Interacting with Mobile Intelligence

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Abstract

The mobile device market offers considerable potential for software products, however, currently there are few compelling applications for hand-helds. We identify the potential for mobile intelligent systems and briefly describe the software that we have developed to enable mobile intelligent system construction. We outline the requirements for a mobile intelligent system for the corporate sector and discuss our attempts to create a demonstrator. The demonstrator is evaluated with some success. Future work is briefly discussed.

1 Introduction

The impact of mobile devices has been considerable over the past year and it is widely expected that the market for wireless data services will continue to grow significantly (Wong & Jesty, 2002). Market research identifies that the era of mobile computing has arrived. However, there has been a significant downturn in the mobile market (Reuters, 2002) seen not only through the limited purchases of new devices but also in a lack of upgrades occurring for hand-helds.

The response to this downturn has been to add functionality to mobile devices, particularly phones. The focus of the market in the winter period of 2002/3 has been to take one of the most successful mobile device applications, SMS (Harmer & Friel, 2001), and upgrade this with the potential to send and receive multimedia short messages (MSM). This has resulted in the sale of a vast number of units.

For the smart phones and Personal Digital Assistants (PDAs) there is no obvious salvation such as the photo-phone and it can be suggested that a significant factor in the downturn of the mobile market (particularly for handhelds) relates to the lack of use-worthy (usable and useful) and compelling software for these devices. Whilst application development has focused on the communication aspects of mobile devices, potential also exists for the exploitation of off-line applications. However, there are few compelling off-line applications for mobile devices, with scaled down versions of office software, retro-games and personal organisation providing the main product offerings. This lack of applications hampers the acceptance and use of these devices, particularly at the corporate level.

This paper discusses the approach used with an Application Development Environment (MADE) and Execution Environment (MEE) that we have developed for the creation and deployment of intelligent applications for mobile devices. Earlier experimentation using toy AI problems has ensured that applications created with MADE and deployed using MEE function at an acceptable

rate on a range of mobile devices. Here, our aim was to determine the translation of user and domain requirements into a use-worthy application that is usable by the intended user population and useful for this group.
Section 2 briefly considers the mobile sector, focusing on corporate use of mobile devices and the trends seen in software development for this market. Section 3 discusses our approach to the development of innovative software for mobile devices, using artificial intelligence techniques to enable access to tailored, focused, expert knowledge without requiring costly communications. Section 4 discusses the development of an mobile intelligent system demonstrator for the corporate sector. Section 5 considers our approach suggests some directions for future work.

2 Corporate Use of Mobile Devices

Apart from communication, the most successful corporate application for mobile devices continues to be the organiser, replacing the time manager or filofax. However, except for calendars, address books, diaries and other essentially administrative support applications there is typically little appropriate use made of the mobile in the work environment.
In an attempt to make the mobile device more useful to mobile workers the recent focus of software for mobile devices such as PDAs and smart phones focuses on mimicking the functionality offered by broadband PCs. However, this approach has had limited success due to the constrained nature of mobile devices. For example, applications that require intensive input and display of large amounts of data (e.g. office software) are not easily usable on constrained devices without the addition of peripherals, such as keyboards. The utility of mobile devices is further reduced by the problems of accessing information resources through such tiny displays (Rist & Brandmeier, 2001). Users are also forced to perform numerous operations by selecting very small icons. The problems of physically manipulating miniaturized versions of "standard" keyboards and pointing devices further reduces the utility of mobile devices.
Activities are often supported through the use of horizontal applications such as wireless e-mail and messaging, workgroup applications, or applications for corporate information access and financial transactions. The dominant approach to providing functions beyond these to wireless computing devices has been by means of so-called microbrowser technologies, such as WAP, and i-Mode. However, the microbrowser model is not suited to the delivery of data services to all wireless devices (Evans & Baughan, 2000):

- It is not suitable for highly interactive and business critical applications because of its dependence on the transmission network - as the network becomes unavailable or slows down, so does the application.
- It is not cost-effective for many users, because of the (sometimes significant) costs of sending data over cellular networks

Information rich environments (e.g. web sites) are also negatively effected by the display capabilities of mobile devices, and are typically viewed in an impoverished format, with a reduced set of information available. Further, user expectations of tools to enable high bandwidth activities (e.g. video downloads) are rarely met (Charny, 2001), with the devices and the infrastructure unable to cope with such applications (Sherman, 2001), typically resulting in user frustration.
The characteristic of mobiles that has been most widely exploited is the communications potential of these devices. However, for the PDA and smart phone market, this potential should only be one part of the product offering not necessarily the dominating force. It can be suggested that the potential offered by mobile devices may be best exploited by off-line applications, with the focus

on portability rather than connectedness, at least until infrastructural and content issues are more firmly resolved.

3 Intelligent applications for mobile devices

Intelligent applications, developed using Artificial Intelligence techniques, provide expert knowledge and advice to users, and have characteristics that make them relevant for the mobile platform. The application of such techniques has been successfully applied to significant problems in a range of domains. Though the technologies for implementing intelligent applications are well established, they have not yet been adapted for delivery via mobile computing devices, because such devices are limited in terms of their memory size and processing power.
Portable intelligent systems could offer compelling user experiences, see table 1. For example an intelligent system operating on a mobile device can offer an employee immediate access to tailored, focused, expert knowledge, without requiring costly communications. The advantages of making an intelligent system mobile are readily apparent. For example, a horticulturist would clearly want to be able to monitor the health of a crop whilst in the field; Health and Safety audits would clearly benefit from being at least partly conducted on site; a consumer would want dietary and nutritional advice whilst out shopping.

