The Roomba Mood Ring: An Ambient-Display Robot

Daniel Rea	James E. Young	Pourang Irani
University of Manitoba	University of Manitoba	University of Manitoba
Department of Computer Science	Department of Computer Science	Department of Computer Science
Winnipeg, Manitoba R3T 2N2	Winnipeg, Manitoba R3T 2N2	Winnipeg, Manitoba R3T 2N2
umrea2@cc.umanitoba.ca	young@cs.umanitoba.ca	irani@cs.umanitoba.ca

ABSTRACT

We present a robot augmented with an ambient display that communicates using a multi-color halo. We use this robot in a public café-style setting where people vote on which colors the robot will display: we ask people to select a color which "best represents their mood." People can vote from a mobile device (e.g., smart phone or laptop) through a web interface. Thus, the robot's display is an abstract aggregate of the current mood of the room. Our research investigates how a robot with an ambient display may integrate into a space. For example, how will the robot alter how people use or perceive the environment, or how people will interact with the robot itself? In this paper we describe our initial prototype, an iRobot Roomba augmented with lights, and highlight the research questions driving our exploration, including initial study design.

Categories and Subject Descriptors

H.1.2 [**Models and principles**]: user/machine systems— *human factors*; H.5.3 [**Group and Organization Interfaces**]: user interfaces—*asynchronous interaction*

General Terms

Design, Experimentation, Human Factors

Keywords

Human-robot interaction, sociable robotics, group-robot interaction, ambient displays

1. INTRODUCTION

The use of peripheral ambient information for communication and interaction has garnered significant research interest (e.g., see [2]). Many have leveraged this communication channel to create *ambient displays*: 'glanceable' and 'unintrusive' electronic appliances that exploit our pre-attentive information processing abilities [2,3]. In this paper we posit that it can be useful to think of robots themselves as ambient displays, and to intentionally design them to use ambient cues for communication.

This is a timely consideration as Human-Robot Interaction research is increasingly targeting robots that enter people's everyday lives such as home utility or public service robots. These robots will often perform their tasks with high autonomy; even though robots and people will share spaces, people may only need to engage the robots for high-level direction or exceptional cases such as robot malfunction. Thus, the robot has an *ambient presence* in people's spaces, and people have *peripheral*

Figure 1. The modified Roomba on dark grey cement

awareness of the robot's actions and sounds, a presence which can be exploited by integrating ambient displays.

One key difference between traditional ambient displays and our proposed robotic ones is that people tend to anthropomorphise robots more than other technologies. They attribute them with intentionality and animacy, and perhaps even assume robotic actions are signs of communication [1]. This is even the case when the robot is not designed as such, for example, people describe random quirks or technical attributes in terms of emotion or personality [4,5]. This raises the question of how the intrinsic anthropomorphic tendency will impact how people perceive the ambient display on the robot and the information it conveys.

In our work we will place an ambient-display robot into a public space to explore the question of how anthropomorphism relates to an ambient display. Our initial prototype and scenario is as follows: we place the robot in a café and enable people to report their mood to the robot by selecting a colour from a given palette (Figure 2). We mounted multi-color LEDs on an iRobot Roomba to broadcast ambient information in the form of a coloured halo (Figure 1). The robot aggregates all responses so that its colors abstractly and artistically represent the mood of the room. We do not do any explicit colour-to-emotion mapping or analysis, but rather directly use people's own selections.

Using this scenario, we conduct an exploratory study to observe how our ambient-display robot impacts the social café space. Our driving research questions are: 1) How is the ambient display robot received by people? 2) Do people tend to anthropomorphise the data from the ambient display, and if so, how is this manifested? 3) How does the ambient display integrate into the social space, e.g., does it impact how people use the space? Our

investigation into these questions will serve as an important initial step toward understanding how people will interact with ambient-robot displays, and will provide groundwork for informing the design and development of robotic ambient appliances in general, for example, for other data sources, other robot types, and other display implementations.

2. PROTOTYPE

We designed our prototype to be used in a public space such as a café or lounge. We created a web interface (Figure 2) – accessible from a smart phone, laptop, or tablet – that people can use to interact with the robot. The web site presents the users with a palette and asks, "What colour do you feel right now?" Their choice (or "vote") is sent to the robot which will then broadcast that colour. The palette was constructed by selecting sample points along the hue, saturation, and lightness dimensions of the color space to create a palette of 36 colors [6].

We modified an iRobot Roomba with 16 bright, individually controllable RGB LEDs (BlinkM 24-bit lights). The lights are mounted to shine onto the floor around the robot in a halo (Figure 1). We use the Roomba's built-in cleaning mode.

We aggregate votes received and send real-time updates to the robot, displaying the results as a pie-graph style groupings of
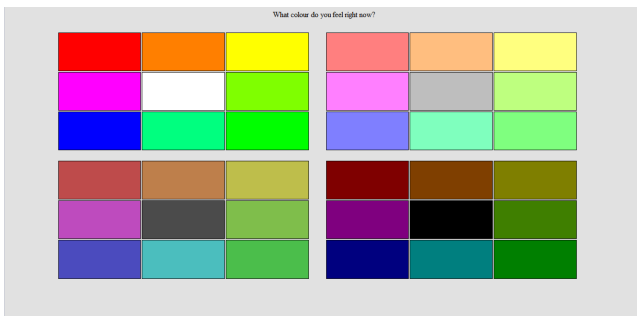

Figure 2: The web interface

color (Figure 1): we first sort votes by hue such that more votes create a larger colour region, and then calculate the saturation and lightness of the region using a weighted average over the votes in the region. While other mappings are possible, we resorted to a simple mapping in this first study.

3. EXPLORATORY STUDY DESIGN

We will perform an exploratory qualitative evaluation investigating how the robot is received by people, if anthropomorphism occurs (and how this impacts the reception), as well as how the social group is affected overall. The procedure is open ended: we will inform people of the robot's purpose, abilities, and its web interface with signs we will post throughout the room., We will passively solicit through these same signs for answers to an open-ended questionnaire about their impressions of our ambient robot display. In addition, through the web-interface tracking, we will analyze repeat usage patterns, both within a day and between multiple days, and the experimenters will take field notes of observations.

One expectation we have is that the robot will be anthropomorphized, and thus perhaps the colours will be interpreted as messages from, or emotions of the robot itself. At

the same time, people will know that the information was reported by the group, which may change their interpretation. So we are curious to investigate how these robotic anthropomorphism and group communication aspects of the interface relate.

We also expect to see the robot affecting the social space. For example, if people perceive the colours as emotions, will the display affect abstract notions of the current *mood* of the environment? More specifically, what would happen if the robot shows many colours in the red spectrum and a person is not feeling "red"? They may choose to leave the environment early, or maybe they would leave feeling more "red". It may even make the user act more "red" to others in the space. The anthropomorphized robot's perceived emotions might evoke an empathic response, which may change how people perceive the physical space.

Another angle we will investigate is the sending and broadcasting of mood as a form of social media: people may use the robot as a bulletin board for their mood. It creates an intra-group communication situation, but with the robot as the medium instead of a traditional display.

Through these efforts we hope to gain insight into how ambient-display robots may be used in a social setting, and develop further targeted questions for continued investigation.

4. CONCLUSION

In this paper we present our initial exploration of *ambient display robotics*. We will investigate how such robots will be received and interpreted, how the ambient-display information may be anthropomorphized, and how such robots may impact environments they occupy.

We believe that a better understanding of how people interact with ambient-display robots will help in designing *group-robot interaction* that can enrich the way people interact with each other and their environments, and can enable people to actively shape their environments in new ways.

5. REFERENCES

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