BotViz: Data Visualizations for Collaborations With Bots and Volunteers

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Abstract

Online bots are quickly becoming important collaborators with humans in tackling issues in healthcare, politics, and even activism. Recently, non-profits have used many bots in place of their human members to scaffold collaborations with citizens. However, this shift invites new challenges: it is difficult for outsiders to understand the joint effort that bots have now initiated with humans, limiting the goals reached collectively. To help non-profits coordinate the volunteers recruited by online bots, we propose BotViz. BotViz is a new online platform that via data visualizations provides outsiders a clear understanding of the interactions of bots with volunteers. Our data visualization presents two benefits related to traditional interfaces: 1) Diversity, wherein people can understand the diversity of the volunteers, especially their unique strengths; 2) Stalling, wherein people who may be delaying the collective effort triggered by bots can be easily identified by volunteers. Together, our data visualizations point to a future where humans and online bots can better collaborate in order to have large scale impact.

Introduction

There is growing interest in designing autonomous agents that can act as important teammates for humans to overcome societal problems and challenges. Several investigators have focused on creating systems that can empower better collaborations between automated agents and hu-

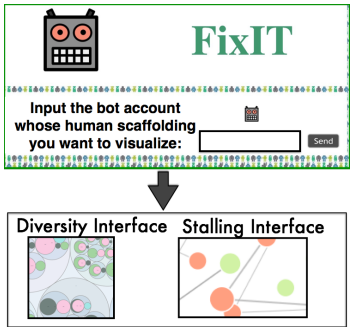

Figure 1: Overview of BotViz's interface. Non-profits input the bot accounts whose collaborations with humans they want to better understand, and BotViz returns data visualizations that show the diverse types of volunteers that bots recruited and the people who could be stalling the effort.

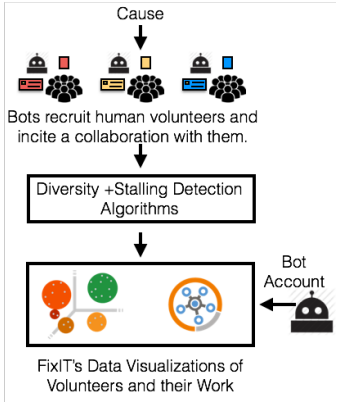

Figure 2: Overview of BotViz's functionality: users input the cause they want bots to scaffold collaborations with humans, and users can then see the type of volunteers a specific bot recruited, and the work produced by such volunteers.

mans. Ramchurn et al. [3] studied techniques for integrating humans and robots to provide more effective responses to disasters. Recently, we have also seen a proliferation of collaborations between humans and online social agents, i.e., bots. Companies, organizations, and even governments are using bots to disseminate their messages to larger audiences and influence behavior. Researchers have started to study community scaffolding between volunteers and automated agents [4].

The high number of collaborations between humans and bots shows the need for interfaces which can better ease the communication between the two. However, given their novelty, most work focuses on simply initiating these collaborations or only detecting bots for spam filtering. As a result, people outside of the experiment cannot easily understand the collaboration nor build upon the scaffolding that bots initiate. This also limits the goals reached by the collective effort, as leaders are obstructed from adopting what the bots started and thus directing the effort themselves for success.

We hypothesize that data visualizations that *profile* volunteers and identify *stalling* can help to better direct a scaffold built by bots. We embody our vision with BotViz: an online platform which, via data visualizations, enables people to understand the characteristics of a volunteer workforce that was recruited by online bots as well as the labor such volunteers have produced. Our vision is that online bots can be used to scaffold community efforts; data visualizations can give insights on how to best orchestrate the collaborations bots have initiated. We tested BotViz with online bots who recruit citizens for different collective efforts, such as to fight corruption or to reduce the gender gap on Wikipedia (For more information on these bots see [5, 4]). Our vision is that BotViz will become a platform that helps humans (in particular, non-profits) scaffold off the collaborations that bots have initiated with human volunteers. Figure 1 shows an overview of BotViz's interfaces, and Figure 2 of BotViz's functionality.

