"The Superhero of the University"

Experience-Driven Design and Field Study of the University Guidance Robot

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ABSTRACT

Robots have recently gained popularity in customer service. Especially social robots are nowadays utilized in healthcare, elderly homes and schools. Although it is crucial to design social robots according to well-defined user experience goals, research related to experience-driven design of social robots is still scarce. Experience-Driven Design (EDD) is a framework to design interaction for technology based on certain goals, known as experience goals. In this paper, we present the design and evaluation of the university guidance robot based on the user experience goals defined in previous research. The experience goals are nurture, fellowship and recreation. We designed applications, interaction, and robot's behavior to support the fulfillment of the experience goals. The social robot Pepper served as a platform for the university guidance robot. The evaluation was conducted as a field study in a university campus with 32 university students during the orientation week. According to our findings, the university guide robot successfully evoked nurture, fellowship and recreation among participants.

CCS CONCEPTS

• Human-centered computing ~ Human computer interaction (HCI) • Human-centered computing ~ Interaction paradigms • Computer systems organization-Robotics • Applied computing ~ Command and control

KEYWORDS

Social robots, experience-driven design, user experience

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1 Introduction

Social robots are gaining popularity as service robots in this modern era. The acceptance of social robots in public spaces is sometimes higher than traditional methods such as maps and digital displays [21]. A well designed screen would only provide certain information without engaging the user in an interactive manner. Social robots, on the other hand, have the potential to evoke a variety of experiences with speech and gestures while serving as an information provider.

Social robots, like any other interactive technology, should aim to evoke positive experiences among their users [13, [27] Experience-Driven Design (EDD) is an approach to determine a specific experience one aims to communicate for the user by technology [27]. Such experiences are known as experience goals. Although there have been studies where social robots serve as teachers [17], museum or airport guides [12], exercise coaches [10] etc., not many have explored the target experiences they want to achieve, or designed interaction based on explicit experience goals. In fact, Alenljung et al. [2] mention that determining the experience goals enhance the interaction quality of human robot interaction. However, they state that specification of experience goals is often left out in HRI due to lack of time or knowledge [2]. Thus, in this study, we aimed to design a university guide robot based on pre-determined experience goals [8, [20] and evaluate the design with authentic users in a field study setting.

During the university's orientation week in the beginning of the academic year, new students arrive from different countries across the world. At that phase, the students may face a new culture and study requirements, and they need to seek for a massive amount of information. This can be exhausting at times. Moreover, information retrieval can be slow due to lengthy queues in front of information desks. The university staff, on the other hand, engage themselves in the repetitive and monotonous task of providing information. Although some universities assign tutors to introduce the new students to the university and its culture, sometimes the support from the tutors might not be available at the time when it would be needed. In this situation, social robots could play a vital

role as information providers, which might ease the stressful experience for students, tutors and staff.

Therefore, we utilize social robot Pepper for university guidance to study the user experience (UX) of the university guidance robot. In our design research, we design a university guidance robot based on the experience goals [8], and evaluate the designed robot in a field study. Although the user needs in case of information retrieval technologies are purely pragmatic, hedonic aspects, such as feelings evoked from the usage, could affect the overall user experience in case of social robots. Since social robots are interactive technology, users perceive the experience based on both positive and negative feelings aroused by the robot. If the robot is fully functional, yet the users feel distrust, unsafe and anxious around the robot, they will avoid the interaction in the long run. The experience goals for the university guidance robot have been reported earlier: nurture, fellowship and, recreation [8]. On this paper, we summarize how we utilized Experience-Driven Design (EDD) to achieve those experience goals. To determine the achievement of the experience goals, we aim to answer the following two research questions:

1. How does the robot evoke fellowship, nurture and recreation during the interaction?
2. What were the other findings during human robot interaction in the context of university guide robot?

