

Lipstick Drawing Robots: Sensuous Collaborative Interactions

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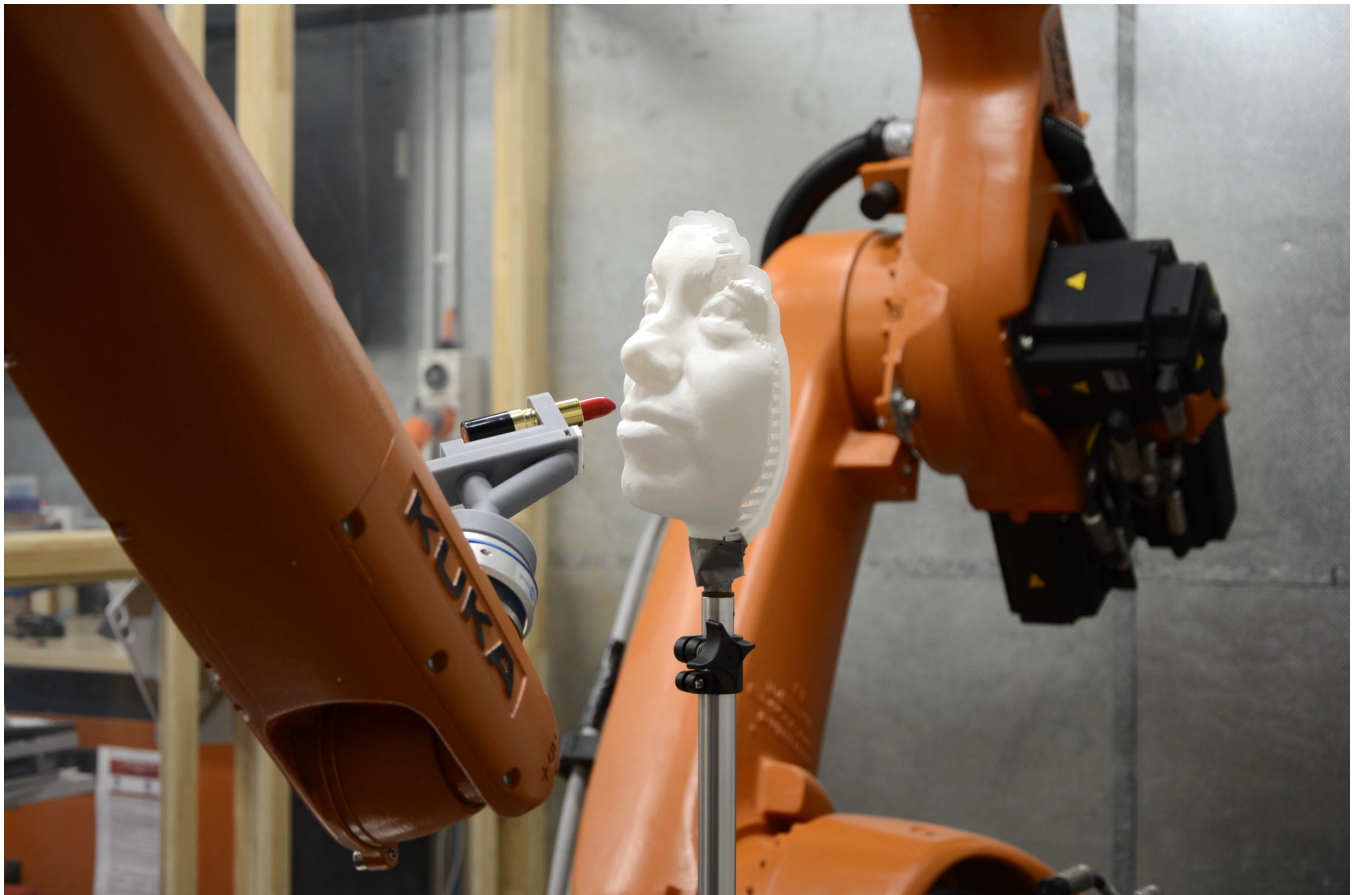


Figure 1: Lipstick Drawing Robot prototyping experiments, Digital Modelling and Fabrication Lab, School of Architecture, Design and Planning, The University of Sydney.

ABSTRACT

The field of social robotics has brought attention to the social, embodied interaction of humans and robots. As we begin to examine how robots can play a role in personal, bodily grooming and rituals such as the feminine act of applying lipstick, a seemingly simple interaction between the human hand and lip raises challenging ethical and technical issues for human-robot interaction. We pursue a feminist, speculative, critical approach to investigating how robots can collaborate through gesture and touch with humans in intimate, sensuous acts. Through research-through-design and creative experimentation, we present our preliminary results into programming an industrial robot to draw lipstick on a human face.

