Taxonomy of Chatbots

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Abstract

The development and implementation of chatbots is a relatively young area, which is rapidly gaining popularity in various fields of life. Nowadays, chatbots are embedded everywhere on websites, in various messengers, or on other forms of communication platforms. A chatbot is a specific virtual interlocutor that can perform a variety of functions, depending on the scope. There are different types of chatbots and different visions of how to classify them. This study presents a detailed multifactorial classification of chatbots for a clear understanding of nature, approaches to creation, advantages, and disadvantages of chatbots on one basis or another. Research and analysis of the features of modern chatbots allowed to divide chatbot programs by seven criteria: purpose; location; type of interface; number of users; form of access; algorithm; functional. Each of these categories is divided into groups and subgroups on different grounds. Possible examples of chatbots of the corresponding categories are given. Also, the scope of application of chatbots is considered in the work. It is substantiated that chatbots are one of the most perspective directions of web interaction with users. This is due, firstly, to the active use of messengers, and secondly, the development of artificial intelligence technologies. In the long run, chatbots will help to minimize many routine processes but are not an alternative to man.

Keywords

Chatbot, virtual assistant, classification, messenger.

1. Introduction

Recently, there has been a surge of interest in chatbots as dialog interfaces for human interaction with computer systems. Nowadays, chatbots are embedded everywhere on websites, in various instant messaging chats, or on other forms of communication platforms. A chatbot is a specific virtual interlocutor that can perform a variety of functions, depending on the scope. The chatbot allows you to simulate a casual, natural conversation through messaging. These bots use artificial intelligence technologies. Chatbots are indispensable assistants in any field where there is a large amount of communication with customers. In addition, when developing chatbots, you can integrate payment systems for online payment when receiving orders, which significantly improves, simplifies, and speeds up interaction with customers, eliminates the need to call them. Using chatbots saves a lot of time, as the customer who asked for support receives an instant response 24/7, without waiting for the operator to connect. At the same time, he does not face spam, unnecessary chatter, obsessive appeals, and receives only useful information.

There are different types of chatbots. Some are aimed at informing potential customers, others are sales-oriented, and still others are used exclusively as personal assistants. Chatbots are used in such areas as e-commerce services, call centers, the gaming industry. The use of chatbots for such purposes is usually limited by narrow

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specialization, and they cannot be used for a wide range of human communication. It all depends on the functionality embedded in the program.

Different scientists have different views on how to classify chatbots. There is a well-known approach when there are two types of classification [1]: 1) business classification of chatbots and 2) classification of chatbots by technical type (chatbots on business rules, chatbots on artificial intelligence, hybrid chatbots. boots). There are more detailed classifications of chatbot programs. For example, in [2], a classification of chatbots according to five criteria is proposed: user, interaction with the user, access, purpose, and principle of operation. The study [3] proposes the division of chatbots into four groups: by purpose, by type of data access, by available services, and by type of response. This taxonomy is quite detailed, but it does not take into account the types of chatbots in terms of functionality and algorithm of interaction.

Within different research positions, there are different approaches to classification. These scientific approaches indicate a certain situationality of research in the field of the taxonomy of chatbots, which indicates the need for further research in this area.

The purpose of this study is to form a multifactorial classification of chatbots for a clear understanding of nature, approaches to the creation, advantages, and disadvantages of chatbots on one or another basis.

2. Classification of chatbots

It is logical to classify chatbots, distinguishing them by criteria. Research and analysis of the features of modern chatbots allowed to divide chatbot programs into seven classes.

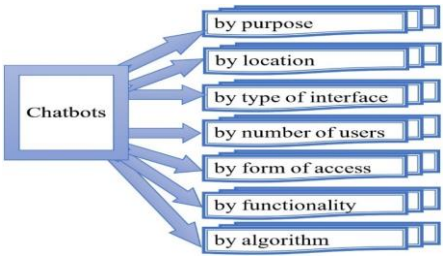

Figure 1: Classification of chatbots

By purpose:

- *chatbots for conversations on a wide range of topics* are designed for dialogue with the user on abstract topics and do not have a clear purpose;
- *chatbots focused on dialogue only on a specific topic or to solve a specific problem or goal* are the most common, for example, for regular distribution of information, setting reminders, etc.

By location:

- *on sites*. Mostly, companies are willing to embed chatbots on their websites to help the customer answer their questions or resolve other communication requests or issues regarding unique tasks or settings;
- *in messengers*. They are mostly used for fast interaction with customers, even in conditions of slow internet or roaming, as most providers do not charge for communication in messengers. The reason for the creation and popularity of certain groups in messengers within Facebook Messenger, Slack, Viber, or Telegram is the combination of people in groups with some common interests. Areas of interest are not limited to the commercial component, but on the contrary, mostly relate to the cultural and educational components of our lives. Chatbots can be created for personal and business use. For example, a logistics company may provide copies of dispatch documents through a chatbot instead of making phone calls;
- *in specialized software applications*, the use of chatbots facilitates and accelerates the process of ordering goods or services, such as ordering food.

