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A Study on Personalities of Actions of Service Robots on Different Industries

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Abstract

As a fast-growing topic in today's society, service robots are valued by many countries. The research direction of service robots shifts from the function level to the sensual level, which combines human-computer interaction（HCI）, human-robot Interaction（HRI）, cognitive psychology, sensible engineering and many other subjects. However, most of the current researches focuses on robots and human, but ignores the influence of the environment, resulting in deviations between the research results and the actual industry applies. Therefore, the purpose of this study is to target consumers' perceptions of robot personality traits. We selected different robot gestures and industry categories (marketing services, family companionship, education) as variables, and explored the cognition of users to the personality traits of different robots. In order to define robots' gestures and industry categories, we investigated three common apply areas of service robots (marketing services, family companionship, education), and set up interactive situational scripts for collecting actions of real human. The questionnaire refer to the Big-five personality traits and some researches, from which the robot personality traits are described as vocabulary.The results show that robot personality traits are divided into three categories: (1) active factor, (2) help factor, (3) dominant interaction factor. Actions have the greatest impact on the "active factor", while industry categories only affect the "dominant interaction factor". In the case of different industry categories, the impaction of actions is also different.

Keywords: Service robot, personality traits, robot action, industry category

Introduction

Objective

The purpose of this paper is to find out the different emotional needs of robot design for different industry categories.

Research Question

This paper studied human cognition of personality traits of service robots. And discussed the impaction of different robot actions on different industry categories.

Theoretical Framework

Theoretical Framework is shown as Figure 1.

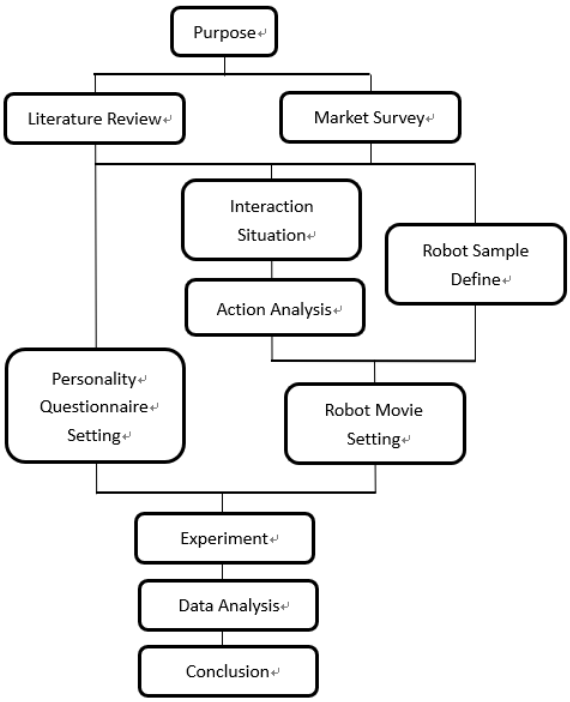

Figure 1. Research Flow Chart

Literature Review

International Federation of Robotics(IFR) defined the service robot as A semi-autonomous or fully autonomous robot that can perform types of services that benefit humans, but does not include equipment that is engaged in production.

As the world's countries begin to experience a decline in birth rates and the gradual formation of an aging society in developed countries, the structure of the labor force has begun to change, which has led to changes in various social patterns and consumer demands. This provides a space and market for service robots. Service robots have developed rapidly in recent years. By the end of 2017, sales of service robots will reach $5.2 billion, and sales in the 2018-2020 are expected to reach $27 billion.

With the development of technology, robots are becoming more and more like a real character, and they begin to enter human society and engage in social activities. Such as to help disabled people, the elderly, or to use in public exhibitions such as museum exhibitions, shopping centers, even in educational fields or scientific research(McGinn et al., 2017; Kanda et al., 2009).

Due to the different needs of different roles in various industries, the design of robots should not only reflect the functionality of the products, but also reflect the perceptual factors of human characters to show the social behavior of human society(Nass et al., 1994). This makes it especially important to reduce the chilly mechanical sense and increase the warm feeling in the robot designs.