BotViz

Our system has two parts: a data modeling component that infers the characteristics of the volunteers and the type of work they produce; and a data visualization component that presents the information back to the end-user. BotViz focuses on visualizing the information that can help non-profits better build off the collaborations bots have initiated. BotViz presents two core benefits related to traditional interfaces:

1) **Diversity.** The ease by which users can understand the different types of volunteers who were recruited. In particular, we emphasize the diverse types of expertise present in volunteers, as knowing this information can help non-profits to dispatch tasks more efficiently [1]. For instance, a person with specialization in law could help when there are possible violations to the non-profit's members.

We identify the areas of specialization of volunteers based on what they tweet in their personal timeline. We consider that a volunteer's areas of specialization correspond to the topics she tweets about the most. For this purpose, we first link each volunteer to all of the tweets she has ever generated. We then input the tweets of all volunteers into a topic modeling algorithm (in specific Latent Dirchlecht Allocation), in order to discover volunteers' main areas of specialization. An area of specialization is defined as a set of words that frequently co-occur together in the tweets of volunteers. For instance, an area of specialization on "Feminism" might be linked to the words or hashtags of "female", "gender," "#women'sRights". Once the system discovers the differ-

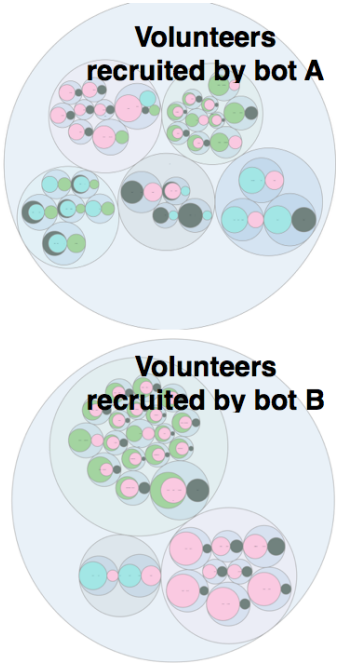

Figure 3: Example of BotViz's diversity interface showing the diverse types of volunteers two different bots recruited.

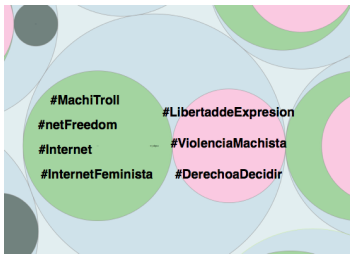

Figure 4: Zoomed-in version of BotViz's diversity interface. It helps understand the details of each volunteer's specialization by seeing the related words or hashtags the person used the most. In this case, a volunteer had two main specialization areas, some words that she used frequently for one area were: Internet, InternetFreedom, Machitroll.

ent areas of specialization of volunteers, it measures how much each volunteer has tweeted about the different areas in comparison to other volunteers. This helps end-users to compare and contrast volunteers.

After this data modeling step, each volunteer is represented as a vector denoting how much she/he relates to a given area of specialization. We then use mean shift algorithm to group together similar vectors and discover clusters of people. We opted to use mean shift algorithm because it is based on a nonparametric density estimation, and therefore we would not need to know the number of clusters beforehand (unlike K-means). Instead, we let mean shift algorithm discover the clusters from our data. The clusters represent volunteers with similar areas of specialization and also allow us to discover the diverse types of specializations present among volunteers. A cluster can, for instance, represent volunteers specialized in technology and feminism.

The information of the discovered clusters, along with the volunteers belonging to each cluster, is fed into BotViz's data visualization engine. The engine graphically represents the data to help users understand the diverse type of volunteers that bots recruited. The engine visualizes each of the discovered cluster as circles, and inside each cluster it presents the volunteers categorized in that cluster. Each volunteer is represented as a circle with a set of nested circles representing her different areas of specialization. For instance, a volunteer specialized in "Feminism" and "Technology", will be illustrated with two circles inside a main circle. Each area of specialization is denoted by a certain color and its size represents how much the volunteer tweets about that area in comparison to others. We propose nested-circles to save space, while still helping users to understand at a glance the diverse types of volunteers present. We play with size to help users to rapidly identify the people with the most expertise in a certain area. Figure 3 presents BotViz's diversity interface showing an overview of the volunteers recruited by different bots. Users can also zoom-in and obtain a more detailed understanding of what each person's specialization entails, specifically the words or hashtags that the person uses the most for each of her specialization areas (see Figure 4). We also plan to explore with interfaces where volunteers can correct the system, and self-report their own expertise and uniqueness.

