



An Artificial Intelligence Powered Ticket Booking Chatbot

Dr. R. Vijayalakshmi¹, Dr. R. Deepalakshmi², M.MukilArasi³, C.Divyadharshini⁴, C.Sowmiya⁵, M.Samina⁶

Associate Professor, Department of CSE, Velammal College of Engineering and Technology, Madurai, India¹

Professor, Department of CSE, Velammal College of Engineering and Technology, Madurai, India²

UG Scholar, Department of CSE, Velammal College of Engineering and Technology, Madurai, India^{3,4,5,6}

ABSTRACT: Chatbots conversational interfaces as they are also known, present a new way for individuals to interact with computers. Traditionally, to get an answer for a question by a software program involved using a search engine. A chatbot allows a user to ask questions in the same manner that they would address a human. The most well known chat bots currently used are voice chat bots. The technology at the core of the rise of chatbot is natural language processing (“NLP”). Recent advancement in machine learning have improved the accuracy and effectiveness of natural language processing, making chat bots a feasible option for many organizations. This improvement in NLP has launched a great deal of additional research which will lead to continued improvement in the effectiveness of chat bots. People standing in queues to book ticket but the proposed system helps to find a suitable option from millions of offers available and try to search for a bus Offer, with a simple chat window that suits your schedule, location, dates and conveniences. Brands can give customers a better experience and assistance with the use of a chatbot, which is somewhat similar to a personalized conversation between a sales representative and a customer

KEYWORDS: Artificial Intelligence (AI), Chatbot, Natural Language Processing (NLP), Recurrent Neural Network (RNN)

I. INTRODUCTION

The creation and analysis of intelligent agents (software and machines) is called Artificial Intelligence or AI. It can be implemented in nearly every field. Intelligent machines can do many tasks – from labor work to sophisticated operations. Prominent trends in this field are human brain simulation, natural-language processing and neural networking etc. A chatbot is a computer program which responds like an intelligent entity when conversed with. The conversation may be through text or voice. Any chatbot program understands one or more human languages by Natural Language Processing. Chat bots or Virtual Assistants have been designed to simplify the interaction between computers and humans and have hit the market. A chatbot is software that uses artificial intelligence (AI) that can converse (or chat) with a user in natural language via virtual chat rooms, websites, mobile apps and messaging applications or through the telephone. Chatbots are often referred to as one of the most exciting and advanced types of human- machine interaction. Although a chatbot can only reflect the evolution of a Question Answering program based on Natural Language Processing (NLP), from a technical perspective.

The virtual assistants should receive an input sentence from a user and interpret it, identifying what this one meant to say. The technology which allows the machines, to go through this process, of analyzing human language and retrieve a meaning out of what was said, is Natural Language Processing. NLP can be viewed, as the science that studies the way, computers can be used to understand and manipulate human language, either as a form of text or speech. One of its goals, is to study how humans understand and use their own language, so that, techniques for machines to interpret it can be developed, in order to allow the virtual agents, to understand the user’s needs and become able to assist them in their tasks. NLP’s methodology is about extracting simple representations that describe limited aspects of the textual information, being that, syntactic or semantic information. Its processes are based on labeling words into certain categories, so that machines can be ready to interpret them. In order to retrieve this information, some benchmarks regarding good NLP practices were developed. Among those are Part-Of-Speech Tagging, Chunking, Named Entity Recognition and Semantic Role Labeling.

- Part-Of-Speech Tagging, is a process of labeling a word with a unique tag that indicates its syntactic role, finding whether it’s a noun, adjective, verb, etc. and also if its singular or plural. The best POS classifiers are trained on text windows and entered in a bidirectional decoding algorithm during inference. They analyze preceding and following word context, and multiple words (n-grams) context and specific proceedings to deal with unknown words (e.g. James [singular noun] likes [verb] apples [plural noun]). Related Work
- Chunking, is about labeling parts of a sentence with syntactic constituents, such as noun phrases NP or verb phrases



