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A Method to Reduce the Burden of the Recreation Moderator by Using a Humanoid Communication Robot

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Abstract

The authors proposed a method to reduce the burden on the recreation moderator by using a humanoid communication robot. This system projects quizzes on the screen, and humanoid communication robots read the explanations to proceed with the recreation. This paper presents the details of the proposed system, the method of implementing recreation using the system, the effect of recreation on participants, and the effect of reducing the burden on nursing care staff. An experiment was conducted comparing cases in which nursing care staff acted as moderators and robots acted as moderators. As a result, it became clear that the burden on nursing care staff could be reduced while recreation remained active.

Keywords: Elderly care, Recreation, Humanoid communication robot.

1 Introduction

According to the definition of aging established by the World Health Organization (WHO) and the United Nations, a society is called "aging society" when the population aged 65 or older exceeds 7% of the total population, "aged society" when it exceeds 14%, and "super-aged society" when it exceeds 21%. Many developed countries with high aging rates are known, including Sweden, Germany, France, the United Kingdom, and the United States [1]. In Japan, among others, the population is aging at a rate unparalleled in the world, and the percentage of the population aged 65 and over is approaching 30% [2]. Meanwhile, the risk of developing dementia increases as people age. For example, the estimated prevalence of dementia and mild cognitive impairment (MCI) is said to be 15% and 13%, respectively, among the elderly aged 65 years and older, and together, one in four elderly people has dementia or its reserve [3]. Therefore, there is concern that as the elderly population increases, the number of elderly people with dementia will also increase, and the importance of preventing elderly people with dementia is

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as the ability to implement the program without preparation by nursing staff, and the ability to implement the program without experienced staff. The challenge in this paper is to resolve these issues.

The remainder of the paper is as follows: Section 2 briefly introduces related works. In Section 3, proposed method is explained. Section 4 describes the experimental results and discussion, and Section 5 concludes.

2 Related Works

Communication robots used in the field of nursing care can be divided into three main types: "automatic execution type," "autonomous operation type," and "remote control type". There are various advantages and disadvantages when these types of robots are used in the field of nursing care.

First, in the "automatic execution type," a motion program is registered with the robot in advance, and the robot automatically executes the program in sequence. For example, in group recreation, the robot acts as a moderator and speaks lines, sings songs, and performs gymnastic movements, and the participants perform recreation in accordance with the robot [8][9]. In this case, the need for nursing staff to intervene during recreation is low, and the effect of reducing the load on the nursing staff is significant. However, since the robot does not receive responses from the participants, the participants need to adjust to the robot's timing, which may give a strong one-way impression to the participants.

In the next "autonomous operation type," sensors implemented in the robot recognize the user's actions and execute programs corresponding to the contents of the actions. For example, in the pet-type robot, a tactile sensor is mounted on the robot, and the robot is equipped with a mechanism that operates by touching the sensor part [9][10]. On the other hand, humanoid robots have implemented functions to recognize faces by image recognition using a camera to call out names and to carry out conversations by voice recognition using a microphone. Attempts are being made to use such functions to communicate one-on-one or with a small group of people [11][12][13]. In this case, the nursing staff does not need to operate the robot, which is highly effective in reducing the workload of caregivers. However, image recognition and voice recognition are not as good as human capabilities in terms of reaction speed and recognition accuracy, which may leave a strong unsatisfactory impression for users with high expectations. In addition, the robot's lines and actions are often limited to simple ones, making advanced communication difficult.

In the last "remote control type," a person remotely controls the robot and selects lines and actions that are pre-registered on the robot. For example, a study has been reported in which a person remotely controls a robot from another room, and the robot gives aids in a group conversation in the form of a co-recall method [14]. In this case, there is a disadvantage that the caregiving staff must operate the robot. However, the robot would be able to select lines that match the situation and perform actions that match the timing of the participants.

