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Original Article

A Chatbot Evolution: Digital Marketing as Case Study

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Abstract - *This paper explores the research field of chatbots, covering historical evolution, types, technological advancements, and how it has impacted digital marketing. It also introduces a new pioneering architecture designed to enhance chatbot findings. It considers the construction of a conversational companion and the underlying infrastructure to ensure a robust user experience. This architecture aims to set the stage for future research where boundaries of the existent task-oriented chatbots are pushed. The paper also pays special attention to many challenges and limitations in this domain, such as dialectal Arabic, focusing on the complexities of Maghrebi dialects. It also examines security concerns, data privacy, and the ongoing pursuit of innovation in chatbot development.*

Keywords - *Chatbot, Digital marketing, User experience, Natural language processing, Machine Learning .*

1. Introduction

The digital age has revolutionized communication and engagement. Technology and automation have become key players in shaping how individuals and organizations engage with each other. At the lead of this evolution stand chatbots, AI entities created to engage in conversations with customers to provide helpful information and autonomously execute tasks. Chatbots have quickly gained popularity in e-commerce and revolutionized customer support by transforming interactions with technology and services. Chatbots' origins can be traced back to Alan Turing's visionary concept of machines, which proposed that machines could mimic human conversation. This idea paved the way for research and progress in the field of AI and marked the first emergence of chatbots such as ELIZA and PARRY. These early prototypes have laid a foundation for the development of chatbots and inspired countless innovators to enhance and expand their capabilities over time. Since then, diverse ecosystems have emerged, including rule-based chatbots that use defined scripts and decision trees. Then, AI-powered chatbots that leverage Machine Learning and NLP algorithms to understand context and learn from user interactions. More than just a chat interface, chatbots are intelligent digital entities that interact conversationally and seamlessly integrate into the customer journey. Although chatbots have demonstrated their capabilities in numerous languages, linguistic diversity is still challenging, especially in dialectal Arabic. In particular, Maghrebi dialects pose a real challenge for chatbot developers, as they include variations in vocabulary or sentence structure and the nuance of context embedded in the language. A novel architecture is crafted to adapt and thrive in dialectal Arabic to face these difficulties. A chatbot architecture is crucial for the conversational bot's clear and fruitful development and operation as it provides it with the foundational blueprint. The main goal is to guarantee the maintainability and scalability of the chatbot. Other than that, developing a well-defined architecture allows the creators to handle all the aspects of user interactions they aim to work on clearly and in a structured manner. Bots' significant role in customer interactions across industries means having a solid architectural foundation is imperative. It should ensure consistent performance, adaptability to evolving requirements, and the ability to achieve desired business outcomes. This paper is part of a series of studies that were conducted on the subject of predictive analysis and user profiling. It is structured as follows: the first section details the chatbot field history from the Turing test to the Generative Chatbots; the second section outlines the types of chatbots by category, and then the technological advancements are detailed. The following section outlines the advancements in the chatbot field for digital marketing. Afterwards, the paper presents a novel architecture for the continuity of this work. A typical case study was detailed, followed by an analysis of challenges and limitations before the conclusion.

2. Chatbot History

One of the early concepts of chatbots was in 1950. Alan Turing proposed the Turing Test [1], which explores whether a machine can display intelligence similar to a human. The test involves a text-based conversation where a human judge interacts with two participants: one human and one machine. If the machine can imitate responses convincingly, the judges

cannot differentiate between them reliably. It is considered to exhibit somehow intelligent behavior. The Turing Test holds importance as it raises deep questions regarding the essence of intelligence, consciousness, and the ability of machines to imitate human-like thinking processes. It played a role in establishing the concept of AI by redirecting attention from the mechanisms of a system to its visible behavior and results. The Turing test can be considered not only as a historical milestone but also as a philosophical one. It highlighted the desire to create machines that think more or less like humans.

The 1960s witnessed the emergence of early chatbots that were rule-based. ELIZA was developed by Joseph Weizenbaum in 1966. This rule-based chatbot was built to simulate a Rogerian psychotherapist by engaging in text-based conversations [2]. Eliza is often considered one of the earliest examples of an NLP program. It is characterized by how simple it is to interact with users as it uses pre-defined scripts and rules to chat with them. It was developed to mimic the doctor-patient talk and to encourage patients to express their feelings and thoughts easily, as they would have with an actual doctor.

