

Holistic PIM: Managing personal information for a nomadic generation

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ABSTRACT

We examine the Personal Information needs and opportunities arising from the widespread introduction of mobile computing as a social medium and personal and professional life management tool by an ever increasing proportion of the population in developed countries. We argue that the current personal information management modalities, carried over from traditional computing practices, are significantly lacking in light of the demands and needs of a mobile generation. We propose a holistic, integrating approach to personal information management, based on the interaction of the mobile device with its environment, and discuss current technology and its potential in supporting advanced, intelligent life management tools.

Author Keywords

Mobile Information Retrieval, Mobile Personal Information Management, Context Awareness, Mobile & Pervasive Services

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. H.3.3 Information Search and Retrieval, H.3.4 Systems and Software.

THE DISAPPEARING DESKTOP

It is an undisputed fact that personal computing (in the form of desktop PCs) has largely penetrated domestic environments and continues to grow in this sector, aided by the wide availability of broadband connections and a range of services. It is also an undeniable fact that within a very few years, mobile computing (through the spread of mobile telephones) has grown at an incredible rate, effectively making almost every citizen of the developed

world an owner of at least one mobile device. Almost every mobile device (phone or PDA) currently available on the market, has support for PIM through the form of a contacts application, calendar and messaging (SMS). Many have support for additional services such as task lists and note taking, as well as access to email and to the WWW. Such applications make devices incredibly capable and, in theory, a possible replacement for the traditional computer. However, the use of mobile devices, instead of desktop PCs, as a tool to manage one's personal information and life, brings additional functional and non-functional requirements to the design of such applications, as well as opportunities for the implementation of services that would have previously been irrelevant or indeed, impossible.

MOBILITY REQUIREMENTS

It is a basic assumption of mobile computing that the user should be able to perform the tasks they require with the aid of their mobile device, in any given location, and at any possible time. Therefore, when considering the nature of mobility, it is important to remember that *mobility* introduces the concept of *changing environments and situations*, which vary the requirements of users for data and the way that this data is presented or created (modalities). The concept of mobility also places special requirements on the way data is created by the users, as the varying situations may not always mean the user is able to spend the same amount of time generating data during each session. Finally, the changing environment presents the requirement for adaptive and intelligent interruption and alert mechanisms to suit the user's context.

DATA CREATION

We mentioned previously that changing situations mean that the users may not always be able to generate large amounts of data – e.g. a user might be taking a note on their mobile while on the subway, and the train might arrive at the desired stop before the user has finished the task. Situations such as these, which we have encountered in our previous studies [1] hint towards the need for increased input support: from making input quicker (e.g. T9), to implementing alternative input modalities such as

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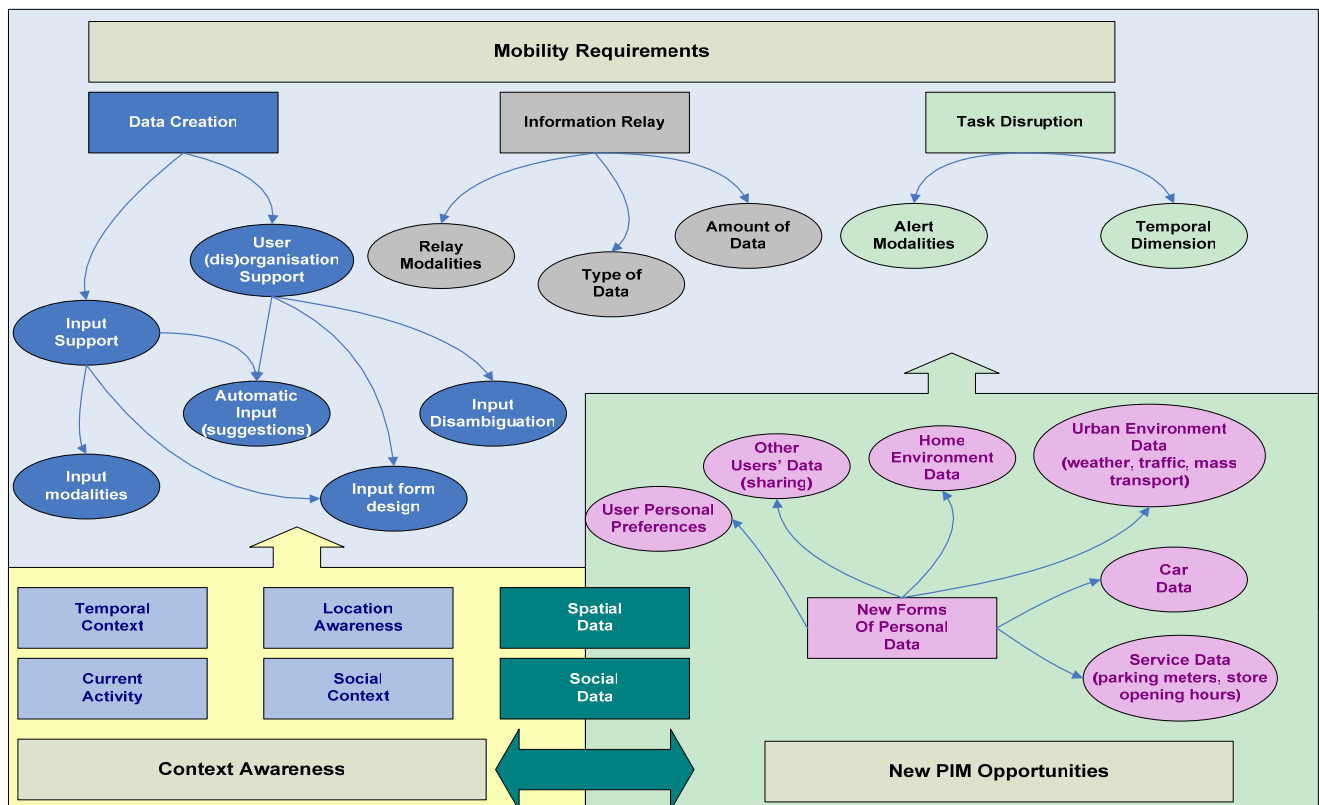


