# Humor used by security guard robots to eliminate malicious nuisances*

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## I. INTRODUCTION

In today's society, robots are increasingly being used for many purposes, and the security guard robot discussed here is one of them (fig1). In order to actually use security guard robots in society, they must detect and deal appropriately with low moral behavior, just as human security guards do, but there are some customers who cannot stop low moral behavior by simple instructions or warnings, or who repeatedly engage in low moral behavior. To deal with these problems, which are difficult for even humans to do, we consider the application of humor as an approach in which robots can make a positive impression to customers, without human intervention.



Fig. 1. an example of a security guard robot

Humor is one of the main forms of interaction that creates a positive impression, and is actually used successfully by humans to control or eliminate troublesome or annoying behavior. For example, a scene in a novel also shows the effective use of humor. A loud and indignant person is quieted when another one complained in a humorous way, saying, "You are so cheerful, is something good happening?"

There have been several previous attempts to use humor in robots. Typical examples of the use of humor include robots performing standup comedy [1],[2] and comic dialogue [3]. These robots construct scenarios based on the performances of human professionals, and we have shown that the robots' imitation of these scenarios can have the same effect as humans. In addition, these robots are effective not only through one-way actions, but also by changing their actions accordingly depending on the audience's reactions. The application of humor by robots is also promising, as it has been well suggested that humor by robots can have a positive impact on interaction and task-oriented experiments [4], [5].

However, humor is very difficult for robots to use. For example, given several humorous and non-humorous dialogues in response to a low moral situation, a human being can select a dialogue that is likely to work to some extent, though not perfectly. The dialogues that should be selected here are those that are comfortable when spoken in that context, that make a good impression on the other person, and that the other person is convinced will eliminate the annoyance. But it is difficult to construct an algorithm that would recognize natural language with such complex and abstract conditions on a computer. What information would be needed to recognize that the dialogues are in context? What kind of dialogues make a good impression? In addition to understanding the context and making a good impression, the dialogues would have to satisfy additional, less explicit, conditions in order to convince the other person of them. The task of this study is to construct a mechanism that enables the selection of appropriate dialogues according to such contexts and situations.

## II. PROCEDURE

In this study, we propose that a security guard robot use humor to deal with low moral behaviors for which normal instructions is ineffective, and investigate methods for the robot to select suitable humor. A brief table summarizing the procedures of this study is provided fig.2. In order to do so, we first observed how humans use humor in talking, paying particular attention to how it is used against low moral behavior. We conducted a survey of various media such as movies, TV programs, games, cartoons, children's educational materials, and Youtube, and analyzed the common elements in each case. As a result, the following characteristics of humor were identified: it must be contextual, it must be a surprising euphemism, and it must give the listener a convincing and positive impression.

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| Procedure | Result |
|---|---|
| 1.Observation on how humor is used | Humor has 3 points as its characteristics. |
| 2.Discussion about using humor for low moral behaviors | The efficacy of humor depends on the attributes of the subject. |
| 3.Building a simulator on the security guard interview | --- |
| 4.Combining situations made by the simulator and dialogues | We get 500 combinations from 20 situations and 25 dialogues. |
| 5.Evaluation the effectiveness of the humor on each combination | --- |
| 6.Training by 3-Layer NN and evaluation | The robot can choose humor. |

Fig. 2. A brief table summarizing the procedures of this study

Next, in order for the robot to handle these properties on the computer, we limited the situation to low moral behavior for further investigation. In this study, we listed candidate dialogues for the robot to say in various scenarios of low moral behavior, and a third party evaluated whether they were humorous and effective against low moral behavior. The results showed that the effectiveness of humor varied greatly depending on the age of the target, the clothing, the number of people, the relationship between them and more conditions. This is part of "the contextual conditions" in the characteristics of humor, and such factors are easier to recognize by robots than other conditions.

To enable the robot to select appropriate humor using this situational recognition, the proposed method is to simulate the occurrence of various low moral behaviors and train a deep neural network using the dataset labeled on the simulation.

First, we build a simulator that can vary the situation on which the humor depends. Here, we used Blender to design and use humanoid models that can acquire and express age, gender, clothing, number of people, behavior, and its details as parameters to build a simulator. In addition, we designed a model of a security guard robot and textures to represent the stage setting (fig.3).



Fig. 3. An example of a simulator representing interruptive behavior by customers

Next, a data set of possible dialogues for the nuisance behavior is prepared and combined with various situations that can be obtained by the simulator. This data set includes many dialogues that the robot could say during its normal

duties as a security guard, as well as humorous dialogues that are effective against specific nuisances.

