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ENTITLED

Development of an Intelligent Tutoring Application for Assisting University Students

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Dedication

I dedicate this humble act to my parents, who have been a source of generosity and patience throughout my academic career. May Allah protect them.

To my brothers and sisters, my family, and my loved ones, each of whom has always shown me the right path and helped me along the way.

To the people who supported me during my university studies, especially Arslane Zakariya and Zerig Salah, my mentor Brahimi Mahmoud, a source of inspiration in the field, as well as to my dear friends for their constant encouragement and support.

To all those who have enlightened my mind with knowledge, however small, at all stages of my life, I extend my sincere thanks and gratitude.

إهـــــــــداء

أهدي هذا العمل إلى أمي وأبي اللذين دعماني وشجعاني طوال سنوات الدراسة هذه. نرجو أن يعتبروها شهادة على امتناني العميق.

إلى إخوتي وعائلتي وأحبابي وإلى كل من شاركني لحظات عاطفية أثناء إنجاز هذا العمل.

لقد رافقني دعمهم الدافئ وتشجيعهم طوال رحلتي.

إلى عائلتي وأحبابي وإلى من يجلب لي الحب والحيوية.

إلى جميع أصدقائي الذين شجعوني دائمًا والذين أتمنى لهم النجاح المستمر.

إلى كل من أحب.

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Finally, we extend our thanks to all those who, directly or indirectly, contributed to the completion of this work. Please accept our sincere gratitude.

ملخص :

يهدف هذا المشروع إلى تصميم وانجاز نظام محادثة ذكي لمرافقة الطلبة الجامعيين، وخصوصًا طلبة السنة الأولى. حيث يعمل هذا النظام على التخفيف من التحديات التي يواجهها الطلبة الجدد من خلال تقديم إجابات فورية على الأسئلة المتكررة، مما يساعدهم على الاندماج بشكل أفضل وسريع في الحياة الجامعية من جهة وتقليل العبء على الطاقم الإداري في الجامعات من جهة أخرى، من خلال الحد من الأسئلة المتكررة وتحسين جودة الخدمات المقدّمة .يتناول المشروع المراحل الأساسية لتطوير هذا النظام، بما في ذلك تحليل الاحتياجات، وتصميم قاعدة المعطيات ومختلف الإجراءات باستخدام لغة النمذجة الموحدة UML. كما تم استخدام إطار العمل Flutter لبرمجة هذا النظام.

الكلمات المفتاحية: نظام محادثة، طلبة جامعيين، مرافقة، AI، Chatbot

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Abstract:

This project aims to design and develop an intelligent chatbot system to provide tutoring for university students, particularly first-year students. The system helps alleviate the challenges faced by new students by providing instant answers to frequently asked questions, thus enabling faster and smoother integration into university life. At the same time, it reduces the workload on university administrative staff by minimizing repeated inquiries and enhancing the quality of services provided. The project covers the essential stages of system development, including needs analysis, database design, and various procedures using the Unified Modeling Language (UML). The system was implemented using the Flutter framework.

Keywords: Chatbot system, university students, tutoring, AI, Chatbot

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Résumé :

Ce projet vise à concevoir et développer un système de chatbot intelligent destiné à offrir un tutorat aux étudiants universitaires, en particulier ceux de première année. Ce système contribue à alléger les défis rencontrés par les nouveaux étudiants en fournissant des réponses instantanées aux questions fréquemment posées, facilitant ainsi leur intégration rapide et fluide dans la vie universitaire. Parallèlement, il permet de réduire la charge de travail du personnel administratif universitaire en limitant les demandes répétitives et en améliorant la qualité des services offerts. Le projet aborde les étapes essentielles du développement du système, notamment l'analyse des besoins, la conception de la base de données et diverses procédures en utilisant le langage de modélisation unifié (UML). Le système a été implémenté à l'aide du framework Flutter.

Mots-clés : Système de chatbot, étudiants universitaires, tutorat, IA, Chatbot

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General Introduction

In our current day, with the rapid growth of the population and the increasing number of students each year, the pressure on university employees is growing as they are required to assist the new arrivals and address all their questions and needs.

However, despite the significant efforts put forth by the ministry and the university administration, that task remains very challenging to accomplish due to the disparity between the number of students and the number of employees, as well as the limited resources available. Even with the assistance of university-made platforms, such as DWS and Facebook pages, the problem remains and is not yet fully solved.

In this project, we proposed a solution that is an AI-based mobile application playing the role of a tutor and helping students get answers to their questions. We also integrated a machine learning model that can learn and adjust to the needs of every student, known as a Chatbot.

To accomplish this work, our dissertation is organized around three chapters:

In the first chapter, we gave a generality on AI, including its origins and long-term development and the things accomplished by the AI, its aspects, fields and applications, as well as its working methods, machine learning models and other variable things about AI field, we also talked about chatbots, what are they and how they can be used

In Chapter 2, we discussed the current practices and their limitations in assisting both new arrivals and older ones. We provided a brief comparison between the current and proposed AI practices, illustrating how these newer practices can help solve the problem and enhance the services provided to new students. Additionally, we examined the vision, structure, and functioning of our chatbot through UML diagrams.

In Chapter 3, we introduced the various tools used for this application and outlined the advantages that led us to choose them. Then, we explained the interface of our application and gave an example of its functioning.

In summary, our project, an intelligent mobile application for student tutoring and guidance, falls under the aspect of helping and assisting new students in their transition to the university. By putting a mobile application in their hands, the questions they have in mind or problems they might face during their first period should be easier to answer and deal with, as they have a virtual guide readily available.

CHAPTER 1

Generality on AI

1.1 Introduction

The evolution of concept to functional application has taken the form of artificial intelligence (AI), which is pervading various sectors, including education. AI technologies are being offered to enhance the interface between humans and computing systems as comprehensive, customized solutions to various problems. AI offers immense value across its diverse applications. Still, its greatest potential may lie in optimizing learning processes and enhancing the overall experience for users, particularly for learners new to the system.

This chapter provides a comprehensive examination of the history of IA, its underlying concepts, key areas of study, and practical applications. Particular focus is paid to conversational agents, or chatbots, which are currently one of the most widely used and accessible forms of IA. We will discuss how they work, their benefits, and their areas of application, which include healthcare, education, and support services.

1.2 Definition of AI

Artificial Intelligence is a concept that falls under the field of computer science, focusing mainly on creating systems that can replicate human intelligence and its aspects, such as problem-solving, continuous learning, and self-development. These tasks are primarily accomplished by analyzing numerous sets of data, processing them, and learning from past experiences to streamline and improve future operations. All that is done automatically, whereas in a normal computer program, human manual interference would be required to fix bugs and improve processes over time [1].

I.3 History of Artificial Intelligence

1.3.1 The initial Phase

1.1. Some people may tend to think that AI is a recent development in technology because it has begun to gain popularity and spread worldwide over the last several years. Still, that assumption is wrong, mainly because artificial intelligence is a concept that was

first introduced between the early beginnings and mid's of the 19th century by many scientists such as Czech playwright Karel Čapek who introduced the first robot in 1921 under the name "artificial people", or Makoto Nishimura who built "Gakutensoku" which is the first Japanese robot in 1929. Since then, the AI has continued to develop until it reached the level we see, use, and know now [1].

1.3.2. The development phase

After AI was introduced, it went through a phase of huge and rapid growth. Yet, it was full of challenges and struggles for the engineers and researchers behind it due to the lack of resources and data necessary for developing such a new concept at the time. This created difficulties for scientists in the computer science field during the development phase [1].

Despite all the obstacles that they encountered back at that time still, that phase is full of remarkable dates and inventions, such as :

- The creation of LISP, the first programming language designed for AI research, is still in use today.
- In 1961, General Motors introduced the first industrial robot under the name « Unimate » in New Jersey. It was tasked with transporting die casings and welding parts on cars (which was deemed too dangerous for humans).
- Edward Feigenbaum and Joshua Lederberg created the first "expert system" in 1965, which was a form of AI programmed to replicate the thinking and decision-making abilities of human experts.
- James L. Adams created The Stanford Cart in 1961, which became one of the first examples of an autonomous vehicle. In 1979, it successfully navigated a room full of chairs without human interference.
- The American Association of Artificial Intelligence, which is now known as the Association for the Advancement of Artificial Intelligence (AAAI), was founded in 1979, and a year later, the First conference of the AAAI was held at Stanford.
- **1997, For the first time in history, the world chess** champion, Gary Kasparov, lost in a highly-publicized match against Deep Blue, a robot developed by IBM; three years later, Professor Cynthia Breazeal developed the first robot that could simulate human emotions with its face, which included eyes, eyebrows, ears, and a mouth. It was called Kismet.

1.3.3. The spread phase

After these remarkable dates and events, AI experienced explosive growth and widespread admiration among people due to its abilities and ease of use, especially with the creation of new AI tools such as virtual assistants, search engines, and chatbots. This period also popularized deep learning and big data [1].

1.4. Key Concepts related to Artificial Intelligence

1.4.1. Machine Learning

- **1.4.1.1 Definition**

Machine Learning is a subfield of artificial intelligence. It enables algorithms to identify patterns in data, whether it's numbers, words, pictures, or statistics. All that is stored digitally and can be utilized as data for Machine Learning. Through the patterns, the algorithms learn and enhance their performance for a given task. Machine Learning algorithms learn autonomously to perform tasks and make predictions based on data, continually improving over time. After being trained, the algorithm identifies patterns in new data [2].

- **1.4.1.2 Machine learning functioning**

The creation of an automated learning model involves four key steps. Most of the time, it is a data scientist who guides and oversees the process.

