Cultural Robotics: Robots as Participants and Creators of Culture

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Abstract. This introductory chapter reviews the emergence, classification, and contemporary examples of cultural robots: social robots that are shaped by, producers of, or participants in culture. We review the emergence of social robotics as a field, and then track early references to the terminology and key lines of inquiry of *Cultural Robotics*. Four categories of the integration of culture with robotics are outlined; and the content of the contributing chapters following this introductory chapter are summarised within these categories.

Keywords: Cultural robotics · Social robotics · Human-robot interaction · Culture

1 Introduction

Over the last decade the field of robotics has seen a significant increase in human-robot interaction (HRI) research [16]. It is expected that the next generation of robots will interact with humans to a much greater extent than ever before [18]. As the distance between humans and robots narrows, robotics research is moving into areas where robotic entities have become participants, and in some cases generators of culture. With this in mind, this introductory chapter aims to identify and outline the notion of *Cultural Robotics* as an emerging field.

As a logical evolution from the field of HRI, and particularly social robotics, the emerging field of cultural robotics aims to understand the role of robots as cultural participants and creators of culture [11,35]. Cultural robotics, then, is defined as the study of robots in culture, cultural acceptance of robots, and robot-generated culture. In other words, a cultural robot is a robotic entity that participates in, and contributes to, the development of material and/or non-material culture. The terms 'material' and 'non-material' refer to tangible cultural products such as a painting or a piece of music and intangible products such as values, norms and traditions respectively.

In this vein, previous research has investigated the effect of culture on both the design [25] and acceptability of robots [1,17]. The cultural influence of

robots, furthermore, can be noticed in theatre [27], stand-up comedy [21], interactive art [8] and religion [31]; all activities previously reserved for humans but today also 'enjoyed' by robots. Additionally, robots such as "Shimon" [19]—an autonomous robotic marimba player—already produce material cultural artefacts, such as an improvised piece of music. Shimon not only communicates a meaningful message to the human counterpart through shared conventions of communication and musical composition, but in turn provides a new avenue for human/robot collaboration that could lead towards a new musical genre. In addition to serving beverages, the "Robot Bartender" [12] recognises and interprets multimodal socio-cultural signals from its human 'clients'.

As noted, culture is a multilayered construct inclusive of not only external artefacts such as language and customs, food and dance, but also nuanced elements of "a group's shared set of specific basic beliefs, values, practices and artefacts that are formed and retained over a long period of time" [38]. We recognise culture as a complex and integral consideration in the design, application and advancement of social robotics. In looking at the social acceptance of robots, we present culture as the touchstone for meaningful and sustained human-robot interaction.

This chapter will present a survey of all aspects of cultural robotics, such as the impact of culture in the design and application of robots, the cultural acceptance of robots and the emergence of robot-generated culture. It serves as an introduction to the book's contributed chapters from a cross-disciplinary group of researchers and practitioners from fields such as HRI, engineering, computer sciences, art and design.

2   Social Robotics as the Foundation to Cultural Robotics

When the field of *Social Robotics* was first introduced it was applied to multirobot systems inspired by the collective behaviours of birds, insects, fish or any creature within the same context [4]. With time, the term changed to study a more heterogeneous group which involves the interaction between humans and robots, particularly robots that people anthropomorphize in order to interact with them.

Despite the fact that robots are not sociable in the way humans are [20], in the early stages of social robotics (as known today) some researchers used the term *sociable robots* to distinguish between the more recent human-robot interaction and earlier work [4]. Robot designers, however, tend to use similar social models to those used during human-to-human interaction to incorporate robots into social environments. Although the robots are not strictly 'sociable', the social models they use are based on the foundation of human interaction and, when interacting with robots, the same social models are unconsciously applied by humans [4].

Although the term social robotics is now widely accepted, some researchers argue about the difficulty of creating social robots without a clear understanding of conscience [33]. They point out that morality and ethics are inherent to an

individual, defined by his or her relationship to others, and not easy to program or emulate into a robot. Roboticists and social researchers are also beginning to appreciate the importance of social, emotional and ethical issues raised by the development of robots. For example, there has been work on social and moral relationships [10,20,28,41]; the concept of 'personal space' [42]; radical-uncertainty [37]; free choice [2]; self-consciousness [5]; and long-term social inter-action [3,15,36] between humans and robots.

The field of social robotics, today, is concerned with the study of all forms of human-robot interaction within a social context, including the appearance and behaviour of socially interactive robots. To different degrees, all social inter-actions are culturally driven. As a response to the significant growth in social robotics, the field of cultural robotics was recently introduced.

