Expecting the Unexpected: Distilling Bot Development, Challenges, and Motivations

André M. Pinheiro, Caio S. Rabello, Leonardo B. Furtado, Gustavo Pinto, Cleidson R. B. de Souza
Federal University of Pará
Belém, Brazil

***Abstract*—Software bots are becoming an increasingly popular tool in the software development landscape, which is particularly due to their potential of use in several different contexts. More importantly, software developers interested in transitioning to bot development may have to face challenges intrinsic related to bot software development. However, so far, it is still unclear what is the profile of bot developers, what motivate them, or what challenges do they face when dealing with bot development. To shed an initial light on this direction, we conducted a survey with 43 Github users who have been involved (showing their interest or actively contributing to) in bot software projects.**

I. Introduction

Bots are useful for several other industries in which customer service play a vital role. To answer the far from trivial questions asked by impatient customers, bots became intrinsically sophisticated software systems. With the widespread use of bots, one could expect that such complexity will skyrocket in very few years. In particular, Gartner is predicting that 25% of every costumer service operation will rely on bots by 2020[1]. As a consequence, bot software developers have to master processes, techniques, and tools that are otherwise not readily available items of their programming arsenal.

Although some preliminary work focused on the use of bots in software development projects [1], [2], [3], [4] , little is known about bot developers, what motivate them, or what challenges they face. This work is an additional step to understand the bot developer [5]. Since this research is still in its early stages, in this paper we focus on high-level exploratory research questions. More concretely, the questions we are trying to answer are: **RQ1:** How do bot developers work?, **RQ2:** What challenges bot developers face when developing bots?, and **RQ3:** What motivated developers to develop his(ers) most recent bot?

II. Method

We collected data using a questionnaire. Our questionnaire[2] had 21 questions (15 open). We sent to software developers that have contributed (forking, starring, or providing a pull-request) to a GitHub project that have tagged itself under the "slack bot" topic. To avoid selecting unmaintained projects, we filter out projects that did not have any activity (i.e. commits) during the period of one year. We also did *not* select bots that were too specific, e.g., a bot that auto-likes someone picture in instagram. We obtained 10 open source projects with these characteristics. We invited a total of 2,306 software developers who contributed to a project. We sent the questionnaire in two batches. The first batch target software developers who forked or starred the project. We sent these emails during the period of December 3rd to December 6th. Then, we sent a reminder on December 12nd, 2018. The second batch of email invitations was aimed to developers who performed pull-requests. We sent the email invitations on January 14th, 2019, and a reminder was sent on January 21st. Overall, we received a total of 47 answers. However, we discarded four of them because the respondents of these answers did not have previous bot development experience. The developers who participated in our study are identified as D1 – D43.

[1]https://www.gartner.com/en/newsroom/press-releases/2018-02-19-gartner-says-25-percent-of-customer-service-operations-will-use-virtual-customer-assistants-by-2020

[2]https://goo.gl/forms/f59U1YPF519XaUml1

III. Results

RQ1: How do bot developers work? In this research question we investigate collaborative aspects of bot development. First, we observed that the majority of the respondents (65%) worked alone when developing the bot. For those that work in groups (35%), 40% of them work with groups of two. Interestingly, 13.3% of the respondents reported to work on groups with more than 6 developers. Moreover, the majority of the groups have developers working collocated (61.9%), although distributed bot development is fairly common (38.1%). To aid bot development, these distributed teams use well-known communication and collaboration tools, such as Slack, Github, Gitlab, Jira, and VScode. Finally, the second part of our survey was about the latest bot developed by the respondent. We asked whether the latest developed bot was intended to be used by one person or a group of people, i.e., whether the bot was collaborative or not. We observed that 20.9% of the bots should be used by one person, 41.9% of bots should be used by a group of people, and 37.2% of responses that it can be used by either only one person or a group. This finding poses several challenges. For instance, since developers work mostly alone to develop their bots (65% of them), they might have a hard time trying to test bot features that are intended to work in a group. We will return to this issue on the Discussion section.

RQ2: What challenges bot developers face when developing bots? The difficulties reported by the developers (43 difficulties) are mainly related to the tools used to develop

bots, bot implementation, testing and finding information about bot development.

Bot implementation (37,2%): According to the survey respondents, bot developers should have a more extensive development arsenal to deal with, for instance, how to respond to users actions, which are intrinsically dynamic. To illustrate, D5 mentioned that "*The mapping of user intent and the response to give back [is a challenge]. Currently, [I have] been using the AIML to develop bots aided with the logic out of the brain*". D12 summarized the interaction between the bot and user as "*"Expecting the unexpected*".

