

Towards Hypedermocracy: Case Studies on an Agent-powered Online Discussion Support Systems

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Abstract

Online discussion among civilian is important and essential for next-generation democracy. Crowd-scale online discussion platforms are receiving great attention as potential next-generation methods for smart democratic citizen platforms. Such platforms require support functions that can efficiently achieve a consensus, reasonably integrate ideas, and discourage flaming. In this work, we propose D-agree platform in which an automated facilitation agent helps to manage crowd-scale online discussions. An automated facilitator agent extracts the discussion structure from the texts posted in discussions by people. In this paper, we present our current implementation of D-agree, a crowd-scale discussion support system based on an automated facilitation agent, which extracts discussion structures from text discussions, analyzes them, and posts facilitation messages. We conducted a large-scale social experiment with Nagoya City 's local government. The results present that our automated facilitation agents succeeded to gather more opinions from people. Furthermore, we present hyperdemocracy, a vision for the next generation democratic platform.

Keywords: Consensus Informatics, Crowd-scale Discussion Support, Multiagent Systems, Collective Intelligence

1 Introduction

The rapid progress of the Internet completely changed the way to communicate. In particular, with the spread of COVID-19 infections, many people have discovered that many social activities that were once considered face-to-face can now be performed online. Professor Thomas Malone of MIT predicted this 20 years ago in "Future of Work," and he argues that the future will be even more so.

An important feature of online communication is the ability to communicate instantly, even when remote. This reduces travel and location costs and makes more efficient use of time than face-to-face communication. In addition, by using smartphones and other devices, we can be connected almost anywhere in the world at any time. This is the first time in human history that we are always connected, and is called "hyperconnectivity". It is said that humans have evolved dominantly by forming groups and cooperating with each other. The recent hyperconnectivity makes it possible to form groups, organizations, teams,

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or larger relationships much more efficiently, and cooperate with each other anywhere on the planet. Text (especially short texts) communication is often used in online communication. For example, LINE, Twitter, Slack, Facebook, and so on, text communication, rather than voice calls, is the main form of communication. Although text communication is more prone to misunderstandings than face-to-face communication, it can be used more efficiently.

Chatbots are widely used in online communication via text. Chatbots are programs that automatically answer user inquiries. In general, they follow predefined stories and rules to guide users to the answers they seek. For example, chatbots are used to answer questions on online banking and airplane ticket reservation sites, as well as to accept reservations for Corona vaccination. Chatbots are less expensive than telephone call centers. On the other hand, chatbots have the disadvantage of only being able to perform interactions that are defined in advance as simple rules.

In the field of AI research, there was news that an AI program won the world championship in Go. However, a program that plays Go can only play Go. A program that plays Go cannot deal with anything other than the initial problem it was given, such as the sudden disappearance of a Go stone from the board (although recently there are programs that go beyond the framework of Go, Shogi, and Chess and learn how to play similar types of games themselves). In other words, many AI programs can only solve problems within the framework of a given problem. In contrast, AI researchers proposed (in the 1990s) the importance of AI programs that interact with their environment, make decisions, and operate autonomously. Such programs were called agents, and the realization of agents became a common goal of AI research. An agent is an AI program or robot that interacts with its environment and operates with a purpose while making decisions autonomously and rationally. Since there will be other agents in the environment, such a system (system) is called a multi-agent system, and interactions among agents are important issues. The fundamental interest lies in how to harness a set of selfish agents. (In this paper, we call them "AI agents" to emphasize that they are "agents" in the field of AI[1].)

In the recent third AI boom, the accuracy of pattern recognition has been dramatically improved by the deep learning techniques that make advanced use of neural networks, and the interaction of AI agents with their environment, interaction between agents, and the mechanism of reinforcement learning has been greatly exploited and has yielded many interesting results. The use of deep learning technology has led to many interesting results. One area where deep learning has had a significant impact is in the field of natural language processing. The field of natural language processing involves the processing of everyday human language in various ways by computers.

