

ANTON NIJHOLT
University of Twente
Human Media Interaction (HMI)
Enschede, the Netherlands
a.nijholt@utwente.nl

Stand-up Comedy and Humor by Robots¹

1 Introduction

This paper is not about industrial robots. Such robots perform tasks in factories, in transportation and in many service tasks. Humanoid robots can be used for many other tasks. There are entertainment applications, but certainly there are also applications where a humanoid robot engages in social interaction with its human partners. We can look at chatbot applications, and although nowadays they can have a virtual physical appearance, it is not the case that they interact in a believable way with their users (or audience). Nowadays chatbots appear on webpages often designed by authors without any knowledge about web design, virtual agents (chatbots), natural language processing, and artificial intelligence.

There is an enormous amount of published research on (embodied) intelligent virtual agents. These agents have AI (artificial intelligence) and this intelligence is used to make these embodied agents more natural and human-like in their interactions with human partners. There is also research on embodied agents where the embodiment is physical, rather than virtual. There we enter the domain of physical and social humanoid robots: robots that have human-like appearance, that have human-like behavior and that are accepted by their human interaction partners in believable social interactions. In social interactions, robots, whether they are physical or virtual, have to obey social interaction rules. Social interaction rules include rules that know about humor. Although we may have different senses of humor, we, our friends and relatives, people we meet, know about humor, are able to understand and appreciate humor, and are able to produce humor. In our daily activities there are many situations where we smile and laugh, and although they are not always related to the experience of humorous events, laughing and especially smiling or experience the feeling of being amused is a common-day experience that we would like to see modelled in our interactions with embodied agents, whether they are virtual or physical.

There are many papers in which humor in human-robot interaction is investigated. Also in the popular press we see many humorous examples of interactions with chatbots such as Microsoft's Cortana, Google Assistant and Amazon's Alexa. Often the humor is unintentional, chatbots make errors because of their lack of understanding their human partners. Misunderstandings can lead to humorous situations and interactions [1, 2]. Chatbots or social robots can apologize for their lack of understanding using 'apologetic humor': "Don't blame me. I'm only a robot." A physical humanoid robot needs to display nonverbal behavior related to such an acknowledgement of failure. More generally, a physical social robot in its interactions with human partners needs to understand user-specific and context-specific interaction behavior, including behavior that involves non-literal interpretation (as in non-literal interpretation of texts), cheating, ambiguous, and other ways of potential humorous interaction behavior.

In this paper we survey and comment on research that deals with humor as it can be generated and understood by physical social robots. Ultimately we want to investigate whether humanoid robots can play the role of a stand-up comedian. Such a robot uses humor in its interaction with the audience, rather than in face-to-face communication in a humorous or joke-telling context with an individual. Clearly, we can expect that telling jokes and have humorous interactions with an audience requires knowledge (or intuition) of how to present humor in verbal and nonverbal ways, whether it is in face-to-face interaction or with an audience that provides more global and collaborative feedback.

In the next section (section 2) we have notes on robots that have appeared in science-fiction movies. Robots also appeared in TV shows and usually made an audience laugh because of taking things literally and acting in extreme 'mechanical' ways. There have been stage plays and TV shows that involved humans acting as robots, there have been many movies where humanoid robots or otherwise embodied artificial intelligence (AI) systems display humor. In section 3 we survey attempts to design social robots that know how to tell jokes. Unfortunately all that behavior is scripted, there is no knowledge of the interaction context and there is no spontaneous humor behavior involved. In section 4 we mention some one-man show performances in which digital technology is used, including drones and robots. Section 5 is about research on robots that act as stand-up comedians and that know about audience reactions. Some conclusions appear in the final section of this paper.

2 Robots in Science Fiction Movies, Stage, and TV Performances

Robots were first mentioned in Karel Čapek's R.U.R. (Rossumovi Univerzální Roboti: Rossum's Universal Robots) [3] theatre play from 1920. The play is about a robot factory where except for the managers all employees are robots. In the play the factory is visited by a representative of the Humanity League, an organization that has as aim to protect robots and ensure that they get good treatment. At about the same time a revolt among the robots starts, also initiated by a just started worldwide revolution of robots against humans. One

¹Keynote speech in this congress.

possible way to prevent such a revolution, mentioned in the play, would have been the production of national rather than universal robots and then have robots from different countries that hate each other. Although the robots win, they have limited lifetime and they have no knowledge of a certain secret element of their manufacture. There is a scene, at the end of the play, where two robots laugh. In performances of this play the robots were played by human actors (see Figure 1).