PARRY [3] can be considered one of the early chatbots and a significant milestone. It was conceived in the 1970s by Kenneth Colby, a psychiatrist, to mimic the paranoid behavior of a schizophrenic patient. This characteristic has made PARRY special because it was not only about conversing with a bot but also delved into the realm of mental health problems. This bot used a rule-based technique to generate responses and relied only on scripts. PARRY remains a good example of the first bots designed for a specialized purpose, not only to converse in vain. The next significant development in the chatbot field was the emergence of Expert Systems in the 1980s. These systems are not considered bots in the traditional sense, but the inventions have prepared the way for more sophisticated research in this area, especially in conversational AI. Expert Systems also aim to mimic human expertise and help in decision-making in specific areas of expertise. These systems relied heavily on a specific encoded data format that computers understand. The step of conversing the data to this different format was critical, as it formed the basis for problem-solving and the reliability of the systems. Its usage was very popular across different applications like healthcare, finances, etc. As cited before, knowledge engineering requires extensive effort to represent accurate expertise. Another limitation would be the adaptability to dynamic situations and the adaptation to continuous changes. Two of the first Expert systems to be released were DENDRAL [4] and MYCIN [5]. DENDRAL was the first expert system developed to replicate the knowledge of an expert on organic chemistry. MYCIN was developed for healthcare professionals; it helped identify infections and provided recommendations for antibiotic treatments. While the 1980s did not witness a significant development in chatbot research, it has laid a strong infrastructure. The 1990s witnessed a resurgence in chatbot development and the emergence of Smarter Chatbots. An Open Artificial Intelligence project that worked primarily on developing AI chatbots was initiated. This initiative originated the Artificial Linguistic Internet Computer Entity A.L.I.C.E [6]. ALICE is also called “Artificial Intelligence Markup Language” (AIML), as it was built upon this markup language used to create chatbots and conversational agents. This language is based on rules and patterns that allow the creation of defined rules and responses. Jabberwacky chatbot was also developed in the late 1990s [7]. This chatbot is different from the ones before it, as it is not based on rules and patterns but is learned by interacting with the user and making patterns based on previous conversations, even though these findings contributed to the AI chatbots’ evolution and have opened more room for the exploration of Machine Learning (ML) Techniques and NLP.

The 2000s started with an extreme background in this research field. It was known for NLP advancement, as developers had more access to linguistic analysis tools. The mix of these two fields enhanced the understanding of user input and context. This era also witnessed the integration of these chatbots into web platforms and offered internet chatbots while also seeing the rise of an open-source mindset, which meant open-source chatbots. The emergence of commercial chatbots has also characterized this era. SmarterChild, a chatbot for AOL Instant Messenger [8], also saw light in 2001 and started paving the way for the development of personal assistant chatbots. One of the biggest, most successful chatbots nowadays that has interacted with countless users, Apple’s Siri and Microsoft’s Cortana, were introduced in the 2010s, marking the integration of chatbots on smartphones and on one the mainstreams of consumer technology [9]. This breakthrough led Facebook to introduce the Messenger Bot Platform, allowing users to create chatbots.

Meanwhile, this era marked significant advancements in deep learning and neural network research fields. In this present era, one of the most significant innovations in chatbots could be considered the release of GPT-3 by OpenAI, a language capable of being conversed human-like [10]. This has revolutionized the chatbot's capabilities and has made it possible to be deployed in every industry possible. The chatbot field is still an ongoing area of research. Studies still aim to improve the ability of these conversational chatbots by improving the ability to understand the semantics of text, extract emotions, and interact in a more human-like manner.

3. Types of Chatbots

The chatbot research field has evolved increasingly, and it has developed from simple rule-based systems to AI-powered conversational bots. More improvement is expected only in the next few years. The classification of chatbots can be based on many bases: Technology-Based, Interaction-Based, or Functionality-Based Classification.

Table 1. Classification of table

Classification	Chatbot type and capabilities	Core Capabilities	Advantages and limitations	Typical Domains
Technology-Based classification	Rule-Based Chatbots [11], [12]: These chatbots represent the first ever conversational agents programmed. It follows explicit rules and pattern-matching techniques to generate responses. This type of chatbot is best known for straightforward answering, for example, frequently asked questions and exact customer support.	Pre-defined decision trees, keyword matching	Very fast to develop; Low compute cost; Extremely brittle to unexpected inputs; Difficult to version and test at scale.	FAQs, simple support.
	AI-Powered Chatbots [13], [14]: These chatbots represent a transformative advancement in conversational AI technology. NLP plays an important role in these advancements, as it allows chatbots to understand the nuances of text more and more. It allows them to understand, more or less, the user intent [15].	Machine-learning inference, intent classification, generative responses	Handles varied phrasing and unseen utterances; Continuously improves with new data; Requires large annotated datasets; High latency and compute overhead.	Personalized recommendations and advanced support.
Interaction-Based classification	Text-Based Chatbots: These chatbots represent one of the most used types of conversational AI. It communicates with users using typed text. NLP is widely used in these agents as it allows them to understand the intent and contextual nuances of the user more closely. It can be found on websites or messaging platforms, allowing customers to engage with businesses and services.	Asynchronous messaging, rich-media embedding.	Easy to integrate with web/mobile Allows for rich content (images, buttons) Users may type slowly or with errors.	E-commerce chat, web customer support.
	Voice-Based Chatbots: These chatbots can be considered a revolution in human-computer interactions. The possibility of conversing through spoken words has made it increasingly easy for customers. Besides NLP's capabilities, it also relies on Advanced Automatic Speech Recognition (ASR) Technologies to automatically transcribe spoken words into text. These chatbots are more popular amongst mobile users as they allow them to encompass activities [16], [17] easily.	Speech-to-text & text-to-speech integration, voice-intent parsing.	Hands-free, natural interaction Good for accessibility Latency in processing audio streams	Call centers, in-car assistants.
Functionality-Based classification	Informational Chatbots: Their speciality is their ability to provide accurate and relevant information about any topic. One of its uses can be by companies desiring to answer the most frequent questions, for	Simple query–answer retrieval, static knowledge bases.	Extremely low development overhead Predictable, safe outputs No learning or personalization Static scope limits	Knowledge portals, FAQ bots.

