

Kitchen Bot - A NAO Robot Based Cooking Assistant

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Abstract—A study of human-robot interaction using a NAO robot to assist people in the kitchen. The NAO robot was used in a user study to assist people in preparing two different recipes. We invited both potential chefs and novice learners for this experiment, and the group's results were statistically analysed. A detailed analysis demonstrates the NAO robot's reliability in assisting an individual cook and the extent to which this robot can be integrated into a larger process. Traditionally, learning a recipe requires the user to read through the manual's instructions and memorise each and every step involved in the cooking process. On the other hand, this type of assistant would be straightforward to use because it would allow the user to simply ask the robot about each step without having to remember or search for a phone during the cooking process. Cooking is a daily routine for everyone, and no one wants to spend time looking for an instruction manual in the print or on their phone while they're cooking. According to preliminary findings and detailed qualitative evidence, it appears almost like people would prefer to have such an assistant in their home. However, additional research on a complex cooking activity and environment is required to substantiate this argument.

I. INTRODUCTION

The Internet has become an important part of societal infrastructure nowadays. What has been posted and accessed through the Internet is the collective knowledge, skills, and expertise of many individuals. More particularly, the information on fundamental daily requirements, such as food, clothes, and shelter, is looked for and used by a significant number of individuals. Considering the cooking scenario in our home there are certain problems which are as follows:

- 1) Cooking may be a lonely experience, and it's not all that pleasurable sometimes when individuals are doing it alone on a routine.
- 2) Cooking a meal while viewing a recipe in the phone or a cookbook is difficult since we must operate the gadget each time we verify the cooking method.
- 3) It is common for individuals to post pictures of their culinary skills on social networking sites or food recipe websites. However, even if we wanted to, we can't use a digital camera or a mobile phone by ourselves to capture and share the cooking process.

Concerning the first problem, we propose an interactive robotic or HRI as a solution for enjoying cooking. The second difficulty arises because the gadgets or traditional cookbooks must be operated by hand manually while cooking. As a result, we create a way for communicating recipes to users so that they do not rely on the user flipping the page by hand or

searching on their gadget. Due to the timing and software-related limitations the third concern is addressed as future work which is posting the cooking video to the social media sites of the user.

The aforementioned concerns motivate us to do research on the cooking assistance robot. Our user study focuses on the first two primary issues mentioned above, as well as the system's reliability and dependability. If the user does not agree with the robot being put in the kitchen area or even with the robot itself, the whole system fails. Furthermore, we elevated this cooking assistant process by dividing people into two groups. One group consists of individuals who are attempting to make the dish for the first time or are a novice to cooking. The other category consists of those who are experienced in the field of cooking (Potential Chefs). The basic way for determining if users are pleased with such an experience is to conduct a questionnaire survey of experiment participants and to collect objective metrics from the interaction process. A complete investigation was conducted on both groups to see how effectively the NAO assists them while cooking and how well it assists them in making the food taste delicious.

II. LITERATURE REVIEW

To understand the social needs of different families for social robots, including family ethical and functional needs, Bengisu et al [1] conducted a participatory study on six families with children. This study provides guidance for the design of interaction between social robots in the family scene and people of different ages. For cooking assistance robots, all families hope that robots can achieve step-by-step recipe guidance. Although most families expressed their support, two of the parents expressed that they do not think this robot can help in limited space. This shows that the cooking assistance robot must gain people's universal trust in function and prove the reliability.

There is a huge motivation to improve the cooking experience. Traditional recipes have many inconveniences in the guidance of cooking. For example, people are reluctant to operate equipment with dirty hands when cooking. In terms of user experience and perception, the cooking process sometimes takes tens of minutes or even more than an hour, and the long process makes cooking lack of fun. Seiichi et al. [2] proposed that these problems can be solved by an interactive robot based on Web services. The research proposes a framework of Web service and clarifies the way to realize voice interaction based on speech recognition library and

Google engine. The study showed examples of how robots can instruct users to make sandwiches and gave a preliminary assessment. This research affirmed the application and value of cooking assistant robots in real life, and it provided a reference for how to design experimental procedures.

