brAInstorm: Intelligent Assistance in Group Idea Generation

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Abstract. In order to generate valuable innovations, it is important to come up with potential beneficial ideas. A well-known method for collective idea generation is Brainstorming and with Electronic Brainstorming, individuals can virtually brainstorm. However, an effective Brainstorming facilitation always needs a moderator. In our research, we designed and implemented a virtual moderator that can automatically facilitate a Brainstorming session. We used various artificial intelligence functions, like natural language processing, machine learning and reasoning and created a comprehensive Intelligent Moderator (IMO) for virtual Brainstorming.

Keywords: Artificial intelligence · Brainstorming · Creativity

1 Introduction and Motivation

Computer tools that allow real-time collaboration over the internet can support the process of idea generation [1], as team members can work together from almost any place in the world [2]. One well-known method for idea generation is Brainstorming, which is a creativity technique for groups with the purpose to produce many ideas that may solve a given problem [3]. In order to accomplish this, it is important to follow basic rules and principles, like no criticism, the generation of unusual ideas, quantity breeds quality and the combination and improvement of ideas. With the help of information technology, Brainstorming has already been successfully digitized [4] and been identified to even outperform conventional face-to-face Brainstorming [5, 6]. However, the key to an effective Brainstorming is good facilitation [7], which is fulfilled by a moderator in face-to-face sessions. A moderator executes several tasks, like the encouragement to contribute or the intervention when Brainstorming rules are not obeyed [7]. Besides of the organization and observation of the Brainstorming session, the moderator also acts as an active facilitator by stimulating the participants to spark new ideas. Hence, a moderator usually needs special skills and knowledge on how to facilitate a Brainstorming session. Therefore, in virtual teams and so-called Electronic Brainstorming (EBS), a moderator always has to be present. In our research, we approach this, by developing a virtual moderator, who can facilitate an EBS session by both, organizing a session and providing creativity stimulating content. Even so, different agent-based Brainstorming support systems exist [8, 9], no research on comprehensive virtual Brainstorming moderation and facilitation was found that uses

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features of artificial intelligence (AI). Following the Design Science Research Methodology, we designed and implemented a novel artifact in order to approach this problem in an innovative matter [10, 11]. We strive to create a useful artifact for practice that can fulfill automated Brainstorming sessions. In addition, we aim to deeper understand the interaction between an AI and individuals within a group creativity processes. With our developed prototype, we will provide a first approach on how computer tools can be designed to automatically moderate Brainstorming, which can lead to new insights for research and practice.

As Plucker and Makel show, creativity has various similar, overlapping and synonymous terms, such as imagination, innovation, novelty or uniqueness [12]. Guilford, who initiated the modern creativity era in psychological thinking, describes creativity as problem solving [13] and examined the characteristics of creative individuals. This led to the challenge, if it is possible to design and implement a computer-tool that exhibits creative thinking abilities. As one of the first who looked at creativity and AI, Boden stated why AI must try to model creativity [14]. Today, computational creativity is a multidisciplinary endeavor, overlapping with cognitive science and other areas [15, 16]. According to Besold et al., the target of computational creativity is to model, simulate or replicate creativity to achieve one of the following ends: (1) create a program or computer capable of human-level creativity, (2) help to understand human creativity or (3) construct a program enhancing human creativity without necessarily being creative itself [15]. In the first step of our research, we designed a computer-tool to enhance human creativity without necessarily being creative itself. Our artifact, "brAInstorm", is a web-based tool for collective EBS, with an Intelligent Moderator (IMO), who fulfills various functions of a Brainstorming moderator and addresses a number of current issues in EBS. One benefit of EBS is, that many participants can share their ideas without having to wait for their turn like in face-to-face Brainstorming [17]. This so-called production blocking is effectively addressed with EBS, even so, without a moderator, no feedback can be given to the individuals. However, IMO can reply to every participant simultaneously and provide individual feedback and stimulating content [18, 19]. This additionally implies, that a number of Brainstorming sessions can be conducted at the same time, without the need for more moderators. Another issue in EBS is the use of anonymity to tackle evaluation apprehension (fear of criticism). Even so, anonymity has been proven to be beneficial [20], its effectiveness is still controversial. However, interacting with an AI could solve the problem of evaluation apprehension, as interacting with an AI does not cause evaluation apprehension [18]. Even so, research on AI and group creativity is still at the beginning, our artifact can lead to valuable insights.

2 Design of the Artifact

For the implementation of brAInstorm, we derived basic user interface principles of prior EBS implementations [21–23]. A chat is used, to allow the users to communicate with each other. In addition, participants can add and edit ideas and view other ideas.

