

Animation and Machines: designing expressive robot-human interactions

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국문초록

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ABSTRACT

Cartoons and consequently animation are an effective way of visualizing futuristic scenarios. Here we look at how animation is becoming ubiquitous and an integral part of this future today: the cybernetic and mediated society that we are being transformed into. Animation therefore becomes a form of speech between humans and this networked reality, either as an interface or as representation that gives temporal form to objects.

Animation or specifically animated films usually are associated with character based short and feature films, fiction or nonfiction. However animation is not constricted to traditional cinematic formats and language, the same way that design and communication have become treated as separate fields, however according to Vilém Flusser they aren't. The same premise can be applied to animation in a networked culture: Animation has become an intrinsic to design processes and products – as in motion graphics, interface design and three-dimensional visualization.

Video-games, virtual reality, map based apps and social networks constitute layers of an expanded universe that embodies our network based culture. They are products of design and media disciplines that are increasingly relying on animation as a universal language suited to multi-cultural interactions carried in digital ambients. In this sense animation becomes a discourse, the same way as Roland Barthes describes myth as a type of speech. With the objective of exploring the role of animation as a design tool, the proposed research intends to develop transmedia creative visual strategies using animation both as narrative and as an user interface.

Keywords: digital animation, collaborative networks, motion design, graphic user interfaces

I . Introduction

What started as an attempt to conduct a philosophical investigation of animation regarding the linguistic aspects of the field and how it can constitute a form of speech or language in itself evolved into embryonary research on the crossroads of animation and cybernetics. Initial investigation looked at how animation facilitated the interaction with mechanical devices and the feedback it returned to humans in the form of animated representation of mechanical or artificial behavior.

This sort of animated interaction is ported over to digital platforms in the form of GUIs Graphic User Interfaces, relying on symbolic and animated metaphors that express behaviours conducted formerly in the physical world. As computing increasingly permeates everyday life and interaction with them evolve into natural user interfaces requiring gestures and movement for input, animation becomes integral to human computer interaction. Such interactions carried on smartphones, tablets and household appliances, can now be managed by personal robots that can either assist you by reminding you of the tasks or in some cases, when instructed, will carry them on and report later on the progress.

Of many issues that emerge from the introduction of robots in our society, from ethical considerations to technical barriers, one that has taken my interest is the communication between humans and robots. The field has advanced in several aspects regarding how a robot can

understand us: voice recognition, facial recognition, ability to decode images into data; as well as how it responds: artificial intelligence, text to speech conversion, and more recently by incorporating facial expressions and gestures. My interest focuses in how animation can make robots more expressive and friendly, this article reflects current research on the subject and provides some insights on the role of animation in Robot Human Interaction.

II. Expanded animation

Considering two of many possible definitions of animation: "Giving life to the inanimate" and "Creating the illusion of movement where it is inexistent", we may consider that animation is an art form that allows the creation of artificial realities in motion, this concept can be applied from abstract cartoons to realistic CGI. Animation is commonly misinterpreted as a film genre - I would argue that animation is an art form in itself, allowing for consumption in different media as well as a technology with its own specificities, in all cases it is both a form of communication and a design process capable of acquiring form, motion and inherent narratives attached to it, in which case it may function as language in itself.

Animation can fall within different categories and commonly can be included in many simultaneously.

- Filmic Animation: cinema, television, video on demand, web.
- Scientific Visualization: astronomy, physics,

- chemistry, bio-medical and exact sciences.
- Visual Communication: motion graphics, electronic displays, advertising and way finding.
 - Prototyping architecture, industrial design and engineering.
 - User Interface: Human Computer Interaction HCI and Robot Computer Interaction,
 - Interactive applications: Art, video games and virtual reality.

Historically animation precedes film - the pre-history of its cinematic form is represented by optical toys such as the zoetrope, taumathrope and the praxinoscope, however predecessors such as puppet theater, shadow theater, mechanical toys and automatons, are non-cinematic forms of animation that are of particular interest to this research as well.