	example.		engagement	
	Customer Support Chatbots: These chatbots specialize in providing support to users. It operates 24/7 and offers immediate responses. An informational chatbot can be labeled as its descriptive manual envelopes the same tasks.	Order tracking, issue routing, escalation workflows.	Deflects simple tickets Integrates with ticketing systems Requires careful design of fallback/escalation and can frustrate users if handoff is not seamless.	Retail, telecom support.
	Virtual Assistants: These chatbots perform different tasks for a user day-to-day, such as setting reminders, passing a call, or sending a message, and can also keep the user up to date with his agenda. It relies heavily on NLP techniques to understand users' exact needs and simplify daily tasks.	Task automation, calendar/email integration, proactive notifications.	Highly versatile across domains Can automate complex tasks Greater surface for bugs and failures.	Productivity, scheduling.
	Healthcare Chatbots: These chatbots can check for symptoms. Its main goal is to make healthcare more accessible and provide timely support to users.	Symptom triage, appointment booking, health-advice retrieval.	High perceived user value; Can reduce clinical load; Requires domain-expert oversight for content Zero tolerance for inaccuracies	Clinics, telehealth services.

4. Technological Advancements

As seen in the development timeline of chatbots, technological advancements have greatly enhanced the capabilities and domain of the application of these agents.

- NLP: it plays a key role in the development of this technology. It enables computers to understand/interpret human language and generate human-like answers to converse with users. It is also used to understand nuances of text such as grammar, syntax, semantics, etc. Unlike rule-based chatbots, NLP allows users to create answers instead of providing generic replies [18].
- Machine Learning and Deep Learning: they are considered a crucial part of chatbots nowadays. It is vital in transforming simple rule-based systems into intelligent, adaptive agents. Through the training and adapting of Deep Learning models, chatbots can interpret text with a level of nuance that was previously unattainable. [19].
- Context Awareness: it is considered one of the critical aspects of NLP, as it allows the chatbots to remember previous parts of the conversation, which means remembering the context and then building their answers while considering it [20].
- Continuous learning: unlike static chatbots, the capability of chatbots to learn and adapt allows them to improve and adapt themselves over time. It allows these agents to identify and rectify errors, thus learning and providing more reliable, helpful information. This ability provides the possibility to personalize recommendations and anticipate user needs.
- Emotion detection: or sentiment analysis, is a field of NLP used to understand the emotion behind a text written by a human. It focuses on analyzing the tone and context of messages. The chatbots can understand the sentiment and deal accordingly or even empathically with users [21], [22], [23].
- Multimodal interaction: chatbots can now handle more than text but also different types of multimedia such as images, videos and audio data
- Etc.

5. Chatbots for Digital Marketing and Related Work

Digital marketing and e-commerce have transformed due to advancements and changes in consumer behavior. The internet has also played an important role in this evolution, giving businesses a platform to connect with target audiences effectively. These changes aim to provide a good experience for the customer across online and offline channels [24].

Chatbots have also played a role in this pivotal shift. They enabled businesses to offer their consumers a personalized shopping experience through automated customer support. It

ensures enhanced user engagement not only through text but also through voice chats based on NLP technologies. This tool helps automatically address customer queries and deliver tailored, personalized product recommendations. In the ever-evolving digital marketing field, chatbots will remain an important part of delivering data-driven customer-centric solutions and will continue revolutionizing customer-company interactions [5], [6], [7]. While commercial chatbot platforms have proliferated, several key shortcomings persist. Some of the most apparent limitations in chatbots for Digital Marketing are that most implementations of features such as real-time banking alerts or customized retail ordering are studied in isolation, and there is no standard for measuring user satisfaction across industries, so it is virtually impossible to generalize best practices.

Also, maintaining conversational context across sessions and channels remains a stubborn challenge. A bot may perform flawlessly on Facebook Messenger yet lose its entire state when a customer switches to web chat, WhatsApp, which undermines continuity and frustrates users. Something else to consider is that very few solutions can offer proper escalation and human-fallback workflows. Ideally, a chatbot would be able to sense if users are getting agitated or sensitive topics and hand off the conversation to a live agent, but most platforms leave this critical functionality to ad-hoc implementations.

