Experiences using Three App Prototyping Tools with different Levels of Fidelity from a Product Design Student's Perspective

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Abstract. Prototyping has become a widely embraced technique in different design fields to facilitate early user involvement to ensure that the end-product meets the users' needs. Each design field has its tools and traditions for working with prototypes. This paper documents experiences with smartphone app prototyping from a product design student's perspective. Three prototyping tools with different fidelity levels were explored. Based on these experiences we reflect upon the prototyping tool characteristics and their suitability for non-computer scientist. We envisage that our experiences may be useful for other product designers who want to develop smartphone apps.

Keywords: smartphone app prototyping, product design, interaction design

1 Introduction

Revolutionary prototyping is a well-established part of product development were ideas are tested early before committing to time-consuming and expensive productions. Prototyping is used within several fields such as architecture, product design, interior design, and computer science. Each field have specific techniques and methods for working with concept development and prototyping. This study focuses on prototyping smartphone apps. The prototyping of smartphone apps involves certain constraints [1], i.e., the interface communicates via the smartphone display with limited real estate, audio, and vibrator for tactile sensations, while input is provided via on-screen gestures such as taps and swipes. Other input modalities are possible such as tilting, in air-gestures, speech, etc., but these will not be discussed herein.

Concept sketches are sometimes mistaken for prototypes. Buxton gives an informed explanation of the differences [2], namely that prototypes are intended to be used for testing, and are therefore concrete and solution oriented, while sketches are used to represent ideas, facilitate communication among designers and generate discussion and evolvement of ideas. Prototypes can be realized with simple hand drawings [3]. Some argue that the organic nature of hand-drawings is beneficial, while others criticize these

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for not being aesthetically pleasing and argue for drawing aids such as GUI-control stencils [4]. Our experiences also show that many computing students prefer to design visual layouts using software (Photoshop) to achieve more realistic-looking results.

Still, computer assisted prototyping tools are popular. Clearly, a prototype generated with a computer tool appears more realistic and holds potential for smoother user testing sessions. Yet, the danger of computer-assisted prototyping is a shift in focus from the concept to technical details resulting in more time being wasted on prototype creation. Moreover, a realistic-looking prototype is more likely to raise customers' expectations giving them a false sense of product completion.

This study explored three prototyping tools with different levels of fidelity [5], namely Adobe XD, Figma and React Native. The experiences with the tool is documented with a product design student who is well trained in design-thinking and prototyping of physical objects using rapid prototyping and 3D printing [6, 7, 8, 9], and basic experience with software development and interface prototyping.

2 Related work

Prototypes are often used to test technologies that are not easily available such as augmented reality displays [10, 11, 12], public kiosks [13, 14], or technologies that do not yet exist such as novel application-specific smart devices [15]. Such prototypes can be simple mockups that leave much to the imagination, or it can be more complete implementations such as using Arduino to prototype mobile technology [16]. The calder toolkit [17] is another example of making complex hardware more easily available for simple and rapid prototyping. Prototyping of objects in three-dimensional space is also a much-studied area [18-25] since the three dimensions somewhat need to be represented using the two-dimensional computer screen. Holograms allows three-dimensional objects to be visualized on two-dimensional planes, and prototyping of holograms using abrasions has also been explored [26]. A general review of prototyping tools and techniques can be found in [27, 28]. For a review of the history of graphical user interface prototyping tools see [29, 30].

Much have been written about prototyping of mobile technology. Raento et al. [31] discussed a prototyping platform for context-aware mobile applications that gets better access to the hardware than other prototyping platforms. Mora, Gianni and Divitini [32] presented an approach for prototyping internet-of-things applications that usually require detailed domain specific knowledge about the underlying technologies. Sabbir et al. [16] discussed the use of the Arduino toolkit to make mobile prototypes.

Bochmann and Ritz [5] classified mobile prototyping along several dimensions such as requirements for hardware functionality, target device, audience, prototype creator, range, focus, stage of project, speed, fidelity and longevity. Bochmann and Ritz [5] reviewed several mobile prototyping tools including Balsamiq Mockups, Axure RP and Adobe Fireworks. Bähr [33] proposed 16 requirements for mobile prototyping tools. Leiva and Beaudouin-Lafon [34] described a system where paper prototypes can be inserted into existing videos using markup points and green-screen areas to avoid reshooting video montages.