VP. Also, each word gets a unique tag, which can be either begin-chunk tag, or inside-chunk tag, indicating its place inside the original sentence (e.g. my big dog [B-NP] really likes [I-VP] chocolatecookies

- Named Entity Recognition, names atomic elements in the sentence into categories such as “PERSON” or “LOCATION”. In this task, each word is assigned a tag prefixed by an indicator of the beginning or the inside of an entity, as well as in the previous one.
- Semantic Role Labeling gives a semantic role to the semantic constituents of a phrase, regarding to its predicate, being that, in case a sentence is composed of multiple verbs, some of its members can have multiple tags associated to them. It assigns different tags to the many components of a sentence. The tags vary from naming general arguments [ARGn], being the order in which they appear towards the verb, but could also name a type of meaning such as location or temporal.(e.g. Last night [ARGM-TMP] Mary [ARG0] ate [REL] an ice cream[ARG1] by the beach[ARGM-LOC]).

All the above concepts represent theoretical processes of retrieving information from natural language and label it in a way that, it could be processed by computers. In order to actually obtain results, implementing those proceedings, one must resort to machine learning techniques based on statistical analyses and classification algorithms, to convert the input data into labeled segments. These approaches' efficiency is measured regarding their results' accuracy, when processed lots of training data. Chatbot systems connect with people and resources, improving customer experience. At the same time, chat bots give businesses multiple ways to improve customer satisfaction and ensure operational productivity by reducing customer service surplus costs. Chatbot solutions must perform each of the tasks effectively for efficient implementation. A chatbot may also perform some productive functions like calculations, setting-up reminders or alarms etc.

The travel sector has expanded at leaps and bounds over the last decade. To meet the needs and demands of the technologically savvy new-age traveler, travel companies continue to search for new ways to boost customer travel and make traveling more convenient. The days are gone when people visited the local travel agencies to book a flight or a hotel. Travel companies that realize the value of digitizing their industry have begun digitally transforming the travel experience to draw more travelers and keep their customers. The new technical deployment, which has had a positive influence on companies from different verticals, is chatbot. For example according to Expedia, travelers visit 38 sites on average while planning a trip. The plethora of travel search journeys begins with goggling and ends with online travel agencies and Trip Advisor. While this problem can be solved more conventionally by unifying user experience within a single platform, it has yielded a great opportunity. To avoid tiresome planning and simplify booking process, we can use chat bots – mobile user-friendly personal assistants with analytical and predictive capabilities.

II. RELATED WORK

In this section, areas related with chatbot and travel booking, work, will be approached, in a way that allows the reader, to get a better understanding about the current state of the technology itself and its current position in the global technology market. Firstly, it will be explained in what consists of a chatbot and what would actually take to built one, followed by an analyses into the travel booking market and the place of the chatbot in it.

A chatbot, also referred to as virtual agent, or virtual assistant, is a conversational service built to provide its users an interactive online chatting experience, which aims to give them the perception of being chatting with another human being. It's a growing technology that is intended to be applied in many fields such as education, information retrieval, business, and e-commerce. Its purpose is to maintain a flow of conversation, while satisfying their users' requests. The clients could simply ask questions about the product, directly to the agent and get straight answers, establishing a line of conversation. Actually, as a technology based on artificial intelligence, chat bots are yet to develop their true potential, being still on early stages of their development. Although, one still tends to find more and more chat bots around the internet and the rising interest surrounding them, can be proven in figure 2.1, as the graph provided by Google Trends technology, shows a significant increase in Google searches containing the word chatbot, over the past five years. Chatbots are not all the same, in fact, a distinction can be made in regard of their work method and subjects range. About the first topic, they can be classified as retrieval-based, or generative. As for their range, are divided in two classes, being those open domain and close domain. Following, the four definitions are briefly introduced.

