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The Office Smartwatch – Development and Design of a Smartwatch App to Digitally Augment Interactions in an Office Environment

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Abstract
In office spaces, knowledge workers interact both with each other and with various analog and digital devices in the office. We think that the office environment opens up an interesting space to utilize smartwatches to support and digitally augment interactions. In this paper, we describe the design and development of a smartwatch application to digitally augment interactions that are commonly performed in an office environment. For example, our application allows one to physically and virtually lock and unlock doors, to acquire room information and to send virtual knocks with an app running on the watch.

Author Keywords
Smartwatches; wearable computing; input methods; office.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

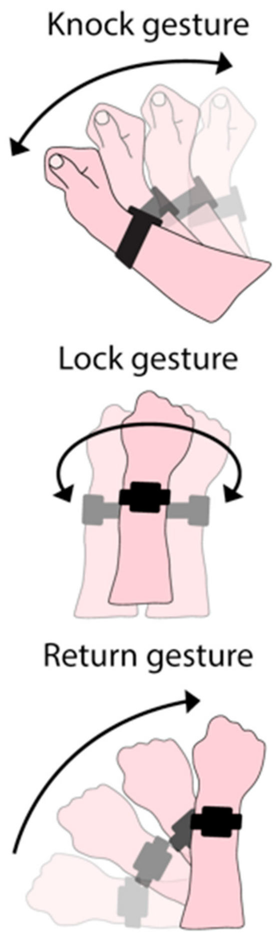

Figure 1: Three different forearm gestures used in our Office Smartwatch prototype.

Introduction & Related Work

The popularity of smartwatches has increased rapidly in the last year. Smartwatches are being hailed as a new disruptive technology that might bring wearable computing to the masses. As smart watches are normally worn on the wrist, we see a big potential for them to digitally augmented gestures performed in day-to-day contexts. In this paper, we describe the design and development of an application for a smartwatch to assist office employees in easily locking and unlocking doors, in acquiring room information and notifying others when they want to enter their office. Many companies are using building management systems (BMS) to manage their office space. There are software packages available for hospital buildings [1], which focus on large-scale management of rooms in particular departments. Other software packages are focusing on door security systems [2]. These systems use RFID or fingerprint recognition to open or close doors. Bieber et al. presents challenges and opportunities of smart watches and introduces a concept of non-obtrusive interaction with smart watches by using physical activity recognition [7].

The "Office Smartwatch" Application Interaction Concept

While the office environment offers a rich set of different interactions between humans and also between humans and various digital devices, we started our development of the Office Smartwatch by focusing on a specific use case. We explored various ways to support interactions usually performed when entering a room or getting information about specific office room. In various brainstorming sessions, we derived the following set of interactions to digitally augment commonly used gestures (see Figure 1). Because of the small screen we wanted to make the interaction fast. We decided to implement three types of physical gestures to support the most important functionalities. First, we provide the opportunity to perform a virtual knock with the same gesture as a real knock. Secondly, we support opening/closing doors using the gesture of turning your wrist, just like turning a key to open a door. Finally, the last gesture we provide is swiping your arm to bring you back to the home screen with room scanning functionality.

Knowledge workers tend to drop by each other's offices regularly, for example, to ask for assistance or quickly discuss something. Even with the door open, knocking on the door is a common gesture to politely indicate your presence and check whether you are not interrupting the person. Using smartwatches, we could digitally augment these gestures, which can provide a number of benefits. For example, when a person is not in his office, knock gestures could still be recognized and transferred to that person's smartwatch. This allows office workers to keep a record of who came by and who they might have missed. Additionally, it is often annoying to interrupt a phone or Skype call to tell the person knocking on the door that now is not a good time. Depending on who is knocking on the door, it might be important enough to interrupt the phone call. Using our smartwatch applications, the person in the call gets a notification about the virtual knock, and can choose to deny their colleague access or let them in, without having to interrupt the call.

Figure 2: Screen design of our Office Smartwatch application.

