Functional or Fictional

By Nima Taherinejad

Designing healthcare devices has always been very challenging, which -partly- stems from their interdisciplinary nature, bringing engineers and physicians together for a close -or an entangled- collaboration. Good communication between the two groups could largely reduce the difficulty: Engineers would understand the problem better and do their best to solve it; physicians would understand better what a device is capable of doing and what the limits (requiring complementary actions) are. Physicians would have an extensive knowledge about the physiology and nature of the problem that they could communicate to engineers. Engineers, on the other hand, would know in advance the (expected) operational and environmental conditions of the device and could take them into account at design time. However, the emergence of wearable devices has been a game changer in many aspects.

Maybe one of the most important changes has been bringing healthcare devices outside medical facilities and putting them in the hands of people at large, mostly with no medical training or knowledge. This has many consequences; for example, consumers have (usually and unrealistically) high and ever-increasing expectations from these devices. On the other hand, they use them or would like to use them in their daily life, i.e., in uncontrolled and unpredictable environments and operational conditions for the device, which makes the design even harder[1]. We have studied and discussed issues such as dealing with low quality data or wearing the device improperly in [8], or the movement artifacts intrinsic to wearable devices in [9]. However, once we surpass these technical challenges, we may face another challenge; medical studies have been traditionally conducted under controlled conditions, partly because there were no tools available to conduct them otherwise. What we know from those studies may or may not be applicable to the uncontrolled environments of our daily lives and activities. However, wearable healthcare devices enable physicians to study people in unprecedented ways and build a new body of knowledge. But, this might take a long time to accomplish and consumers are somewhat impatient expecting more immediate answers.

Another important aspect that has changed by the emergence of wearable healthcare devices is the need for a deep involvement of people at large in the design procedure. This requires more communication with more parties and with more clarity, some of which might not be as easy or as straightforward as one would assume and it sometimes goes completely unacknowledged. For example, we witness everyday traditional teams of engineers, or engineers and physicians, designing wearable healthcare devices. Their main concern is, naturally, the quality of the device in terms of accuracy of measuring what they intend to monitor. Better designs may consider some extra aspects such as battery lifetime to ensure that the users could wear the device for a long enough period of time, which is necessary for monitoring them during the daily or targeted activity period. Moreover, there are not many designs that emphatically consider the ease of use, being it the interface or the physical use (the ease of wearing the device in a daily setup). For

[1] In my previous article for IEEE LifeSciences [1], I briefly reviewed some of the challenges related to these two issues and some solutions, such as described in references [2]-[5], that computational self-awareness provides. For a sneak peek to computational self-awareness check ref. [6], or [7] for a bit more information on the topic, especially in resource constrained systems (which wearable healthcare systems are).

instance, a device designed for the elderly who have not grown up in the digital age may require a much more intuitive and simpler interface than what a teenager or a young child nowadays is used to handle. Another example is a mouthpiece to monitor breath rate, which may be acceptable for a hospitalized patient but is not practical for an athlete wearing one during sport activities. That aside, there are even a much smaller number of devices that consider issues such as the social stigma of using the wearable device that they are designing. Smartwatches that symbolize wearable devices nowadays are considered very “cool” to wear but that does not apply to all wearable devices. Would an epilepsy patient be willing to wear an EEG cap or a headset continuously during their daily activities to monitor seizures? Due to the way many of them currently look like, the answer is more often no than yes. Some people may not like to wear them even for shorter periods, even in a socially safe environment, because it stirs negative feelings in them. Therefore, even if they are functional, they may be as good as fictional, ending up on a shelf rather than being worn by the consumer. However, if it looked and felt like a fashionable baseball cap, things would be considerably different and its reception could improve. Therefore, it is extremely crucial to involve another group in the design of wearable healthcare devices - fashion designers. Wearable healthcare devices need to be comfortable and look good. It is reasonable to involve another group too - social scientists. If a major reason for not using a certain wearable healthcare device is social stigma, shouldn’t we study this aspect and see what elements create them or how could they be addressed? Monitoring some parameters may strictly require access to body parts, which may be impossible or very hard to be easily hidden inside a socially acceptable piece of clothes or accessory. Prescription glasses are a good example of that type of wearable healthcare devices. They came with a social stigma and it took us centuries to be able to come up with a hidden “cool” solution, aka contact lenses. It took us even longer to come up with a “cure”, i.e., surgery. However, the social stigma of wearing glasses was dealt with differently. That is, not by changing the wearable device, rather by changing the culture (and stigma) around it. This reduced the stigma such that nowadays we can say it has disappeared. Admittedly, there are still people who wear contact lenses only due to social stigma but they are a small portion of all who need vision correction. What could we learn from those experiences and how could we apply them to designing new wearable healthcare devices that might face social stigma?

Therefore, we need to note that designing wearable healthcare devices is much more complicated than ever and even though it may appear to be similar to designing medical devices it is significantly different. To make sure that a wearable healthcare device will not be fictional, it does not suffice anymore to ensure that it is functional. Designing such devices requires a much deeper involvement of a larger group of stakeholders; consumers, fashion designers, and social scientists on top of the traditionally involved group of engineers and physicians. This, of course, makes the design procedure more interdisciplinary and more challenging; however, ignoring this need may lead to the result of a great many hours of effort sitting on a shelf collecting dust.

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