- Closed domain: This kind of chat bots are only ready to talk about certain topics and will be lost, if any questions outside their field are asked.
- Open domain: Contrary to the previous, the open domain models are supposedly ready to argue about any subject

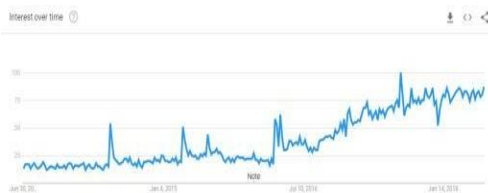


Figure 2.1: Increase in Google searches containing the word "chatbot", over the past 5 years.

with the user. Ideally, every chatbot should be of type generative and work in open domain, but in fact, this kind is the most difficult to develop and science is still far from having a stable line of production for them. In figure 2.2, a table describing the different types of chat bots can be consulted. As the figure indicates, combining the two categories previously mentioned, leads to three distinct types of chat bots, being the ones from generative type more efficient than the retrieval. Although, for the prototype to be developed, will be used a closed domain and retrieval-based one, due to the amount of time and resources available.

III. SYSTEM ARCHITECTURE

The system can be separated into three distinct parts. The first one consists in securing a reliable line of communication between human and machine. To accomplish that, the messages sent by the user, must be processed in a way that, they become readable by the machine. Once the program is able to interpret sentences, it must question itself, what was the intent behind the textual exchange and act according to its meaning. Finally, it should be connected to external APIs to gather the data it might need, to fulfill its users' requests. Throughout this chapter, the architecture will be described in more detail.

Natural language interpretation

Generally, chat bots can be used to solve a large variety of problems; depending on the environment they are inserted. In this particular case, one's services would be required to deal with travel logistic issues. No matter what the field of action might be, they all must take an essential step to reach its goals, which is to receive an input from a conversation and extract something meaningful out of it, in a way that, an appropriate context-sensitive answer can be generated. To achieve this, it's necessary to convert the natural language given from the user, into machine language, understandable to the agent. To deal with this problem, one could opt from one of two solutions; either develops a NLP classification system from scratch, or use a bot building framework. The big advantage of opting with the first option, would be to have much more control over the system to be developed, in terms of not being limited by a framework's general structure and being able to adapt the code to fit the specific needs of the product to be developed. However, since the scope of this thesis is to assess the application of chat bots in solving the issues of travel logistics, developing an NLP classification

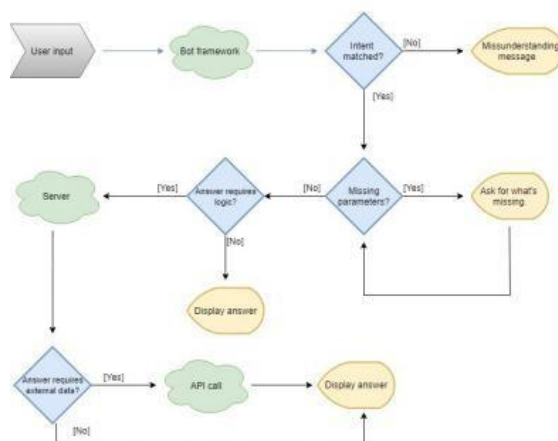


Figure 3.1: Message processing architecture.

Figure. 3.1 System Architecture



As previously stated, the bot framework's goal is to translate human natural language into machine language. In a sentence such as : "I want to book a trip to Madrid for 5 people", the tool should be trained in such a way that it would identify, not only that the user's intent is to start booking a new trip, but also recognize parameters such as the destination and the number of people the trip is for, while inferring omitted parameters, such as departure date and location.

This tool works based on NLP algorithms that allow the programmer to train their virtual agents in any areas of their choice. The training process relies on the programmer, to insert big amounts of data into the chatbot, allowing the framework to recognize patterns among the training examples that would, ultimately, allow the system to form the shape of intents.

IV. METHODOLOGY

A. DIALOG FLOW

To carry out this prototype, it was used Dialog flow, due to its wide range of functions, intuitive interface and easy integration in a variety of chatting platforms. Actually, this system's purpose is to create agents, whose goal is to receive input messages from a user, identify their meaning and process them, to later return an appropriate answer. Once an input is entered, it will be interpreted by the NLP logic and its key parameters will be identified, what may lead to the recognition of a known intent, or failure to do so, which would lead to the default fallback intent, which is basically, the agent telling the user it didn't understand what this one just said. If an intent is recognized by the agent, either an immediate response will be generated, or the retrieved parameters will be sent to the web hook server, where the business logic is processed and if necessary, the server will also interact with additional APIs or databases, to retrieve information required by the user. This entire process can be observed in figure 4.1



Figure 4.1: Dialogflow architecture.