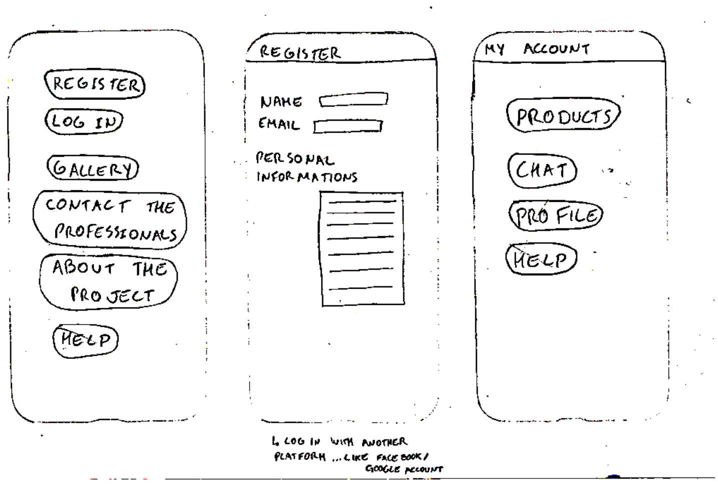

Fig. 1. Initial paper sketches of the app.

3 Method

Smartphone apps holds great promise for health and rehabilitation. Advanced technology can bridge the gap between health professionals and users at a lower cost than was previously possible. Examples include oral health promotion [35], diabetes self-management [36], and blood donation [37]. This project involved the design of a smartphone app concept to facilitate the communication between rehabilitation professionals and users of prosthetic assistive technologies. The concept was identified during practical work with the development of a customized prosthesis. First, the vision of the app was determined followed by early concept sketches (see Fig. 1).

Next, app prototypes were created. The first prototypes were created using Adobe XD and used for preliminary user tests. These tests showed the need of a more detailed prototype with more responsive features and more interactivity. For this, React Native was used. Development with React Native proceeded at a low pace and towards the end of the project the React Native was replaced with Figma. In this study we focus on the experiences with the prototyping tools and not the artefact per se.

The product design student found the process of developing the application very interesting and educational specially as the approach was quite different to typical product design practices. Product designers tend to focus on the details in the beginning of the project development, while with app development it is not equally relevant to focus on details in the beginning. Also, with app development it is very common to conduct many user tests early in the development as the feedback provides clues to relevant adjustments. This is especially helpful when the application is being developed for a specific user group.

It is worth noting that the product designer had no previous experience with the three prototyping tools. Although Figma and Adobe XD are quite different, their interface and workflow have several similarities. It was therefore easier to switch between Figma and Adobe XD than between these and React Native.

3.1 Product design versus interface design

This project explored design from the perspectives of product design and computer science. Product designers typically design and develop products by analyzing all the aspects of a product and its interaction with the user. A product can be defined as having three functions, namely practical, symbolic, and aesthetic. When designing a product, it is also common to focus on the usability and the user experience. Many products are developed with a user-centered design approach, where the user is involved in the process of development, increasing the chances of a successful product that is adaptable especially customizable assistive technology products. The computer science perspective on user interface design often focus on usability and user experience, as well as accessibility and appeal. What both disciplines have in common is the focus on the needs and requirements of the user, the creation of prototypes to evaluate ideas by the participation of the user during the process. The final prototype serves as the requirements specification to be used to code the final product and put it into production.

3.2 Prototyping tools

Three prototyping tools were explored, namely Adobe XD, React Native and Figma. Adobe XD [38] is a simple prototyping tool allowing the designers to define the layout of the views and connect these with navigation structure. Adobe XD had the lowest fidelity of the three tools but for user testing it was found to be more suitable than Figma overall. The student was unable finish any React Native prototypes and this tool was therefore not used for user testing.

React Native [39] can both serve as a prototyping tool and an implementation tool as the final products can be deployed and put into production. React Native require programming in JavaScript and design of views that are then connected. React Native is the most high-fidelity tool of the three tools. Yet, the general nature of the tool means that it can be used for cross platform development with the same codebase, that is, develop apps for both the IOS and Android platforms simultaneously. See Dalmasso et al. [40] for a survey of cross-platform mobile application development tools.

Figma [37, 41, 42] is a mid-fidelity prototyping tool that allows the designer to use several interface controls and connect these together. The designs can be immediately tested and users get a realistic impression of the application.

4 Results and discussion

4.1 Adobe XD

At the time of writing Adobe XD is freely available. Adobe XD has the lowest fidelity of the tools explored, and the easiest tool to get started as no programming is needed.

