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ABSTRACT

A Chatbot is a computer program which conducts a conversation via auditory or textual methods. The purpose of a Chatbot system is to simulate a human conversation; the Chatbot architecture integrates a language model and computational algorithms to emulate informal chat communication between a human user and a computer using natural language. The earlier chatbot lacked AI in the true sense due to certain limitations or problems that the Chatbot have to go through. So, various technologies were developed which would overcome these limitations in developing the chatbots and make them more efficient. Here, we will be learning about the Chatbot technologies, their approaches and the research or further developments of the Chatbot systems.

Index Terms: AI, Chatbot, AIML, NLP.

1. INTRODUCTION

The development of the information technology and communication has been complex in implementing of artificial intelligent systems. The systems are approaching of human activities such as decision support systems, robotics, natural language processing, expert systems, etc. Even in the artificial intelligent fields, there are some hybrid methods and adaptive methods those make more complex methods. Not only that, but nowadays there is also a hybrid of natural language and intelligent systems those could understand human natural language. These systems can learn themselves and renew their ask to the systems like usually did to other human. These systems are often known as internet answering-engines. In addition the internet answering-engines, currently in the internet also begins many applications of chatter-boot or known as Chatbot which is often aimed for such purposes or just entertainment. A **Chatbot** is a computer program which conducts a conversation via auditory or textual methods.

The purpose of a Chatbot system is to simulate a human conversation; the Chatbot architecture integrates a language model and computational algorithms to emulate informal chat communication between a human user and a computer using natural language. They can also be pedagogical agents or

personifications of historical figures who will be able to talk about their life and work. The Chatbots have been applied in different domains such as: linguistic research, language education, customer service, website help, and for fun.

The basic application of Chatbot is to provide Customer Service via messages or call centres. Chatbots are used as a marketing strategy in various businesses. Chatbot have proved very beneficiary to the business world. We already have certain Chatbot, which are gaining popularity again due to success of virtual assistants such as Siri, Evi, S-Voice, Jeannie, CallMom and others. The Chatbot are designed usually to serve some specific purposes such as searching the web, organizing files on the computer, setting up appointments, etc.

There are applications where the work of creating a Chatbot is very simpler because the knowledge is already programmed in advance. One such widely used application is Artificial Intelligence Markup Language (AIML). The AIML has modularly knowledge processes. This system is a web service-based which could be accessed by client. The chat patterns are language knowledge in the format of AIML stored in the database. More complex methods like Parsing and ChatScript are also used widely.

Currently the biggest challenge that existing chatbots have is maintaining of the context and understanding the human inputs and its responses. And the pattern-matching approach however cannot result in a fully satisfying conversation or lead a conversation with some specific purpose. Due to the obvious drawbacks of scripted responses, developers and researchers kept adding new functionalities to the existing ways how Chatbot works. While these improvements made Chatbots much more successful, at the same time introduced a number of different approaches, systems and solutions to the same problem.

Here we will be learning about the Chatbot technologies, their approaches and the research or further developments of the Chatbot systems.

2. ANALYSIS OF PROBLEM

AI community have tried to construct Chatbot like ALICE and ELIZA. These are generic chatbots. These chatbots function similarly. If we consider ALICE, it basically generates an AIML file from a dialogue corpus with patterns and templates. A chatbot like ALICE lacks AI in the true sense due to certain limitations or problems that the Chatbot have to go through.

Firstly, if a bot wants to mimic a human, it should not memorise every conversation in database. An intelligent chatbot must be powered by AI/NLP to reply coherent messages atleast from the business point of view. ALICE has no way to understand the intent of the user. That is why these chatbots are not good enough for replacing human beings. They are over reliant on AIML. There is a demand for an interface between AIML and the chatbot such that it understands chats, filters entities and then generates text in AIML readable format in a smart way. Thus, it can convert its knowledge to a response custom made for AIML. So AIML will become a layer that is at the lowest level of the chatbot brain and is used just an interface to reply in a natural language.

Secondly, an intelligent bot will never respond in the same way if user is sending same text. A random response as customary in AIML is not always the right way to deal with repetitions. The chatbot should have a counting mechanism to know that there is repetition in incoming messages and if this behaviour continues further then the chats should be routed to a human agent in a polite manner or the chat should be terminated in case of completely automated bots. The ability to count can be achieved only if the chatbot has a system to understand the intent of the client and if it maintains a state diagram or a milestone status with a counter for each state. In this manner, if it encounters the same state on two or more consecutive occasions, it can safely route the user to a human agent or terminate.

Thirdly, response cannot be generated based on probability. That will cause havoc because sentence generation should be accurate and in AIML, i.e. in a self curated way and not just a random response generated by using pattern matching algorithms.

