

## Google Duplex - What it is and how Google's Artificial Intelligence works

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**ABSTRACT :** In contemporary times, Artificial Intelligence (AI) is growing exponentially. Therefore, new tools and applications are emerging every day for the most varied fields and areas of application, such as education, business, health, among others. Among these applications is Google Duplex, an AI belonging to the Google company, which is based on natural language and can call establishments and people with incredible accuracy by understanding the nuances of conversation and actually emulating human behavior in a phone call. Based on this information, this work aims to analyze the Google Duplex tool through some aspects such as availability, usability, architecture, strengths, weaknesses, advantages and market opportunities. To this end, the methodology adopted is that of bibliographic research. It is expected that as results, the research will become an important part of the existing theoretical framework on the subject of AI.

**KEYWORDS :** Google Duplex; Artificial Intelligence; Natural Language; Conversation; Emulating.

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### I. INTRODUCTION

Artificial Intelligence (AI) has grown exponentially in contemporary times and has been applied in various areas such as health, finance, industry, and entertainment. According to Bill Gates, one of the founders of Microsoft, artificial intelligence is the most important technological advance in decades. (GERKEN, 2023) According to Russell and Norvig (2013), AI is the ability of cyber systems (made up of computers, software, sensors, and actuators) to mimic human cognitive functions, which we can summarize as problem-solving through learning supported by perception. In addition, Warwick (2011) defines AI as a field of research that aims to create machines capable of performing tasks that require human intelligence, such as reasoning, learning, and perception. According to the book "Artificial Intelligence: The Star of the Digital Galaxy: A Study of Digital Disruption, Innovation, and Economic Transformation" by Asawa (2018), AI is a technology that is transforming the way we live and work. It is a branch of computer science that deals with the creation of intelligent machines that can perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. AI has been applied in various areas such as health, finance, industry, and entertainment. Some examples of artificial intelligence applications are: Production monitoring through sensors that collect real-time information; Automation of repetitive learning and discovery from data; Document verification and validation; Route applications; Inventory control of products in companies, natural language-based chatbots, among others.

Among the AI-based conversation technologies, the article focuses on Google Duplex, which according to Picaro (2022), is a technology that allows Google Assistant to make automated phone calls with a natural human voice. With this tool, it is possible to make reservations at restaurants or schedule appointments at beauty salons, for example. Google Duplex was launched in 2018 and is available in some countries, including Brazil. Furthermore, Google Duplex caused a huge stir around its technological innovations but also raised ethical questions. Therefore, according to the video "Google Duplex: A.I. Assistant Calls Local Businesses to Make Appointments"<sup>2</sup> available on Jeff Grubb's Game Mess channel on the YouTube platform, AI calls two commercial establishments - a restaurant and a beauty salon. In both calls, the people on the other end of the line did not realize they were speaking with an AI system and respectively scheduled the services being requested. Moreover, the fact that people did not realize they were speaking with a machine refers us to the popularly

known Imitation Game or using the more academic expression: Turing Test which was developed by an English mathematician named Alan Mathison Turing.

Primo et al. (2002 p. 1) state that questioning whether machines can think is based on:

*The text by mathematician Alan Turing, Computing, Machinery and Intelligence, originally published in 1950, and one of the most cited texts in works on artificial intelligence, proposed, from the still current question "can machines think?", a test he called the Imitation Game, but which came to be known as the Turing Test. In this game, an interrogator, communicating via terminal with software and another person, should find out who is who. Alan Turing died in 1954, a decade before programs simulating human dialogue, such as Eliza, began to proliferate. However, it was only in 1991 that the Turing Test had a formal application: the Loebner Contest, which came to annually award the best chatterbot. The maximum prize (for the first program whose "intelligence" cannot be differentiated from human), however, has not yet been won.*