In natural language processing, a language model is constructed by quantifying (vectorizing) words (concepts) into a distributed representation. For example, subtracting the "female" vector from the "queen" vector and adding the "male" vector yields the "king" vector, which can be calculated conceptually ("queen" - "female" + "male" = "king"). In recent years, large language models have been developed that include more words (concepts) and allow contextual processing. BERT is one such large language model, built using a state-of-the-art deep learning mechanism called transformer, which is used in a variety of applications. Using these recent language models, it is now possible to classify and process words (concepts) with much higher accuracy than was possible 10 years ago. This enables the construction of AI agents that can understand (classify and process) and respond to human conversations with high accuracy. The difference from the simple program called a chatbot described above is that it makes more profound use of the natural language processing techniques described above.

2 D-Agree: AI-based Online Discussion Support System

As described above, with the spread of online communication in general, online discussion, negotiation, and consensus building as well as information sharing will become important in the future. By conducting discussions online, information on discussions can be stored in a database while being organized. In the future, it will also be possible to search the database for past discussions and automatically find similar discussions. By observing the participants, AI will also be able to understand the opinions of minority groups without overlooking them. With this vision in mind, the author is conducting research with the goal of using AI technology to support online discussions, negotiations, and consensus building.

In 2013, we developed the COLLAGREE system[2, 9, 15, 17, 14], which was actually used to collect citizens' opinions on the next comprehensive plan of Nagoya City in collaboration with Nagoya City, and conducted a social experiment. In the COLLAGREE system, a human facilitated online discussion. In 2013 experiment, a high school student proposed the park design idea, which was actually reflected as a park in 2020. In fact, the COLLAGREE system has allowed us to confirm that citizens' opinions are reflected to the city government. After that, various social experiments were conducted, and it was found that online opinion aggregation was effective to a certain extent.

3 D-Agree System

In 2018, D-Agree[3, 7, 10, 16], a large-scale consensus building support system with an AI agent that facilitates discussions, was developed as part of the JST CREST project. It is currently in operation at Agreebit, Inc. D-Agree (<http://www.d-agree.com>) is being introduced to local governments such as Nagoya City, general companies, and educational institutions such as high schools.

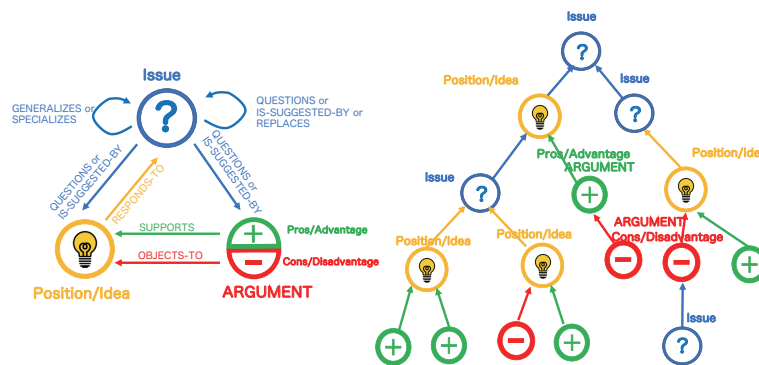


Figure 1: IBIS discussion model

D-Agree itself is a web forum, which is a platform for users to conduct discussions on the web. The AI agent proceeds the discussion based on the desired form of discussion called the IBIS discussion model[4]. Figure 1 shows the IBIS argumentation model. The left panel of Figure 1 shows the three (four) elements of the IBIS argumentation model and their relationships: Issue, Position/Idea, and Argument. Argument (discussion) has two parts: Pros/Advantage (good points) and Cons/Disadvantage (bad points). It is said that a good argument is one that develops based on the above elements, and that this form of

argumentation provides a comprehensive view of the topic under discussion.

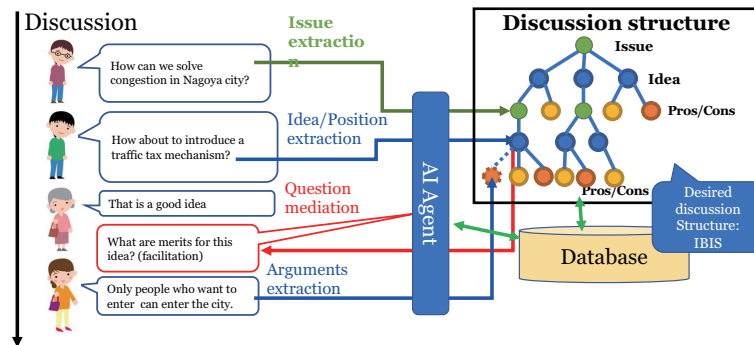


Figure 2: D-Agree Concept[3, 7, 10, 16]