Some of the most renowned chatbots that can be used nowadays for digital marketing and e-commerce use are:

- Tidio [25]: This chatbot is considered one of the pioneering tools for customer services. The most particular aspect of this chatbot is that it combines both AI and human support based on the situation. This chatbot offers the possibility to craft automated and clear answers. It offers a simple user interface for creating conversation flows. This tool does not offer the possibility to personalize by writing code. It is also popular because it can integrate with popular CRMs and e-commerce platforms like Shopify, Wix, WordPress, etc. while offering free plan options.
- Ada [26]: This chatbot is characterized by using conversational and generative AI to offer a smooth customer journey in multiple languages (more than 50 languages). This tool is easy to use without code and offers an extensive learning path to learn how the platform works. It is considered a robust Natural Language Understanding (NLU) tool, relying on a resolution engine. This tool does not offer a free plan and can be integrated with popular social media platforms.
- Chatfuel [27]: This chatbot is mainly optimized for social media chatbots. It creates a conversation flow in an easy, user-friendly interface that allows drag-and-drop manipulation. It also allows integration with e-commerce platforms and offers a free plan.
- SnatchBot [28]: This chatbot also relies on NLP models and can present intelligent conversations that can converse as humans and understand the sentiments behind the text. It also ensures continuous improvement by learning from conversations. It does not only work with text data but also voice conversation. It can integrate with robust e-commerce platforms and social media platforms. What makes this bot special is its Robotic Processing Automation, which can carry out various tasks and transactions within databases and enterprise systems more efficiently than humans.
- Manychat [29]: This chatbot is rule-based and built on templates and patterns to answer customers' needs. It can be integrated with WhatsApp, Facebook, Instagram, and Shopify. It has a free plan, and it offers basic analytics reports. Nevertheless, this tool does not integrate Generative AI and conversational AI, but it is considered a decent option as a modern chatbot for lead generation.
- FellahBot [30]: was designed to fill the information of Moroccan farmers by providing agronomic advice in Darija (the spoken Moroccan language), Modern Standard Arabic and French. This bot is based on Retrieval-Augmented Generation; it is supported by a compiled database of Darija agricultural terminology and aims to respond to free-text customer queries on schedules for planting, pest control, and subsidy programs.

6. Proposed Architecture for the Continuity of this Work

While the chatbot research field has developed significantly in the last few years, there are still some areas of improvement that robust and innovative architecture can work on. The main goal is always to improve design and functionality. One of the difficulties that can be stated is the struggle to deal with contextual understanding. The bots often still cannot maintain the context from prior conversations or even parts of present conversations with the user. Another difficulty is the high percentage of present chatbots that rely on patterned or pre-defined scripts or decision trees.

These two points can result in the incapability of the chatbot to handle unexpected or nuanced user queries, which makes the conversations feel more robotic than human. Another complicated limitation would be the ability of the bots to converse based on emotional intelligence. Many chatbots deployed today cannot discern emotions or underlying intent from users' queries. This shortcoming could result in inappropriate responses to the user's emotional state. This means that if the chatbots are not given precise requests, they might give irrelevant answers. Furthermore, ethical and privacy concerns have become more pressing since AI chatbots rely heavily on sensitive users' data to propose tailored personalization. Another popular shortcoming can be labeled as the integration challenges. This means that most

chatbots cannot integrate with other platforms, and the process is highly complicated. Giving the possibility to use a chatbot outside of its nest or even give access to it via open-access APIs would potentially mean more data and user interactions for the chatbot to learn from and develop. Another essential point is the inability of a chatbot to fall back and escalate in case of detecting the anger or discomfort sensation from the user, especially if the chatbot is working on a case of post-shopping experience or a return case. One of the most important keys to successfully retaining a customer is immediately transferring context to a human representative when necessary. Chatbots should also consider using third-party API to work on specific aspects they do not necessarily consider. The primary goal should be to advance this research field and not to reinvent the wheel. These gaps have helped with the elaboration of the proposed architecture in this paper:

