Designing an User Interface for Google Glass that provides Step-by-step Instructions

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Abstract. In a highly automated world there still are assembly processes that are based on hard human work, such as installing ready-to-assemble products. The instruction guides used for these activities haven't really changed much since their first appearance. In this paper we will take a closer look to the limitations of the traditional, paper-based manuals and give an alternative solution using Google Glass. Therefore, we will present the system we have developed and show how it can be integrated in other assembling processes.

Key words: wearable user interface, step-by-step instructions, google glass

1 Introduction

Over the past few decades much of how we communicate, work, and even play has evolved as advancements have been made in technology. Wearable technology, one of the latest trends in mobile computing, is expected to bring significant improvement in industry, medical system, and sport. The main reason why wearables can make a difference in these fields is because they are designed to support a new human-computer experience based on micro interactions. This paper will focus on the possible improvements that can be achieved in the assembly process done by humans with the help of existing wearable technology.

1.1 The problem

We live in a highly automated society and industry is no exception. In most of the factories, machines and computers handle the job with human supervision. Although most of the production is machine-driven there still are assembly processes that are based on hard human work. A great example is hard-assembling the engine of special cars by master mechanics for a better, more calibrated outcome. An additional example would be putting together ready-to-assemble products, such as affordable furniture for our home.

Instruction Manuals. From novice to expert assemblers, all of them need an instructions manual in order to get their job done. The paper-based instruction manuals haven't really changed much since their first appearance. We can easily spot a few limitations of them, such as:

- They require full users' attention. This is important because the user always has to interrupt the main task in order to read the next instruction. It can have an impact in time needed to complete the work, especially for the beginners.
- Hands are needed to manipulate them. What if the worker is using some special kind of gloves that obstructs him/her to see the next instruction? Again, the consequences of this restriction can be reflected in production time.

1.2 Our contributions

In this paper we make the following new contributions:

- We present an alternative way for the traditional manuals using Head Mounted Displays. More precisely, we will use a pair of Google Glass. (Section 2)
- We take a closer look at the common features of the assembling processes. It is surprising how similar they are. (Section 3.1)
- Then we demonstrate all of these by presenting the system we developed for Google Glass for assembling a particular item. (Section 3.2)
- Finally, we will point out a few recommendations in order to use the system in other assembly processes. (Section 3.3)

2 The ideea

IKEA Instructions. Everyone is familiar with the IKEA ready-to-assemble furniture which all require a set of instructions to help the buyer assemble the items on his own. This method allows them to reduce the transportation and storage costs enabling the production of affordable items which are designed for quick assembling. The instructions they provide are truly remarkable and served as an inspiration for us because:

- They use pictorial forms to represent each step. We believe this is a representative way to show how to assemble a product.
- They work good for both beginners and experienced users. The learning curve for this method is steep. Also, a lot of people are already used to them since their products are very competitive.
- They truly are the only instructions that don't need translation. This is important for a company spread over 4 continents.

Instructions for Glass. Our idea is to develop this method in a way that can be accessible on a monocular, see-through Head Mounted Display. For this experiment, we have decided to use a pair of Google Glass as we believe in their potential in industry and the "Glass at Work" program [1]. Also, they provide us the necessary resources to turn some of the limitations of traditional instruction manuals into advantages:

- The information will be available on the upper right of user's field of view without distracting him/her from the main task. The worker will no longer have to interrupt the task in order to see what the next instruction is.

- The worker will be able to control the system using voice commands while keeping the hands free for performing the main task. The speech recognition system of the device is a must to use it for this kind of application.

Adjustments. Just presenting the pictures as they are on IKEA instruction manuals will not work on a small display simply because they require full users' attention. So we have to find a good way to decompose the images such that they are accessible on a Google Glass screen. Moreover, we have to respect the design principles provided by the device manufacturer in order to give users the best experience. Our goal is to design a native application for Google Glass that helps people assemble the IKEA furniture replacing the conventional manuals. In addition, we want our system to be easily integrated in other assembling processes, so we will point out a few recommendations in order to do that.

3 Details

3.1 Common Features

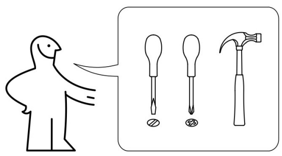

Fig. 1. Tools needed

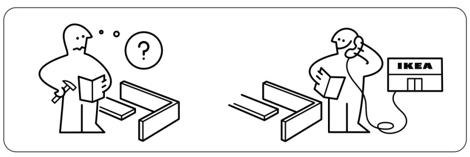

Fig. 2. Useful tip before assembling begins

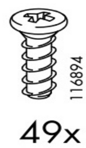

Fig. 3.

