School of Informatics
The University of Edinburgh

Project Proposal for Informatics MSc project 2005.

“Adoption of handheld computers in medical health care”

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Introduction

Digital wireless technology has proven a valuable addition to many organisations and areas of business. Although the technology has been available for a decade, it has yet to be adopted by the majority of health care institutions. This study will address the feasibility of handheld computers in a medical environment. It will summarise regulatory constraints as well as current projects that affect development in this field. An overview of existing systems will be presented, and strengths and weaknesses with their use will be analysed.

Software that simulates digital patient records will be developed and installed on a carefully selected piece of handheld hardware. The device will be sufficiently sophisticated so that it will have a broad range of uses, and selected test users will be urged to use it for personal purposes as well as for work. Feedback from the user-questionnaires will be analysed and presented back to them, to establish their real thoughts about the intended system. The obtained data will be compared with feedback from users who have used a handheld device solely for work purposes.

The results may show if familiarisation with the device, and a stronger dependability outside work, will make adoption easier within the institution. The final report will include advice on both hardware and software to be used in a medical environment.

Purpose and Motivation

“We are finally approaching the stage of evaluating handheld computers as tools that can contribute to the clinical process, rather than just admiring them as miracles of miniaturisation.”

Dr Mohammad Al-Ubaydi, Guest Editor, UK Health Informatics 2004 [1]

A broad introduction of digital patient records during the 1990s was the start of an increasingly effective way of storing and retrieving patient data in hospitals and doctors offices. Over the last decade computers have been distributed in wards and offices, so that a patient’s clinical data can be retrieved and altered. Equipping medical staff with handheld computers has been tried, with varying degrees of success [2, 3, 4, and 6]. Although Chelsea and Westminster Hospital in London have used the technology for ten years [6], there has been no formal introduction of a mobile system through the NHS to this date. Work is in progress on digitalising all patient records nation wide through the National Programme for IT (NPFIT), a process that is claimed to be completed and running in 2010. This project will also connect all NHS institutions to a centralised network.

Is the use of hand held devices feasible in medical health care? To answer this we need to look at several factors. Security, reliability, technology and user friendliness play important roles to different shareholders, which is addressed in this review. It proves to be more than a straight forward implementation project. Holleran et al. [2] report on their usability study in 2003 that “most physicians were enthusiastic about the possibilities of wireless technology, however were disappointed with the performance currently provided. More than half felt as though this was a worthy addition to their clinical toolkit.”. Nevertheless, a great problem with deployment is that decisions whether to adopt mobile technology or not is taken by the physician in charge of a ward [6]. This means that some departments may turn down new technology, whilst others adopt it. Those who have rejected it have done so on the grounds that it is too cumbersome, too complicated, the menus are badly organised, and because the screen is too small [2,3,4,5,6].

Current trends in handheld technology suggest that features from a variety of individual tools are combined in modern handheld computers. Examples are personal digital assistant (PDA*) features, phone, camera, email and web browser, and wireless networks. The manufacturers benefit from the mass market opportunities that result from the variety of uses that the devices offer. Small additions to

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* For readers who are not familiar with technical terms surrounding handheld computers and wireless networking, a glossary can be found at http://www.chin.gc.ca/English/Digital_Content/Tip_Sheets/Pda/glossary.html
the physical hardware lead to a much more sophisticated product, and the handheld computer market is therefore steered in this direction. Because of this integration of features in commercial products, the need for a device tailored for use in a medical setting is diminishing. Modern handheld computer that are available on the market can be of much greater use then just for keeping track of patient data. A doctor may for instance find it useful to take a picture of an infected wound and send to the specialist for comments, or communicate with co-workers in text in a virtual chat room.

This project will analyse the feasibility of multipurpose handheld computers in medical healthcare. A simulation software that acts as the hospital environment will be implemented on a selected device, to give test users a feeling of what such a tool can do for them at work. In contrast to most previous studies, the device will be configured for each individual user. Personal email and files can be accessed when the device is used outside of work, and the full power of the handheld computer can fully utilised. For instance, the device replaces the mobile phone, works as a diary, and the user can send a picture to a friend when on holiday. This is done in order to make the user more familiar with the tool, to overcome the problem of acceptance. The results will prove if personalising the handheld computers, and allowing physicians to use them outside work, will make transition to deployment in hospitals more feasible.

**Background**

Some of the problems in today’s hospitals are cumbersome routines for entering clinical data, inefficient paging systems, and problems with loss of information when patients are transferred between points of care. A suggested solution to these problems is use of advanced telecommunication technology and hand held computers, such as PDA’s. It carries prospects of enabling access to patient data without being tied to a desktop computer, along with several helpful functions. Various systems have been developed and adopted in the USA. There is a great possibility of learning from these earlier projects, but due to differences in government regulations, legal, operational, and economical matters, here in the UK, one can not directly convert from the American systems.