In this experiment, the reliability of the interaction is one of our core concerns. If in the process of human-robot interaction, the robot cannot effectively recognize and monitor the participant's language or actions, and cannot provide accurate feedback on the participant's progress, this will greatly reduce the participant's confidence in robot-assisted cooking. Nicole et al. [3] conducted a user study to explore how participants would evaluate the robot's wrong behavior by intentionally programming wrong behavior into the robot's routine. In terms of experimental methods, by setting up a control group, explore the consequences of different robot behaviors. Participants were asked to fill out questionnaires before and after the interaction to confirm the participants' emotional benchmarks through pre-questionnaire surveys. Both qualitative and quantitative surveys were used to determine the user's true evaluation of the robot. An optimistic conclusion showed that even if participants recognize the robot's mistakes, they do not necessarily reject the robot that made mistakes in the interaction.

User satisfaction is an important indicator of human-computer interaction experience, and a reasonable quantitative analysis of the questionnaire is needed. Pham et al. [4] proposed a prototype of a home kitchen assistant robot. This prototype is based on wearable devices interaction. This study defines the cooking process as a complex multi-task scenario, and the purpose is to explore whether users think the assistance of robots makes people more comfortable. The experimenter set up a controlled experiment to allow participants to simulate the cooking process in scenes with and without robot assistance. And the satisfaction samples through questionnaire surveys were collected for t-test. The experimenter took the satisfaction data and the time spent as two objective measurements. It is concluded that the kitchen assistant robot can improve the comfort of the user while optimizing the task completion time. This research provides ideas for how to deal with questionnaire survey data. In traditional questionnaire surveys, satisfaction is measured by very general questions, which is not a good objective measurement on the feelings of users. By quantifying satisfaction as a Likert scale, the proposed hypothesis can be verified by paired t-test and Pearson correlation.

Reiko et al. [5] proposed a cooking navigation system, which has been proven to optimize cooking time, improve the accuracy of the user's cooking process, and improve the user's learning experience. When designing the recipe process, how to optimize the cooking work is our core consideration. The goal of the cooking process is not only to use the least amount of time, but also to allow users of different cooking levels to be comfortable. This system is based on multimedia interaction, which is significantly better than simple video and text tutorials. The research also mentioned the importance of voice interaction. Based on the scene of cooking assistance,

voice interaction is the most important of all media. Therefore, maintaining good voice interaction accuracy can significantly improve cooking efficiency and user experience.

III. METHODS

We set up a user study to explore the extent to which the robot was involved in cooking. A human and a robot interacted with each other in two sessions. Both the two sessions were cooking tasks, but in the first session the human was asked to make a cup of tea under the guidance of a paper recipe, and in the second session the human was asked to make a cup of tea under the guidance of the robot. We conducted pre-questionnaires and post-questionnaires to collect feedback from users before the user study and after the user study. The user study was performed between subjects, with each participant taking part in both the following two conditions: (a) making a cup of tea under the guidance of a paper recipe and (b) making a cup of tea under the guidance of the NAO robot.

A. Hypotheses

In this user study, we hypothesize that:

- 1) The participation of robot can improve the cooking efficiency and satisfaction.
- 2) The robot can be involved in the cooking process to a large extent.

B. User Study Design:

For this user study, the participants were asked to interact with a NAO robot. According to whether robot is involved in the cooking process, the interaction was set up in two sessions. During the first session, the participants would follow a given paper recipe to make a cup of tea. During the second session, the robot would give a detail guidance on how to make a cup of tea and the participants should follow the guidance. Each participant was required to take part in both sessions. The user study was performed in the University of the West of England at the teaching room of the engineer building. The robot was placed on the center of the table facing to the participants. All needed ingredients and tools such as a paper recipe, a kettle, teabags, spoons and cups for making a cup of tea were placed on either side of the robot to ensure easy access for participants. During the entire interaction the participants sat adverse to the NAO robot at a distance of 0.75m. NAO was standing on the table. The transition between the two sessions was immediate with no break in between. Both sessions happened in the same setting. Because of the possible hazards involved in making the food, such as hot water spilled and dropped teacups, the researchers would stand by the table to ensure that the experiment was conducted safely. Other than that, the researchers would not interfere with the experiment unless the participant initiated a conversation directly with the researchers.