- **1st step:** it involves the choice and preparation of a set of data for training. The data will be used to feed the automatic learning model, thereby enabling it to acquire the skills required to tackle the issue it was designed for. They can be labelled data to tell the model the attributes that it needs to identify. Or they can be non-annotated, in which case it is left to the model to determine and extract independent repeating features. In both cases, it is extremely important that data must be well-prepared, organized, and cleaned. Otherwise, the machine learning model can be affected by biases. The results of its subsequent predictions will be directly affected [2].

- **2nd step:** this step involves choosing an algorithm to implement on the entire learning data. The type and size of the learning data, as well as the nature of the problem to be solved, determine the kind of algorithm to be used [2].

- **3rd step:** now comes the training of the algorithm, which is done iteratively. The variables are inserted into the algorithm, and the obtained results are checked against the expected results. Then, the « weight » and also the bias may be tweaked in a bid to improve the accuracy of the results. Then, it runs the variables again until the algorithm

reaches the correct result most of the time. The algorithm, thus trained, is the Machine Learning model [2].

- **4th step** is the application and optimization of the model. The latter is applied to new data whose origin is determined by the issue to be resolved. For instance, a machine learning model meant to detect unsolicited mail will be utilized on emails. On another level, an automatic learning model of a robot vacuum processes data from its interaction with the real environment, such as the movement of furniture or the addition of new objects in the room. Efficiency as well as accuracy can be improved over time as well [2].

- **1.4.1.3. Machin learning types**

There are three Machine Learning approaches: supervised learning, unsupervised learning, and reinforcement learning.

- **Supervised learning:** In the case of supervised learning, the most common approach, data are labelled to instruct the machine about the patterns to find. The system is developed from a corpus of labelled data containing the information it must be able to identify. It is also possible that this data is already classified according to the criteria by which the system is supposed to operate. This approach requires fewer training data than the other approaches and simplifies the training task by allowing for comparison of the model's results with already labelled data. Nevertheless, preparing the data to be labelled can be expensive. Moreover, a model can have biases due to the training data, which will influence its future performances when dealing with unseen data [2].

- **Unsupervised learning:** Conversely, in unsupervised learning, data is not labelled. The algorithm undergoes the process of analyzing the data to search for potential patterns. It handles large volumes of information and executes algorithms to derive meaningful features needed for the process of labelling, sorting, and categorizing data in real-time, without any human intervention. Rather than automating the decision-making and prediction, this method simplifies the discovery of patterns and correlations that are not apparent to humans in the data. Although less popular due to the complexity of deployment, this method is gaining popularity in the cybersecurity sector [2].

- **Reinforcement learning:** This method involves allowing an algorithm to learn from its mistakes in order to achieve a goal. The algorithm will attempt various methods to achieve its goal. Based on its discovery, it will be rewarded or penalized to motivate it to continue on a certain course or to adopt a novel strategy. It is most typically utilized to help artificial intelligence overtake human performance in the area of games. For

instance, Google AlphaGo defeated the Go champion using reinforcement learning. Similarly, OpenAI trained an AI that can defeat the top players of the video game Dota 2 [2].

- We also have a fourth, but less popular, type: semi-supervised learning, which falls between supervised and unsupervised methods, thus offering a compromise between these two approaches. During the training phase, a labelled but relatively small dataset is used to guide classification and feature extraction from a larger set of unlabelled data. This methodology proves relevant in situations where the amount of labelled data is small for learning a supervised algorithm. It provides a solution to overcome this issue [2].

- **1.4.1.4. Machine Learning models**

There exists a large variety of Machine Learning models. Still, some of them are more used than others. These are some of the most used machine learning models that are applied to the labelled data:

- **Regression models,** whether linear or logistic, make it easy to analyze the relationships that exist among the various variables. Linear regression is used to estimate the value of a dependent variable based on an independent variable. A good example would be to predict a commercial's yearly sales based on either their level of education or professional experience. On the other hand, Logistic regression is used when the dependent variables have a binary nature. Another form of regression algorithm, which is referred to as the support vector machine, is relevant when the dependent variables have increased challenges when it comes to classification [2].

- **Decision tree:** One other popular machine learning algorithm is the decision tree. The latter simplifies the process of making recommendations according to a list of decisional rules based on already classified data. For example, it recommends which football team to bet on according to factors such as the age of the players or the winning percentage of the team [2].

As for unlabelled data, we have:

- **Clustering algorithms:** they are often used. This method involves identifying groups of similar records and labelling these records according to the group to which they belong. The features of clusters and whether they existed were unclear. Some of the clustering algorithms include the K-means, TwoStep, and Kohonen model [2].

- **Association algorithms:** they detect patterns and relationships in data, and the "if/then" relationships are called "association rules." The rules are also similar to those used in data mining.
- **Neural networks:** these are algorithms that come in the form of a multi-level architecture. The input layer allows the input of data, one or more hidden layers make deductions from the input data, and the final layer provides a probability for each one of the conclusions. Also, A "deep" neural network consists of several hidden layers, each having the function of refining the results produced by the previous layer. This architecture is used in the field of deep learning [2].

1.4.2. Deep learning

Deep learning is a branch of machine learning, but it's currently the most widely used technique. This technology was developed by Geoffrey Hinton in 1986.

In simple terms, deep learning is a vast improvement over machine learning. This learning process employs a technique that gives it an extraordinary ability to detect patterns, including the subtlest ones. This approach is called « deep neural network ». This depth corresponds to the enormous number of layers of calculation nodes that constitute these networks and work together in order to process data and make predictions.

These neural networks are directly inspired by the functioning of the human brain. The computational nodes are similar to the neurons, and the network is similar to the brain [2].

1.5. Artificial Intelligence aspects

- **Learning:** one of the main and most important aspects, it allows AI systems not only to evolve but also assimilate data and enhance functions without direct human coding through data annotation, pattern recognition, and feedback reinforcement by a reward/penalty system.
- **Reasoning and decision making:** another viral component of AI, it applies logical rules, probabilistic models, and algorithms to make decisions and derive conclusions. AI models are designed to apply reasoning to yield reliable outcomes when confronted with challenges.
- **Problem-solving:** Closely associated with reasoning and decision-making, problem-solving in AI involves dealing with data, processing it, and using it to arrive at solutions for a given problem.

- **Perception:** The last important feature of artificial intelligence, perception, deals with the utilization of real or virtual sensory organs by the technology. Artificial intelligence systems read data to recognize objects and sense their spatial relationships, e.g., distance, to the objects. This is usually done through activities such as image recognition, object detection, image segmentation, and video analysis [3].

1.6. Artificial Intelligence Fields

- **Machine learning:** as previously mentioned, it is the procedure by which a computational machine utilizes large amounts of data to carry out specific tasks. Artificial intelligence and machine learning are distinct, although they share some commonalities. Machine learning programs can recognize known patterns but lack reasoning or innovation capability.
- **Neural networks:** they are a robust method of machine learning that can find patterns in data that are much too complicated for humans to comprehend, as previously mentioned. Modelled after biological neural networks, this system enables several algorithms to collaborate with each other to process multifaceted inputs effectively.
- **Deep learning:** The outcome of neural networks learning from massive chunks of information by performing a task repeatedly, each time tweaking it slightly for a better outcome.
- **Natural language processing:** A branch of AI that gives computers the ability to process, analyze, and manipulate human communication, both spoken and written. NLP is best exemplified by products such as Alexa and Siri.

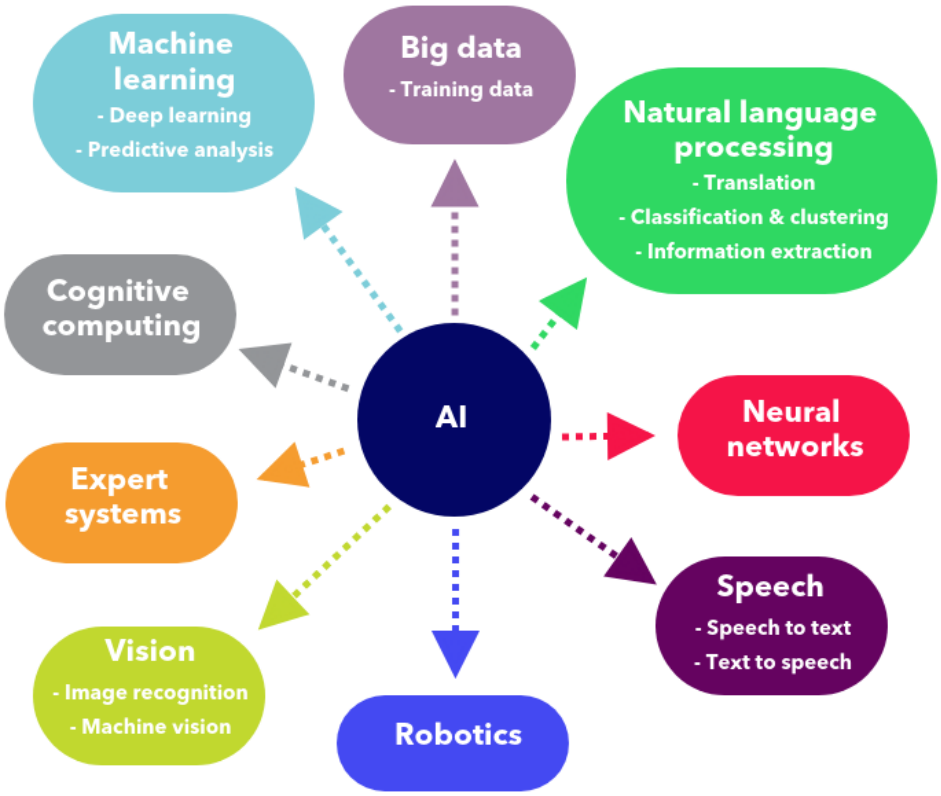

Fig 1.1 The branches of Artificial Intelligence [4]

- **Cognitive computing:** A cognitive system replicates the activities of the human brain and enables improved decision-making through the extraction of insights from unstructured data. Key elements of cognitive analysis are self-learning algorithms, pattern recognition, and natural language processing.
- **Computer vision:** a field of artificial intelligence that is based on pattern recognition and deep learning techniques to interpret the visual world. Computer vision enables computers to interpret images, videos, and multi-dimensional data in real-time [4].

