Bot-based IT Troubleshooting

Benjamin Braun, Jonas Jelten*, Simon Bauer*
*Chair of Network Architectures and Services, Department of Informatics
Technical University of Munich, Germany
Email: ga82vah@mytum.de, jelten@net.in.tum.de, bauersi@net.in.tum.de

Abstract—The use of relatively newer technologies like chatbots and artificial intelligence has seen a steady rise for customer service encounters in various companies, in order to minimize cost and personnel while providing a broad access point with an individual feel to it to the general customer base. The state of the art of these chatbots and their use cases is compared for a general overview, as well as their applicability to customer service in IT system administrations and service providers. The difficulties and problems of this specific application, in comparison to other uses of chatbots, are highlighted and discussed.

Index Terms—chatbots, troubleshooting, customer service, service encounters, information technology

1. Introduction

The improvement of customer services in efficiency and effectiveness has always been an ongoing issue across many fields. One of the most promising approaches to solve this challenge is the use of technologies such as artificial intelligence or chatbots, which have been developed heavily over the last decades and seen some significant advancements in recent years.

Chatbots are programs working as a dialog system for human-computer interaction, which emulate human behaviour in a conversation and can provide both chatter and serious help with tasks and questions of the user.

The goal for customer services is to enhance the user experience in service encounters by providing immediate and exact responses, which are available at all times, something that is difficult to achieve and costly with customer service personnel. Companies might have a great interest in reducing the human factor in these matters, for both cost and efficiency, but at the same time the experience with customer service should not become more impersonal.

It is the responsibility of the service providers to solve the customers' problems by not only making the desired knowledge available for look-up, but also offering creative and custom solutions to the individual issues.

To bring together these desired aspects of customer service, chatbots seem like one of the most ideal approaches, which is proven by the already manifold uses across many different websites of companies.

2. Value of Chatbots

An ideal chatbot would behave indistinguishable from a real human working in customer service, but would also be much faster, always available and with perfect knowledge and memory. While there is no perfectly human-like or sentient artificial intelligence yet, this concept of the ideal customer service helps outlining some of the most important values and benefits of chatbots, and serves as the long-term goals for these kinds of technologies.

2.1. Advantages over conventional customer services

The most important aspect of having a chatbot, in place of, for example, just a FAQ-section on their website, is the personal nature of this access point to the knowledge databases. Customers can talk to them about their problem or ask questions, and then it is within the responsibility of the program to process the query and provide the corresponding answers. The workload of searching for relevant information is taken away from the customers. In addition, if further information is needed, the program can selectively ask for additional data.

This possibility of a dialog about the specific issues of the user is the usual reason for consulting customer services anyway, and it is of great importance that chatbots keep this nature of interaction preserved.

Some of the more obvious advantages that chatbots provide, in opposition to human customer services, are speed and availability. In order for service personnel to compete with the speed of a chatbots' direct link to their databases, they would need to be experts on the corresponding field and memorize the solutions to most issues.

Even if such experts could be hired for customer services, it would need an unfeasible amount of employees to cover the availability that chatbots offer. The software is available 24/7 and no matter how many clients are already in dialog with the customer service, a new request should never be placed on hold, as long as there is enough server capacity to run and process all queries.

2.2. Benefits in costs

Especially the before mentioned last two advantages come hand in hand with another significant benefit. The cost of a bot-based customer service is overall much lower than employing humans. On top of running costs, chatbots do have a substantial initial implementation or setup price though, which depends on the method used to acquire the bot, as well as the extend of its functionality.

There are several ways of obtaining a chatbot as discussed by Viktoria K. and Vlad V. in [1]: Buying an

already existing solution, using self-service platforms to build and design chatbots, or implementation from scratch. After the initial setup costs, there might also be maintenance costs, for analysis, adjustments and improvements, or further bot training if needed.

While developing and integrating a chatbot can cost from a few thousands to several tens of thousands of dollars (Estimations by [1], [2] and [3]), the low running costs make up for it very quickly; and the comparison to the unrealistic customer service team which would be needed to even come close to a chatbots' knowledge, speed and availability, makes the advantage in costs very apparent.

