Requirements for a new generation of
Personal Digital Assistants intended for medical use[1]

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Abstract: This paper introduces requirements on Personal Digital Assistants (PDAs) targeted for medical use. Special attention has been given to the requirements within medical imaging departments. The gathering of data was done by a questionnaire that was filled in by medical staff from Spain and Germany.

The Multimedia Terminal Mobile (MTM) project is an EC funded project that aims to develop hardware as well as software for a PDA that uses next generation broadband transmission. The PDA device will introduce new solutions within clinical decision making and be equipped with special software to allow increased access to medical expertise. This is enabled through integrated services such as wireless connection, capability of data and video exchange, Internet access, e-mail and voice messaging. Possible application scenarios are: in-house

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communication, image and report delivery to referring hospitals, remote reporting, neuro surgical emergency consultation, bedside access to patient data, increased access to senior staff, radiologist in contact with modality.

1. Introduction

In medicine, and particularly within its highly specialized areas, the access to domain experts is limited for many practical reasons. It is also the case that access to medical data — such as electronic medical records, patient images, and laboratory results — is often limited by physical properties. In general, the main difficulty is that medical data is not available or accessible at some point: because it is not physically there, because the expert is not where the data is, or that data cannot be accessed without time-consuming manual procedures.

In order to address some of these issues, the MTM consortium is working on a solution by developing a PDA with special capabilities, such as high speed communication using Universal Mobile Telecommunication System (UMTS), possibility to send and receive video, access to data such as web pages and e-mail.

2. Materials and methods

2.1. User group

The questionnaire was distributed to physicians in Spain and Germany. All physicians work at imaging departments, most of them at radiology departments. 40 physicians filled out the questionnaire. The user group represents a total of more than 400 years of expertise in their respective fields.

2.2. Medical Scenarios

Each scenario is a realistic description of how the PDA could be used to solve some specific problem. The rationale behind the scenario-based approach is that it allows us to ask more detailed questions, and users still are able to understand the context of the questions. It also

provides a means to contrast different solutions and options in relation to each other. The scenario descriptions below are edited to fit into this context.

2.2.1. Neuro Surgical Emergency

If in need of help with a head injury, the physician at the emergency intake makes a connection to the expert's PDA, and then transmits the vital head scans to the expert's PDA. The expert will get an acoustic or mechanical signal indicating incoming message. With voice connection the expert can immediately decide which further images have to be transferred. After the decision about the procedure the expert can give some feedback, or can mark points for a surgical approach in the images.

2.2.2. Bedside access to patient data

The PDA hardware is equipped with a bar code reader. The patient or the patient's bed is given an ID in the form of a bar code. This bar code identifies the patient. When a group — of one leading physician, other physicians, medical students and other staff — enter the room of a patient for the medical round, they first scan the bar code and then the applications running on the PDA knows what patient to fetch data for. The group can then access these data through a web-like interface and, for example, view the 10 last images of the patient in question.

2.2.3. Increased access to senior staff

The PDA is used instead of a conventional pager, allowing attending and senior staff to reply directly to imaging questions from junior radiology staff. The junior staff sends messages (like e-mail) to the senior staff with questions and images attached:

- The hospital's senior radiologist is backing up junior staff while being at home during night shifts. The radiologist receives images either to answer difficult questions, to decide on further procedures, or whether she/he has to come in.
- A neurosurgeon on call can decide directly from the images whether a patient needs operation or conventional treatment.

2.2.4. Radiologist in contact with modality

With a PDA device and voice connection to the Radio Technician, an experienced physician can monitor the progress of examinations from anywhere inside or outside the department, in order to prevent unnecessary irradiation of the patient. The PDA will have a buffer showing a number of intermediate images taken to allow for better overview.

**2.2.5. Access to functional MR specialist**

If the possibility of contacting with specialized reference centers exist (through the PDA) and an experienced specialist could validate functional MR examinations, it could be anticipated that these kind of functional explorations would spread, with benefit for patients as well as for MR units.

3. Results

3.1. Communication capacity

Users indicate extremely high demands for fast communication. A typical image has 12 bits depth (but stored and handled as 16 bit), and resolution is most often between 512^2 and 256^2. This translates to an image size of about 500 KB, or 130 KB in the case of a smaller image.

