Charting Design Preferences on Wellness Wearables

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ABSTRACT
This paper presents a study on people's preferences with wearable wellness devices. The results are based on an online survey (n=84), where people assessed different features in wearable wellness devices. Our salient findings show that the highest rated features were the comfort of wearing the device and long battery lifetime. Altogether, factors related to the form factor and industrial design were emphasized, whereas social sharing features attracted surprisingly little attention.

CCS Concepts
• **Human-centered computing ˗ Empirical studies in HCI.**

Keywords
Wellness; wearable computing; user studies; design.

1. INTRODUCTION
Even though wearable computing is largely still taking baby steps as consumer products, it has already emerged to mass markets in some forms, one of these areas being wearable wellness devices. Different user groups ranging from people interested in quantified-self data [3] to ordinary weight-watchers are using various wellness devices to track their sports performance as well as their everyday wellness data. The design of wearable wellness devices has evolved from combinations of a heart rate chest belt and a smartwatch towards embedded and more sophisticated form factors, such as sensors integrated to shoes, as in the Nike+ or bracelets such as Fitbit. An overview of different possible form factors available today for wearable wellness devices is illustrated in figure 1.

Earlier research has especially addressed mobile phones as a tool for supporting wellness and physical exercise. Tacking outdoor sports with a mobile phone's integrated sensors has been found convenient, e.g., as users state that they carry the phone with them anyway [1]. Also playful design is often utilized [4]. Whereas research has introduced general guidelines for designing wellness technologies [5], we focus on perceptions of wearable wellness devices. Especially, we are interested in industrial design aspects, which has so far been an under-explored area. Our findings are based on an online survey, where people assessed and ranked

different design features for wellness applications. Similar methodology has been used to chart people's preferences for jewelry type wearable computing [6].
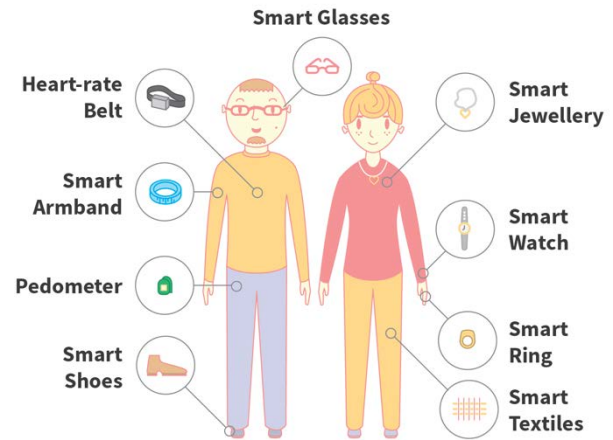

Figure 1. Illustration of various different wearable wellness device form factors

2. DATA COLLECTION
2.1 Online Survey
To evaluate and define users' requirements for wearable wellness devices we implemented an online survey. The survey was designed in a Web-based survey tool and was open for answers for a period of six weeks from early August to September 2015. The survey was distributed at two university campuses in different cities, via social media, and through a citizen participation Web portal hosted by the city. Our core target group for study participants was young adults either studying or working, because we considered them as being interested in their personal health and already used to using different gadgets and mobile applications.

2.2 Survey Design
The survey had a total of 10 questions, and took 10-15 minutes to complete. First, demographic information regarding age, occupation and location was asked, as well as current experiences with wearable wellness devices and opinions on their usage. We asked the participants whether they own a wearable device and, if so, do they still use it and how has the usage changed over time.

In the second part of the survey we asked the users to rate various features and aspects of wearable health devices by distributing 100 points between 22 different requirements for wearable wellness devices. The requirements are listed in table 1. The number of points awarded to various features gave us insight into what people consider as being the most important aspects in the design of wearable wellness devices.

Table 1. Requirements for wearable health devices in the survey.

Form factor	
FF1	The device looks good
FF2	The device is small
FF3	The device is lightweight
FF4	The device is tough
FF5	The device is comfortable to wear
Functionality	
FU6	The device battery lasts for at least 24 hours
FU7	The device offers several functions e.g. feedback on physical activity and heart rate monitoring
Body location	
BL8	The device can be worn somewhere else than the wrist
BL9	The device can be worn on the wrist
Customizability	
CU10	I can change the device's appearance
CU11	I can configure how the information is presented on the device's screen
Interaction design	
ID12	The device can be operated unobtrusively
ID13	I can operate it quickly and with little effort
Context-awareness	
CA14	The display adapts to my environment, e.g. brightness of the light display adapts to lighting conditions
CA15	The display adapts to my situation, e.g. display is deactivated while driving; light display is dimmed during a meeting
CA16	The device automatically recognizes my activity type and I don't have to set it to do so
Feedback and sharing	
FS17	The device gives instant feedback based on my performance during exercise or activity
FS18	The device gives detailed feedback on my performance during exercise or activity
FS19	Without further knowledge, people nearby cannot understand the meaning of the displayed information from the device
FS20	I can easily share the results with other people
FS21	I can easily compare my performance to other people's performances
FS22	I can compare my performance to my previous performances

2.3 Participants

We received altogether 123 responses to the survey, however, only 84 answered all the questions as instructed. In the following, the results are reported based the sample size that answered the individual questions. The demographics were as follows for the 84 participants. Of these, 54 (64%) were female and 30 (36%) male. The average age of the participants was 29 years, ranging from 20 to 61 years (SD = 9.8), and 90% of them came from Finland.

