Minimal Design for Human-agent Communication

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Abstract

Robots have been anticipated to become both workers and partners of humans from the earliest period on their history. Thus, robots should become artificial entities that can potentially socially interact with human beings in social communities. Recent advances in technology have added various functions to robots: Development of actuators and grippers show us infinite possibilities for factory automation, and robots can now walk movements and performance very smoothly. All of these functions have been developed as solutions to robots moves and performance However, there are many remaining problems in communication between robots and humans. These unsolved problems can be clarified by adopting the idea of subtractive methods.

In this paper, we consider minimal design of the robots from the viewpoint of designing communication. By minimal design, we mean eliminating the non-essential portions and keeping only the most fundamental functions. We expect that due to the simple and clean design of minimally designed objects, humans can interact with these robots without becoming bored too quickly. Because humans have "a natural dislike for the absence of reasoning" nature, artificial entities built according to the minimal design principles have the ability to extract the human drive to relate with others. We propose a method of designing a robot that has "character" and is situated in a social context from the viewpoint of minimal design.

1. Introduction

The goal of robot research is not to manufacture mechanical humans. What we are interested in is communication between robots and humans. Communication between robots and humans cannot replace communication among people. Without using a Turing test to determine whether they are communicating with a robot or a human, humans would communicate with a robot based on the assumption that a robot is a machine. The behavior in such communication is called quasi-interpersonal behavior. People are always looking for non-human things subconsciously and it could be said that communication is an exchange of incomplete information with others. People often complement such incomplete information automatically. In designing a communication robot, it is also important to arouse such abilities in humans who communicate with robots. However, robots to date have been designed only to feature improved functions, without a strong focus on communication between robots and humans.

"Life-likeness" can also be found on television, in video games, etc. People can get a feeling of "life-likeness" from other people, even non-living objects, so describing a robot as life-like is quite feasible. However, which may be why humans and robots cannot maintain smooth communication. This problem cannot be overcome via the methodology of building robots as copies of living organisms.

A good communication robot cannot be designed by the present method of only enriching the functions of a robot. By such a method, the problem of lost "life-likeness" mentioned above is unconquerable, In order to realize interaction with people over a long period, it is also an important condition that a robot 's appearance should be attractive to humans. Norman who argued what is difficult to use in the book "The Psychology of Everyday Things," classified the elements of a design into instinctive design, behavioral design and introspective design in a recent work "Emotional Design." The ease of use referred in Norman's previous work was intended only for behavioral design. Norman claimed that balance between instinctive design in connection with appearance, and introspective design in connection with meanings of appearance, and an action-design, is important. Moreover, he claimed that not only ease of use but also the attractive features of a design, could satisfy people.

In this paper, in order to design a continuous-communication robot different to conventional robot research, we claim that subtraction design and minimal design, in which subtraction is systematically performed based on a certain intention, are important. In minimal design, not to abbreviate elements but to clarify the interface in communication, the design should be completed after distinguishing what is essential. In addition, we propose a minimal design to clarify what the interfaces in communication are, such as the type of action or a situational setup, not only abbreviation as a design.

2. Communication Design

Communication is exchanging incomplete information with others. Communication robots to date have been intended to deal with problems of how to resolve incompleteness of information. Communication is not enriched by large quantities of information, but should be designed to clarify intentions or messages that contain insufficient information. It is difficult to simulate communication, since there is so much background information necessary to realize communication and that information is uncontrollable in engineering, making it difficult to make a simulation that includes it.

2.1. Additional design

To contrast the minimal design proposed in this paper, we call the main guiding principle of robot design the "additional design" here. In the design of a conventional communication robot, transfer equipment and a structure for voice dialogs are added to a fixed-position, industrial type factory robots. Although there are robots that depend on wheels as a simple form of transfer equipment, bipedal robots have also received much research attention in recent years. Robot researchers believed that their purpose was attained by enriching the functions of the robot. However, even if the number of functions increases and each function approaches that of a living thing, in comparison with a dog or a cat which are actually alive, people will lose interest
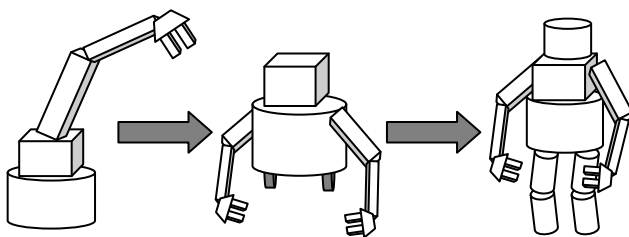
examples of design by addition

2.2. Subtractive design

A design with function curtailment will be called "subtraction design" as opposed to the methodology of function addition. As a robot designed by functional addition becomes more like a living thing that really exists, ironically the difference between the robot and the living thing becomes even clearer. Such a problem could be avoided by a design peculiar to the robot, not by copying the figure of a living thing. A clear policy is needed to determine how far a design would be reduced.