These comparisons are disregarding one important fact though: chatbots are not yet competent enough to cover all customer service needs for any company. The usual application of bots entails taking care of a majority of queries from customers that are repetitive or easy to look up. For the more complex user requests that are to difficult to understand for the software, the bot usually refers the client to human staff. Therefore it is not yet possible to dispense with all employees, but their workload can be greatly reduced.

Despite the requirement of some form of remainder human staff alongside chatbots, the advantages of using such technology in customer service still hold and the subsequent reduction in costs is still significant.

An estimating study by Isabella Steele in [4] shows that even if only 50% of queries are eligible for chatbots (this percentage is predicted to go up to 90% in the next years), the deployment of a bot can cut the costs on staff by at least 44%.

As a side effect, it is also proposed in [4] that the shift in tasks for human employees, away from repetitive and dull questions and towards mostly complex and skill-challenging queries, leads to a more fulfilling experience for the service agents, and happier, more motivated staff leads to more satisfied customers.

Beyond all extrapolations of return values, chatbots are a long-term investment for any company. The requests for chat-based customer support saw a rise of 180% from 2016 to 2017 as stated by [4]. The number of queries a bot can easily answer goes up in a similar fashion; not only because of the higher amount of requests, but also as a result of the rapidly evolving technologies behind these bots, the complexity of queries artificial intelligence systems are able to handle is increasing quickly.

In conclusion, chatbots are already very profitable and capable, and they will continue to grow in both factors.

3. Current Use Cases

The advantages of using chatbots or similar technologies has already been realized by many companies across many fields of use, although there is still much room for improvement.

Chatbots have been researched and developed since the 1960s; Joseph Weizenbaum's ELIZA, published in 1966, is believed to be one of the earliest working bots. It was designed to act like a Rogerian therapist, but its main functionality consisted of using the recognition of keywords and the output of corresponding answers to fool people into the assumption that the machine was actually intelligent [5].

This trend shaped the development of chatbots for many years, the research was mostly aimed at passing the Turing Test rather than commercial use. Especially the Loebner Prize Competition, which is the first formal instantiation of the Turing Test and has been giving out prizes for the most human-like chatbot annually since 1991, has sparked some controversies, "whether this competition is really contributing to the development of AI, or it is blocking it", as stated by Bradesko et al. in [6].

Nonetheless chatbots designed for actual commercial tasks have emerged in many different domains, with varying functionality and applicability.

A study conducted by Prof. Dr. Julian Kawohl and Stefanie Haß in [7] investigated the use of chatbots by DAX and MDAX corporations. Their findings conclude that 15% out of the 80 examined companies have bots available for their customer experience. Whether this amount is too low for the present times and proof of the slow adaptation of big, established corporations, or a sign of progress and proof of the usefulness of bots in various fields, is debatable.

At the very least the twelve inspected chatbots of these big companies give an insight into the diversity of commercial applications. Some of these chatbots are only designed for a very specific purpose, showing that most of even these few companies are still far from an AI supported customer service. Some examples for the chatbots' purpose in life, as listed by [7], are:

- Booking of sport courses at Adidas Gym London (Adidas)
- Calculation of automobile insurance (Allianz)
- Broadcasting tool for touring car tournaments (BMW)
- Assistant for spot removal (Persil)
- Information as to flight prices (Lufthansa)
- Assistant for searching for second-hand cars (VW)
- News service, primarily for German Football League (Bild)
- Personal shopping consultant (Zalando)

Other chatbots are listed with the broader term "personal customer consultant", implying a more general field of application across the companies' offers.

The very varied and in some cases extremely specific uses of chatbot technology show that at least big German companies are slowly exploring the market with the introduction of artificial dialog systems, but are still far from the potential of this innovative medium.

3.1. Comparison of the capabilities of different chatbots

While the functionalities of different chatbots overlap for the most parts, roughly three roles can be determined for commercial bots: personal assistants, shopping assistants and troubleshooting.

