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Embodiment Matters: Toward Culture-Specific Robotized Counselling

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Abstract In this paper, we propose adding the traditional Japanese nodding behavior to the repertoire of social movements to be used in the context of human-robot interaction. Our approach is motivated by the notion that in many cultures, trust-building can be boosted by small body gestures. We discuss the integration of a robot capable of such movements within CRECA, our context-respectful counseling agent. The frequent nodding called "unazuki" in Japan, often accompanying the "un-un" sound (meaning "I agree") of Japanese onomatopoeia, underlines empathy and embodies unconditioned approval. We argue that "unazuki" creates more empathy and promotes longer conversation between the robotic counsellor and people. We set up an experiment involving 10 subjects to verify these effects. Our quantitative evaluation is based on the classic metrics of utterance, adapted to support the Japanese language. Interactions featuring "unazuki" showed higher value of this metrics. Moreover, subjects assessed the counselling robot's trustworthiness and kindness as "very high" (Likert scale: 5.5 versus 3 - 4.5) showing the effect of social gestures in promoting empathetic dialogue to general people including the younger generation. Our findings support the importance of social movements when using robotized agents as a therapeutic tool aimed at improving emotional state and social interactions, with unambiguous evidence that embodiment can have a positive impact that warrants further exploration. The 3D printable design of our robot supports creating culture-specific libraries of social movements, adapting the gestural repertoire to different human cultures.

Keywords Counselling Robot · Social Movements · Nodding (Unazuki) · Dialog Promotion · Implementation, Evaluation

1 Introduction

Software counselling agents are increasingly used as alternatives given the insufficient number of human counsellors. As acknowledged by the International Committee of the Red Cross [9], initial reviews of software counsellors' effectiveness are mixed. While software agents are not expensive and are easy to deploy, some limitations have also been described. Software counsellors do not have a mind of their own; they follow a predefined - though carefully randomized - script. Therefore, they are not always able to understand users and their issues. Experts suggest that they should be used in conjunction with a human therapist to ensure nothing gets missed. Nonetheless, the Red Cross report recognized that some initial studies on the efficacy of conversational agents for mental health have been promising [9], a notion confirmed by recent research [12].

A precondition for successful adoption of software agents in counselling is establishing trust in the counsellor [1]. Only trust makes clients[1] ready to express their inner feelings as well as their distress and to take counsellors' advises [23]. A second condition for automated counselling is detection of clients' emotion [10]. In our previous work, we proposed a Context-Respectful Counselling Agent (CRECA) [28]. Our agent listens to clients and replies to their utterances according to the current conversational context. This way, it encourages clients to be more aware of their own problems and offload their emotional burden. Still more, to help clients

[1] Following a well-established practice in counselling literature, in this paper we use the term "client" to designate humans seeking the assistance of a counsellor.

recognize their true emotions, emotionally relevant words and changes in clients' utterances are detected and summarized. They trigger responses with unconditioned positive attitude, like parental affection, which make clients feel appreciated and supported. Therefore, clients' conversation with the counselling agent is deeper and lasts longer.

However, CRECA communicates only via text messages, which are known to be unsuitable for interacting with ordinary people elderly persons suffering from loneliness [21].

We enhanced CRECA by integrating it with a robot capable of body movements and adapting, in real-time, its verbal and non-verbal communication messages to those of its clients (an early description of our design was reported in [37]). We consider two types of minimal robot movements: social movements to communicate social engagement and deictic movements related to the task at hand. In this paper, we focus on the communicative power of culture-specific social movements and its implications for designers who want to achieve spontaneity, animacy, likeability, and helpfulness with simple and easily implementable robot movements. Robotized CRECA integrates CRECA's original cognitive component with an affection attractor due to social movements. Our work contributes to human-robot interaction research by providing a first indication of the potential of robot movements to communicate social engagement and helpful referential information during counselling. Software agents are bodiless and use language-only communication that may seems awkward, unkind, cold, and/or untrustworthy to ordinary people. Robot integration allows CRECA to adopt a typically Japanese nodding behavior called "unazuki", which is very frequently used in conversation in Japan. Sometimes coupled with the onomatopoeic sound "un-un", which can be translated as "Exactly" or "Right", "unazuki" expresses the listener's empathy. Our research question is whether a "unazuki"-enabled CRECA can be expected to increase the empathy and support longer as well as deeper interaction with emotionally impaired clients, such as students suffering from career problems like low wages, long commutes, long working hours, etc. In order to enable social movements, we equipped CRECA with a simple 3D-printable robot as well as a voice recognizer hosted in the cloud.

Thus, our "unazuki" robot can nod ("unazuku") as well as hear and talk using a microphone and speaker. To measure the effect of social movements, we introduce a variation of the classic quantitative metrics for dialogue continuation. Our metrics computes the number of Roman-equivalent characters that a client speaks out during each session[2], separately weighting Kanji and Hiragana/Katakana characters. Results show that interactions with the robotized counsellor are longer than the ones with the software version. Qualitatively, user acceptance of the robot was compared to the one of the original CRECA via a questionnaire survey. The counselling robot equipped with "unazuki" achieved very high acceptance rate on the classic Likert scale.

The remainder of the paper is organized as follows. In Section 2, related works are reviewed. Section 3 proposes a fundamental method for solving psychological discomfort of IT workers. In Section 4, conceptual framework of the "unazuki" (Japanese-type nodding) integration with CRECA is introduced. In Section 5,

[2] In Japanese, Kanji characters represent a whole word while Hiragana / Katakana characters represent a syllable.

culture-specific "unazuki" embodied robot and its integration with CRECA is introduced. Section 6 describes the quantitative evaluation experiments and its results. Section 7 concludes the paper.