Earlier in the Human-Computer Interaction(HCI) field, Reeves & Nass (1996) found that people unconsciously showed their attitude towards real people because of the social interactivity of the computer. This view is also known as Computer as Social Actors (CASA). CASA has also been widely recognized by scholars in the field of HRI. Researchers have found that when people interact with robots, such as talking or singing, it is easier for people to regard it as a living, socially individual. Even for sweeping robots(low-level robots) people will add a description of their sociality(Hendriks et al.,

2011). This shows that people who treat robots also show behaviors and reactions that interact with real people(Kim et al., 2013; Lee et al., 2006).

People's attitudes and preferences for robots are affected by many factors. After the Uncanny Valley proposed by Mori (1970), the robotic shape was subdivided, and some scholars pointed out that the cartoon version of the humanoid robot is the most popular. As for sound, the sound of the robot should match the shape, otherwise it will cause discomfort(Walters et al., 2008). Besides, non-verbal communication of robots, such as movements and gestures, is also a key factor in the development of robots(Tojo et al., 2000). The study by Chidambaram et al. (2012) even pointed out that for Human-Robot communication, the simple non-verbal communication method is better than the simple language communication method. This means that non-verbal communication also has irreplaceable importance in the process of human and robotic penetration. At the functional level, the duration of the action may even affect the user's interpretation of the meaning of the action. It will also significantly improve the success rate of human-computer collaboration tasks(Lohse et al., 2014). On the perceptual level, the smoothness of the action will also cause different psychological feelings for the user(Riek.,2010). Kim et al. (2008) also found that the range, frequency and speed of robot motion caused differences in personality traits. This shows that the action is very important in the design of the robot.

From the user's point of view, there are many measurements of perceptual factors. In recent years, the judgment of robot personality traits has emerged as a new topic, because robots with different personality traits can better distinguish and play different characters in different environments.

The study of robot personality traits refers to psychological theory. Raymond Bernard Cattell first applied the factor analysis method to study personality and proposed the famous Castel 16 personality factors(Cattell, 1946). Then Costa and other scholars combined the theory of The Sixteen Personality Factors of Cartels to define the dimensions of five personality traits from a broader perspective. This is the famous Big Five personality traits.

For robots, Hendriks et al. (2011) believe that when humans give different traits to robots, the robots will exhibit different behaviors, and these behaviors are accepted by the user, then the user will have a social impression of the robot. This impression is the user's judgment on the personality trait of the robot. In recent years, scholars have studied the personality traits of robots with reference to psychological theory. The four dimensions of the MBTI personality test are used in the study to measure the personality traits of robots(Kim et al. ,2008). At the same time, Tapus et al. (2008) studied the model of human personality traits proposed by Eysenck (1991)(Figure 2), and applied it to robot research to discuss the personality traits of robots. It is worthwhile that the personality traits in the model used are composed of vocabulary in two directions. This shows that there is a two-way correspondence between personality traits.

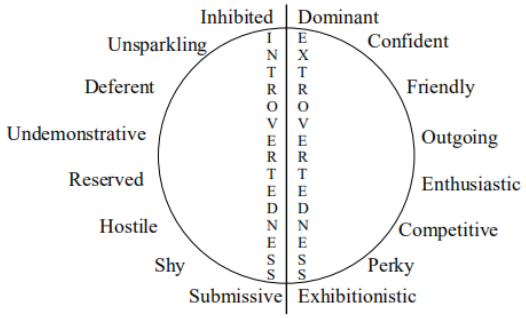

Figure 2. Mode of Eysenck Personality Traits

Then, Hwang et al. (2013) refers to the five personality theories, and selected the adjectives of 13 personality traits, and uses these words to test the differences in personality traits caused by the shapes of the robot. This is an important way for humans to study the judgment of robot personality traits.