The AI agent can structure discussions in real time as shown in Figure 2 right while interpreting human postings as shown in Figure 2 left. In the left panel of Figure 2, opinions are posted in chronological order from top to bottom. The first remark is: "One of the issues that would improve Nagoya City is the annual traffic congestion problem. The AI agent recognizes (classifies) this sentence as an "issue" using deep learning methods. The AI agent then registers it as an issue in the discussion structure shown on the right side of Figure 2. The next statement is, "How about a system to charge a toll tax for entering the Sakae area, etc.?" The AI agent recognizes (classifies) this sentence as an "idea" and at the same time infers the relationship that this idea is an idea for the above issue. By repeating the above, the discussion is structured. The structured discussion can be visualized in various ways. Further accumulation of the structured discussions makes it possible to search in the future for past discussions that have a similar structure to the current discussion.

4 Case studies in Nagoya and Afghanistan

In 2018, as a joint social experiment with the City of Nagoya, we used D-Agree to collect citizens' opinions on the interim draft of the next comprehensive plan of Nagoya City. For the first time in the world, AI agents facilitated online discussions by citizens. There were five discussion themes (Theme 1-5): Theme 1 and 2 were conducted by humans, Theme 3 and 4 by AI. Themes 1 and 2 were facilitated by humans, themes 3 and 4 by AI agents, and theme 5 was facilitated jointly by a human and an AI agent. There were fewer failures than initially anticipated. An interesting result was that the themes facilitated by AI agents collected almost twice as many opinions as those facilitated by humans. The AI agents were able to respond well to the comments because they were able to reply to them 24 hours a day without fail, thus motivating them to post their opinions. Furthermore, the number of opinions increased when the AI agent co-facilitated with a human who could provide thoughtful comments. In addition, the post-questionnaire showed that users' satisfaction with the discussions facilitated by the AI agent was almost the same as that facilitated by a human, and the satisfaction level was above the average. For details, please refer to the paper [3].

D-Agree is also widely used in Afghanistan. In particular, D-Agree has been well received by the international community. In Afghanistan, it is culturally difficult for women

to participate in politics, but the fact that they can participate in online discussions has also attracted attention [5, 6, 11, 12]. In Afghanistan, some people said that they trusted the facilitation by an AI agent because they could not know the political beliefs of a human facilitator. The UN published a report on the results of the survey. These were reported in a report published by the United Nations, and have attracted attention from the perspective of humanitarian assistance[5, 6, 11, 14].

5 Conclusions

The recent spread of smartphones and the Internet has created a hyper-connected situation. The author introduced D-Agree, a large-scale consensus building support system based on AI agents as a JST CREST research project.

D-Agree's deep learning enables AI agents to classify and interpret participants' comments and structure discussions. This paper introduces the social experiment in Nagoya City and the experience in Afghanistan.

The author is currently researching and developing a hyperdemocracy platform[8, 12, 13] that further evolves D-Agree and supports consensus building with multiple AI agents to ensure the reliability of information on SNS. Fake news and digital gerrymandering have made democratic discussion and consensus building on the Internet and SNS difficult. The hyperdemocracy platform aims to support consensus building and opinion aggregation by deploying AI agents to each user to estimate deeper values and emotions of each user, while preventing fake news.

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References

- [1] Takayuki ITO and Toramatsu SHINTANI: "Persuasion among Agents : An Approach to Implementing a Group Decision Support System Based on Multi-Agent Negotiation", In Proc of IJCAI-97, pp.592-597.
- [2] Yuma Imi, Takayuki Ito, Takanori Ito, and Eizo Hideshima, "COLLAGREE - A large-scale opinion aggregation system based on online facilitation support mechanism - Social implementation for citizen discussion for the next comprehensive plan of Nagoya City," IPSJ Transactions, 2015.
- [3] Takayuki Ito, Rafik Hadfi, and Shota Suzuki, An Agent that Facilitates Crowd Discussion: A Crowd Discussion Support System based on an Automated Facilitation Agent, Group Decision and Negotiation Journal, 2021. <https://doi.org/10.1007/s10726-21-09765-8>.
- [4] Kunz, Werner; Rittel, Horst W. J. (July 1970). Issues as elements of information systems (Working paper). Berkeley: Institute of Urban and Regional Development, University of California, Berkeley.
- [5] United Nation. regional Commissions report on the progress on the Implementation of the New Urban Agenda (2019-2022). D-Agree - An AI-based solution to support participatory urban planning: <https://www.un.org/ecosoc/sites/www.un.org/ecosoc/files/files/en/2022doc/UNECE-QR-report.pdf>

