Evaluation and development of FacePrint: a tool for the design of facial prostheses

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How can we improve and optimize the usability of an interface? By using an iterative design process, the interface of a software used for design of facial prostheses was evaluated and further developed. Since technology is advancing into spatial computing, the interface was adapted into AR, Augmented Reality. AR is a technology that combines real and virtual components. By using the iterative design process, the interface was significantly improved and a first draft for an AR prototype was developed.

In Europe and the US, about 32 000 nose and ear prostheses are needed today due to maxillofacial defects [1], [2]. These defects are mainly caused by cancer, trauma or congenital craniofacial anomalies. The patients that have these defects often experience psychological problems and have problems with social integration, reducing their quality of life [3]. Therefore, patients often receive facial prostheses. However, these are made manually and take roughly ten weeks to be made, burdening the patient and increasing their psychological stress [4].

Prostheses are also very expensive and costs about €4300 [4], burdening the healthcare system and the expertise within the area is limited. There is a big need for a service that can provide facial prostheses faster and cheaper. And with that, FacePrint was born.

FacePrint, a project developed by a consortium, aims to efficiently provide facial prostheses. Purple Scout, one of the companies involved, is responsible for developing the interface that the clinicians will use to design the prostheses. The patient and doctor will together decide what the prosthesis should look like using the interface. A prosthesis will be generated using machine learning and then modified using parameters in the interface.

A software is needed to design and print the prostheses and should have patient specific parameters. When designing an interface like this, it is important to make is usable. Usability for FacePrint means that the clinician and patient easily and in an effective manner can design the prosthesis with satisfactory result. Patient safety is extremely important and thus an interface with this purpose has to prevent errors from occurring. FacePrint has been tested using three different methods in an iterative design process with two phases. By doing this, the usability of the interface greatly improved. The iterative process with a variety of tests proved to be a successful method when designing an interface from scratch. The number of errors committed when users tested the interface significantly decreased, as can be seen in Figure 1, and the overall feedback from the testers was that the interface was intuitive and had great potential. The iterative design process resulted in a usable interface. This could be used as a template for future design work. In Figure 2, a view of the end-version of FacePrint can be seen.

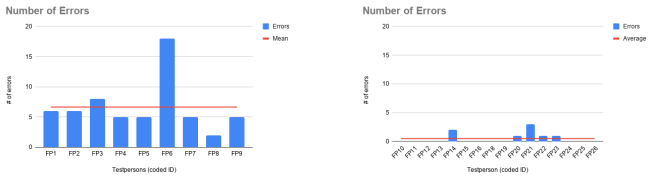

Fig. 1. The number of errors for test 1 and test 2.

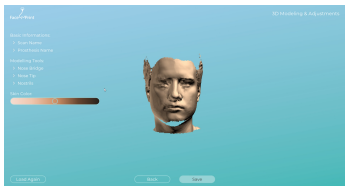

Fig. 2. One of the views in the interface. In this view the design of the prosthesis is done using the modelling tools, which contains sliders.

In the future, technology will be all around us, not just in a computer screen. FacePrint needs to be adapted for this and therefore the possibilities for using it in AR were researched. This product would be called fiXR, Facial Interactive Extended Reality, and is a tool for designing prostheses in AR. Designing in AR is still an untouched subject but by trial and error a prototype was made. The end result was satisfactory to everybody involved and therefore it can be said that the methods used were appropriate.

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References

[1] Hatamleh, M.M., et al., *Maxillofacial prosthetic rehabilitation in the UK: a survey of maxillofacial prosthetists'and technologists' attitudes and opinions*. Int J Oral Maxillofac Surg, 2010. 39(12): p. 1186-92.
[2] Khan, Z., L. Gettleman, and C.S. Jacobson, *Conference report: materials research in maxillofacial prosthetics*. J Dent Res, 1992. 71(8): p. 1541-2.
[3] Leonardi, A., et al., *Maxillofacial prosthetic rehabilitation using extraoral implants*. J Craniofac Surg, 2008. 19(2): p. 398-405.
[4] Tanner, P.B. and S.R. Mobley, *External auricular and facial prosthetics: a collaborative effort of thereconstructive surgeon and anaplastologist*. Facial Plast Surg Clin North Am, 2006. 14(2): p. 137-45, vi-vii.