2 Related Work

In this section we briefly review related work in three areas: counseling, conversational agents and embodied agents (a.k.a. conversational robots). As to counselling, we shall not attempt here to review the huge body research on counselling and emotional distress [5]. Rather, we refer to the classic notion of client-centered therapy introduced in [23]. It assumes that a therapist who provides unconditional positive regard (feedback, understanding, or empathy) will stimulate psycho-therapeutic personality change in a vulnerable client, if the client perceives these attitudes [26]. CRECA [28] adopts this assumption for building up and preserving human clients' trust in a software counsellor. Another relevant research line in counselling uses the so-called 5W1H (who, what, when, where, why, how) approach [6]. 5W1H information, together with four basic emotional states (happy, afraid, sad, and angry), is used by counsellors to drive dialogue with their clients. However, 5W1H interaction includes emotional profiling questions that do not always respect the context. Clients who seek career counselling [27] often feel these questions to be unworthy of an answer, as they are unrelated to the issue for which they sought counselling in the first place.

Today, a growing area of interest for software counsellors is compassionate mental health care, where software counselling is the only available option [12].

As to conversational agents, research on conversational software agents started more than fifty years ago with J. Weizenbaum pioneering work on ELIZA in [36]. An early attempt to use conversational agents as counsellors was DOCTOR, a variation of ELIZA. DOCTOR mimicked a psychoanalyst by paraphrasing or mirroring. It is quite amusing to talk to DOCTOR, but not very helpful to solve real world problems [4]. Researchers have continued to develop demonstration systems with natural language capabilities, although none of them could pass the "Turing Test" requiring indistinguishability from human operators [4]. In the early 1980's, ALICE [34] was created, together with the Artificial Intelligence Markup Language (AIML). While ALICE conversational capabilities where never outstanding, AIML is still used to represent the pattern-matching rules that link user-submitted words and phrases with topic categories. Modern conversational agents receive natural language input, sometimes interpreted through speech recognition software, and may engage in goal-directed behavior (often on behalf of a human user)[3] [31].

Indeed, they have greatly influenced user interface development since the early 1980s [3]. However, conversational agents have only recently become easy to implement due to plentiful open source code, widely available development platforms, and implementation options via Software-as-a-Service (SaaS). A pre-condition for successful adoption of software agents in counselling is establishing trust in the counsellor [1], encouraging people are ready to express their true feelings as well as their distress [23]. The detection of clients' emotion changes is also important [10].

[3] Interactive Voice Response (IVR) systems used in voice menus are also dialog systems but are not usually considered conversational agents since they implement simple decision trees.

Cloud Computing Vendors are providing platforms (SaaS) for building conversational (software) agents called chatbots. Such platforms include API services for speech recognition and natural language processing. For instance, Microsoft provides Microsoft Speech Recognition API [17] and IBM provides IBM Watson Speech to Text API [8]. Each of both services has a text-to-speech conversion API. These APIs enable bi-directional conversion between voice and text to construct conversational agents. Implementing chatbots requires stitching together several components. Microsoft Conversational AI tools enable developers to build, connect and manage intelligent bots [18]. Developers can add layers of sophistication to their bots or conversational agents by using a panoply of services that include language understanding, speech recognition, and so on. IBM Watson AI Assistant [8] is also a framework for building such agents. Usually, chatbots built using such platforms can answer just simple questions in rather short speech conversation.

A related research area deals with "embodied conversational agents" in the forms of animals, or humanoid robots [31]. Recently, simple non-anthropomorphic robots for mental care and rehabilitation have been getting much attention [33, 15, 32]. The former works off human frustration by making users enjoy the shape or texture of animal-inspired robots. For example, a simple non-anthropomorphic robot of a seal robot called Paro is reported in [33] to have mental healing effects. This robot models a baby seal having a cute appearance. Its fur is nice to touch, and it has a pleasant childlike voice. However, the words it recognizes are very limited. The latter [15, 32] mainly focuses on the construction of complex systems including robots. For them, body movement is just a part of system features, though they use multimodal interaction whose effects are proven in some degree. Robots as chatting friends are also getting much attention [25]. These robots use social body movements to support non-verbal communication in the framework of multimodal interaction [11]. Recent studies on children [38] also confirmed that social movements significantly increase likeability of the robot. Recent research [22] showed that nodding behavior has an important role as a social signal or social body movements to support non-verbal communication. Some researchers [20] showed that the nodding head motion significantly increases the ratings of subjective likability and approachability. However, their prototypes were evaluated without conversational interaction [18]. Recent research [2] confirms that socially assistive robots (SARs) capable of social movements can stimulate interaction, helping people with health conditions to maintain positive social lives.

3 Baseline System

3.1 The Baseline Counselling agent: CRECA

CRECA (Context Respectful Counselling Agent) [28] can engage in a dialogue session with clients like human counsellors. CRECA uses ELIZA-style mirroring [36, 35], but also generates its own responses for digging deeper. Furthermore, it supports periodic summarization of clients' previous utterances, considering emotion and chronological order. Summarization helps clients to check how accurate the counsellor's listening has been, as well as reviewing their own thinking. CRECA detects emotional words within clients' input. On recognizing the emotional change,