In addition, in the context of real Human-Computer Interaction, the motivation of interactive behavior, the environment in which interaction occurs, the social background and cultural will also cause changes in users' psychological emotions(Geven et al., 2009).This is also the point of Situated Cognition Theoty. The situation will also shape and influence the user's experience, and the user experience will also affect the user's feelings and decisions. Therefore, research must consider the relationship between the user and the environment(Obrist et al., 2010). Forlizzi & DiSalvo (2006) pointed that when considering the family as an ecological environment, the design of the robot needs to consider the influence of people, products, and activities in the environment. This also means that different environments require different traits of the robot.

Methodology

Interactive Situation and Dialogue Script Creation

This study focuses on real robot application scenarios. To this end, we collects data and establishes interactive situations through literature, internet, field surveys, etc.. According to the results of the situation investigation and through expert discussion, it is found that the current service robots are mainly used in the three services of business service, family companion and education. The structure of its overall dialogue process can be divided into four phases(Figure 3). Among them, the "explanation" is the main task of the robot, because the "explanation" behavior is one of the most common behaviors in human-computer interaction. It is also the most important part of human-computer information communication. It is the stage with the greatest information exchanges. In the process is often accompanied by a lot of non-verbal communication behavior to help accomplish this task.

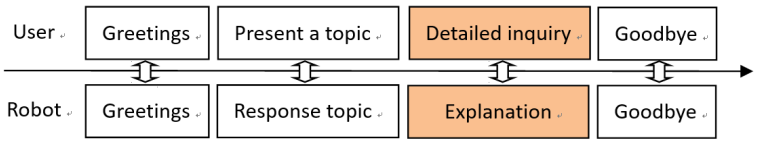

Figure 3. Dialogue Process Framework

After that, we integrated into a dialogue script according to the dialogue process framework, and finally created the dialogue scripts of three different industries through expert discussion. In the script of the service of business service, the robot acts as a salesperson and the user plays the consumer. Consumer wants to buy a refrigerator, the robot introduces the refrigerator information, including the functions and features of the refrigerator. In the dialogue script of the family companion robot, the robot plays the role of a family care worker, and the user plays the role of an elderly person. The robot needs to introduce the detailed menu of the dinner and the its benefit. In the education robot dialogue script, the robot plays the role of the teacher, the user plays the role of the student. The robot needs to explain the concept of "golden segmentation".

Questionnaire Establishment

We used the Big Five Personality Traits as reference and expands on the basis of 13 robot personality traits proposed by Hwang et al. (2013). We refer to various literatures, and used the method of Semantic Difference to carry out two-way pairing of vocabulary, and 67 pair of adjectives related to personality traits are preliminarily selected. Through

the discussion of experts, the vocabulary with high similarity is merged, and 20 pairs of two-way robot personality trait adjectives are finally summarized(Figure 4) . Finally, they are used to construct the questionnaire.

1 extroverted-introverted	11 emotionally stable- emotionally unstable
2 confident-unconfident	12 compatible-incompatible
3 friendly-hostile	13 professional-amateur
4 happy-frustrated	14 proactive-passive
5 useful-useless	15 passionate-frosty
6 intelligent-ignorant	16 decisive-hesitant
7 imaginative-unimaginative	17 independent-dependent
8 flexible-dull	18 strong-weak
9 social-lonely	19 rational-sensual
10 hard working-lazy	20 fashion-tradition

Figure 4. Adjective Words

Action Observation

Therefore, this study is based on the dialogue scripts of three different industries, selected the target group for sampling observation and record the process through the photographic device. The observed person is asked for playing the role of the service provider in the situation(salesperson, family care worker, teacher). The observer is responsible for playing the role of the user in three different industries(consumer, elder people, student). A total of 22 observed person were selected for the observation experiment(4 experts from each industries and 10 people from the general public)(Figure 5).

Figure 5. Action Obersavation Video Screenshots

Action Analysis

At present, the robot's action mode is mainly the movement of the head, body and gestures(Breazeal et al., 2005;Chidambaram et al., 2012). Among them, the changes in head and body movements are smaller than gestures. Scholars have different research on

gestures according to different classification criteria(Krauss et al.,2000; Huang & Mutlu., 2013; Nehaniv et al. ,2005; Kim et al., 2007).