In the aforementioned article, Turing proposed the following question: "Can machines think?", and as an alternative to this inquiry, the mathematician presents the Turing Test, which works as follows: it is a game composed of three 82 people, being a man represented by letter "A", a woman by letter "B", as well as an interrogator by letter "C". Furthermore, the objective is for the interrogator to be in a separate room in front of which are the man and woman and his main purpose is to determine which of the two is male and which is female. Therefore, the questioner only knows the other two by labels X and Y and at the end of the game must answer whether "X" corresponds to player "A" and "Y" to "B", or vice versa. (TURING, 1950) As an addendum, the questioner in order to determine labels "A" and "B" can question them through written messages so as not to have the tone of voice of those questioned as a criterion for decision. Furthermore, player "A"'s goal in the test is to induce player "C" (questioner) into error while player "B"'s goal is to assist "C". Turing still questions what would happen if player "A" were replaced by a computer with the same purpose of leading him into error? In this scenario would "C" distinguish between times when the game is played between "A" and "B" and between computer and "B"? The answer to this question can replace the question about machines' ability to think (TURING, 1950) since if "C" decides incorrectly during both scenarios of play one can say that this computer has intelligence. Since then many technologies and computers have emerged such as Google Duplex for example as well as AI field has advanced significantly however despite being able to designate many technologies as AI it is still not possible to say that they are fully intelligent that is at most these machines can mimic human behavior they still do not have sentience capacity so they do not perceive their own existence as a machine nor feel feelings and sensations consciously. Based on this information this work aims to present Artificial Intelligence (AI) called Google Duplex. This technology was developed with the aim of emulating humans on phone calls regarding making calls to commercial establishments such as restaurants beauty salons among others.

## II. METHODOLOGY

The methodological approach adopted in this work was that of bibliographic research, through books, scientific articles, texts, and internet research that focus on the subjects addressed. Furthermore, the work also makes use of basic research, that is, research used for the development of science and the theoretical framework on the subject, but without a practical application envisaged. Thus, some particularities of Google Duplex were analyzed, such as its operation, availability, usability, among other important aspects.

## III. RESULTS AND DISCUSSIONS

Availability: Initially, Google Duplex was only available to users of Pixel devices (Google Pixel, Pixel XL, Pixel 2, Pixel 2 XL, and Pixel 3 and Google Pixel 3 XL) from Google and only called restaurants in the areas of Atlanta, San Francisco, New York, and Phoenix. Currently, Duplex is being made available to other types of devices and to many countries, among which we can mention: Canada, United Kingdom, New Zealand, and Australia. (TILLMAN, 2020) Launch: Google Duplex was presented to the public at the Google I/O conference (a developers' conference organized by Google in the United States) in 2018 by CEO Sundar Pichai. On the occasion, a video was presented where the aforementioned AI calls a restaurant and a beauty salon, emulating human behavior through voice and successfully scheduling appointments. The fig. (1) below shows the presentation of Google Duplex at Google I/O.

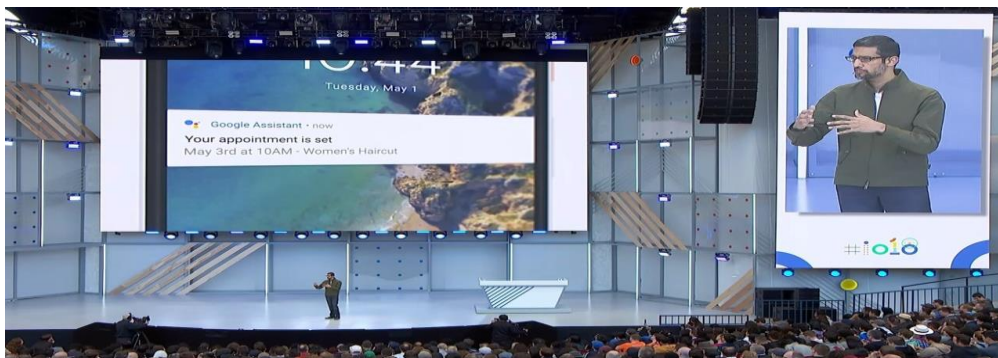


Figure (1) - Google CEO Sundar Pichai at Google IO Keynote.