2 Related Work

2.1 Social Robots in the Context of Guidance and Learning

Social robots have been explored a lot in the context of learning and guidance [14,18, 21]. Robots have been used in hospitals [10], therapy center [28], schools [18], university [21], office environment [22], shopping malls [14] etc. for increasing pleasurable experience and increased efficiency. Although the robots cannot completely replace humans at this moment [21], they have gained good appreciation compared to other interactive services [21]. Research indicates that humans trust social robots in public spaces [14]. Robots possess persuasive qualities to gain human trust and motivate them to come back for interaction. Moreover, people tend to develop sympathy for robots in certain scenarios [19, 25]. Needybot [19] and hitchhiking robot [25] are two examples of such empathetic robots which convinced people to help them. It is suggested that robots should possess friendly, reliable, empathetic and intuitive qualities [14, 15], otherwise, human might avoid interacting with the robot. Certain non-verbal communication cues, such as eye contact, could make the interaction feel natural and human-like [12], thus increasing the perceived reliability of the robot. In addition to that, robots are proven to be efficient teaching agents [18]. Robots can teach new skills to humans in a playful manner. Such interaction has been found to be pleasurable to users and help reduce stress during learning process [17]. For example, a Pepper robot has been utilized for teaching service-center visitors about the new places in the city in a playful manner [13]. The visitors enjoyed learning about the places and interacted with other visitors to learn how much they know. Thus, social robots could also be utilized to initiate conversation among people.

Although the behavior of the robot can be designed to be playful and friendly with the participants, it should not invade anyone's personal space [12]. For example, in the context of the airport, where there are people from different culture and countries, the social robots should ask for a permission prior to initiating an interaction that might invade users' personal space. Moreover, the usage of gestures should be well thought out when designing an interaction with a social robot [6]. Burgard et al. [6] mentioned that it is necessary to design universally accepted gestures in multicultural environment to prevent negative publicity of robots. These aspects are crucial in an international environment and can positively or negatively affect human-robot interaction.

We can conclude from previous research that in order to create a positive human-robot interaction the robot should be friendly and intuitive. The information provided by the robot should be reliable and authentic to build trust among the users. Certain non-verbal gestures and eye contact can make the interaction natural. However, it should be taken into consideration that the robot does not initiate any gesture that is offensive to certain culture.

2.2 Experience-Driven Design

Experience-Driven Design (EDD) approach helps to identify certain experiences that should be considered throughout the design process [20]. The process begins with identifying specific experience for a particular technology. These experiences are deduced from users' needs and values. Designers and users cooperate to identify specific user needs related to the technology, which could then be used to establish the target experience [20][27]. These specific experience then become guiding light for the designers [27]. These experiences are known as experience goals [4]. Such design process aims to aid the designers to communicate specific experience [27]. Experience-Driven Design has not been widely utilized in the context of human-robot interaction (HRI). Nevertheless, exploring the preferred target experiences and studying how we can achieve them on design is crucial for any interactive technology. This is true especially in case social robots because it is a novel technology and people are unsure of how to interact with such agents [5]. Moreover, many people get impression of robots from sci-fi movies and they believe robots might take over or destroy human [5]. To define specific target experience, designers could refer to existing frameworks for inspiration, such as PLEX (playful experience framework) framework. PLEX defined 22 categories for playful experiences [3]. Although these aim to evoke especially playful experiences, human-social robot interaction could be designed in light of these experience goals for natural and positive experience. For example, one of experience goals mentioned in PLEX was *nurture* (*taking care of oneself or others*) [4]. Such experience could be taken into account in design, as a lot of care-taking behavior is visible on the studies about the social robots, e.g. on [28]. The participants built a social connection with the seal robot, which helped them recover faster [28]. *Fellowship* (friendship, communality, intimacy) [4] is another potentially interesting experience goal in HRI. Building an

emotional connection with the technology can convince the users to continue using the service for longer term [15]. Previous work around experience goals [1] has introduced some novel experience goals, which are not included in the PLEX model. For example, *recreation* (getting relaxed and "recharging batteries") [1], could also be utilized in the HRI context. Social robots have the capability of evoking pleasurable experience among users by performing recreational activities [13].