3.1.1. Personal assistants. The most well known types of chatbots are the personal assistants, due to just about every big IT company building their own virtual assistant following the success of Apple's "Siri" in 2011. Amazon

has "Alexa", Google offers their "Google Assistant", Microsoft followed with "Cortana", Samsung has "Bixby", and the list continues.

Although there is not quite a consensus yet whether there is a difference between virtual assistants and chatbots, or one of these words is just an umbrella term for the other [8], they share enough significant features to be worth mentioning.

The basic services of these assistants include providing current information and facts, setting alarms or timers, adding or retrieving events from the calendar, calling or texting specific contacts, accessing media libraries or streaming services, and many more.

This shows their early intended use as a voice commanding tool for the phone, while also having the gimmick of chitchat. The ability to talk with the user and to tell jokes etc. was something new and exciting at the time and surely helped their popularity.

As times and bots made progress over the years, they also gained some more significant capabilities. Especially "Alexa" and "Google Assistant" acquire more and more service features, ranging from controlling various aspects of smart homes to buying products online with just voice commands [9].

Recently Google pushed another advancement for self-dependence of chatbots, the ability to let the virtual assistant call services like shops or restaurants and scheduling appointments or asking for information, as presented recently in the form of "Google Duplex", see [10]. While this concept has yet to become reality and widely available, this great leap in technological advancement shows that virtual assistants will continue to grow more potent.

3.1.2. Shopping assistants and troubleshooting bots.
The other two roles of chatbots are much more similar to each other in opposition to personal assistants, and also tie in better with the issues discussed in previous sections. Both shopping assistants and troubleshooting bots are chatbots for customer service, and quite often the systems are capable of fulfilling both roles.

As, for example, the before mentioned study in [7] showed, being a pure shopping/searching assistant is still the more common task of bots, primarily because they get used by companies that want to improve their sales and do not have a very consistent troubleshooting process, for example clothing shops or travel agencies.

Due to the large amount of small and very specialized chatbots in this domain, it is hard to get a generalized overview of their capabilities, but some of the usual details can be summarized.

- Chatbots tend to present themselves as a visible dialog partner, with the help of avatars or similar, and can be written with some form of personality to reinforce humanness and sympathy.
- The basic framework of a well-constructed chatbot contains common phrases for small talk and chatter, and some general knowledge.
- The chatbot needs to be capable of understanding and outputting natural language. Some bots only use keyword searches to guess the query, others are able to process full sentences, but specific technical inputs by the user should never be required.

- Shared details about the client are often stored and retrieved when necessary to personalize the dialog.
- Bots have access to a database of the relevant knowledge, in order to answer questions, but also to proactively show the user additional content.
- Whenever the system realizes it can not sufficiently help the client anymore, it refers them to supplementary services, usually human staff.
- And in general, chatbots are available for free around the clock, and have the ability to answer queries in reasonably short time, with high enough effectiveness and efficiency to satisfy the customer.

These general qualities for chatbot systems in customer support are referring to the metrics used in the study by Kawohl and Haß in [7], which most of the tested chatbots satisfied to an acceptable degree.

Additionally, chatbots also used as troubleshooting customer service are able to ask the user in a search tree-like fashion about several "symptoms", until the most likely problem is found and a solution can be proposed. For this role the systems have to be capable of identifying the best route for questioning the client about their problem with very little starting information given. An elaborated tree structure for all possible problems and how to identify them is crucial for this kind of customer service.

Two examples of commercial service bots will be examined in more detail.

At first a rather negative exemplar: Ikea's chatbot "Anna" was one of the earliest better known customer service bots in the industry, and was online for over ten years, before being retired with no plans of replacement in 2016. "Anna" aimed at answering questions and guiding customers around the website in an interactive way, but users seemed to be too frustrated with the bot. The developers tried too hard to be natural and human-like, and diverted too far from the real purpose of the bot, to provide correct answers as efficient as possible. "Anna was too human", according to an Ikea representative [11].