3. Benefit of Minimal Design

We discussed, design by subtraction in the preceding section. In this section, we will discuss minimal design, which is we called the directional simplification of subtraction design. In order to emphasize the main point of communication, it is better to omit non-essential design elements. Which design elements to omit are determined by goal setting. A minimally designed robot is not complete in itself. It is designed for communication with others, initiating interest in communication in a human. A minimal design targets the principle design of communication.

3.1. Designing derivative form of robots

Once the principle design elements are found, they will facilitate in designing a derivative form of a robot based on principle design. A design problem is solves by the calculation of elements, and such calculations comprise with exaggerations, omissions, and other modifications. They will help in the design of future personalized robots.

4. Expression technique

The design of a robot is considered with the design of living organisms in mind. The expression methods for living things can be a good reference for minimal design. Character designs in comics, cartoons and video games are particularly inspired by nature. We also have much to learn from the representation techniques of performing arts. For example, Noh-play, a Japanese traditional performing art has no stage props, only big drawings of a pine tree.

4.1. Expression technique in comics

The expression technique in comics provides useful information for minimal design. In comics, non-realistic descriptions, grossly exaggerated and with bold omissions are often used. Character design in

comics uses a lot of symbols and metaphors for living things, comics the characters are drawn vividly. They are expressed by character form, speech, body movements, and others in various communication channels, Characters have strong features. A communication robot must also be designed like a comic character, having strong features.

4.2. Expression technique in Noh Play

The expression technique in Japanese Noh plays also provides useful information for minimal design. Noh mask for the lead actor, which is called Onna-Men(woman's mask) wears an empty expression. The mask is not complete in itself, It takes meaning from actor's movements.

A robot with a cute face, like that of a stuffed toy, softens the user's heart as its first impression, though this feeling does not last long. Such a prepared pretty face is unusable for long-term communication design. Instead of preparing a pretty face, we suggest designing robot movement to express the robot's feelings. If the robot laughs, it will actually show it is pleased. If it takes five seconds, however, it may show an artificial smile. Feelings can be expressed by actions.
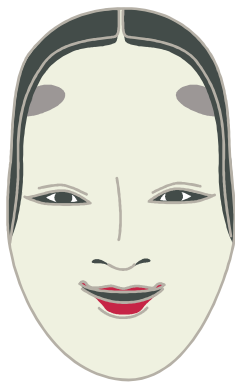
Noh mask(Onna men)

5. *in situ* Design

In minimal design, a robot is designed in accompaniment with a situation and the user's preference,; communication depends on the situation. A message can have various meanings in a given situation; non-verbal expressions also affect communication. However, even if communication is successful the first time in a controlled environment like an experimental laboratory, there is no guarantee that the second time will be successful. We expect there to be many further problems in classrooms, patients' rooms, or in homes.

A robot must be designed not to fit various environments, but to tune in to the relationship between itself and a user. In a classroom, it may be more important for a robot not to break even if it drops from a desk than to climb one flight of stairs. It would also be important that it could talk in small voice in a patients' room. A user may also wish to take a bath together with a communication robot.

Summary

Until recent times, robots were merely tools for production. Now, however people have certain expectations to robots as partners in communication, and recently many communication robots have appeared. Many of such robots are designed on the same principle as factory robots: the idea of design by addition. Also many robots have been created to imitate the figures of living things, as mechanical animals. Although such robots resemble living things differences do stand out.

In this paper, we proposed a technique called "minimal design." Minimal design is a design primarily for maintaining communication. Also, we showed the significance of designing a robot with relation to the user and the situation. In minimal design, in order to emphasize an important design element, the non-essentials are omitted.

Although a minimal-design communication robot is dissimilar to animals, it still recalls animal characteristics in some ways. Since they are not physically similar to animals, users don't expect too much. In addition, we suggested a useful way for robots to express feelings similarly to characters in comics and a Noh plays.

Minimal design does not express sharp disagreement with improvements in elemental technology of robotics. Technology can be used for making superior communication robots with minimal design way. Though minimal design, a communication robot that never causes boredom can become possible.

Acknowledgements

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