CCS CONCEPTS

• **Human-centered computing** → *Interaction design; Human computer interaction (HCI)*; • **Applied computing** → *Arts and humanities*.

KEYWORDS

social robotics, affective touch, tactility, movement, kinaesthetics, collaboration, personal grooming, research-through-design

1 INTRODUCTION

As robots enter the sphere of everyday life, the field of social robotics has begun to question the role robots can and should play in

society [3]. No longer confined to the factory, robots are beginning to appear in domestic and public space contexts. As the physical dexterity of robots improves, new opportunities arise in how social, tactile robots can play a role in human bodily activities and rituals such as personal grooming and bodily care [4] [6].

We pursue a feminist, speculative, critical approach to investigating how robots can collaborate through gesture and touch with humans in intimate, sensuous acts. We chose the feminine act of applying lipstick as a case study, as it presents an understudied area of human-robot interaction. By placing it within a feminist and thus critical lens, we aim to unpack "how technologies construct and perpetuate gender" [1, p.1301]. The inherent contradiction of employing an industrial robot for such a delicate, sensuous act is one of our tactics.

Compared to the fast, deft, repetitive motions of industrial robots, the application of robotic arms to acts of delicate, sensuous human gesture and touch requires a closer examination of the expressive dynamics, kinaesthetics, tactility and affective touch of the human-robot interaction. Applying and wearing lipstick is a highly individual act, endowed with personal meaning, yet sharing social and cultural connotations. It also raises challenging ethical and cultural issues for human-robot interaction and collaboration related to intimacy, vulnerability, identity, and agency, that resonate with feminist human-computer interaction agendas [1]. What are the implications for a robot to participate in this personal act? We begin to explore these issues through research-through-design and creative experimentation, and present our preliminary results into programming an industrial robot to draw lipstick on a human face.

2 METHOD

In our approach to research-through-design for human-robot interaction, we combine thinking and methods from art, architecture, interaction design, and human-computer interaction. Through physical prototyping, material exploration, 3D digital simulation and robot programming in the lab, we are able to explore and experiment with ideas, interactions, and scenarios. Figure 2 summarises the stages in our creative experimentation and prototyping process in the robotics lab. In the future, we intend to display our research results through exhibition, or what Koskinen et al. [5] call the Showroom. The presentation of ideas and results through a speculative, critical lense in an exhibition format enables us to produce tangible, material artefacts that provoke and destabilise cultural norms, preconceptions and imaginaries [2]. The use of cinematic film in particular provides tools for framing and amplifying ideas, issues and aspects that may not be obvious or bear a new significance when presented in a different way.

3 PRELIMINARY RESULTS

Through defamiliarising what seems a simple, ordinary act, the process of research investigation has begun to reveal the complexities inherent in personal acts of applying and wearing lipstick. Initial studies we conducted within the research team of how women apply their lipstick indicate a wide variety of approaches to what is actually a skilful act of hand-lipstick-lip coordination. Variations include: start applying the lipstick to the bottom lip, then fill in the top lip; trace around the outline of the lip and then fill in the rest;

or press lips together to blend the lipstick over both lips. Interestingly, the lips are not passive, but reach towards the hand-lipstick and collaborate in this sensuous, tactile interaction. These varied approaches complexify how to program a robot to perform similar gestural, tactile interactions.

Our study involved working with the Kuka KR10, an industrial robot with a 6-axis articulated arm and end effector. The 6-axis arm sparked our interest for its range of motion dynamics and movement expression; and its capacity for precise, delicate gestures. Working with industrial robots poses challenges in relation to proximity and safety. There are strict protocols to follow to ensure harm minimisation to humans working in close proximity. As a workaround, we scanned the human face and produced a 3D print as a proxy for the real human.

We set up an end-to-end process (see figure 2), that begins with 3D scanning of a human face. The 3D face data is combined in Rhino with a digital model of the KR10 robot to provide a simulation environment. The experimentation with scripting of the robot movements is done in Grasshopper with Kuka PRC plugin. The last stage of the process is to send the program script to the KR10; the robot then draws lipstick on the human face (or proxy), which is positioned very carefully to ensure calibration.

