Using Mobile Phones for Domain Specific Information Appliances

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ABSTRACT
We have investigated how mobile phones can be used as basis for domain specific information appliances. In many areas in service and production industry mobile workers use specifically designed handheld information appliances. Such appliances are developed to be highly suitable for the task that has to be performed. However the development of such appliances is fairly expensive and only makes sense for settings where there are large numbers of mobile workers doing similar tasks. In our work we analyse the domain of policing inner city parking. We developed a prototype based on a camera-equipped mobile phone which could be used in this context. In this case study we highlight advantages and shortcomings of the use of mobile phones as domain specific information appliances.

Keywords
Information appliance, mobile camera phone, mobile work.

MOBILE PHONES ARE A VERSATILE PLATFORM

A wide variety of powerful mobile phones have become very low priced. Devices are available to suite different tastes and to accommodate different user needs. Even devices for specific domains are available, e.g. the rugged phone Nokia 5140.

Many of these devices offer extensive multimedia functionality including a camera for still images and movies, sound recording and playback abilities, and extensive storage capability. Additionally as the devices are mobile phones they offer voice and data connectivity over mobile networks. Some phones even include sensors, e.g. Samsung SCH-S310, or separate sensing modules are provided as add-on components.

Using Bluetooth connectivity mobile phones can be extended with various additional devices. Mobile wireless printers or GPS-receivers are typical examples. Similarly short range communication can also be used to communicate with other mobile phone based appliances or stationary computers.

The functionality included can be programmed by third party developers. These developments can be based on the level of the operating system (e.g. C/C++ on Symbian OS) or using JAVA (e.g. JAVA 2 Micro Edition). Most phones offer a wide variety of APIs to access the basic input/output, multimedia, and network communication (short range and long range) functionality.

Given these technical capabilities we were curious how mobile phones can be used as a platform for domain specific mobile information appliances.

MOBILE INFORMATION APPLIANCES

In different domains where mobile workers access or create information mobile information appliances are in use [3]. Typical examples are handheld devices for:

- conductors on trains,
- facility management, security personnel,
- delivery personnel of parcel services,
- traffic and parking police.

These devices are often custom made and designed to suit the particular need. Besides processing power and storage space such devices may include:

- screens for output,
- mechanisms for user input,
- printing facilities,
- additional input mechanisms (e.g. card reader),
- network access and synchronisation.

In many areas of mobile work paper and pens are still used as the development of specific appliances is not economic due to high costs of the development. In domains where appliances are used they are often combined with paper solutions (e.g. a customer receives a delivery slip).

CASE STUDY: INFORMATION APPLICANCE FOR A TRAFFIC WARDEN

For this case study we spoke with traffic wardens about the tools they use (mobile device to record the case, parking tickets forms, etc.) and the workflows for their daily work. Based on these observations we redesigned the system.

Redesign Based on a Mobile Phone

The basic design criterion was that the information appliance lets persons do what they are good at (like judging a situation) and let the system do where human errors are likely to be introduced (like when specifying the location, documentation of the case and writing the ticket). Some sources of errors are already eliminated by the mobile devices they use: the date and time are automatically set by the device and the ticket is printed. However, describing the location is at some places problematic and often inexact. Documenting the situation by taking pictures is very helpful in later legal disputes.

After analyzing the current work practice of traffic wardens we designed the following workflow for our application. After the warden spots a situation she selects a violation from a predefined list containing, e.g., *ignored parking prohibition*. Then she has to take a take photo of the overall situation and of the number plate. The latter is used to analyse the information on the licence plate by the server. To check if the quality is sufficient for extracting the information of the picture it is immediately transmitted to the OCR module on the server. Afterwards the traffic warden can record an audio comment for describing the situation. During the whole process the position is gathered, e.g. by using GPS or PlaceLab [1]. After closing the case all data is transmitted to the server and stored in a database. The GPS information is converted into a symbolic location representation (street name and house number) using a geographical dataset. Furthermore a mobile printer is used to print the parking ticket.

Figure 1 depicts the architecture and implementation details of the prototype. The mobile unit of the system consists of a mobile phone with a camera, a GPS device and the mobile printer. All three devices are connected over Bluetooth. Alternatively a mobile phone with integrated GPS could be used. The phone communicates via GPRS or in a future version via UMTS with a server.

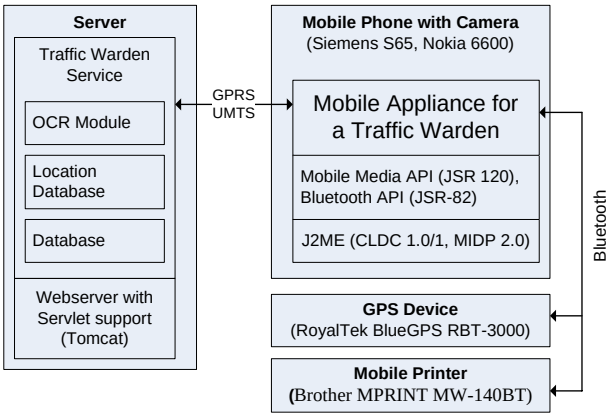

Figure 1. Architecture and Prototype

We build a prototype to explore the concept and to show that the implementation of such an information appliance is already possible with today's hardware and software platforms. As depicted in Figure 1 we used two different mobile phones (Siemens S65, Nokia 6600), the GPS device RoyalTek BlueGPS RBT-3000 and the mobile printer Brother MPRINT MV-140BT.

Figure 2. Screenshots of the Prototype

Figure 2 shows three screenshots of the prototype that illustrate the workflow: selecting the violation, taking photos of the license plate and the overall setting of the case before transmitting it to the server.

We have developed the drivers and software for the mobile printer and the GPS device. This software is Open Source and can be found at [2].

Advantages and Problems

The advantages of using standard mobile phones to implement information appliances are: variety of form factors, price, user's familiarity, and good usability with respect to the hardware. Additionally, the available development environments, the development support, and the provided APIs are suitable for quickly developing custom software for specific use. The built-in support for short and long range network communication are very convenient for many application areas.

Depending on the mobile device and the additional components used, the battery time may be shorter than with specific devices. For certain applications the available form factor (button and display size) may not be optimal. A further issue is that users may want to use the device with their basic phone functionality instead of using it in the appliance mode.

Towards Guidelines for Designing Information Appliances on Mobile Phones

An important issue is the selection of the device or the set of devices that constitute the hardware platform for development. A great variety of devices is available.

Making use of the capabilities to link the real world efficiently with the virtual world is a further important issue. In many cases this can accelerate the workflow significantly and it can help to prevent human errors. Typical technologies for that are based on the camera of the mobile phone, GPS, visual markers or RFID and Near Field Communication (NFC).

When designing an information appliance on a generic platform like a mobile phone it is important to restrict the functionality to support the task in an optimal way. Even if it is technically easily possible we should not get lured into adding generic functionality to the device.

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