C. User Study Procedure:

The participants were welcomed to take part in the user study firstly. After a short briefing, they were asked to sign an informed consent. Next, the participants were asked to complete pre-questionnaires to assess to what extent they thought the robot can assist them in cooking and attitude toward placing a robot in the kitchen. Finally, the general process of this user study and some instructions about the NAO robot were introduced to participants. As soon as the participants took their position opposite the robot, the user study began. First, each participant made a cup of tea under the guidance of a paper recipe (session 1). Second, each participant made a cup of tea under the guidance of the NAO robot (session 2). After the interaction, the participants were asked to taste the food they made themselves and complete post-questionnaires to offer their feedback. The user study was finalized with a short debriefing in which the purpose of this user study was explained to the participants.

D. Dependent Measures:

Questionnaires are frequently used and widely accepted among the HRI community. We designed two kinds of questionnaires, i.e., pre-questionnaire and post-questionnaire. The pre-questionnaire aims to collect the participants' expectations on kitchen robot and the post-questionnaire aims to collect the feedback from the participants after interaction. We also measured two objective variables, including time taken from the start to the end of each participant and the number of mistakes made by each participant in the whole cooking process.

E. Participants

A total of 10 participants that were recruited on site took part in our user study (10 males). They were postgraduate students and they had a certain experience with robots. Their age ranged from 22 to 26 years, with a mean age of 24.6 years. As regard conditions, all of the participants took part in both sessions.

IV. RESULT

During the interaction process, we recorded two objective variables, including time taken from the start to the end of each participant in both sessions and the number of mistakes made by each participant in both sessions. The results are illustrated in 1 to 4. The unit of the time taken is second(s), and the unit of the number of mistakes is time(s). As can be seen, all data follow the normal distribution.

To better analyze the data, we calculated the mean value and standard deviation of the time taken and the number of mistakes, as shown in Table I.

And the time taken of each participant in both sessions and the number of mistakes made by each participant in both sessions are shown in figure 5 and figure 6.

From the questionnaires, seven of ten participants thought the robot could assist them in cooking to a large extent, and two of ten participants thought the robot could only provide

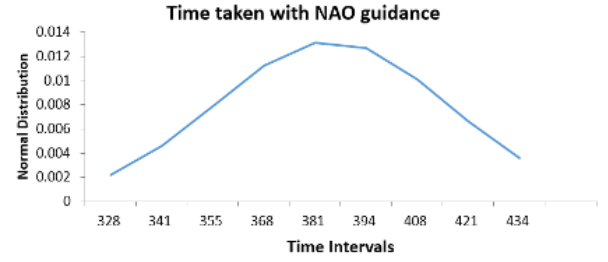


Fig. 1. The time taken with NAO guidance

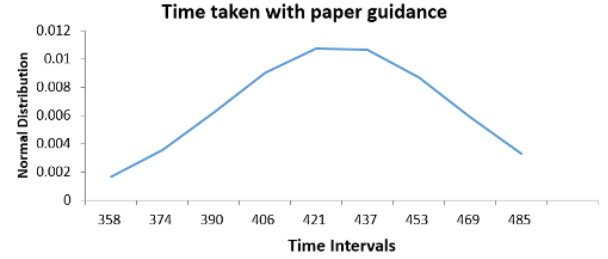


Fig. 2. The time taken with paper guidance

little help with cooking. Only one participant did not think the robot could provide any help with cooking. As regard the quality of the food made by participants, six of ten participants thought the taste of the food was acceptable, and two of ten participants thought the taste of the food is delicious. However, the remaining two participants thought the food tasted awful. Besides, all participants enjoyed the interaction with the NAO robot..