It is relatively efficient to operate with some templates provided. The interface (see Fig. 2) was perceived as intuitive and easy to use. The interface is consistent with other Adobe software such as Photoshop and Illustrator allowing designers with experience from such tools to reuse existing experience and skills. It was relatively easy to make changes to designs, once exception being changes that involved multiple modifications in connections between pages which may require many time-consuming edits. Adobe XD designs can be stored in the cloud and updates deployed to the smartphones. This allows for easy and rapid user testing. It also simplifies the sharing of the project with other designers and testers. To access the prototype, one only need to install the app on the smartphone via a shareable link. Adobe XD support more complex interactions, however these were not perceived as straightforward to use. It was easy to view changes to the design using the desktop preview. The prototype quality was perceived as good but did not fully meet the expectations in terms of features and experiences during testing. One problem was the mismatch between available fonts in the desktop tool and the Android test app.

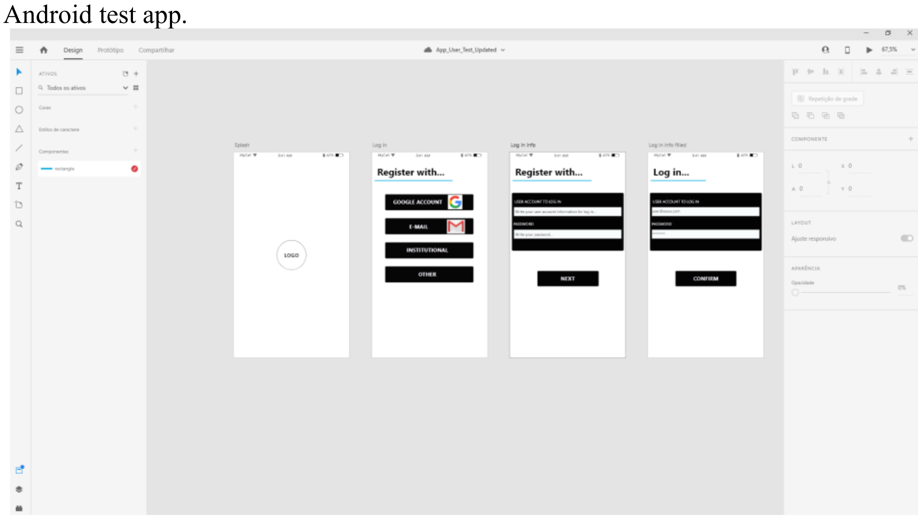

Fig. 2. App prototype in Adobe XD.

When testing the prototype on a smartphone we found that the swipe action could be enabled, but there was not a straightforward way to realize the swipe flow according to the artboards linking order. When swiping to go back to the previous page, the system was only going back to the previous linked artboard, even when it was connected to a different artboard. It was possible to share the project with other designers. Our tests showed that the Adobe XD Android app gave the most realistic experience despite the problems with swipe.

We found that the tool could be learned quickly. The first prototype did not require advanced functions as the attention was on the interaction, intuitiveness of the steps, and aesthetics. Some features were not responding realistically, such as swipe, popups, and textual field input. Consequently, the workflow could not be fully analyzed during the preliminary user testing.

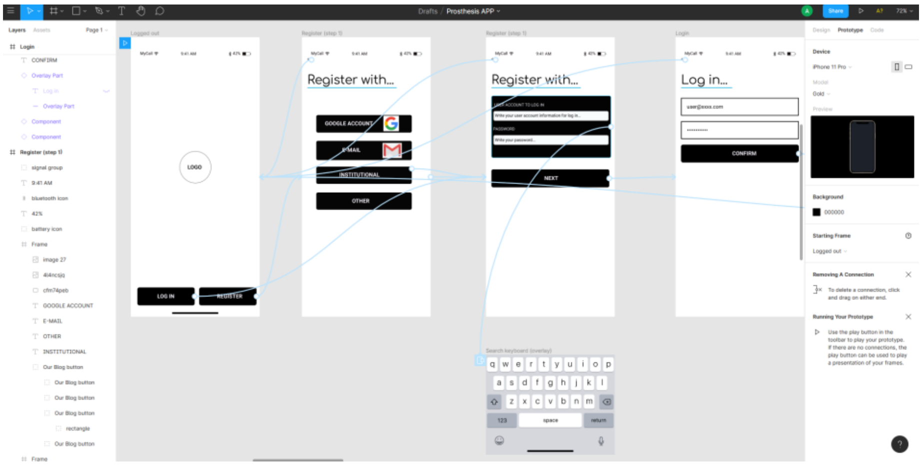

Fig. 3. App prototype in Figma.