This study combines the former research, and through the analysis of video recording, we can find that the actions are mainly divided into two categories. The first category appears once at a specific information point and is accompanied by information transfer functions. Their purpose is to better explain the content of the conversation. For example, "Large fruit and vegetable room", "Level 1 standard", "cut into pieces", "3-4 blocks", "Longer part". We define them as "actions with information transfer function ". While the second type of action does not have a specific point in conversation, and it continues to appear during the dialogue. It is only an auxiliary action in the interaction, and we define it as an "auxiliary action", such as "intermittent nod" and "beat gesture".

Robot Video Setting

Brule et al. (2014) pointed out that in recent years, the research method of establishing robot animation using real robot as a model is called Video-HRI or VHRI. Bartneck et al. (2004) pointed out that in robot-related experiments, virtual screen simulation is easier to control than physical prototypes, with greater flexibility. We selected the robot "Pepper" as our sample. The dialogue script is used to synthesize the robot sound through the TTS system and add the sound to the video. And built robot videos of three different industry categories(Figure 6). Videos of each industry category contains three different action categories, (1)none action;(2)only actions with information transfer function;(3) actions with information transfer function and auxiliary actions. A total of 9 videos were used in experiment.

Figure 6. Robot Video Screenshots

Experiment and Subjects

The experiment run in a laboratory, which uses a screen TV for video playback. The subjects played a user role in the interaction. After watching each video, the subjects evaluated the personality traits of the robot in the video and answer the questionnaire, then start the next video. A total of 34 questionnaires were received in this experiment, 5 invalid questionnaires were excluded, and 29 valid questionnaires were included. Including 13 males and 16 females, for subsequent data analysis.

Findings

Action Classification

The results show that during the "Explanation" process, there are 2 types of actions. One type of action includes information transfer functions, which only appear in specific information points in the dialogue, and its action functions are supplements of language descriptions. These actions are usually different for different kinds of information, but most people use the same action when expressing the same information. Such actions are roughly included "metaphors", "instructions", "simulations", etc. This is similar to the classification of actions by scholars such as Krauss et al. (2000), Nehaniv et al. (2005), and Kim et al. (2007). The other type does not have the information transfer function, which continues to appear during the dialogue process, has no specific location, and does

not express any advisory meaning. We also found that in addition to "beat gesture", " intermittent nod" is also a common auxiliary action in the interaction process.

Personality Vocabulary Classification

The results show that personality trait adjectives are divided into three new factors. F1 "active factor(active-negative)" includes 8 pairs of adjectives. They mainly describe the extent to which robots are lively and open. F1 is similar to the "openness" and "extroversion" of personality theory. F2 "usage factor(useful-useless)" includes 5 pairs of adjectives. They mainly describe whether the trints of the robot are beneficial to the user during the interaction process. F2 is similar to "Agreeableness" and "Conscientiousness". These factors will affect the user's benefit in the interaction process. F3 "leading factor(leading-auxiliary)" includes 3 pairs of adjectives. Although this type of vocabulary is somewhat similar to "extroversion" of Big Five personality traits, it is more about describing the dominant strengths (levels of status) of the two sides of the interaction, and which party is leading and controlling the process of interaction. This is because that in the interaction, the robot has the job and role, its personality traits will be affected by human impression of traditional roles.

In addition, among the four items deleted, "emotionally stable- emotionally unstable" and "rational- sensual" are similar to "Neuroticism" in the Big Five personality traits. Because of the mechanical sounds synthesized by TTS used in this experiment, there is no change in tone, so emotional stability cannot be effectively judged in this experiment. While "professional-amateur" and "strong-weak" cannot be divided into a single component. Because they have strong influence on both components at the same time and the vocabulary itself covers a broader meaning. In the future it may be possible to discuss the two adjectives separately.

