer screen on the right (a). After the corresponding dataset is loaded into the AquariusNET viewer, an instantaneous 3D impression is provided (b).

Daily use statistics

The integration between the different software packages running on the workstations is realized at different levels (Figure 2). For example, integration between the electronic patient file (EPD) and the HyperVIEW is low, and is triggered only with activation of the application. Full integration is achieved between our speech recognition software (Intelligent Speech Platform (ISP)) and the AquariusNET client software. A button in the HyperVIEW activates

the AquariusNET client software and the accession number of the exact series under review is transferred to the AquariusNET client (Figure 3). Thus, the exact same dataset is retrieved and displayed in three-dimensional display. Additionally, automated login is achieved to reduce reporting time.

The graph displaying the number of instances of use per week clearly shows a positive trend (Figure 5). Finally, the average per weekday was calculated over

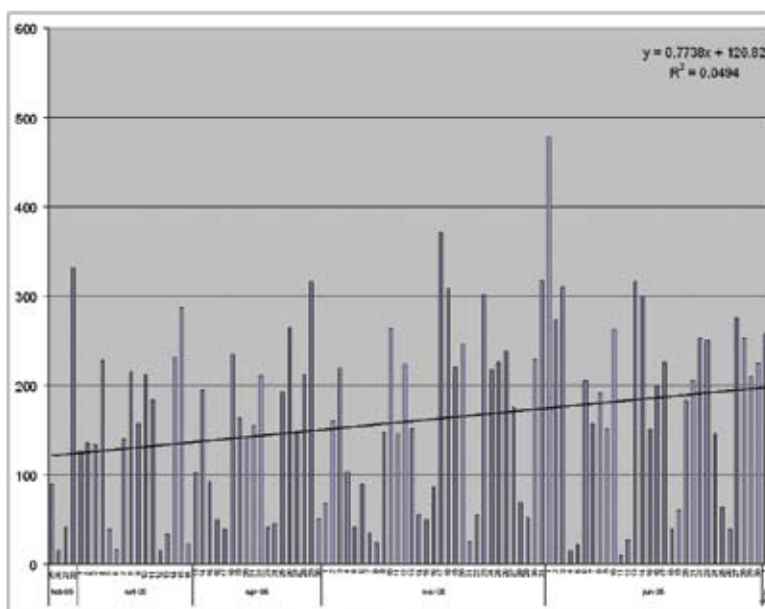


Figure 4. Recorded instances of use per day available in the login files.

the recording period (Figure 6). This again shows that during the weekends, the usage is low. The mean on the other days of the week are vary between 195 on Thursday to 240 on Tuesday.

Conclusion

Increased production of radiological imaging modalities also increases the demand for three-dimensional visualization. Instead of installing expensive hardware and software, we decided to integrate server-based software from different vendors into one single workstation. This resulted in a workstation with a high level of integration between different software packages each developed by specialists in their respective fields. We started off with an AquariusNET server with two VolumePro® boards having 1 GigaByte memory. After about a year of using this server, we suddenly got messages from radiologists that the AquariusNET was not

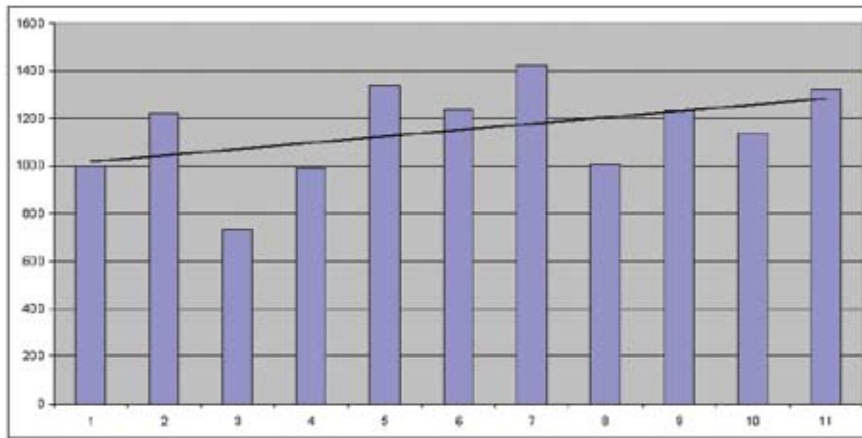


Figure 5. Recorded instances of use per week from April 22, 2005 until July 1, 2005.

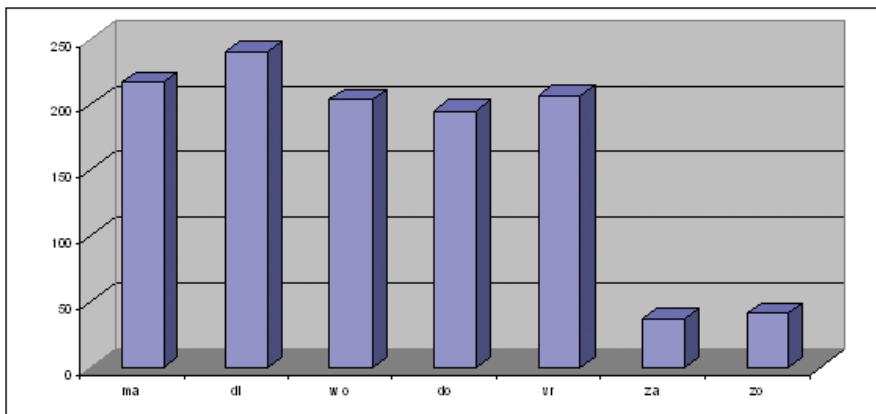


Figure 6. Mean recorded instances of use per weekday. Showing a similar usage throughout the week with maximum usage on Tuesday and minimal on Thursday. With very low usage on weekend days.

available. After analysing the problem reports and using the information on the management console, we deduced that the limitation of the maximum number of simultaneous users had exceeded.

This was caused both by the increased size of the datasets loaded and by more frequent use of the AquariusNET viewer by our radiologists.

To solve this problem and to allow our radiologists to fully utilize the capabilities of the AquariusNET server, we recently upgraded to a completely new AquariusNET server with two VolumePro® boards having 2 Gigabytes of memory each. Its total capacity doubled to about 7000 concurrent 512x512 CT slices.

Using old and recent log files, we were able to record the usage of the AquariusNET server on a daily basis. The number of instances of use was recorded per day (figure 4) and per week (figure 5) for a couple of months. The records indicated an increasing use of the AquariusNET application over the past months. The graphs demonstrate that the usage is much more intense on weekdays than on the weekends.

References

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