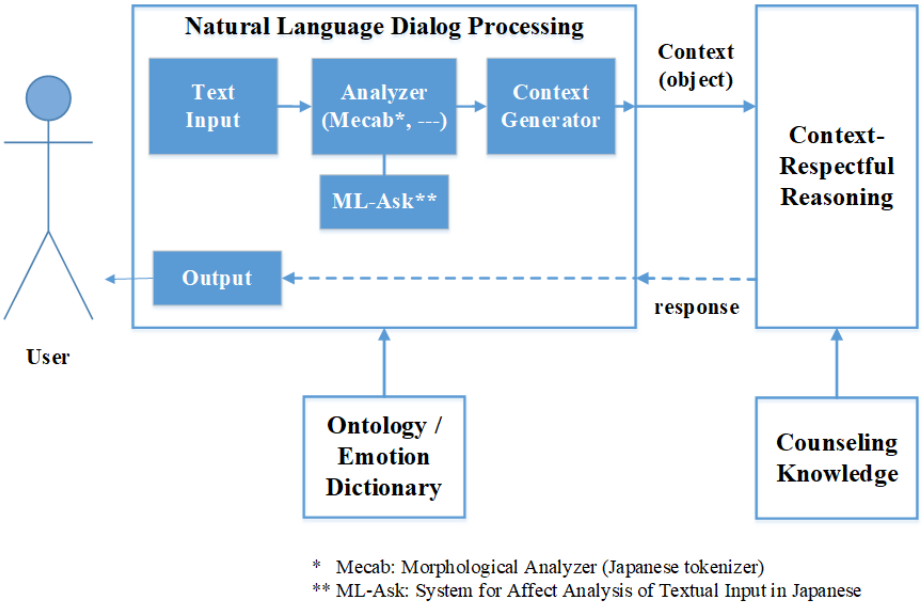

Fig. 1 CRECA system architecture.

the agent replies with a summary, aiming at (1) checking if clients accept the summary and (2) recognizing the emotional change.

3.2 Implementation of Baseline CRECA

Fig. 1 shows the overall architecture of CRECA. By natural language processing, terms and their structure are extracted using an ontology dictionary, and then saved in context objects. CRECA creates its dialogue response using information stored in context objects and an internal Counselling Knowledge Base (CKB). The natural language dialogue processing module consists of (1) an initialization and termination module operating as the interface between humans and the Counselling Agent (CA), (2) a text analysis module and (3) a text input / output module. When the CA is launched, the initialization/termination module initializes the context objects and generates the dialogue-starting messages. At the end of the interaction, it saves all relevant information (including the conversation log) and generates the dialogue-end messages.

In the text analysis module, dialogue texts are tokenized. Then, a context analysis is done. New context objects are generated according to the user input, the current state of the context objects, and the ontology dictionary. Via the dialogue text input/output module, the CA receives the client's inputs and outputs responses to the client. The counselling knowledge base contains prompts to narrow down the dialogue context or dig deeper in the client's problems. Such prompts are combined with the identified context objects to generate the agent's responses.

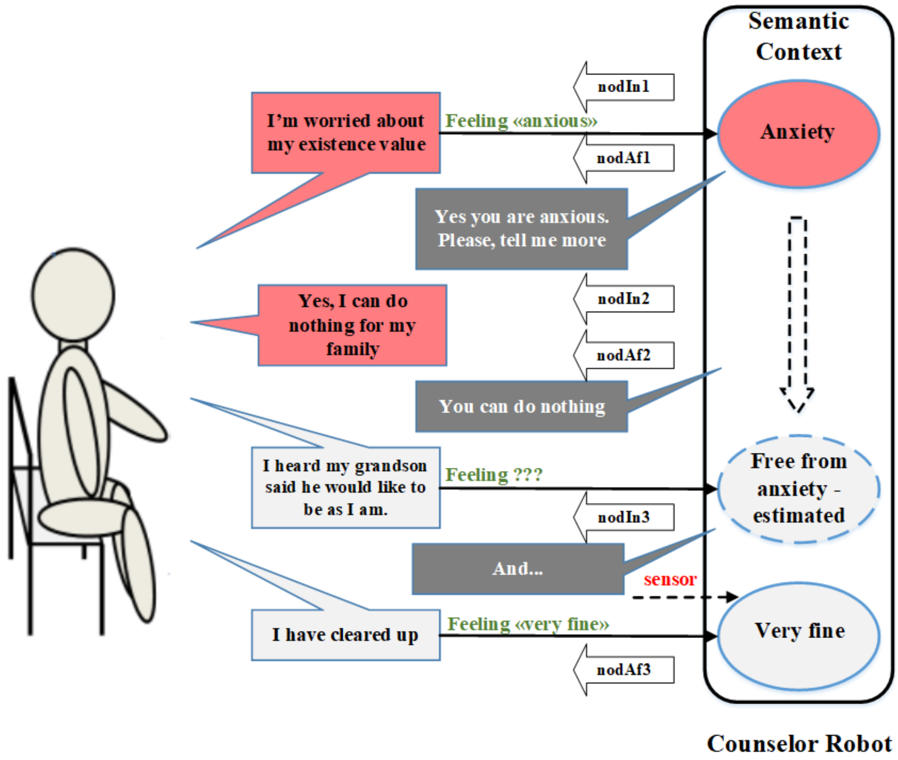

Fig. 2 Conversation flow in counselling robot with nodding behavior.

3.3 Limitations

CRECA does not attempt to suggest specific remedial actions; it fundamentally responds only to confirm/summarize clients' utterances or to encourage them to dig deeper. As CRECA internal rules for summarization and digging must be limited in number [28], care has been taken to prevent conversation from being repetitive and boring. Thus, CRECA uses fuzzy reasoning to guide selection among different digging prompts for avoiding repetitive dialogue [28, 29].

4 Adding Social Motions

As described in Section 2, CRECA [28] adopts client-centered therapy's assumption [23] that unconditional positive remarks will build clients' trust in a software counsellor [26]. A way to build trust is to show that the therapist pays attention to clients. To show attention, non-verbal communication is useful, and nodding behavior has an important role [22]. Besides "unazuki" continuous nodding, there are other non-verbal signals such as "ojigi", that is nodding once deeply. While "ojigi" expresses courtesy or gentleness, "unazuki" expresses empathy leading to unconditional positive trust-building.