III. Animation and ubiquitous computing

Video games, virtual reality, map based apps and social networks constitute layers of an expanded universe that embodies our network-based culture. They are products of design and media disciplines that are increasingly relying on animation as a universal language suited to multi-cultural interactions carried in digital ambient. In this sense animation becomes a discourse, the same way as Roland Barthes describes myth as a type of speech [1].

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language, the same way that design and communication have become treated as separate fields, however according to Vil m Flusser[2] they aren't. The same premise can be applied to animation in a networked culture: Animation has become intrinsic to design processes and products - as in motion

graphics, interface design and three-dimensional visualization.

Brenda Laurel in *Computers as Theater* lays the ground work for an important foundation to the field as she relates interface design to actions that take place on a theatrical stage, while objects and actors are represented as symbols and metaphors, actions use animation as a way to convey information to the user. [3] According to Laurel:

Designing human-computer experience isn't about building a better desktop. It's about creating imaginary worlds that can have a special relationship to reality worlds in which we can extend, amplify, and enrich our own capacities to think, feel, and act. (Laurel, 1993)

The plural presence of computers in our environment has generated an "exosphere"[4] consisting of social networks, maps and remote systems constituting a digital counterpart of our reality, such can no longer be considered a virtual reality as it is an integral part of real life. We can understand this data layer as an artificial reality

extending our physical world into digital networks. Within the graphic user interface discipline a whole set of linguistic conventions have been established cutting, copying pasting, linking and deleting. Emoticons used in messaging and social networks, not only serve as representational symbols of objects or actions, they mainly serve the purpose of expressing emotions in a non-verbal manner.

Computing also increasingly populates the inner workings and interfaces of machines around us, cars, trains, household appliances and even homes themselves are evolving into smart automated machines, assembly lines are progressively being replaced by mechanical robots, automated customer service systems that are being populated by chat bots. The next leap into the future of AI text based robot interactions are emotional chatting machines ,an article in UK daily The Guardian [5] reports that researchers from China and the United States [6] are working on creating machines that can fully understand user emotions.

"The resulting program could be switched into five possible modes –happy, sad, angry, disgusted, liking –depending on the user s preference. In one example conversation a user typed in: Worst day ever. I arrived late because of the traffic. In neutral mode, the chatbot droned: You were late ."[7] (Devlin, 2017)

IV. Social Robots: a survey of the state of the art

Cybernetic research has seen great advances in this century, Japan being in the forefront [8] in part due to an aging population leading to an effort to replace the workforce with automation and robots, which have been gaining acceptance within the society. Recently a number of social robots have become available to retail consumers, these robots fall in different categories: from high-end hyper-realistic androids to cute cartoon like creatures. In all cases these robots interact with human beings emulating our senses and expressive channels, hearing, speaking, seeing and more recently expressing emotions through gestures and facial expressions.

Social robots or personal robots, can perform an array of digital tasks such as sending emails, online shopping, online reservation, scheduling appointments and so forth, communication with humans is mainly conducted with synthesized voice, speech and optical recognition and may be complemented by animated avatars on a screen. Ultra realistic robots mimic human expression using head and eye movement, facial expressions that range from mandibular and labial movement, to emulation of

muscular distortion of the face in order to convey expressions and feelings. However the result is quite uncanny [9], with reactions ranging from fear, repulse to emotional attachment. Uncanny-ness is not a privilege of robots, it is a quite common feeling when playing video games, where ultra realistic

characters such as the FIFA players move and loop in an

eerie manner.

This territory is quite familiar to animators, that have for over a century perfected an art form where cartoon characters can express emotions, carrying dramatic weight and involving the audiences' affection or revolt, Frank and Ollie' s Disney sprinciples of animation [10] is an integral part of the animators vocabulary and linguistic tool set, having been applied in traditional, model and computer (3D) animation for the last fifty years. More recently these same principles have been revisited by UX experience designers as they build interfaces that rely on animation both as transitional and semantic devices, more recently smartphones interfaces consistently rely on animation in order to display multiple layers of information on a single tiny screen.