V. DISCUSSION

As a consequence of the above-mentioned result, we can observe that the time required for NAO assistance is significantly decreased by roughly a mean average of 43.1 seconds, a difference of nearly a minute when compared to the previous technique of paper guiding. Given the complexity of the cooking process, and the fact that both of them have a very slight variance of about 2 to 3 minutes, a more complicated recipe would have yielded a more varied set of data. Additionally,

Group	Mean	Standard deviation
Time taken with NAO guidance	385.3	30.16
Time taken with paper recipe guidance	428.4	36.41
The number of mistakes with NAO guidance	1.5	0.769
The number of mistakes with paper recipe guidance	2.7	1.210

TABLE I
THE MEAN VALUES AND STANDARD DEVIATION VALUES

Group	Student's t-test		Cohen's d
	Statistic	p-value	
Time taken	-2.734	0.01362	1.289
Number of mistakes	-2.394	0.02773	1.184

TABLE II
THE COHEN'S D VALUES AND STUDENT'S T-TEST

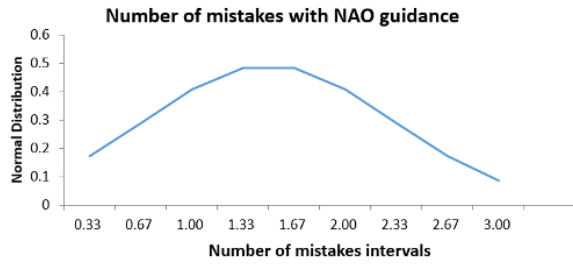


Fig. 3. The number of mistakes with NAO guidance

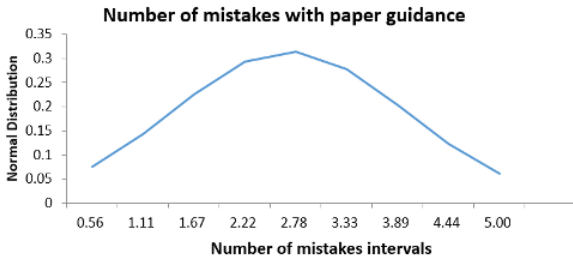


Fig. 4. The number of mistakes with paper guidance

to account for the user's acceptance, this experiment was limited to a simpler cooking task. The future research of this experiment may include a complex recipe that involves a significant amount of time to prepare, as well as the user's tolerance of support for such a complicated activity, in order to get a deeper understanding of this cooking assistance on a bigger scale. Our experiment may be used to provide a baseline for further studies. Additionally, our pre and post questionnaires enable us to get a deeper understanding of how the user's perspective changes before to and afterwards usage. Additionally, when the NAO guidance is being used, the amount of cooking errors is significantly reduced. This enables us to comprehend how both the potential chef's recipe and the dish itself might have tasted given the amount of errors involved.

We had several difficulties implementing this experiment due to the time constraint and incompatibility of the NAO robot's software. One such prominent problem is that each time we create behaviour and attempt to deploy it on a

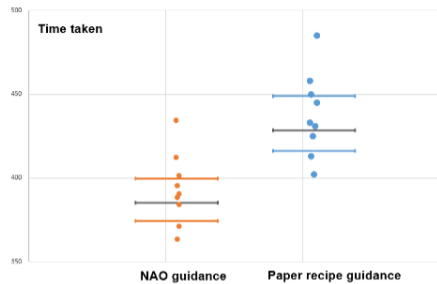


Fig. 5. The time taken of each participant

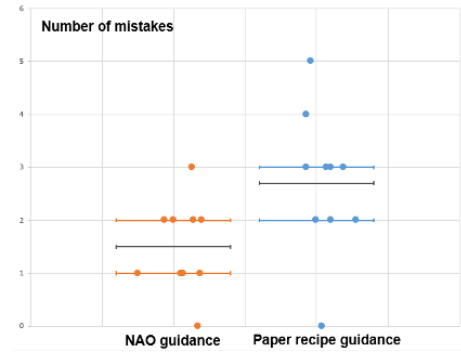


Fig. 6. The number of mistakes made by each participant

separate robot, some functions that functioned flawlessly on the previous robot do not operate on the subsequent one. Second, when placed in a noisy environment, the NAO Robot's internal speech recognition system fails to detect the user's voice. This may be a significant impediment when the robot is employed in a real-time kitchen environment.