Based on our previous research and related work, we derived three experience goals for our university guide robot; *nurture, fellowship and recreation.* The robot should evoke *nurture* to build a social connection with the students, so that they are comfortable with the technology. In addition, we [8] found that students seek care from someone is an unfamiliar environment, for example, in a new university. The robot should play the role of care-giver in this context. The robot should also evoke *fellowship* for the participants. Moreover, the robot should help evoke fellowship among other students [8]. According to our finding [8], the new students expected someone to introduce them with other students. Finally, the robot should evoke *recreation* by some activities to "charge the batteries" of the participants. This could be achieved by playful design In order to introduce playfulness in a non-game context, gamification is implemented to increase the pleasure [11]. It usually utilizes elements used in games such as scoreboards and medals [16]. Engaging the users in a playful manner could help them forget about their hectic schedule for a while and *recharge their batteries.*

2.3 Concerns regarding the use of robots

Although social robots have been accepted widely among users, they raise certain ethical concerns. Sharkey et al. [24] expresses their concern that introduction of robots in elderly home might decrease the amount of human contact. Calo et al. [7] also raised their concern if utilization of robots for therapy cut down human interaction for elderlies. This could be true in case of university guidance robot as well. Introduction of such robot might reduce the urge for human assistance, which could be threat for the jobs of student tutors and receptionists. In fact, Chui et al. [9] mentioned that the advancement of language processing for automation might enable robots to take over human jobs in retail industries.

Our purpose of designing university guidance robot is to assist students when their tutor is unavailable and to reduce overwhelming queue in front of information desk. Therefore, while designing the university guide robot, we made sure that the robot does not conduct duties of student tutors, such as receiving the students and showing them around the university.

3 Methodology

3.1 Designing the University Guidance Robot According to the Experience Goals

Pepper robot [29] served as a university guidance in this research. Pepper is a humanoid robot with embedded microphones, sensors, camera and tablet on the chest to support versatile interaction. We chose Pepper robot for its suitability for many customer service tasks. Moreover, it has the advantage of having an integrated tablet for interacting in a noisy environment.

As reported in [8] and in the Related Work section, the target experiences for the university guidance robot were *nurture, fellowship,* and *recreation*. As mentioned earlier and in our previous studies [8], *nurture and fellowship* should be evoked from human to robot and robot to human. To achieve these experience goals, we deduced the following design implications:

1. The university guide robot should communicate authentic information to the students via natural interaction to gain their trust and evoke *nurture and fellowship***.** Robots should not use any complicated technical terms or any inappropriate gesture that might intimidate the user. It should also consider what gestures are appropriate in a certain context.
2. The guide robot should be able to provide as much information about the university as possible to help or *nurture* the students in crisis. As robots have more memory than human, it is expected that it should know everything regarding the university. If there is something it does not have information about, it should be able to refer to appropriate person or place where the information is available. Furthermore, the information provided by the robot should be genuine and up to date, so that the users can trust the robot.
3. The guide robot should also be a mediator for students to evoke *fellowship* towards other students. Robots should try to introduce classmates to each other and help them get along. If a student finds himself or herself lonely in the university, the robot should try to introduce him or her to new people. In this way, the amount of communication of that particular student with other students will not decrease. Furthermore, the student will not be solely dependent on the robot for information retrieval after the orientation week.
4. The guide robot should behave as naturally as possible for smooth human-robot interaction and to evoke *fellowship* towards the robot. Since the university orientation week is very hectic, it is better to approach human in a friendly manner to reduce their anxiety. Robots are emerging technology and they are not as common as electronic gadgets like mobile phone. Thus, people are often confused how to approach a robot in a new multicultural environment. Thus, it is recommended that the robot communicates with the users in a human like manner, rather than machine like manner.
5. The guide robot should interact in a pleasurable or enjoyable manner with the students in stressful situations to evoke *recreational/relaxing experience.* Just as human guides, robots should also try to help students by providing pleasurable experience.
6. The robot should also entertain the students for *recreation*. This could be done in a playful manner to keep the users engaged for a while. This will help them

to release their stress and forget about hectic schedule for a moment.

7. The robot should evoke *nurture towards itself* by showing that it needs care via nonverbal cues.

Based on the derived design implications, we implemented seven applications for the university guidance robot (Figure 1): Show me the way, Restaurant services, Events and places to visit, Find a friend, Fun and entertainment (Language quiz and Sing and Dance), Random contacts, and Freshman's quiz. The language of applications was English.