2) **Stalling.** While the above helps to understand volunteers' traits, this is not optimized to detect who might be delaying the collective effort initiated by bots. We propose a visualization that helps non-profits to identify who is making off-topic contributions, and could be derailing/stalling an effort from its objectives. Visualizing stalling helps non profits to take action to get the effort back on course. To detect off-topic contributions, we take ideas from crowd markets that use gold standards to detect quality work [2]. In this case, non-profits provide examples of on-topic contributions (gold standard) and we use that to detect when a volunteer is on-track or derailing from the effort's purpose. For each volunteer we then calculate the percentage of contributions which were on-topic and off-topic; total number of contributions; and the list of volunteers with whom they collaborated (i.e., they had at least one tweet mentioning them.)

The stalling interface uses this data to showcase the work of volunteers. It represent volunteers as circles, and color-codes them based on their type of contributions. We use a gradient scale to denote how much people's contributions were on-topic or off-topic work. The size of each volunteer shows the number of contributions made. The way by which we encode size and color helps to identify the volunteers who deliver many quality contributions. This is important as such volunteers have the potential of becoming long-term

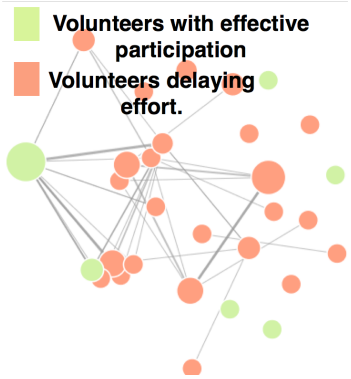

Figure 5: BotViz's stalling visualization helps to understand the type of work contributed by the volunteers recruited by the bots, with a focus on highlighting the volunteers who could be delaying others by being off-topic.

core members of a non-profit. The interface also shows links between volunteers who have collaborated. BotViz's stalling interface thus grants users the ability to not only detect the volunteers who could be derailing an effort, but also the people who might be directly affected by them. Figure 5 presents the stalling interface. Overall, BotViz can empower non-profits to better understand the scaffolding initiated by bots to take action and also to better orchestrate the recruited human volunteers.

Usability Inspection

We ran a series of in-depth cognitive walkthroughs with a small number of subjects in order to solicit feedback about BotViz's basic design, as well as to identify how effective this type of data visualizations might be for: (1) understanding the diverse types of volunteers that a bot recruited; (2) identifying the volunteers stalling the effort by making off-topic contributions. For this purpose, we first ran our bots to initiate collaborations with volunteers. Four of our bots focused on initiating scaffolding to fight corruption, and two on reducing the gender gap in Wikipedia. Our bots recruited 216 volunteers (41 for gender equality and 175 for corruption) who then produced 494 contributions. We collected volunteers' online interactions with the bots, as well as their personal timelines. We fed this data into BotViz in order to generate the data visualizations. We then had our subjects use BotViz to visualize the scaffoldings from each bot. All subjects were able to navigate the represented information within a few seconds and with only minimal instruction. Subjects had positive responses to the visualization and noted that it aided them in knowing the type of volunteers recruited by each bot. Subjects also felt that the visualizations helped to identify the volunteers who might be stalling the effort due to their off-topic contributions. However, some subjects noted that having a balance of off-topic and on-topic contributions might be important in order to not stress volunteers and could actually help execute the effort faster in the long-run.

Discussion

This paper introduced BotViz, an online platform that aims to help humans better build off the scaffolds that bots have initiated. BotViz presents data visualizations that highlight the diversity of volunteers recruited by bots, as well as the volunteers currently delaying a collective effort. A formal user study of our system is forthcoming.

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