This case is especially interesting because the usual complaints about chatbots deemed them "overly robotic and lacking a personal touch" [11], signifying the importance of balance.

The second example is an application of a chatbot, which is not from a specific company, but rather available as an add-on extension for browsers. The bot called "SuperAgent" leverages publicly available e-commerce data in the form of product descriptions and user generated data like Q&As and reviews, to generate a customer service dialog in-page of online shopping websites like Amazon or Ebay, as presented by Cui et al. in [12].

It uses state of the art natural language processing and machine learning techniques to obtain the desired information from the available data. This innovative technology has been shown to improve end-to-end user experience for online shopping and to make large amounts of information and user generated content easier comprehensible [12].

"SuperAgent" demonstrates effectively how the pinnacle of customer service bots in the form of shopping assistants is not yet reached, and that there are more ways to enhance the customer experience besides just the

hope for every company to provide a decent and capable chatbot.

3.2. Application in IT

Information Technology (IT) companies are not utilizing chatbots as much yet, which is surprising, considering these systems are developed in this industry sector.

The website "chatbots.org" maintains a list of registered chatbots, virtual assistants and conversational agents all over the world, and has them categorized by countries, languages, platforms and consumer themes. Their archive contains 1368 chatbots as of December 2018.

And yet, an extensive search through chatbots in the category "electronics and hardware" and "telecoms and utilities" yielded in just about one accessible and visibly troubleshooting chatbot from an IT company. This bot is Dell's "Assisted Search" (see [13]), and it is built for troubleshooting common technical issues with dell products. This system is not much of a conversationalist, and rather quick to direct towards articles with solutions to the identified problems. After the initial typed-in question, the user is mostly navigating with links provided by the bot to further specify the issue, until solutions from the article database are presented, or the agent knows some short tips, which are given directly in chat.

In contrast to the rather plain "Assisted Search", T-Mobile's "Tinka" has a lot of personality and even a fictitious backstory (see [14]). This chatbot is an assistant for products and the website, but also offers customer support regarding accounts and contracts, as well as tech issues. Some basic functionalities of troubleshooting are therefore integrated in this bot, as it is the case with many customer service chatbots.

Finding only very few cases of troubleshooting bots in IT does not mean there are no other, the list from "chatbots.org" is by no means complete. But it does show how underutilized this technology is in the context of IT, a domain with a lot of requests for troubleshooting.

4. Difficulties and Problems in the IT Domain

As Subsection 3.2 showed, the use of chatbots in IT troubleshooting processes is still very much improvable. But as discussed throughout Subsection 3.1, the qualities of troubleshooting bots are not that different from other customer service systems, so wherein lie the difficulties?

Not much information can be found on this topic, therefore this section will try to discuss possible issues and reasons for this discrepancy.

Troubleshooting in IT services is done by defining the problem, analyzing possible causes and following them to the root, and then looking for the best fix.

One of the most important difficulties with this approach are often the users themselves: technological understanding can occasionally be extremely limited. "It does not work" can be a very challenging starting point for any customer service to try and fix the issue, human or bot alike. Guiding such a client through the process of finding possible causes can become even more of a sticking point.

Chatbots would need to have a way of identifying the user's affinity and knowledge about technology, and adapt accordingly. The search tree for analyzing the symptoms and causes needs to be both very general and elaborate, but also detailed and specialized enough to actually identify the correct issues. Users with greater technological understanding would also want the bot to respond on a higher level.

This makes the setup of databases and search trees quite difficult and much more extensive than with other types of chatbots.

A sophisticated natural language processing system is necessary for the same reasons, it has to be adaptable in its level of communication and recognize how much technical jargon it can and should use with the client.

On top of that, the language processing system needs to be able to extract information from even the most vague descriptions of the problems of customers, as well as identifying potentially wrong "self-diagnoses" and proposing some other possible causes for the issue proactively (Monitors have been wrongly blamed for enough computer problems already).