Figure 1: Repliee Q2, Index Osaka (2006)¹⁾



Figure 2: Actroid-DER, Expo Aichi (2005)²⁾

Hiroshi Ishiguro is the director of the Intelligent Robotics Laboratory at Osaka University, he is responsible for the research that developed one of the most human-like robots available today: the Actroid, a hyper-realistic android produced by the Kokoro Company in Japan. Actroid has highly detailed facial expressions based on human anatomy. Research being conducted in human expression applied to robotics relies mainly on physiological and psychological mapping methods such as Paul Ekman's facial coding system [11], currently being applied to Web GL coding generating 3-D data for detailed render of facial models [12].



Figure 3: Aldebaran Robotics, Nao (2005)³⁾



Figure 4: Softbank Robotics Pepper (2016)⁴⁾

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- 1) Images: Wikimedia commons license CC BY-SA 3.0, User:Gnsin~commonswiki/Upload Gallery/EXPO 2005
 - 2) Images: Wikimedia commons license CC BY-SA 3.0, File:Repliee Q2.jpg Created: 1 December 2006
 - 3) https://commons.wikimedia.org/wiki/File:Le_robot_Nao,_Futur_en_Seine_2015.jpg

Aldebaran Robotics is a French company that has released two humanoid Robots: Nao and Pepper. Nao is an autonomous robot launched in 2004 and became the official robot used in RoboCup Standard Platform League (SPL) in 2007 [13], it is used for research purposes at academic institutions worldwide. Pepper was introduced in 2014 and according to the company it is capable of communicating and understanding emotions. Currently it is manufactured by SoftBank Robotics, a Japanese company that acquired Aldebaran in 2015 [14].

V. Cartoons, animators and robots

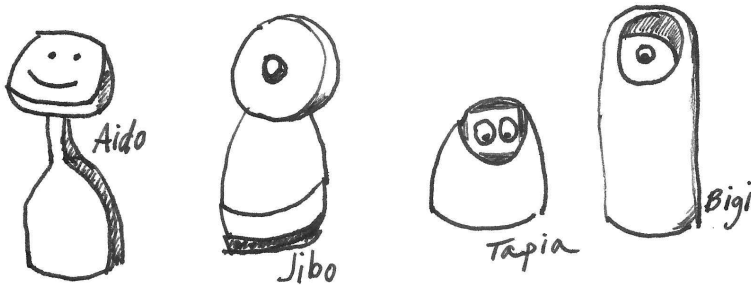


Figure 5: Cartoon-like Social Robots: Aido, Jibo, Tapia and Bigi.

Toy robots such as Tamagotchi and Furby introduced in 1990' s can be considered early examples of social robots as they foster social interaction with their users. In both cases the robot' s personality is represented as a cartoon character, on a screen or as a puppet. This appears to have been a design approach to make robots more appealing to children [15] and is being adopted by many social robot designers. Starting in 2015 a variety of social robots have

4) Autor: Cheng-en Cheng File:ペッパー羽田 2016 (30856190656).jpg

been introduced in the consumer market, most of them function as semi-mobile personal assistants, performing tasks such as reading stories to children, reserving airline tickets, picking a soundtrack for dinner or checking if you turned the lights off when you leave the house. Jibo is a personal assistant robot that is fruit of research conducted by social robotics pioneer Cynthia Breazeal at MIT' s Media Laboratory - Personal Robots Group. In 2014 Breazeal launched a crowd funding campaign to develop Jibo, it has reached its fundraising goal, though release dates have not been met yet.