4.2 Figma

Figma is a commercial product, but it has a free edition with fewer features. Figma can be classified as a medium fidelity prototyping tool. It was therefore more intricate and time-consuming to operate than Adobe XD. However, more advanced features such as popups and long screen with scrolling were perceived as more intuitive than the Adobe XD static views. Many tutorials facilitate exploring more advanced features. It is seemingly easier to make changes to existing designs as changes involves fewer operations than with Adobe XD. Figma is browser-based platform (see Fig. 3) with similarities to Adobe XD but with some differences, notably the prototype mode.

The prototypes created with Figma were more interactive than Adobe XD hence giving users a more realistic experience and continuous flow. Figma also supports different templates giving more realistic prototypes. Most of the difficulties that occurred with Figma were relatively easy to solve due to the available tutorials and examples. More challenging issues included pages extending beyond the height of the screen.

It was straightforward to test the prototypes on the desktop. It took several attempts to make the prototypes run on a smartphone because the Figma Mirror app needed to work together with the Figma tool in the web browser and the frame to be tested need to be selected. This procedure complicates user testing.

4.3 React Native

React Native is both a high-fidelity prototyping tool and a development tool for cross platform development. React Native can thus also be used for incremental prototyping where the final prototype is the actual product. React native require programming. Development is thus slower than with Adobe XD and Figma and programming knowledge is needed. Changes are easily made if the code is well structured. Hence, it is hard to maintain and make changes to code that is made in a rush. Clearly, React Native gives easier access to the hardware functionality than the other two platforms. React Native is not visually oriented to the same degree as the two other tools. The lack of visual orientation was perceived as negative as product designers usually work visually.

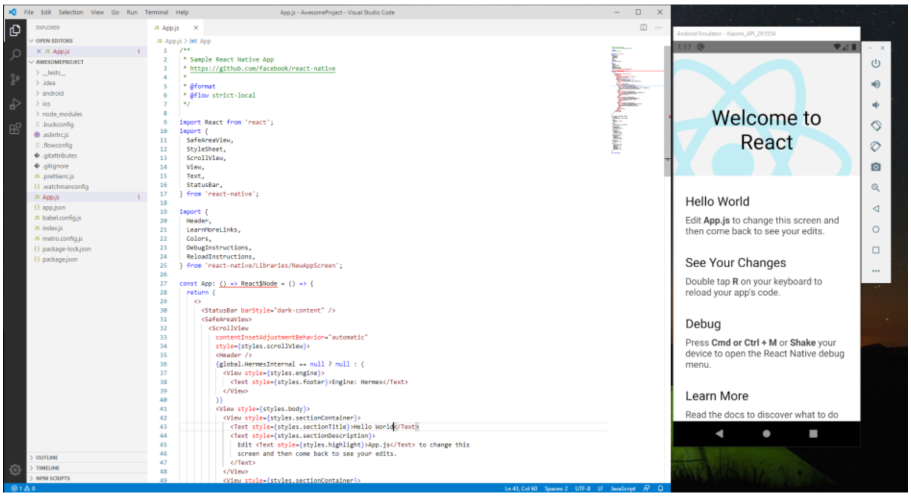

Fig. 4. React Native interface.

The product designer had some coding knowledge. However, difficulties arose already during the installation of React Native CLI Quickstart (Development OS Windows and Target OS Android) as the process was perceived as confusing with much trial and error. Note that Node, Android Studio and Visual Studio Code (see Fig. 4) were also installed. After many difficulties compiling example code snippets and smartphone deployment following the tutorial steps, the debugging tools on Sandbox Code website was used instead. Eventually, React Native was abandoned as the time invested did not yield any concrete results. The curve was too steep. It seems that one needs extensive coding experience, and investment in time to use React Native. This tool seems not suitable for non-designers.

5 Conclusion

Experiences with smartphone app prototyping tools with varying levels of fidelity were reported. Our experiences show development took much longer than expected. Using React Native proved quite challenging, and we would conclude that implementation-oriented tools such as React Native requires too much programming experience and knowledge to be practical for individuals without a computer science background. Adobe XD and Figma are both pragmatic alternatives, with Figma being perceived as the most practical tool. Our experiences show that much time went into the operation of the tools diverting attention away from the concept. We would therefore argue for using even simpler means such as hand drawn prototypes, or software package the designer masters, if this cuts prototyping time and help maintain the attention on exploring the design space rather than aesthetics [43]. Especially, as product designers are trained in sketching. Also, choosing tools that facilitate simple prototype development may benefit the design process and the product quality. Our experiences support separating design from implementation as designers should focus on the concept development and user testing, leaving the implementation to programmers.

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