3   Background to Cultural Robotics

For some time now there has been research directed towards building robots that can interact with humans in a social and culturally meaningful way. In fact, some of the earliest examples of embodied robotic agents were in cultural applications, including a radio-controlled anthropomorphic robot titled "K-456" by Nam June Paik and Shuya Abe built in 1964. K-456 was a provocative and controversial political piece; an androgyne in terms of gender identity, the robot played a recording of John F. Kennedy's inaugural address and excreted beans. In 1970 Edward Ihnatowicz produced "Senster," the first robotic sculpture controlled by a digital computer. This large scale interactive system was responsive to sound and low level movement, but would shy away from loud sounds and violent movements, encouraging the audience to adapt their behaviour in an affective response to the movements of the robot.

In spite these early examples, within the traditional robotics community the question of culture has been primarily considered in relation to the reception of robots or the level of general technology acceptance within a particular cul-ture. A number of studies have been conducted comparing preferences between different countries and cultures, for design factors including the size, capabil-ity, intelligence and 'life-likeness' of social robots [1,17,25]. However, within the last six years, a new conversation concerning the role of cultural considerations within robotics has emerged.

In 2010, in response to the prevailing linear 'technologically determinis-tic' scientific discourses on social impacts and acceptability of robotics, Selma Šabanović proposed a framework for 'bi-directional shaping' between robotics and society. Šabanović's publication "Robots in Society, Society in Robots" [40] focuses on "analysing how social and cultural factors influence the way tech-nologies are designed, used, and evaluated as well as how technologies affect our construction of social values and meanings" [40, p. 439]. Together with the obser-vations of MacKenzie and Wajcman [26], Šabanović identifies an existing linear and technocentric trend in technology research and acceptance where "society fills a passive role" and the public is encouraged to view technological change

as inevitable and "adapt to technology... not shape it" [26, p. 5]. Further, she notes that despite the significant social implications of robotics research, society is often not included in the design process until the final testing and evaluation stages [40, p. 440].

With a desire to address the nature of this dynamic, Šabanović proposed an approach to design which is value-centred, "consciously incorporating social and cultural meaning into design" [40, p. 445]. Her framework is not presented as direct design recommendations, but rather as recommendation for a relationship—or co-production—between society and technology, as one of "continuous feedback between practice, sense-making and design" [40, p. 445]. It is this very desire to address "the role that social-cultural norms, values and assumptions play in the daily practices of designing robotic technologies" [40, p. 440], that has led to the further development of research on the topic of cultural robotics.

The use of the term *Cultural Robotics* was first explored in depth by Hooman Samani et al. [35], who attributed the development of culture in robotics to the cultural values of the designers, the importance of embodiment in robotics, and the current (and potential) learning capacity of robots. Samani et al. proposed the potential progression of robots from simple tools, to luxury items, to members of human society and projected that they would one day become an integral part of our culture, and perhaps develop their own unique culture. Samani et al. discuss culture from a number of angles including the influence of popular culture and media on robot design and acceptance, and the potential use of robots as telepresence technology. They argue that the design and use of robots ought to be informed by a specific cultural context, and used as both a product and a medium to contribute to the sustainability of cultural practices.

In response and addition to this research, Dunstan and Koh [11] published on the emergence of cultural robotics, defining it as "the study of robots in culture, cultural acceptance of robots, robot-cultural interaction and robot-generated cultures" [11, p. 134], and a social robot as one that contributes to the generation of material and non-material culture. Here, Dunstan and Koh outlined stages of cultural interaction, moving beyond the influence of the values of the designers to identifying specific cases through three stages of immersion; firstly, a robot as an actor within a particular culture; secondly, a robot as a participant in or producer of culture; and thirdly, the potential for the advent of robotic community culture. By surveying emerging social robotics projects from non-traditional robotics conferences, together with analysis of cultural determinants within a cognitive behavioural model, they predicted an increasing integration of culture in robotics and robotics in culture.

The papers within this publication demonstrate that the extent to which human and robot culture overlap and intertwine is now reaching well into the category of 'robot-generated culture' as robots are used to teach, plan and lead culturally meaningful activities. Robots are also generating a new branch of cultural and philosophical inquiry into the roles of gender, embodiment, ethics, performance, and politics in technology.