Figure 1. Requirements presented by mobility; Most of these can only be addressed by increased context awareness, which introduces new forms of personal information and new requirements for its management.

speech or gestures and better design for input forms. Advanced methods such as auto-completion of input form fields by disambiguation of any user input is also a good research direction in the area. Our previous research has shown that not all users are good data creators [2]. Actually, most will scribble cryptic notes that serve as reminders to themselves. It is, however, entirely possible to disambiguate entries with adaptive, knowledge based systems, in order to support the varying levels of user organization (or disorganization) when personal information is created [3].

INFORMATION RELAY & TASK DISRUPTION

Since users interact with mobile devices very differently than with desktop computers (short “bursts” of interaction rather than “long sessions”), the requirement arises that the user should not have to spend large amounts of time to find the data they need on their mobile device in fact our research has shown that when on the move users become increasingly frustrated if the task takes more than one minute to perform this contrasts with users only becoming frustrated after over two and half minutes on a PC [1]. It is extremely important therefore, to consider making the data presented to the user relevant to the situation, and to filter and present that data at an appropriate time so that the user might actually act upon it. This introduces the

question of when is a good time to interrupt the user to present them with information (such as event reminders). *Intelligent appraisal* of the user’s context extends to considering the user’s current task and any social implications arising from the situation the user is currently in. This context is critical to take into account, in order to interrupt the user at a time that is meaningful and at which information can be acted upon, as well as to proffer a modality that is the least likely to cause problems to the user (e.g. a loud alert during a presentation for the user to buy milk).

NEW FORMS OF PERSONAL DATA

Mobile devices are carried by users in most situations and environments; as a result mobile phones have become for many an extension of their persona. The constant presence of mobile devices and their ever growing sensory capabilities introduce new forms of personal information, which needs to be managed. This *me-Data*, which includes location data, social data, data of other users and data relating to the user’s environment and its services, presents many opportunities to offer new services to the user, when cross-linked with traditional personal information data, such as calendar entries and to-do lists. For example, linking location data to calendar reminders can dynamically alter the reminder timing to increase a

mobile worker's likelihood of making a remote appointment in time. Furthermore, information from environments the user is likely to be present in, in the near future, immediately becomes relevant to the user- a fridge could text the user its contents when they were at the supermarket so that the user could make better decisions about what it is they would like to purchase. Again, the information needs to be managed carefully. Notice that in this simple example we introduced a *multi-dimensional context vector space*: The Future Environment data (home inventory) and Current Environment data (supermarket and its services), imply not only location awareness, location type and a new type of personal information item (home contents) but also introduce temporal context (user likely to be close to supermarket soon and then likely to head home). This level of context awareness is required to present to the user data that is relevant, preferably at a time when it can be acted upon.

FUTURE DIRECTIONS IN PIM

From the overview of the requirements mentioned above, which are imposed on Personal Information Management by the context of mobility, it is apparent that traditional assumptions and approaches to PIM have to be revisited for the generation of the disappearing desktop. Users require information that is relevant to them to be available with minimal interaction and in every location they are present in. Naturally, such level of service assumes extensive revisions of the current infrastructure levels and a degree of pervasive and ambient intelligence, which is much higher than that available to the average user today. However, progress made in the area of context awareness and personalization of mobile devices and services [4][5][6][7], leads confidently towards the holistic approach we have described in this paper. This paradigm can give rise to new levels of service for the user, including advanced PIM tool functionality, 3D and color data visualizations for small-screen (or even no-screen) devices, and interoperability with other applications – a good example of this was a study to show that mobile queries can yield better results when location, was included in the search terms [8].