1.7 Natural language processing

1.7.1 Definition

A branch of artificial intelligence (AI) and computer science called natural language processing (NLP) employs machine learning to make it possible for computers to comprehend and interact with human language. By combining computational linguistics—the rule-based modelling of human language—with statistical modelling, machine learning, and deep learning, natural language processing (NLP) makes it possible for computers and digital devices to recognize, comprehend, and produce text and speech. from large language models' (LLMs')

communication abilities to image generation models' comprehension of requests, NLP research has paved the way for the era of generative AI. Many people currently use natural language processing (NLP) in their daily lives, as seen by the use of voice-activated GPS systems, chatbots that respond to spoken orders for customer service, search engines, and smartphone digital assistants that can answer questions [14].

1.7.2 NLP Approaches

There exists three different approaches of NLP, which are:

- **Rule based NLP:** Simple if-then decision trees, which required preprogrammed rules, were the first NLP applications. Examples include the original Moviefone, which had limited natural language generation (NLG) capabilities and could only respond to specified commands. This function is extremely limited and not scalable due to rules-based NLP's lack of machine learning or artificial intelligence capabilities [14].
- **Statistical NLP:** Statistical natural language processing, which was developed subsequently, automatically extracts, categorizes, and labels text and speech input pieces before giving each potential interpretation a statistical likelihood. Part-of-speech tagging is one example of the advanced linguistic breakdown made possible by machine learning. In order to describe language using mathematical (statistical) techniques like regression or Markov models, statistical natural language processing (NLP) developed the crucial technique of mapping language elements, such as words and grammatical rules, to a vector representation. Early NLP innovations like spellcheckers and T9 texting—text on nine keys for use on touch-tone phones—were influenced by this [14].
- **Deep learning NLP:** Deep learning models, which use vast amounts of unstructured, raw data—both text and voice—to grow increasingly accurate, have recently taken over as the predominant NLP paradigm. With the exception of the usage of neural network models, deep learning can be seen as an extension of statistical natural language processing. There are a number of models, such as the Transformer model, which determines the relationship between various language components by using self-attention (which records dependencies and relationships) and tokenization of language (which determines the location of each token word or sub-word). Self-supervised learning on large text collections can effectively train transformer models. Google's bidirectional encoder representations from transformers (BERT / DistilBERT) , which served as the foundation for Google's search engine and continue to do so, were a turning point in transformer models [14].

1.7.3 Benefits of NLP

NLP makes it easier for humans to communicate and collaborate with machines, by allowing them to do so in the natural human language they use every day. This offers benefits across many industries and applications, such as:

- **Automation of repetitive tasks:** Tasks like data entry, document handling, and customer service can be entirely or partially automated with the use of natural language processing (NLP). NLP-powered chatbots, for instance, can answer standard consumer questions, freeing up human agents to deal with more complicated problems. NLP tools can automatically categorise, extract important information, and summarise text in document processing, saving time and minimising errors that come with manual data management. NLP makes it easier to translate texts between languages while maintaining context, meaning, and subtleties [14].
- **Improved data analysis:** By making it possible to extract insights from unstructured text data, such news articles, social media posts, and customer reviews, natural language processing (NLP) improves data analysis. NLP may find sentiments, patterns, and trends in big datasets that aren't immediately apparent by employing text mining approaches. Sentiment analysis makes it possible to identify subjective traits, attitudes, feelings, sarcasm, perplexity, or distrust in written material. This is frequently used to route messages to the system or the individual who is most likely to respond next. This enables companies to gain a deeper understanding of public opinion, market situations, and consumer preferences. Large volumes of text can also be categorised and summarised using NLP technologies, which helps analysts find important information and make data-driven decisions more quickly [14].
- **Enhanced search:** By helping algorithms comprehend the purpose of user searches, natural language processing (NLP) improves search by producing more precise and contextually relevant results. NLP-powered search engines examine the meaning of words and phrases rather than just matching keywords, which makes it simpler to locate information even in cases where queries are complicated or ambiguous. This enhances the user experience in enterprise data systems, document retrieval, and web searches [14].
- **Powerful content generation:** Advanced language models are powered by NLP to produce text that is human-like for a variety of uses. Based on user-provided prompts, pre-trained models, like GPT-4, can produce reports, articles, product descriptions, marketing copy, and even creative writing. Additionally, NLP-powered applications can help automate processes like creating legal documents, social media postings, and email drafts. NLP saves time and effort in content generation while ensuring that the generated

information is coherent, relevant, and in line with the intended message by comprehending context, tone, and style [14].

1.8. Artificial Intelligence Applications

Artificial Intelligence has various applications in today's society. It is becoming essential for today's time because it makes our daily life more comfortable and fast, and because of its efficiency in multiple industries. Following are some sectors which have the application of Artificial Intelligence:

- **Astronomy:** AI identifies and categorizes objects in space photos, aiding in the identification of galaxies, stars, and cosmic events. It also examines space images to classify objects automatically. AI is also indispensable to space research, helping scientists sift through complex observations and aiding astronomers in recognizing patterns and anomalies. Essentially, AI sifts through vast amounts of information for useful data. AI enhances telescopes by automatically setting adjustments. During weather fluctuations or when scientists target specific areas, AI optimizes performance to create a smart, adaptive telescope.
- **Healthcare:** AI enhances doctors' ability to visualize within the body, diagnose diseases early, and develop drugs successfully. It also creates personalized treatment plans and streamlines hospital resources to ensure efficient operations. It can predict patient arrivals, allowing hospitals to staff and allocate resources more efficiently.
- **Gaming:** AI serves as the brain for non-player characters, enabling them to behave like real humans or intelligent enemies. They learn and adapt according to player actions, which adds excitement and realism to the game. Imagine enemies adjusting to what you're doing—that's AI in action. In addition to automatically generating game maps and levels, this also reduces the need for manual labour. This enables the creation of larger, more interactive worlds and realistic graphics, which benefits developers. It also predicts player movements for more flowing play.
- **Finance:** AI detects suspicious activity, like unexpected use of a credit card. It alerts the bank to potential fraud, allowing it to be prevented quickly without any manual intervention. It also trades and shares automatically using algorithms to increase efficiency and profitability. AI evaluates information to measure loan and investment risk, too, considering repayment potential and safety. It enables financial institutions to make informed decisions, avoiding losses and fostering growth.

- **Data security:** AI can identify anomalies present in huge volumes of data, detect unauthorized use or theft, and alert against problems to prevent sensitive information from cyberattacks. It can also examine the past to anticipate future dangers, such as cyber breaches or cyberattacks, protect the firm, and quickly quarantine cyberattack areas to safeguard your information.
- **Social media:** AI enhances your social media experience based on your behaviours and interests, making intelligent suggestions to you. Virtual assistants and AI chatbots are social media, online assistants. They are quick responders, interact like humans, answer queries, offer information, and resolve issues, providing 24/7 assistance to enhance the overall experience. Additionally, AI tracks conversations and trends, helping individuals and companies understand the public narrative. It is the social media reporter, keeping clients informed of what is happening in the present.
- **Travel and transport:** AI enhances delivery and travel routes, making them more efficient in terms of cost and time, thereby reducing expenditures on time, fuel, and money. It provides travel advice for convenient travel, enhancing safety through rapid bag and person screening to eliminate threats, improve efficiency, and promote safety smoothly. AI chatbots are also virtual ticket, suggestion, and query assistants that make travel convenient and accessible around the clock, including at night. Another benefit is forecasting car and aircraft maintenance needs, enabling early repairs, decreasing downtime, and resulting in financial savings.
- **Automotive Industry:** from the ADAS (Advanced driver assistance system) that ensures that the car can respond to obstacles sooner, keeps to the correct lanes, brakes early, and pulls up alongside traffic to prevent accidents to the Voice Recognition that assists navigation, audio, and communication through speech raised the idea of the Autonomous vehicle that uses AI and sensors to evaluate the world around them to make decisions such as turning or braking, acting like intelligent drivers to ensure safe transportation. AI also coordinates equipment, minimizes downtime, and helps with material ordering. It increases velocity, saves money, and enhances quality, serving as an efficient factory manager.
- **Robotics:** Self-navigating robots that AI empowers to move independently, acting like GPS navigators for package transportation and discovery. It also allows robots to identify, pick, sort, and package products in warehouses. With AI, robots can cooperate with humans, learning to accomplish tasks that increase safety and productivity, such as that of a steady robotic colleague.

- **Entrainment:** The AI processes movie and music histories to recommend titles, serving as an individual entertainment guide. It assists artists in producing art, music, and video, enriching their work and enhancing creativity through the skilled application of technical details, while allowing artists to keep their focus directed towards their vision. AI also enhances live performances with real-time translations, effects, and audience preferences, thereby adding to the interactivity.
- **Agriculture:** AI monitors crop health using sensors, optimizing seeding, irrigation, and harvesting, and supports farming by applying fertilizers and pesticides with precision, conserving them, and maximizing crop development. It tracks livestock health using sensors, reporting problems to ease care—to serve as a caretaker. AI also automates tractors and drones for planting, weeding, and spraying, thereby increasing farming efficiency.
- **E-commerce:** AI reviews your purchases and preferences to suggest items you'll love, becoming your personal store assistant. It makes your experience personalized, increases discovery, drives retailer sales, and saves you time. AI also controls inventory by forecasting demand and automating refills, maintaining optimal stock levels, preventing capital lockup, and guaranteeing customer satisfaction. It also varies pricing depending on demand, competitors, and stock to maximize profitability and value for customers.
- **Education:** AI frees up instructor time by developing quizzes, curriculum plans, and course guides, allowing for enhanced quality time interactions. It is a highly efficient clerk that facilitates educators in engaging and motivating students more effectively. It also helps by adding Virtual Learning Assistants that answer questions at any time, increasing learning accessibility and fun. It saves instructors time by managing routine questions, enabling one-on-one support, and grading assignments rapidly, while also providing instant feedback to students. It monitors areas for improvement as well as overall progress, freeing instructors to focus on instruction. Last but not least, it offers Personalized Learning Pathways, detecting strengths and weaknesses to present customized content and approaches for enhanced learning [5].