MIT' s Media Lab Personal Robots Group gained popularity on the web with the release of NEXI [16] a humanoid robot that expresses emotions using facial articulations. A project that may interest animators is TOFU a soft plush robot intended for kids, according to the description on the projects' webpage:

" Disney Animation Studios pioneered animation tools such as squash and stretch and secondary motion in the 50 s. Such techniques have since been used widely by animators, but are not commonly used to design robots. TOFU, who is named after the squashing and stretching food product, can also squash and stretch." [17] (Personal Robots Group, 2017)

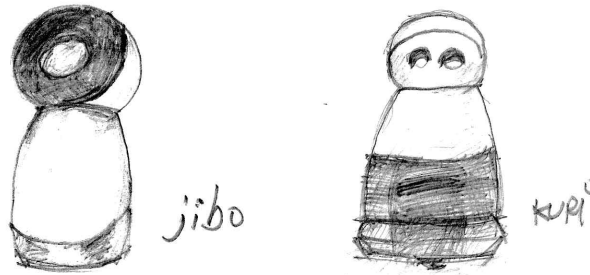


Figure 6: Jibo Personal Assistant Robot

Figure 7: Kuri Social Robot

Evan Ackerman in his report on personal robots presented at CES 2017, argues that all social robots at the consumer electronic show "look alike"[18] probably due to technical limitations, however the interviews he conducts with developers reveal that one unaccounted factor by Ackerman is that in order to make these robots friendly and avoid uncanny feelings from consumers, researchers have adopted cartoon like personalities for these robots. Kuri[19] developers intended to use a screen in order to display it's eyes, in the end they built physical eyes, on the other hand Jibo's team thought that by using only one eye the robot would feel less intimidating.

Jibo's body has a limited set of animated possibilities, there is body movement and the eye movement and expressions should follow animation guidelines documented in detail on the companies website [20]. Third party developers have access to a toolset enabling to program animated reactions and

movements adequate for the apps being written for the robot, according to Jibo's animation specs on the website:

"Jibo's animation system is responsible for coordinating expressive output across the robot's entire body, including motors, light ring, and eye graphics. The system supports playback of scripted animations, as well as expressive look-at and orientation behaviors." (Developers.jibo.com, 2017)

Anki is one of the companies that have taken a step forward, towards integrating animators in the product design team. Carlos Baena who worked at Pixar and Dreamworks on animated films Toy Story and Wall-E, is now part of the team that conceived how Cozmo moves and interacts, Cozmo conveys it's emotions by means of an animated LED style eye display [21] and even looking like a tractor, the robot's body moves in a surprisingly expressive manner.

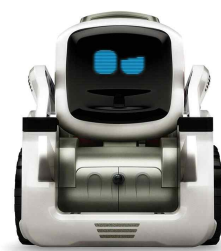
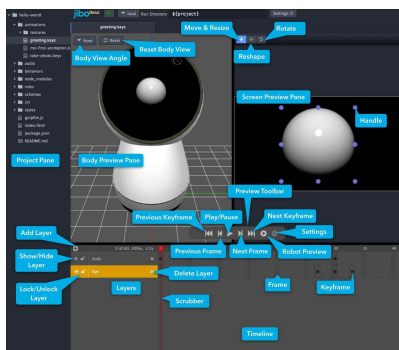


Figure 8: Jibo's Animation System⁵⁾

Figure 9: Cozmo - Anki⁶⁾

5) Autor: Cheng-en Cheng File:ペッパーパー羽田 2016 (30856190656).jpg

A fairly vast literature can be found on animation applied to robotics, mainly available in proceedings of computer science, electrical and electronic engineering conferences, I have selected examples demonstrating the interest of these researchers in the field and the willingness to collaborate with animation professionals.