- [6] Jawad Haqbeen, Sofia Sahab and Takayuki Ito. "How did discourse shift among Afghan citizens during the fall of the republic: Early insights using conversational AI platform". The 23rd Annual International Conference on Digital Government Research, June 15-17, 2022.
- [7] Takayuki Ito, "Discussion and Negotiation Support for Crowd-Scale Consensus" in the book "Handbook of Group Decision and Negotiation", Editors: Kilgour, D. Marc, Eden, Colin (Eds.), Springer, 2021, https://doi.org/10.1007/3-030-49629-6_41
- [8] Takayuki Ito, Tokuro Matsuo, Susumu Onuma, Shun Shiromatsu, "Hyperdemocracy: Realization of a Large-Scale Consensus Building Platform Based on Social Multi-agents", 2022 National Convention of Japanese Society for Artificial Intelligence (36th), 2022.
- [9] Takayuki Ito, Towards Agent-based Large-scale Decision Support System: The Effect of Facilitator, The 51st Hawaii International Conference on System Sciences, January 6, 2018.
- [10] Takayuki Ito, Shota Suzuki, Naoko Yamaguchi, Tomohiro Nishida, Kentaro Hiraishi and Kai Yoshino, D-agree: Crowd Discussion Support System based on Automated Facilitation Agent, Demonstration, 35th AAAI conference, February 7-12 2020.
- [11] Jawad Haqbeen, Sofia Sahab, Takayuki Ito and Paola Rizzi "Using Decision Support System to Enable Crowd Identify Neighborhood Issues and Its Solutions for Policy Makers: An Online Experiment at Kabul Municipal Level " *Journal of Sustainability* ,2021.
- [12] Rafik Hadfi and Takayuki Ito, Augmented Democratic Deliberation: Can Conversational Agents Boost Deliberation in Social Media?, International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS2022), 2022.
- [13] Rafik Hadfi, Jawad Haqbeen, Sofia Sahab and Takayuki Ito. Argumentative Conversational Agents for Online Discussions. *Journal of Systems Science and Systems Engineering*. Special Issue on Enabled System Simulation and Modelling, 2020 <https://doi.org/10.1007/s11518-021-5497-1>
- [14] Takayuki Ito, Yuma Imi, Takanori Ito, and Eizo Hideshima, "COLLAGREE: A Facilitator-mediated Large-scale Consensus Support System ", *Collective Intelligence* 2014, June 10-12, 2014. MIT Cambridge, USA.
- [15] Satoshi KAWASE, Takayuki ITO ,Takanobu OTSUKA,Akihisa SENGOKU, Shun SHIRAMATSU,Tokuro MATSUO,Tetsuya OISHI,Rieko FUJITA,Naoki FUKUTA, and Katsuhide FUJITA, "Cyber-physical hybrid environment using a largescale discussion system enhances audiences' participation and satisfaction in the panel discussion", *The IEICE Transactions on Information and Systems*, 2018
- [16] Takayuki Ito, Daichi Shibata, Shota Suzuki, Naoko Yamaguchi, Tomohiro Nishida, Kentaro Hiraishi,and Kai Yoshino, " Agent that Facilitates Crowd Discussion ", *The 7th ACM Collective Intelligence* 2019, June 13-14, 2019
- [17] Takayuki Ito, Takanobu Otsuka, Satoshi Kawase, Akihisa Sengoku, Shun Shiramatsu, Takanori Ito, Eizo Hideshima, Tokuro Matsuo, Tetsuya Oishi, Rieko Fujita, Naoki Fukuta, Katsuhide Fujita, Experimental Results on Large-scale Cyber-Physical Hybrid Discussion Support, *International Journal of Crowd Science*, Emerald Publishing, ISSN 2398-7294, 2017.