The purpose of this paper is to propose a method to reduce the workload of caregiving staff by using a humanoid robot to assist in hosting group recreational activities. In group recreation, it

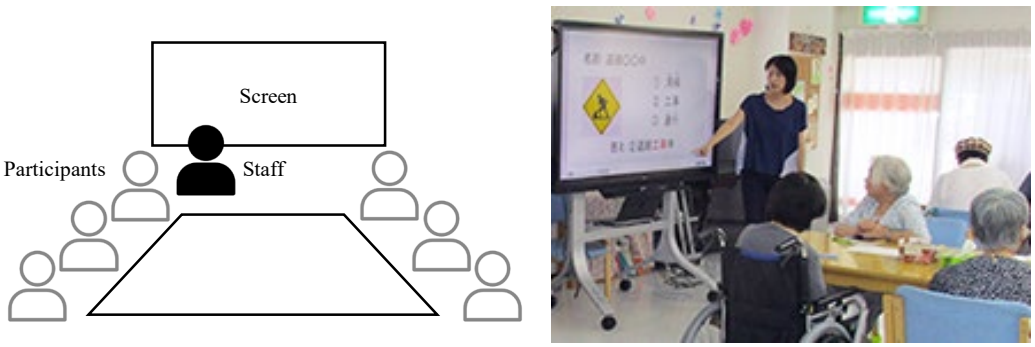
is difficult to apply the "autonomous action type" because of the need to accommodate a large number of participants, and the "automatic execution type" is often used. However, as mentioned earlier, participants need to match the robot's timing, and in addition, participants may have a strong impression that the process is one-way. Therefore, this study adopts the "remote control type. In the conventional "remote control type," it is necessary to concentrate on the remote operation, and it was difficult to provide individual participants with more care so that they can enjoy participating in the program. In addition, preparation, such as training for operation, was often required, and a certain level of experience was often required. The challenge in this paper is to resolve these issues.

3 Proposed Method

3.1 Recreation method

Among the various methods of group recreation in senior citizen facilities, this study focuses on recreation using IT materials. Figure 1 shows an overview. Figure (a) shows the layout and Figure (b) shows the appearance of the execution. This IT material is used by displaying a PowerPoint presentation activated on a tablet terminal on an electronic blackboard. The presenter operates the tablet terminal to display the educational material on a large TV and asks participants to take a quiz. Participants look at the material and answer the quiz. Participants listen to the answers of others and use them as hints to expand communication by speaking up and discussing their experiences and opinions.

The moderator of such group recreational activities is required to play three roles. The first role is that of "explaining the material," which involves explaining the material and eliciting comments from participants. The second role is called the "enlivening role," which is to calm the atmosphere and make it easier for participants to speak. The third role is called the "facilitator," and is responsible for ensuring that each participant enjoys his or her participation. In this study, we aim to reduce the burden on nursing staff by having the robot take on the role of these moderators.



(a) Layout of recreation (b) Appearance of the recreation

Figure 1: Recreation method

3.2 Research approach

Of the three roles required of the moderator, the robot was chosen to play the "role of explaining recreational materials". The "role of explaining the recreational material" can be realized by having the robot speak lines that match the recreational material. If the robot can take on the role of explaining the recreational material, it will reduce the burden on the staff to prepare by reading the lines of the recreational material in advance. In addition, the staff only needs to respond passively to the robot in between recreational activities, which is expected to greatly reduce the burden of the staff.

We have identified four requirements for having the robot play the role of "explaining recreational materials". The first is "gestures during speech," which means that the robot gestures in accordance with the speech. If this could be achieved, it would be possible to draw the participants' attention to the robot. This is a necessary function for caregivers who avoid recreational work because they are not comfortable in front of a large number of people.

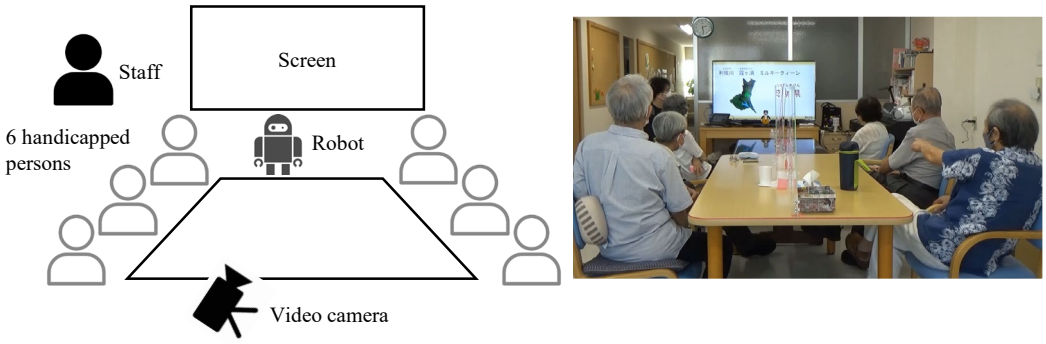
The second is "timely speech timing". The robot does not use timings that are pre-registered with the robot, but rather, it adapts its speech to the situation of the place. For example, if participants are thinking, or if participants are talking excitedly with each other, it is necessary to delay the timing of the robot's utterance. It is difficult for the current robot technology to understand such a situation with a high degree of accuracy, and it is necessary to use human intervention. In other words, the "remote control type" described in the previous study is suitable.