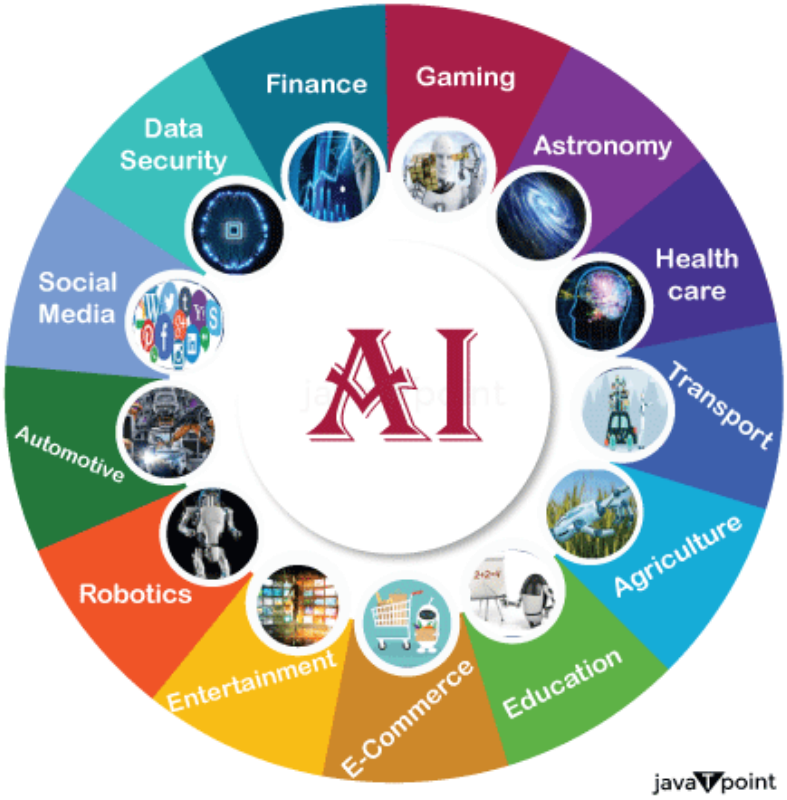

Fig 1.2 Applications of Artificial Intelligence [5]

1.9. Chatbots

1.9.1. Definition

chatbot is a computer software that mimics human communication with a user. While not all chatbots utilize artificial intelligence (AI), contemporary chatbots are increasingly employing conversational AI methods, such as natural language processing (NLP), to comprehend user inquiries and generate automated responses [6]. **Another definition:** A chatbot is a type of conversational AI that provides round-the-clock customer assistance by automating client support in a warm, recognizable manner. However, conventional chatbots are changing quickly due to the emergence of generative AI. The next generation of AI-powered bots, known as AI agents, is capable of handling complex consumer requests independently while providing personalized assistance and accumulating knowledge from each interaction [7].

1.9.2. How Chatbots Work

In essence, the first chatbots were interactive FAQ programs that utilized a limited number of frequently asked questions and pre-written responses. These FAQs typically required users to choose from basic terms and phrases to advance the conversation because they were unable to

understand natural language. Such basic, conventional chatbots are incapable of processing complicated queries or providing answers to straightforward queries that developers have not anticipated.

Customer inquiries can now be articulated conversationally due to chatbot algorithms' increasing ability to perform sophisticated rules-based programming and even natural language processing. As a result, a new kind of chatbot emerged that is contextually aware and equipped with machine learning to continuously improve its capacity to comprehend and anticipate requests accurately by being exposed to an increasing amount of human language.

Contemporary AI chatbots now utilize natural language understanding (NLU) to interpret open-ended user input, thereby overcoming issues such as typos and translation errors. Then, using conversational AI, sophisticated AI algorithms translate that meaning to the precise "intent" the user wants the chatbot to respond to. To create a more detailed knowledge base of queries and answers based on user interactions, these AI technologies utilize both machine learning and deep learning, two distinct yet complementary aspects of AI. This sophistication has led to more adaptable chatbot applications and higher customer satisfaction, thanks to recent advancements in large language models (LLMs).

The technology stack and development tools used, the complexity of the chatbot, the required features, the availability of data, and whether it needs to be coupled with other platforms, databases, or systems can all impact the time required to build an AI chatbot. AI chatbots can be developed even more quickly using an easy-to-use, low-code or no-code platform [6].

1.9.3. Chatbot Applications

- **Educational environments:** When students miss previous lectures, chatbots that provide learning support can replay them to help students retain the information. Additionally, they collect data throughout a course, which aids in enhancing instruction and the learning process. Chatbots can respond to inquiries about the course material, which helps students with their studies. To significantly lessen the burden on school departments, a chatbot can also assist students with school administration concerns, including course enrollment, exam scheduling, grades, and other pertinent information. A chatbot assisted students with registration, increasing the number of students enrolled in a university course [8].
- **Customer Service:** Many businesses utilize chatbots to assist their clients. User satisfaction is increased since customer service is accessible around the clock through the chatbot, allowing customers to submit their requests outside of regular business hours. A Rive Script-written chatbot on the Gupta website helps users select the best

product for their needs. Another AIML and LSA-enabled chatbot responds to users by using a dataset of frequently asked questions (FAQs). To enable customer service chatbots to assess knowledge from dispersed environments, a framework with a big data interface was presented by Balakrishnan (2018).

It is anticipated that chatbots will soon dominate the customer service sector due to their ongoing development and increasing utilization [8].

- **Health field:** Chatbots in the healthcare industry are made to give patients personalized health and therapy information, products and services connected to them, and the ability to diagnose and recommend treatments based on their symptoms. A chatbot called OneRemission assists people in learning more about cancer. Florence reminds patients to take their medications, and Youper (Youper—Emotional Health Assistant Powered by AI) looks after the mental well-being of its users: Sensely (Sensely: Character-based Enterprise Virtual Assistant Platform), AdaHealth (Ada), Your.MD (Your.MD - Health Guide and Self-Care Checker) and Buoy Health (Buoy Health: Check Symptoms & Find the Right Care) are just a few of the several additional healthcare chatbots available. Additionally, several chatbots, including HealthBuddy (a novel chatbot designed to engage with communities in Europe and Central Asia on COVID-19), were utilised to provide information during the pandemic.

  The benefits of employing healthcare chatbots include promoting and assisting with medical decision-making, enhancing physical exercise, supporting cognitive-behavioural therapy, and treating somatic disorders with effective medical care that is as precise as that provided by human physicians (Palanica et al., 2019). Compared to human physicians, patients view chatbots as more trustworthy communication partners; they disclose more symptoms and share more patient information. However, because chatbots are perceived as less transparent and consistent than in-person appointments with human doctors, they are often associated with poor patient adherence in the healthcare industry. However, doctors believe chatbots are more effective at administrative tasks, such as scheduling appointments, locating hospitals, and reminding patients to take their medications. However, they come with serious hazards, such as inaccurate medical information. Consequently, doctors do not believe that chatbots can replace complex decision-making processes that require expert medical guidance. Chatbots have the potential to be a novel and useful tool, particularly in the field of psychiatry. They are tailored to various populations and used for cognitive-behavioural therapy and suicide prevention. People who are reluctant to go to a doctor because they feel uncomfortable sharing their thoughts can benefit from a chatbot that

provides therapy, which can increase accessibility to the mental health care system. In 1964, ELIZA worked as a Rogerian psychotherapist. In 1972, PARRY, a program that could mimic a person's behaviour with schizophrenia, was developed. ELIZA frequently provided "counselling" for PARRY [8].

- **Industrial use:** Many businesses and organizations have already extensively adopted chatbots at this stage of technological evolution. They provide the reader with a sense of what is happening in practice, for instance. Chatbots in the banking industry converse with consumers and, among other things, assist them in activating their cards, paying bills, finding ways to save money, and providing account balance information. At the same time, they help the Bank gather client feedback. These chatbots include Ceba from Bank of Australia, EVA from HDFC, and Erika from Bank of America. Chatbots in the food sector take orders, track them, set up delivery information, create bookings, get feedback from consumers, notify them of deals and discounts, and respond to their inquiries using the company's frequently asked questions [8].

1.9.4. Benefits of Chatbots

- **Improve customer engagement and brand loyalty:** Before the advent of chatbots, any customer questions, concerns or complaints, big or small, required a human response. It goes without saying that timely or even urgent client concerns occasionally come up on the weekends, holidays, or after hours. However, it is expensive and challenging to staff customer service departments to satisfy erratic demand, day or night. These days, chatbots can reliably handle consumer contacts around the clock, continuously enhancing response quality and minimizing expenses. Chatbots automate processes and relieve workers of tedious work. Because chatbots are instantly available to any number of users at once, they can also eliminate lengthy wait periods for phone-based customer care or even longer wait times for email, chat, and web-based help. The user experience is excellent, and happy consumers are more likely to show brand loyalty [6].
- **Reduce costs and boost operational efficiency:** It costs a lot of money to staff a customer service center day and night. The time spent responding to the same questions over and over again, as well as the training needed to ensure that the responses are consistent, are equally expensive. Many foreign businesses offer to outsource these tasks, but doing so comes at a high expense and takes away control over how a brand interacts with its target audience.