Takayama [22] suggests that animation is non-verbal communication, therefore allowing people to interact simultaneously, for instance: if the animation principles "preparation" and "follow through" are applied to the robot's reaction it allows a robot to play in synchronism with a human. Balit, Vaufreydaz and Reignier [23] present an open-source robot animation software dedicated to design robot animation that is specific of the "robot as a medium": "As previous research has shown, 3D animation techniques are of great use to animate a robot. However, most robots don't benefit from an animation tool and therefore from animation artists knowledge." (Balit, et al, 2016)

Tiago Ribeiro and Ana Paiva [24] from INESC-ID Portugal, adapted principles and practices of animation from Disney and applied them to emotional expressions on robots: "Our work shows that applying animation principles to robots is beneficial for human understanding of the robots emotions". (Ribeiro, Paiva, 2012). Van Breemen from Philips Research [25] argues that since animated user

interface characters have applications similar to robotics and have proven the value of applying principles of

6) <https://brandfolder.com/cozmo/public>

animation in HCI they should be considered by RHI designers: "We proposed to apply principles of traditional animation to make the robot s behavior better understandable." (van Breemen, 2004).

VI. Conclusion

Robot Human Interaction designers are increasingly understanding how animation principles can make robots more expressive and have been applying them do development of social robots. Ultra realistic service robots that mimic human expressions even can provoke uncanny feelings in people interacting with them. One successful solution encountered by developers to create more friendly robots is to create cartoon like humanoid robots instead of androids. Also, certain styles of character animation transcend cultural boundaries, therefore may be accepted more easily in different societies.

UX designers and RHI researchers have tackled the field of animation with some success, however it seems most professionals do not have the training or the background in order to fully master the art of motion. Animation allows the coding of human expressions in two and three-dimensional images in a variety of styles, which is different from using animation to "act out" previously categorized expressions - a technique being adopted in RHI design. Research in this Interaction Design field will benefit enormously in a creative environment where animators can collaborate with engineering and design teams researching Robot Human Interaction.

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애니메이션과 기계: 감정 표현 로봇과 인간과의 상호작용 연구

장 파울로 스클리터

만화와 종국적으로 애니메이션은 환상적 시나리오 시각화의 효과적인 방법이다. 본고 에서는 어떻게 애니메이션이 미래 현재(변모되어가고 있는 인공두뇌, 매개 사회) 아주 흔한, 그리고 필수 불가결한 부분을 차지하게 되었는지 알아볼 것이다. 따라서 애니메이션은 인터페이스이거나 혹은 대변자로서 일시적 형태의 대상인 인간과 현실의 담화형태가 된다.

애니메이션 혹은 특히 애니메이트된 필름은 보통 단편, 실사 영화, 픽션이나 논픽션의 캐릭터와 연결되어있다. 하지만 애니메이션은 전통적 영화 형식과 언어와는 거리가 있고 같은 이유로 디자인과 커뮤니케이션 역시 다른 영역으로 구분된다. 하지만 Vilém Flusser에 따르면 그렇지 않다. 같은 전제가 네트워크 문화 속 애니메이션에 적용된다. 애니메이션은 디자인 과정과 제작에 본질(모션 그래픽이나 인터페이스 디자인 그리고 3D 영상작업 등)로 자리한다.

비디오 게임, VR, map 기반 app과 소셜 네트워크 등은 확장된 우주인 우리의 네트워크 기반 문화에 자리하는 것으로 여겨진다. 이러한 것들은 애니메이션과 연결성이 증대된(세계공통어가 디지털 환경 속 멀티-컬처 상호작용에 적용된 것처럼) 디자인 제품과 미디어 혼연이다. 이러한 감각에서 애니메이션은 담론화되었으며 같은 방법으로 Roland Barthes는 담화 형식의 신화를 묘사한다. 디자인 도구로서의 애니메이션 역할을 탐구하는 목적으로, 제안된 연구는 애니메이션을 사용하여 트렌스 미디어 창작의 이미지 전략을 네러티브와 유저 인터페이스 측면에서 발전시키고자 하는 것이다.

주제어: 디지털 애니메이션, 콜라보라티브 네트워크, 모션 디자인, 그래픽 유저 인터페이스

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