AMIE

Esprit Project 8610

1. Life before AMIE

The AMIE pilot installation at St James's Hospital in Dublin

a photographic essay

At the Department of Cardiology, doctors meet every Tuesday to discuss any non-normal or difficult cases, e.g. any that might require angioplasty or surgery.
Each patient may have undergone many examinations (chest X-ray, ECG in various forms, echo ultrasound, doppler ultrasound, nuclear medicine, coronary angiography etc) which his/her doctor will have seen; but, due to time constraints, at the conference the doctors generally only discuss the angiograms, which are the most definitive test in the detection of coronary disease. Results of all patient examinations are discussed by the cardiologists at the conference prior to the viewing of the angiography sequences. Patient notes, with results of all examinations, are at hand throughout the conference for reference purposes.

Angiograms are video clips showing moving X-ray images of major blood vessels. The X-ray machine produces a roll of conventional cine film that later needs to be developed by chemical means. Here is a roll of cine film coming out of the developing machine.

The doctors arrive at the conference with a pile of such cine film rolls, one for each patient to be discussed.

The presenter only has a few minutes for each patient, so he starts discussing the background of the case while he loads the projection machine with the appropriate film.

Then the lights go off and the doctors review the cine film together.

Then the lights are switched on again, another cine film is selected and loaded and another case is discussed.

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2. A multitude of data types

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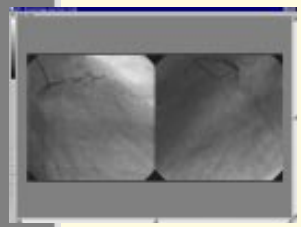
With AMIE, the medical sequences and images are displayed on a large-screen digital video projector. It is driven at 1152x864 pixels, 24 bits per pixel, by a PC running Windows 95.

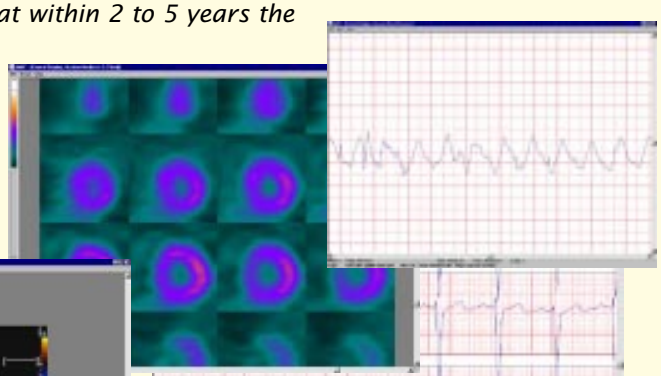
A distributed system controls the setup. The control pad is a Windows 95 application that runs on a pen-based laptop. It presents an organised view of the available patient records and lets the doctor recall any desired data item on the video projector. It has controls for image enhancement such as brightness, contrast, zoom and artificial colouring.

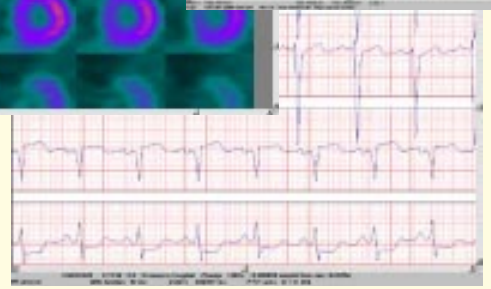
All the data types used in the cardiology department are supported: among these are textual patient notes, angiogram movies, ultrasound movies, ECG graphs, X-ray pictures and more. Some of these items, like the ECG graphs or the patient notes, are very easy to deal with on a computer; but some others, like the movies, have very stringent requirements in terms of resolution, frame rate and colour depth: the DCI (digital cardiac imaging) movies, for example, require grey scale frames of at least 512x512 pixels, 256 greys, and a sustained rate of between 10 and 50 frames per second. No image degradation is accepted, as this would impair the diagnostic quality of the data. This rules out any form of lossy compression.



A first rough estimate placed the data for one patient at approximately 250 MB. In practice the actual size is very variable depending on the number of examinations undergone and the length of each image run. During the field trial it was not uncommon to generate up to 600 MB for a patient undergoing all the tests. All the diagnostic results are archived on ATM networked RAID-3 arrays in the machine room. Each array contains 5 discs of 2 GB each, for a net RAID capacity of 8 GB; three arrays are used for the pilot, for a total storage space of 24 GB. This is equivalent to a minimum of 36 patients if each one of them gets a complete set of diagnostic exams; more patients will fit in if some require fewer tests.

The 2 GB discs were the largest commercially available drives when the prototype storage unit was built. In just three years, 20 GB drives with the same form factor have become available: these would yield RAID arrays with a capacity of 80 GB. Besides, optical tape drives are now available which hold 5000 GB. It is thus reasonable to assume that within 2 to 5 years the current storage needs of the entire hospital could be covered by a suitable combination of disc and tape storage units.





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3. An integrated, distributed, scalable multimedia environment

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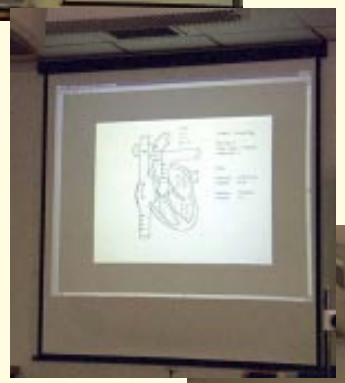
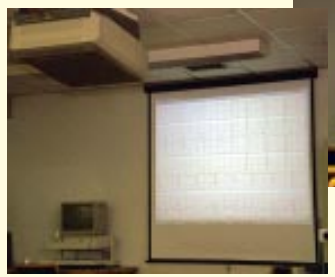
Indexing and retrieval of individual items is of course rather more convenient on the AMIE system than on the conventional archive; there, you have to search one library for X-ray images, another one for cine-films, yet another one for videotapes and so on. In AMIE, all the data is available online in a searchable central database.

A video phone system allows doctors to participate in the conference even when they can't leave the intensive care ward. The video window appears on top of the main diagnostic display but without obscuring it. Participants at both ends can then discuss the images being shown and point at details with a mouse- or pen-controlled cursor.

The data is routed over optical fibre from the machine room to the seminar room via ATM switches. It is then cached locally on the PC that drives the display.

The laptop unit is equipped with a wireless radio transceiver whose antenna sticks out from the side. This PCMCIA transceiver is compatible with various types of commercially available laptops and in the AMIE pilot it has been successfully used on off-the-shelf Toshiba machines. It talks to the radio base station which connects it to the rest of the network. The laptops can also be used to take notes during the meeting using the AMIE handwriting recognition system.





AMIE integrates all the medical data discussed at the cardiology conference in a distributed and scalable digital system. All the data items are available though the same Windows-based user interface, with no time penalties in switching from one data type to the other. The pilot system is an excellent proof that AMIE's integrated multimedia approach is a success: when they use it, the doctors are keen to show all the available data items, while with the traditional system they generally limited themselves to the cine-films. Ironically, though, their complaint about AMIE is that discussing patients on the new system takes too much of their time...