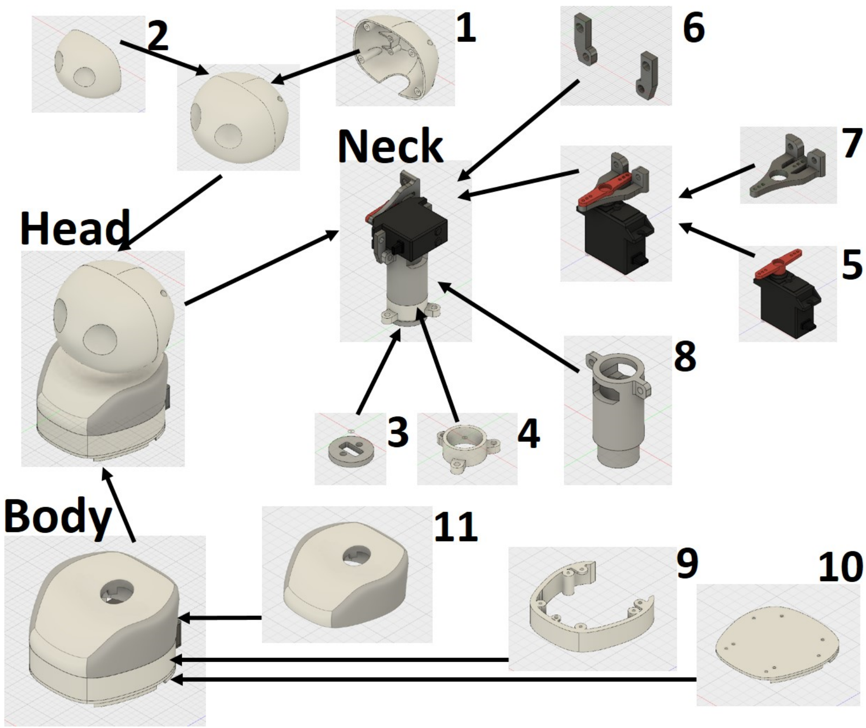

Fig. 3 Counselling Robot's composition.

Therefore, we connected a robot with CRECA and equipped it with Japanese non-verbal "unazuki" communication to clients. In this section we describe and discuss the impact of the integration between CRECA and a simple robotic body capable of social movement. A qualitative, descriptive, exploratory design was employed [37]. The robotized version of CRECA firstly displays an avatar on the screen to make the CA visible. Then, it exploits "unazuki" to underline empathy or unconditional approval as required by Rogers-style counselling. Cultural factors play a significant role in our choice of movements. Japanese communication requires to keep aware the conversation partner that he/she still has the partner's attention. Japanese people do that verbally by interspersing short remarks of agreement (called "aizuti" in Japanese). Non-verbal communication, especially nodding or "unazuki" is also used to express empathy in Japanese conversation. Our robot's nodding timing was designed as follows: (1) the CA nods shortly after the client inputs a statement to the CA. (2) To avoid repetitive behavior, time between the client utterance and the nod is randomized within an interval that depends on the length of the utterance. An example of a dialogue using nodding behavior is shown in Fig. 2.

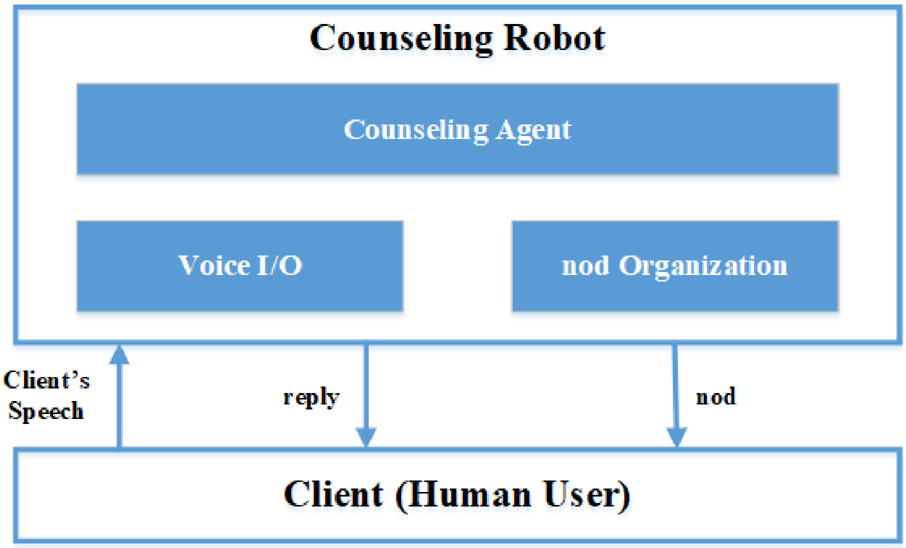

Fig. 4 Organization of the Robot.

5 Implementation of CRECA Nodding Robot

Our CRECA embodiment was driven by the idea that social interactions can establish simple robots as entities worth of human empathy [7]. Our robot was designed to be inexpensive and 3D printable [16], while providing ample room for customization of morphology and proportions. Here to avoid giving a client a bias for a robot caused by its figure, we design a robot as it has no personality.

This way, the entire robotized CRECA can be made available as an open source service for compassionate healthcare facilities [12] or individual users willing to print the robot on their premises. Our robot consists of three main parts: head, neck, and body. Fig. 3 shows the way our robot is assembled. All components are saved as STL, the *de facto* standard format for 3D modelling, so that our robot can be manufactured by anyone.