Usability: Google Duplex can be used to schedule a time at a restaurant by following these steps:

- On your phone, activate Google Assistant by saying “Ok Google” or touching and holding the Home icon;
- Ask the Assistant to make a reservation for breakfast, lunch, or dinner. This should trigger the Duplex service. Asking the Assistant only to make a reservation may not be enough to activate Duplex;
- The assistant should provide a list of nearby restaurants. However, not all of them will support being contacted by Google’s AI. It may take a few tries to find one that supports calls via Assistant;
- Once you find a restaurant that accepts Duplex calls, the Assistant will ask what day and time you would like to schedule at the chosen restaurant, along with how many people will be included. It will also ask for an alternate time period in case your first option is not available;
- Finally, you confirm with the Assistant to allow Duplex to call the restaurant, and the AI’s voice does the rest, informing you if everything went well or if there was any problem with the scheduling. (CALLAHAM, 2020, freely translated)

Google Duplex can also be used to schedule a time at a beauty salon by following these steps:

- Search for your stylist’s location in Search or Maps on your phone and then tap “Request an Appointment”;
- Choose one of these options: general haircut, men’s haircut or women’s haircut;
- Enter your preferred date, time and time range for your appointment;
- Next, you have to inform whether or not you have been to the stylist’s location before. You also have the option of naming your specific stylist;
- Tap on your contact information (name, email address and phone number), and then the rest is up to AI who calls and informs you if the appointment has been scheduled or not. (CALLAHAM, 2020, freely translated)

Market opportunity: Google Duplex is born in a market of consumers and users who are already familiar with and use voice searches a lot. In a 2017 survey, it was found that about 40% of millennials already conduct voice searches, such as Siri, Alexa or Google Assistant, before buying something. In other words, it is safe to say that Google Duplex will popularize this type of search even more. (MEHTA, 2018)

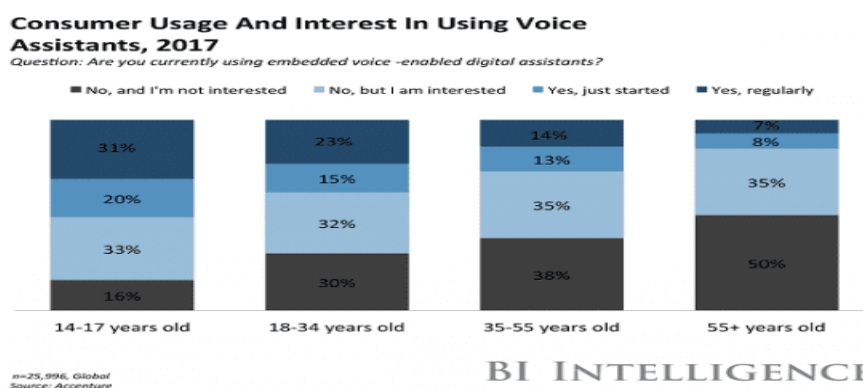


Figure (2) - Voice assistant usage survey

Architecture: Google Duplex's conversations sound natural thanks to advances in understanding, interaction, timing, and speech. Duplex's architecture is composed of a recurrent neural network (RNN) designed to handle challenges in conversation, built with TensorFlow Extended (TFX). To achieve its high accuracy, Duplex's RNN was trained based on an anonymous dataset of phone conversations. The network uses the output of Google's automatic speech recognition (ASR) technology, as well as audio features, conversation history, conversation parameters (e.g., the desired service for an appointment or the current time of day), and more. The understanding model was trained separately for each task, but the dataset was shared across tasks. Finally, TFX hyper parameter optimization was used to further optimize the model. (LEVIATHAN; MATIAS, 2018, freely translated). Fig. 3 presents the basic architecture of Duplex.

