Development of a Interface Which Was Customized for People with Disabilities Using 3D Printers

Yudai Sato[1(✉)], Takeo Ainoya[1], Ryuta Motegi[2], and Keiko Kasamatsu[2]

[1] serBOTinQ, Tokyo Metropolitan University, 6-6 Asahigaoka, Hino-shi, Tokyo, Japan
yudaisato141@gmail.com
[2] Tokyo Metropolitan University, 6-6 Asahigaoka, Hino-shi, Tokyo, Japan

Abstract. The UI (User Interface) usable by handicapped people has used a combination of ready-made products in the past. However, combining ready-made items alone is not sufficient for ease of use, and not only the yaw and row of the operating angle but also the angle of the pitch must be considered. In this research, we design the interface design of the Boccia robot project, temporarily prototype an interface capable of analyzing and manipulating UX (User experience) and UI for people with disabilities by mockup using 3D printers, and using CAD production and 3D printers Proof and modify the actual prototype outputted and produced it. Through four steps, we made interface of Boccia robot by repeating the process of CAD data production, 3D printing, verification from evidence investigation through idea sketch. It became clear that the technical and knowledge necessary for implementation and the need for structural thinking are also necessary.

Keywords: 3D printer · Custom interface · Design process

1 Introduction

Conventional interfaces for persons with disabilities have used combinations of off-the-shelf components like wheelchair controllers, for example. However, combining ready-made products alone is not sufficient for ease of use when considering the degree of disability, and not only the yaw and row of the operating angle but also the angle of the pitch is important and must be taken into consideration. However, like the introduction movie of Apple's accessibility page, Apple products can implement technologies that can be customized according to the extent of the obstacle, as well as ophthalmic equipment Oton Glass that extends the ability to read letters for visually impaired people, As well as the interface of Microsoft's Xbox Adaptive Controller announced in 2018, a customizable interface has been announced depending on the degree of disability, and the importance of interfaces specialized for persons with disabilities is being recognized globally.

S. Yamamoto and H. Mori (Eds.): HCII 2019, LNCS 11570, pp. 547–555, 2019.
https://doi.org/10.1007/978-3-030-22649-7_44

We analyzed UX and UI for disable people using mockup using 3D printer as a theme of interface design of Boccia robot project, rapid prototype interface that can be operated with idea sketch, outputted by CAD production, 3D printer Proof by actual prototype, made with modifications made.

The project members are two students specializing in product design in charge of design review, one student specializing in car design, one student specializing in motion graphics, and one product designer in charge of design direction We made a total of five people in total, two other students specializing in robotics who was in charge of the moving parts when building the implementation model.

2 Design Process

2.1 Step 0

The design process of this project, like the development of Apple's ipod, observes users from the comparison with competitors, finds problems and repeats the process of design creation, prototyping, verification, so that unprecedented music We adopted the design thinking that produced the player. By thinking of design thinking (see Fig. 1), I thought that I could answer social needs more accurately than before. In this research, we focused on three processes of creation centered on idea sketches, 3D CAD, trial production with 3D print, and verification with printed prototype.

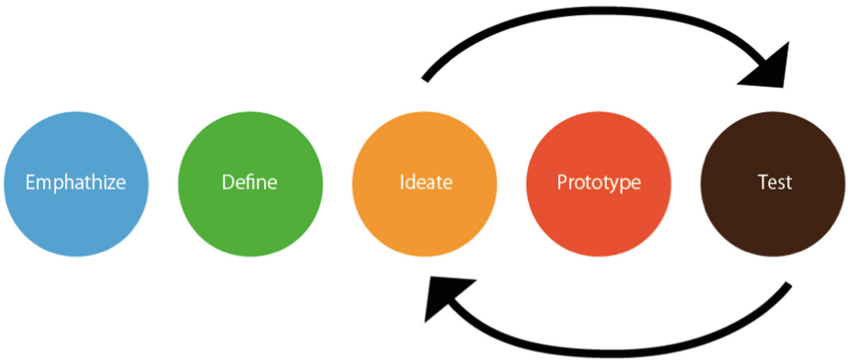

Fig. 1. Design thinking process

2.2 Step 1

When entering the design work, the disposition can be pushed in any scene during the competition Button arrangement, the size of the button, easy operation that can be intuitively operated even in a tense situation, if it becomes an obstacle to the competition However, it was not so small that it was difficult to operate, but on condition that moderate size feeling which is easy to operate was drawn, I drew a number of idea sketches (see Fig. 2) and verified.