To date, we have successfully conducted one run-through of the process, with all components operating. In our first version, the robot paints the bottom lip twice, and then draws on the top lip from the centre to one side and then the other. The angle of the lipstick is varied along the path to achieve a better coverage, and more closely mimic how lipstick is applied by people. The 3D mesh of the scanned face and lips was used as a reference in figuring out the path and angle of the robot end effector, using the digital modelling environment of Rhino and the scripting tool of Kuka PRC in Grasshopper. Preliminary results of this process are illustrated in Figure 3, showing the digital simulation in Rhino, and in Figure 4, showing the real robot drawing lipstick on a 3D printed face. Future work pending ethics approval will invite anyone who wears lipstick to contribute both the gestural, tactile actions of applying lipstick, and the personal relationships and stories people have with their lipstick. This will provide a corpus of data for further exploration and experimentation into how a robotic arm can be programmed to draw lipstick in a nuanced way, that takes into account the unique variations of individual lips.

4 CONCLUSION

Bringing industrial robots as prototypes of future social robots into close proximity with humans for intimate, personal collaborative acts such as personal grooming and bodily care enables the speculative, material exploration of possible futures. It also facilitates thinking and critique around the associated ethical and cultural implications of human-robot interaction for intimate, sensuous activities. Through our preliminary research, we have begun to unpack some of these issues through creative experimentation and prototyping. Future work will further explore these issues through cinematic film-making for critical, speculative narratives, and technical problem-solving of the dynamic behaviour of both robot and human in the collaborative act of drawing lipstick on human lips.

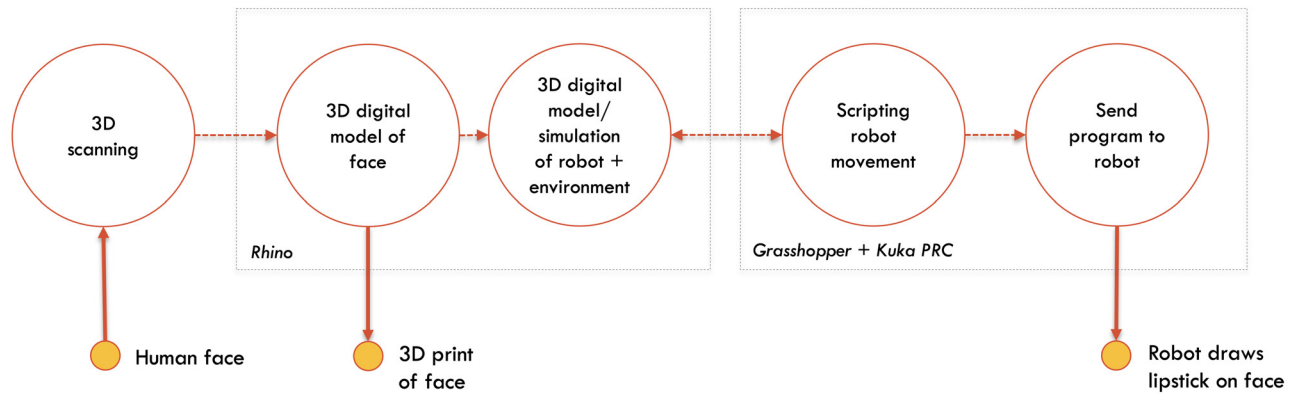


Figure 2: A summary of the key stages in our research-through design creative experimentation and prototyping process.

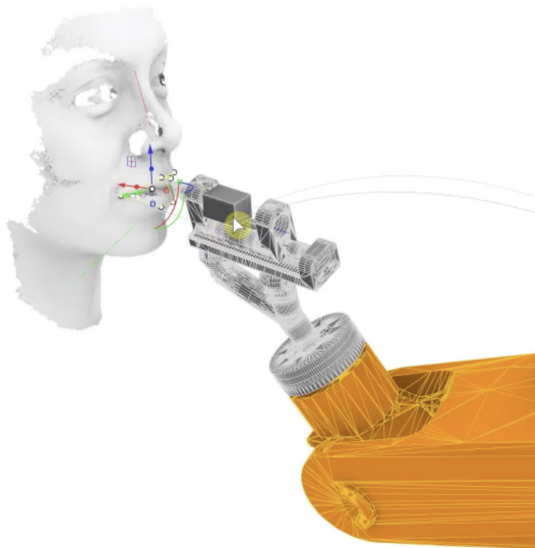


Figure 3: A screenshot of the digital simulation in Rhino, showing the path the robot will follow to draw on the lips.

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Figure 4: A photo of the real KR10 robot drawing lipstick on a 3D printed face.

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