Mnemonical Body Shortcuts

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Abstract. We present a body space based approach to improve mobile device interaction and particularly, on the move performance. The human body is presented as a rich repository of meaningful relations which are always available to interact with. Preliminary studies were carried and validate mnemonical body shortcuts as a new mobile interaction mechanism.

Keywords: Mnemonics, Shortcuts, RFID, Gestures, Mobile

1 Introduction

Mobile computers are currently omnipresent, and became a part of the user's daily life. Their potentialities are diverse: communications, GPS, video and music players, digital cameras, game consoles and many other applications. The characteristics of these multiple-task devices surpass the desktop user interfaces and give more importance to new possibilities in human-computer interaction (HCI).

Mobile devices and desktop interaction are quite different due to their different physical characteristics, input/output capabilities and interaction demands. They have to be small and lightweight to be carriable therefore limiting battery resources and processor capabilities. Input and output capabilities are reduced. The interaction while mobile is also different because users' visual attention is not always focused on the device, making eyes-free and low-workload important characteristics to create a suitable mobile interface. Also, there is a core of applications that are used recurrently, and their menu access is often too slow due to the limited input capabilities. This implies the growing importance of shortcuts: users need fast application access. To achieve this goal, mobile phones provide voice and key shortcuts. Voice shortcuts are not suited to noisy environments, are too intrusive, have a low recognition rate and low levels of social acceptance. Key shortcuts don't provide any auxiliary memorization about which shortcut is in which key.

To overcome mobile shortcuts issues and ease on-the-move mobile device interaction, a gestural input technique is proposed. Gestures are a natural and expressive method of human communication and are often combined with body hints to empathize an idea (i.e. reaching the heart to show an emotion). It is possible to apply different technologies to enhance mobile devices with gesture recognition, making those gestures a meaningful triggering method to the main functions of the device. We give special attention to the body space and related mnemonics to increase shortcut usage and therefore improve user mobile performance.

2 Related Work

There are many options which detect body or device movement and allow a response to the movement. This response may be a shortcut to an application or any other effect in internal or external applications. The most common techniques and works in gestural recognition for mobile devices were studied, namely Radio Frequency Identification (RFID), Accelerometers, Cameras, Touch Screens, Electromyography, Capacitive Sensing and Infrared Laser beams.

RFID Technology is now starting to be incorporated in mobile devices, making it possible to read a tag (a small sized chip with an antenna emitting radio frequency waves and usually storing a unique identifier) with an approximation gesture with the device. Those gestures can only be based on single/multiple point recognition and not in the whole gesture. A mobile gestural interaction with RFID demands a permanent presence of tags, which is possible with their embodiment (attaching it to clothes, wallets, etc.) Following this idea, Headon and Coulouris [1] created a wristband to control mobile applications with gestures, based on reading a grid of RFID tags attached to the user's shirt. The inconvenience of this solution is the need to stick tags in clothes or personal objects.

An accelerometer is a small electromechanical inertial sensor device that measures its own acceleration, and its currently being used in commercial mobile phones. With an accelerometer on a mobile device is possible to recognize explicit gestures such as hand gestures based on vibrational [2], tap [3] and tilt [4] input or innumerous arm movements. For example, Choi et al [5] used a mobile phone with inertial sensing to recognize numbers drawn in the air to trigger phone calls or delete messages with a double lifting, while Ängeslevä et al [6] presented preliminary studies on the possibility to associate gestures with parts of the body and trigger applications using those body space mnemonics.

Pressure sensitive surfaces are commonly integrated with screens in some devices like PDAs. They are able to detect 2D gestures, such as taps, directional strokes or characters, allowing eyes-free interaction with the device. Pirhonen et al [7] prototyped a mobile music player placed on the belt, controllable with metaphorical finger gestures, like a sweep right-left to the next track or a tap to play and pause. There are other approaches: Friedlander et al [8] suggested a gestural menu selection based on directional strokes to select an entry on a concentric ring of options. However, applications in touch screens may only be used in over-sized devices and are limited to 2D gestures.