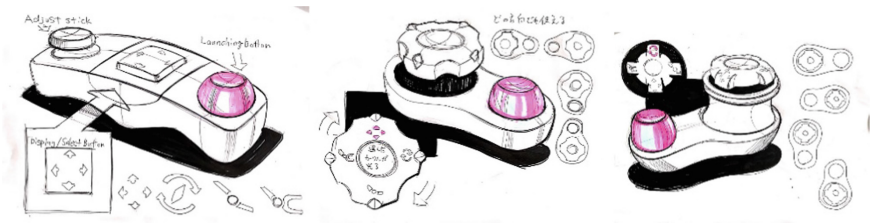

Fig. 2. Idea sketches

Three ideas which seems to be highly likely to finish beautifully in a short time easily in the 3D skills of 3D CAD production within the member and the 3D print are selected while matching the conditions described earlier from the idea sketch, Combining CAD data, making actual size prototypes with 3D printers, and combining buttons, joysticks, rotary selectors as an operation system.

Project participants actually operated and verified the prototype of the three proposals, and as a result there is a need to revalidate the size of the buttons and the spacing between the buttons, and the rotary selector is more disabled than the joystick, It was hard to use for the result (see Figs. 3 and 4). In addition, as a result of the verification, it was found that the operation method and the operation environment are different depending on the extent and kind of the obstacle, so it was decided to produce three kinds of interfaces, the operation with the wrist, the operation with the chin, the operation with the finger.

Fig. 3. A prototype combining a joystick and a button

2.3 Step 2

In Step 2, prior to entering the idea sketch verification, based on the previous result, measurement of the width of each hand of each person to check the size and interval of the button, interface mounting position when operating with chin, between buttons Was confirmed.

Fig. 4. A prototype combining a rotary selector

Drawing multiple idea sketches (see Fig. 5) reflecting the survey result, 3D printing with type of wrist operation, type operated with chin, type operated with fingers, 3D printing (see Fig. 6) with variable interface and manipulation with chin even by hand, I verified again (see Fig. 7).

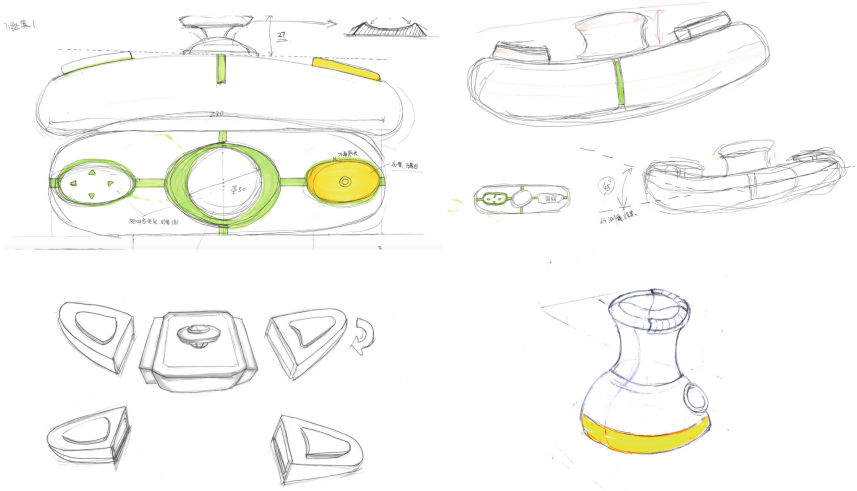

Fig. 5. Idea sketches of step 2

As a verification item, it is confirmed whether reliable operation with arm, chin and finger is confirmed. For two proposals of arm manipulation and jaw manipulation type, it is necessary to revalidate the height of the button with respect to the angle of the button and the finger operation type. Also, the variable interface is technically challenging when implementing it, and it was postponed in this project.