Figure 4.1 Dialogflow architecture

B. TRAINING PROCESS

First of all, to achieve a virtual agent capable of understanding English, it must first be trained to do so. Dialog flow is the tool that allows one to train an agent, preparing it for specific conversation topics. In fact, the agent's behavior will be structured, based on contexts and intents. For every action the agent is expected to do, there has to be an intent triggered by the user, through the messages sent in the chat. Intent is defined by key words that identify it and also parameters that change its properties, depending on the variety of inputs coming from the user. Nevertheless, to teach the agent a new intent, one must provide it with several examples of training phrases that mean to represent it. That being said, dialog flow's natural language processing algorithms, will analyze the provided example sentences, identifying them and creating patterns that will represent the intent to be executed. Briefly, the agent's developer has to introduce through dialog flow, the variety of ways that the agent should expect to detect each intent. With that in mind, while training for certain intent, the developer has to properly define every parameter required, to process it correctly. In the example of booking a bus, the training process for that intent, must imply that the it requires at least the parameters for the destination and the dates of the travel, for its completion and while training the agent with a new sentence it's also necessary to mention which words refer to which parameters.



C. HANDLING RESPONSES

When sending a message to a chatbot, there are two possible outcomes, either the message's structure is recognized and triggers a specific intent, or it is classified as unknown and triggers the default fallback intent. In case intent is identified, the response depends on the type of intent in question.

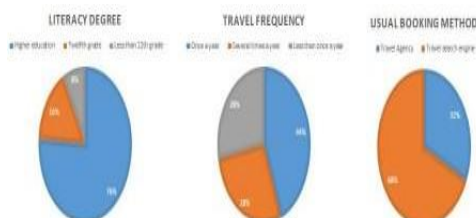
For example, if the user greets the machine, it will simply reply back with a greeting message of its own. This quick response, will be selected from a group of default responses, which the bot has prepared for that intent. ("Hey, I am here to help you book a bus."). Also, if intent is matched, but dialog flow notices some of its required parameters are missing, the response given is a custom sentence asking the user, to input the missing data.

Nevertheless, in dialog flow there is a relationship of dependency between contexts and intents, which means, that for an intent to be ready to be activated, the context or group of contexts, that allow it to be activated, must be already active, otherwise, even if a sentence that would normally trigger it is received, will be recognized by the agent as an unknown intent and trigger the default fallback intent. To be more specific, the user can write a sentence that would be the trigger for a particular intent and yet, still not trigger that intent. That could happen when the state of the conversation is not at a certain point, where the required contexts to make a certain intent available are active. The relation between intents and contexts and how they affect this system in particular.

D. CONVERSATION FLOW

To perform a reliable bus booking conversation, its intents should be well structured, following almost a unique path, that guides the user through the entire process, without allowing many chances for it to take alternative routes, in order to try that the human doesn't drive it to subjects, that the chatbot would not be prepared to talk about. Once the user types a message selecting one of the bus options displayed (condition to surpass this intent), it will make the intents "Confirm" and "Reject" active.

First a range of options is shown to the user, among which, this one has to choose one from, then the option is highlighted, to be confirmed or rejected, being that, in case of rejection, the program displays the options menu again, for a new choice to be made and in case of acceptance, the system saves the option and moves on to the next phase of the booking plan. After picking the bus, the system shows the three selected options once more and asks for a final confirmation from the user, to make sure everything is correct. In case negative answer is received, it would cancel the booking, but in case of an affirmative one, it would proceed to the payment process, phase which was not approached in this dissertation, but could easily be incorporated in a similar chatbot prototype.



