A Glove for Seamless Computer Interaction – Understand the WINSPECT

Michael Lawo, Hendrik Witt, Holger Kenn, Tom Nicolai, Rüdiger Leibrand

TZI -Universität Bremen {mlawo,hwitt,kenn,nicolai@tzi.de, quitex@wearlab.de}

Abstract. As the mouse is the standard user interface for graphical desktop computer applications and the glove has beside joysticks and other immersive interaction devices gained some popularity in several virtual reality applications, the glove seems to be the preferred human computer interface (HCI) for wearable computing. In this paper the concept of the WINSPECT is presented and put into the context of advanced wearable computing applications.

1 Introduction and state-of-the-art

Gloves are a piece of clothing and a part of fashion. However, the origin of gloves is a protective purpose: In ancient Egypt, Greece and Rome mittens were used by farmers and gardeners in the form of little sacks from fur or cloth. The Romans also wore thin finger stalls during meals. It is an invention of the Persians and Germans of the Bronze Age to produce mitten gloves from sheep wool. In the 8th century gloves became a sign for rule and jurisdiction and others were only allowed to wear mitten.

From the 16th century on gloves became common and a part of fashion until about 1950 when gloves lost this meaning for fashion and their use was reduced to the protection against cold and injury. Negative aspects of gloves are that at room temperature wearing those causes sweating and gloves in general hinder fine motor skills.

With the upcoming use of wearable computing this might change: gloves may again become a part of fashion as in some sports or a protective interaction device for the information overload in the professional working environment as for consumer use.

One of the challenges gloves for computer interactions have to master is the integration of electronics and textiles. There exist some examples (see fig. 1) for the appropriate integration e.g. in sports like gloves with integrated heating for snowboarding or gloves with integrated lightning for bikers or the perfect golf glove with an integrated pressure sensor and a beeper for feedback in case of to high pressure. All those gloves are not designed for computer interaction but have some well integrated electronic parts and for the purpose a perfect textile design; they are all consumer products of a reasonable price (up to 150 €).

(a) (b) (c)

Figure 1: “stupid” sporting gloves with (a) heating (b) lightning (c) pressure sensor and beeper

There exist as well some examples for “intelligent” virtual reality gloves designed for complex computer interaction. Those commercially available US produced gloves from Immersion[1] and 5DT[2] are equipped with five to 22 sensors (see fig.2). They are designed for virtual grasping and able to detect exact finger motion. The gloves from Immersion are also delivered with actuators for feed-back and those from 5DT are also available as a pair. The standard interface is a RS232. For the 5DT gloves exists a version with a Bluetooth® interface but the interface and the battery, which allow more then 8 hours operation without changing the batteries. Interface and power supply are not integrated into the gloves but a belt (see fig. 2). The price range for those gloves is between 1.500 and 7.500 US$ including drivers. Those gloves are made of Lycra® in one size fits most.

- Above 5 and 14 sensor gloves from 5DT with Bluetooth® interface
- Left 22 sensor CvberGlove® and CvberTouch™ from Immersion

Fig. 2 “intelligent” virtual reality interaction gloves from Immersion and 5DT

Another approach for the integration of electronics into textiles is the “Wanted” phone by Berglin[3].

---

[1] http://www.immersion.com/3d/products/cyber_glove.php

[2] http://www.5dt.com/hardware.html#glove

[3] http://www.cs.chalmers.se/idc/publication/pdf/berglin_wanted.pdf

2 Devices for computer interaction in wearable computing

Classical wearable computing is based six components (see fig. 3 left): a core wearable computing unit (CWCU), a communication subsystem to interact with the working environment (CS), input and output devices (ID & OD), general peripherals (GP) like servers, databases, number cruncher and sensor subsystems (SS), which are mandatory for the necessary context detection in wearable computing. It is more or less a desktop computer where the rack (CWCU+CS) is reduced in size as far as possible, the monitor is replaced by a head mounted or wrist mounted device (OD) and as Input device (ID) one-hand keyboards like the twiddler[4] connected by cable to the CWCU are used. The wireless computing unit (CWCU +CS) gives in this approach access to the general peripherals based e.g. on wireless LAN technology. Sensor subsystems are usually understood as sensors somewhere applied to the body and connected via wires to the CWCU.