3. RESULTS

In the first section we detail the answers from the questions regarding the participants' use of wearable wellness devices in their everyday life. In the second section we describe the results of the survey question #9, where users had to allocate 100 points between different features of wearable wellness devices. In the last section we make note of additional comments and information received from the participants during the study.

## 3.1 Current Wearable Wellness Device Usage

From the 123 test participants 26% owned at least one wearable health device and 11% owned more than one. Of the people who owned a wearable health device, 46% used it everyday, 13% every week and 15% about once a month. A total of 27% of the participants had stopped using their devices altogether. When asking specifically about the continuation of the use with device(s), 45% of the participants who owned the devices continued to use them, 29% had seen their usage decrease over time, and 30% of the participants who used their wearable devices had stopped using them completely after a while. The slight incongruity between the results may be due to some participants owning multiple devices.

The main reason for stopping using the devices was that users felt that they did not get relevant feedback from the devices (53%). One participant commented that: *"… It would give me "inactivity alerts" when I was driving or in long meetings, which felt like I was being punished for being inactive in situations I could not avoid"* (#28, male, 26 years). Also usability problems, mismatch with context, and interoperability issues were brought up. One participant commented on their stopped usage: *"The device didn't work well enough with my other devices and the operation took too much manual control through bad user interfaces, the device's quality wasn't tough and good enough."* (#33, male, 28 years)

3.2 Overall Ratings of Requirements

Figure 2 shows the overall ratings participants gave to the 22 different requirements. The results are aggregated total points for each requirement and sorted based from the highest to lowest number of points. The most important features are, that the device battery lasts for at least 24 hours (FU6) and that the device should be comfortable to wear (FF5). The least prioritized features were, the ability to share results with other people (FS20) and the ability to compare your performance with other people's performances (FS21). However, social aspects and sharing came up in comments: *"People want to share their information on social media at least during the initial phase of usage, especially young users. After it evens out and they may use the devices more to observe their health, improve it and gain insight into it."* (#71, male, 26 years).

Overall, all requirements related to the form factor (5 items) and functionality (2 items) were ranked in the top half, i.e. among the 11 highest prioritized features of the total of 22. Hence, the industrial design aspects in the design requirements for wearable wellness technologies were emphasized. Additionally, in the free text comments, the industrial design and form factor aspects also gained attention, e.g.: *"Intelligence in fabrics and clothing and also in smartphones is interesting. The design in the device should be of really good quality. More jewel-like options."* (#52, female, 51 years).
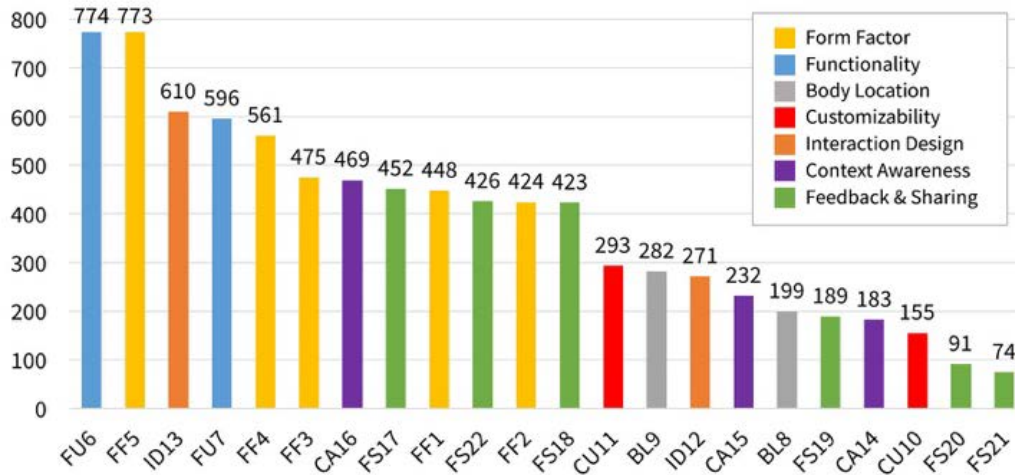
Figure 2. Aggregated points of the 22 requirements sorted from the most to least important. Abbreviations of requirements are described Table 1. Bar colours indicate categories.