  On the other hand, a chatbot may respond to inquiries seven days a week. To enable human agents to focus on more complex problems, they can offload tiresome, repetitive

tasks, serve as a new first line of support, or supplement assistance during busy periods. Businesses can more effectively scale up their workforce to meet growing demand or requests during off-peak hours by using chatbots to help reduce the number of users who require human assistance [6].

- **Create leads and please customers:** Chatbots can increase conversion rates and help generate sales leads. For instance, a consumer visiting a product or service's website may have questions about various features, plans, or characteristics. These responses can be provided in person by a chatbot, helping the customer move closer to making a purchase. A chatbot can ask lead-qualifying questions and even put the buyer in direct contact with a trained sales agent for more complicated orders that involve a multi-step sales funnel [6].

1.10. Conclusion

in this chapter, we've covered the history of artificial intelligence, from its inception as a basic idea to its current widespread application. We have also seen the several domains that fall under the umbrella of artificial intelligence, along with its facets. We also demonstrated several key concepts, including natural language processing, neural networks, and autonomous learning. We also discussed chatbots and how well they illustrate how technology may simulate human speech and provide efficient, detailed assistance. Intelligent, approachable, and responsive solutions are made possible by their integration into a variety of disciplines.

CHAPTER 2

Chatbot design

2.1 Introduction

The influence of Artificial Intelligence in the educational sector is increasingly evident, providing new resources that assist students and educators. AI chatbots and intelligent tutoring systems are influencing the enhancement of universities in accessibility, personalization, and engagement.

The transition to college can, for new students, remain overwhelming and stressful. It is common for them to have questions about courses, policies, or where to access information, which do not get addressed in a timely manner. It was this deficiency that served as the motivation for the development of our AI assistant: a simple yet efficient program aimed at supporting and guiding new students from day one.

In this chapter, we will first consider the uses of artificial intelligence in the guidance domain against the traditional instruments and systems which perform similar purposes. Then, we will go through the analysis of chatbots' global architecture, emphasizing the key elements that give these systems their functionality and responsiveness. Before delving into the fundamental architecture that underpins chatbot operations, we will examine the usefulness of chatbots in providing advice and support, particularly in academic settings. The relationship between these elements will be clearly shown using diagrams and system overviews.

2.2 Current practices in Algerian universities

Student support structures in Algerian universities are primarily based on traditional, people-focused approaches. In the first year of a Bachelor's degree, a tutoring system is in place to assist students in their academic journey and provide help when difficulties arise throughout the year. This is outlined in Article 3 of Executive Decree No. 09-03 of January 3, 2009.

Tutoring is provided by faculty members from the relevant Faculty or Institute, each responsible for supervising a small group of students—typically between one and eight—over the academic year. In some cases, a Master's or Doctoral student may act as a co-tutor, working under the supervision of a faculty tutor with proven teaching and interpersonal experience, as specified in Article 4 of the same decree.

The tutoring system is part of the broader LMD (Licence–Master–Doctorate) framework, which was introduced in Algerian universities during the 2004/2005 academic year. Originally developed in Western countries, this system was adopted in Algeria to enhance the quality of education and research. At its core, the LMD system emphasizes tutoring as a key component to help students integrate into university life and succeed in their studies.

To ensure effective implementation, Algerian legislation has introduced several official texts:

- Executive Decree No. 09-03 of January 3, 2009, which defines the objectives and implementation methods of tutoring;
- Ministerial Decision No. 189 of June 16, 2010, which outlines procedures for managing tutoring across higher education institutions;
- Ministerial Order No. 713 of November 3, 2011, which sets the composition and operating rules of the tutoring committee.

Though necessary, these systems naturally call upon explicit human involvement, static resources, and human resources demanding administrative processes characterized by inefficiency and limited outreach. Even with the fact that these methods have been the starting point of student assistance over many decades, they have inherent drawbacks that affect their overall effectiveness, especially at a time when the number of students is increasing rapidly, and students are looking for increasingly quick and tailored help.

2.2.1 Traditional systems

- **DWS:** DWS is a website designed to publish announcements from university faculties and departments, featuring a special FAQ section and a professors' email section. This allows students to search and email professors, but not directly contact them through the website.
- **E-Learning:** Unlike DWS, E-learning, known among students as 'Moodle', allows students to chat and contact their professors directly through the website, as well as search for courses, exams, and other information related to the university or their field of study.
- **Progress:** a newly introduced mobile application that gives the students the ability to consult either their sessions, exam marks or their final results, as well as their groups, schedule and other options within the application; it's also important to mention that this application allows the students to look up some information and answer some of their questions.

2.2.2 Human-based systems

- **Guide offices:** existing in each faculty an office known as the «Pedagogical Support Office », which allows teachers to help students, answer their questions and tutor them; their system works by shifts, which means each teacher/professor that volunteered work a certain amount of hours to cover up the needs of students within the faculty.
- **Administration:** As we all know, each facility has an administration, and this is no different case. The faculties and departments of the university have administrations headed by a chief, vice chiefs, and staff, which provide pedagogical assistance and support for students alongside their administrative tasks.
- **Elder students:** previous class students are also able to help new students because of their experience and long years within the university, not to forget the graduated students of previous years who are still in contact and provide help for their senior mates.

2.2.3 Limits of current practices

Despite all these efforts and resources, whether human or technical, they are still very limited due to:

- **Limited availability:** Traditional support facilities, such as pedagogical aid and faculty offices, typically operate only during regular business hours. This can be inconvenient for students whose schedules for classes or other obligations match these established times. Outside these defined hours (like evenings, weekends, or holidays), services may not be available, leaving students without assistance at key times.
- **Overload during special events:** whenever a new school year starts, or when exam registration time arrives, or when schedules are released, the support services become unbelievable. You will have huge lines, crowded offices, and everybody waiting ages for responses, which is just annoying and makes everything a mess. In addition, there are not adequate staff to handle all the inquiries at those peak periods.
- **Lack of personalization:** Websites rely on stock answers and pre-designed information. They are not suitable for considering the particular backgrounds, needs, or learning paths of individual students. Such a one-size-fits-all approach quite often leaves some students feeling neglected, unsupported and lost.
- **Dependence on Physical Presence:** Many processes require students to be physically present at offices, either to ask questions or follow up on requests. This can be particularly

challenging for students who live far from campus, have mobility issues, or are managing a tight schedule. It also increases waiting times and office crowding.

- **No Real-Time Answers:** Students who send emails often wait days for a reply. There is no real-time feedback in place to answer urgent questions instantly. This delay can cause students to miss important deadlines or make uninformed decisions.

2.3 Chatbot for Student Guidance and Services

The use of Artificial Intelligence in the educational field is becoming increasingly relevant, as it not only aims to improve teaching and learning processes but also can significantly enhance the overall experience of students during their learning journey. At the university, Artificial Intelligence can make a significant contribution by effectively guiding students through various administrative and academic processes required for them to excel. By successfully emulating human communication, AI systems have the remarkable ability to respond to and answer frequently asked questions that arise repeatedly. Furthermore, these intelligent systems can recommend services tailored to users' requirements, provide personalized support specific to individual interests, and greatly assist students in navigating the complexities of campus life in a far simpler manner. These new technologies have been carefully crafted with the attributes of being responsive, scalable, and accessible, empowering students to find the information they need at the exact time that they need it. This system enables them to do so without relying solely on conventional physical offices or being constrained by the availability of human resources, which could otherwise limit their access to critical information.

2.4 Comparison between current practices and AI practices

In the table 2.1, a comparison highlights the significant improvements our chatbot offers over current support practices in universities. Unlike traditional methods that are limited to office hours, our chatbot is available 24/7, ensuring continuous access to assistance. It delivers personalized responses based on user input and context, in contrast to the generic, one-size-fits-all replies typically provided. Moreover, while traditional support systems struggle to scale without increasing staff and resources, our chatbot can effortlessly handle numerous users simultaneously.

It also offers instant responses, eliminating delays commonly experienced during peak times. Importantly, the chatbot has the ability to learn and improve over time through user interactions, whereas current systems remain static. From a cost perspective, the chatbot proves to be more sustainable in the long run, reducing the need for constant human involvement. Additionally, it enhances the user experience by offering a simple, conversational interface, and its use of natural

language processing allows it to understand flexible question formats—something traditional systems based on rigid forms cannot achieve.

Table 2.1 Comparison between current and AI-based practice.

	Current practices	**Our Chatbot**
Availability	Limited to working hours	Available 24/7
Personalization	One-size-fits-all responses	Specific responses based on user input and context
Scalability	Hard to scale (requires more staff/resources)	Easily scalable to support many users at once
Response Time	May involve delays (especially during busy periods)	Instant responses
Learning Capability	Static (same answers, no evolution)	Can improve over time with user interactions and data
Cost Over Time	High (requires human effort and training)	Cost-effective after initial development
User Experience	Often complex and bureaucratic	Simple, conversational, and interactive
Language Understanding	Limited to forms or predefined options	Natural Language Processing allows flexible question formats.