Figure 1. A Robot in Karel Čapek's "R.U.R." Theatre Play (1920)



Figure 2 A Robot in Fritz Lang's "Metropolis" Movie (1927)

Humanoid robots have appeared in many movies, starting with Fritz Lang's "Metropolis" (1927) with a female robot and its inventor who tells us: "Give me another 24 hours -, and no one, ... , no one will be able to tell a Machine-Man from a mortal - - !" The female robot was played by actress Brigitte Helm (see Figure 2). But there were also attempts to build mechanical animals and men². An early humanoid robot, indeed, using the word 'robot', was built in 1934 in Havana by Ángel Surís Busto. The robot with the name Macaz was described in the Cuban news magazine Bohemia (see Figure 3). The robot could shake hands, walk (roll), turn, talk, and smoke. The robot was displayed at many events and a truck took care of transportation from one reception or exhibition to the other. A close-up of its face is in Figure 4.



Figure 3. Bohemia Magazine 1934 on the Macaz Robot



Figure 4. The Macaz Robot

² <http://cyberneticzoo.com/robot-time-line/>

In movies and on stage robots were played by human actors and comedians. In comedy movies actors also displayed robot-like behavior to induce laughter. This was not unusual in the silent comics between the First and Second World War. What about Buster Keaton in his 1920's and 1930's movies not showing any emotion with his stone face and - what movie critics call - his mechanical timing and gags? Clearly, here we can see Bergson's [4] idea that humor comes from "something mechanical encrusted upon the living" put into practice.

Many more movies with human-like robots appeared and still do appear. Robbie the Robot, appearing in the 1956 science fiction movie "Forbidden Planet", became famous. His robot costume was made from rigid parts. An operator had to climb into it in order to have the bulky robot 'walk' around. Robby sometimes used witticisms. In 2004 he was inducted in the Robot Hall of Fame in Pittsburgh.

Very much related to this paper is the "Star Trek: The Next Generation" series (1987-1994). In this series there is an important role for Lieutenant Commander Data, an artificial intelligence that does not know about emotions, let alone humor. In the episode "The Outrageous Okona" aired in 1988 he decides to learn about humor because he knows that it is a very important factor in human relations. He knows what a joke is, he laughs when people expect him to laugh, but humor and jokes only trigger his intelligence and no affective feeling. He hopes to find help from a computer: "Computer, I wish to know more about humor." The computer sends him to a stand-up comedian. Data learns about jokes but is not able to deliver a joke with correct timing and gestures and his joke telling is not appreciated. When being told so he answers: "My timing is digital.", which we can consider as a good example of unintentional humor.

In later years humans were not asked anymore to play the role of robots in movies. Robot technology made it possible to control the movements of a robot performing a particular task and to 'program' the required actions. Moreover, movie directors did not always embody the artificial intelligence in their movies. The HAL 9000 computer in Stanley Kubrick's "A Space Odyssey" is only visible as a red camera eye. HAL can interpret emotional behavior. His attempt to take over the command of the space ship is prevented by the crew by anticipating HAL's emotions. In a Wired 1997 interview Artur C. Clarke, author of the book on which the movie is based answers the question: "So is there a 'Clarke Test' for computer consciousness?" with "I'll tell you what: if it showed a really genuine sense of humor, then I'd decide it was conscious. That could be a really good test. It would have to be able to make jokes - and make jokes at its own expense." Clarke, however, did not give HAL the capacity to understand humor.

In George Lucas's ongoing "Star Wars" (1977-) movies there are lots of human-like robots, but we also have R2-D2, a toy-looking robot with a hardly recognizable human appearance. This is also the case for the main robot character in Disney's "Wall-E" (2008) movie, that resembles a toy bulldozer. In "Interstellar" (2014, Christopher Nolan) we see cubic-like robots that can shift their forms. This TARS robot has different levels of sense of humor. The humor can be spontaneous and sarcastic and we can ask TARS to adjust its humor setting. Not all its humor is appreciated by the crew of the Endurance space craft. Rather than asking to increase his sense of humor they ask him to lower its sense of humor.

