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A PRELIMINARY STUDY ON USING CHATBOTS APPLICATIONS TO SUPPORT ARTIFICIAL INTELLIGENCE DECISION MAKING PROCESS

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Abstract: *This study offers on overview on chatbots in terms of definition, their evolution from the theory which triggered these systems to nowadays implementation using the available libraries in Python. Moreover, a classification of the chatbots and a basic architecture are provided. Current industry implementations are presented next, followed by the minimum risks which should be kept in mind when adopting such systems.*
Key words: *Chatbots, Decision-Making, Artificial Intelligence, Human-computer interaction*

1. INTRODUCTION

In recent years, an increasing number of managers in businesses have come to rely on a variety of information systems that give them access to analytics tools and capabilities to aid in their decision-making and planning processes. Big data analytics techniques may now fully capitalize on the trend of increasing business process automation and the resulting growth in the volume of data stored in databases to assist decision-makers in their decision-making process. Lately chatbots have received increased attention [1] as one of the technologies which can contribute in data collection and support in decision making.

The main objective of this paper is to provide an overview of what a chatbot is, to discuss on its current applicability in different industries and how it can support as middleman between decision making systems and BigData analytics.

2. THE CHATBOTS APPLICATIONS EVOLUTION AND DEVELOPMENT

2.1 Chatbots - Definition and Evolution

A chatbot is a communication interface which helps individuals and companies have successful conversations. Essentially, it is an Artificial Intelligence (AI) software that can be trained to provide information that the interlocutor is interested in.

Although nowadays, an intelligent chatbot can be implemented within few lines of code by implementing some of the public available libraries (Figure 1), the stage for these programs was set in the mid `90s.

The hypothesis of Alan Turing from 1950 sustained that an intelligent machine should not be distinguishable from a human during a text-only discussion, and this represented the starting point for the chatbot revolution. Table 1 presents an evolution of these programs.

Classification of Chatbots

Depending on the knowledge domain, chatbots can be classified into Generic chatbots, Open-Domain and Domain-Specific [3]. Based on the type of service provided, chatbots can be Interpersonal (services like booking services in restaurants, airlines, or searches in

FAQ without being a friendly companion), Intrapersonal (are close companions that live in the user's domain and understand his needs; usually connected to messenger applications like Slack and WhatsApp.),Inter-agent (provide communication with other chat-bots)[4].

The primary goal of the chatbots situates it under the umbrella of Informative (to get specific information stored in a fixed source),

Table 1

The Evolution of Chatbots.

Year	Name	Program specifics
2014	Alexa	Developed by Amazon, it is an intelligent personal assistant which can search the web, play music, create to-do or shopping lists, set alarms, stream podcasts, play audiobooks, get news or weather reports, control your smart-home products and more.
	Cortana	Uses voice recognition and relevant algorithms to get and respond to voice commands.
2012	Google Now	Was meant as a technique to obtain information that was appropriate for the situations dependent on the place and time of day. Later was replaced by Google Assistant in 2017.
2001	SmarterChild	Able to carry out conversations with a quick data access to other services, this was the precursor of Siri, Siri set the stage for all subsequent AI bots and could reply to a text, audio, images, and video when transferred to it by the user.
1995	Alice	Invented as a program which worked with the AIML (Artificial Intelligence Markup Language), which helped specifying the conversation rules. The program simulated a young-looking woman with whom the user can chat over the internet.
1992	Dr. Sbaitso	One of the earliest efforts of integrating AI into a chatbot was in 1992 within Creative Labs for MS-Dos. The software acted as a psychologist.
1988	Jabberwacky	Made use of the contextual pattern matching and simulated human conversation in an entertaining way.
1972	Parry	Simulated a person with paranoid schizophrenia and was based on natural language program
1966	Eliza	Created in a MIT laboratory, without having a built-in framework for contextualizing events. it matched user input to scripted responses.

```
# for speech-to-text
import speech_recognition as sr
# for text-to-speech
from gtts import gTTS
# for language model
import transformers
import os
import time
# for data
import os
import datetime
import numpy as np
# Building the AI
class ChatBot():
    def __init__(self, name):
        print("----- Starting up", name, "-----")
        self.name = name
    def speech_to_text(self):
        recognizer = sr.Recognizer()
        with sr.Microphone() as mic:
            print("Listening...")
            audio = recognizer.listen(mic)
            self.text="ERROR"
        try:
            self.text = recognizer.recognize_google(audio)
            print("Me  --> ", self.text)
        except:
            print("Me  -->  ERROR")
```

Fig. 1 Snipp of a chat bot created with existing libraries in Python

Conversational (hold a natural conversation with the user like a real person would do) or Task-based (handle different functions, such as room booking) [3,4]. Depending on the Response-Generation Method, chatbots can be Rule-based (match the user input to a rule pattern and select a predefined answer from a set of responses with the use of Pattern Matching

algorithms), Retrieval-based (use a neural network to assign scores and select the most likely response from a set of responses) or Generative (synthesize the reply, usually using deep learning techniques) [5].

