

TattooAR: Augmented Reality Interactive Tattoos

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Abstract. This paper describes the design process of TattooAR mobile app, an experimental project that explores the use of tattoos as an artistic, interactive and dynamic wearable ornament. Tattoos have been used as different forms of expression throughout history, and in contemporary society people have been increasingly using tattoos as a form of art and a way to express themselves. TattooAR explores the frontiers between Art, Design and Technology by using Augmented Reality (AR) technologies in order to allow a basic skin tattoo to receive layers of image that transform it into different virtual tattoos that can be viewed on the screen of a mobile device and can also be shared in social networks.

Keywords: Interaction design · Education · Augmented reality · Tattoos

1 Introduction

Tattoos have been used as varied forms of expression throughout history and cultures. In contemporary society people have been increasingly using tattoos as a form of art and a way to express themselves into the world, generating individuality and exposing what they think, how they see life and society.

People's interpretation of the world changes as they live and interact with other people. The main objective of TattooAR Project is to explore the human body as a platform to express these mutant interpretations of the world through interactive and dynamic tattoos. The work explores the frontiers between Art, Design and Technology by using Augmented Reality (AR) technologies in order to allow a basic skin tattoo form to receive layers of image that transform it into different virtual tattoos that can be viewed on the screen of the mobile device and can also be shared in social networks.

This paper describes the design process of TattooAR mobile app, an experimental project that investigates the human body as a platform for self-expression and communication. It explores the use of tattoos as an artistic, interactive and dynamic wearable ornament.

2 Background: The Interaction Design Research Environment at PUC-Rio

TattooAR was developed as a final Project at the B.A. Course in Design for Digital Media at the Pontifical Catholic University of Rio de Janeiro (PUC-Rio). The Course is a pioneer Interaction Design teaching program in Brazil. The work was conducted by student Gabriela Schirmer Mauricio, under the academic supervision of Professors João Bonelli and Maria das Graças Chagas. During the Design process, reflective practice and experimentation were highly encouraged in the search for innovative and creative solutions. The experiments were built at the course's Physical Computing Lab (LIFE - Laboratório de Interfaces Físicas Experimentais), where the student was provided with the adequate environment to conduct creative experiments with Interaction Design techniques.

In the Design-Digital Media curriculum at PUC-Rio, Interaction Design is a significant field of study. Five individual classes cover specific aspects of Interaction Design: *Design e Expansão dos Sentidos* (Design and Expansion of the Senses); *Hipermídia* (Hypermedia); *Conceitos de Informática* (Introduction to computer programming); *Interfaces Físicas e Lógicas* (Physical Computing); and *Design de Objetos Inteligentes* (Design of Smart Objects). In the *Design and Expansion of the Senses* class the students are introduced to theoretic aspects of Interactive Media. In the *Hypermedia* class the students explore topics related to Information Architecture and Navigation. In the *Introduction to Computer Programming* class, the students acquire basic programming knowledge in the HTML and JavaScript programming languages. Subsequently, in the *Physical Computing* class, the students further their knowledge in programming and electronics while building experimental Physical Computing projects. Finally, in the *Smart Objects* class students develop innovative projects that make use of computational intelligence. These classes are responsible for providing the students with a vast array of theoretic and technical knowledge, which will become the student's toolkit to be used when developing their individual Interaction Design projects.¹

Furthermore, in the curricular structure of the program, students are required to enroll in eight *Design Project* classes – that have a 10-hours-per-week schedule – before they can graduate. In the *Project* classes, the students are introduced to methodological aspects of design, while developing their individual Design projects that are presented on the end of the academic semester to an examination board of professors.

Also the Lab LIFE² is an initiative of PUC-Rio's Arts and Design Department that aims to provide an appropriate environment for the practical development of Physical Computing projects. The lab, established in 2009, currently has 36 sq. meters of floor space equipped with computers, open source software, electronic components, Arduino boards and a small library. The lab is planned to be a space dedicated to the creative experimentation in interaction design. The goal is to provide computational and

¹ Further information about the Design-Digital Media Undergraduate Program at PUC-Rio can be accessed at: http://www.puc-rio.br/ensinopesq/ccg/design_midiadigital.html.

² Further information about the LIFE Lab can be accessed at: <http://www.life.dad.puc-rio.br>.

electronic resources, in order to support the development of innovative Physical Computing projects.