Tools used to develop bots (16,3%): The developers had difficulties in finding tools for developing bots. D24, for instance, answered: "*No good frameworks existed for developing Slack bots in Python. I created one (...)*". The difficulty in using the tools were also mentioned in D1's and D2's answers. D1 reported that "*Integrating with third party APIs; orchestration*" is a hard issue, whereas D2 spotted that "*Integration with services, lack of api or documentation*" are a source of concern.

Testing Bots (14%): We gathered evidence that testing is a major concern in bot development. Part of this is due to the intrinsic nature of bots: they have to be integrated with other applications to exist. D16 reported that "*They may be difficult to test on the API calls of the integrated software, since the test API calls may be limited to a simple ping*". Along these lines, D18 highlighted that "*Debug and connect each component*" can be a challenge. Among these applications, the most cited were: Slack, GitHub and Discord, alongside others like Salesforce, Microsoft and IBM Speech-to-Text/Text-to-Speech services and ERPs. In other words, bots are integrated with both open-source and propietary software.

RQ3: What motivated developers to develop his(ers) most recent bot? When analyzing the motivations cited in the open questions about motivation for bot development (38 motivations), we identified four main categories: personal need, workplace assistance, personal learning and commercial purposes.

Personal needs (31,6%): Some bots are created just to attend a personal need, as reported by D2: "*As i'm creating my own house automation box, i wanted a bot to interact with for a lot of purposes: weather, light, ...*". Although some bots were initially designed to deal with specific problems, they can be used for general public, as reported by D11: "*The weather in Korea is very volatile. I made it to know the weather. It notifies the user about weather every day specific time*".

Workplace assistance (26,3%): In this situation, the bot was intended to be used on the workplace environment of the developer. D16 commented that (s)he wanted to facilitate the access to messages exchanged with the client (considering that the team uses a different communication channel from the one used in the client): "*We are using Intercom in my job for communication with clients, and Discord for in-team communication. There was a need for the Intercom messages to be easily visible to the team, without leaving Discord, in order to handle bug reports and requests better*". The bots developed could also be used to automate tedious tasks, as D20 and D24 reported in their answers, respectively: "*Ops automation in team*", "*Automate tasks at my current workplace (which uses Slack) and test drive my own bot development framework for Python*".

Learning (18,4%): In this case the developers simply wanted to gain experience and knowledge about bot development. As an example, D19 reported: "*for fun, and to learn something new*". Also, the different landscape of bot development motivated D3 to develop a bot so that (s)he could "*learn Slack API, computer vision, and to assist with a game*".

Commercial purposes (13,1%): In this category are developers that intended to commercialize their bots. D30 was very objective in his answer. He said: "*Commercial purposes*". In this category, there is also the case of a developer being paid to develop a bot, as is the case of D34: "It was developed for a big company".

IV. Conclusions

In this research revealed that the bots developed are mostly used by few users and had the main purpose of satisfying the developer's personal needs as well as to solve a problem in his workplace or to assist on his daily life. Nonetheless, the task of implementing a bot has revealed to be an activity that can present complicated tasks for the participants mostly when it is related to machine learning. Another problem also mentioned with certain frequency regarded the use of APIs of bot development whereas a huge percentage of the developers reported having difficulties using them.

Acknowledgment. We thank the 43 developers who participate in our survey, the reviewers for their helpful comments, and PROPESP/UFPA and CNPq for the financial support (#420801/2016-2, #311256/2018-0, and #406308/2016-0).

References

[1] B. Lin, A. Zagalsky, M. Storey, and A. Serebrenik, "Why developers are slacking off: Understanding how software teams use slack," in *CSCW*, 2016, pp. 333–336.

[2] S. Pérez-Soler, E. Guerra, J. de Lara, and F. Jurado, "The rise of the (modelling) bots: Towards assisted modelling via social networks," in *ASE*, 2017, pp. 723–728.

[3] M. S. Wessel, B. M. de Souza, I. Steinmacher, I. S. Wiese, I. Polato, A. P. Chaves, and M. A. Gerosa, "The power of bots: Characterizing and understanding bots in OSS projects," *PACMHCI*, vol. 2, no. CSCW, pp. 182:1–182:19, 2018.

[4] N. C. Bradley, T. Fritz, and R. Holmes, "Context-aware conversational developer assistants," in *Proceedings of the 40th International Conference on Software Engineering*, ser. ICSE '18. New York, NY, USA: ACM, 2018, pp. 993–1003. [Online]. Available: http://doi.acm.org/10.1145/3180155.3180238

[5] M.-A. Storey and A. Zagalsky, "Disrupting developer productivity one bot at a time," in *Proceedings of the 2016 24th ACM SIGSOFT International Symposium on Foundations of Software Engineering*, ser. FSE 2016. New York, NY, USA: ACM, 2016, pp. 928–931. [Online]. Available: http://doi.acm.org/10.1145/2950290.2983989