Towards Creative Applications for Socially Assistive Robots

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ABSTRACT

This paper describes the framework and research methods of the Health, Engineering, Art, Robots, & Technology (HEART) project, an interdisciplinary pilot project that develops new approaches for strengthening mental health and improving well-being for patients experiencing symptoms of depression, anxiety and stress using socially assistive robots. The project aims to increase motivation and strengthen mental health through collaborative drawing and painting with a robot. The project consists of a series of workshops conducted by robotics researchers and a visual artist in collaboration with an established program for high-functioning mental health patients facilitated by Arts in Health experts. Through the workshops, HEART aims to implement and promote arts and cultural activities designed to strengthen mental health and improve well-being through increased confidence, communication and social skills. This work contributes relevant insights towards the development and integration of socially assistive robots within health care and mental illness in non-medical/non-clinical contexts.

CCS CONCEPTS

• Computer system organization → Robotics • Human-centered computing → Empirical studies in interaction design • Human-centered computing → Interaction design theory, concepts and paradigms

KEYWORDS

Human Robot Interaction, Robotic art, Health care, Community engagement, Quality of Life, Artistic methods, Creativity

1 Introduction

Depression affects millions of people worldwide, and anxiety and stress are the leading causes of disability at the workplace.

Prior research [1-3] has demonstrated that art and cultural activities that promote a sense of belonging to a community and shared experiences can improve patient well-being and quality of life (QoL). Encouraging people to take part in creative practices and art experiences has been recently applied in different countries across Europe, Australia and the UK as a form of non-medical "prescriptions" for those persons on long term sick leave due to mental health. Working together with the local municipality, the HEART project is situated within an established cultural program [4] which targets citizens with depression, anxiety and stress in an effort to positively impact participant health and well-being by increasing their social network through community and cultural engagement. The program runs 10-week long courses where participants engage in group-based creative activities led by cultural "guides". These activities direct focus away from the patients' illness and help participants to create new, empowered self-images as capable and motivated persons with skills.

Previous efforts to incorporate robots in health care contexts as assistive or therapeutic tools have shown great promise. However, robot solutions in health care are typically technology-driven and oftentimes rely on presumptions about patients' needs rather than involving the target groups directly [5]. Embedding robots in health care contexts requires a nuanced understanding of human-centered factors that are integral to working with vulnerable populations, such as trust and acceptance. There is a growing interest in using robots in health care, and the use of medical robots for diagnosis, surgery, and therapy is on the rise [6]. In many cases, patients, families, and health care providers have concerns or anxieties about being treated by robots. This research provides another context for meeting and interacting with robots in a way that makes robot technologies more approachable and less fearful.

Our interdisciplinary team is comprised of researchers from the fields of HRI, persuasive design, information architecture, arts and music therapy. We worked closely with Arts & Health experts to understand how arts and cultural projects can be designed specifically to promote positive health outcomes, including

alleviating loneliness and promoting well-being. We are focused on developing evidence-based, interdisciplinary research that integrates arts and culture with socially assistive robots within a comprehensive health care system.

In collaboration with the regional centre for mental health, we designed a series of non-medical/non-clinical artistic workshops based around the task of collaborative drawing together with a robot. Based on the initial findings from a pilot workshop with sample participants from the target group, we plan to recruit a focus group of twenty participants for a 10-week long study to investigate the potential benefits of collaborative drawing on QoL and well-being among participants on long-term sick leave due to depression, anxiety, or stress. A secondary outcome of the project is to improve upon and discover novel use cases for socially assistive robots aimed at motivation, creativity and self-expression.

2   Motivation

A recent report by World Health Organisation (WHO), which references over 900 publications, including 200 reviews covering 3000 further studies, concludes that art has valuable potential for improving health and well-being [7]. According to this report, the arts may be successful in promoting good health as well as preventing a range of mental and physical health conditions. Previous research conducted in our lab further demonstrates how participatory design of robots might improve everyday life for people struggling with rehabilitation (e.g. in traumatic brain related injuries) by inviting them to design and personalise a robot that helps in ways that are specific to them [8]. HEART explores strategies for combining assistive technology with arts in order to improve health, specifically for people suffering from stress, anxiety, and depression. We will also gain insight into the limitations, challenges, and potentials of introducing socially assistive robots in health care contexts.

Similar to long hospital stays, long-term sick leave can be an extremely isolating experience: there is limited social contact and no daily routine or meaningful connection with the outside world. Sustained community-building activities are therefore vital to managing and overcoming symptoms associated with mental health. Last year, we piloted a robots and art project in collaboration with a hospital [9]. Our research showed how a simple drawing robot had the potential to positively influence patients' QoL. Actively placing the robot in the patients' environment increased social activity within the hospital ward. These early results support the results of the WHO report [7] which concluded that arts may affect the social determinants of health (e.g. some cases showed how arts developed social cohesion and reduced social inequalities and inequities among study participants). Furthermore, arts and culture activities "on prescription" are increasingly used in treatment and rehabilitation efforts in the UK, as results show improvements in both physical and mental health [8]. In this context, specifically engaging with art installations and physical interaction has proven useful [9,10].

