

## Chapter 3.9

# Human Factors Problems of Wearable Computers

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### ABSTRACT

In this chapter wearable computers are considered from the perspective of human factors. The basic argument is that wearable computers can be considered as a form of prosthesis. In broad terms, a prosthesis could be considered in terms of replacement (i.e., for damaged limbs or organs), correction (i.e., correction to ‘normal’ vision or hearing with glasses or hearing aids), or enhancement of some capability. Wearable computers offer the potential to enhance cognitive performance and as such could act as cognitive prosthesis, rather than as a physical prosthesis. However, wearable computers research is still very much at the stage of determining how the device is to be added to the body and what capability we are enhancing.

### INTRODUCTION

There is a wide range of technologies that have been developed to be fitted to the person. Depending on one’s definition of “technology,” this could range from clothing and textiles, through to spectacles, to cochlear implants. The use of these different technologies can be basically summarized as the supplementation or augmentation of human capability, for example the ability to regulate core temperature (clothing), to see (spectacles) or to hear (cochlear implant). One reason why such supplementation might be required is that the current capability does not fit with environmental demands, either because the environment exceeds the limits over which the human body can function or because the capability is impaired or limited. From this perspective, a question for wearable computers should be what are the cur-

rent human capabilities that are exceeded by the environment and require supplementation by wearable computers? In the majority of cases for wearable computers, the answer to this question hinges on communicative, perceptual, or cognitive ability. As Clark (2006) notes, "...the use, reach, and transformative powers of these cognitive technologies is escalating" (p. 2). but the essential point to note is that "Cognitive technologies are best understood as deep and integral parts of the problem-solving systems that constitute human intelligence" (p.2). Thus, such technologies could represent a form of 'cognitive prosthesis' in that they are intended to support cognitive activities, for example, having a camera (performing face-recognition) to advise the wearer on the name of the person in front of them. The immediate challenge is not necessarily one of technology but of cognition. If the technology is 'doing the recognition,' the question is raised what is the human left to do? To draw on a commonly cited analogy, spectacles serve as a perceptual prosthesis, that is, to improve or correct a person's vision. For wearable computers (and the related field of augmented reality), the 'improvement' could be to reveal to the person objects that are not present by overlaying an artificial display onto the world. The display could simply take the form of labels or directional arrows, or could be more a sophisticated presentation of moving (virtual) objects. In both cases, the 'augmentation' could either enhance the person's understanding of the environment or could substitute this understanding.

In terms of communication, mobile telephones and MP3 devices contain significant computing power such that they can easily be considered as being computers, albeit with limited functionality. These devices can be worn, for example MP3 players can be worn on the upper arm, attached to belts or neck-straps, or placed in hats, and mobile telephones can be attached to belts. Furthermore, with the wireless (Bluetooth) headset, the user interface of a mobile telephone can be worn on the

ear at all times. Thus, both can be always present and both can be considered part of the person. A definition of wearable computers ought to, at least, allow differentiation from devices that can slip into the user's pockets (if this technology is to be treated as a new area of research and development). Two early definitions of wearable computers, from Bass (1996) and Mann (1997), emphasize that wearable computers are designed to exist within the corporeal envelope of the user and that this makes them part of what the user considers himself or herself. In many respects this allows an analogy to be drawn between wearable computers and prosthetic devices. Having something added to the body, whether externally, such as spectacles, artificial limbs, hearing aids, or internally, such as pace-makers, or cochlear implants, changes the performance of the person and (for external prosthesis) the appearance of the body. This now becomes a very different concept from the mobile telephone, MP3 player and the computer that we traditionally encounter. This raises all manner of interesting questions relating to physical, perceptual, and cognitive aspects of human factors, as well as a whole host of emotional aspects of wearing devices (for the wearer and the people with whom they interact). At the moment, there remains a gap between what a wearable computer is intended to be and what mobile telephones and MP3 players currently are. This gap can best be considered as a form of perceptual and cognitive prosthesis, in which the wearer's ability to view the world, retrieve pertinent information, and respond to environmental demands are enhanced by the technology across all aspects of everyday life. At present mobile telephones and MP3 players are able to be tailored (by the user) and can deal with a limited set of situations (relating to communications or music playing) but do not fill the specification that one might have for a wearable computer. The basic difference between a wearable computer and these other technologies lies in the question of how well the user can interact with both the device and the environment

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