

iSite: advanced visualization tools and clinical applications

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iSite provides an integrated image and information workflow using an advanced communication protocol linked to a central server. This makes it possible to create a ubiquitous information system, offering fast and effective transfer of information and images within and between healthcare institutions, and paving the way to the integration of images and image related information into electronic patient records.

The versatility of the iSite platform lays the foundation for the fast and easy access to advanced image processing and analysis from any desired location.

The iSite workstations can be enhanced with a wide variety of advanced visualization and image analysis applications, including packages from various third-party suppliers. These applications can effectively increase the flexibility of the workstation, allowing users to perform a diverse set of image-related tasks during the same work session. An additional advantage is that it is no longer necessary for users to move around various systems in a department in order to get a task done.

This article reports on the capabilities and constraints of application integration on iSite, and presents some examples of practical applications.

Viewing and processing

Image viewing and processing capabilities are in a state of rapid evolution, driven by the broader adoption of archiving and communication systems, progress in the deployment of digital acquisition technology, the image data explosion, and the rapid increase of computer memory and computer power.

When integrated into iSite, with full PACS functionality, these capabilities become accessible from any desired location, with the added advantage of faster access. The result is a significant increase in flexibility and user efficiency.

Some of the viewing and processing capabilities are an integral part of the iSite system, while others can be integrated as optional extras. A number of Philips applications will become available on the iSite workstation soon, starting with a series of advanced visualization tools. However, the iSite concept also features a powerful and open application interface for the integration of third-party applications, offering a virtually unlimited set of specialized tools.

The impact of implementing advanced clinical application software packages on PACS has been discussed in previous publications [1-3]. This article focuses on the integration capabilities of iSite, and describes a number of practical applications.

Increased efficiency

Image and information handling systems are geared to efficiency: reducing waiting times for patients, improving quality and throughput of radiologists and technicians, and reducing overall costs. Only then will the investments in these systems pay off with satisfied patients and profitable hospitals.

Workstation performance and functionality is a key factor in obtaining this efficiency. Bringing the right tools, to the right people, at the right time, at the right place, helps to ensure optimal workflow in the radiology department, and beyond: in fact, throughout the healthcare enterprise.

Bringing advanced and clinical applications to the people who need them, in the working environment they are most accustomed to, means that it is no longer necessary for them to move around various systems in a department, possibly disturbing other people, in order to get a task done.

Application integration on iSite

iSite integration capabilities

Software applications can be integrated using the iSite Application Programming Interface (API).

► **iSite provides an integrated image and information workflow.**

► **Image viewing and processing capabilities are accessible from any desired location.**

The software development kit includes the API definition, documentation, tutorials and code samples to expedite the development process. Philips can provide assistance and review any chosen implementation to make sure it is the best approach for the user's specific needs. Some examples of the ways in which applications have been integrated into iSite are given below.

iSite Enterprise in Web-based Applications

The iSite Enterprise application can be easily embedded into a web-based application. iSite Enterprise is an ActiveX control that can be invoked from web pages through the use of a scripting language such as JavaScript or VBScript, or directly with an HTML OBJECT tag.

iSite Enterprise in Stand-alone Applications

Using iSite Enterprise in the C++, Visual Basic or .NET implementation is the most versatile way to use iSite. iSite Enterprise controls are used like any other control by placing them into windows or dialogs using Visual Studio.

iSite Radiology

iSite Radiology provides a COM/C++ API that allows other applications to control specific functionalities of iSite Radiology, or vice versa, allows iSite Radiology to launch and control other applications.

iSite viewer component integration

Applications can also integrate the iSite viewers to display images, instead of the integral application. In this case, a small subset of the iSite Enterprise API is available through the interface including the functions to log in and display images.

iSite advanced visualization tools

Modern imaging systems such as multislice CT, parallel MRI, 3D Ultrasound, and the combined PET-CT and SPECT-CT scanners, produce vast numbers of images, requiring new viewing tools. The viewing environment now requires far more than simply displaying the original axial images. For example, the reader may require a tiled layout with skipping of slices, a combination of consecutive slices with a maximum or average operation ("slice thickening"), or interactive MPR tools to allow direct coronal or sagittal viewing.

When the 2D image stacks are compiled into volumetric or three-dimensional (3D) data, direct projection viewing becomes feasible. Techniques such as maximum intensity projection (MIP), surface and volume rendering (VR), initiated from default presets, with interactive manipulation of view settings give direct access

to the 3D medical data. These capabilities are available in advanced image processing devices such as the Philips ViewForum workstation as well as in various third-party workstations.

Philips has now transferred a selection of these advanced tools to the iSite application. This selection was based on a detailed classification of the usage of the advanced tools by a number of experienced radiologists.

The data transmission for MPR, MIP and VR is optimized using iSyntax technology [4]. In iSyntax, the images are represented by wavelets, allowing the maximum amount of information to be represented by a minimum number of coefficients, without loss of information. This reduces the data transfer and network bandwidth requirements to the absolute minimum: only those voxels that are essential for rendering the desired reformat or projection image are transmitted. In low bandwidth situations the renderings can also be started with various compression levels of the original data sets.