V. PERFORMANCE ANALYSIS

One observes a larger abundance in the twenties sector, which could mean that the majority of those who attended the tests, already grew used to relying on computers. Ideally, a more singular distribution of ages would bring more benefits to the analytic process, since it could, more likely, better highlight age related patterns. On the other hand, a more abundant presence of older users, would also contribute to improve this study, regarding the benefits that the chatbot could bring to those less capable and not so accustomed to work with technologies.

The biggest take away here is that the majority of the respondents are highly qualified people, who are used to work regularly with online booking search engines. In fact, the literacy degree chart, the usability scores were projected to be high from start, which translates into a lack of less qualified people to test the product, to gather whether or not, its simplicity could in fact, be a real advantage over the most sophisticated traditional booking platforms' layouts. As for the travel frequency results, one concludes that, the large majority of those who took the tests, travels at least once a year, highlighting the big demand there is in nowadays booking market, which encourages the development of new tools for the industry. In this particular case, with such percentage of yearly travellers, it translates that, even if most of them are not inclined to start using chat bots as a reference for trip booking, still, there is a chance that a significant slice of the market could see it as a useful tool. At last, the dominant percentage of people who book their trips online represents a good possibility of future chatbot clients, since it would be a small step to replace a search engine, for an also online



booking experience, as is the chatbot. Although, keeping in mind that a possible transition to chatbot usage, would have to be slowly integrated, due simply to the fact, that psychologically, people tend to stay in their comfort zones, instead of trying to learn new habits, or how to work with new tools.

User feedback summary

The last part of the survey contained an optional open question, where the respondents were challenged to write a statement describing their general opinion about the experience of having used the chatbot to book a trip and what they thought that could be the future of chat bots in the travel booking business. Following, are highlighted some of the most notable points made by the users, being that the full responses are available in the annex section

- The chatbot looks like an interesting concept, but still feels more comfortable using regular websites
- The chatbot seems simpler to use
- As someone with good IT skills, I feel more limited using a chatbot.
- A lot of people would benefit in using a chatbot because it feels like a much more personal experience
- It offers less flexibility when you need complex choices, but seems like a very appropriate option for those not familiarized with ITs
- Interesting solution, since its clean menus make it easier to visualize options, avoiding the usual unnecessary extensive lists
- It probably will overtake web platforms in the future, because it's much more intuitive and practical
- It seemed simpler, felt safer and was less complicated to use
- It lacks searching criteria
- Equivalent to the existing alternatives but simpler and more objective
- Good option for older people

VI. CONCLUSION AND FUTURE WORK

To conclude, an overall balance of the project will be made, in a way of clarifying the important aspects to highlight, regarding chatbots and their future within the travel industry. After carefully designing and projecting the model, the prototype chatbot was successfully built, ending in an automated conversation system able to guide a natural language speaking user, through a travel booking process. More specifically, the built project's function is to receive travel details, such as destination and number of passengers, to search for travel options regarding those preferences, handling the entire process, in a straight flow of chat room conversation.

The major concern towards the use of a chatbot to book online trips is the fact that, it gives the users a small range of choices. That being said, for it to be effective, the search algorithm behind those choices must be as effective as possible, in order to assure the customers, that the bot will not only provide them a faster and more intuitive experience, but also that they will be presented with the best options in the market. If in fact, a system can be developed that guarantees an easier and more productive experience to the customers, then one could speculate that the chatbot could be a success among travelers and compete with the traditional booking methods.

A great and unique use of the chatbot would be to fully adapt it to interact with the user via audio.

This measure would, not only please a large quantity of the regular users, but would also have a huge impact among visually impaired people, since it would allow them to interact with the agent, without having to read or write. Furthermore, it would be possible to incorporate this feature in the current project without making major changes, since voice recognition is a technology already developed and present in general virtual assistants, like Siri or Google Assistant, which means that, developing the project to interact with Google Assistant instead of Skype, would make this feature possible. Actually, adding this voice component expands its potential, allowing to incorporate some other features, providing the users a much more complete experience, in a way that, it would not only help them booking trips, but could also talk about a lot of different subjects and give assistance in a large variety of ways.

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