The purpose of the *Show me the way, Restaurant services, Random contacts* and *Events and places to visit* applications is to provide information about the university for the students. The objective of the *Show me the way* is to provide directions to the students. The guide robot displays a digital map on its tablet with directions for each university building. *Restaurant services* provides participants with food menu and location of all restaurants in the university. *Events and places to visit* provides

Figure 1: Landing page of the University Guide Application

information to the students about the ongoing events and interesting places to visit in the city. The robot expressed its *nurturing* characteristics by providing necessary information they would get from information desk or their tutor. The robot explained each information verbally to the users and offered more help if required. Furthermore, the robot tried to express nurture via non-verbal gestures. For example, the robot would explain a certain information by bringing both its hand on the back and nodding gently. Afterwards, the robot would open both his arms and bring it to the front and offer more help with a bow.

To ease the information processing for the students the guide robot offers the *Freshman Quiz (*Figure 2: Example of a quiz question from the freshman quiz*).* This application aims to achieve *recreational* experience goal as well as provide basic information about the university in a playful manner. Our aim was to create a meaningful game that might be useful as well as enjoyable for the users. The guide robot offers a quiz containing 8 questions with 3 choices. These questions are basic information about the university. After the participant made their choice, the guide robot reveals the correct answer. All the questions and options are displayed on tablet. Due to noisy environment, the interaction is confined within tablet. However, the robot verbally appraises the students for answering correctly. We added gamification elements like scores and rewards. After answering all questions, the robot revealed the final score. As reward, the robot would perform different gesture upon achieving certain score. Nevertheless, the robot never gave any negative feedback for users' performance. In addition to that, we designed a *language quiz (*Figure 3:- Example of a quiz question from the language quiz*,* which is a sub section of *Fun and Entertainment*. The purpose of this quiz was to teach few important Finnish words to the international students in a *recreational manner*. The set up was similar to *Freshman Quiz*, where the guide robot shows the English word for the students and provides 3 Finnish word as options. The university guide had *Sing and Dance* application as a sub section. *Fun and Entertainment.* The robot sang and danced with the participants as *recreation*. This activity would also encourage participants to dance with the robot for a short enjoyable experience in the university premise. To evoke *fellowship towards itself,* the guide robot kept a friendly tone during the interaction and often asked the participants to shake hand or fist bump with it. This characteristics will also evoke *nurture towards the robot*, as the robots asked for attention. To evoke *fellowship towards other participants*, the robot also introduced students with people it already met in the university via *Find a friend* application. The purpose of this application is to show a list of students the robot met in the university, displaying a short bio of them. If the student is willing to communicate with anyone from the list, the robot exchanges contact information with him/her. The robot also requests the participants for provide their information if they wish to make more friends. All the contact information are kept confidential and the name of the participants were not revealed.

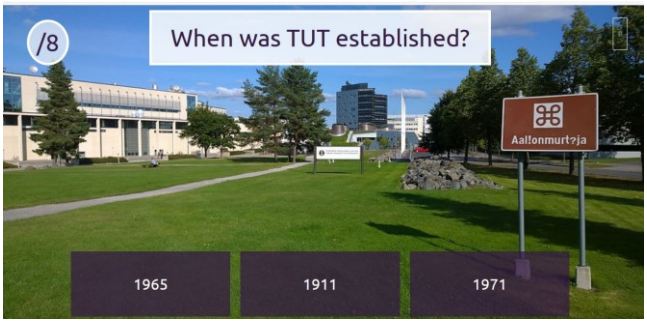

Figure 2: Example of a quiz question from the freshman quiz

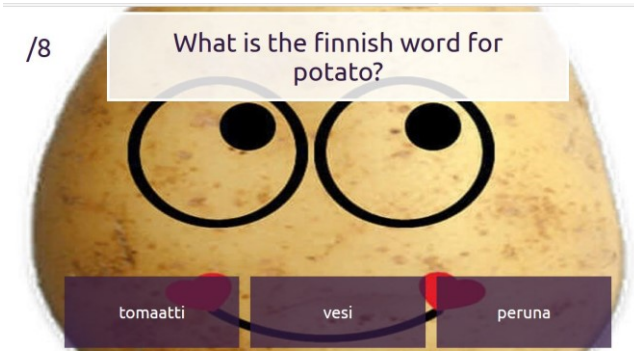

Figure 3:- Example of a quiz question from the language quiz

3.2 Programming the robot

The main platform to program the university guide robot was Choregraphe (Figure 4: Example of the programming platform, Choregraphe.), which was developed by Softbank Robotics [29]. We also used HTML, CSS and Javascript to program for the tablet, which was integrated with the help of Choregraphe.

