“What is a Wearable Computer?” Metrics for Assessing Wearable Devices

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The most common question about wearable computers is "Is my cellular phone/PDA a wearable computer?" Let's start by settling this question: the answer is yes. A better question is “How wearable are these devices?”

The most confusing thing about the emerging field of wearable computers, commonly referred to as wearables, is that there has been little agreement as to what exactly the requirements are for a wearable. Researchers and academics have developed a description that requires that the device be portable, enable hands-free use, possess a wide array of environmental sensors, and always be proactively acting on its user's behalf. While this describes quite a powerful and flexible device, it falls short as a metric and is definitely not a definition of a wearable computer.

Let's start with a definition. A wearable computer is any device (A) that qualifies as a computing device (i.e. it must assemble, store, correlate, or otherwise processes information), (B) that is worn, or is carried on one's person habitually, and (C) whose primary interaction is with the person wearing, or carrying, the device.

By our definition, modern cell phones, PDAs, PIMs, and laptops meet all the requirements of wearables. However, if we look at prisoner tracking collars, Alzheimer's tracking systems, child locator beacons, etc., each case fails requirement (C)--the user is not the person wearing the device. Thus, none of these is, by definition, a wearable computer.

Now that we can evaluate whether something is or is not a wearable we need metrics to be able assess the performance of a device as a wearable. We need to be able to answer the question, "So, is my PDA better or worse as a wearable then my laptop or cell phone?" Or "What needs to be done to make a better wearable?"

We can measure the performance of a wearable with two central criteria: its transparency, and its efficacy. Transparency is the degree to which the wearable's use is visible when set upon the backdrop of the user's daily life. This covers both form factor and the user interface. For wearables to be used habitually, they must be physically inconspicuous, be light and small, and have a natural and intuitive user interface.

An autonomous metric for transparency is difficult to define. The most obvious metrics for transparency involve one of two systems of measurement. The first is a heuristic evaluation with an accompanying survey of multiple opinions. The other is a relative comparison of how much less a device is visible to the user than a separate device with comparable functionality, which requires multiple devices. Ultimately both of these

methods are very poor metrics as they rely on a pluralism of either people or devices in order to appraise a device's transparency.

An initially more obfuscated, but ultimately more useful and autonomous metric of transparency, is the ratio of the total time spent performing a task to the component of the time which was spent on interface overhead. The less time spent on the interface for a given task the higher the transparency. For a wearable computing example, information that pops up on a display, such as an HMD, which is already in your field of view, may have a higher degree of transparency than having to raise your arm to look at a static display on a device such as a watch or a PDA.

Efficacy is a measure of the degree to which the wearable is effective.

In order to further define efficacy for wearables, we need to know what the purpose of a wearable is. At this point we need to add another requirement to our definition of a wearable computer: (D) a wearable computer's purpose is to provide its user with the means, knowledge, or opportunity to be either more capable, or simply able, to complete a given task or tasks. Efficacy is then a measure of the degree to which the wearable enables its user, either by making existing tasks easier or by enabling them to perform entirely new tasks.

Efficacy for a device can be measured as a function of the adjustment required by its user to accommodate use of the device. For example, a PDA requires that it be taken out of one's pocket to check the time on it. By comparison, a laptop requires it be taken out of a bag, opened, and booted up, and a watch simply requires that the user's wrist be angled such that the user can see the watch face. All of these accomplish the same task, but with varying degrees of efficacy. Were it not for the remaining criteria (A, B, and C), a watch could be said to be the most efficacious wearable computer of the three examples above. (It is not, in fact, a wearable computer because it does not meet criteria A in that it does not process information.)

While PDAs such as the Palm or Handspring are, by definition, wearable computers, they are highly modal: you are either using them to the near complete exclusion of all else, or not using them at all. Thus while they are highly efficacious for specific tasks, they suffer from very poor transparency. A cellular phone, on the other hand, outfitted with an in-ear microphone/speaker such as the Jabra is highly transparent, but much less efficacious due to its single focus. As cellular phones, pagers, PIMs, and PDAs take on more functionality they will fill out the low end of the wearables markets.