Position paper: the development of robot specific behavior for tour guide robots

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1 The FROG-project

The EU FP7 project FROG (Fun Robotic Outdoor Guide) proposes to develop a guide robot with a convincing personality and behaviors that will engage tourists in a fun exploration of outdoor attractions. The project work encompasses innovation in the areas of vision-based detection, robot design, navigation, human-robot interaction, affective computing, intelligent agent architecture and dependable autonomous outdoor robot operation. This paper focusses on the design of the behaviors of the FROG-robot. FROG's behaviors will be designed based on the findings of a combination of an iterative and user-centered design approach, social behavioral studies and exploratory field studies on human-robot interaction. The intelligent agent architecture is a platform that will allow the integration of low-level guidance and communication controls with high-level interaction generation including affective computing algorithms and contextual recognition. This approach will lead to the creation of a new generation of highly sophisticated autonomous outdoor robotic guide services.

Keywords: Tour guide robot, User-centered design, anthropomorphism, specific robot behavior, design.

2 Effective robot specific behavior

More and more robots become available for public and private spaces. About these robots Fong et al. state: "it (*the robot*) must establish appropriate social expectations, it must regulate social interaction (using dialogue and action), and it must follow social convention and norms" [1]. Most behavior of robots is copied from humans (anthropomorphism), or animals (zoomorphism), because people tend to understand human- and animal-like cues best. However, are human- or animal-like communication cues and behavior the only possible behaviors for robots that people understand?

2.1 Presumption

Robots are built to help people with various tasks; therefore, robots should be designed to be able to perform these tasks. Even though current robots often have anthropomorphic features or have a human-like appearance, for the purposes of the task

adfa, p. 1, 2011.

the robot needs to perform (fetch, carry, clean etc.) a human-like shape may not be necessary. For instance, the design of a robot that has to swim will more likely resemble a fish rather than a person. Robot bodies should be designed in a way that is optimal for the task at hand. We argue that this also holds for the design of robot behavior. Designers should not just copy human behavior and communication cues one-on-one to robots. Instead, they need to identify robot specific communication cues people will understand intuitively and experience as natural.

2.2 User-centered design approach

We adopted a user-centered design approaches taken from Industrial/Product Design. We would like to incorporate these methods more in the field of human-robot interaction (HRI) as the first author has a product/interaction design background. In user-centered design approaches, designers develop products to effectively perform a function while continuously keeping the user (and their needs and requirements) in mind during all phases of design. With a user-centered design approach, we can design the robot for people, but not by definition as a person. Most important is that the robot will support a person in an effective and intuitive way with a task or a series of tasks.

2.3 Anthropomorphism

The first computers were not designed to resemble humans. Nevertheless many people tended to treat the computer as a social actor; they projected human social behavior norms to a computer [2]. This is even more the case with robots, now robots enter everyday social environments. People tend to anthropomorphize objects or robots they see. They tend to assign human-like attributes to objects/robots so they can apply mental models they have already learned [3].

2.4 How to design specific robot behavior

It is important that a robot’s behavior, personality and appearance match [3]. The robot can have the perfect nice and gentle behavior, but if the shell of the robot looks aggressive, many people would judge from the shell that the robot will not be nice to interact with in the first place. For the design of the robot behavior, we argue that iterative design and continuous user testing will help find the best solutions. Anthropomorphic form or behavioral patterns can be a starting point in designing robot behaviors. However, we argue that the (intended) effects and outcomes of the human behavior should be studied and robot behavior should be designed to evoke the same communication goals.

In the next section, we describe how we used a user-centered design approach and iterative, explorative sessions to analyze human tour guide behavior and guide robot behavior. Results from these studies lead to design guidelines for guide robot behavior, with a focus on behavior that is robot specific and intuitively understandable.

3 User-centered design in the FROG-project

3.1 Studies to effective guide behavior

For the FROG-project we started with gaining an understanding of visitors' likes and dislikes when visiting tourist sites with a participatory design approach. We found that visitors really liked the structure provided in guided tours, however, they did not like the rush of tours and long duration [4]. Also, we observed human tour guide behaviors, and we found that human tour guides use many (non-verbal) strategies to gain and keep the visitor's attention, to direct their attention and to balance the information given [5]. In these observations, we focused on the intended effects and outcomes of the guide's actions and interactions with visitors.

In May 2013, we conducted an iterative and exploratory study with a machine-like robot in a real world cultural heritage setting (the Royal Alcazar in Seville, Spain). We did not directly copy the robot behaviors from human tour guides, but we developed robot behaviors based on the intended interactional outcomes. Hence, in iterative sessions, we tested several different robot behaviors for its orientation and for its utterances. Preliminary results of this study indicate three zones of proximity: 1) visitors stand very close, almost touching the robot, 2) they stand more than three meters away, 3) they stand somewhere in between. Also, we found that gaze direction of the robot influenced where visitors looked at. Only well-designed text can direct the gaze of visitors to a point the robot did not gaze at. Finally, we found that visitors who left the robot did not necessarily influence the other people in the group.

3.2 Preliminary design guidelines for guide robot behavior

Previous mentioned studies formed the basis for developing design guidelines for guide robot behavior. Note that the robot will differ from human tour guides: it will give short tours, based on the interests of the visitors. Also, it will only guide in some places of the tourist site, so visitors still get a chance to explore the site on their own as well. In addition, the robot can carry devices that a human tour guide will not carry, such as a projector or a screen. These devices can make the robot tour more lively and interesting; also, it forces the design of the robot to differ from the human body.

From the results of the participatory design study and the iterative exploratory study, we deduced design guidelines for the robot behavior that resemble human tour guide behavior. First, the robot should use some specific strategies human tour guides uses. For example, give curiosities to capture and keep the visitors' attention. Second, the perceived gaze direction of the robot can steer the visitors' gaze direction. If the point of interest is somewhere else than the robot seems to gaze to, the robot should give sufficient information in text about where to look.

On the other hand, visitors tend to show interest in the robot only (not in its guiding function), which is very different from their reaction to human tour guides. Therefore, some guidelines are very different from human tour guide behavior. First, as long as visitors pay attention to the story, the robot should go on giving information. However, when people only show interest in the robot itself, the robot should display that it is aware of these visitors. Then after a while, the robot can try to bend this more playful interaction into a guide-visitors interaction. Second, the robot does not only catch the attention of people that are standing close, also visitors who stay at a distance show interest. Therefore, the robotic tour guide should scan the surroundings occasionally. It should continue the tour when it detects visitors, who probably stand further away, but show an orientation towards the robot and stay there during the whole story. Reacting to these visitors becomes important if a visitor close by loses interest and walks away. In that case, the robot should not stop or interrupt the story and keep focused on the visitor that left, but instead the robot should focus on visitors that still show interest. If the robot does not show interest in these visitors anymore, they are likely to lose their interest in the robot as well. Last, the robot should not solely rely on its detection of visitors by gaze (cameras directed to the front-side) to continue or stop the explanations because in some situations visitors tend to stand next to or behind the robot, while they still show interest in the story of the robot.

4 Conclusion and future work; a tour guide robot in the field

Observations of human tour guides and iterative design of robot behavior show that robot behavior can partly be copied from human behavior; however, as people tend to react to the robot itself, the robot should show some specifically designed robot behavior as well. In this paper, we gave some preliminary guidelines for robot tour guide behavior. In near future, we will analyze all video material of the exploratory field study. We will use a specially developed “HRI analysis tool” that helps to speed up and standardize the analysis of large HRI datasets; however, the development of the HRI analysis tool is still ongoing work. The results finally will lead to a set of design guidelines for tour guide robots.

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