The Influence of Actions

The "actions" variable has the most obvious effect on the "F1 leading factor", while has less influence on the "F2 usage factor" and "F3 leading factor". This shows a certain degree of consistency with the results of the robot's movement speed and amplitude that affect the "extroversion- introversion " result in the study by Kim et al. (2008). It is also meets the understanding of people's traditional impression that the richness and increase of action will enhance the individual's liveliness and openness. In addition, the "actions" variable will have different effects on overall preference and overall acceptance. For the overall preference, the "None Action" category has the lowest preference, and the "Only the action of the information transfer function" category has the second preference, while the "Actions of information transfer function and the auxiliary action" group have the highest preference. For the overall acceptance, there is no difference between the "actions only for information transfer function" group and the "action with information transfer function and auxiliary actions". This is because the overall acceptance reflects whether the user will use the product, most of which is considered from a functional level, while the overall preference includes additional emotional factors. "Actions with information transfer function" assumes the expressive ability of the robot part. In the absence of such action, the expression of the robot is incomplete, and the user cannot admit or accept such a robot to provide the service. While "auxiliary actions" does not convey information. Adding "auxiliary actions" on the base of "actions with information transfer function" does not affect the expression of information, so it does not improve overall acceptance. However, the addition of "auxiliary actions" will increase the vibrancy of the robot to increase emotional preferences of user, so the overall preference will continue to rise.

The Influence of Industry Categories

Industry category will only cause significant differences in the F3 "leading factor". And this dominant position is more strongly affected by the traditional impression of jobs. Because teachers and the other two industries have completely different social status, students are usually led and controlled by teachers in the classroom, so education robots are more dominant. While the salesman and family health care rely on the user's ideas and purposes to provide services, so the dominant of business service robots and family accomplish robots are lower. In addition, the industry category does not cause significant differences in overall preferences and overall acceptance. This shows that users have no preference for robots of different industry categories, because different industry categories only represent different roles and functions, and can not affect the quality of service.

Conclusion

The difference in actions will affect the personality trait of the robot, which has the greatest impact on the F1 "active factor(active-negative) ". "Actions with information transfer function" will significantly increase overall acceptance without increasing overall preference. While " auxiliary actions" will significantly improve overall preference. This is because the overall preference is more emotional than the emotional level, while the overall acceptance is mainly considered at the functional level..

Industry category has an impact on the F3 "leading factor(leading-auxiliary)" of personality traits. This is because industry categories represent professional images, and different occupations have different dominant level in the interaction process, and people's traditional impressions of specific occupations will influence the judgment of robot personality traits.

Discussion

Limitations

First limitation is the range of subjects. In this study, research is conducted in different industry categories, and in the current market situation, there are some differences in user groups for different situations. For example, family companion robots are mostly for elderly, while educational robots are mostly for young children. However, the subjects selected in this experiment need to have a good understanding of language and vocabulary, so that the judgment of personality traits can be accurate, and the experimental process can be ensured. While elderly have limitations in their ability to accept and understand technology products, and their language skills cannot be ensured. The mentality of young children is still immature for doing experiment Therefore, this study selected a group of college students who are relatively good at these levels as experimental subjects. Second limitation is the difference of areas. The requirements of robots in different markets and areas may vary, and the understanding and translation of vocabulary will be different. However, due to the limitations of research conditions and consideration of practical feasibility, Taiwan is used as an example, and Chinese is the language of robotic voice.

Recommendation

For the future researches , the dialogue content, function, and action of the robot should be more combined. Only discuss action itself is meaningless. For robot applications, the action is for a better completing of task, so it should be studied under specific tasks.

Compared with previous robot research, this study is different with others because of the combination of the factors of industry category (environment), so the research is not limited among both sides of human-computer interaction. The consideration of the

industry category (environment) is also a factor that must be added in the future of robot researches. In subsequent studies, more industry categories may be considered.

This study develops a vocabulary scale for the evaluation of robot personality traits from the five personality theories. In the future researches, user emotions can be added as another level of evaluation and the relationship between the two can be explored.

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