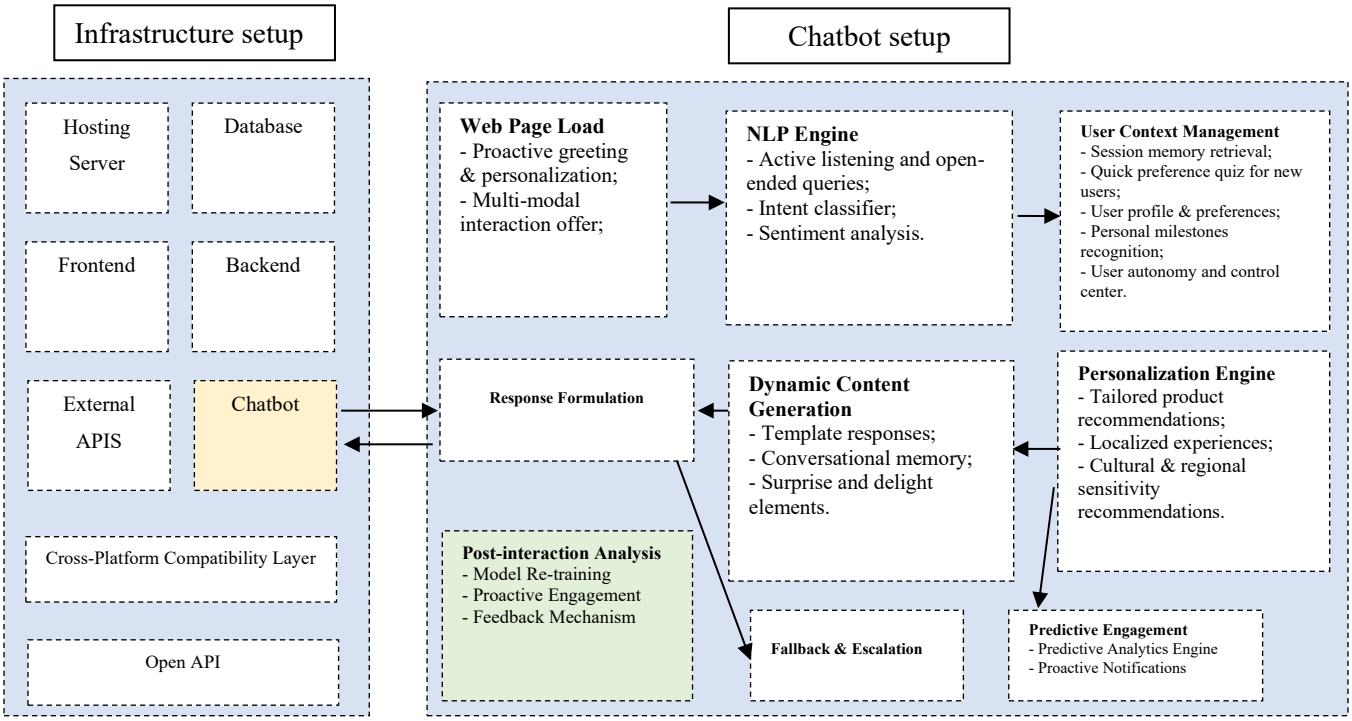

Fig. 1 Proposed architecture in this paper with the infrastructure and the chatbot setup

This architecture presents an overall idea of the infrastructure setup needed to ensure an immersive user experience. This would enable understanding user preferences from multiple angles, from their browsing behaviors to their emotional state. This architecture ensures the adaptability to future needs expressed by the user's direct queries or detected in their behaviors. Another important point that should be highlighted is the modular nature of this architecture. It offers a practical agile foundation for the creators, allowing the platform to expand and evolve as needed. The scalability of this kind of architecture is crucial because it makes it easier to grow as the demands of the system grow without having to re-engineer the entire architecture. The infrastructure setup outlays the different modules needed for a successful base. A good hosting server is crucial for using any chatbot, and it ensures performance and responsiveness by offering prompt and smooth interactions. The underlying logic should be executed quickly, and a good hosting server choice ensures the necessary computer power to carry out the tasks. This step also ensures security for the platform as it provides features like firewalls, SSL certificates, etc. A good hosting server is significant in guaranteeing a superior user experience. One of the most reliable cloud hosting servers is Microsoft Azure [31]. As indicated in its name, Microsoft created Azure, which is considered one of the leading cloud computing service platforms. It offers different services such as computing power, storage options, etc. Its popularity is also due to its developer-popularity nature. It provides robust programming and development tools like .Net, Java, Python, and more. It also considers the security of apps, including multi-factor authentication, encrypted communications, etc. These features alone are enough for the app's development, scalability, and flexibility.

While cloud servers have advantages, dedicated data centers give organisations more control and customization over the IT infrastructure. Moreover, this option can result in long-term cost savings. Considerable investments are only needed when preparing the infrastructure, but long-term and recurring costs will be eliminated. It also allows for more precise hardware, software, and network configuration. The most important advantage is data security; when using cloud services, the data is stored and processed outside the organization, potentially raising concerns about data

sovereignty. Dedicated data centers eliminate this uncertainty. A good choice of frontend technology profoundly impacts the user experience as it represents what the users interact with directly. Modern frontend technologies ensure smooth navigation, quick loading time, and cross-platform consistency; the application's ability to function and keep an exemplary user interface across various devices and browsers is vital. From another point of view, for a developer, a correct frontend framework can build faster and more efficient apps while ensuring modular development, reusability, and maintenance for an agile workflow. The same can be said about backend technology, as it represents the backbone of the application. While the front end defines the look and immediate feel of the app, the back end ensures the underlying functionality and performance. Without it, frontend applications would lack the support to function effectively. It ensures the practical storage and retrieval of user data and application content. It also encapsulates the core business logic of how the app operates.