In the context of this teaching environment described above, the TattooAR project was developed by student Gabriela Schirmer Mauricio extensively in the LIFE Lab, and presented as her final undergraduate project for the conclusion of the B.A. Design-Digital Media at PUC-Rio.

3 Motivation and Related Work

The TattooAR project was born from a desire to explore the body as a means of self-expression and creativity. A motivational starting point was the perception of the skin as being the surface of expression that is closest to the human being: our own body. The initial proposition of the project was to use the body as a surface for graphic information, in order to introduce interaction between people and making them change their perception.

In this context of the *Body as Surface*, the tattoo is a major form of expression that has been used through history in social contexts such as rites of passage and prisoner's marks. In contemporary society, tattoos have been widely used as a way to individualize and express ideas. Even though tattoos have been used for thousands of years as a tool for expression, they have the limitation of being static and permanent. The TattooAR project was born from the question: "how can Digital Design enhance the interactive experience of the tattoo?".

Being the student herself an illustrator and tattoo enthusiast, the project's goal became to explore the body as a surface for artistic expression by transforming something once permanent as a tattoo into a mutable form of art through the use of emerging digital and interactive technologies.

In searching for theoretic references, this research considers relevant the vision by Marshall McLuhan present in his seminal book 'Understanding Media: the extensions of man'. [1] In the chapter entitled 'The Medium is the Message' the author proposes a vision of Media as extensions of the human body. Also in the article 'Pequena Digressão Sobre a Natureza e Conceito do Design', [2] Rita Couto from PUC-Rio proposes a vision of Design as a multidisciplinary field of knowledge that has relation with the major areas of Science and Art.

In the Interaction Design research field, the design concept project 'SKIN: Tattoo' by Phillips [3], explores tattoos as a mutable form of expression and is a main reference for this research. Also 'Sixthsense' [4] by MIT's Pranav Mistry – a wearable interface that augments the real world with digital information – was inspirational in terms of establishing possible relations between virtual information and the human body. The projects 'Firewall' – an interactive installation by Mike Allison [8] – and 'Apparition' – a dance performance by Klaus Obermaier [9] – explore interactivity in an artistic approach while using projection as an extension of the human body.

The works by Katia Vega – namely the 'Beauty Technology', 'Blinkifier' and 'Twinkle Nails' projects [5–7] – explore new ways of interaction through the human body and are a main reference in the field of wearable technology.

In the tattoo field, relevant references are the works by Karl Marc [10] – who tattooed a QRCode marker in his own skin, establishing a link between the body and virtual information – and Shelley Jackson [11], who composed a narrative in several different tattoos, each word tattooed in a different person.

4 Design Process

The project's methodology was divided in steps that went from theoretic research – explicit in the previous topic – followed by a series of practical experiments. In a reflective practice approach, every single experiment led to testing and reflection upon its results. This reflection generated conclusions that inspired the conduction of the next experiment, and so forth, in a cyclical process. As a first step, the student started by experimenting with projection mapping technologies in order to have digital images projected onto the skin. The first software experiment was developed in the Processing environment [12], and used a color marker as a tracking reference for positioning a projected image on the user's skin (Fig. 1).

Even though these results seemed viable, the student considered an important technical requisite for the project that it should be portable, so that it could be used in the urban environment just like the real tattoo does. In searching for a mobile solution for her project, the student encountered the technology of Augmented Reality (AR) and used it in her next experiments. The AR opportunity was considered more viable, because it did not depend on a video projector to form the virtual image on the skin, and the mobile platform allowed for the desired portability and embodiment. Therefore the next effort became to try to develop an augmented reality application that would run on a smartphone – which she could achieve in the Processing development



Fig. 1. Experiment in projection mapping: software developed in the Processing environment is used to track the position of a red led and use it as a reference to place a projected image precisely on the skin.