Replacing a human actor by a very life-like android has been done in the Japanese movie Sayonara (2015) of director Koji Fukada. Here one of the female characters is played by Geminoid F, a remotely controlled android created by robot researcher Hiroshi Ishiguro.



Figure 5. Mike Michael, the Mechanical Magician



Figure 6. Mr. Zed, the Robotic Comic

In the 1990s we also see comedians acting as a robot. Human robot Mike Michael performed for large audiences as the 'mechanical magician' (see Figure 5). Mr. Zed (David Kirk Traylor), the Robotic Comic appeared in TV shows (see Figure 6) with his robot act

With some reticence we can conclude that an audience does not necessarily expect that the delivery and display of humor and emotions needs a human-like embodiment. From a more general point of view this is of course not unexpected. Jokes and cartoons are humorous just because we understand and empathize with the characters that appear in them. Anthropomorphism plays an important role. We assign human qualities to non-human entities. A human-like robot will certainly evoke this anthropomorphism. But there is not necessarily a need to assume that the delivery of humorous content requires human-like embodiment. That is, humor can be delivered by entities that are not necessarily human, or human-like in appearance and behavior.

3 Robots Displaying Humor

Research on humor in human-robot interaction is usually performed under the hypothesis that the positive effects of humor in human-human interaction will also show in human-robot interaction. From findings on the use of humor in human-human interaction we can conclude that humor helps in reducing tension between conversational partners, it reduces social distance, it improves attention, makes a partner more attractive, and there are positive correlations with work performance and health. Humor also helps to disclose threatening information and it can make partners more open to new perspectives. Hence, part of humor research in human-robot interaction is about investigating whether similar benefits can be obtained in human-robot interaction. Unfortunately, in order to do so we need to deal with a large amount of variables and technological problems. For example, already in 2000 [5] it was shown that humor has a positive effect on the appreciation of a human-computer dialogue. But what happens if the computer gets a humanoid embodiment? Should the robot display facial expressions, gestures, gaze, nonverbal speech and other aspects of human behavior display when telling a joke or making a humorous conversational act? Is the appearance of the robot important? Is there an uncanny valley for humor processing by a robot? How should a robot react on human humor or on human reactions to its humor? Then there are the technological problems. State of the artificial intelligence and robot technology does not allow us to experiment with all these variables. We can only experiment with human-like behavior in the context of physical social robots in very limited ways. There is no way we can simply change the appearance of a robot, its intelligence, its verbal and nonverbal interaction behavior or its physical capabilities. There are no 'natural' circumstances where we can study human-robot interaction. On the contrary, human-human interactions have been studied for many centuries. The study of human-robot interactions usually requires laboratory settings, Wizard of Oz experiments, or the building of specialized robots. And, obviously, there are limited funds, and because of that limited time and only a limited number of participants in experiments. Finally, participants are not necessarily representative for the population of future users of human-robot interaction.

For these reasons, and in addition because humor is a multi-disciplinary field of research, and taken as less important than efficiency issues, the many research questions in human-robot interaction are not explored in a very systematic and elaborate way. In particular, large human-human interaction data collections that contain sufficient humor and that not only contain verbal information but also nonverbal information that can help to detect humor and humor appreciation are missing. For conversational (verbal only) humor there is the possibility to look at automatically recorded telephone conversations, chatbot conversations or meeting recordings. Transcripts of (verbal-only) chatbot interactions were used in [6] to detect possibilities to interrupt dialogues with humorous remarks based on reference-resolution misunderstandings. Hence, the aim was not to detect humor, but to detect where a humorous remark could have been made because of the interaction. Unfortunately, hardly any opportunities could be found in the data collection. Hundred hours of multi-modal meeting recordings have been collected in the European funded AMI (Augmented Multi-party Interaction) project.³ No research on the presence of humor or the possibility to introduce humor in the dialogues in this corpus has been done until now. A more recent project that explicitly addresses humor, including nonverbal expressions, as part of human-robot interaction is the European JOKER (JOKE and Empathy of a Robot) on social and affective relations with a robot.⁴ Some results of this project can be found in [7, 8]. Data collection is one of the aims of the project and results on humor appreciation (human conversational partners that appreciate various kinds of humor generated by a robot) and humor support (humor-related feedback on humor generated by a human conversational partner) have been obtained. Data collection was done with a NAO robot in a Wizard-of-Oz setting. This data, once annotated, allowed machine learning methods to detect features (rules) and classify types of humor appreciation.