2.5 Our Chatbot global structure

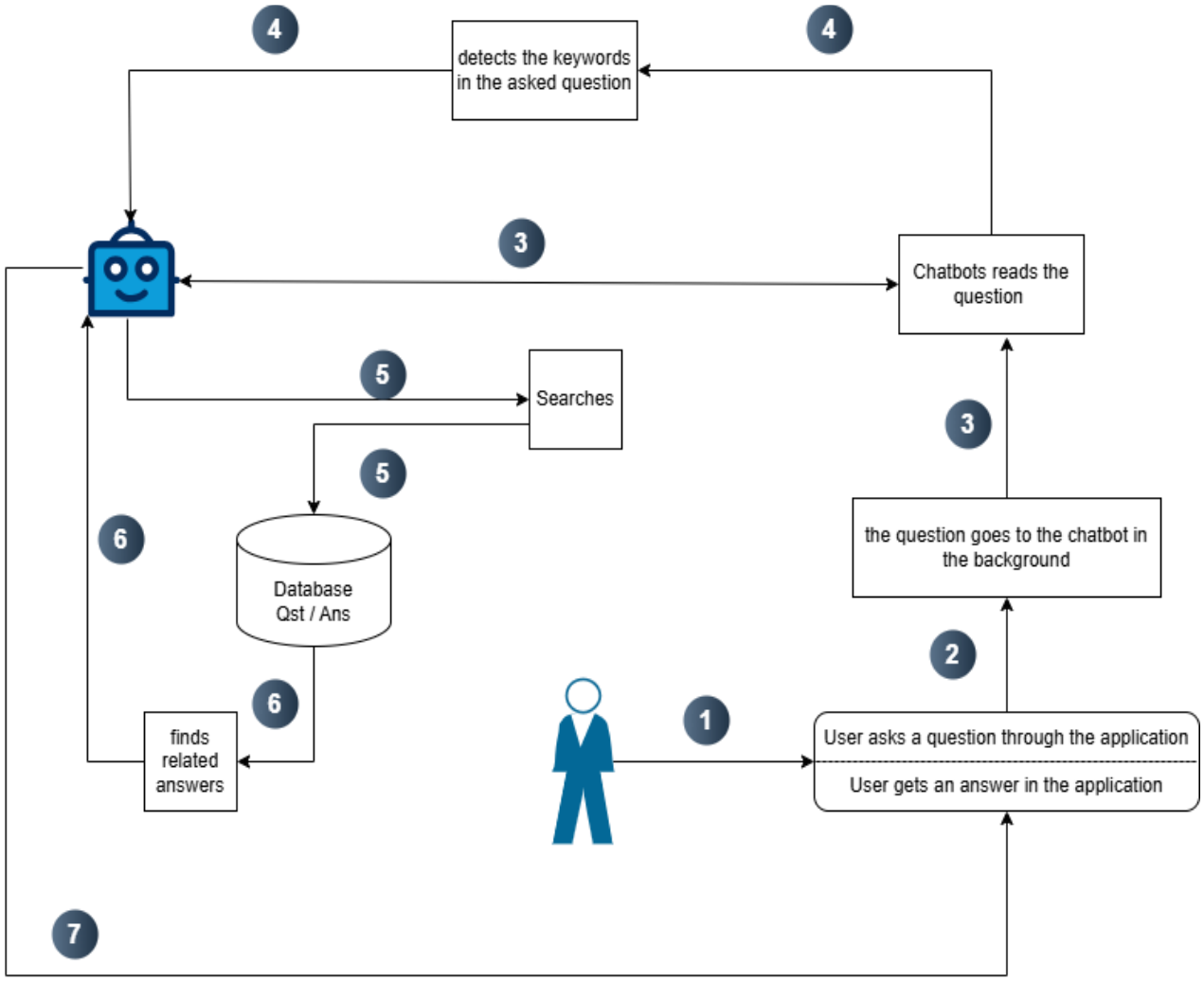

Fig 2.1 Chatbot's global structure and functioning

- **Step 01:** First, the user opens the mobile application named "Botty". Then, they find a conversation-like interface with a text input field where they write their question and click "Send".
- **Step 02:** The question is sent to the chatbot working in the background, and from here, the entire process begins.
- **Step 03:** The chatbot reads the question and analyses it word by word to detect the language it's written in and the length of the words used in that question.
- **Step 04:** The chatbot, in this step, analyses the question and treats every word as an individual entity, rather than a string of words.
- **Step 05:** The chatbot starts searching and matching every word with the database it has been trained on, in order to find the matching keyword under the name "tag" in its database, which will then identify the related tag and question formulated as "patterns".

- **Step 06:** Here, the chatbot finds the matching tags and then uploads the “answer” related to the “question” matching the “tag” asked by the user and analyzed by the chatbot.
- **Step 07:** After all the work is done in the background, the chatbot displays the uploaded answer from the database in the application’s interface as a replied message to the user, which appears as a conversation between the human and the chatbot.

2.6 UML Diagrams

2.6.1 UML definition

The Unified Modeling Language (UML) was designed to be a common,

semantically and syntactically rich visual modelling language. It is intended for the architecture, design, and implementation of software systems that are complex in both their structure and behaviour. UML has applications beyond software development, particularly for process flows in manufacturing [7].

It resembles the blueprints used in other fields and consists of different types of diagrams. Overall, UML diagrams describe the boundaries, structure, and behaviour of the system and its objects.

2.6.2 User case diagram

A use case diagram is the primary form of system/software requirements for an underdeveloped software program. A key concept of use case modelling is that it helps us design a system from the end user’s perspective. It is an effective technique for communicating system behaviour in the user’s terms by specifying all externally visible system behaviour [8].

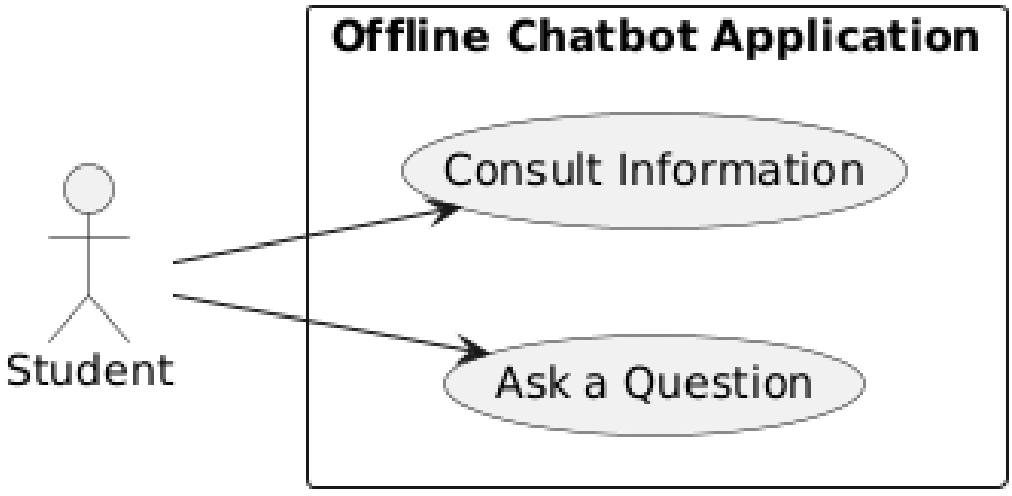

Fig 2.2 User case diagram

2.6.3 Sequence diagram

A Sequence Diagram is one of the notable aspects of the Unified Modeling Language (UML) utilized for the representation of object interaction in a time-ordered manner. It is concerned with how objects interact with one another over a period of time and thus plays a fundamental role in modelling dynamic behaviour in a system. Sequence diagrams represent object interactions, message flow, and operation order and, therefore, are utilized in use case analysis, system architecture design, and system documentation [9].

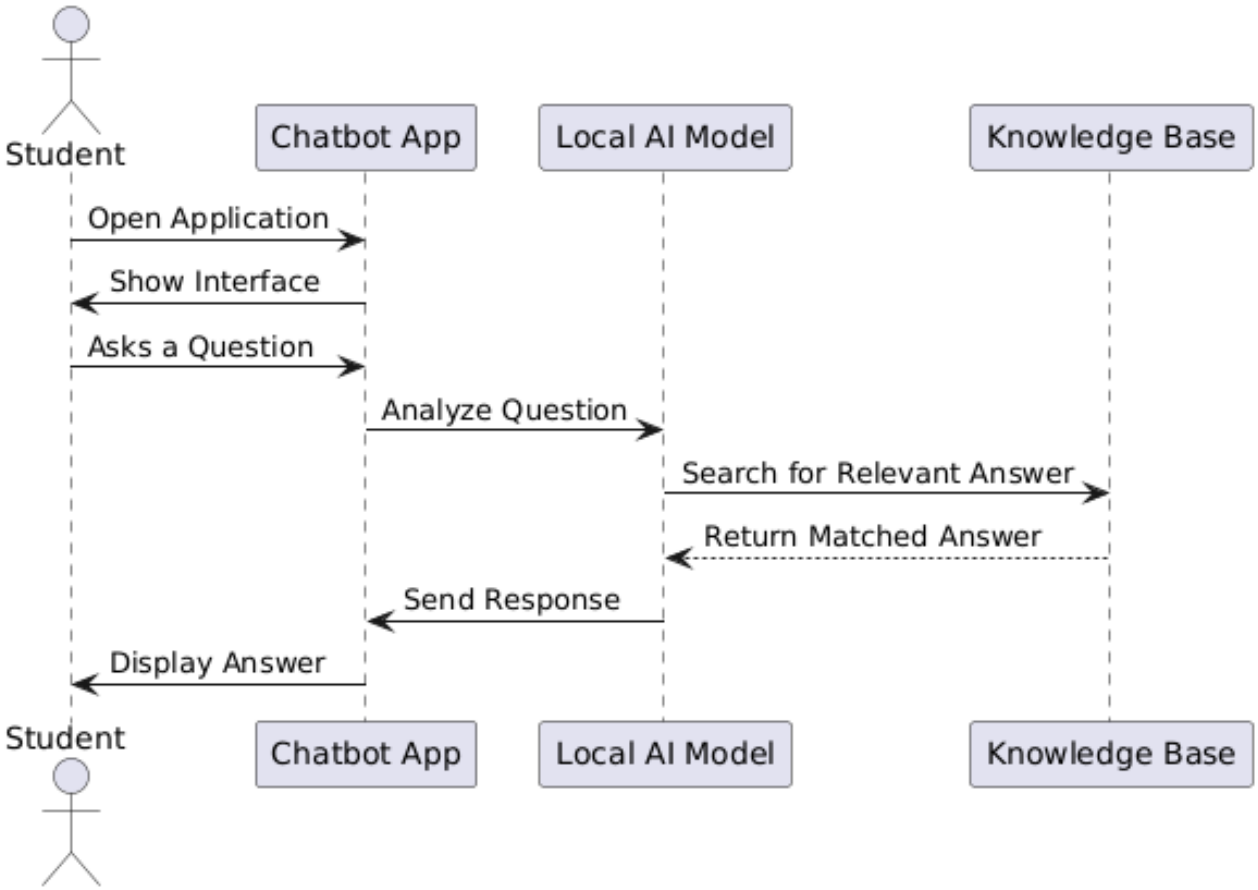

Fig 2.3 Sequence diagram

2.6.4 Class diagram

The class diagram is the main object-oriented modelling construct. It is used for high-level conceptual modelling of the application structure and also for detailed modelling to transform the models into programming code. Class diagrams can also be used for data modelling. The classes in a class diagram represent both the interactions between the main elements within the application and the classes to be programmed [9].