VI. CONCLUSION

In general, our experiment research indicates that end users prefer this type of assistance during the cooking process. Additionally, our trial establishes a baseline value for future trials that incorporate cooking assistance with complex recipes and a more effective guiding strategy. As a result of the fact that both novice learners and potential chefs accept these types of cooking assistants at a similar rate, we conclude that these types of cooking assistants can be involved to a greater extent. A recommendation for future work is to employ a more advanced humanoid robot with superior hardware and software capabilities. When a greater degree of human-robot interaction occurs, the future recommendation system must also take safety into account.

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VII. APPENDIX



Consent Form

Study Title: Kitchen Bot

This consent form will have been given to you with the Participant Information Sheet. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions, please contact a member of the research team, whose details are set out on the Participant Information Sheet.

If you are happy to take part in this study, please sign and date the form. You will be given a copy to keep for your records.

Please read the statements below and sign below to give consent:

I have read and understood the information sheet
I have been given the opportunity to ask questions and have had my questions answered to my satisfaction.
I am aware of the risks and benefits of taking part in the study
I am aware that data collected will be anonymised, kept in accordance with General Data Protection Regulation (GDPR), and will be viewed and analysed by the research team as part of their studies.
I am aware that I have the right to withdraw consent and discontinue participation without penalty before or during the study.
I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed).....AADHE.....

Signature.....[Signature]..... Date.....7/5/21.....

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Fig. 7.

Pre Questionnaire:

1 what percentage do you think the robot can assist you in cooking?

A. 20% B. 40% C. 60% ~~D. 80%~~ E. 100%

2 How long do you think it will take to make a cup of tea?

A. 0-5mins ~~B. 5-10mins~~ C. 10-15mins D. 15-20mins

3 How long do you think it will take to make a sandwich?

A. 0-5mins B. 5-10mins ~~C. 10-15mins~~ D. 15-20mins

4 what do you think of placing the robot in the kitchen?

A. Extremely difficult ~~B. Difficult~~ C. Undecided D. Easy E. Extremely easy

5 Do you think the robot will be disturbance?

A. Yes ~~B. No~~

6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 8.

Questionnaire

- (1) What is your group?
☒ A. Novel learner B. Potential chef
- (2) How is the quality of the tea?
A. Good B. Bad ☒ C. Medium
D. Others : _____
- (3) How is the quality of the recipe 2?
☒ A. Good B. Bad C. Medium
D. Others : _____
- (4) How do you think the time period for making the tea?
A. Too long B. Too short(rush) ☒ C. Just suitable
D. Others: _____
- (5) How do you think the time period for making the recipe 2?
☒ A. Too long B. Too short(rush) C. Just suitable
D. Others: _____
- (6) What do you think of the overall process design for making a tea?
A. Too Simple ☒ B. Too Tedious C. Just Suitable
D. Others: _____
- (7) What do you think of the overall process design for making the recipe 2?
☒ A. Too Simple B. Too Tedious C. Just Suitable
D. Others: _____
- (8) How do you judge the whole experience of making a tea?
☒ A. Good B. Bad C. Just Suitable
D. Others: _____
- (9) How do you judge the whole experience of making the recipe 2?
A. Good B. Bad ☒ C. Just Suitable
D. Others: _____

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Fig. 9.

(10) What do you think of the quality of the conversation of making the both recipes?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long ☒ C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

☒ A. Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

A. Nothing to display(Mute)

☒ B. Other dances and music, for example: option to choose the music I like

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Fig. 10.

Consent Form

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I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed).....K. S. Danti.....

Signature.....Danti..... Date.....7/5/21.....

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Fig. 11.

Pre Questionnaire:

1 what percentage do you think the robot can assist you in cooking?

A. 20% B. 40% C. 60% ☒ D. 80% E. 100%

2 How long do you think it will take to make a cup of tea?

☒ A. 0-5mins B. 5-10mins C. 10-15mins D. 15-20mins

3 How long do you think it will take to make a sandwich?

☒ A. 0-5mins B. 5-10mins C. 10-15mins D. 15-20mins

4 what do you think of placing the robot in the kitchen?

A. Extremely difficult B. Difficult ☒ C. Undecided D. Easy E. Extremely easy

5 Do you think the robot will be disturbance?

A. Yes ☒ B. No

6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 12.