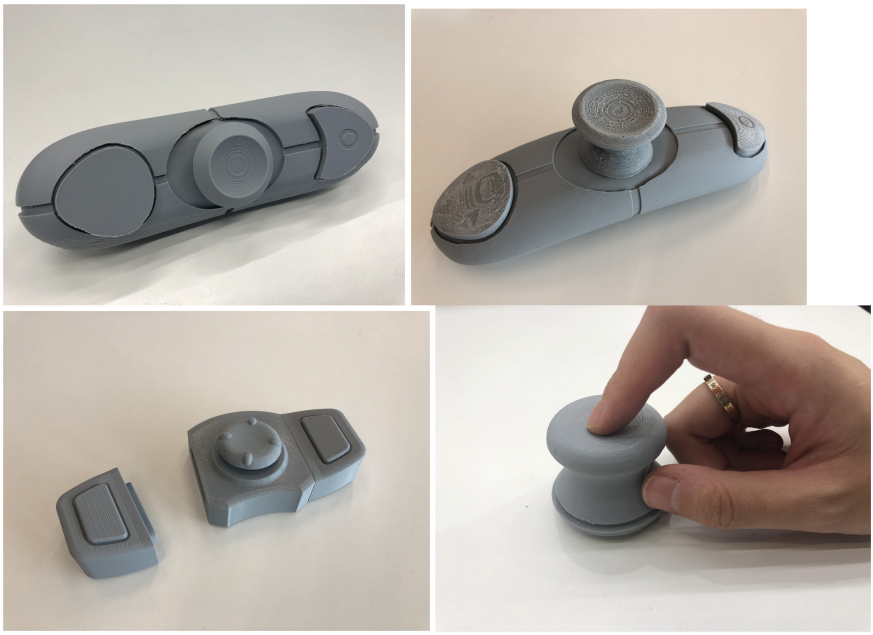

Fig. 6. 3D print model of step 2

Fig. 7. Validation of 3D model

2.4 Step 3

We verified the angle and height of the button which was newly verified in the secondary verification, and verified the design that considers not only usability but also the sports feeling as a parasport tool.

First of all, the definition of sports sense is derived from the discussion, and the sports feeling is defined as having a meaningful form in everything, even in the extreme state when operating, like F1 steering, for example, and carried out an idea sketch (see Fig. 8). 3D prints of ideas (see Figs. 9, 10 and 11) selected as clean shapes that are