3. PROCESSING OF A CHATBOT

The working of a Chatbot program is basically divided in two parts:

- 1) Getting the intent of user message (query).
- 2) Generating the response.

Message processing begins from understanding what the user is talking about. Intent classification module identifies the intent of user message. Typically it is selection of one out of a number of predefined intents, though more sophisticated bots can identify multiple intents from one message. Intent classification can use context information, such as intents of previous messages, user profile, and preferences. Entity recognition module extracts structured bits of information from the message. The weather bot can extract location and date.

The candidate response generator is doing all the domain-specific calculations to process the user request. It can use different algorithms, call a few external APIs, or even ask a human to help with response generation. The result of these calculations is a list of response candidates. All these responses should be correct according to domain-specific logic, it can't be just tons of random responses. The response generator must use the context of the conversation as well as intent and entities extracted from the last user message, otherwise, it can't support multi-message conversations. The response selector just scores all the response candidate and selects a response which should work better for the user. These two methodologies are further explained below:

3.1. Intent Extraction

Unlike normal app inputs, human language tends to be messy and imprecise. Therefore the chatbot system uses the NLP engine. Made up of a number of different libraries, the NLP engine does the work of identifying and extracting entities, which are relevant pieces of information provided by the user, using libraries for common NLP tasks like tokenization and named entity recognition. Tokenization breaks sentences down into discrete words, stripping out punctuation, while named entity recognition looks for words in pre-defined categories (for example, place names or addresses). They might also use a library called a normaliser, which catches common spelling errors, expands contractions and abbreviations, and converts UK English to US English.

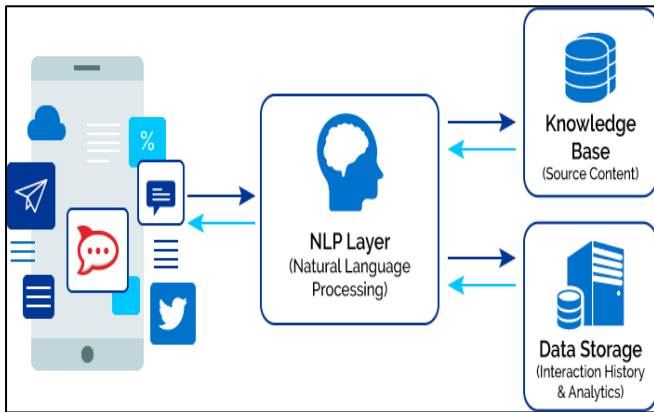


Fig-1: Intent Extraction using NLP

Every message from customer is treated equivalently. This is our key assumption. Any message can contain intent, name, email-id, places, etc. The first step is to extract names, places, emails, etc. from the message. Whatever is left can be an empty string or it may contain some intent. To get the intent, we categorise the statement based on a Naive Bayes classifier into one of the categories like food, travel, utilities, beauty-services, etc based on services provided by our company. Then we obtain the intent and the sub-category of the message. Once we have all this information we route the chat to a human agent who is an expert in that category. Also we provide a score that how likely our classification is correct.

For a bot that's a more generalized assistant rather than a text-powered version of a simple web app the bot is going to need to understand context and intent. To establish context and intent, you'll need some additional NLP tasks that allow the NLP engine to understand the relationships between words. Part-of-speech tagging takes a sentence and identifies nouns, verbs, adjectives, etc. while dependency parsing identifies phrases, subjects, and objects. You can add more complex NLP tasks like sentiment analysis, which can identify when a user is becoming frustrated and perhaps escalate the interaction to a human CS rep.

3.2. Response Generation

There are various techniques and algorithms used for generating response after understanding the intent of the user message. Some of them are listed as following :

- Pattern Matching

This is by far the most common approach and technique used in chatbots. Variations of some pattern matching algorithm exist in every existing chatbot system. The pattern matching approaches can vary in their complexity, but the basic idea is the same. The simplest patterns were used in earlier chatbots such as ELIZA and PC Therapist.

- Parsing

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Textual Parsing is a method which takes the original text and converts it into a set of words (lexical parsing) with features, mostly to determine its grammatical structure. On top of that, the lexical structure can be then checked if it forms allowable expression (syntactical parsing). The earlier parsers were very simple, looking for recognizable keywords in allowed order. Example of such parsing would be that sentences "please take the gold" and "can you get the gold" would be both parsed into "take gold". With this approach the chatbot with a limited set of patterns can cover multiple input sentences. The more complicated parsers used in latter chatbots do the complete grammatical parsing of the natural language sentences.

- AIML

AIML's syntax is XML based and consists mostly of input rules (categories) with appropriate output. The pattern must cover the entire input and is case insensitive. It is possible to use a wildcard (*) which binds to one or more words. It can submit input to itself using the <srail> tag and the contents of * using <star/>.