4   Latest Work in Cultural Robotics

This section presents an overview of the latest works in Cultural Robotics, as exemplified through the submissions to this publication. The submissions are divided into four sections, demonstrating the layers of integration of culture in robotics, and robotics in culture. Namely, these are: (1) culture affecting the design, application and evaluation of robots, (2) robots as participants in culture, (3) robots as producers of culture: material and non-material, and (4) the advent of robotic culture. The following is an overview of each section, and the chapters included therein.

4.1   Culture Affecting the Design, Application and Evaluation of Robots

As mentioned in Sect. 3, in the robotics community the question of culture has been primarily considered in relation to the design and evaluation of socially interactive robots as perceived by a cross-cultural population. In this vein, Yasser Mohammad and Toyoaki Nishida [30] present, in Chapter Two, a comprehensive review of cross-cultural differences in the perception of robots, and include results from an experiment that investigate cross-cultural changes in robot perception using the back-imitation effect, where participants from different cultural backgrounds are required to imitate a robot's behaviour.

Then, in Chapter Three, Hyelip Lee et al. [24] introduce the process followed to design M4K, a telepresence robot created in response to globalisation and the need of people to communicate, and interact, across distance. This robot exceeds the common capacity of bi-directional communication by integrating the ability of tele-manipulation. In this chapter the authors present the main considerations followed during the robot design, considering not only the environment where it will be placed and the tasks that it should achieve, but also the robot's appearance and behaviour that would improve its social acceptability. In this case, the robot would be used as an extension of a user rather than as an individual, independent agent.

In Chapter Four, furthermore, Mauricio Reyes et al. [34] explore the use of a robot's facial expressions during collaborative tasks with humans. Facial expressions, strongly affected by social and cultural context, play a significant role during the communication and interpretation of emotions. This chapter investigates, particularly, the effects of negative facial expression feedback (i.e. sadness) communicated by a robot during a failed human-robot collaborative task, and investigate if human intervention exists on the initial presence of an unexpected failure, and how the intervention is affected by the robot's facial expression.

Clearly, the evaluation of human behaviour and robot perception in a social, cross-cultural environment is complex, and significant work is still needed. In Chapter Five, Diego Compagna et al. [7] introduce a sociology-based theory-driven method to evaluate HRI, and identify aspects of successful and satisfying interactions. The method is based on "a definition of social interaction based on the symbolic interactionism paradigm."

4.2   Robots as Participants in Culture

The participation and integration of robots in culture is demonstrated in Chapter Six with a study conducted by Evgenios Vlachos et al. [39], which aims to provide insight on how users communicate with an android robot and how to design meaningful human robot social interaction for real life situations. The study was initially focused on head orientation behaviour of users in short-term dyadic interactions with an android, however, the results of this study revealed unexpected findings: the female participants spent a significantly longer time interacting with the robot, and further, the setting of an art gallery proved to be a rich context for measuring human-robot interaction. This chapter observes diversities in human-robot interaction behaviour between groups and individuals, and between genders, and most compellingly, that as robots are moved out of the laboratory and into a cultural setting, their reception and the behaviour of participants interacting with them changes in unanticipated ways.

From the art gallery to the classroom, in Chapter Seven, Christian Penaloza et al. [32] discuss their research that explores the potential use of robots as educational tools for non-technology related fields such as history. The authors explore this unique application of robots not only as a means to engage the attention of students, but as a methodological approach for designing the morphology of educational robots, inspired by the ancient gods and historical characters of South American cultures. This chapter includes a number of conceptual designs for culturally-inspired robot morphologies, and cultural educational activities centred around building a robot.

As demonstrated in Chapter Eight through the work of Petra Gemeinboeck and Rob Saunders [14], not only are we seeing the emergence of robot participation in culture, but increasingly, the use of cultural activities to shape the morphology and movement planning of social robots. In this chapter the authors discuss a novel approach towards socializing non-anthropomorphic robots, which involves the 'Performative Body Mapping' of the movement of dancers, to teach non-humanlike robots to move in affective and expressive ways. The authors conduct a number of experiments that attest to the potential of movement to turn an abstract object into an expressive, empathy inducing social actor.

The inclusions of robots in cultural settings generates a number of new questions and discourses. In Chapter Nine, the question of subjectivity and objectivity in films and visual culture is discussed, as increasingly, the use of robotic camera systems removes the human operator entirely from the production and interpretation of images and film. Author Chris Chesher [6] discusses the use of motion control systems and robotically-controlled cameras, and how these alter image genres, and question the audience's perception of subjectivity, surveillance, intimacy, and the uncanny.