The construction of the head is performed by putting together its rear part (1) and its front part (2). The construction of the neck necessary for nodding is performed by attaching the neck gear (3), a neck-holder (4), the servo (5), two servo mounts (6), and the servo connector (7) to the round neck torso (8). The body is assembled by attaching the body-box (9) to the flat body-seat (10) and putting the body-top (11) on top of it. Finally, these three main parts are assembled together. Fig. 4 shows the overall organization of the robot. The robot is equipped with a Raspberry Pi3 computer having interface for data input/output and is controlled by a browser program in JavaScript. Raspberry Pi3 I/O interfaces support extending our robot design in order to perceive (rather than simply listen to) the client, connecting a camera or other input devices in addition to the microphone and speakers currently available. Fig. 4 shows the conceptual organisation of the system, while Fig. 5 shows the hardware/software architecture including the robot. As shown in Fig. 5, the bi-directed communication between the user (client) and CRECA is as follows: 1) The client utters the emotional words/phrases. 2) CRECA (via the robot) responds by "Unazuki" (Japanese nodding) and utterances such as "un un", followed by paraphrases and/or a summary of previous user input. Then, it utters a prompt to narrow down the dialogue context or dig deeper in the client's problems. Voice dialogue is handled through JavaScript code called by Google Chrome (on the local PC) using Google Cloud Speech API (at the server site) and Google Speech Synthesizer (at the client site). The speech API is deployed at the server site. It performs speech/voice recognition and generates the texts as the recognition result. Texts are sent to the remote server through the local webserver. A WebSocket script handles the session of conversation for counselling. Texts generated as responses by CRECA are sent to the robot, where the speech synthesizer translates the response texts to voice output.

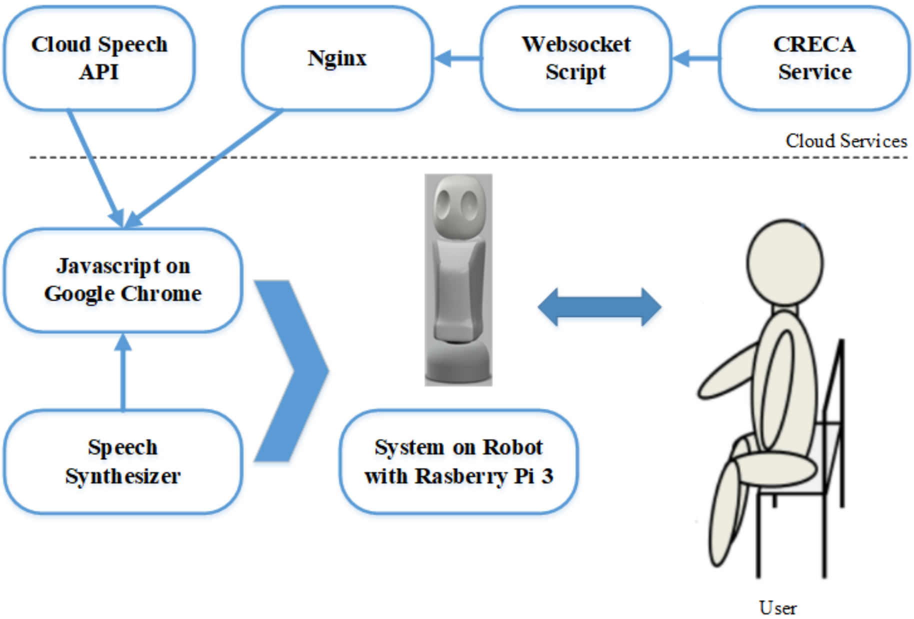

Fig. 5 Architecture of the entire system

The robot's data processing flow (Fig. 6) is as follows:

1. Input of client's voice data
2. Voice recognition to produce a text out of client's voice
3. Automatic correction of voice recognition results, using our recognition error correction dictionary
   a. Voice recognition results by WebSpeechAPI are obtained.
   b. Speech recognition error by WebSpeechAPI is automatically corrected, using our correction dictionary (a tuple of possibly mistaken word or phrases and their corrections). The dictionary consists of correction pairs such as [recognition error (word or phrases), expected recognition (word or phrases)]. For example, correction pairs = {("残量" (remainings), "残業" (over-

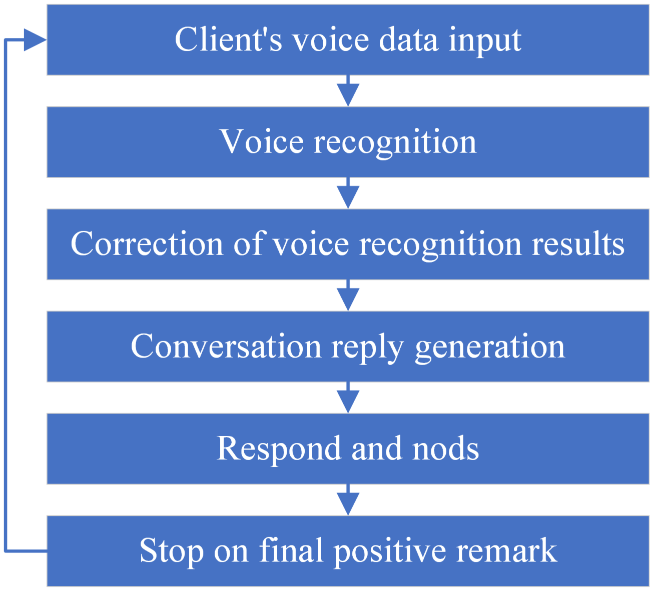

Fig. 6 Robot's data processing flow.

works)), ("いつもピリ" (always hot)", "いつもビリ" (always last)),...)}. These correction pairs are manually entered and dynamically added to the dictionary by our interactive dictionary editing tool for automatic correction of speech recognition error.
   c. For each correction pair in the above-mentioned dictionary, the recognition error in string is replaced with the expected recognition.