The user interface has been further simplified and optimized in order to make the application as easy to use as possible for a broader user base. This results in the new iSite advanced visualization tools (Figure 1a-d).

The diagnostic value of 3D visualization is open to discussion. However, the 3D images are certainly of value as reference or roadmap images, where they give an intuitive and easily understood overview of the anatomy of interest, or provide a good spatial insight in complex three-dimensional structures. In addition, they have great potential in the communication of diagnostic findings to referring physicians, general practitioners, and the patient.

Nevertheless, the 3D images always need links to the original slice data for conclusive diagnosis.

iSite clinical applications

Philips applications on iSite

Philips has started to introduce some of its advanced analysis applications into iSite. Integration and validation of iSite VolumeVision and iSite Colonography [5] are planned for the near future (Figure 2).

Third-party applications on iSite

A large number of third-party application and system vendors have integrated their applications on iSite (Table 1). In most cases, integration has been done at the request of the iSite users, helping to optimize their working environment.

► **A selection of advanced visualization tools has been transferred to the iSite application.**

► **iSyntax technology transfers the maximum amount of information with minimum bandwidth requirements.**



▲ Figure 1. iSite advanced visualization tools. Figure 1a. Cerebral aneurysm. CT MIP & MPR. Figure 1b. Renal arteries. MR 3D reconstruction and MPR. Figure 1c. Carotid arteries. MR original images, MPR, MIP and 3D reconstruction. Figure 1d. Renal arteries. MR, MIP and thick MPR.

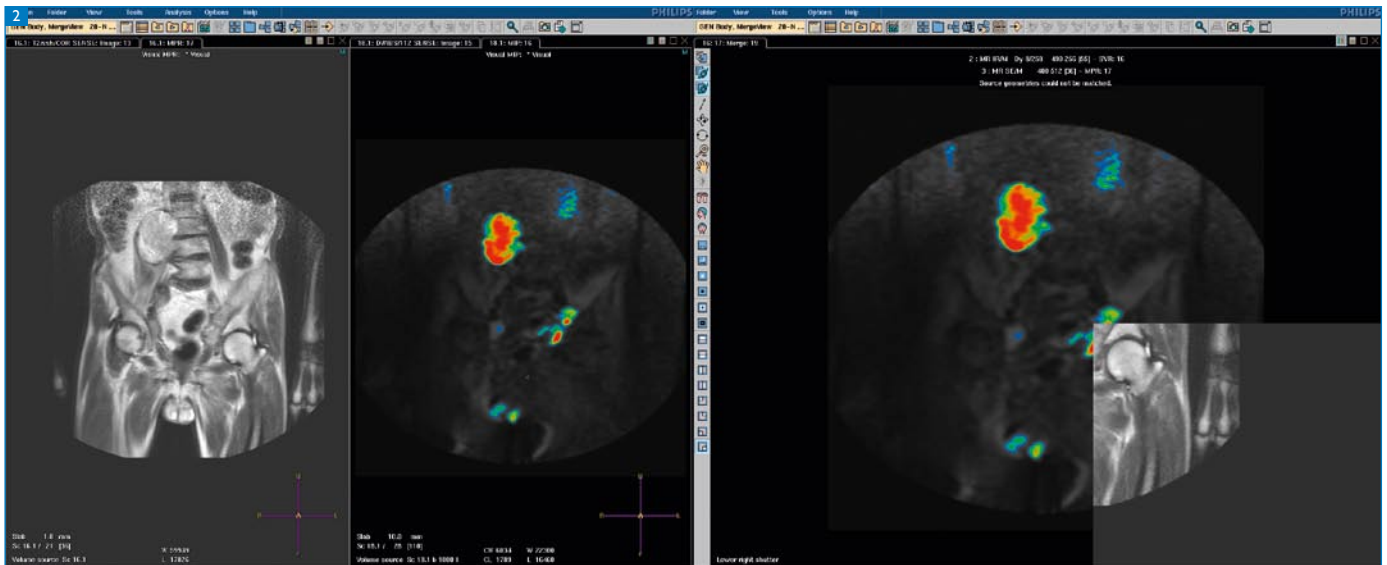
Customer application integrations on iSite
 Some users, particularly academic sites, have integrated their own image analysis developments on iSite. Examples include the Henry Ford Hospital in Detroit and the University of Pittsburgh Medical Center. Skilled software engineers find the iSite software development kit effective and easy to use.

Integration constraints

iSite has been designed for easy integration, and makes few demands on the equipment and expertise available on site. Nevertheless, certain minimum conditions must be met.

Hardware

Advanced software tools that process large amounts of (image) data typically require hardware configurations with a relatively high



performance, with respect to both processing power and computer memory. The workstation hardware and network bandwidth will need to be optimized for the use of multiple applications on the same computer.

Displays

Typical PACS workstations are equipped with both low-resolution color and high-resolution grayscale displays. Some applications may need color, e.g. for native visualization of color Doppler US or for 3D visualizations using color. The iSite API allows applications to be launched on either the color or the grayscale monitors. iSite's advanced visualization tools can then operate on the color monitor for such applications as 3D volume rendering, and on the pair of grayscale displays, e.g. for large coronal or sagittal reformat images.