Questionnaire

- (1) What is your group?
A. Novel learner ☒ B. Potential chef
- (2) How is the quality of the tea?
A. Good B. Bad ☒ C. Medium
D. Others : _____
- (3) How is the quality of the recipe 2?
A. Good B. Bad ☒ C. Medium
D. Others : _____
- (4) How do you think the time period for making the tea?
A. Too long ☒ B. Too short(rush) C. Just suitable
D. Others: _____
- (5) How do you think the time period for making the recipe 2?
A. Too long B. Too short(rush) ☒ C. Just suitable
D. Others: _____
- (6) What do you think of the overall process design for making a tea?
A. Too Simple ☒ B. Too Tedious C. Just Suitable
D. Others: _____
- (7) What do you think of the overall process design for making the recipe 2?
A. Too Simple B. Too Tedious ☒ C. Just Suitable
D. Others: _____
- (8) How do you judge the whole experience of making a tea?
A. Good ☒ B. Bad C. Just Suitable
D. Others: _____
- (9) How do you judge the whole experience of making the recipe 2?
A. Good B. Bad ☒ C. Just Suitable
D. Others: _____

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Fig. 13.

(10) What do you think of the quality of the conversation of making the both recipes?

A. Good B. Bad C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good B. Bad C. Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

A. Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

A. Nothing to display(Mute)

B. Other dances and music, for example: _____

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Fig. 14.

(10) What do you think of the quality of the conversation of making the both recipes?

☒ A. Good B. Bad C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

☒ A. Good B. Bad C. Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long ☒ C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

☒ A. Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

☒ A. Nothing to display(Mute)

B. Other dances and music, for example: _____

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Fig. 15.

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I am aware that I have the right to withdraw consent and discontinue participation without penalty before or during the study.
I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed)..... K. Keshava

Signature..... Keshava Date..... 07 May 2021

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Fig. 16.

Pre Questionnaire:

- 1 what percentage do you think the robot can assist you in cooking?
A. 20% B. 40% ☒ C. 60% D. 80% E. 100%
- 2 How long do you think it will take to make a cup of tea?
A. 0-5mins B. 5-10mins ☒ C. 10-15mins D. 15-20mins
- 3 How long do you think it will take to make a sandwich?
A. 0-5mins B. 5-10mins ☒ C. 10-15mins D. 15-20mins
- 4 what do you think of placing the robot in the kitchen?
A. Extremely difficult ☒ B. Difficult C. Undecided D. Easy E. Extremely easy
- 5 Do you think the robot will be disturbance?
A. Yes ☒ B. No
- 6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 17.

Questionnaire

(1) What is your group?

☒ A. Novel learner B. Potential chef

(2) How is the quality of the tea?

A. Good B. Bad ☒ C. Medium

D. Others : _____

(3) How is the quality of the recipe 2?

A. Good B. Bad C. Medium

☒ D. Others : Amazing

(4) How do you think the time period for making the tea?

A. Too long B. Too short(rush) ☒ C. Just suitable

D. Others: _____

(5) How do you think the time period for making the recipe 2?

A. Too long B. Too short(rush) ☒ C. Just suitable

D. Others: _____

(6) What do you think of the overall process design for making a tea?

A. Too Simple B. Too Tedious ☒ C. Just Suitable

D. Others: _____

(7) What do you think of the overall process design for making the recipe 2?

A. Too Simple B. Too Tedious ☒ C. Just Suitable

D. Others: _____

(8) How do you judge the whole experience of making a tea?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(9) How do you judge the whole experience of making the recipe 2?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

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Fig. 18.

(10) What do you think of the quality of the conversation of making the both recipes?

A. Good B. Bad ☒ Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good B. Bad ☒ Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long ☒ Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

☒ Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

A. Nothing to display(Mute)

B. Other dances and music, for example: _____

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Fig. 19.

Consent Form

Study Title: Kitchen Bot

This consent form will have been given to you with the Participant Information Sheet. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions, please contact a member of the research team, whose details are set out on the Participant Information Sheet.

If you are happy to take part in this study, please sign and date the form. You will be given a copy to keep for your records.