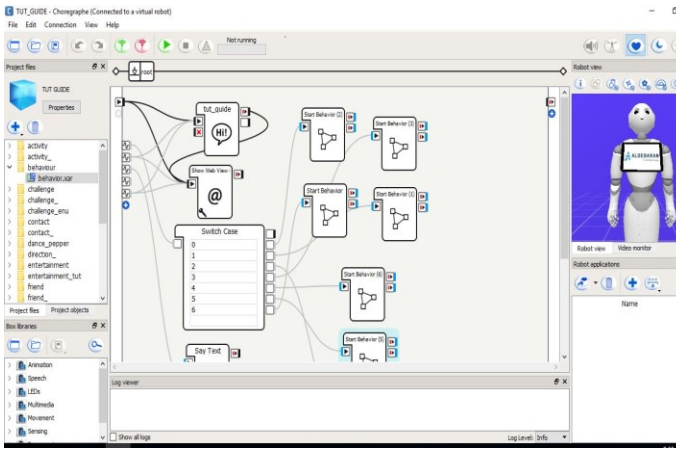

Figure 4: Example of the programming platform, Choregraphe.

3.3 Study Design

We conducted our qualitative research study at the university lobby (Figure 5: We conducted our study in the university lobby, where the new students could interact with the guidance robot) in August 2018 by utilizing interview and observation as qualitative data collection methods during the orientation week in the beginning of the academic year. Newly admitted students come to the university on this week to attend practical sessions and complete registration related tasks. The university robot guide was located near the information desk of the lobby. The purpose of choosing such location was to invite students who were waiting in front of information desk to seek help to interact with the robot. Students who agreed to interact with the robot were asked to sign a consent form. We clarified that there will be no identification information about them and the data will be stored for two years. Moreover, we asked for permission to publish the anonymized data to conference or journal articles. We collected some background data like age, gender and nationality. We then asked the participant to try out the applications on Pepper. During the interaction, the communication language was English. While the participants interacted with the robot, we encouraged them to think aloud and asked some follow up questions about the application on the robot, the interaction and the expectations about the robot. We also asked them to think about what role the robot was playing during the interaction. Meanwhile, we observed the participants' facial expressions, body language, tone and modality of interaction, and other aspects related to the interaction.

We conducted a 10-12 minutes long interview after each participant's interaction with the robot. The interview questions

Figure 5: We conducted our study in the university lobby, where the new students could interact with the guidance robot

were mostly about the experience with the robot, the role of the robot, preferred method of interaction, emotions evoked while interacting with the robot. We asked few follow up questions based on participants' answers.

3.3 Participants

33 voluntary students participated the study. The participants were 23 to 27 years old; 18 were male and 15 were female. The participants were exchange and degree students from Morocco, China, Finland, Spain, Italy, Mexico, Tunisia, Chile and Iraq. None of the participants interacted with social robots before. Only one participant was studying Robotics and AI and 2 participants study Automation at the university. The other participants had no previous background in robotics. All 33 participants agreed to take part in the interview.

3.4 Data Analysis

Observation and interview data was analyzed with the qualitative content analysis method [30]. The interview data was transcribed

and then categorized under the themes and sub-themes on the spreadsheet. We pre-defined some categories before going through the data, for example, *age, gender, nationality, nurturing behaviour, being nurtured by the robot, friendliness towards robots, friendliness towards other participants, enjoyment.*

First, we went through the interview data to identify cues about the evoked experience during interaction. We initially categorized the data under the pre-defined themes. Few new themes, for example, *control, robots' recognition, artificial intelligent, adaptive nature* etc. emerged while going through the data. After that, we then went through the observation data. We followed the prior procedure for categorization. The review of observational data led the emergence of new themes such as *peer influence and proximity*. We revised all categories and data in the spreadsheet and checked for coherence. We merged few categories with the pre made categories. The final categories were divided into three sections; background data (age, gender, nationality), experience goals achieved (*nurturing behaviour, being nurtured by the robot, friendliness towards robots, friendliness towards other participants, enjoyment.*) and other findings (*peer influence, and competition*).