Studies within the field of handheld computers for health care have recently been carried out in Scotland. A team of scientists from Napier University, lead by Mr. Phil Turner, published a paper in 2004 called “Toward the Wireless Ward: Evaluating a Trial of Networked PDAs in the National Health Service” [4]. Here they describe a pilot study carried out at the Western General Hospital Trusts gastrointestinal (GI) unit, where five clinicians were equipped with hand held devices (PDAs) for them to use over a period of several weeks. The software was based on an existing intranet CPR called GIPSY [4], which was designed for the GI unit. The server scripting was coded with PHP connected to a SQL database. It could offer four main features:

1. Patient details, i.e. name and date of birth.
2. Clinical history.
3. Entry of vital signs, medication, test results and requests.
4. Unit directives and procedures.

In addition to this the device gave clinicians access to the internal email-server and a sound recorder with playback function that could be used as a Dictaphone.

Although this study is in its initial phase, some results have already been gathered based on user feedback. Participants were mainly positive to the use of the device, especially towards the possibility of using it as a voice recorder and for reading email. Writing email was not so popular, because of the PDA’s somewhat cumbersome stylus writing and lack of keyboard. For the GIPSY application this was made easy with drop-down menus. This, together with auto-completion in fields on lab requests (such as name of the patient) makes the application as quick or even quicker then filling in the standard paper forms. The computational speed of the system was accepted, even though it was slower then existing desktop computers.

A worry that was expressed by the clinicians was concerning the portability of the device. Because of its small size it could easily be dropped out of a busy doctor’s pocket, which can result in damage
or loss. The paper does not suggest any remedy to this, but one might think a belt clip or carrying holster can solve this. A range of accessories to the chosen device already exists. It could also be made callable, so that it will ring even if it is set to silent mode, or connected to the user by a virtual lanyard that will make the device unusable and/or sound an alarm if detached for a given period of time.

Methods
The project will have its out spring in a literature survey done in 2004 [9]. Several important papers were identified their summary will stand as the starting point for this project. Several more papers that will be consulted have been found since then.

It will be necessary to clarify government regulations concerning data usage, storage, processing and transmission when dealing with sensitive data within hospitals. The National Programme for IT (NPFIT) may give answers to this, and a brief overview of the NPFIT in general must be created. Standards for security may have to be implemented beyond what is required by for instance the NHS, because of the high level of information sensitivity surrounding a mobile clinical computer. This will contribute strongly to the constraints for any software development in this field.

Next step would be to look at existing systems, and map their features. Trial software could be obtained by contacting development teams mainly in the US. These individuals may also be willing to provide information on current issues in the field. Private companies that may be of interest are:

- Epocrates
- Unbound Medicine
- Medtech
- Sky Scape
- Patient Keeper
- Mobile Design Technology

These are all American based companies that develop software solutions where doctors and care takers are key users. Some research should be made to extract these users’ feedback from existing systems and their “dreams” for a future application. This may be done through personal contact or a small questionnaire. Some strengths and weaknesses of the current situation should derive from this study. Results from the study done in Edinburgh may also be a valuable source of information.

The selection criteria for handheld computer hardware will be wireless network connection, mobile phone, and an operating system for which an API can be obtained. The software that will be developed will be a simulation of a patient record system and contain some features that would be useful in the ward. Specification of this software will come as a result of the research conveyed on existing products.

In order to create the software necessary, some project time will be allocated to research on development tools and programming language. Operating with handheld devices require careful programming when it comes to memory use and processing power because of limited capacity compared to a desktop computer.

See workplan on page 7 for a work breakdown structure outlining the whole project period.

Evaluation
Evaluation of the project will be strongly based on user feedback, but also the final report’s coverage of important topics, such as regulations, evaluation of existing products, pitfalls and problems in deployment, and advice for further implementation projects.

The first part of the project will establish a broad overview of status quo in health services and IT. This will include legal and regulatory issues, current development projects such as the NPFIT, software from private organisations, research on handheld computers for this particular purpose, and the opinion of the final users. This work will be successful if the needs and requirements of all major stakeholders are identified and analysed, and most relevant prior work is studied and summarised.
The second part of the project, which includes software development, is meant to be a process that runs throughout the lifetime of the project (see time schedule). The handheld computer with developed simulation software will be tested by a few medical doctors. The system will be configured to each individual, such as email setup, contacts and calendar, and they will evaluate the mobile device for a period of time. They will be interviewed of their feelings towards the system and any recommendations or comments they may have.

If the individual evaluation of the tool can not be completed by some reason, the software will be available on-line, for users to download and try on their own handheld devices. This is meant as a backup plan for user assessment, because time is very limited in the project.

The user feedback will be valuable in the concluding parts of the project, in order to point at areas that need further research and development. Data from questionnaires will be analysed and rephrased, to extract what each test user’s true feelings were. These analyses will be reported back to the user for verification. The results will be important for evaluating the project as a whole.

This data will be compared against feedback from users of similar systems, but with handheld computers that are just used for work purposes. If results show significance in any direction, the project can be summarised and presented as a paper to relevant journals, such as the UK Health Informatics Today (UKHIT). A publication may confirm that valuable work has been done, and will probably result in feedback from readers that can be used in further work on similar topics.