Please read the statements below and sign below to give consent:

I have read and understood the information sheet
I have been given the opportunity to ask questions and have had my questions answered to my satisfaction.
I am aware of the risks and benefits of taking part in the study
I am aware that data collected will be anonymised, kept in accordance with General Data Protection Regulation (GDPR), and will be viewed and analysed by the research team as part of their studies.
I am aware that I have the right to withdraw consent and discontinue participation without penalty before or during the study.
I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed)... AMRIT DINESH

Signature... [Signature] Date... 07/01/21

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Fig. 20.

Pre Questionnaire:

1 what percentage do you think the robot can assist you in cooking?

A. 20% B. 40% C. 60% D. 80% E. 100%

2 How long do you think it will take to make a cup of tea?

A. 0-5mins B. 5-10mins C. 10-15mins D. 15-20mins

3 How long do you think it will take to make a sandwich?

A. 0-5mins B. 5-10mins C. 10-15mins D. 15-20mins

4 what do you think of placing the robot in the kitchen?

A. Extremely difficult B. Difficult C. Undecided D. Easy E. Extremely easy

5 Do you think the robot will be disturbance?

A. Yes B. No

6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 21.

Questionnaire

- (1) What is your group?
A. Novel learner B. Potential chef
- (2) How is the quality of the tea?
A. Good B. Bad C. Medium
D. Others : _____
- (3) How is the quality of the recipe 2?
A. Good B. Bad C. Medium
D. Others : _____
- (4) How do you think the time period for making the tea?
A. Too long B. Too short(rush) C. Just suitable
D. Others: _____
- (5) How do you think the time period for making the recipe 2?
A. Too long B. Too short(rush) C. Just suitable
D. Others: _____
- (6) What do you think of the overall process design for making a tea?
A. Too Simple B. Too Tedious C. Just Suitable
D. Others: _____
- (7) What do you think of the overall process design for making the recipe 2?
A. Too Simple B. Too Tedious C. Just Suitable
D. Others: _____
- (8) How do you judge the whole experience of making a tea?
A. Good B. Bad C. Just Suitable
D. Others: _____
- (9) How do you judge the whole experience of making the recipe 2?
A. Good B. Bad C. Just Suitable
D. Others: _____

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Fig. 22.

(10) What do you think of the quality of the conversation of making the both recipes?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long ☒ C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

☒ A. Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

A. Nothing to display(Mute)

B. Other dances and music, for example: _____

Scanned with CamScanner

Fig. 23.

Consent Form

Study Title: Kitchen Bot

This consent form will have been given to you with the Participant Information Sheet. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions, please contact a member of the research team, whose details are set out on the Participant Information Sheet.

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I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed)..... Zhao Zhang

Signature..... Zhao Zhang..... Date.....

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Fig. 24.

Pre Questionnaire:

1 what percentage do you think the robot can assist you in cooking?

A. ☒ 20% B. 40% C. 60% D. 80% E. 100%

2 How long do you think it will take to make a cup of tea?

A. 0-5mins B. 5-10mins C. ☒ 10-15mins D. 15-20mins

3 How long do you think it will take to make a sandwich?

A. 0-5mins B. 5-10mins C. ☒ 10-15mins D. 15-20mins

4 what do you think of placing the robot in the kitchen?

A. Extremely difficult B. ☒ Difficult C. Undecided D. Easy E. Extremely easy

5 Do you think the robot will be disturbance?

A. ☒ Yes B. ☒ No

6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 25.

Questionnaire

(1) What is your group?

A. ☒ Novel learner B. ☐ Potential chef

(2) How is the quality of the tea?

A. ☐ Good B. ☐ Bad C. ☒ Medium

D. Others : _____

(3) How is the quality of the recipe 2?

A. ☐ Good B. ☐ Bad C. ☒ Medium

D. Others : _____

(4) How do you think the time period for making the tea?

A. ☐ Too long B. ☐ Too short(rush) C. ☒ Just suitable

D. Others: _____

(5) How do you think the time period for making the recipe 2?

A. ☐ Too long B. ☐ Too short(rush) C. ☒ Just suitable

D. Others: _____

(6) What do you think of the overall process design for making a tea?