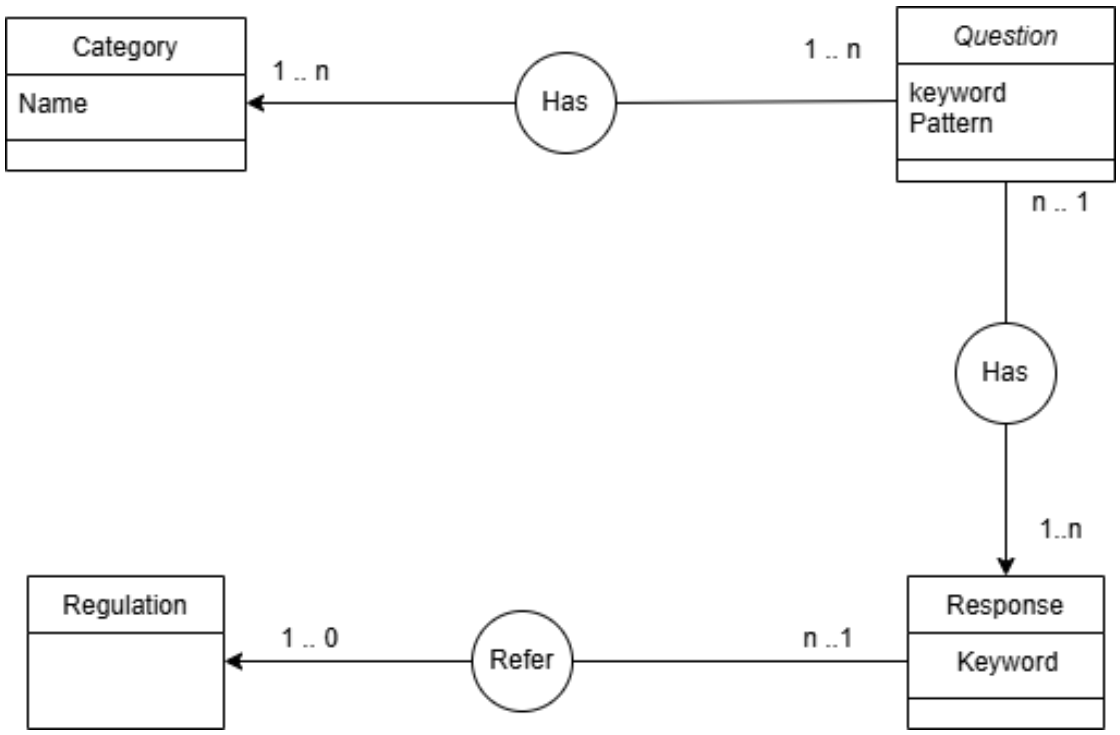

Fig 2.4 Class diagram

2.7 Conclusion

In summary, this chapter outlined the current student guidance methods used in Algerian universities and highlighted their limitations in terms of accessibility, responsiveness, and scalability. It then introduced the role of artificial intelligence as a promising alternative, particularly through smart systems capable of offering personalized and instant assistance. A comparative analysis confirmed the added value that AI-based solutions can bring in this context.

CHAPTER 3

Chatbot implementation

3.1 Introduction

In the previous chapters, we gave a general and brief introduction to the field of artificial intelligence, where we defined what it is and mentioned the basic concepts, applications and fields of use; then, we specified the chatbots and their benefits in various domains, then in the second chapter we talked about the use of chatbot in guidance specifically, then mentioned the general structure of our chatbot and gave some diagrams explaining how it's supposed to function.

In this chapter, we will talk about how the chatbot is built, dive into its interface and back-end tools, explain what they are used and how they were used to reach the final application, define the used framework "flutter" and the model used for the chatbot's functionality "DistelBERT" and the database language used to train the model as well as the database itself.

3.2 Used tools

3.2.1 Flutter

- **3.2.1.1 Definition**

Flutter is an open-source framework that belongs to the programming language "Dart" (Developed by Google) and is used for building beautiful, natively compiled, multi-platform applications from a single codebase. It was first introduced in 2017, and it gained a wide fan base ever since due to its various advantages [10].

- **3.2.1.2 Flutter Advantages**

Flutter has a lot of advantages over other frameworks that do the same thing, including:

- **Ease of use:** Flutter offers an easy-to-use experience for its users, whether in programming and writing code or implementing it across various operating systems, including Android, Linux, and macOS.
- **Unique graphics:** Flutter offers a wide set of beautiful and dynamic interfaces and design choices for its users, creating visually appealing and eye-catching applications that give it a significant advantage, especially in mobile applications.
- **Multi-Platform:** One of Flutter's most important features is the multi-platform feature, which means that it can run on many devices with different operating systems, means that

it can run on Android, iOS, MacOS, Linux and Windows with the same code, which makes it easier for programmers to create an application that runs on both desktop and mobile.

3.2.2 DistilBERT

- **3.2.2.1 Definition**

DistilBERT, developed by Hugging Face in 2019, is an advanced version of the BERT model intended for effective NLP tasks with limited computational resources. It uses distillation to transfer the knowledge of a larger model (BERT) to a smaller model, hence increasing speed and performance while maintaining accuracy. DistilBERT, used in fields such as customer support automation, reputation management, medical data analysis, education, and marketing, has proven itself to be one of the most trusted AI models [11].

- **3.2.2.2 DistilBERT advantages**

Even though there exist many artificial intelligence models, DistilBERT remains one of the best due to these advantages that it possesses over the other AI models:

- **NLP:** Natural language processing (NLP) is a machine learning technique that enables computers to comprehend, interpret, and manipulate human language. Businesses now have access to significant amounts of textual and voice data from various communication channels, including emails, SMS, social media news feeds, videos, and audio. They use natural language processing (NLP) software to automatically process these data, assess the message's intent or sentiment, and provide real-time responses to human conversation, which makes it essential to thoroughly and effectively examine both textual and audio data. It can overcome dialectal differences, argot, and grammatical irregularities common in everyday discussions [12].
- **Small size:** DistilBERT is a lightweight version of BERT. All in all, it's only around 60 MB in size (compared to BERT, which is around 400 MB) since it has 40% fewer parameters than the original BERT, and this makes it perfect for mobile applications as it allows it to run on low-end devices with no problem, which is essential as not all students have strong phones to download and run the application.
- **High accuracy:** Despite being over 80% lighter in size than the original BERT model and having almost half the parameters, DistilBERT still scores a very good accuracy percentage of 97% in most of the tasks it's required to accomplish, which makes it one of the best AI models for chatbots.

3.2.3 JSON

- **3.2.3.1 Definition**

JSON (JavaScript Object Notation) is a widely used data-interchange format that is a lightweight, human-readable text-based representation of structured data. It is derived from JavaScript object syntax and is commonly utilized for data transmission from servers to web applications, particularly for web pages [13].

- **3.2.3.2 Implementation**

in our chatbot, we used a JSON database divided into three sections to train the model:

- **Tags:** the "Tags" section represents the intent of the question, more specifically, the keyword the model uses to detect the desired intention of the asked question. We included more than 30 different keywords to cater to various intents and questions.
- **Questions:** This section included the predicted questions that the user would ask. We included more than 500 different questions, and since our model supports NLP, we typed them in three different languages: Arabic, French and English.
- **Responses:** this section, as the name suggests, is the section where we put the answers to the questions, so after they're being analyzed and treated by our model, and based on the language the question was asked in, the response will be, this is mainly to ease the process of getting and understanding the desired information by the student.

3.2.3.3 Data collection

The data used to build the training and testing set for the chatbot was collected through a poll that was done on the students of Mohamed Boudiaf University in M'sila, where we asked over 150 1st year students from different faculties about the problems they faced and the questions and the lack of clarity they had about certain things related either to their studies or to their outside the faculty life including residence, transport and the university scholarship. We also asked the employees of University services like scholarship and residence employees to help us get more information about certain things like the registration and renewal file, the procedures in case of a problem and the regulations the students must be aware of and respect in order to organize and well maintain the residence.