More advanced 3[rd] generation wearable computing systems use an on body network and try to go beyond the desktop paradigm (see fig. 3 right). Here the system is reduced to four components with wireless communication, three of them as wearable devices. The sensor subsystem and the input device can be integrated.

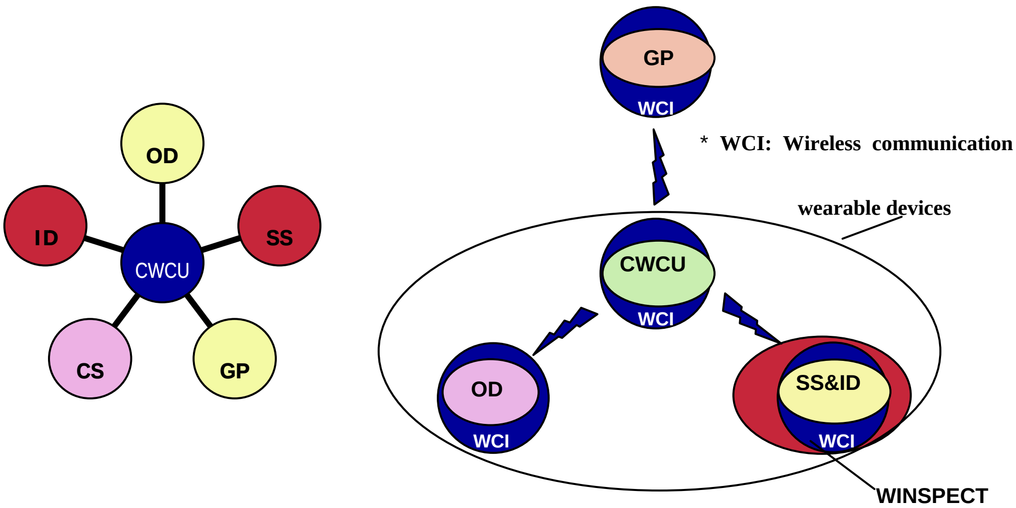

Fig. 3: classical wearable computing architecture (left) and on body wearable computing network (right)

To achieve a user friendly and wearable sensor subsystem it seems to be quite natural that the device has to base on wireless communication; thus the device itself could be put on and off like clothing.

---

[4] http://www.handykey.com/

3 Components of the wireless WINSPECT

To achieve an implementation of a wireless sensor subsystem the following components have to be managed in an integrative manner: textile as liner, wiring for interfacing the sensors (binary, analog, digital) with the sensor signal processor, a communication interface like Bluetooth ® and the energy supply. Possible sensors are given in fig. 4. Here it becomes obvious that with such a glove much more information especially on the context of the user can be achieved.