Anticipated outcomes

Communication:
Several publications are anticipated from this project. First of all, the project report will be available through the University of Edinburgh Library’s collection of master thesis. If results are of significant value, the report will be rewritten into a three papers, which will be presented for publishing. Because the subject of the project is of an interdisciplinary character, one paper will focus on the medical perspectives, the second on the technological issues, and a third paper will be a summary of the thesis (which should be of interest to both disciplines).

The thesis can be rewritten to a series of articles for publication in magazines and journals, such as the UKHIT. An effort will be put in to translating the thesis into Norwegian (the native language of the author), and published in relevant Norwegian journals. This will only be possible for parts of the project, as issues like regulatory constraints may vary from the UK.

Content:

Regulatory constraints:
The project report will contain a clear outline of government regulations concerning health related informatics. Important issues, such as security will be addressed both in terms of prior work, but also with suggestions to the road ahead.

Current projects for wireless technology within the NHS will be reviewed, as they will indicate the direction and speed of development for any broad scale deployment of handheld computers in the medical field.

Previous work:
A broad overview of the current position handheld computers have in the health care system should be one of the primary outcomes of this project. It will be based on statistics and prior research papers, together with interviews with knowledgeable people. The number of studies done both inside and outside academia is believed to be high, and on very different scales, and effort will be put in to identifying and evaluating them. This is important not only for the purpose of an overview of the field, but also for the development that will take place during the project, and its evaluation. The project will identify weaknesses of existing products, and the way that they are deployed.
Hardware advice:
An un-biased evaluation of different hardware tools will be analysed, and a comparison with strengths and weaknesses will be part of the outcome. The device that seems to be best fitted for the purpose will serve as tool for the prototype software that will be developed during the project.

Software advice:
Existing software will be researched, and shortcomings pointed out. Earlier studies have pointed out several weaknesses that one may come across in this type of software, and the report will try to summarise them and recommend how the problems may be addressed. Simulation software will be developed for the chosen platform. Design documentation and diagrams will follow the report, together with a technical specification and user manual. The software itself will be publicly available on-line for evaluation purposes.

User feedback:
User feedback will be an important outcome of this project. Firstly, user opinions from prior studies will be analysed. Then this will be compared with findings from this study. This is believed to present a tendency that physicians who are presented with a more comprehensive tool and who allowed to familiarise them selves with it outside work, are more likely accept deployment of such a tool on their ward.

Summary

The project will address questions about the feasibility of handheld computers in medical health care. It will summarise regulatory constraints and current projects that will constraint the way devices are implemented and used. Existing software products will be overviewed, and their best features summarised. Feedback from users of existing devices, together with existing research, will be used as background for a list of current problems and concerns that decision makers may have.

Software that simulates key features needed when working in a hospital ward will be developed and installed on a carefully selected piece of handheld hardware. The device will be sufficiently sophisticated so that it will have a broad range of uses, and test users will be urged to use it for personal purposes as well as for work. User questionnaires will be analysed and results will be cross checked with the people providing the feedback. The information collected may show if familiarisation with the device, and a stronger dependability outside work, will make adoption easier within the institution.
Workplan / timetable May – August, 2005

See workplan table in appendix.
References

   Newsletter of the UK Health Informatics Society. This issue was devoted to handheld computers. Guest editor is Dr Mohammad Al-Ubaydli, a well known name within handheld computers for medical practices.

   This paper suggests the use of handheld computers outside work, and how wireless technology can for instance make time doctors spend commuting more efficient.

   This study provides information about common problems that handheld computers may solve in hospitals. It also points out problems or complaints users made during a deployment study.

   Study done in Edinburgh. Interesting in terms of contact persons and test users.

   Introduces several interesting ways of improving communication in medical health care, such as virtual white boards.

   Dr. Al-Ubaydli was very positive, and willing to provide information throughout the project period.


   Interesting survey of GP’s use of PDAs, covers the US, UK and a few other European countries.

9. Huuse, 2004, Feasibility of Mobile Computerised Patient Records (CPR), Literature review done for the MSc project, Department of Informatics, University of Edinburgh.

Papers to be consulted:

11. Blackman et al., The Usefulness of Handheld Computers in a Surgical Group Practice, Division of Medical Informatics and Outcomes Research, Oregon Health Sciences University.
13. Luo et al., Use of Personal Digital Assistants in Consultation Psychiatry, Psychiatric Services, March 2002 Vol. 53 No. 3
15. Shiffman et al., User Satisfaction and Frustration with a Handheld, Pen-Based Guideline Implementation System for Asthma, Yale Center for Medical Informatics, New Haven, Connecticut.
16. Ruland, Clinicians’ Use of a Palm-top Based System to Elicit Patient Preferences at the Bedside: A Feasible Technique to Improve Patient Outcomes, Institute of Nursing Science, University of Oslo, Norway.
## Appendix – Workplan table

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