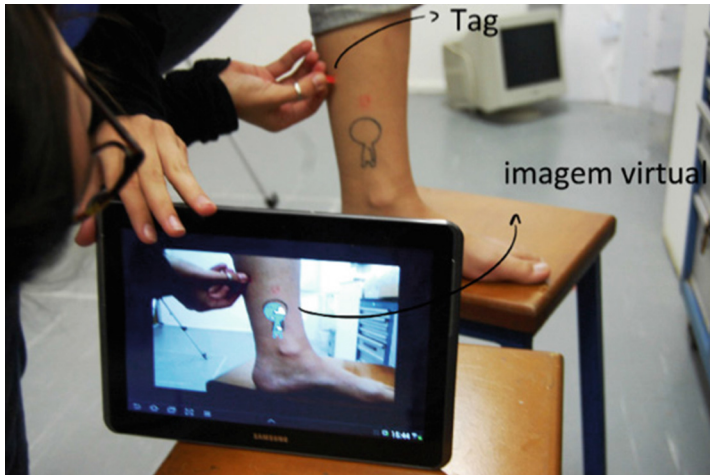


Fig. 2. Experiment in Augmented Reality. A color tag is used as a tracking reference for positioning a virtual image on the screen of the Android mobile device.

environment, using the Ketai Sensor Library [13] for the Google Android mobile platform [14] (Fig. 2).

Even though the student succeeded in the task of positioning a virtual image over a real image, the experiment still had a technical requisite: having to use a color tag to serve as a positioning reference for the virtual image. At this point the student made a shift to using the more complex Java programming language [15] used in the Android Development Toolkit (ADK) [16], becoming able to work with the Metaio Augmented Reality Software Library [17] in order to experiment her project's concept of AR Tattoo. The student was already proficient in the Processing programming language – which she learned in the *Physical Computing* class. Since Processing is based in the Java programming language, the Design student was able to easily move to the more complex Java development environment. Therefore the next software experiment was capable of tracking a shape – that was drawn on the skin – and precisely positioning a virtual image on the smartphone's display.

For the development of the tracking component – the part that is drawn on the user's skin – the young designer experimented with different graphic techniques such as rubber stamp, cutout, adhesive label and removable tattoo. In the graphic experimentation process, the student used the resources provided by PUC-Rio's LPG-Laboratório de Processos Gráficos (Lab for Graphic Processes), also revealing the important interdisciplinary approach present in this Design Program (Fig. 3).

After intensive testing, the removable tattoo format was chosen because it allowed for a more precise image tracking. The temporary tattoo is then applied in the user's skin in order to work as an Augmented Reality tag – and also as an outline for the virtual drawings. The graphic form of the temporary stamp was designed to fit artistic and functional purposes of the visualization. The drawings were based on the student's own tattoo, used in the first experimentations. The outline shape of a character is used



Fig. 3. A virtual image is positioned precisely over a drawing on the person's skin. In this experiment, a pen drawing over tracing paper was positioned on the user's arm and used as a tracking reference.

as a frame to explore new drawings. At this stage, several shapes were created and tested as tracking tags for the virtual drawing that would complete these outlines (Fig. 4).

For the final presentation of the project, the student demonstrated her Android mobile application that allows users to visualize and choose from previously stored tattoo art that can be seen on the skin without the permanence of real tattoo ink. The software also allows users to take pictures that can be saved on the device's gallery and also shared in social networks (Fig. 5).



Fig. 4. Testing different tag shapes



Fig. 5. A virtual tattoo created with the TattooAR app using augmented reality

5 Conclusions

Considering the development process of the TattooAR project, it becomes notable the relation between theory and practice. Theory background was accessed to inspire the project, while the reflective practical methodology fostered the development of a series of experiments that resulted in an innovative and creative solution to the design question posed in the beginning of the process: “how can Digital Design enhance the interactive experience of the tattoo?”

In addition, the project reveals an interesting interdisciplinary approach between the areas of Design and Computer Sciences. The student was able to test and experiment her proposed interaction concepts because she worked in a real-life context, in a design methodological process that was supported by the interdisciplinary knowledge of computer programming acquired in the Design-Digital Media Program at PUC-Rio. The knowledge of computer programming was determinant in this project’s design process because it empowered the designer to test, experiment and experience her Design decisions.

The results achieved with this work contribute to the use of digital technology as a mean for human expression. The TattooAR mobile app explores one of the many ways to use Augmented Reality technology and proposes a new way to interact with tattoos. It allows for a shared interactive experience, where spectators are transformed into users and new interactive experiences are created as the users interact with their bodies. TattooAR adds an interesting contribution to the fields of Electronic Art, Design for Interactive Media, Augmented Reality and those related to Wearable Technology.

As further possibilities of the project, options like allowing the users to generate their own tattoos based on their individual drawings, and also animated motion tattoos are being considered, and should be produced in the near future.

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