The third is "simple speech instructions". When the "remote control type" is adopted and the timing of speech is controlled by human operation, it is necessary to simplify the speech instructions in order to reduce the burden on the care staff. However, in the method described in the "remote control type" described in the previous study, the operation buttons are lined up for each line, and it is necessary to select which button to press, making the operation complicated. This needs to be solved.

The fourth is "easy line editing". This means that the staff must be able to easily edit the robot's lines. Recreational materials need to be constantly updated with new content to avoid getting stuck in a rut. In addition, to increase the attractiveness of recreation, it is desirable to be able to adjust the lines to suit the circumstances of the participants. However, in the "remote control type" described in the previous study, lines need to be registered in advance by a technician with expertise in robotics, making it difficult for staff to edit them easily. This needs to be resolved.

To realize the four requirements explained above, this study focused on the "PowerPoint linkage function" [15]. This function transfers lines written in the notes section of PowerPoint to the robot to be spoken in conjunction with the animation function of PowerPoint. By employing this function, "simple speech instructions" can be realized. Specifically, it is possible to proceed with a PowerPoint slideshow by simply clicking on it, thus reducing the burden on nursing staff. Also, for "easy line editing," care staff can adjust the robot's line by simply editing the notes column of the PowerPoint presentation. Furthermore, it is easy to create new recreational materials to prevent ruts.

questions were displayed on a screen in front of the robot, and the nursing staff explained the questions as they proceeded. The care staff advanced the slides by clicking the finger presenter. The first half of the session was moderated while explaining the slides. In the second half, the



robot was asked to speak by judging the appropriate timing and facilitating the slides.

(a) Layout of experiment (b) Appearance of the experiment

Figure 3: Experimental condition

The experiment was captured on video and analyzed with the annotation tool ELAN [17]. Specifically, while playing back the video, the speech timing was identified from the speech waveform, and the speaker, speech duration, and speech content were manually recorded and tabulated. Therefore, the position of the break between consecutive utterances was determined at the discretion of the authors, and the results may contain some errors.

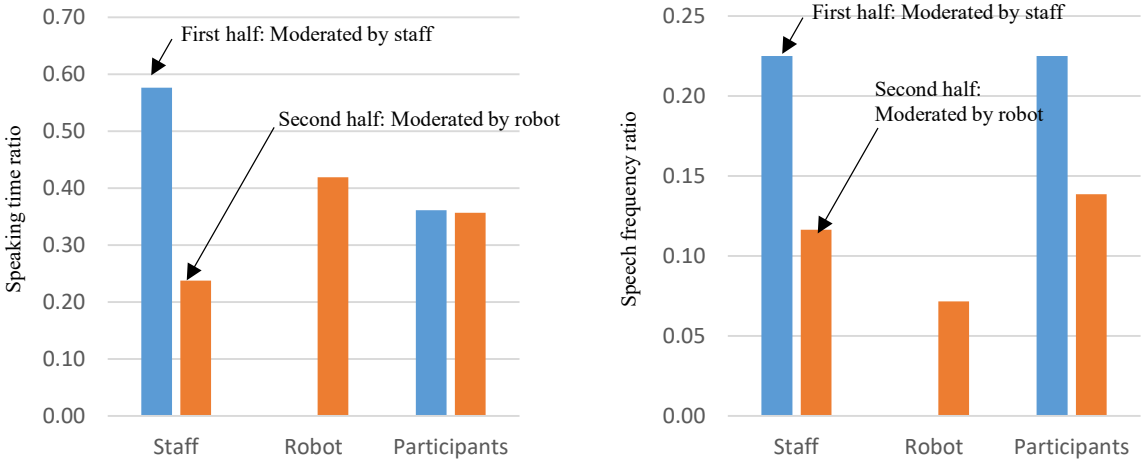
4.2 Experimental results

Figure 4 shows the experimental results. The figure shows the transition of the speaking time ratio. The horizontal axis shows the order of the quiz questions, from left to right. A total of nine quiz questions were administered. The first four questions were moderated by the staff, and the latter five were moderated by a robot. The line graph corresponds to the right axis and shows the time for one quiz. The duration of one quiz question varied between one and three minutes, and generally lasted about two minutes. The bar graphs show the ratio of speaking time to the time spent administering the one-question quiz. From left to right, they are shown for the staff, the robot, and the participants, respectively. The higher the ratio of participants, the more active the recreation and the more effective the recreation. The lower the ratio of the staff, the lower the burden on the staff.