- ChatScript

ChatScript is successor of the AIML language. It focuses on the better syntax which makes it easier to maintain. It fixes the zero word matching problems and introduces a bunch of additional functionalities.

4. ADVANTAGES

Chatbot are basically used by various businesses to provide Customer Services via Web Applications or Phone Applications to improve the quality of services. The following are some advantages that the business has by using the chatbots.

1. Customer service
2. Consumer analysis
3. Personalized ads
4. Proactive customer interaction
5. Site feedback
6. Lead-nurturing
7. Maintain a presence on a messenger act via a chatbot.

5. DISADVANTAGES

Like any other form of innovative technology, chatbots come with a few disadvantages and potential risks. They are as follows:

1. The problem of rogue Chatbot
2. Chatbots can be too mechanical
3. Increased personalization can be a problem
4. Lack of individuality and generic conversations
5. Accuracy, trustworthiness, accountability
6. The often-overlooked need for encryption

6. APPLICATIONS OF CHATBOT

Due to the various advantages that a Chatbot provides there are many fields where Chatbots are used. Here we have mentioned some noteworthy applications of Chatbots.

6.1. Messaging platforms

Currently chatbots are widely used as part of instant messaging platforms like Facebook Messenger, WeChat and Hike for entertaining purposes as well as B2C marketing and customer service. The bots usually appear as one of the user's contacts or as a participant in a group chat. Some IM bots are able to connect to outside databases and provide the user with news, weather reports, driving directions, movie times, stock quotes, and other information. Companies like Domino's, Pizza Hut, Disney, Nerdify, Yamato's Line and Whole Foods have launched their own chatbots to increase end customer engagement, promote their products and services, and give their customers a more convenient and easier way to order from them. In 2016 in the travel industry, several agencies and airlines launched chatbot services via Messenger – Aeroméxico's sells tickets and answers questions using artificial intelligence, and both Aeromexico's and KLM's provide flight status updates, allow users to check in for flights, deliver mobile boarding passes and recommend hotels, restaurants and things to do in the destination.

6.2. Apps and websites

Previous generations of chatbots were present on company websites, e.g. Ask Jenn from Alaska Airlines which debuted in 2008 or Expedia's virtual customer service agent which launched in 2011. In 2017, the Israeli company Snatchbot launched a chatbot creation website, which claimed the capability of building bots with sentiment analysis.

6.3. Company internal platforms

Other companies explore ways how they can use chatbots internally, for example for Customer Support, Human Resources, or even in Internet-of-Things (IoT) projects. Overstock, for one, has reportedly launched a chatbot named Mila to automate certain simple yet time-consuming processes when requesting for a sick leave. SAP partnered with Kore Inc, a US-based chatbot platform vendor, to build enterprise-oriented chatterbots for certain SAP products. A SaaS chatbot business ecosystem has been steadily growing since the F8 Conference when Zuckerberg unveiled that Messenger would allow chatbots into the app.

6.4. Education

Some chatbots, such as the Nerdy Bot developed by Nerdify, have been created to solve

challenges in education and make studying easier and more time-efficient for college and school students. Nerdy Bot communicates via the Facebook Messenger interface and aims to speed up studying by instantly delivering answers back to students in response to homework-related questions- answers, a chatbot for the UC Irvine libraries was piloted in 2014 and was considered highly successful.

6.5. Toys

Chatbots have also been incorporated into devices not primarily meant for computing such as toys. Hello Barbie is an Internet-connected version of the doll that uses a chatbot provided by the company ToyTalk, which previously used the chatbot for a range of smartphone-based characters for children. These characters' behaviors are constrained by a set of rules that in effect emulate a particular character and produce a storyline. IBM's Watson computer has been used as the basis for chatbot-based educational toys for companies such as CogniToys intended to interact with children for educational purposes.

7. CONCLUSION

Chatbot technologies evolved from the very simple pattern matching systems, over the statistical models of chats, towards complicated patterns. It can be argued that even the newest approaches like ChatScript, AIML are still just a small improvement over the ELIZA pattern matching idea and that the biggest improvement is the amount of scripts written for it. We agree that there is some truth in it; however it is notable that the recent developments, especially with ChatScript the chatbots are moving out of the scripted era. It is obvious that there is a trend towards semantics, which can lead to a conclusion that future chatbots probably will start to incorporate more and more computer reasoning systems. Still we can say that presently we can't depend or rely on technologies entirely when it comes to ensuring 100% customer satisfaction and support. Human intervention is always necessary. However, chatbots ensure logical, transparent, and clear communications. You will have them right within your applications, and no matter what you speak will get recorded. So, there's no chance of ambiguities or confusions. As far as the current market trends suggest, chatbots are heading towards a bright future.

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