The municipality's arts and health program, located within the centre for mental health, has been a first-mover in the region in adopting this novel approach to treating people outside of clinical and medical interventions by introducing culture and art experiences as a form of prescription for persons on long term sick leave. An external evaluation of the program documented the program's success, which resulted in a noticeable increase in general well-being and social engagement [4]. HEART uses the program as a scaffold to conduct applied research in the field of socially assistive robotics aimed at improving patient health and well-being.

HEART builds on prior research conducted with socially assistive robots in museums [11,12] and hospitals [9]. In these studies, we found that collaborative drawing with a robot is a highly enjoyable activity that fosters creativity and promotes meaningful social engagement, both of which are known to positively impact QoL. We predict that creative activities facilitated by socially assistive robots can positively impact well-being through non-medical/non-clinical interventions. This research is especially timely given the growing trend for social robots and other assistive technologies in health care and therapeutic contexts to provide companionship, motivation, and diversionary activities. We will investigate to what extent a socially assistive robot can help improve QoL and well-being through boosting confidence, communication and social skills. One significant aspect of this creative application of socially assistive robots is that the focus is not on treatment, but instead on empowering participants to engage in social interaction and creative expression. We were also inspired by Fasola and Matarić's study on socially assistive robots that involve elderly users and physical exercise [16]. Their study builds upon patients' intrinsic motivation and evaluates the use of the physically embodied robot coach over the usage of a virtual coach. We predict that increased collaboration will lead to better health and better artistic outcomes, including increased motivation and confidence among the study participants.

3   Workshops

The project activities are organised around a pilot workshop and four main project workshops with participants enrolled in the municipality's arts and culture program. Each group enrolled consists of 10-20 participants who follow a 10-week course, where they are required to select and participate in a minimum of four workshops per week. Possible activities include attending professional musical performances, literature workshops, a tour of the local historical museum, and acting classes taught by professional actors. Previously, the program did not include any visual arts programming. Working closely with a professional painter and illustrator, we designed a series of workshops that introduce basic techniques for drawing and painting. The goal is not on art therapy, but rather on creating a framework where creative expression is encouraged and cultivated. Building on our prior research in the area of collaborative drawing with a robot [13], we generated a series of activities and interventions that teach collaborative drawing between people and robots.

The pilot workshop consists of two parts. The first part is similar to a traditional drawing class, where participants are introduced to basic techniques for line drawing and color theory, and are tasked with collaborating together to create a common art piece (e.g. mural). Collaborative drawing between people reduces the anxiety and pressure to produce a polished art work, as the focus is on mutual experience and emphasizes the individual contribution to a communal project . The focus is not on aesthetic criteria, but rather on using artistic methods to cultivate a shared creative process. The first part of workshop provides a baseline understanding of what means to contribute to a joint collaboration that allows room for individual exploration and expression.

The second part of the workshop is a study on human-robot collaboration (HRC). The focus of this section is to use drawing exercises and collaborative drawing facilitated by a robot to promote creative expression, and to investigate the possible health benefits and outcomes. Over the course of the workshops, it is possible to explore different socially-assistive "roles" for the robot through specific actions and programmed behaviors: the robot may act as a collaborator, a drawing teacher, or a motivational bystander. Over time, our goal is to introduce more levels of autonomy into the robot using computer vision and machine learning. The workshops also enable us to consider how health care providers might participate in drawing activities, and where and how these activities might be included in other health care contexts.

We know from previous experience working with vulnerable populations that the evaluation methods must be centred around the patients' needs and requirements. Therefore, the results from the pilot workshop will inform the future research design and programming of the subsequent workshops.

4   Project Aims

HEART is an exploratory project grounded in a robust, tested platform for investigating HRI. The project holds tremendous potential for understanding the potential value of socially assistive robots in mental health and could help pave the way for new applications for social robots within health care. At the same time, the project addresses important questions regarding HRC, which is an area of critical importance in the field of HRI. Therefore, we see multiple beneficial outcomes from HEART, including:
• Possible health benefits to the participants enrolled in the cultural program of the municipality.
• Health care professionals could gain novel tools and strategies to help treat people suffering from stress, anxiety or depression.
• Advances within HRI research based on a human-centred approach, as opposed to purely technology-driven

5   Expected outcomes

HEART combines the initial positive results from the portrait drawing robot at a hospital [9] with custom-built software for a collaborative drawing robot. At present, the robot only produces simple line drawings. Through subsequent open studio sessions with the project team led by a professional artist, we will identify and implement strategies to improve the robot's functionality and artistic capabilities, which will ideally result in a more capable drawing partner.

We plan to work with the same group for all four workshops. Based on the outcome of the pilot workshop, we are designing and conducting separate evaluation questionnaires following each workshop. This approach assures that we understand how/whether our specific intervention has benefitted the patients and in what ways. Pending participant consent, we expect to mainly evaluate the HRC using questionnaires, video recordings, observations and short interviews. We predict that increased collaboration will lead to better health and better artistic outcomes, including increased motivation and confidence among the study participants.

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