Every IKEA item instruction manual respects a pattern that seems very logical and can be easily used for any other ready-to-assemble product. They begin with a picture representing the tools needed for assembling the item (Fig. 1) and then a list of tips to consider before assembling begins (Fig. 2). The next stage consists of showing the inventory of components used to assemble the current product. Each component (Fig. 3) has a unique identification code which is a six-digit number. It is recommended for the user to check all the components before start assembling the item so the number of repetition of each component is specified. After that the actual assembling instructions are presented step-by-step. Each step (Fig. 4) consists of a list of items (and tools) needed and indication about how to use them. Sometimes an extra picture for the components used is shown to help the worker quickly and correctly identify them (Fig. 4 - upper right). In addition, some tips or warnings regarding current step can be mentioned (Fig. 4 - left).

3.2 Glassware Presentation

In this section we will present our Google Glass system that can be an alternative for traditional instruction manuals. The system was designed to respect the

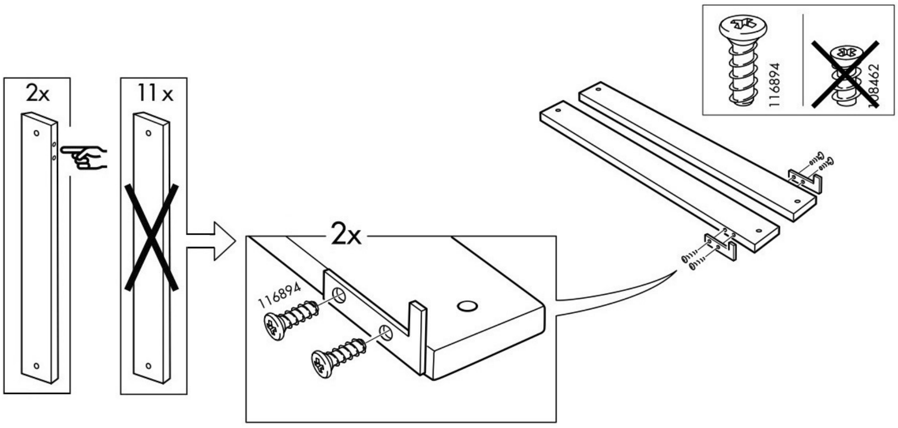

Fig. 4. Actual instruction step of an IKEA product

Design Principles [2] recommended by the manufacturer and it supports both touch and voice commands. We have chosen to exemplify this by modeling the assembling guide for an existing IKEA product (Hemnes Daybed). Because the design is based on pictures to show instructions it feels appropriate to present the user interface using images. The application can be launched using the voice

Fig. 5. Application launch

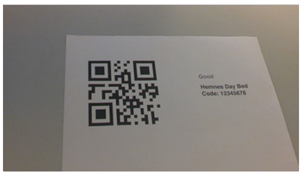

Fig. 6. Scanning QR code

Fig. 7. Processing data

command "Show instructions" (Fig. 5). The user has the option to scan the QR Code of the product (Fig. 6) which downloads from the server all the information needed for the respective item and stores it locally on the device (Fig. 7). After data is processed, the instructions begin with the pre-assembling tips (Fig. 8 and 9). The two tips actually represent the ones shown in Fig. 2 and are presented sequentially using using a View Scroller. Each time a view is selected it triggers an audio message describing the tip. The next stage shows the tools and components (Fig. 10) presented again by scrollable individual images. Each of the first two stages can be skipped by the user. After that the actual instructions are displayed.

Step prerequisites. We followed the same structure as in the original manual, so the assembling guide is divided into a series of steps. The step we will present next is the exact same step shown in Fig. 4. At the beginning of each step, the list

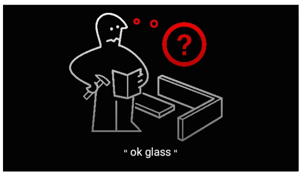

Fig. 8. Product tip: cause

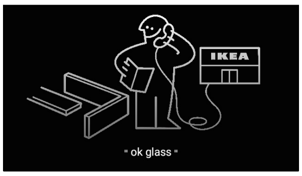

Fig. 9. Product tip: solution

Fig. 10. Tool needed

of tools (Fig. 10) and components (Fig. 11) is displayed. A hint is available for the user for choosing the right component (Fig. 12). After dismissing the tools (by swiping down touchpad gesture or by voice command) the step tip will appear (Fig. 13). This will inform the user to choose the appropriate boards using both image and customized audio message. Dismiss again to view the instructions.

Fig. 11. Component needed

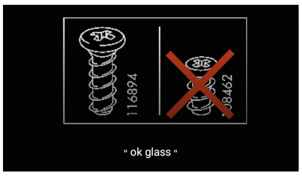

Fig. 12. Component hint

Fig. 13. Tip for step

Instruction Step. Each step found in the IKEA brochure can be decomposed in a series of sub-steps using the same idea shown as in the following example:

- Fig. 14 represents the step overview and this sub-step is marked by the magnifier symbol found in the upper right section of the image.
- Scrolling to the second sub-step we can see a step detail (Fig. 15). It is also marked by the magnifier symbol found in the upper left section.
- The third sub-step (Fig. 16) informs the user where the previous detail applies using small blue arrows. The blue number represent the arrows count.