Some short surveys of humor in human-robot interaction containing references to less recent literature on humor in human-robot interaction can be found in [9]. Among the issues we can find there are the differences in appreciation when jokes are told by a human or a robot, the effects of multimodality, the types of jokes (e.g., disparaging versus non-disparaging), the effect of joke telling on perceived robot intelligence, et cetera.

4. Stand-up Comedy and the Use of Digital Technology

In the previous sections we saw humans imitating robots and robots imitating humans. When human performers on stage or in movies display robot-like behavior they have choppy and mechanical movements, they have clumsy social behavior, there is unawareness of repetition of behavior, and common sense is lacking. Behavior of robots as it is now shown in movies or on stage, whether they are controlled by a human being inside, tele-controlled or (in movies) seem to display autonomous behavior, has developed from clumsy social interaction behavior to emotional and even empathetic behavior. In addition there can be 'superhuman' qualities, not only intellectual but also physical, that surpass human qualities. It may be the case that such qualities are demonstrated at the wrong moment in order to achieve a humorous effect, but there are also many movies where such qualities play an essential role in the narrative.

Solo performers on stage sometimes have digital technology as subject of their humor. They can ridicule Google search, strange autocomplete results and suggested corrections in MS Word. Moreover, they can initiate ridiculous conversations with chatbots. Their smartphone, tablet or laptop can be their digital partner in the performance. In traditional stand-up comedy (or solo performances or one-person shows) we sometimes see the

³ <http://www.amiproject.org/ami-scientific-portal/meeting-corpus.html>

⁴ <http://www.chistera.eu/projects/joker>

presence of a human sidekick. More traditionally, there are many examples of comic duos. In a circus we have Whiteface and Auguste, in movies we have Laurel and Hardy, or Abbott and Costello. Usually they have different, contrasting personalities that cause conflicts, misunderstandings, and humorous situations. In Japanese Manzai comedy we have two actors on stage where one is the 'straight' guy while the other offers ideas and opinions that are not bad at all, but are made ridiculous by the 'straight' guy.

Other examples, where the sidekick is not human but has human behavior, are a ventriloquist and his puppet, where the puppet usually is more clever (and logical in assessing situations) than the ventriloquist. A stand-up comedian or solo performer can also enter a humorous interaction with an audience member or even invite an audience member on stage. For example, during performances of the Cuban comedian Mariconchi (Ricardo Isidró) in Teatro America in Havana it happens that an audience member is invited on stage and has to bear being a victim of his wit. In solo or stand-up performances it is possible that the performer anthropomorphizes some of his stage-props and starts interacting with them as if they were human. Nowadays, can we expect to have smart stage-props that make use of digital technology and interact with the performer in a humorous way?

Before looking in the next section at robots that act as stand-up comedians, we give a few examples of Dutch solo performers who used robot-like devices in their performances. Pieter-Jan Derks is a Dutch comedian who has a drone enter his performance and makes the drone the butt of his humor, allowing it to make photographs of the audience, command it to go head over heels ("Oh, he wants to play. Go ahead. Show us.") and then uses a dog-like command to have it land on the stage (Figure 7).