By type of interface:

- *button* – communication of the user with the bot is organized by pressing the selected button in the list of buttons with different options. Such an interface can resemble a voice menu "press 1 to find out ...". The vast majority of simple chatbots work on this principle. Such chatbots are widely used to order goods and services from the list of companies in their chats in messengers;
- *text* – communication with the user is carried out in the form of text messaging. Chatbot recognizes words that are common in the user's query, clarifies questions, and offers solutions;
- *mixed models* – to form a text response to requests, the bot can offer the user buttons with clarifying questions. An example of such chatbots is a handy tool from utilities for transmitting meter readings, with which household consumers can transmit meter readings by combining button clicks and

forming text messages of certain content following instructions in the messenger;

- *voice* – the user communicates in the form of voice messages. The voice message is first converted programmatically into text, analyzed, and only then synthesized audio response to it. Voice assistants are more natural and user-friendly than graphical interfaces. Today, modeling human speech interaction with a computer, as a full-fledged interlocutor, plays an important role in the development of conversational dialogue systems and answering machines. Further research aimed at strengthening voice communication with modern network computing devices will attract more and more attention because language is one of the most effective types of human communication;
- *runtime interface* – no dialog interface system is complete without the robust runtime interface required to connect virtual agents to external systems. This interface is needed to communicate with external systems to obtain dynamic information to continue the conversation or perform certain intended actions. After all, the bot interface is responsible not only for the way information is entered, but also for the methods of interaction of the bot with this information, i.e. for support of commands, the ability to separate commands from the user message, and the ability to understand the context of dialogue.

By the number of users:

- *personal chatbots*, which in turn can be divided into two groups:

1. *for personal use without data transfer to others*. These can be personal repositories of systematized data, for example, time-bots to store their memories in the form of photos taken with a possible link to the geolocations of their creation, for example, during their trips to create a memorable personal photo album, or for creation and storage of personal records and user files (photos, audio, video, etc.) with ensuring the confidentiality of access to this data;
2. *interactive chatbots* – a kind of user's assistants in interaction (data exchange) with other users or other programs to perform certain actions on behalf of the user, for example, to manage the calendar, send texts (for instance, the above chatbot from utilities for transmission of meter readings), receiving personal calls, searching and playing audio and video files, etc. Assistant bots help to document the user's schedule, remind him about scheduled tasks and meetings. Virtual assistants can partially replace secretaries for some executives. Another striking example of such a bot is a bot-lawyer who provides answers to various legal questions and helps to file lawsuits, for example, to appeal fines for improper parking, to receive compensation for unexpected travel expenses;

- *business chatbots* are designed to enable simultaneous business use in automatic communication with many customers without involving manual employees of the company in the service process. Such chatbots are used in many areas of the business to automate commercial processes of communication with customers, as well as perform analytical and other ancillary functions. Possible niches for such chatbots are information services for members of certain groups, routine information processes of election campaigns and higher education institutions, especially at the beginning of the school year, ticket booking and purchase services, support services for delivery of goods, food, flowers, etc.

By form of access:

- *chatbots in certain groups (chats) of the messenger* are a useful means of communication between members of this group and coordination of their interaction. For example, a chatbot of a faculty or the entire university can effectively combine teachers, management, and students, providing each of them with detailed information on the schedule of classes for full-time and part-time forms of education or other specialized information about the educational process;
- *chatbots in the messenger dialog* can be called directly in any dialog by simply typing the @ symbol and the bot name after it. After launching the chatbot, you will be asked to choose options or actions, and the result can be sent to the interlocutor of the dialogue or share with his friends from the contact list;
- *subscribed chatbots* allow you to collect a chatbot subscriber base on your site and send mass and personal mailings within Facebook Messenger, Slack, Viber, and Telegram, thereby converting users to potential buyers. You can subscribe to the chatbot in different ways: by linking to the bot on the Facebook page or in the Telegram; finding a bot by

@username; by the direct link to the chatbot, posted on the site or social networks; via the subscription widget or the corresponding QR-code on the site without going to the Facebook page or in Telegram.