Intended users

Clinical software applications may require specific user training to ensure proper interpretation of results and to avoid potentially dangerous misuse. Within iSite the launch of specific applications can be limited to authorized users through individual user profiles.

On the other hand, it is possible to make selected applications available to various users in the clinical enterprise, allowing them access to a richer view of e.g. isotropic 3D volumetric data or fused multi-modality images.

Application design

Advanced and clinical applications are typically designed for a specific and dedicated system, such as a modality console or workstation, a treatment planning system, etc. Bringing such applications into the context of a universal workstation may

necessitate significant changes in the application design.

The image data needs to be selected from the work list or primary viewer and loaded from the central storage or archive. Result images and other data often need to be sent back to the central archive.

When the application generates texts, such as reports or numerical tables in text only or rich text formats (e.g. rtf or pdf formats), these need to be integrated into the normal reporting tools of the image and information handling system.

Finally, the design of the user interface of the application needs to be sufficiently consistent with the user interface of the workstation. If not, conflicting user interface concepts may confuse the user, and result in an unusable system. This is particularly important for mouse usage, screen layout, button icons and terminology.

Impact on work flow

iSite is designed to optimally support the workflow of a radiology department. The integration of clinical applications with the iSite viewer applications allows optimization of the workflow by combining multiple tasks on the same work spot.

Work lists and examination states are continuously tracked and adapted to ensure an efficient flow of patients, images and reports through the department and the hospital. Some hospitals have experimented in driving workflow from applications that are integrated with iSite instead of leaving workflow control to iSite itself. Future extensions are expected to allow an even broader flexibility in workflow

▲ Figure 2. iSite advanced analysis tools. MR of the abdomen. From left to right: T2 weighted anatomy image, color-coded diffusion weighted image, and fusion of the diffusion information on the anatomy image.

► **iSite is designed to optimally support the workflow of the radiology department.**

► **Integration of clinical and viewer applications allows multiple tasks to be performed from the same workspot.**

Product Name	Solution Type	Sold By
<i>Enterprise Solutions</i>		
VA CPRS	EMR	CPRS
Hyperspace	EMR	Epic
LastWord	EMR	IDX
MediTech PCI	EMR	MediTech
NetAccess	EMR	Siemens
VistaWeb	EMR	VistaWeb
Elysium	Portal	Axotl
Physician Portal	Portal	McKesson
EmpowerNET	Portal	Park City Solutions
<i>RIS PACS Solutions</i>		
EasyRIS	RIS	Philips
RADOffice	RIS	WDS
Xiris	RIS	Ximis
<i>Mini PACS Solutions</i>		
Encompass	Cardiology Workstation	Heartlab
TCS Symphony	Cardiology Workstation	MedCon
<i>Imaging Solutions</i>		
Voxar 3D	3D Imaging	Barco
AcquariusNET	3D Server Rendering	Terarecon
Vitrea	3D Workstation	Vital Images
Orthoview	Orthopedic Templating	Orthoview
MIM	PET-CT Fusion	MIMVista
MedImage	PET-Nuc Med Workstation	MedImage
<i>Dictation Solutions</i>		
DictationLink Lanier Integrations (Telephony Systems)	Dictaphone C-Phone & Primordial	
Talk	Dictation & Speech Rec	Agfa
PowerScribe	Dictation & Speech Rec	Dictaphone
Fusion	Dictation & Speech Rec	Dolbey
SpeechQ	Dictation & Speech Rec	MedQuist
Millenium Reporting Module	Dictation & Speech Rec	ObjectForge (for Cerner)
ChartScript/MD	Dictation & Speech Rec	SoftMed
WinScribe	Dictation & Speech Rec	WinScribe
EWS	Enterprise Dictation	Dictaphone
<i>Workflow Solutions</i>		
Vergence	CCOW	Sentillion
Rimage and Primera tools	CD/DVD Burner & Label Printer	C-Global Systems
PACSGear	Image and Paper Scanning	PACSGear
Percipio	Order Entry & Scheduling	Medicalis
Aventail	VPN Extranets	Aventail

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Table 1. Third-party applications on iSite.

interactions between iSite and third-party applications.

Reporting

The reporting results of clinical applications need to be viewable and storable in iSite and/or the RIS. This is crucial since the billable steps in each medical procedure need to be traced and documented. The applications must therefore be integrated with the normal report flow. iSite allows third-party applications to add images to the data storage for later distribution and viewing.

Conclusion

The iSite workstation can be enhanced with a wide variety of advanced visualization tools and image analysis applications, integrated with the main viewing application, sharing the patient and exam context. This can effectively increase the flexibility of the workstation, allowing users to perform a diverse set of image-related tasks during the same work session.

iSite's advanced visualization tools show the benefits of deep integration of 3D viewing tools within the iSite environment. Various Philips and third-party application integrations have shown benefit to the majority of iSite users.

Future challenges are related to the image loading and image processing performance of more advanced applications, and the integration of image analysis applications with (structured) reporting tools.

References

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