Figure 7. One-man Humor Show with a Drone

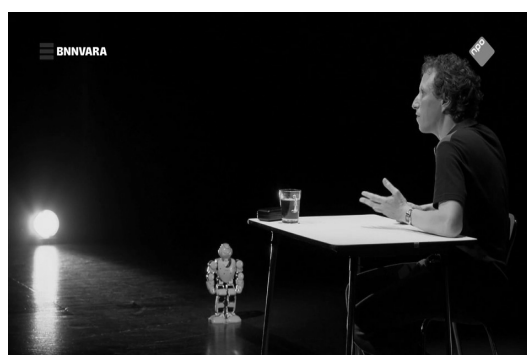


Figure 8. One-man Humor Show with a Robot

Another example is Dutch solo performer Micha Wertheim. In his performance 'Ergens Anders' ('Somewhere Else', 2016) he simply was not present. He had a robot on stage that interacted with the audience and it invited audience members on stage to perform certain tasks. Some audience members became angry, they paid to see their favorite performer, expecting lots of jokes, and instead were confronted with a humanoid robot taking the stage. Hence, they wanted their money back. In a next-year's performance 'Iemand Anders' ('Someone Else', 2017) Wertheim discussed his previous theatre act with his audience. He also entered a discussion with the humanoid robot, that made clear that it was quite unsatisfied with his role in the performance. "You are only talking about yourself Micha. What about me?" (see Figure 8). The robot felt neglected, heard the same stories every evening during the performance and didn't want to be involved in the performance anymore. As part of the performance the robot does imitations of Stephen Hawkins and the Dutch football player Johan Crujff.



Figure 9. 'Lost Voice Guy' Performance at Britain Got Talent

A rather different perspective on the use of digital technology during stand-up comedian performances can be found in the work of the UK comedian 'Lost Voice Guy' (Lee Ridley) [10] who is disabled and unable to speak and uses a voice synthesizer and a tablet to interact with his audience. Based on audience reactions he chooses from preprogrammed texts or types a reaction in his tablet when something unexpected happens. Lost Voice Guy gives professional performances but also took part in the Britain Got Talent competition where he became the 2018 winner.

In these examples we have digital technology as a sidekick or in the case of Wertheim's performance, have a (tele-controlled) robot as main performer. Is there more research where humanoid robots take the role of stand-up comedian, generate humor and are aware of audience feedback?

5. Robotic Stand-up Comedians

We mention examples of robots that are designed as stand-up comedians. A more elaborate survey is in [11].

There are examples of duo or double acts with robotic stand-up comedians. In Japan culture we have Manzai comedy, a traditional style of stand-up comedy. We have two comedians take the stage, one of them talks about a recent experience the other comments on it, expresses doubts, introduces misunderstandings and makes remarks that reduce the credibility of the other actor. There is research where both Manzai actors are physical robots and where one of the Manzai actors is human and the other is a physical robot. So, unlike the examples in the previous section, there is not really a professional performance in which digital and robot technology plays a role, but we rather have demonstrations of research projects in which sometimes also an audience plays a role.

In [12] an interactive Manzai system is introduced where the system is the aggressive and offending partner and its human partner is on the defense. In the interactions the system analyses content, emotion, speed and timing of its human partner's utterances and tries to find an appropriate offensive phrase. In [13] we have a duo comedy performance (not Manzai) by a humanoid robot (Pepper) and a human sidekick. The robot can tell jokes and its movements are scripted for each joke. During a performance a team member takes care of moves and speech of the robot in response to its human partner and the audience feedback. Interesting is an ongoing research project from Konan University, where two robots, inspired by Manzai comic duos, engage in a silly conversation (a 'wise guy' versus a 'straight man') [14,15,16]. Scripts for these conversations are automatically generated from newspaper stories. Their conversations can be watched, there is no interaction with a human participant or audience.

A 'stand-alone' physical humanoid robot that displays funny behavior was designed in Waseda University [17]. Methods for robot skits were extracted from books on Manzai comedy. However, behavior is fully scripted, there is no interaction, just some funny behavior including doing 'unexpected' things, exaggeration, imitation and making self-deprecating humorous remarks. But clearly, to do this in a believable way requires simulating human funny behavior.

In [18,19] we find a report on 'Silicon-based Comedy'. In newspapers the designer's robot was called the world's first robotic stand-up comedian. Nevertheless the designer had to act as a sidekick in order to guide the robot in its performance. The robot had access to audience feedback while telling jokes. By raising green or red signs, registered by a camera, the audience had the possibility to show their positive or negative appreciation of a joke. In addition there were microphones to register the amount of laughter. Based on these appreciations a next joke was selected (see Figure 10).