The aspect of the human intervention classifies chatbots into Human-mediated (utilizes human computation in at least one part of it.) and Autonomous (humans try to fully integrate their intelligence into them) [3, 5]. Based on permissions, chatbots can be Open-source or Commercial [5]. Finally, depending on the Communication channel, chatbots can classify into text, voice or image. With the advances of technology, chatbots can now use all of them and react in a comment to the objects found in an image [6].

3. DESIGN STEPS AND ARCHITECTURE OF THE CHATBOTS

Chatbots have come a long way, and this goes hand in hand with the evolution of the technology. As companies plan to grow their investment in this field [1] it is important to have a basic understanding of their design and the underlying architecture. Planning the objectives, operational procedures, and user needs is the first step in creating a chatbot. The chatbot is then developed using a programming language (e.g. Python, C#) or a chatbot development platform (Microsoft LUIS [7]), and its local functionality is tested after that. Afterwards, it is made available online or in a data center and connected to one or more channels for message sending and receiving.

As a next step, the chatbot needs to be integrated with the application and this can be done either by integrating it using APIs, manual integration or third-party integration [8]. Figure 2 showcases a possible basic architecture for a chatbot.

In terms of components, two important components are the dialog managing (Figure 2-Natural Language Processing (NLP)) and the training component (Figure 2 -Knowledge Base).

The first one gets the input, and after processing, it returns an answer from the Knowledge Base (KB). The KB acts as a training component because based on the trained data it outputs an answer. Because there is a significant amount of collected data, there can also be a component which collects it and serves as data storage based on which new models can be trained.

The chatbot acting hence as a middleman between the user, the Data Storage and the KB.

4. CHATBOTS APPLICATIONS AS MIDDLEMAN AND RISKS

4.1 Industrial Use cases for Chatbots

As the literature shows, businesses from different industries started sooner or later to take advantage of these now advanced programs. The *ecommerce* [9, 10] field started using chatbots quickly. They started to replace the email for the customers, create a more personal content and a more relational marketing.

Within *customer service*, the chatbots solved the problem of employees not answering on time [11] while an intelligent bot is available 24/7. As the questions (e.g., FAQ) asked by a customer are 80% of the time similar, a chatbot can be trained to answer the questions and ask the human to intervene only when it gets stacked ([12, 13, 9]).

In addition, the internal help desks teams can be replaced by one chatbot, as the process it is usually also based on repeated questions, preventing the customer from having to read the documentation.

Recruiting and HR is another department in which companies can make use of a chatbot by training it to give a score for certain aptitudes (e.g., coding test for developers), help in the preselection process by asking a set of question to determine how well the candidate will fit in the company`s culture or use the chatbot as a body for the new employee.

The *tourism industry* ([14, 15]) is using the chatbots as a relationship ecosystem. Chatbots can be used as a personal assistant which premium customers can call at any time. Hotels also use the data collected via this chatbots and create customer profiles.

Fintech adopted the chatbots [16] and is using them in multiple ways: sending intelligent

messages for unauthorized transactions; offering suggestions on how the savings could be invested; offer 24/7 client support; simplify the internal process by automating the password reset process or parsing the employee's email.

A new industry in which the chatbots are researched is the *healthcare industry*. The research trends are around using AI chatbots to replace human interaction in health care [17]; using chatbots for adult healthcare [18]; the use of chatbot during pregnancy [19].

4.2 Risks that come with chatbots use

Although in the above section it was visible that chatbots bring innovation and are useful in multiple scenarios, there are also some drawbacks which come with their implementation [20].

First, customers are used to communicate with companies using phone, email or website and the change management should accommodate the time needed for the customer to adjust to the new way of communication.

Secondly, data security is another concern and customers should be informed that their data from the chatbot is gathered, stored and used for marketing purposes [20].

Thirdly, from an information point of view, because technology is still lacking the emotional comprehension, such programs might offer biased personalized information and lack in empathy.

5. CONCLUSION

Chatbots evolved from simple systems to programs which can interact on many levels with customers or with employees.

Nowadays implementing a chatbot can be done within few lines of code due to available libraries or a chatbot development platform can be used. In its basic architecture, the chatbot acts as a middleman between the user, the KB and the Data Storage. Hence it provides a space for data collection fur future decision making.

Adopted by multiple industries such as ecommerce, health, fintech, tourism etc. chatbots are here to stay. Although they represent the research topic of multiple studies, some missing topics which could be covered in the future refer to (1) their implementation in enterprises vs. small-medium companies, (2) chatbots as data source for a recommendation system, (3) the evolution of chatbots in web.3.0.

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Oportunități de utilizare a aplicațiilor de tip Chatbots pentru a sprijini utilizarea inteligenței artificiale pentru luarea deciziilor

Rezumat: Acest articol oferă o privire de ansamblu asupra aplicațiilor Chatbot-urilor în termeni de definiție, evoluție de la teoria care a declanșat aceste sisteme până la implementarea lor în zilele noastre, folosind bibliotecile disponibile în Python. Mai mult, sunt furnizate o clasificare a chatbot-urilor și o arhitectură de bază. Scopul final este de a prezenta implementările curente din industrie, urmate de riscurile ce ar trebui să fie considerate atunci când se adoptă astfel de aplicație pentru a crește interactivitatea utilizatorilor cu sistemele informatice.

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