Third-party or external APIs can be integrated with the app for added functionality. Popular external APIs can be used instead of developing new functions from scratch that are unrelated to the core business. Leveraging pre-existing services can incorporate many functionalities, such as payment processing, geolocation, etc. It allows app enrichment by connecting to a broader ecosystem of services and data. One essential feature where this functionality can be used for enhancing the digital marketing aspect of the app is integrating social media APIs to get user demographics, preferences, and behavior to assist the business logic in crafting tailored marketing strategies. OpenAPI Specification (OAS) [32], formerly known as Swagger, is a specification for building APIs. It is used to define a standard interface for RESTful APIs. It can be used as a private interface for frontend developers, which is only allowed by a token-based authentication login. Not only that but it can also be used to document an open-access API for external use. This would allow other researchers or developers to create plugins or extensions, expanding the chatbot's capabilities. Database plugins are one of the most important pillars for the good functioning of chatbots. NoSQL databases allow them to adapt to dynamic environments, especially document-oriented ones. It can handle high volumes and simultaneous interactions efficiently. This type of database is essential as it ensures real-time interaction for users with chatbots. Moreover, the data types it can handle are not just text but also a mix of multimedia, making it an important asset in the chatbot ecosystem.

The next configuration in the architecture is the Chatbot setup. It shows the important modules the chatbot must contain to ensure a good user experience. The first module is the 'web page load'. It will be in charge of the first interaction with the user, and it subtly scans the browsing patterns and material usage to assess the user's requirements. It can personalize the first interaction of the chatbot with the user by showing a small, non-intrusive chat icon (this scenario can change based on which device is used). This module will also take care of the type of user interactions (voice, text, Images, etc.). The next module is the 'NLP engine', which is responsible for the application's NLP engine. Every user interaction goes through this engine for the chatbot to understand the user queries, classify their intent, and understand the context. The objective is to answer the user's needs adequately. This engine should be able to detect when the user is not asking yet for a response and is just chatting, and it should be able to encourage the user to converse in a more engaging conversation that would lead the user to make a purchase. The NLP module should be able to detect the user's mood from the user's input by understanding the sentiment behind the query.

After that comes the 'User Context Management' module, which retrieves session memory about existing users and builds the user profile and preferences. This module focuses on preparing the data for personalising the user's interaction and highlights the user's autonomy. The user should be able to see and control what personal data the chatbot can retain. The module should also be able to detect the user's milestones. This could be achieved by third-party APIs linked to the user's social media, or they could fill in answers to some important questions that will be pre-defined. The data gathered by this module would be led to the 'personalization engine' (PEng). This module should be able to tailor product recommendations based on past purchases and the user's needs through their queries. The recommendations should also be able to be personalized based on cultural and regional experiences. Beyond the single-user target, this module should be able to profile users into groups based on their interaction history, purchase behavior, and feedback. It should be able to offer product suggestions based on similar user behaviors. It should also be able to build customer loyalty by providing discounts and deals that are proper for the user. The PEng module will lead the data flow to the 'Dynamic Content Generation' (DCG) or 'Predictive Engagement' (PE). The DCG stores a set of response templates to deal with different scenarios. It should be able to insert dynamic product recommendations in these templates based on the context. It should also have a conversational memory and be able to remember context in an ongoing conversation across different user sessions to ensure that the user does not have to repeat themselves and has the option to pick up where they left off. This engine should be able to showcase a random selection of trending and unique products.

The PE module is a predictive analytics engine that predicts when the user will return, the churn, and when they might need assistance. This engine should be able to predict upcoming needs and desires and present the user with results before even the user realizes a need. This add-on in the architecture is a new direction that emphasizes predictive

analytics and unanticipated discovery. The Response Formulation module formulates answers that are conversational and engaging. The response can be multimodal (text, image, or video) as the chatbot estimates adequate. This step comes after understanding the user intent and accessing the correct information so it can craft a suitable reply for the user.

The response should also align with the chatbot's tone, style, and pre-defined guidelines to finally be relayed back to the user. If successful, the interaction loop will not be completed until it interacts with the 'post-interaction analysis' module. It ensures that the model is re-trained using the latest user interactions. It also guarantees proactive engagement by retargeting users who showed interest in a product but did not purchase it. These reminders could be through notifications about new stock, order status, etc. Another important function of this module is ensuring a feedback mechanism.

This mechanism can either occasionally prompt users for feedback or measure user satisfaction by assessing if the user immediately leaves the conversation or expresses dissatisfaction after an answer. The feedback can be gathered via standard forms and by asking simple, relevant questions, for example, asking, 'Did you find this review helpful?' after the user asks for a review. Instant feedback buttons can also be given as single-click emotive icons. This step is crucial for continuous learning and refinement as the data gathered from these interactions will also be used to update the chatbot's model regularly. Nevertheless, the interaction between the chatbot and the user could not go well; thus, the chatbot should be able to discern ambiguity in the conversation and seamlessly transfer to a human representative, when necessary, while simultaneously transferring the chat history for context.