Figure 10. 'Silicon-based' Robotic Stand-up Comedy

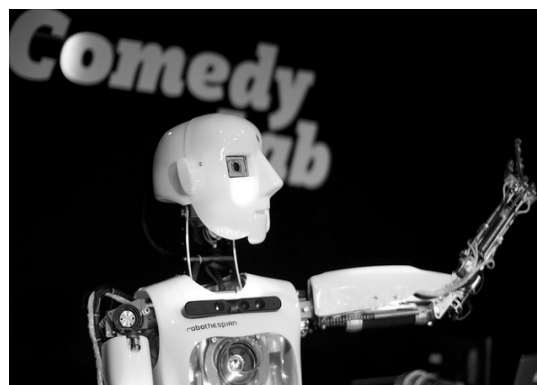


Figure 11. Robotic Comedian (Photo: Toby Harris)

A life-sized humanoid robot that performed at a comedy night has been described in [20]. See Figure 11. This RoboThespian robot controls body posture, head orientation, gestures, and gaze. This allows various ways to tell jokes or to interact in nonverbal ways with the audience. The authors made video analyses of human stand-up performances and annotated nonverbal signals. In the implemented robotic stand-up comedian we see the modeling of gaze behavior (e.g., gaze shifting at the end of a sentence, between phrases, gaze shift to elicit audience response, delivery of punchlines) and other nonverbal comedian behavior when delivering a joke or humorous remark.

6. Conclusions

In a magazine paper on humor and artificial agents it was mentioned that joke telling robots are the final frontier of artificial intelligence⁵. We sympathize with this view, but don't agree. Telling a pre-canned joke can be scripted. We can script the way the joke is told, taking care of the facial expressions, body movements and timing and intonation. It is more interesting when the robot knows when it is appropriate to tell a joke and to choose one of the jokes in its database that fits the situation. In stand-up comedy that situation is a joint agreement between the stand-up comedian and the audience. But clearly, more situation-dependent spontaneous behavior is expected from a stand-up comedian. Improvisation is needed. But it is the stand-up comedian that makes the decisions, it is the stand-up comedian who to a certain extent can overrule the audience. Robotic stand-up comedians can have scripts that exploit such advantages and allow choices that are believable for the audience. For that reason we think that robotic stand-up comedy will improve and given the humor resources that can be made available can perform better than human competitors in a stand-up comedy competition.

⁵ https://motherboard.vice.com/en_us/article/z43nke/joke-telling-robots-are-the-final-frontier-of-artificial-intelligence

