An Infrastructure for Distributed Computing and Context Aware Computing

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Abstract

This paper focuses what we see as main issues in context awareness, small size and low power of today's mobile computing devices. Until now, these devices are heterogenous and mostly used standalone to accomplish certain task. That means there is no a single generic type device and user needs to be aware of different devices to perform different tasks, which is of course practically inconvenient. We propose a generic device and a network infrastructure which address low power consumption, context aware computing and protable device for the ubiquitous computing environment. Where the generic device (as a mobile device) interacts with the different distributed devices which are fixed in the physical infrastructure.

1. Introduction

The mobile computing devices such as PDA, cellular phone are getting more and more useful in our daily life. Despite of their contribution, they still possess lack of some features which make users inconvenient. For example device heterogenous, context aware computing, small size, power consumption etc. As a solution for above issues, we address in this paper both on network side and hardware side of the device. For the network side, we propose a topology [6] with wirelessly connected devices as shown in figure 1. It consists of several pico cells of size about 10 m^2 of area and one local server. Each cell consists of several Distributed Computing Devices (DCD), one Master Device (MD) which are stationary and the UbiComp Device (UCD) as a user mobile computing device. In addition to these, there are also distributed public devices like screen, keyboard etc. which can be personalized by the UCD when they are needed.

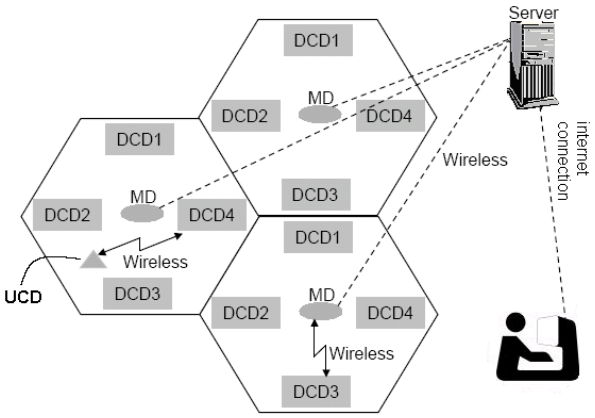

Figure 1: The Network Topology for the ubiquitous computing

The UCD as a user generic device handles several tasks which are associated with audio, video and text data without doing any major computation locally but doing some necessary computation. Instead of doing major computation locally, we propose to migrate those computation units to the DCD and keeping some necessary computing units locally to meet the required performance. The resulting architecture of the UCD consists of sensors/actuators, RF interface, data encoding/decoding unit, a microcontroller and A/D, D/A converter.

The DCDs, we define here are dedicated for the computation which serve their results to either the UCD or other party in a network. All of them within a cell has their unique ID so that the MD as an intelligence device, utilize and control them depending on the traffic (mobile users) within a cell. In addition to these tasks context awareness, network interface, packet routing and

handover procedure fall under the responsibility of the MD.

2. Context Aware Computing

For the context aware computing, the MD and the DCDs play an important roles by having their unique ID within a cell and a network respectively. Because of global ID of the MD, it knows where am i, what are the information that may be interesting to user for this context etc. That means the MD of seminar room and railway station acts differently in terms of context awareness and providing information, but its functionality is same everywhere. To illustrate the communication between devices for the context awareness, we have presented following scenario:

An Example Scenario:

Shambho has just entered inside the seminar room, the MD of his cell sent a request which made UCD to change its alert tone from ring to vibrate mode. That made him secure with not having the chance of ringing UCD during his stay in seminar room. Once the MD knew that the user is in that cell, it sent offer to the user to get information about seminar like topic of talk, their speakers, time table etc. Shambho acknowledged that offer then the DCD sent the detail information about seminar to display on the display. At the mean time, he got a message that there is an e-mail for him but he could not read that e-mail because of the interesting talk that's why he simply ignored the message for a moment by not acknowledging to the MD. After some waiting period of time, the MD realized that Shambho is not willing to receive this message currently then it stored the data for a temporary period of time. Once the interesting talk was finished, he sent an acknowledgment and e-mail was displayed on the display of the UCD.

In the above scenario, the MD and DCD act as the peripheral devices which sense the user activity within a cell and provide data depending on the context. As each MD and DCD know their fix location, this topology can also able to identify the location of the user within a certain area. With this approach user needs to carry only the generic device which does not do major computation. So from the device power and size point of view, the UCD consumes less power, bears small size and offers the different services.

3. Future Work

We propose above network topology and distribution of several devices assuming that the computing devices will be available everywhere [4] so that the user mobile device interacts with them to do certain task. Since they will be available everywhere, we proposed a generic device by moving its some major computation units to the distributed computing device and having its architecture which support all applications which are associated with audio, video and text without effecting the performance. Of course being a small and a generic device, it does not do all the tasks as the normal PC does in terms of user and device interaction. In that situation, user needs to personalize the public associable devices with a help of generic device.

On the opposite side of this approach, there are still some open questions and challenges like the security of data while not doing local computation, ad hoc connectivity, high data rate, handover scheme for the user roaming etc. To evaluate whether this proposed method meets the challenges, obviously we need to test on an real application. As part of our effort, we are planning to take standard mobile device communication architecture for audio, video and text applications then evaluate different possible wireless standards and digital modulation scheme in order to meet the optimum data rate and power consumption. Once we fix the maximum data rate between the mobile device and the DCD then we tune for power and performance by moving major computation units of considered architecture to the DCD. After this analysis, we can decide which units are worth to move and which are worth to keep in the mobile device. In addition to this, we will also focus on security, context awareness and network connectivity issues for the proposed concept.

4. References

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