Our own research has shown that it is possible to employ rule-based adaptive systems that learn from the user's input style in order to disambiguate cryptic calendar entries [3]. This has allowed further research into providing advanced services to users, based on this new level of personal information management, and namely to pre-cache internet content to support the users' future tasks, based on the contents of their calendar [5]. In this article we showed that including future location extracted by calendar entries in web queries yields useful internet content, which correlates with the later findings in [8]. Furthermore, the automatic categorization of entries based on this disambiguation has allowed us to investigate the efficacy of dense displays using color in calendar views, with very promising results – users on average taking less

time to make decisions [6]. Finally, our further research, along with that of others in the field, is taking us into the realm of making information from remote environments (i.e. home) available to the user, using currently available components and devices [7].

A HOLISTIC PIM EXAMPLE

Continuing the theme of context-aware personal information management, our current work focuses on the usability of GPS-driven calendar reminders for nomadic workers, where location awareness is used to dynamically adapt reminders to help users reach event locations on time. The hardware required for our nomadic calendar system is very much off-the-shelf and representative of the capabilities many consumer devices already possess: A mobile phone with an embedded 3-axis accelerometer and GPS receiver (e.g Nokia N95 or SonyEricsson W910i with an HGE-100 serial GPS attachment).

Our system utilizes several context indicators to achieve its purpose: Calendar entries are used to determine the desired time for the user to be present at a particular location, and also to determine the actual location itself. For this part of the system, users should be able to insert precise coordinates, or perhaps a database of coordinates for known locations can be automatically compiled for the user over time, as in [12][13]. The user could then type in location names (e.g "Office") and the GPS sensor could automatically associate these with GPS coordinates, taken closest to the time of the event. Furthermore, clues like a person's name in the entry title, could hint towards the type of task, e.g a social event, a meeting or a to-do item with a strict deadline. This might indicate user's need to be on time, from "absolute need", to "nice to be there on time".

To determine distance from the event and estimate an appropriate timing for a reminder, our system considers GPS coordinates (current vs. required) and looks at the user's recent movement history: Accelerometer data patterns and GPS speed data can tell us whether the user has been walking today, as compared to being stuck in slow traffic. This fact would hence likely mean the user will have to walk to the next event. Such a prediction could be reinforced by looking at the distance to the next event– anything more than 15-20 minutes walk could be assumed to require some sort of transport medium. Naturally, the type of transport medium the user might use, cannot always be known or guessed in advance. However, the user can be presented with relevant options at the time of the alert: "It would take you about 35 minutes to walk, 15 minutes by bus, 8 minutes by subway and 5 minutes in a taxi. When would you like me to alert you again?". Such an alert would require knowledge of transport media schedules, historic data of traffic flow rates in the city, knowledge of current route or traffic problems etc.

Assuming momentarily that a user decided to walk towards a desired destination – could a Holistic PIM system somehow support this activity? We believe that monitoring the user’s physiological (and through deduction, emotional) context with the phone’s accelerometer, we can provide services to support the transit process. Perhaps, a tone or vibration played at the rhythm of the walking pace required to get to the next event on time, could help the user “tune their body in” and arrive in a timely manner. We are looking at possibly making song selections that support the required pace of walking to get to the destination in time (faster vs. slower tempo music), something which has been shown to affect physiological performance [14].

Our system is very much a work-in-progress, at the stage of implementation. We are currently working on the nature of accelerometer data at the moment and attempting to assess how the position of the mobile on the body (trouser pocket, jacket inside or outer pockets, handbags) affect the quality of the data. Previous work, such as [15] has not provided any insights on what the effects of position are, however, our early trials seem to indicate that by far, hip pocket placement yields the most accurate results. There is still a long way to go and we predict particular problems with the integration of accurate real-time and historic traffic data, however, the type of work explained here is indicative not only of the mobile intelligence that is required, but the citywide infrastructures that will support pervasive PIM for the mobile workforce.

CONCLUSION

To be truly successful, the disappearing computer must know much more about its user than the traditional desktop ever had to know – if not more than the user themselves. While Holistic PIM might seem like a distant goal, work in the area is bringing the technologies required to achieve it closer to being fully integrated. Adaptive User Profiling and Context awareness is the key to managing Personal Information and providing services a user could truly need for the next wave of nomadic computing.

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