The extensiveness of possible issues in information technology, together with the unpredictability of the users and their knowledge, is most definitely a significant reason for the relatively unexplored potential of chatbot-supported troubleshooting services in IT. Although current chatbots are capable of fulfilling the role of general customer service, the additional competence needed to build an adaptable, more-than-decent chatbot for IT troubleshooting might be what is holding the bots' advancement in this industry back.

5. Conclusion and Future Work

Chatbots have some very distinctive advantages in the domain of customer services, they are always available, fast and have a big knowledge base. On top of that, they can reduce a company's cost for customer service by a significant amount while also increasing the work satisfaction for human employees.

Development over the recent decades assured that the capabilities of chatbots and virtual assistants are growing exponentially, and while they might not always be used to their full potential yet, companies are finding more and more ways to integrate dialog systems into their service experience.

As for the IT sector, it became apparent that the utilization has not proceeded as much as in other fields. Chatbots are still very much applicable in this domain and could bring great benefits for service providers and clients alike, but several additional difficulties demand for a more sophisticated and extensive creation of a chatbot.

In order to have an excellent troubleshooting bot for issues in IT, the varying amount of technical understandings of users and the extended amount of problems and possible causes need to be countered by extraordinary adaptability and a higher than usual intelligence of the assistant.

For the future, the next step would be to go into more detail about the technical possibilities of creating such a chatbot for IT customer service, investigating any current projects from the industry further, and working together towards the creation of a new chatbot system, built for the specific purpose to address the ongoing issues.

References

[1] K. V. and V. V., "How Much Does it Cost to Build a Chatbot", Retrieved December 13th, 2018, from https://rubygarage.org/blog/how-much-does-it-cost-to-build-a-chatbot

[2] Borisov H., "Anatomy of a Chatbot - How Much Does it Cost to Build One?", Retrieved December 13th, 2018, from https://www.progress.com/blogs/anatomy-of-a-chatbot-how-much-does-it-cost-to-build-one

[3] Kaarma J., "How much does a chatbot cost?", Retrieved December 13th, 2018, from https://chatbotslife.com/how-much-does-a-chatbot-cost-783bf583ac4

[4] Steele I., "It's All About The $$$ - How Much Money Can Chatbots Actually Save You?", Retrieved December 13th, 2018, from https://www.comm100.com/blog/how-much-can-chatbots-actually-save-you.html

[5] McNeal M. L. and Newyear D., "Introducing chatbots in libraries", Library technology reports, vol. 49(8), 2013, pp. 5-10.

[6] Bradesko L. and Mladenic D., "A survey of chatbot systems through a Loebner prize competition", Proceedings of Slovenian Language Technologies Society Eighth Conference of Language Technologies, 2012, pp. 34-37.

[7] Kawohl J. M. and Haß S., "Customer Service 4.0 - Wie gut sind Chatbots?", from https://www.heise.de/downloads/18/2/5/4/1/3/4/2/Studie_chatbots.pdf

[8] Lobo J., "What is the difference between a chatbot and a virtual assistant?", Retrieved December 16th, 2018, from https://www.inbenta.com/en/blog/difference-chatbot-virtual-assistant/

[9] Martin T. and Priest D., "The complete list of Alexa commands so far", Retrieved December 16th, 2018, from https://www.cnet.com/how-to/amazon-echo-the-complete-list-of-alexa-commands/

[10] Leviathan Y., "Google Duplex: An AI System for Accomplishing Real-World Tasks Over the Phone", Retrieved December 16th, 2018, from https://ai.googleblog.com/2018/05/duplex-ai-system-for-natural-conversation.html

[11] Brandtzaeg P. and Følstad A., "Chatbots: changing user needs and motivations", Interactions, vol. 25(5), 2018, pp. 38-43.

[12] Cui L., Huang S., Wei F., Tan C., Duan C., and Zhou M., "Superagent: a customer service chatbot for e-commerce websites", Proceedings of ACL 2017, System Demonstrations, 2017, pp. 97-102.

[13] http://www5.nohold.net/Dell/Loginr.aspx?pid=3&userrole=USen, Retrieved February 11th, 2019

[14] https://www.t-mobile.at/tinka/, Retrieved February 11th, 2019