Needs and Challenges of Personal Data Visualisations in Mobile Health Apps: User Survey

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Abstract—Personal data visualisations are critical contributors toward the successful adoption of mobile health apps. Thus, understanding user needs when using mobile personal data visualisation is essential to ensure the adoption of these apps. This paper presents the results of our survey to understand users’ needs and challenges around using mobile personal data visualisations. We received 56 complete responses, which showed that fun and curiosity are the primary drivers of health-tracking apps. Furthermore, the main challenges are the lack of interaction with the presented charts, the complexity of the presented data and the inconsistency of charts’ presentation. In contrast, complete and customisable charts that are easy to read encourage frequent app use. Finally, we recommend reviewing current data visualisation design and development guidelines to help avoid the reported challenges.

Index Terms—data visualisation, mHealth apps, user experience

I. INTRODUCTION

Health tracking apps are one of the fastest growing app categories on app stores attracting the interest of developers, researchers, and investors [1]. In 2021, IQVIA [2] published a report confirming that over 350,000 health apps were developed to help users manage several health conditions. In addition, a recent survey of 20,000 participants indicated that 47% of smart device owners used their devices for health tracking purposes [3]. With the anticipated increase in smartphone users, the number of health trackers and health tracking apps are also projected to increase to 68.7 million users by the end of 2022 [4]. In this paper, we focus on non-expert mobile health (mHealth) app users with little to no experience with data visualisation. This places mobile data visualisation at the centre of building successful, effective and widely adopted health-tracking apps [1]. Existing design thinking practices address this by engaging end-users in early design steps to ensure building the right apps, and data visualisation requirements [5]. For example, previous studies have focused on designing tracking apps by investigating older adults’ creativity in designing mHealth apps [6], approaching an emerging design space to enable users to make accounts of their data [7] and construct models to allow users to customise their tracking goals [8]. However, studies need to capture the challenges and needs of data visualisations in mHealth apps, which introduces gaps related to the content and design of charts in mHealth apps targeting multiple users. Similarly, best practices to evaluate mobile data visualisations, specifically in adapting visualisations for small screens and their compatibility with user preferences, have yet to be studied [9]. The authors in [10] used mHealth app reviews from Google Play to understand user challenges and concerns related to data visualisations. They listed 18 data visualisation issues, such as missing charts (based on data entries), chart interactivity (such as zooming to access more details), and chart layout and style. The authors also highlighted the impact of poor data visualisations on user experience (UX) and overall app rating. This work complements [10] with a user survey investigating users’ preferred charts, everyday tasks, and what they like and dislike about data visualisations in these mHealth apps, and we ask the following key questions: RQ1 - What are the most common data visualisation tasks and goals users want to achieve?; RQ2 - What do users like or dislike in the data visualisations provided by their apps?; and RQ3 - What are the key user requirements to improve their experience when using data visualisation in these apps?

II. STUDY DESIGN

We designed the study based on the design thinking process and the value proposition canvas as the two widely adopted techniques to build a successful and well-received product [11], [12]. These approaches were chosen as they were adopted in developing and evaluating mHealth apps [13]–[15]. Figure 1 lists the main dimensions derived by applying these frameworks and the questions for each dimension.

The survey includes 17 questions covering four aspects as shown in figure 1. Our anonymous survey was hosted on Qualtrics and advertised through several social media channels including Facebook, Instagram, Reddit and Twitter. In addition, we added a link and QR code to the survey flyer to ensure we reached users interested in tracking their personal data.

III. SURVEY RESULTS

In total, 56 respondents completed the survey. Reviewing the written responses, we validated the completed responses to ensure these were not bots.

A. Participants profile

We got diverse respondents in terms of Age: 28.57% (16) of the participants were (18-30), 35.71% (20) of the participants...
Fig. 1: Questions distribution based on customer profile aspects

were (31-40) years old, 21.43% (12) were (41-50), and 14.29% (8) of participants were above (50) years old.

**Gender**: 55.36% (31) of participants were females, 42.86% (24) were males, and 1.79% (1) preferred not to specify their gender.

**Education level**: 50% (28) of the participants had Bachelor’s degrees, 30.36% (17) earned a master’s degree, 7.5% (4) completed their post-secondary and upper education, and 12.50% (7) earned a PhD degree.

### B. Users goals and needs

To understand users’ goals of utilising data visualisation in mHealth apps, we provided 4 options and asked participants to rate the importance of these goals. Interestingly, the fun and curiosity option has the highest mean (8.20). Next, the tracking goals option was the second most important (7.88). Analysing habits and making decisions was the third most important (7.45). Finally, the share achievements option scored as the least essential goal (5.24).

We introduced 3 questions to understand the most frequent visualisation tasks and common interactions. The first question was to select the preferable way to interact with the visualised data. We provided 4 options; Read-only (32.14%), read and edit visualisation (26.79%), drill down to show details (21.43%) and drag and drop (12.50%). The second question was to identify the most frequent tasks users do.

### C. Users’ pains and gains

#### Top issues that affect mHealth data visualisation:

We asked respondents to rank 27 issues on a scale of 1 to 10, with 1 being not important and 10 being very important (or concerning). These issues were sourced from existing literature [10], [16] and covered multiple aspects around developing and designing data visualisation - e.g. chart functionality, displayed data, chart style and interaction. As expected, the net promoter score (NPS) was negative for all provided options, indicating that data visualisation design and development need improvements. The 5 top challenges based on user perspectives covering the presented data, chart functionality and interactivity aspects of data visualisation are:

1. Not showing the information (NPS = -9);
2. Difficulty to drag points (NPS = -11);
3. Touch interface is not precise (NPS = -13);
4. Data displayed is too much (NPS = -15);
5. I cannot see a chart of my entries (NPS = -17)

#### Top factors that affect acceptance of data visualisation:

Users were provided 19 statements which they rated on a scale of 1-10 (1-less encouragement; 10-most encouragement). Eight of these options scored a positive NPS score indicating user satisfaction. The following factors influencing acceptance cover the presented data and chart interactivity aspects of data visualisation are:

1. Easy to read presented data (40.74);
2. Data are complete and shown in the chart (15.69);
3. Ability to set your own goal (14.81);
4. Charts show progress (13.73);
5. Easy to navigate (11.11).

### IV. DISCUSSION AND CONCLUSION

This paper introduced a survey to investigate user needs, challenges, and goals for data visualisations in mHealth apps. The study was designed based on the well-known value proposition canvas with three components covering user tasks, pains and gains. One part of the value proposition canvas focuses on a value map comprising products or services [17], and in our case, the **service** is to enable end users to have a better experience browsing and tracking their mHealth data using charts. Ideally, frameworks and guidelines are required to help visualisation designers during this process.

We have identified two main industrial guidelines developed for data visualisation design: **Google material design** [18] and **IBM design language** [19]. These frameworks have 4 main limitations: a lack of consideration for non-expert users, chart functionality, smartphone limitations and suitable data visualisations for different types of tracked data. Thus, these frameworks are not appropriate, and hence there is a need for a revised framework.
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