Figure 5 shows the transition of speaking frequency. The horizontal axis shows the same sequence of quiz questions as in Figure 4. The bar graph shows the speaking frequency per unit of time for one quiz question. From left to right, they are shown for the staff, the robot, and the participant, respectively. The higher the frequency of speech, the more active the recreation and the more effective the recreation. The lower the speaking frequency of the staff, the lower the load on the staff.

Figure 6 compares the speaking time ratio and the speaking frequency between the first half and the second half. Figure (a) shows the results of the comparison of speaking time ratio, with

Figure (b) shows the results of the comparison of speech frequency, with the horizontal axis arranged in the order of staff, robot, and participant. The staff's speech frequency was almost halved from 0.23 times/sec in the first half to 0.12 times/sec in the second half. The robot's



speech frequency was only in the second half and was 0.07 times/second. The participant's speech frequency was almost halved from 0.22 times/sec in the first half to 0.14 times/sec in the second half.

(a) Speaking time ratio (b) Speaking frequency

Figure 6: Comparison between first half and second half

Figure 7 shows a comparison between the first half and second half of the staff's speech. The vertical axis shows the ratio of speaking time, and the horizontal axis shows explanation on the left side and dialogue on the right side. Explanation is a one-way explanation of the content of the slides, while dialogue is two-way communication, such as asking and answering questions to the participants. The first half of the staff's speech consisted of 35% explanation and 24% dialogue. On the other hand, 25% of the second half was entirely dialogue.

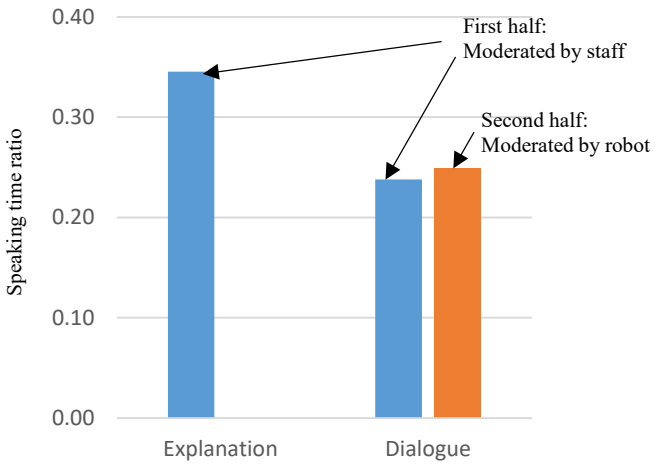


Figure 7: Comparison of utterances by staff

finger presenters. As for 2), the robot does not moderate alone, but rather, the caregivers follow up with the robot to remedy any discrepancies between what the person says and the situation at the place where the robot is speaking. Regarding 3), for the time being, the plan is to address this issue by creating and using a library of recreational content with made-up lines, but this is an issue for the future.

(5) Qualitative evaluation of the proposed method:

After the experiment, interviews were conducted with the moderator and participants. As a result of interviews with the moderator, he said that the mental burden is reduced because he can participate in recreation in a passive manner. This shows that the aim of this study has been achieved. On the other hand, participants made comments both for and against. Positive comments about the use of robots included, "It provides a topic of discussion," "I'm glad it was new," and "I don't mind robots as long as humans can help." Negative comments on this included, "It would be nice if we could have a dialogue instead of one-sided talk," and "If there wasn't a shortage of people, it would be good to have someone host the event." These results suggest that the significance of using the proposed method should not be that the robot can completely replace the human host, but that the robot can reduce the preparation time before recreation for the nursing staff and reduce their mental burden during recreation.

5 Conclusion

This paper proposes a method to reduce the burden on caregivers by utilizing humanoid robots to assist in hosting group recreational activities. The proposed method is to have a robot take the role of a moderator for IT educational materials that are used by display-ing a PowerPoint presentation on a screen activated by a tablet terminal. Specifically, a system was proposed in which a robot explains a quiz displayed on the screen, asks questions, and answers the questions using the PowerPoint linkage function. Experi-ments on recreation using the proposed system revealed the possibility of reducing the burden on the moderator while achieving participant communication equivalent to that of a human moderator.

Future issues to be addressed include the study of ways to streamline the process of making up the robot's lines, and to enable the robot and participants to catch up in small increments of conversation.

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