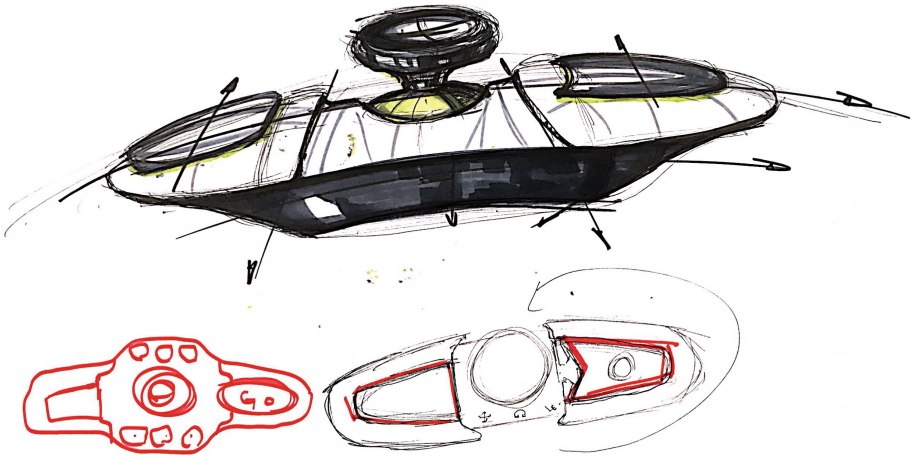

Fig. 8. Ideasketchs of step 3

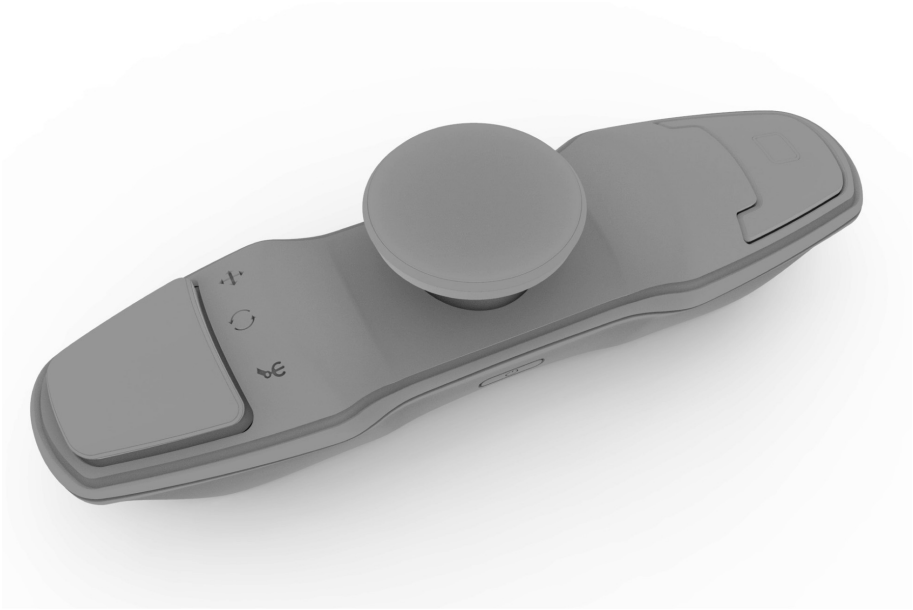

Fig. 9. Rendering of arm manipulation type

consistent with the above conditions while conforming to the above conditions are out of a plurality of sheets, among which the arm model type mounting model was produced this time. When building a mounting model (see Fig. 12), a student specializing in robotics built a mounting part, and the designer designed the housing part so that the