4. Dialogue correction of the voice recognition results by dictionary
5. Conversation reply generation
   a. Morphological analysis of the input sentence structure
   b. Rule-based generation of the response
6. Output of response and nods
   a. Recognize a change in feelings by comparing current input with inputs of the conversation so far
   b. In case of an improvement of feelings is detected, add a corresponding remark to the reply
   c. In case a desire was expressed within the previous two dialogue interactions, add relation between the desire and the feeling to the reply
   d. In case there is no desire expressed within the previous two dialogue interaction, ask the client to express a desire
   e. If there more than one of the above rules applicable, identify the most appropriate one by fuzzy reasoning
   f. Generate timing of output noddings, whose number of times and duration are computed as in (e).
   g. Generate voice for the derived output based on a Japanese Kanji dictionary
7. Stop the conversation, if there is a final positive remark of the client such as "I feel refreshed" or "It was good" or there is no further clients input

6 Evaluation

6.1 Experimental design/method

Along with the research background presented in Section 1, we defined some hypotheses to be tested by our experiment. Humans tends to experience closer intimacy, with a real body than with a disembodied avatars. Adding a non-verbal body language to real robots reduces the mechanical, cold impression given by text messages. This encourages clients to talk longer. Our first hypothesis to be tested is as follows:

H1. As robot's "unazuki" (Japanese nodding) increases empathy, clients/ users feel trustworthiness or kindness and dialogue continues longer (the amount of utterance increases)

When dialogue continues longer to deepen and concretize user's spiritually suffering topics, user's reflection proceeds and thus their awareness becomes increased and profound.

The second hypothesis to be tested is the following:

H2. As the degree of empathy increases (dialogue continues longer), self-awareness becomes deeper or its degree increases.

6.1.1 Experimental design.

We compared the duration of dialogues involving CRECA with "Unazuki" type of nodding and the one without nodding. A classic survey was also used through gathering qualitative assessment after the session. The experiment adopted a within-subject design for testing hypotheses H1, H2.

6.1.2 Variables, Factor and factor levels.

In our experiment, the independent variable is "Unazuki", or better if our 3D robot connected with CRECA has "Unazuki" or not. Dependent variables are the amount of utterance and user's feelings or subjective impression such as trustworthiness, kindness, awareness etc. The experiment was scheduled immediately after client's utterance to express further or maximum empathy with clients. Such experimentation settings are shown in Table 1.

6.1.3 Subjects.

Experiments were performed on 10 male students aged from 21 to 29. By focusing on young male students made sure to filter any adverse effect of gender and old age in human-robot interaction [19].

6.1.4 Measurements of dependent variables.

Our experiment design aims to show that there is a statistical correlation between the presence of "Unazuki" nodding and change of a classic quantitative metrics used to measure the quality of conversational agents, called utterance amount for testing H1. These metrics measure the length of dialogue sessions and have been

Table 1 Experimentation Settings

Item	Content Setting
number of nods	2
nodding degree	20
nodding timing	silence after client's utterance is detected
dialogue system	CRECA

Table 2 Survey Settings

Item	Content Setting
number of people	10
Settings	1^{st} time: previous method (CRECA without nods) 2^{nd} time: newly proposed method (CRECA with "Unazuki" nods)
evaluation method	evaluation of impression,value of the utterance amount
dialogue content	worries about job hunting and going activity

shown to be well related to Caller Experience, a subjective measure describing how well a human interlocutor was treated by the dialog system [30]. The quantitative evaluation based on the utterance amount is illustrated in Fig. 8[4]. It basically determines the type of words (noun, verb, and other particles). Fig. 8 illustrates the estimation of the conversational agent performance based on utterance mount [30]. Table 2 shows the corresponding survey's settings.

For testing H2, we use a questionnaire to measure the subjective assessments expression (on 0-7 a classic Likert scale [13]). Each subject experienced 20 key emotions related to human-system interaction experience [24], namely (a) brightness, (b) enjoyment (c) motivation (d) goodness (e) friendliness, (f) kindness, (g) prettiness, (h) stability, (i) rationality, (j) complicacy, (k) reliability, (l) warmness, (m) sensitivity, (n) poise, (o) fascination, (p) discretion, (q) softness, (r) cheerfulness, (s) sense of responsibility, and (t) quietness.

Our experimental setup is shown in Fig. 9. Our experiment design aims to show that there is a statistical correlation between the presence of nodding and change of a classic quantitative metrics used to measure the quality of conversational agents, called utterance amount. These metrics measure the length of dialogue sessions and have been shown to be well related to Caller Experience, a subjective measure describing how well a human interlocutor was treated by the dialog system [30]. The quantitative evaluation based on the utterance amount is illustrated in Fig. 6. It basically determines the type of words (noun, verb, and other particles). Fig. 7 illustrates the estimation of the conversational agent performance based on utterance mount [30]. The corresponding survey's settings are shown in Table 2.

6.2 Experimental Results

We carried out an experiment to compare the performance of our robot to baseline CRECA. Fig. 10 shows the experimentation result by comparing the utterance amounts without nods (blue bars) versus with nods (red bars); individual values are shown in Table 3. Regarding the survey results, Fig. 11 shows the subjective

[4] Since a Japanese morphologic analyzer (MeCab) was used the dialogue language analysis, this dialogue can be shown in Japanese only.

