Quest for Mobile and Pervasive Data Management
- Position Paper for NSF Workshop -

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I believe we need to have a clear and simple future vision as our quest or goal to lead our research activities in this field. It should be also easily understandable to outsiders of the field, even to general public.

In this early stage of determining the direction and research agenda of this research area, I also believe that we should think in a human-centric way first. We need to start with what people's needs might be, not with what we might be able to do with technologies. Only then we can determine what kinds of needs arises for data management Therefore I define "context" in "context-aware mobile database management" as that of users [1].

I have tried to come up with such a vision, analyze the elements in it, and present potential research issues in this position paper. It is just one example of such visions, and I hope this to be a good starting point for further discussions.

1 Quest

I would like to set forth the following as our quest to lead our research activities.

> To realize a world in which it is unnecessary to carry around anything with you.

I have come to believe the ultimate goal of pervasive computing is to "make it unnecessary to carry around anything with you." In our current day society, we must carry many items of necessity and/or efficiency including:

- Watch, alarm clock
- Wallet
  - money, credit cards, membership cards, driver's licence, business cards, passes, coupons, receipts, ...

[1] I am not sure whose context it is from the introduction paper of this workshop (http://www.sice.umkc.edu/nsfmobile/wshop.html/workshop-intro.html).

- Cell phone, paper
- Laptop computer, PDA
- (Digital) camera, audio recorder
- Document, Planner
- (Blank) paper, pen, marker, pencil, post-it note
- Keys (for houses, cars, offices, ...)

If computing becomes as pervasive to its full potential, there will be no need to carry these items at any time. If computing is ubiquitous and fully connected, you will get the same functionalities provided by the above items from the pervasive computing infrastructure.

Think about a king. Does he need to carry anything around? Entourage will take care of everything. Why not us? [2] With networked computing, sensors, and actuators, it should be possible for us, too.

You can be identified from a distance using biometric technologies such as face recognition. This eliminates the need for such things as membership cards, driver's license, and passes. With devices connected to the network and identification provided above, there should be no need for money, credit cards, name cards, and keys. With displays and speakers/micro phones already in cars and at places such as home, kiosks, offices, and hotels, we can get rid of watches, cell phones, PDA's, laptops, and documents.

2 Research Issues

First I try to categorize the purpose of the things we carry around. The categorization is not complete nor perfect and subject to further discussion.

Proof of rights, privileges, or accesses to resources: money, credit cards, membership cards, driver's licence, passes, coupons, keys (for houses, cars, offices, ...)

Access to information/transaction from potentially insecure environments:

Private information: PDA (schedule, contacts, ...), laptop computers (data, documents, ...), documents, alarm clock (your scheduled time), planner

Public information (for free or cost): Watch (Current time), PDA's, laptop computers (Web, weather, news, stocks, ...)

Transaction: Vending, tolls, ...

Communication to other people: Cell phone (voice, video), pager, emails on laptop computer/PDA, IM on laptop computer/PDA

[2] As for food, we are eating many of what only kings could eat.

Recording: (Blank) paper, pen, marker, pencil, post-it note, (Digital) camera, audio recorder

Uncategorized: business cards, receipts

From those needs, I identify the research issues.

Non-intrusive, distant, and quick identification technology: To better serve people, people should be identified accurately when they are ready to give their identities. There should be non-intrusive, distant, and quick identification technologies depending on the context. Biometry such as face recognition is a good candidate. There also should be systems in which data used for identifications is not compromised.

Sensors and systems for user's context: Sensors to understand and secure distributed management system of, user's context are needed. Systems need to provide not just snapshots, but also continuum of information views based on user (type, interest, time, schedule, location, group, privilege), resources (energy, display, computation, communication), and environment (other users, mobility). Contexts can also be categorized as follows:

- Physical context such as user's position, orientation, posture, etc.
- Symbolic context such as in a car, in the kitchen, fixing dinner, working, etc.
- Emotional context of the user

Secure communications through people's senses: Communications through human senses, vision, hearing, tactile, smell, and taste should be provided through actuators and sensors. Of those, video and voice communications are critical. Appropriate channel needs to be chosen depending on user's context.

Dynamic working environment: Setting up dynamic working environment for an ad hoc group of people is needed to realize a pervasive computing version of CSCW (Computer Supported Cooperative Work).

System attributes: Scalability, performance, robustness, self-organizing, etc. are needs to be investigated to accommodate people's needs sufficiently.

3 Conclusion

When we set the research agenda, a clear and simple vision will help a lot in convincing others as well as ourselves. I believe people should come first in determining importance of each research issue. In this paper, I tried to give one example of such a vision. I hope this will serve as a good starting point for further discussions at the workshop