Microinteractions beside ongoing manual tasks

Katrin Wolf
T-Labs (Quality & Usability Lab)
Technical University Berlin
Ernst-Reuther-Platz 7, 10587 Berlin
katrin.wolf@acm.org
+49 30 835354265

ABSTRACT
This paper explores how microinteractions as finger gestures allow executing a secondary task without interrupting the manual primary tasks such as driving a car or using a smart stylus. An analyses of Bock's Grip Taxonomy helps to identify manual primary tasks that have a huge benefit of not being interrupted by secondary tasks to control mobile applications and devices. This vision could offer the possibility to use the mobile phone safely while holding a steering wheel of the car as well as augment the functionality of a smart stylus such as change the stroke width without stopping to write or to draw.

After discussing some in this research field used tracking technologies, such as EMG or depth camera, we explore the benefits and device hardware of our prototype, which uses accelerometers to track finger gestures without disable any hand-skills, like its flexibility or tactile sense.

Author Keywords
Wearable, mobile, spatial, gestures, microinteractions.

ACM Classification Keywords
H5.2. [User Interfaces]: Interaction styles.

General Terms
Design, Human Factors, Experimentation.

INTRODUCTION

Bock et al [1] developed a grip taxonomy that compared 14 grip taxonomies of 92 years human hand's research. Bock identified 33 different manual grasps and classified them as 3 main types: palm, pad, and side. For investigating microinteractions that are executable beside manual tasks; we have chosen 3 tasks: each one is using one grip of each main group of Bock's taxonomy (see Table 1). Therefore, we ensure research results that are scalable to preferably a wide range of manual activities.

Primary tasks such as driving a car, using a smart stylus, focusing a camera, turning a key in a lock, or insert a cash card into a bank automat does not need our complete cognitive effort nether all of our fingers are strictly involved into these processes. This offers the possibility to perform tasks in parallel. These can be completely separated like answering a phone.

Grasp type (Bock [5])	**Description** (Bock [5])	**Involved hand-parts** (Bock [5])	**Potentially still movable hand-parts**
Palm **(i.e. Steering a car)**	 **Encompass grasp**	**Low power grasp performed by 2-directional force between palm (finger 2-5) and abandoned thumb**	**Particular fingers and thumb**
Pad **(i.e. Inserting a cash card into an ATM)**	 **Precision grasp**	**2-directional force between abandoned thumb and index finger**	**Finger 1-3: middle, ring, and little finger**
Side **(i.e. Drawing with a stylus on a graphic tablet)**	 **Dynamic tripod**	**2-directional force between : a) added thumb and middle finger while index finger stabilizes or b) thumb and index finger while middle finger stabilization**	**Ring, little finger** **Stabilizer: index finger or middle finger**

Table 1. Microgesture options while ongoing manual tasks: Analysis of Otto Bock's grasp types: Palm, Pad, and Side. Graphics by Kapandji [4]. Fingers are counted starting from the thumb

But there is also the possibility of redesigning the primary tasks by augmenting them. For instance, micro-finger-gestures could control automotive functions while driving a car, but without releasing the steering wheel. Also tiny movements with the little finger could select the color or the stroke with a smart stylus during drawing with it.

Each primary task is different, but there are a few common requirements guiding the interaction design for the secondary task:

The secondary task has to be realizable with fingers that are not in particular involved in the primary task (see Fig.1).

The system that tracks the microinteractions shall not bug the primary task at all. Therefore we aim to keep the complete flexibility of the fingers as well as not disable the tactile sense of the finger tips by covering them with e.g. data gloves.

RELATED WORK

The presented approach in this paper is related to microinteractions that are performed by finger gestures. That focuses on gesture-based interaction styles as well as on wearable but hands-free gesture tracking systems.

Computer vision based gesture tracking for identifying pinch gestures is investigated by Loclair [5]. Vardy [8] tracks finger flexion with a camera integrated in a wrist band. Howard [3] is using optical detectors (that are also integrated in a wrist band) for measuring LED light that is reflected by the fingers.