Keys (or keycards) are commonly used to open doors in office buildings. However, they also have several disadvantages: generic keys could still provide access to restricted rooms; they might be lost or forgotten (e.g. people could lock themselves out); or people might forget to lock the door, which could lead to theft of personal belongings or sensitive information. Our Office Smartwatch application tracks the identity of its users to provide more fine-grained access control. Using the user's identity, we can restrict access only to the doors that they are allowed to open. Users do not have to remember to bring their keys, assuming they always have their smartwatch on their wrist. To prevent theft, doors could be automatically locked after a specific period of time and door entry and exit could be logged.

In our application, we have three kinds of feedback: visual feedback on the smartwatch display, audio feedback (e.g., a knocking sound when performing a virtual knock) and vibration in case of a notification. Also for smartwatches, visual feedback remains the most common way of providing feedback to users. In order to keep the display contents easy to grasp, we only show information that is essential, following the recommendations of Kärkkäinen and Laarni [8]. As mentioned previously, we display up to four buttons at the same time on the screen. In between those buttons in the center of the screen, we show additional information about the room. There are also layouts with only two buttons. In those screens, we use all the space above the buttons. We have also tried to reduce the amount of text in the interface. We use as many visuals as possible to make things clear and reduce the time needed to understand what is shown on the watch (see Figure 2).

When doing gestures, it is difficult to see what is happening on the screen. During the development of our app, we noticed that when a gesture was performed, the device could have detected two different gestures in sequence. However, when the user looked at the screen, he only got feedback of the last gesture that was performed. To address this problem, we decided to add audio feedback and play a sound every time a gesture has been detected. Users should be able to immediately distinguish the performed gesture based on the sound they hear. For example, when a virtual knock gesture is performed, the device plays a real knocking sound. For the opening/closing gesture we decided to use a rattling keys sound. For going back to the scan functionality, we use a sibilant whoosh sound.

Audio feedback will also be generated when someone needs to be notified, like receiving a virtual knock on his device. This is helpful because users might not look on their watch at all times. Vibrations are only used sparingly, as they can be annoying to the user. Vibrations are only used for notifications: for notifying the user when someone is knocking on their door, when they need to attend a meeting, in case of an error, or when the user tries to perform an action without the right permissions (e.g. opening the boss's office door).

Figure 3: The Office Smartwatch application in use, running on a Samsung Galaxy Gear.

Implementation

We implemented the application for the Samsung Galaxy Gear (see Figure 3). The Samsung Galaxy Gear needs to be connected through Bluetooth to another Samsung device, such as the Samsung Galaxy S4, to receive and handle events. The Samsung Galaxy Gear has a touch sensitive screen and one physical button to interact with it. It features different sensors such as a camera, vibration, sound, a microphone and an accelerometer.

For our application to work, we need to be able to recognize the correct door. Since GPS is not available indoors, several methods for indoor positioning have been developed [3]. For example, there are RFID-based indoor location algorithms [4] or indoor user location based on QR-codes [5]. The Office Smartwatch uses QR-codes attached to the doorplate to get information about the rooms and schedules. The code links to the room information in the building management system (in our case a simple MySQL database). The QR-codes are scanned using the smartwatch camera. After scanning the QR-code, a Bluetooth message is sent to the smartphone. The smartphone then asks for the data in XML format through an HTTP request to the webserver. This data is finally forwarded to the smartwatch again, where it will be parsed and displayed on the screen.

For recognizing the user's gestures, we use polling and analyze the data from the accelerometer. The smartphone is checked, at a periodic rate, if a defined gesture (e.g. a "knock" on the user's office door) is performed with the smartwatch. If this is the case, the smartwatch is informed by the smartphone. The user then receives a notification and can react upon it.

Conclusions and Future work

We presented the Office Smartwatch, a smartwatch application to perform common actions in an office environment without losing too much time. The Office Smartwatch does this by coupling actions to forearm gestures. In terms of limitations, the detection of a door is not optimal as the user has to explicitly scan a QR-code before other actions are possible. Ideally, the system should automatically detect the correct door, which could be tackled if an indoor location system would be in place in the office. In future work, we would like to perform a user study with our application to evaluate the intuitiveness of our interactions.

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