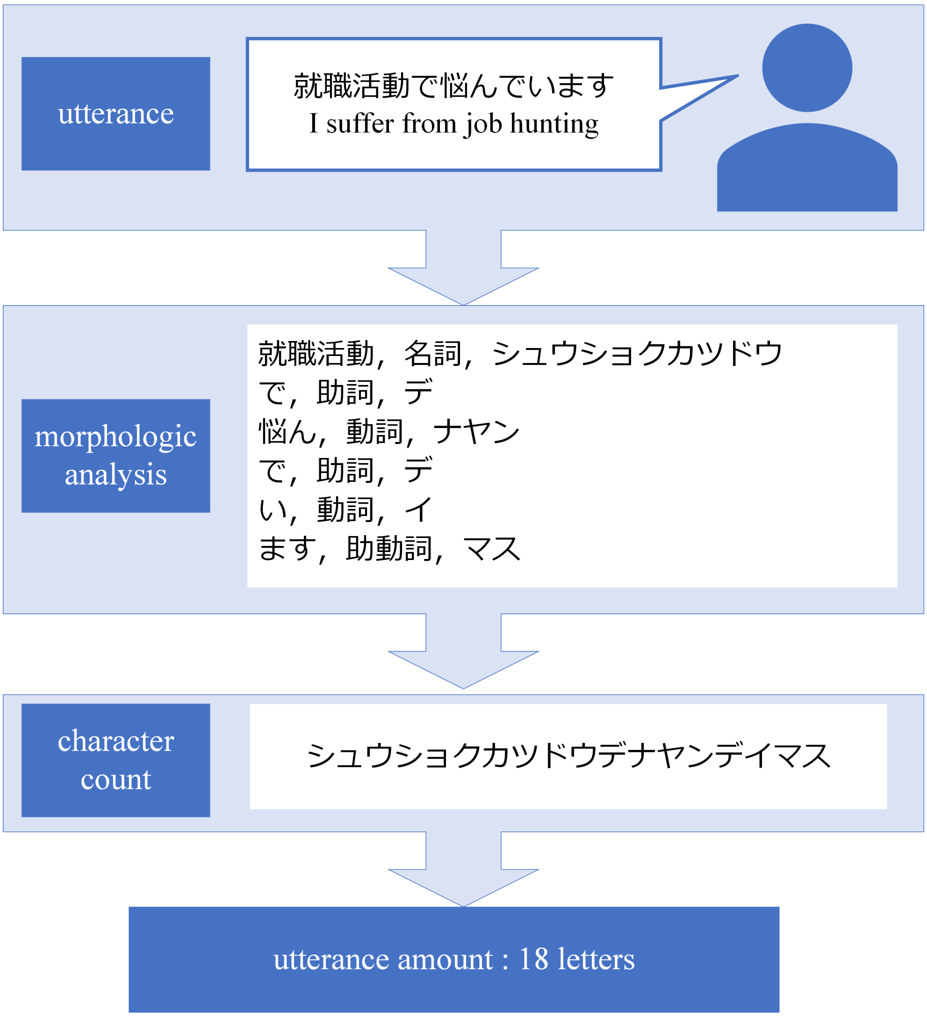

Fig. 7 Quantitative evaluation based on utterance amount (letters).

assessments expressing up to which degree (on 0-7 a classic Likert scale). The influence of nod movement on the quality of the interaction is clearly shown by the quantitative comparison of the utterance amounts as well as by the questionnaire after counselling. The increase of the utterance amount by introducing the nodding behavior was 541 versus 490 characters, namely 7% up. Subjectively, “unazuki” was reported as encouraging toward continuing the conversation and promoting self-reflection.

As shown in Fig. 11, CRECA robot with “unazuki” was ranked higher (better) than one without “unazuki” in most feelings. Especially, the robot with “unazuki” was very high in trustworthiness and kindness, achieving a 5.5 (Likert scale) average for both feelings over the sample of 10 persons though CRECA robot wit-

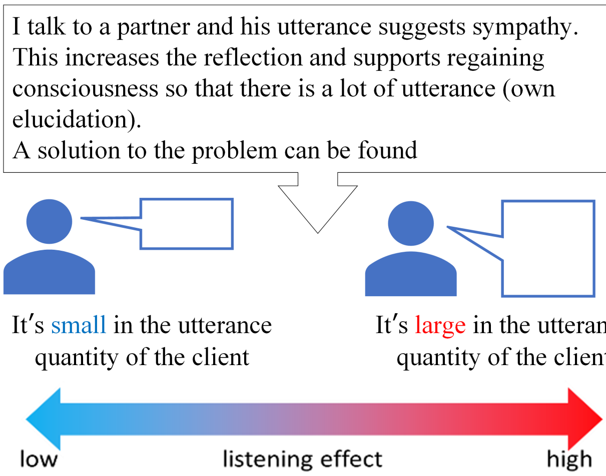

Fig. 8 Listening effect estimation.

Fig. 9 Experimental setup.

hout "unazuki" was 3 in kindness and 4.5 in trustworthiness. These factors is so important to build up trust between a therapist and a client.

All clients except no. 9 felt trust earlier and counselling proceeded faster than the case without "unazuki". As a result, the utterance amounts increased. The research reported in [22] did not analyze such performance experimentally. Other works [20] demonstrated that the clients' attitude will change only by seeing the person who is doing the nodding notion. Their results showed that the nodding head motion significantly increased ratings of subjective likability. However, this evaluation was carried out only by showing CG movies without dialogue. To the best of our knowledge, our work is the first study to verify the effect of nodding motion in a fully fledged dialog system.

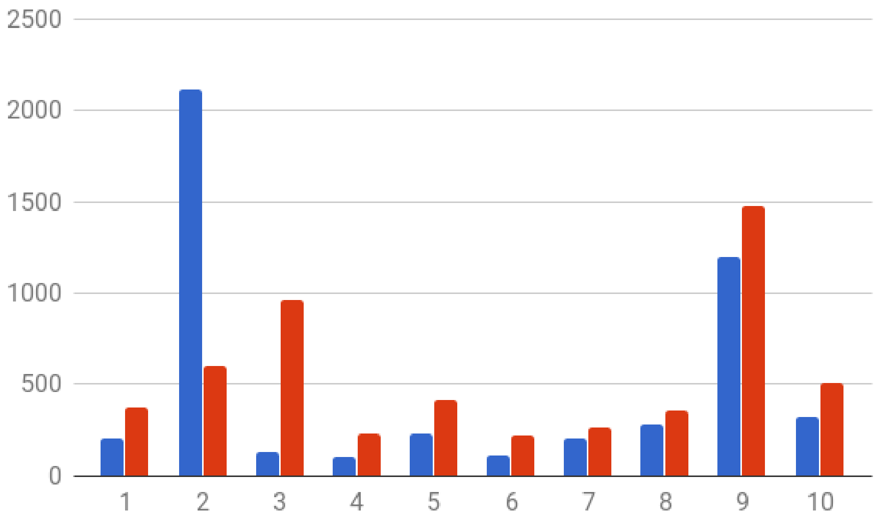

Fig. 10 Utterance amount (letters)/person, with nod (red bar) vs without (blue).