4 Findings

On this section, we present the findings related to the experience goals of designed for university guide robot, and other experience users had with the robot.

4.1 Fellowship, Nurture and Recreation

As explained earlier, we designed our university guidance robot to respond to the experience goals fellowship, nurture and recreation. We determined the achievement of our goals from participants' interview and observation data. Here, we explain how we achieved the experience goals on our design.

Fellowship. Out of 33 participants, 14 people referred to the robot as a "friend" when asked to think about a role. According to the participants, it evoked *fellowship towards robot* by its nonverbal cues, gestures and tone of interaction: "*He is so nice and friendly*" (Female, 23). We also observed participants uttering words like "*buddy*" and "*pal*" whenever the robot asked them for fist bump or handshake. One group of participants interacted and danced together with Pepper. They named the robot as a "*dancing mate*" and one of them commented, "*He or she would be the center of attraction in the dance floor.*" (Male, 25). Upon asking why they though the robot had a gender, one participant said, "*I don't know, he or she feels like a person, more like a friend*." (Male, 25). While trying out *Find a friend* application, participants expressed their intention to be friends with the robot: "*He can just be friend with me instead of showing a list of people*." (Female, 28) Overall, the participants felt the robot interacted with them in a friendly manner and evoked *fellowship towards the robot*.

Find a friend application did not evidently evoke *fellowship among other students* due to few security concerns among the students. "*I am not sure if I am ready to share my personal information with someone*" (Female, 24). However, the quiz applications seemed to make students to work in pairs. Specially, when the new students performed the Freshman Quiz individually, senior students approached them and tried to give hints. This behavior initiated a short conversation among students. Many participants met students from the same department or major: "*Not only the robot provided information about the university; I got to know my future classmates.*" (Male, 19) At times, random people formed groups and started interacting with the robot, taking quiz and comparing each other's score. One of the student tutors, mentioned that: "*My tutees are getting along well with the robot and other students. Looks like the robot will take over my job soon* [laughs]." (Male, 29).

Nurture. 10 participants referred to the robot as a "guide" when asked to think about a role for the robot. Upon asking for reason, participants expressed their feeling of being *nurtured* by a guide or a tutor: said "*The robot is just like my tutor taking care of the things I should know.*" (Female, 23) Tutors usually take of new students to adapt to the new environment. Pepper occasionally offered to hug the participants. The participants felt warmth and comfort while hugging the robot and expressed sense of being loved or taken care of: "*I think he likes me."* (Female, 27).

The participants were often seen to express their concern about the robot. They constantly checked if the robot was doing okay. One of them commented upon encountering an error state: "*I think I broke him. Please fix him*." (Female, 23) Few participants also expressed their concern during the interaction: "*He must be tired after all the dancing.*" (Male, 23). Participants assigning him or her gender during the interaction proved that they perceived it as human-like. One participant commented *"I think he is a child, short and sweet.*" (Female, 23) Another mentioned that *"I think he is amazing. I said "he" because, he was almost human."* (Male, 28).

Recreation. The robot also sang and dance for the participants, which seemed to cheer up their mood. Participants were trying to copy the robot and danced along it. They seemed to forget about the hectic day while dancing with the robot: *"I actually have a session starting in 5 minutes, but I would like to dance with him more.*" (Male, 21). *"Wow! I forgot why I actually came here for."* (Female, 25). Overall, the participants felt the experience with the robot was pleasurable, enjoyable and entertaining, thus satisfying our third experience goal, *recreation.*

4.2 Other Findings on Guidance Robot

Apart from the experience goals, we observed additional aspects on the interaction with the university guidance robot. We report few aspects below:

Peer influence was an interesting aspect observed during the field study. Mostly participants would prefer to interact with the robot in groups rather than interacting alone. The participants were hesitant to interact with a novel technology alone. "*It is always better to interact with friends; they can save me when I make any mistake*." (Female, 23) Another participant said, "*The more people the better, I can learn from them since I am not familiar with it*." (Male, 24). In some cases, peer was the influential factor for the participants to interact with the robot: "*I would never approach the robot alone. I am doing it because my friends are interested.*" (Female, 28). We observed another interesting phenomenon, where

the students ignored the robot when alone; however, they started approaching the robot when someone else or a group started to interact with the robot. They were curious to know why the robot was there, what was it doing and wanted to be a part of it.