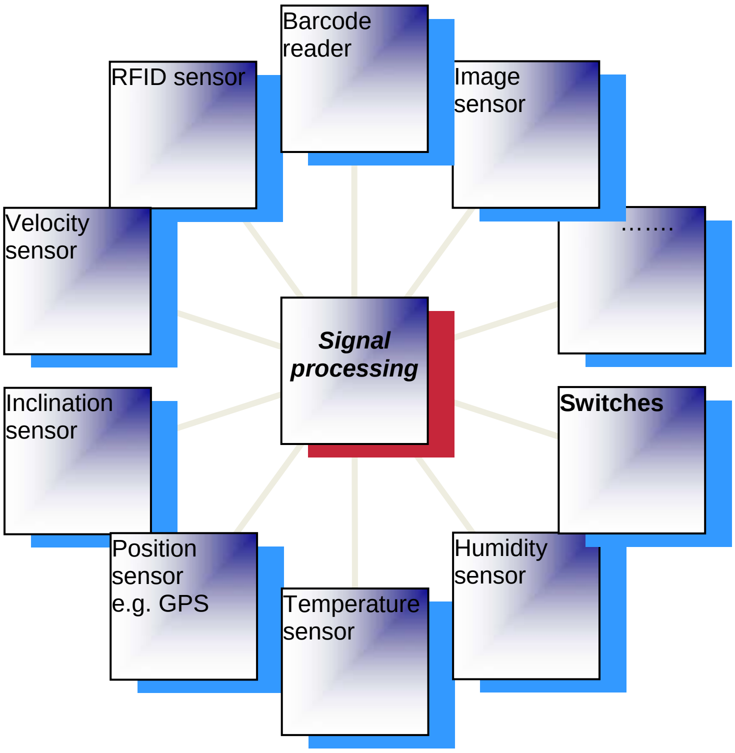

Fig. 4: Possible sensors for wearable computing, e.g. on the wireless WINSPECT

The WINSPECT is a well documented device for wearable computing maintenance applications[5]. But the device was not wireless connected to a wearable computer, which is crucial as explained above for increased user acceptance. The glove was used for applications like seamless selection of displayed items in menues or used as pointing device in computer graphics.

[5] http://csdl2.computer.org/persagen/DLAbsToc.jsp?resourcePath=/dl/proceedings/&toc=comp/proceedings/iswc/2001/1318/00/1318toc.xml&DOI=10.1109/ISWC.2001.962124

The implementation presented here is based on a three layer glove, an inner layer of a hygiene glove from cotton (user specific) the sensor glove from lattice lining where the electronics are on leatherette and hook and loop fasteners are used as fixtures. The third and outer glove is an application specific working glove (see fig. 5).

Fig. 5 wireless WINSPECT

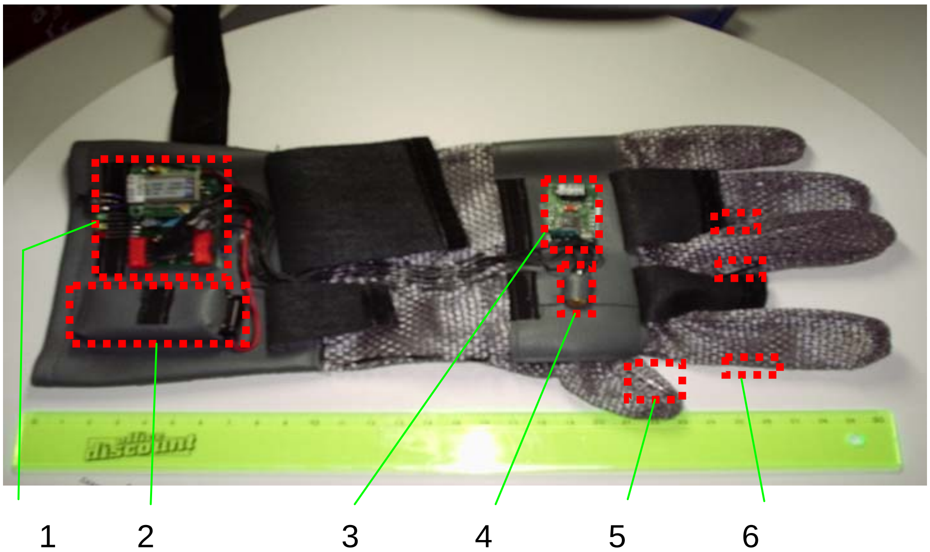

Fig. 6 electronic components of wireless WINSPECT

The following electronic components (see fig. 6) are integrated in the device (1) an electronic module including a Bluetooth® interface (55 x 32 x 15 mm³), (2) an accumulator (9V block), (3) a RFID scanner (37 x 10 x 18 mm³), (4) an inclination sensor (18 mm, Ø 7 mm), (5) a magnet (20 mm, Ø 4 mm), and (6) three Reed-switches (10 x 3 x 3 mm³)[6].

4 Outlook and needs of improvement

The wireless WINSPECT meets the important criterion of wireless communication already quite well. However are the Bluetooth® interface as well as the RFID reader quite energy consuming. Actually on times with the used batteries of approximately one hour can be achieved.

This implementation of the WINSPECT is compared to previous designs a real improvement.

However, there is still some work necessary to improve some aspects:

First of all is this the energy supply. There is a need for flexible boards. Chips without housing would as well as using SMD technology an advance towards an industrial use. The integration of sensors and wires into the textiles seems to be a necessary additional enhancement as well as the used textile material proved to be not optimal. A fingertip free version would also be a benefit.

[6] * http://www.lichen-int.ebigchina.com/sdp/355735/4/pl-1675186.html