A. ☐ Too Simple B. ☐ Too Tedious C. ☒ Just Suitable

D. Others: _____

(7) What do you think of the overall process design for making the recipe 2?

A. ☐ Too Simple B. ☐ Too Tedious C. ☒ Just Suitable

D. Others: _____

(8) How do you judge the whole experience of making a tea?

A. ☐ Good B. ☐ Bad C. ☒ Just Suitable

D. Others: _____

(9) How do you judge the whole experience of making the recipe 2?

A. ☐ Good B. ☐ Bad C. ☒ Just Suitable

D. Others: _____

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Fig. 26.

(10) What do you think of the quality of the conversation of making the both recipes?

A. Good B. Bad ☒ C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good ☒ B. Bad C. Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. Too long ☒ C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

A. Yes I enjoy ☒ B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

☒ A. Nothing to display(Mute)

B. Other dances and music, for example: _____

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Fig. 27.

Consent Form

Study Title: Kitchen Bot

This consent form will have been given to you with the Participant Information Sheet. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions, please contact a member of the research team, whose details are set out on the Participant Information Sheet.

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I am aware that I have the right to withdraw my data from the experiment up to 7 days after the completion of the experiment, using the participant ID that the researcher will provide.
I have freely volunteered and am willing to participate in this study.
I am willing to have my questionnaire responses collected.

Name (Printed)..... TAD 21/IAN

Signature..... TAD 21/IAN Date.....

Scanned with CamScanner

Fig. 28.

Pre Questionnaire:

1 what percentage do you think the robot can assist you in cooking?

A. 20% B. 40% ☒ 60% D. 80% E. 100%

2 How long do you think it will take to make a cup of tea?

☒ 0-5mins B. 5-10mins C. 10-15mins D. 15-20mins

3 How long do you think it will take to make a sandwich?

A. 0-5mins ☒ 5-10mins C. 10-15mins D. 15-20mins

4 what do you think of placing the robot in the kitchen?

A. Extremely difficult B. Difficult C. Undecided ☒ Easy E. Extremely easy

5 Do you think the robot will be disturbance?

A. Yes ☒ No

6 If you choose yes, then what factors do you think will disturb the robot?

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Fig. 29.

Questionnaire

- (1) What is your group?
A. ☒ Novel learner B. Potential chef
- (2) How is the quality of the tea?
A. ☒ Good B. Bad C. Medium
D. Others : _____
- (3) How is the quality of the recipe 2?
A. Good B. Bad C. ☒ Medium
D. Others : _____
- (4) How do you think the time period for making the tea?
A. ☒ Too long B. Too short(rush) C. Just suitable
D. Others: _____
- (5) How do you think the time period for making the recipe 2?
A. Too long B. Too short(rush) C. ☒ Just suitable
D. Others: _____
- (6) What do you think of the overall process design for making a tea?
A. Too Simple B. Too Tedious C. ☒ Just Suitable
D. Others: _____
- (7) What do you think of the overall process design for making the recipe 2?
A. Too Simple B. Too Tedious C. ☒ Just Suitable
D. Others: _____
- (8) How do you judge the whole experience of making a tea?
A. ☒ Good B. Bad C. Just Suitable
D. Others: _____
- (9) How do you judge the whole experience of making the recipe 2?
A. ☒ Good B. Bad C. Just Suitable
D. Others: _____

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Fig. 30.

(10) What do you think of the quality of the conversation of making the both recipes?

A. ☒ Good B. Bad C. Just Suitable

D. Others: _____

(11) What do you think of the intelligence of the robot?

A. Good B. Bad C. ☒ Just Suitable

D. Others: _____

(12) Is the time suitable for you to do the required task in the single given period?

A. Too short B. ☒ Too long C. Just Suitable

D. Others: _____

(13) Do you enjoy the music and dance from Nao robot during the waiting period?

A. ☒ Yes I enjoy B. No I'm not

(14) If no, which options do you prefer, nothing to display or other dances and music?

A. ☒ Nothing to display(Mute)

B. Other dances and music, for example: _____

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Fig. 31.