Competition among peer was vividly visible while taking the language quiz. The participants who interacted in groups took the quiz in turns to see who scored the highest. They would also taunt each other to get any answer wrong: *"Now I need to take Finnish course to beat my friend, he knows more than me!"* (Male, 28); "*This quiz is motivating to learn a new language, especially when your friend scores more than you.*" (Male, 24). Some students were also expecting rewards from the competition: "*It could give me a cool badge or a stamp maybe, so that I can show off to my friends*" (Female, 24). We realized such playful competition among peers could motivate students to learn a new skills or languages.

Among all participants, three participants mentioned that they did not experience any of the mentioned experiences. "*I don't want to have any feeling for the robot, it's just a machine*" (Male, 23). These participants felt that there is no need to humanize a robot as they feel it is just a machine. *"I don't like the concept when someone add emotions to robots."* (Female, 26)

5 Discussion and Limitations

5.1 Fellowship, Nurture and Recreation

We designed a university guidance robot to support the new international students arriving to the university in the beginning of the academic year. The design of the applications for the robot followed the three experience goals set for the robot, based on the previous work [4, 8, 13, 20]: *nurture, fellowship and recreation*. We conducted a qualitative field study about the user experience of the university guidance robot for new international students. According to our findings, most students were quite comfortable with the robot acting as a university guide. We were able to achieve all three experience goals for the university guide robot.

Nurture towards the robot was surprising for us. In most cases, users get annoyed if a technology encounters error. They seem to withdraw themselves from the technology and starts loosing trust. In our case, participants were sympathetic towards the robot. If the robot was not functioning properly, participants felt it was tired or sad. Researches showed that human nurture a robot if it explicitly asks. However, in our research the robot's nonverbal gestures evoked *nurture towards the robot.*

Constant eye contact and requests for hugging and handshaking made the participants believe that the robot needs attention and care, which was designed to achieve our goal, "*nurture towards the robot*". To our surprise, the participants perceived the robots' resting posture as "sad" or "tired". The robot by default attains half-bend posture at the state of rest. Participants perceived the gesture as "sad" or "tired". Whenever we would reboot the robot, the robot would reach the half bend posture. The participants would then be sympathized with the robot. This is a similar finding to Smith et al. [25]. The death of hitchhiker robot aroused sympathy among many, especially kids. In our case, the resting position of the robot seemed to be melancholic, which made the participants sympathize with the robot.

Robot's error state could affect trust and reliability of the users towards it [23]. In our case, it was opposite. The utilization of nurture could be an interesting method to handle error in human-robot interaction. Although, *nurture towards the robot* has only been utilized to provide pleasurable experience for the users and to recover from stress [28], this experience goal could also be used in designing error messages to reduce the anxiety of the users.

Fellowship towards the robot was quite evident while the participants interacted with it. However *fellowship towards other students* was not evoked by the application we designed (*Find a friend*). Participants were not willing to contact any students without prior meeting. Nevertheless, the quiz applications gathered many student around, which initiated conversation among them. Sing and dance application also served in bringing students together. Our findings support the notion by Kaipainen et al. [13] that social robots can act as ice breakers in social events. As discussed in the "Result" section, participants approached the robot when someone else was interacting. Thus, *fellowship towards others* could be utilized as a goal for the robot to serve as ice breaker in social events.

Recreation was the most interesting aspect for the participants. Participants enjoyed recreational activities with the robot, such as singing and dancing. This experience goal helped participants to recover from the stress of the orientation day. In fact, such an experience goal, in the context of HRI, could be utilized in stressful environment, such as in offices and industries. Although, Sabanovic et al. [22] have designed a break robot concept, but they did not have recreation as an experience goal. Having recreation as an experience goal can make the robotic breaks even more enjoyable.