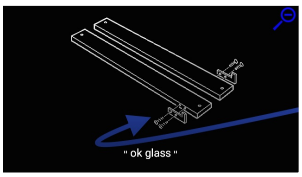

Fig. 14. Step Overview

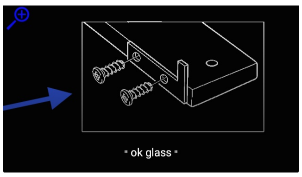

Fig. 15. Step Detail

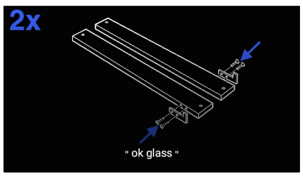

Fig. 16. Detail appliance

The blue arrow notifies the user about the existing detail and will visually connect the two separate views while scrolling (Fig. 17). For each step there is a series of commands (Fig. 18), all of them being accessible using both voice and touch gestures:

- The commands "Back to main menu", "Show next" and "Show previous" are equivalent to "Touch down", "Swipe back" and "Swipe forward" touch gestures
- "Show next step" or "Jump to next step" will move to the next step
- "Show components" presents the tools and components view
- "Show warnings" shows tips or warnings for current step
- "Display progress" gives the user information regarding current assembling progress (Fig. 19)

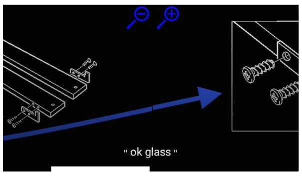

Fig. 17. Sub-steps scrolling

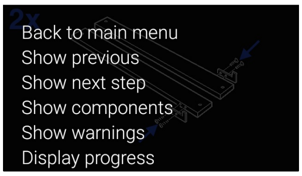

Fig. 18. Step voice options

Fig. 19. Progress view

The application saves the current state so after closing and reopening it, the user is able to continue the instructions. In addition, the assembler can access the locally stored items where multiple actions are available (Fig. 20). For a better navigation, multiple steps are grouped by assembly phases so the worker can select to start from a specific one. In Fig. 21, "(3x)" suggests that this phase repeats for 3 times. The delete option triggers a grace view for 2 seconds when the user has the chance to cancel this action (Fig. 22), otherwise the item will be removed.

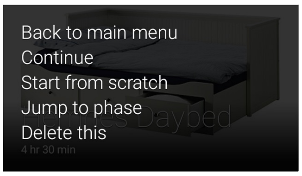

Fig. 20. Item voice options

Fig. 21. Assambly phase

Fig. 22. Delete grace period

3.3 Design your own instructions

In order to use this system for creating custom instructions, one should consider the following recommendations:

- Consider a step as an activity where one uses no more than three kind of components and one tool (if possible). Group the steps by phases for a better navigation experience.
- Use black background with white drawings and text. Black appears on glass as it is transparent and white looks just great in every light condition.
- Blue and orange colors are great to highlight certain aspects of a picture. Be consistent when using colors.
- "ok glass" label informs the user that voice options are available so it will always be there. Use a bottom padding of at least 60 pixels when creating the assets.

4 Related work

When designing for wearables we should keep in mind what is their purpose. Edward O. Thorp introduced us the first wearable computer used to predict the roulette back in 1960s [3]. Thad Starner, one of the pioneers of wearable computing, suggests that that the ultimate goal for a wearable system is to augment "memory, intellect, creativity, communication, and physical senses and abilities" [4]. In another article [5], he mentions that wearables can be used to provide instructions for users. In addition, he presents some interesting results in the context of multi-tasking indicating that the ability for a user to perform a task can be enhanced using secondary task that supports the primary one [6].

Wearables Applications. There already are many examples of wearables applications developed for different scenarios. Anhong Guo et al. [7] compared four different methods for order picking and found that picking assisted by head-up display and card-mounted display are superior on all metrics to the current practices of picking by paper or by light. Shahram Jalaliniya and Thomas Pederson developed a Google Glass-based system aimed at facilitating touchless interaction with x-ray images, browsing of electronic patient, and synchronized ad-hoc remote collaboration [8]. Dr. Hendrik Witt used a head-mounted display for solving the hot-wire experiment [9].

Design. There are no general rules to follow when designing for a wearables and is recommended to respect the manufacturer guidelines, if they are available. Google provides a set of design principles to follow in order to give users the best experience [2]. In this inspiring article [10] the author outlines the fact that "desktop metaphor is dead" for a wearable user interface and a better metaphor in this context is a personal assistant that predicts what information is needed and prepares it in anticipation of its need. Also, Dr. Witt [11] suggested that WIMP (Windows, Icons, Menus, Pointer) is not suitable for Glasses.

5 Conclusions and further work

We have presented our approach for replacing the traditional, paper-based manuals using a head-mounted display. A system that tracks the time needed for the user to complete each step can be further developed and data can be centralized to the existing server and used to improve the instructions. Since the Google Glass device is still under development there were some issues regarding battery drain. However, this problem can be solved using an external portable battery. Moreover, by the time we write this paper, a new version of the product is announced by the manufacturer which targets the enterprise market segment and is supposed to fix the current problems, including battery drain and overheating.

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