For the obtained data set, we evaluate whether the dialogues work in that situation, by labeling binary classes. In other words, the evaluator sees the situation recreated by the simulator and evaluates the dialogue, such as this dialogue is humorous for a child, or this dialogue is humorous for a couple. What we are doing here is to substitute our perception of "unexpectedness", "convincingness", and "positive impression", which are the remaining characteristics of humor. By learning from such samples, we thought that the robot would be able to choose appropriate humor for unknown situations.

Learning is performed by combining feature extraction of dialogues using BERT and a 3-layer neural network (fig.4).
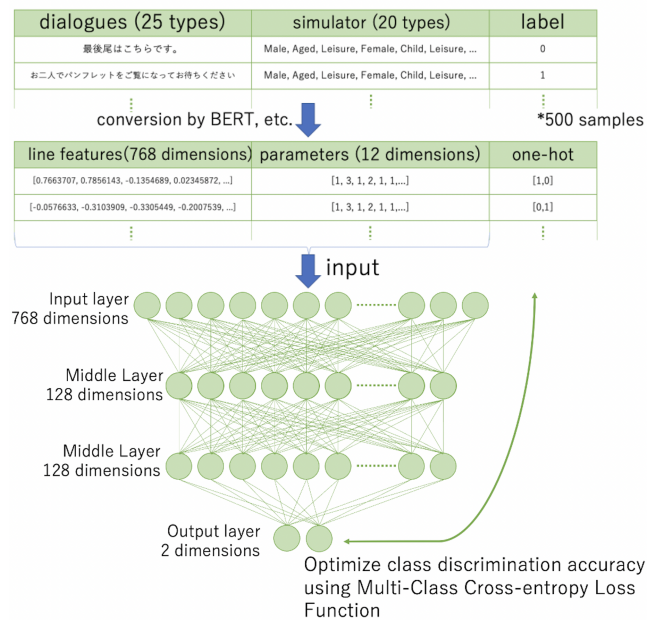


Fig. 4. Learning Machine Overview

In this study, based on interviews with security guards with practical experience, we set up the nuisance behaviors and their scenes to be reproduced on the simulator. Then, as a preliminary position, we prepared 20 unique scenes and 25 dialogues of dialogues (table.I), which do not contain identical combinations of parameters, and used each combination as a data set.

| Examples | Targets |
|---|---|
| "If you do bad things, Santa won't come!" | children |
| "Big brother, make sure you take your sister to the end of the line." | young sibling pairs |
| You and your wife, enjoy the exciting time you have lined up! | married couple |

TABLE I

EXAMPLES OF HUMOR DIALOGUES THAT WORK FOR SPECIFIC SITUATIONS

## III. RESULT

We trained and evaluated each scene using the leave-one-out method, and took the average of the results. The total of 500 samples for the true positive, false positive, false negative, and true negative rates are shown in Table II. As a result, the accuracy of class discrimination was improved to 80.0% compared to 71.6% in the untrained case, and the probability of selecting an appropriate humor for a situation was improved to 69.6% compared to 28.6% in the untrained case. This means that the robot can choose humor for various situations by learning them beforehand through the simulator, showing the potential of the robot as a means of eliminating low moral behavior.

|        |   | correct label | | |
|--------|---|-----|-----|-----|
|        |   | 0 | 1 | Sum |
| result | 0 | 317 | 60 | 377 |
|        | 1 | 83 | 40 | 123 |

TABLE II
DISCRIMINATION ACCURACY FOR 500 SAMPLES.
"EFFECTIVE HUMOR" LABEL IS 1 AND "NON-EFFECTIVE HUMOR" IS 0.

## IV. DISCUSSION

While our study show encouraging results, however, there were many instances in which the results did not discriminate as expected, and the primary reason for this is the small number of samples. The number of similar scenes and dialogues was small, and as a result, it is thought that the study was not able to learn their associations. In addition, the quality of the dialogues in this study also remains an issue, since they were evaluated by me. Therefore, in addition to expanding the data of the situation, we will work to improve the proposed method in this study by expanding the candidate dialogue data through crowdsourcing and labeling the evaluation of these data sets as a future task. When used by a third party, the accuracy of the simulator's reproduction will need to be considered and improved. When the robot will be able to select appropriate dialogue, we should study how to detect low-moral behavior, how to convey humor most effectively, and whether the robot's use of humor can be counterproductive.

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