Figure 3 shows the relative perceived importance for each of the total of six categories of requirements, gathered by tallying up the points for each category and divided by the requirements in each category. The figure shows that overall concern when regarding the requirements for wearable health devices was given to functionalities and form factor.
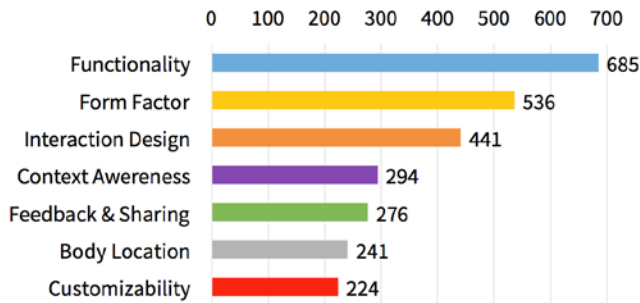

Figure 3. Normalized aggregated points for the 7 categories. (Total points / number of requirements per category.)

3.3 Gender Aspects

Figure 4 presents the results of the prioritized features separated by gender. The design requirements are presented in the same order as in Figure 2, i.e. based on the cumulative total score. The scores in Figure 4 are normalized, by dividing the cumulative score for each gender by the number of participants of that gender.

To identify significant differences between male and female participants' views on each criterion, independent samples t-tests were conducted. Applying a significance level threshold of 0.1, the following were identified as significant. Battery lifetime was significantly more important for women than men, $p = .057$ (FU6: The device battery lasts for at least 24 hours). Sharing and competitive features were rated significantly higher by men than women (FS20 $p = .0735$ and FS21 $p = .0138$). In particular, for FS21 (FS21:I can easily compare my performance to other people's performances) the difference between genders was significant at the $p<0.05$ level.

In general it may be noted that female participants tended to give higher scores on design requirements related to effortless use of the device (FU6, ID13) and 'self' focused aspects – privacy and comparison to one's own performance (F19, FS22). Male participants paid more attention to technical aspects, such as the configuration of the device, automatic activity recognition and detailed feedback.
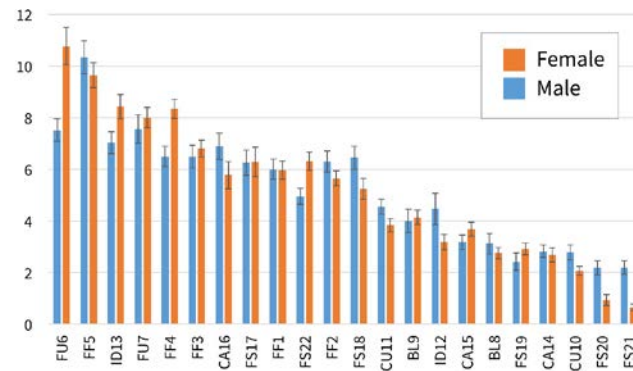
Figure 4. Mean score for each feature, separated by gender. Error bars indicate standard error of mean.

3.4 Other User Comments

In the freeform comment section at the end of the survey, sustainability and green values were raised as an additional theme. Participants wondered about the ethical and ecological issues related to the devices: *"… the device should be as recyclable as possible and safe to the users and the surrounding environment …"* (#123, male, 22 years) and: *"The ethics and ecological issues (of the products)? How do you dispose or get rid of the device?"* (#111, male, 21 years).

In addition, some participants commented on the technical aspects and data analyzing capabilities of the devices: *"The current devices can't refine good enough information from the measured*

data, too many services provide just measured data to the user and leave the interpretation to the user even though analyzing the data and making compilations of it should be the main focus of the companies" (#47, male, 27 years). Moreover, the viewpoint of multiple device ownership was mentioned: *"[The device] should integrate itself into my device ecosystem"* (#1, male, 30 years).

4. DISCUSSION

Interestingly, design requirements related to sharing and comparing results received a surprisingly small amount of attention were given a low priority. This is a somewhat surprising result considering the earlier research on wellness technologies, which has emphasized social and sharing aspects, e.g. [2]. We speculate that one reason for the result might be that earlier research has focused much on utilizing mobile phones, a domain with a vast number of wellness applications [7]. Mobile phones are by nature regarded as social communication devices. It may be that, in users' perception, wearable wellness devices relate to other types technologies, e.g., health devices such as blood pressure monitors or step counters, and sharing and communication features are not perceived as being inherently a part of them. We consider this finding interesting, as it suggests that user's expectations and priorities with wearable devices may be different from those of phone-based wellness applications.

The priority given to features related to the form factor indicates that industrial design plays a major role in the appeal of wearable wellness devices. Based on the results, we participants wanted wearable devices to be lightweight, comfortable, durable, and to look good. Attention to industrial design also changes the emphasis in the design space compared to mobile phone based apps, where graphical UI design has dominated. The top requirements, i.e. long battery life and comfort of wearing the device, show that effortless use is expected and highly appreciated.

Our study is limited by its method (online survey) and sample size. For instance, observations in the field would have given deeper insight into the phenomenon and preferences. Moreover, the majority of study participants did not own a wearable wellness gadget. However, we believe our findings are interesting for the growing number of designers working on wellness technologies.

5. ACKNOWLEDGEMENTS

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