7. Case study

7.1. Illustrative Case Studies

Even though this study identifies many practical technical and organizational barriers to chatbot introduction, the implications from real-world deployment make these challenges less abstract. For example, Sephora's 'Virtual Artist' uses a transformer-based recommendation engine: It is implemented in the brand's mobile application, which helps customers select the right product [33], [34]. By linking it directly to the company's loyalty database, the team dropped customer-service response times significantly and lifted conversion rates. Bank of America's "Erica" shows off enterprise-grade integration in finance. Erica leverages transactional data feeds to notify users of potential fraud and irregular patterns in spending. Six months after launch, user engagement increased by 15%, and support calls were down meaningfully [35]. Lastly, for quick-service restaurants, Domino's conversational ordering bot reduced the ordering process [36]. Moreover, to handle real-world inputs, the team developed a text-normalization layer to tokenize and preprocess messages, map emoji and numeric shortcuts to menu items and apply a series of regex-based heuristics for standard abbreviations. Based on these cases, future chatbot projects in digital marketing will soon foresee implementation roadblocks, develop auditable data pipelines and communicate impact with traceable KPIs to boost the trustworthiness and return on investment.

7.2. Real-World Scenario

This case study delves into a real-world scenario that aims to showcase the user experience of this chatbot. It is tailored specifically for e-commerce assistance. This Case study chatbot's name is Adaptive Shopping Assistant ASA.

7.2.1. Dynamic Entry and First Impression

In this step, the chatbot acquires contextual awareness. It detects the user's location, what type of hardware they are using, the location, and also if the user is a newcomer.

- User activity: The user lands on the e-commerce website
- Chatbot response: It slides gently with a subtle animation from the bottom. It greets the user with: 'Hello! Looking for something specific or just browsing?'

7.2.2. Personalized Shopping Experience

This step waits for the customer to formulate their desire or displays recommendations based on past purchases. In this phase, the customer can also ask for gift suggestions, and the chatbot should be able to recommend a list of products that satisfy that specific need.

- User Activity: User asks: 'Searching for summer dresses.'
- Chatbot Response: It shows a list of products and answers: 'Here are the top-rated summer dresses in our collection. You can filter by color, size, or brand.'

7.2.3. Visual Search and Integration

The user should be able to search for a specific product by uploading an image as a query to the chatbot. The answer should be a list of recommendations of products that look like the image and more. In this step, the chatbot should also be able to ask the user if they would like alerts when a particular product goes on sale or comes back in stock if the size is missing, etc.

- User Activity: The user uploads a picture of a dress they like.
- Chatbot Response: quickly processes the image and responds: 'We found similar dresses! Here they are. Would you also like accessory recommendations to match?'

7.2.4. Detailed Product Exploration

In this step, the user asks for details about a specific recommended product. The chatbot should be able to show the product's details in the chatbot window and, based on the user

preference, point to the other users' reviews if that user has always been known to go directly there. If there are images or 360° models, the chatbot asks if the user needs to see them.

- User Activity: The user clicks on a dress to view details.
- Chatbot Response: It showcases the dress with close-up images, fabric details, washing instructions, and user reviews. Then it asks: 'See this on a virtual model or view a 360° showcase?'.

7.2.5. Instantaneous Query Resolution

The chatbot should be able to answer user queries and help if it detects indecisiveness in the chat. That could be done by recommending more products or using interactive fun quizzes to narrow preferences and product recommendations.

- User Activity: The user asks, "Does this come in green?"
- Chatbot Response: instantly filters and shows the green variants, stating, "Yes, here is the dress in green. In case you are interested, we also have it in teal and mint."

7.2.6. Intelligent Cart Management

This module's role comes when the customer adds a product to their cart. They propose other products that other consumers buy together. It also reminds the user about their carts in case they forgot.

- User Activity: The user adds the dress to the cart.
- Chatbot Response: It responds: 'Got it! The item was added to your cart. Many customers who bought this dress also liked these sandals. Want to take a look?'

7.2.7. Simplified and Assisted Checkout

In this part, the chatbot simplifies the user's checkout process. It keeps all the data needed for safe shipping. It also manages the one-click purchase functionality for returning users without going through the process.

- User Activity: The user proceeds to checkout.
- Chatbot Response: smoothly guides them with a message: 'Let us get this dress to you. Please confirm your shipping address.' It then shows saved addresses and offers real-time address validation without the need to pass manually.

7.2.8. Payment and Security Assurance

This step offers multiple payment methods. It also offers the one-click possibility for returning clients. It also guarantees a transparent and secure payment process.

- User Activity: The user moves to the payment page.
- Chatbot Response: It displays available payment methods, stating: 'Your security is our priority. All transactions are encrypted and secure. Need help choosing a payment method?'