Within cultural contexts, we see that the applications of robots are moving beyond the role of 'servant' or worker simply performing efficient assembly-line tasks, but rather, are increasingly involved in creative activities. In Chapter Ten, Christian Laursen et al. [23] discuss the way in which robots can not only support, but spark the imagination of dessert chefs working in food preparation and

plating. The authors present a range of prototypes that explore robots providing a role in the creation of aesthetic interactions and experiences regarding the preparation, serving and consumption of food. This research not only presents robots as participants in a culturally rich environment (the kitchen), but even more significantly, it demonstrates the ways in which robots can support and enhance human creativity and move towards being classified as producers of culture.

4.3   Robots as Producers of Culture: Material and Non-material

Since the 19th century, robots have played an important role not only as participants, but also as producers of culture. Early examples include the use of dummies and mechanical puppets: *Automata* (Ernst T.A. Hoffmann, 1814) and *The Sandman* (Ernst T.A. Hoffmann, 1817). Popular media, furthermore, have used robots to create a vision of what the future could be, with human-looking robots contributing and interacting with people as 'equals': *The Bicentennial Man* (Isaac Asimov, 1976). Although we are still far from this impression, in Chap. 11 Elena Knox [22] presents Geminoid-F, a female-appearing Android robot, as the main character of an experimental video artwork—*Comfortable and Alive*—created to facilitate a wider, yet fractional discussion of the cultural provenance and potential integration of female-appearing robots.

From cinema to the performing arts, through the work of Wade Marynowsky et al. [29], Chap. 12 shows how framing a robot-based performance as a Gesamtkunstwerk—a work that synthesizes all art forms—contributes to the creation of culture. In this chapter Marynowsky et al. present "Robot Opera" and the history and exploration of robots in the performing arts. Following a similar direction, in Chap. 13 Petra Gemeinboeck and Rob Saunders continue the discourse of the cultural legacy of robots in the performing arts [13], including historical and contemporary works that explore the 'machine creativity' as a cultural, bodily practice, where machines (robots) are performers capable of expanding the 'script' given by their human creators.

4.4   The Advent of Robotic Culture

In this final section we explore the advent of robotic culture, through the work of Alex Davies and Alexandra Crosby [9], in Chap. 14. In this chapter the authors present the 'on-stage' and 'off-stage' storyworld of the first all-robot band, Compressorhead. Here the authors argue that robots can indeed be seen not only as performers, but even as celebrities and therefore be taken seriously as participants and producers of material (e.g. music and merchandise) and non-material (e.g. social values and norms) culture, and further, they point towards the real emergence of autonomous robotic-generated culture.

5   Conclusions and Future Direction

At the RO-MAN 2015 conference, we were so fascinated to watch short films presented by the authors of robots so deeply immersed in cultural practices;

robots being carefully dressed in traditional robes by children who were being taught about ancient cultures (by the robots!); robots gently spiralling chocolate to assist a dessert chef with plating a dish; and a human dancer in a large geometric costume, mapping fluid human gestures for robotic movement planning. Reflecting on our key line of inquiry, 'What is the future of robotic contribution to human cultures?', while the answer grows and changes almost daily, the nature of the contribution is emerging; one which is substantial, considered, nuanced, and deeply significant.

As technology advances, we believe that the role of robots will change from interactive social agents with the ability to emulate and respond with human-like social behaviours, to independent, emotional and intellectual entities with the ability to create their own identity. For this to happen, however, significant work is needed. To date, most socially interactive robots don't have the ability to work unattended, for extended periods of time, without human intervention. In fact, most social robots (if not all of them) are either remotely operated or follow a very specific set of rules that define their social/cultural behaviour. Technological advances in artificial intelligence will allow robots to have their own 'intelligence,' learn and make independent decisions, creating a world of opportunities for them to participate and create their own culture. Through this ability, we believe, continuously-evolving socially-interactive robots that adapt to human behaviour will be created.

Currently, interaction with a social robot is still something most people only experience as part of an experiment or on a very rare public occasion. In order to gain a deeper understanding of the interaction capacity and potential use of social robots in cultural settings, more robots need to be moved out of the laboratory and into art galleries, kitchens, classrooms etc.; where the benefit of their inclusion in these settings, for both testing and participation, are illustrated clearly by the contributions to this publication.

We hope to continue to contribute to the conversation around the emergence of robot generated culture, and we anticipate that this will be the category of cultural robotics which will see the most rapid and interesting growth in the next few years.

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