For this feature, we used the open-source chat platform Rocket.Chat[1], where we added additional functionalities, like adding and editing ideas. For the essential Brainstorming phases, we adopted the process by Gallupe et al. and implemented it into the system [6]. The process is divided into an individual idea generation and a collective idea evaluation. These phases are facilitated and organized by IMO (see Fig. 1), a chatbot based on Hubot, an open-source chatbot, developed by GitHub, Inc[2]. Besides of organizing the EBS process, the moderator additionally intervenes, if participants use so-called killer phrases, get impertinent or talk too much. The killer phrases are adopted from Dave Dufour, who defined 50 phrases, which can heavily impair a Brainstorming process [24]. IMO is capable of identifying these phrases and intervenes, even if they are alternated. In addition IMO, intervenes, when the group drifts away from the topic or the group stagnates. Even so, Hubot has hearing and responding functions (text/voice input and output), it does not offer conversations, context understanding or machine learning. For this reason, Hubot is extended with wit.ai's Bot Engine. Wit.ai[3] is an open-source and extensible natural language platform, offering various functionalities for building applications, a user can text or talk to. An Intent Parser, which converts user texts or voice into structured data, extracts the intent and other parameters of a user's input. A bot engine combines machine learning with a rule-based behavior, consisting of three key concepts: Stories, actions and an inbox. Stories are rule-like example conversations between the bot and a user, specifying how the bot should react on a certain statement. With the help of wit.ai's predictions, Hubot can execute an action at the needed points in the conversation. Wit.ai's Inbox allows machine learning by collecting all users' expectations. Using this, brAInstorm can be optimized through continuous learning, based on actual usage. With these functionalities, brAInstorm can be seen as a highly novel contribution that offers a comprehensive automated moderation for EBS. Figure 1 shows the adopted Brainstorming process within our artifact and the underlying technology behind each function. A screencast of the artifact is available on https://vimeo.com/203283219 (pw: desrist2017).

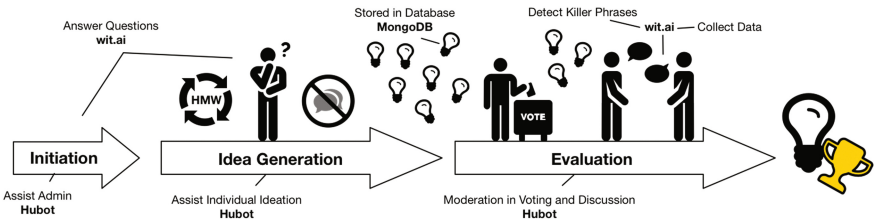

Fig. 1. The Brainstorming process within our artifact, "brAInstorm".

[1] https://rocket.chat/.

[2] https://hubot.github.com/.

[3] https://wit.ai/.

3 Evaluation of the Artifact and Outlook

Our planned evaluation can be divided into two parts. First, we plan to conduct a set of experiments, where we will specifically assess the effectiveness of brAInstorm. We will measure the perceived effectiveness and the perceived satisfaction of the users [6, 25] with the functionalities of IMO and whether the Brainstorming process was successfully executed. Following prior research on group creativity and artificial intelligence [18], we aim to examine, whether specific enhancing and impairing group factors apply, when interacting with an AI. Additionally, we plan to examine the specific functions of IMO, e.g. whether IMO is able to maintain the rules of Brainstorming and if IMO is even able to encourage the participants to contribute. The second part of our evaluation is a long-term case study, where we will implement the artifact in an on-going Design Thinking project. Within the Ideation phase of the Design Thinking mind-set, Brainstorming is often used to generate ideas. We will use brAInstorm for ideation and examine, whether our artifact can be used in virtual teams and effectively substitute a real moderator. Both evaluations can lead to valuable insights, for research and practice. Practice can benefit from an innovative artifact that can be used in creative problem solving in virtual teams. New insights on group ideation and the interaction with an artificial intelligence can contribute to current issues in computer-supported collaborative work, group support systems and collaborative creativity support like production blocking and the use of anonymity [18].

With our artifact, we created an innovative solution for virtual Brainstorming that can be supported, organized and executed with the help of a virtual moderator. With our evaluations, we plan to examine the applicability of our prototype. Furthermore, we plan to examine the interaction between individuals and an AI, which can contribute to the understanding of group interaction theories. In this context, we take our artifact to the next level, by developing an independent artificial participant, a Creative Artificial Intelligence (CAI). Currently we are implementing CAI, a creative and active participant that is capable of human-level creativity. We plan on further investigating the interaction with AI in creative process and examine, whether theories of group interaction apply. In summon, it can be said, that we designed a novel artifact, that can contribute to practice in many ways and change or further develop theories on group interaction.

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