Other approaches also relevant but not so common include: Mobile cameras reading visual tags or processing their optical flow to recognize movement, rotation and tilting of the phone; Electromyography where the user can subtly react to events by contracting a monitored muscle; Capacitance Sensing used to scroll a presentation, control a DVD or MP3 player by approaching a finger to the sensor; Laser beams, used to detect finger movements near an handheld device.

The fact that those techniques can be implemented in mobile devices doesn't make them suitable to be used on-the-move. Current applications lack the possibility of using gestural shortcuts in mobile scenarios. Furthermore, the gesture selection doesn't provide enough mnemonical cues for them to be easily remembered.

3 Task Analysis

In order to capture the actual panorama considering shortcuts in mobile devices, 20 individuals were interviewed and observed. The task analysis consisted on a first part with questions about current habits on mobile phone interaction and in a second part where users were asked to reach the most used applications and contacts. It was found that 75% of the interviewed used key shortcuts, while none used voice shortcuts due to its social constraints and low recognition rates. An average of 5 key shortcuts is used, where 93% of the users execute them on a daily basis. Users with more programmed shortcuts reported difficulties in their memorization. In user observation, results show that people needed an average of 4 keystrokes to access the 3 most used applications and 5 keystrokes to call the 3 most used contacts. Key shortcuts seem to be used but observation results reflect a large number of keystrokes. Users often make mistakes or simply forget to use them and apply menu selection. Mobile device interaction still needs to find new input forms to achieve a more efficient interaction.

4 Proposed Approach

We propose the creation of mnemonics based on the association between applications and the body space. Mobile gestural interaction has to be strongly based on a high recall of commands and the human body with its meaningful associative space offers the needed, and always available, mnemonical cues. For example, the user should be able to trigger a clock with a gesture towards the wrist or open the music player with an approximation to the ears.

System Requirements. The system should be able to produce a shortcut after a recognized gesture. Some of these gestures can be predefined but the user has to be able to build personalized ones. Those gestures are intended to be associated with body space and store a meaningful body mnemonic to help in its future recall. Feedback is important and should be also personalized, giving the user the possibility to choose visual, speech, audio or vibrational feedback. Related both to the gesture and the feedback are the user and social acceptance, making interaction aesthetics an essential requirement.

RFID Body Shortcuts. To validate our approach we developed a RFID-based prototype able to associate body parts (through sticker tags) with any given mobile device shortcut (i.e. an application or a call to a certain contact). We selected RFID technology to apply our approach because it provides direct mapping, easing the creation of body shortcuts. Other solutions were clearly limited as they restrict the scope of interaction (touch screens, cameras, laser beams and EMG). Accelerometers are also suitable to detect gestures towards a given position and have a higher scope of interaction possibilities, adding full-movement recognition, which brings higher complexity and error rates, therefore discarded at this stage where we focus on mnemonical body shortcuts.

Evaluation. The prototype was evaluated with 20 users in a controlled environment using a Pocket LOOX 720 with a compact flash ACG RF PC Handheld Reader. In the first stage of the evaluation the users were asked to select the five most frequently tasks effectuated with their mobile phones and associate them both with a body part and a mobile device key (in their own mobile device). Considering body shortcuts, it is interesting to notice that 89%, out of 18 users, related message writing with the hand, 88%, out of 17 users, related making a call to their ear or mouth and 91%, out of 11 users, related their contacts to their chest, among other meaningful relations. An hour later, the users were asked to access the previously selected applications, following both approaches (reaching tagged body parts or pressing key shortcuts). For each of the approaches, users were prompted randomly 20 times (5 for each application). Although several users selected already used key/application relations, 50% (10/20) made at least one error, with an average of 9% errors/user. Considering body shortcuts, 15% (3/20) made a mistake averaging 0.8% errors/user.

5 Conclusions and Future Work

We presented a work in progress to improve shortcut execution in a mobile context focusing on the body space as a meaningful target for interaction. A RFID-based prototype was developed and evaluated. The conducted user studies showed that body mnemonics, besides meaningful, and sometimes universal, are easily recalled and surpass traditional key shortcuts. The work will continue with focus on feedback, shortcut personalization and user acceptance issues. We will also explore accelerometer-based gestural interaction aiming at mnemonical gesture shortcuts, a wider scope.

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