The figure below represents the general structure with examples of the data we used and how it was organized and treated,

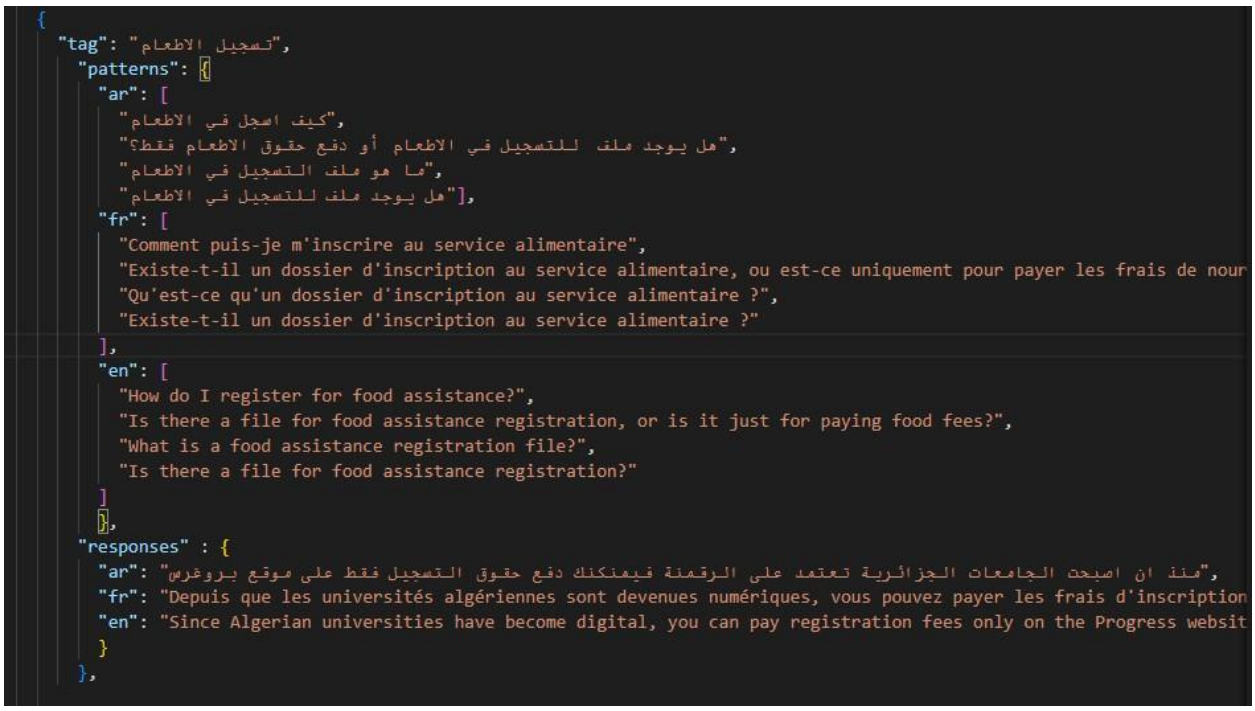

Figure 3.1 Sample of the data

3.3 Realization

3.3.1 Interface

The figure below shows the interface of our chatbot mobile application.

Fig 3.2 The user interface

The figure above shows the interface the user sees when he logs in to the application; as we can see, the interface contains only the necessary elements that the user needs, which are the text input field for where he can type in his question, then his question goes up as a chat where the other part of this chat is the chatbot as the name suggests, responding with the corresponding needed answer, so in total it is a very simple yet effective interface to make the user's experience lightweight and less unnecessarily complicated.

3.3.2 Chatbot's work

Let's take an example where the user asks a question about the registration file. He opens the app, types in his question about the registration in any language the chatbot supports, and then clicks enter to send it to the chatbot. Here, the chatbot will read the question and detect the keyword, which is, in this case, "registration ", and then searches his database for related answers to the keyword detected; he finds a full detailed answer, gets it and then sends it back to the user as a message on the screen.

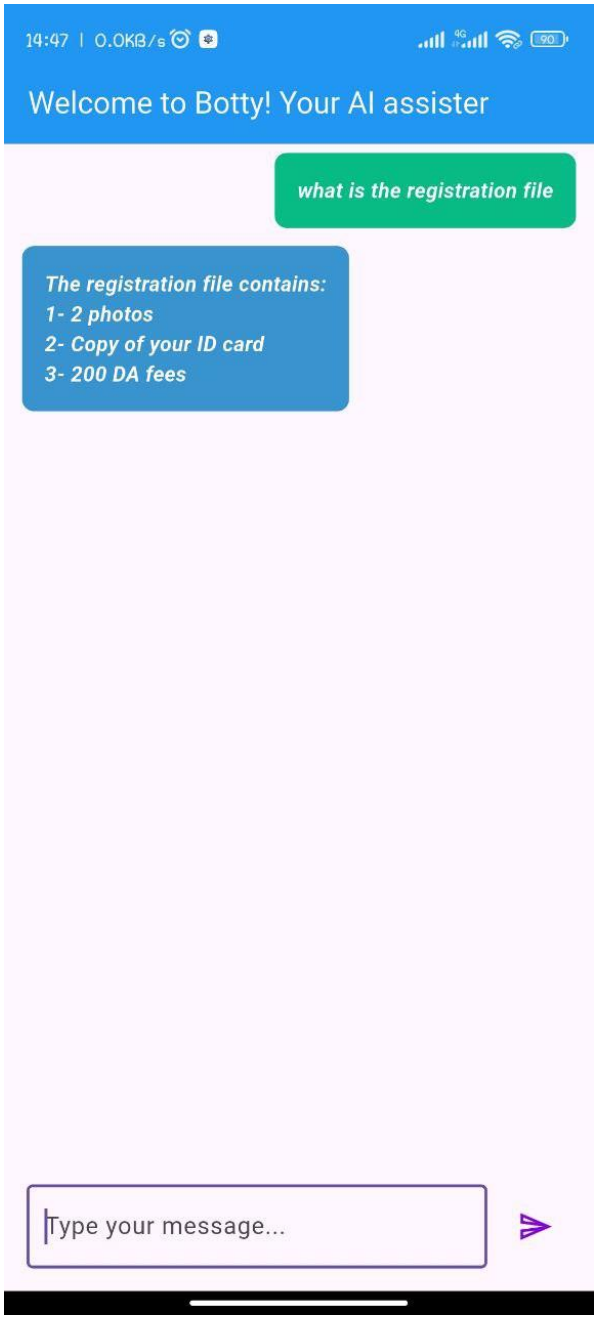

Fig 3.3 Example of use of the application

3.4 Conclusion

In this chapter, we have discussed the implementation details of our chatbot system at a practical level, describing the various tools and technologies used in its development. With Flutter, we can develop a smooth and interactive mobile interface that offers ease of access and use to students. The use of JSON as a data interchange format enables efficient communication between application layers and simplifies data handling.

Python powered the back end, which was utilized to develop the fundamental chatbot logic and manage interactions. By leveraging the power of DistilBERT, a compact yet powerful transformer-based language model, we enabled the chatbot to process natural language input precisely and effectively. This enabled smart and context-dependent responses based on the user's queries.

Finally, we examined the process of the chatbot's interaction, from input to response generation, discussing how each component collaborates in an ensemble effort to deliver a smooth and intelligent user experience. These tools and techniques together form a coherent and stable foundation for a guidance-based chatbot system — one that is aligned with the objectives of our project and addresses the needs of its prospective users.

General Conclusion

This thesis presented the idea of a smart, AI-driven mobile chatbot application to assist university students, particularly first-year students, in navigating academia. Faced with increasing numbers of students and the limited availability of administrative support in Algerian universities, traditional guidance systems have shown serious limitations in scalability, responsiveness, and personalization.

To address these issues, we proposed and implemented a mobile application named “Botty,” leveraging Artificial Intelligence and Natural Language Processing (NLP) through the DistilBERT model. The chatbot is integrated into a Flutter-based mobile interface and trained using multilingual data in JSON format. This allows it to understand and respond to student queries instantly and contextually, around the clock, without requiring human intervention.

The project demonstrated the practical promise of AI-powered educational support services. Our system offers considerable benefits in the areas of accessibility, real-time assistance, and operational efficiency. Offering personalized, immediate, and precise responses not only simplifies the workload for university staff but also provides students with a user-friendly tool for self-orientation and problem-solving.

Ultimately, this project demonstrates that AI-powered solutions, when properly designed and thoughtfully implemented, can play a crucial role in enhancing the student experience and improving institutional support systems. Future steps may include ongoing growth in the chatbot's knowledge base, its learning potential, and integration with other university systems to deliver an even more useful academic assistant.

Bibliography

[1] https://www.tableau.com/data-insights/ai/history visited in April 14th, 2025

[2] https://datascientest.com/machine-learning-tout-savoir visited in April 20th, 2025

[3] https://www.aiacceleratorinstitute.com/what-are-the-top-7-branches-of-artificial-intelligence/ visited in 20th, April 2025

[4] https://news.cgtn.com/news/2019-06-12/Everything-you-need-to-know-about-artificial-intelligence-HswDK6aQdW/index.html visited in 20th, April 2025

[5] https://www.tpointtech.com/applications-of-artificial-intelligence visited in 20th, April 2025.

[6] https://www.ibm.com/think/topics/chatbots visited in 18th, May 2025.

[7] https://www.lucidchart.com/pages/fr/langage-uml visited in 28th April 2025.

[8] https://www.zendesk.com/blog/what-is-a-chatbot/ visited in 18th, May 2025.

[9] https://www.sciencedirect.com/science/article/pii/S2666827020300062#sec8 visited in 18th, May 2025.

[10] https://flutter.dev/ visited in 27th, May 2025.

[11] https://latenode.com/fr/blog/what-is-distilbert-exploring-the-ai-model-and-business-integration-of-nlp-model visited in 27th, May 2025.

[12] https://aws.amazon.com/fr/what-is/nlp/ visited in 27th, May 2025.

[13] https://www.w3schools.com/whatis/whatis_json.asp visited in 27th, May 2025.

[14] https://www.ibm.com/think/topics/natural-language-processing visited in 26th, May 2025.