7.2.9. Post-Purchase Engagement

When the user gets to this step, the chatbot ensures to keep interacting with the customer and grows fidelity. For example, it sends usage tips for products that the consumer has bought. It also stores the conversation that led to the purchase and re-trains the model.

It also integrates with shipment providers to provide real-time within the chatbot interface (the user can exit the current session and log in again. By providing the purchase ID, they can track the shipment). This module also offers tips on environmentally friendly usage and educates about product recycling, upcycling, and disposal in an eco-friendly manner.

- User Activity: Purchase is completed.
- Chatbot Response: It confirms: 'Order successful! I have sent the details to your email. Track your order anytime here. Also, here is a sneak peek at our upcoming collection. Exclusive for you!'. It also shows a feedback form or asks a question about whether the user is satisfied or not.

7.2.10. Proactive Support and Feedback Loop

In this step, the user can ask about post-purchase information. It also manages the returns. The chatbot asks for user feedback and feedback to improve continuously. It also informs users about order status or relevant promotions.

This step is achieved when the purchase is made and if the user shows a special interest in a product and does not purchase it.

- User Activity: The user enquires about the return policy.
- Chatbot Response: It immediately senses that there might be a problem and provides the return policy details. Then, it asks: 'Are there any issues with the product? We are here to help.'

8. Challenges and Limitations

Working on a new innovative architecture is a promising endeavour but comes with its fair share of challenges and limitations. The first and most obvious challenge is related to the pillar of any chatbot, NLP or, more specifically, Natural Language Understanding NLU, which can be very challenging due to the variability in language, slang, and context. Continuous model re-training and refining should be able to achieve high accuracy. From an infrastructure point of view, handling the popularity of a chatbot and scaling it to handle a growing user base can be very challenging and cost more. Maintaining a certain level of responsiveness and efficiency under high traffic is crucial for the success of any platform. Similarly, ensuring the integration with specific existing platforms can be complex. Development costs can even expand further as chatbots need ongoing support and maintainability. In the ever-developing digital landscape,

potential concerns related to data privacy and security are always one of the persistent challenges in every platform. Vulnerabilities can threaten users' data, thus affecting the chatbot's integrity. The platform should comply with data protection regulations and ensure the security of user information. The same thing can be said about adhering to the ever-evolving regulations and AI ethics guidelines, which require constant monitoring and updates. In this architecture, third-party integrations are encouraged to gain more insights about the customer. However, a security breach from these services can also impact the chatbot. The data shared to these APIs should be carefully monitored, including only the name and not personal data about the user. Additionally, asking the user for consent and informing him about the data that will be shared is crucial. Another challenge for a chatbot is working with Arabic Dialects. Unlike Modern Standard Arabic MSA, the Maghrebi dialect lacks standardization, which makes it difficult to establish a consistent linguistic framework for a chatbot to rely on [37]. Another limitation is the readiness of vast amounts of data, and it certainly is a real challenge to acquire and curate this data for training a chatbot. Other than that, Maghrebi speakers often mix dialects and languages in their speech, which adds another layer of complexity to understanding and responding accurately [38], [39], [40]. Overcoming these challenges requires scrapping vast and robust data, adding linguistic expertise, and ensuring an ongoing adaptation to the evolving language patterns.

9. Conclusion

In conclusion, this paper has comprehensively explored many facets of the chatbot's history and future. It traced its origins from the Turing Test to modern generative AI chatbots. The diverse types of chatbots were also detailed, highlighting key technological advancements driving this evolution. The next part discusses the revolutionizing developments that chatbots have contributed to digital marketing, such as customer engagement, lead generation, personalized marketing, etc. This paper introduces a new innovative chatbot architecture that aims to enhance the user experience by focusing on different aspects of the development phase. First, a detailed infrastructure was set up by focusing on the latest, most effective technologies to ensure the adaptability to future needs expressed by the user's direct queries and a practical agile foundation for the creators as it allows the platform to expand and evolve as needed. Scalability is critical, enabling seamless growth with rising demands and avoiding architectural overhauls. After the infrastructure, a chatbot setup detailing multiple modules that guarantee a smooth user experience was developed.

The challenges and limitations were also addressed, such as security concerns and data privacy, development costs, and adaptation to dialectal Arabic (exemplified by the complexities of Maghrebi dialects). Overcoming these challenges requires scrapping vast and robust data, adding linguistic expertise, and ensuring an ongoing adaptation to the evolving language patterns. Adequate natural-language understanding of Maghrebi Arabic faces challenges, such as sharp diverging from Modern Standard Arabic in vocabulary and morphology terms. Non-standardized spelling makes it difficult for token-based models to generalize all across the different spellings and surface-level variants of the same word. Also, the speakers of Maghrebi dialects tend to blend French, Standard Arabic and local dialects seamlessly, which should be addressed. These problems require robust transfer learning pipelines and rigorous annotations of large datasets, all detailed in this proposed architecture. This work launches a research series to pioneer chatbot development by pushing boundaries and remediating to challenges while promising a continuously enhanced user experience.

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