Harrison [2], Saponas [7], and Rekimoto [7] are measuring natural finger gestures by body transmitted signals, such as acoustic signals, EMG, and electrodes that display forearm movements.

We aim to investigate which interaction design (namely microgestures) might be best suited to apply secondary tasks for a wide range of primary tasks. Therefore we are designing hardware to track the input gestures for these secondary tasks. Our design is meant to reflect the benefits and challenges of wearable input devices regarding

primary task compatibility, wearing comfort, and quality of measurements.

INTERACTION DESIGN

Many manual tasks are often performed without using actively all fingers. In example while driving a car the steering wheel is almost at any time just lightly touched by a palm grip and not grasped with power. The fingers are mostly floating above the wheel and can easily be moved without risking to loose control of the car, as it is shown in Figure 1 graphic (1)-(3). Our gesture set is build of touches, tabs, and spatial movements. One big challenge is to define gestures which can be recognized clearly as input gestures and not mixed up with natural ones. A second problem is the definition of the gesture starting event. To avoid misinterpreted gestures, we build up our set from dynamically performed gestures. Moreover, we have chosen gestures that are usually not being performed while the primary task AND that are designed as unique and distinguishable as possible.

Our guideline is resulting into synchronous and inverse gestures (Fig.1, (4)-(6), (10): Touch or Tab, (7): Flip, (5), (8), (11), (12): Touch&Drag, (9): Ream, and (13): Surround. The touch and tap gestures can also be augmented by touching or tabbing a specific rhythm to be identified clearly as an input gesture.

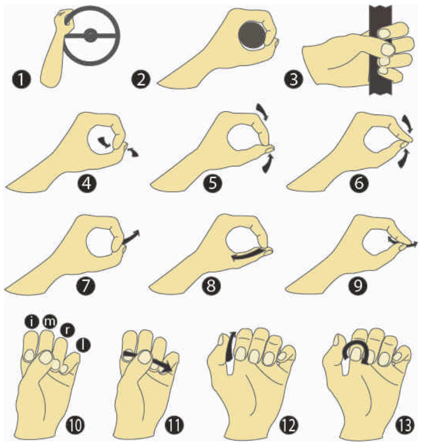

Figure 1. Microgestures for palm grip that show finger interactions which are performable while steering a car.

DEVICE HARDWARE

We are using the accelerometer ADXL335 and integrated it into a finger ring to measure the microgestures. A second similar sensor will necessarily be fixated on the backhand. This is important to generate unique data for identifying the finger gestures rightly and not mixing them with data that come from arm or whole body movements.

REFERENCES

1. Bock, O., Feix, T.: Grasp Taxonomy Comparison Sheet, DOI = http://web.student.tuwien.ac.at/~e0227312/documents / taxonomy_comparison.pdf.
2. Harrison, C. et. al.: Skinput: Appropriating the Body as an Input Surface, In Proc. CHI 2010.
3. Howard, B, Howard, S.: Lightglove: Wrist-Worn Virtual Typing and Pointing, In Proc. ISWC 2001.
4. Kapandji, I. A. The Physiology of the Joints, Vol. 1, Upper Limb. Edinburgh: Churchill Livingstone, 1982.
5. Loclair, C., Gustafson, S., Baudisch, P.: PinchWatch: A Wearable Device for One-Handed Microinteractions, In Proc. MobileHCI 2010.
6. Rekimoto, J. et al.: GestureWrist and GesturePad: Unobtrusive Wearable Interaction Devices, In Proc. ISWC 2001, pp. 21-27.
7. Saponas, T. et. al.: Enabling Always-Available Input with Muscle-Computer Interfaces, In Proc. UIST 2009.
8. Vardy, A. et al.: The WristCam as Input Device, In ISWC, pp. 199–202, 1999.