Table 3 Quantitative Evaluation Results using the Utterance Amount

Subject	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**average**
Utterances w/o nod	206	2110	134	102	227	115	203	277	1198	325	489.7
Utterances with nod	327	600	966	232	416	225	261	355	1478	504	540.9
Differences	166	-1510	832	130	189	110	58	78	280	179	51.2
Difference rate	0.81	-0.72	6.21	1.27	0.83	0.96	0.29	0.28	0.23	0.55	1.0715

7 Conclusions

We integrated our CRECA software counsellor with a 3D-printable, nodding ("unazuki") robot. Experimental results showed that culture-specific robotized counselling transmits to people the amount of "empathy" that leads to a higher level of trust than other disembodied conversational agents. Our overall conclusion is that the robot embodiment accompanied with culture-specific body language causes a significant difference in the interaction quality and quantity even for more general less introspective less self-searching immature clients such as students. CRECA robots equipped with and without culture-specific nodding were compared by the test group of students. The increase rate of the utterance amount by introducing "unazuki" behavior causing "empathy" was 7, which means longer interaction/ dialogue. Further, according to subjective feelings generated by interaction, CRECA robot equipped with "unazuki" achieved a very high acceptance rate (Likert scale: 5.5 of 7) in trustworthiness and kindness. The following results were proved: 1) CRECA combined with a nodding robot increases the feeling of trustworthiness (Likert scale: 5.5 versus 4.5) and kindness (Likert scale: 5.5 versus 3). 2) This feeling caused longer dialogue continuity (7% increase due to "unazuki") for deeper awareness to solve problems of rather general people (clients).

In the future, we will aim at further improving the counselling performance by a long-term experiment involving multiple types of clients following the methodo-

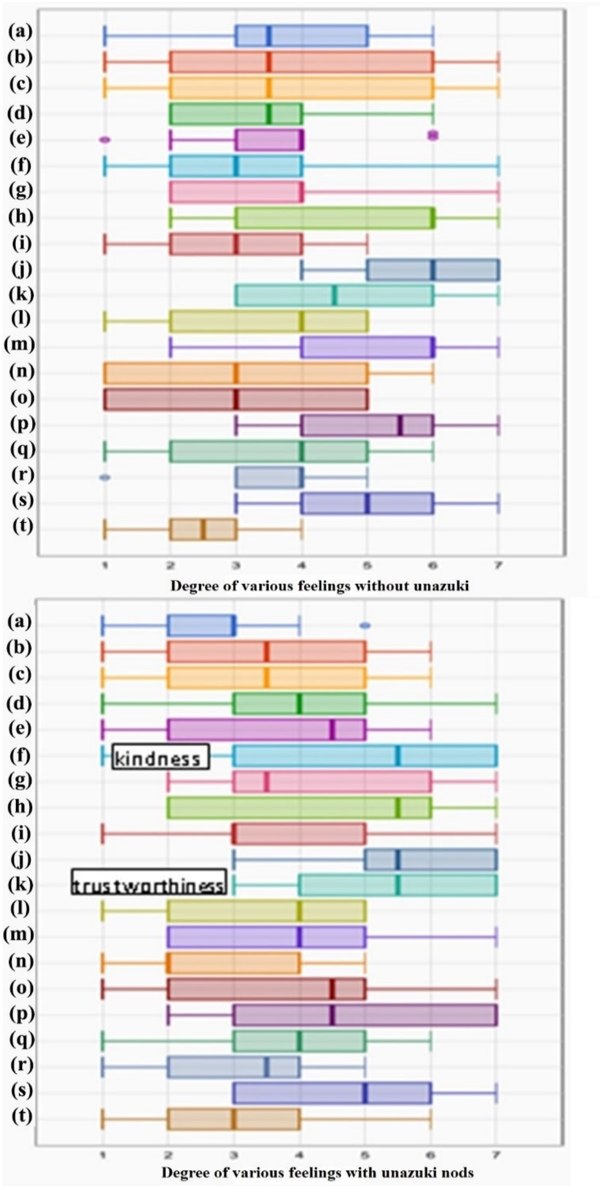

Fig. 11 Degrees of various feelings without "unazuki" nods (on the left) and with "unazuki" nods (on the right): (a) brightness, (b) easiness of enjoying, (c) highly motivated, (d) goodness of the feeling, (e) friendliness, (f) kindness, (g) prettiness, (h) stability, (i) rationality, (j) complicacy, (k) reliability, (l) warmness, (m) sensitivity, (n) poise, (o) fascinating, (p) discreet, I arrive, (q) softness, (r) I was cheerful, (s) a sense of responsibility, I have that, and (t) quiet.

logy outlined in [14]. The 3D printable design of our robot supports the idea of culture-specific libraries of social movements, adapting the gestural repertoire to different human cultures. We are considering hand (rather than head)-related social movements targeted to Western and Middle-Eastern users. Additionally, other types of "unazuki" (Japanese-type multiply and very frequently used nodding) will be implemented and experimented. Especially, the nodding timing will be adapted to each individual client or context.

Conflict of interest

The Authors declare that there is no conflict of interest.

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