References

- [1] A. Nijholt. Smart Bugs and Digital Banana Peels: Accidental Humor in Smart Environments? In: Distributed, Ambient and pervasive Interactions, 4th International Conference, DAPI 2016, Toronto, ON, Canada, N. Streitz, P. Markopoulos (Eds.), LNCS 9749, Springer, Switzerland, 329-340, 2016.
- [2] A. Nijholt. Designed and Accidental Humor in the Smart Digital Wild. Proc. Fifteenth International Symposium on Social Communication "Eloina Miyares Bermudez in Memoriam". Nuevos estudios sobre Comunicación Social, Centro de Lingüística Aplicada, Santiago de Cuba, 310-317, 2017.
- [3] K. Čapek. R.U.R. (Rossum's Universal Robots). Kolektivní drama o vstupní komedii atřech dějstvích. 1920. eBook #13083, Project Gutenberg, 2004.
- [4] H. Bergson. Laughter. An essay on the meaning of the comic. Translated from Le Rire. Essai sur la signification du comique, 1900. Gutenberg project, 2003.
- [5] J. Morkes, H. Kernal, C. Nass. Effects of humor in task-oriented human-computer interaction and computer-mediated communication: a direct test of srct theory. Hum.-Comput. Interact. 14(4), 395-435, 2000.
- [6] H.W. Tinholt, A. Nijholt. Computational Humour: Utilizing Cross-Reference Ambiguity for Conversational Jokes. In: 7th International Workshop on Fuzzy Logic and Applications (WILF 2007), Camogli (Genova), Italy, LNAI 4578, F. Masulli, S. Mitra & G. Pasi (eds.), Springer, Berlin, 477-483, 2007.
- [7] L. Bechade, G.D. Duplessis, L. Devillers. Empirical study of humor support in social human-robot interaction. In: Streitz, N., Markopoulos, P. (eds.) DAPI 2016. LNCS 9749, pp. 305-316. Springer, Cham, 2016.
- [8] L. Bechade, L. Devillers. Detection of humor appreciation from emotional and paralinguistic clues in social human-robot interaction. In: Joshi, A., Balkrishan, D.K., Dalvi, G., Winckler, M. (eds.) Adjunct Conference Proceedings Interact 2017, pp. 215-227. Industrial Design Centre, Indian Institute of Technology, Bombay, 2017.
- [9] A. Nijholt. The Humor Continuum: From Text to Smart Environments. Proceedings International Conference on Informatics, Electronics & Vision (ICIEV), IEEE Xplore, Kitakyushu, Fukuoka, Japan, pp. 1-10, 2015.
- [10] K. Fairclough-Isaacs. Lost Voice Guy: Transcending Barriers of Disability through Technology in Live Comedy Performance. In: D. Reidsma, I. Choi, R. Bargar (Eds.), Intelligent Technologies for Interactive Entertainment. INTETAIN 2014. LNICST 136, Springer, Cham, pp. 91-98, 2014.
- [11] A. Nijholt. Robotic Stand-up Comedy: State-of-the-Art. In: Distributed, Ambient and pervasive Interactions, 6th International Conference, DAPI 2018, N. Streitz, S. Konomi (Eds.), LNCS 10921, Springer, Switzerland, pp. 391-410, 2018.
- [12] N. Tosa, R. Nakatsu. Interactive comedy: laughter as the next intelligence system. In: International Symposium on Micromechatronics and Human Science, pp. 135-138. IEEE Press, New York, 2002.
- [13] S. Cosentino, T. Kishi, M. Zecca, S. Sessa, L. Bartolomeo, K. Hashimoto, T. Nozawa, A. Takanishi. Human-humanoid robot social interaction: laughter. In: IEEE International Conference on Robotics and Biomimetics (ROBIO), pp. 1396-1401. IEEE, New York, 2013.
- [14] R. Mashimo, T. Umetani, T. Kitamura, A. Nadamoto. Human-robots implicit communication based on dialogue between robots using automatic generation of funny scenarios from web. In: 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), pp. 327-334, IEEE Press, New York, 2016.
- [15] R. Mashimo, T. Umetani, T. Kitamura, A. Nadamoto. Automatic generation of Japanese traditional funny scenario from web content based on web intelligence. Proc. of the 17th International Conference on Information Integration and Web-based Applications & Services (iiWAS '15), Article 21, 9 pages. ACM, New York, USA, 2015.
- [16] S. Aoki, T. Umetani, T. Kitamura, A. Nadamoto. Generating Manzai-Scenario Using Entity Mistake. Barolli L., Enokido T., Takizawa M. (eds) Advances in Network-Based Information Systems. NBIS 2017. Lecture Notes on Data Engineering and Communications Technologies, vol 7. Springer, Cham, 2018.
- [17] T. Kishi, N. Endo, T. Nozawa, T. Otani, S. Cosentino, M. Zecca, K. Hashimoto, A. Takanish. Bipedal humanoid robot that makes humans laugh with use of the method of comedy and affects their psychological state actively. 2014 IEEE International Conf. on Robotics & Automation, pp. 1965-1970. IEEE, New York, 2014.
- [18] H. Knight. A savvy robot standup comic: online learning through audience tracking. In: Workshop paper. ACM TEI, 2010.
- [19] H. Knight. Eight lessons learned about nonverbal interactions through robot theater. In: Mutlu, B., Bartneck, C., Ham, J., Evers, V., Kanda, T. (eds.) Third International Conference International Conference on Social Robotics (ICSR 2011). LNCS 7072, pp. 42-51. Springer, Cham, 2011.
- [20] K. Katevas, P.G.T. Healey, M.T. Harris. Robot comedy lab: experimenting with the social dynamics of live performance. Front. Psychol. 6, 1253, 2015.