5.2 Other Findings on Guidance Robot

Peer influence was an important aspect in human-robot interaction. It was interesting to observe how students submit to their group's willingness to interact with the robot. This finding was similar to one of the playful experience mentioned in PLEX framework, submission (being a part of a larger structure) [3]. Although, in our study, the group would stay back if one person wishes to interact with the robot, the essence is similar. Groups or individual student "were willing to submit to the will of others" [4]. This experience goal is common with novel technologies. Kanda et al. [14] reported parents would submit to their children's request of re-visiting the same mall due to the presence of a robot. It would be interesting to study how could submission be designed for long-term human-robot interaction and what would be the value of this experience goal.

As mentioned earlier, positive and healthy competition among peers would help motivate people to learn new skills. In fact, competition is an experience goal according to the PLEX framework. Robots have been serving as teaching agent recently [17] and has been proven successful. We believe designing teaching robot according to the experience goal, competition, would bring more value to the robot, motivate the students to be

involved in healthy competition and learn new skills, and increase the efficiency of the learning process. However, it would be interesting to explore if there is any positive impact when the robot competes with human.

We mentioned different scenarios and aspects in HRI, where EDD could be utilized to design interaction for the robot according the derived experience goals. EDD is a novel approach in human robot interaction by making the human-robot interaction more meaningful. This approach would help designer to concentrate on specific goals and design according to them. Social robots are interactive agents, which can evoke both positive and negative experience. Users might stop interacting with the robot if they encounter negative experience, such as *cruelty* or *suffering* [3]. Thus, the designers should carefully select their experience goals and follow them to develop a smooth and pleasurable experience.

5.3 Design Guidelines for Guidance Robot

In this section we list the design guidelines that could be deduced from the findings:

- The experience goal *nurture* could be utilized to handle error situations to empathize the users with the robot.
- University guide robot should be designed to bring other students together and let them socialize, rather than one-to-one human-robot interaction.
- University guide robot should utilize its recreational features to help users relax in stressful environment. This could also be applied in corporate settings.
- The experience goal *submission* could be utilized to keep the users engaged for long term interactions.
- University guide robot could engage students in healthy competition among each other to learn new skills. This goal could also be utilized in school environment.
- The robot should not evoke any negative experience such as *cruelty or suffering***.**

5.4 Limitations

On our field study, we intentionally restricted both the speech recognition and movements of the robot. At the moment, the robots' ability for speech recognition in noisy environment is limited. Hence we decided to minimize the speech interaction. The robot could speak to the participants and understood the words "yes" or "no". We also restricted the movement of the robot to avoid any miscommunication among the participants. The robot might walk away in the middle of conversation if eye contact was lost. To avoid such circumstances we limited the movement of the robot. Moreover, we believe that part of the participants' positive attitude towards the robot was because of the novelty of technology. Long-term utilization of social robots in university guidance context may have resulted in different findings in terms of evoked experience.

This study was based purely on qualitative data analysis. Thus, we could not present any quantifying data to measure the success or failure rate. In future, we can gather more quantitative data to validate our findings.

6 Conclusion and Future Work

This study aimed to evoke identified user experience in the context of university guidance robot. It was evident that the robot evoked positive experience among the students. Such university guide robots could be utilized by other universities as well. Furthermore, this concept could be integrated on other humanoid platforms as well. We designed our university guide robot based on three experience goals*: nurture, fellowship* and *recreation*. We also reported about other findings during the interaction with the university guide robot. Although we reported three experience goals in our study, there is potential to design HRI based on other experience goals as well. Experience-Driven Design can add value to a certain technology by guiding the designers to follow certain goals, but the goals need to be first explored on the user needs study or from the previous work.

One of our aims in future is to design interaction for industrial and collaborative robots based on EDD approach. Industrial robots often induce fear and anxiety among workers. Although industrial robots are slowly becoming collaborative, exploring the experience goals for such robots are farfetched. This approach will be beneficial for the workers in the industrial settings and will evoke a pleasurable experience among the workers. In the future, we will continue our research by conducting contextual studies about human-robot interaction, exploring various experience goals and designing interaction both for social and collaborative robots.

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