Fig. 1 What is the maximum delay that should be permitted when waiting for one image of 1MB?
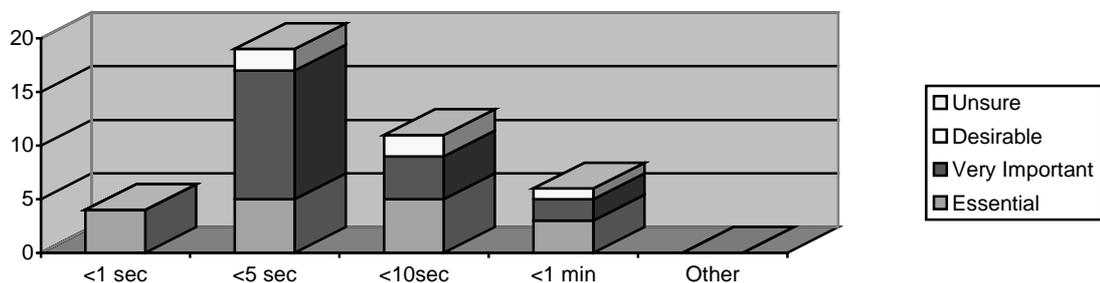

User's wishes in transfer speed corresponds to a 200 kB/s transfer rate. The maximum UMTS transfer rate is 384 Kbit/s (i.e. 48 KB/s), resulting in a single file transfer in about 11 seconds. For some scenarios this performance is not enough and the PDA will therefore also need to be equipped with, for example, wireless Ethernet for more demanding in-house applications. This protocol provides speeds up to 11 Mbit/s.

3.2. Display

Users do not prefer to reduce display size in favor of reducing PDA weight and size. Color display is not required by all. Many gray levels are wanted. It can be noted that, in comparison to what's available on the market, users have high expectations on display size and resolution.

**Fig. 2 What would be the ideal screen size? (In pixels, width x height)?**
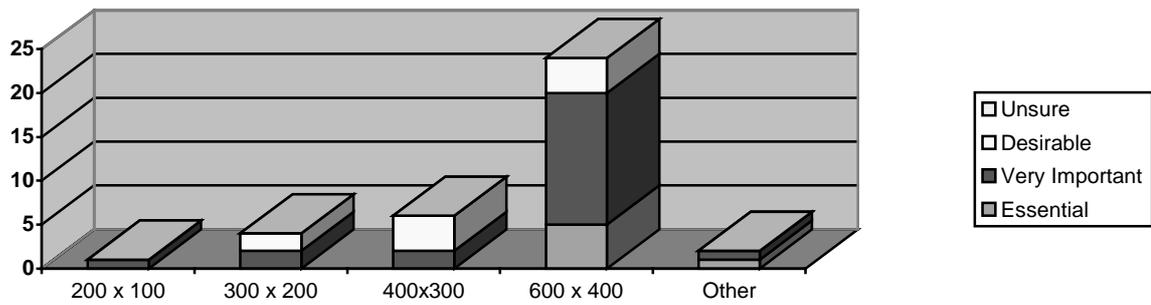
3.3. Software Platform

Users indicate they appreciate open software environments, compared to proprietary solutions, and many users even would be interested in developing their own future applications!

We believe that the reason behind the strong focus on open platforms is because many departments are getting more and more comfortable with not only using computers but also complex software packages. Many departments have experience in fine-tuning and customizing software for their specific local needs, and the decision to develop their own applications is therefore not that big a step.

Fig. 3 How much would you like the idea that the platform for MTM would be "open" and programmers all around the world would program for your device?
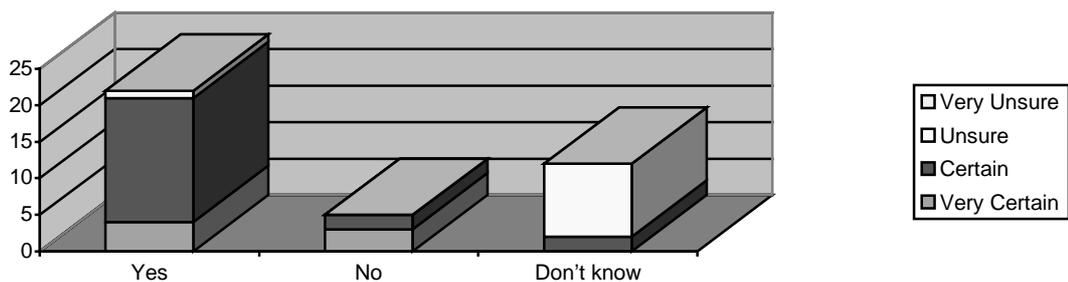
To further expand on the issue, about 75% of the medical users would appreciate an open environment for development. About half of the respondents said they themselves would like to have a go at development! We believe the open systems character is one of the most important findings derived from the questionnaire.

3.4. Scenarios

Neuro surgical emergency consultation is regarded as the most important application area followed by Increased access to senior staff as second.

4. Acknowledgments

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