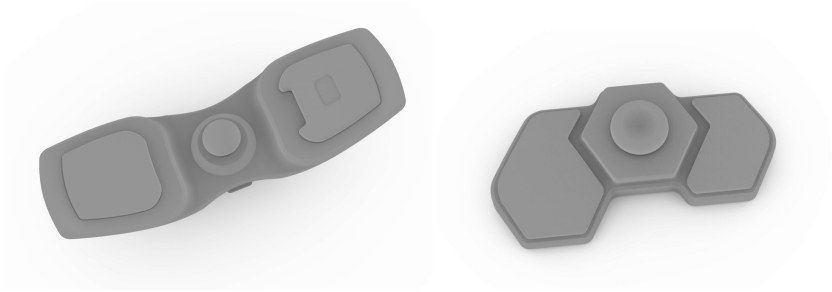

Fig. 10. Renderings of chin and finger manipulation type model

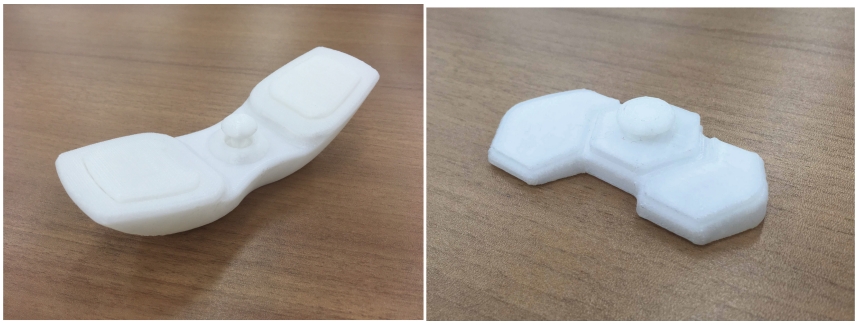

Fig. 11. 3D print models of chin and finger manipulation type model

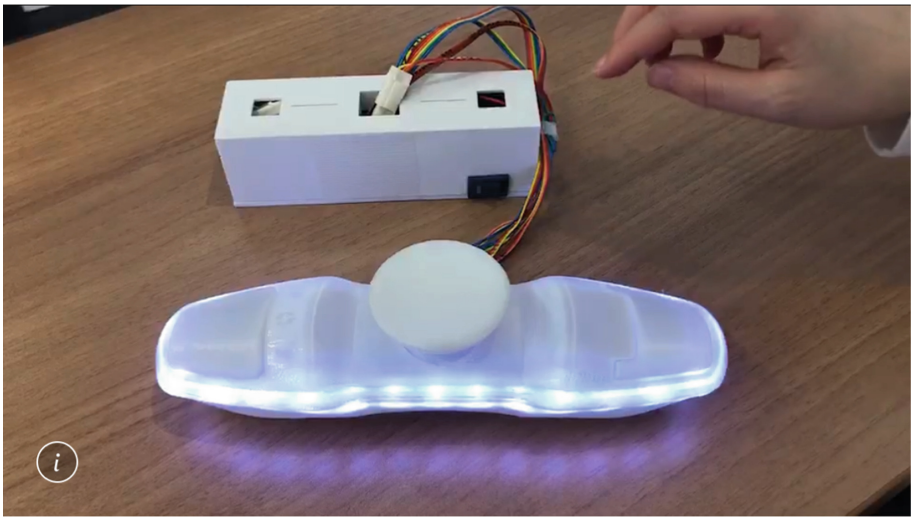

Fig. 12. Implementation model of arm manipulation type

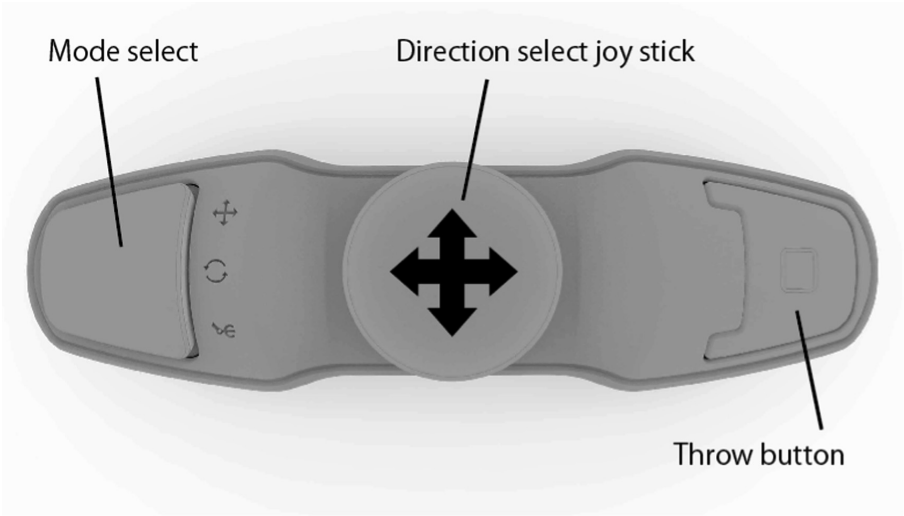

Fig. 13. How to use arm manipulation type

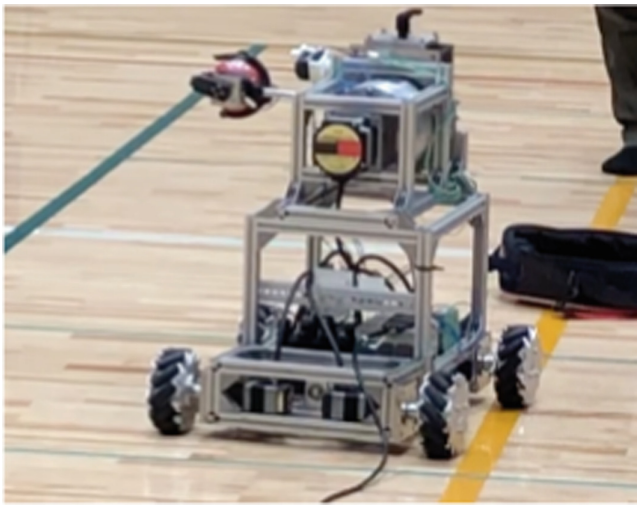

Fig. 14. Boccia robot

mounting part enters.In the operation method (see Fig. 13), the function switching of the movable part of the Botcher robot is made with the button on the left side, and the light of a different color is lit up according to the switching mode. You can handle the direction of the machine with the joystick in the middle, and throw the ball from Bocchiarobot (see Fig. 14) with the button on the right.

3 Discussion

From the evidence survey through the idea sketch, we have made interface of Boccia robot project by repeating CAD data production, 3D printing, verification process. Although it is a nice aspect of this process to actually touch and validate the 3D printed model, it takes time to produce CAD data and output it with a 3D printer, the point that it requires technology and knowledge for implementation, It also became clear that structural thinking is also required.

However, if these problems are overcome, we think that it is a very effective process that can accurately answer social needs for design and interface development.

References

1. Brown, T.: Change By Design. ISBN 978-0061766084 (2006)
2. Andoh, M.: User Experience Design Textbook. ISBN 978-4-621-30037-4 (2016)
3. Sato, T., Kameyama, H.: Application to the P2M of Agile development Lean product development and Design thinking (2012)
4. Apple Homepage. https://www.apple.com/jp/accessibility/. Accessed 9 Mar 2019
5. Oton Glass Homepage. https://otonglass.jp. Accessed 9 Mar 2019
6. Microsoft Homepage. https://www.microsoft.com/en-us/p/xbox-adaptive-controller/8nsdbhz1n3d8. Accessed 9 Mar 2019
7. Fujitsu Homepage. http://www.fujitsu.com/jp/group/fri/column/opinion/201404/2014-4-4.html. Accessed 9 Mar 2019