Table 1: Examples of Intelligent Systems

Domain	Typical Tasks / Functions
Agriculture	diagnose and propose treatments for plant disorders advise on plant care schedule fertilization and irrigation
Health and Safety	interview users about buildings, work practices and policies conduct detailed compliance reviews on such things as fire regulations
Finance	help independent financial advisers to propose packages of financial products tailor products to individual clients support investment decisions
Consumer market	advise shoppers on diet and nutrition plan and monitor an exercise regime help the amateur gardener choose and care for suitable plants

The awareness of the lack of intelligent applications for mobile devices has resulted in our creation of a proof of concept prototype that allows the development and deployment of intelligent systems on mobile devices. Intelligent system creation requires a powerful development environment, which offers facilities for rapidly constructing, modifying, and testing intelligent systems. To enable this intelligent system to then function on mobile devices the executable has to be dramatically compressed, so that in deployment it will use the minimum amount of memory and processing power possible. This has resulted in the construction of:

- Mimosa Application Development Environment (MADE): which allows intelligent systems to be built and tested on a powerful desktop computer
- Mimosa Execution Environment (MEE): which allows such systems to be deployed on a variety of mobile computing devices, ranging from mobile phones to Personal Digital Assistants (PDAs). MEE compresses the knowledge base into a sufficiently small application for the limited memory and power of typical mobile platforms.

The intelligent system is developed using MADE, which provides an extensible language for developing rule based applications, together with an environment for executing, testing and debugging such applications. This runs on a conventional personal computer and permits the creation of "write once, run anywhere" intelligent systems for mobile devices. Once developed, an intelligent system is deployed on a mobile or wireless device using MEE, which is capable of executing intelligent systems effectively and efficiently on a range of mobile computing devices.
Solving the technical requirements of MADE and MEE has resulted in an environment with potential for developing mobile intelligent systems. To explore the possibilities offered, we are in the process of creating a number of demonstrators, focusing on the commercial, corporate and consumer sectors. These demonstrators will enable the assessment of the feasibility of a range of mobile computing hardware and software configurations for delivering intelligent systems using the Mimosa architecture. Here, we discuss the use of the Mimosa architecture to create a demonstrator for the corporate sector.

4 Corporate Demonstrator

Mobile devices could offer an ergonomic and usable approach to the requirements of mobile workers (i.e. any employee who regularly operates in a non-PC-supported environment or who works outside of the workplace, even if that location is home). These requirements relate to identifying a satisfying task structure that fits within an efficient, enjoyable user experience, based within the context of the user having to be mobile and with the device being optimal.
Sector and user analysis identified a number of specific requirements that aid in determining whether applications would be appropriate for mobile devices:

- Rapid, effective resolution of tasks
- Narrow focus of application goals: *thinware*
- Users will have widely differing levels of device experience and computer literacy (this will often initially be novice and low)
- High pragmatic user expectations (Ralph & Shephard, 2001), based on use of social and recreational software, i.e. no toleration of poor interaction design
- Use of medium must add value / reward the user, this may be in improved worker satisfaction as the total user experience includes social style
- Activity where application to be used must require mobility and use of the application should add value to the business process and worker it supports (Sacher & Loudon, 2001)

For the corporate sector a demonstrator application is being constructed that supports the sales staff of a Call Centre operation. The sales staff spend most of their time on-the-road visiting clients and ideally would like to make instant decisions in relation to whether or not they will accept the client's business. The domain selected was appropriate, as workers are mobile and have little desire to support their work (which is largely face-to-face) with a lap top, but find the idea of digital support tempting. The intelligent system makes recommendations about the data provided by the sales staff based on the application of a set of heuristics, for example relating to manning levels and call pattern type. An early prototype of the Call Centre application was evaluated by sales staff with mainly positive results. The evaluation criteria for the demonstrator were based on the requirements identified above.
The task structure requires only a limited amount of information, most of which can be categorised and then selected by pointing rather than text entry, for example call patterns are represented graphically. Task structure is based on the business model created with expert knowledge and

results in rapid task resolution. The value to the sales staff relates to the knowledge encoded within the system and this requires regular updating (quarterly). The reward to the sales staff relates to the social style, with staff identifying the demonstrator, or more appropriately the device itself, as cool. Users identified that it would support their work functions in a portable, discrete and fashionable manner. However, issues related to monitoring and acceptance of demonstrator consultations still need to be resolved and its integration into the already existing work system.

5 Conclusions

In this paper, we have provided an overview of the development environment MADE and the deployment achieved through MEE. We have discussed the construction of a demonstrator application for the corporate sector. This Call Centre demonstrator matched the requirements of the domain, sector and user and suggests the potential of an intelligent mobile system to provide tailored, focused support in a timely, accurate and appropriate manner.

Future work focuses on further development of this and other demonstrators, focused on the commercial and consumer sectors. For the commercial sector, a hotel demonstrator is under development that incorporates the use of an electronic marketplace populated by intelligent agents. For the consumer sector, a poker tutor is under development. Each of these demonstrators highlights significant issues both for the requirements of use and the design of the interaction.

There are few examples of intelligent systems being developed for mobile devices publicly available. This sector is one which offers considerable potential, however, few applications of any calibre are available. The creation of innovative products will enable a significant step forward for the sector enabling enable mobile devices to graduate from trite applications such as games and to-do lists to useful, intelligent systems that can provide informed responses to complex user queries.

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