By algorithm:

- *simple (limited) chatbots* interact with users on a pre-prepared script – a tree of decisions of a tree-like structure, which contains a set of answers to common questions, i.e. the answers are selected from the template phrases of the script by keywords. If the user does not use keywords when communicating, the bot does not understand him and performs the actions provided for such cases, for example, offers to contact the operator. Chatbots of this type usually avoid questions that require free answers and instead contain a large number of buttons. The functionality of such bots is limited, but for certain situations, they can be useful. With the help of special services, you can set up a simple chatbot for free. This will allow you to try and understand whether this option is useful for business;
- *intelligent ("smart") chatbots* are based on an artificial neural network that "understands" the meaning of the conversation. The conversation path is determined implicitly based on the training data (training samples) used to teach the machine learning model. That is why such chatbots need large data sets for self-learning because it depends on the degree of their "reasonableness" and the adequacy of answers to questions. Such software assistants are developed individually and are much more expensive to develop because to create a high-quality chatbot a lot of effort is invested in the development of artificial intelligence (AI, Artificial Intelligence – AI) and machine learning neural networks. The core on which the intelligent chatbot is built consists of NLP (Natural Language Processing), NLU (Natural Language Understanding), and NLG (Natural Language Generation). NLP is the ability of the machine to process what is said, understand its meaning, determine the necessary action in response and respond in language understandable to the user, by converting computer text into structured data. NLU is the backbone of any chatbot and is essentially a subset of NLP processes. It is responsible for the computer's ability to choose how best to handle unstructured input and turn it into a machine-friendly structure. This core component is extremely important for such unpredictable data as abbreviations, modified words and misspelled words, slang, unintelligible language, metaphors that a person can understand and a machine cannot understand. NLG is the process by which a computer converts structured data into text. In essence, this is the creation of a bot text to communicate with a person who understands the language. Such chatbot can collect information about users, track their actions, and then, if necessary, analyze their habits. Collected in the process of dialogue, user data allows you to personalize offers and newsletters. The bot can be used as a tool for debugging smart processes within the company and the interaction with it takes place in a familiar and user-friendly interface of a particular messenger, such as Telegram. Chat-bot API allows you to connect to external systems and synchronize with corporate systems, such as CRM, ERP, "Google Spreadsheets", etc;
- *hybrid chatbots* are a combination of the first two types of chatbots. Bots of this type communicate with the user in a predetermined way, but use AI to recognize the user's intentions, as well as to extract valuable data from user messages (name, date, period, etc.). This type of chatbot is the most widely used in commercial applications. In medicine, such chatbots can be used primarily for rapid remote pre-diagnosis. In addition, artificial intelligence tools can be used to analyze the health data of both individual patients and predict the trend of viral diseases during seasonal fluctuations and possible epidemics [4]. In addition, such chatbots in general and clinical psychology allow users to talk about whatever they want and are smart enough to ask meaningful questions and answer them [5]. Their goal is to provide psychologicalhelp to people struggling with depression, especially if they lack attention and have no one to talk to about their problem.

By functionality:

- *information and communication* – chatbots that do not have a specific purpose and are designed solely to support communication with people, to share information about special offers and discounts, to help choose a product or service, etc. Currently, one of the main areas of application for such chatbots is the distribution of

advertisements, promotional offers, etc. Research [6] shows that messages in messengers are five times more effective than e-mail and SMS. At the same time, the cost of mailing is much lower. Therefore, companies are interested in expanding the base of contacts and increasing sales through appropriate chatbots;

- *"questions and answers"* – chatbots (Q&A – questions and answers), designed to give simple answers on the principle of "one question – one answer"). The use of a such chatbot can significantly reduce the load and cost of support, as it automates the processing of simple, frequently repeated requests from customers. At the same time, there is parallel processing of an unlimited number of applications. This allows you to unload the team and involve managers only when you need to solve complex problems, thereby optimizing staff costs;
- *assistants* – chatbots that generate data based on user responses to achieve certain goals, for example, when filling out web forms for bank statements, online mortgages, etc. Such bots are useful in the field of statistics, because they can automatically track stock prices, page views of the company's website, or the number of contacts that were created in the previous day, generate statistics in a user-friendly format, etc.;
- *functional* – chatbots, which allow you to immediately perform certain actions, for example, transfer money to the account, specify the status of the order by its number, etc. In the field of recruitment, such chatbot is considered an effective communication system that successfully simplifies the work of HR managers and recruiters, automatically collecting and systematizing the relevant competencies, skills, and experience during the automatic online survey of candidates [7]. Such chatbots successfully identify the best candidates, automatically schedule interviews and answer questions from job candidates.

3. Conclusions

The development and implementation of chatbots is a relatively young area, which is rapidly gaining popularity in various fields of life. Therefore, the topic is relevant, and unified approaches to the classification of chatbots according to various criteria have not yet been developed. The analysis of various approaches to the taxonomy of modern chatbots carried out in the article revealed some discrepancies and inconsistencies.

The paper forms a multifactor detailed classification of chatbots for a clear understanding of nature, approaches to the creation, advantages, and disadvantages of chatbots on one or another basis. Research and analysis of the features of modern chatbots allowed to divide chatbot programs into seven criteria: purpose; location; type of interface; the number of users; the form of access; algorithm; functional. Each of the categories is divided into groups and subgroups on different grounds. Possible examples of chatbots of the corresponding categories are given.

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