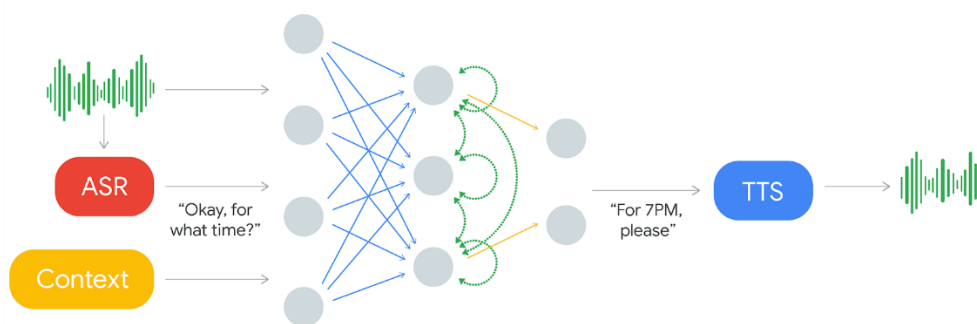


Figure (3) - Google Duplex Architecture

Google Duplex was developed by product designers and engineers in New York, Mountain View, and Tel Aviv, and its service is free for smartphones that have the Google Assistant app, as well as access to searches in the Maps app. However, to generate revenue, it is believed that Google will rely on ads and data collection, since Duplex learns through neural networks, and to optimize its operation, it needs to learn from data and nuances of conversations already held. The company is also planning to launch Google Duplex for the web, to assist even in filling out forms and even buying movie tickets.

#### IV. CONCLUSION

In conclusion, it can be stated that the application of Google Duplex can provide businesses with a great technological advantage and time-saving, as Duplex makes calls for people, which can make the conversation experience comfortable, as Duplex understands the context and nuances of the conversation, in addition to having Natural Language Processing, i.e., emulation of human language. Some weaknesses of the tool can also be listed, such as interpreting the nuances of conversation accurately, as something misinterpreted can generate some discomfort during the conversation; privacy, since Google Duplex will record conversations and notify the recipient of this, but experts are debating whether this solves the consent problem since the recipient does not know how the recording will be used and for how long. Furthermore, as opportunities, Google Duplex can help those who have difficulty using the phone due to some disability; Education area, where Duplex technology can be used in chatbot projects with the aim of assisting students with specific doubts about tasks or even about a specific concept, using natural language in responses, such as chatbot prof.<sup>a</sup>. Elektra; Assisting busy people; Benefiting companies that do not have online reservation systems; Customer service; Assisting in the Human Resources department of companies, being able to call candidates in the preliminary phase of acquiring new talents; Real estate sector: Can help call potential buyers and sellers of real estate, automating brokers' tasks; Health sector: "Google Duplex can help reduce loneliness-related illnesses by engaging with users on a more human level. It can also help with preventive care and lifestyle disease management such as diabetes by ensuring patients continue to take medication, keep appointments, provide emergency first aid, call 911 etc." (MATHUR, 2018, freely translated)

In addition, as possible threats, ethical issues and lack of regulation can be cited since Google was questioned about the need to inform the human part of the phone call that it is interacting with a machine since many people may feel uncomfortable knowing that they did not speak to a person or even being targeted by some kind of technological test such as Turing Test to avoid people being at the mercy of the assistant; Fierce competition in the technology sector besides Google's Assistant program there are others such as Microsoft's Cortana; Apple's Siri; Amazon's Alexa among others; Distrust in Artificial Intelligence: Many people are skeptical if AI can

accurately schedule an appointment and if it fails or something goes wrong will AI correctly signal this to people?; Dangers of misuse of technology such as social engineering; The places that will receive Duplex calls must be prepared for this in order to avoid many unbridled calls and cause spam; Hacker attacks: like all technology Duplex as such can also be targeted by hacker attacks which in this case can generate numerous problems since a convincing machine call posing as a person can be used by wrongdoers for threats and various crimes.

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