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Implementation of a chatbot for virtual attention of queries. Case: Postgraduate School of the UNMSM

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Abstract*– The COVID-19, in different businesses, has generated the need to migrate from face-to-face attention to virtual attention, for the DGEP (Dirección General de Estudios de Posgrado de la Universidad Nacional Mayor de San Marcos) face-to-face attention to those interested in making consultations regarding postgraduate studies was simply impossible considering that, due to the sanitary measures taken during the pandemic, the university closed its doors. The alternatives to continue attending could have been the implementation of the telephone consultation service or text messages, however, these alternatives had drawbacks such as: a high percentage of unattended queries, the fact that many users wished to make queries after regular working hours, the existence of frequent queries and the delay in responses; therefore, in the present research a chatbot has been implemented to ensure the virtual attention of queries from the public providing an online attention, with adequate answers and 24 hours a day. Optimally satisfying the doubts of students and those interested in postgraduate studies allows reaching a greater number of applicants to the various specialties offered by the DGEP. As a result, 100% of the queries have been attended in a timely manner, reducing the average time of attention per use.

Keywords*-- Chatbot, virtual attention, online attention, Postgraduate Studies at UNMSM.

I. Introduction

According to the consultancy [1], a US-based IT research company, on February 19, 2018, stated that by 2020 more than 25% of customer service operations will use virtual customer assistants. This figure was surpassed thanks to the technological breakthrough of the internet and due to the global pandemic of COVID 19. In the various customer service units of the Universidad Nacional Mayor de San Marcos, before the pandemic, customer service was provided in person, by telephone or by e-mail, which resulted in long waiting lines, unanswered calls, and e-mail messages with delayed responses or no response at all.

The pandemic has caused businesses to adapt to non-face-to-face service, making phone calls, or other voice and text messaging alternatives, much more efficient. The DGEP has migrated its traditional face-to-face admission exam to the virtual exam modality, which has generated a considerable increase of queries, so the solutions implemented for the attention of the queries were insufficient since many users (postgraduate students and those interested in applying for a diploma, master's or doctorate) required online attention and in general the number of people who attended the phone calls were always insufficient, while the queries and messages sent frequently could not be attended with the promptness required by the users. Likewise, a statistic on the frequency of the types of queries was elaborated, concluding that there were some questions with high frequency, so it was decided to implement a chatbot-based attention system so that users can virtually make their queries online 24 hours a day, ensuring that the doubts regarding postgraduate services are satisfactorily addressed with the purpose that in these times where face-to-face attention is restricted, postgraduate studies can continue to be carried out normally.

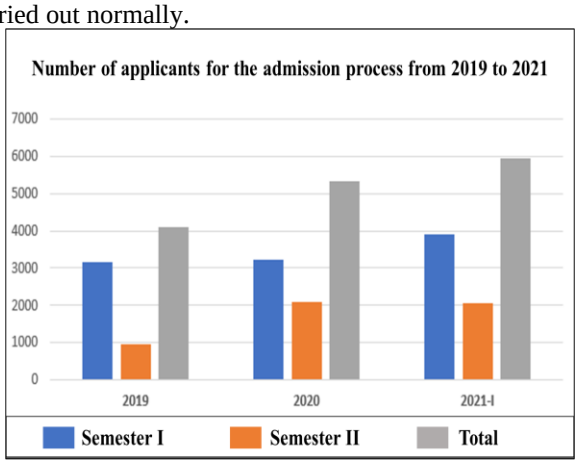

Fig. 1. Number of applicants in the last admission processes, Source: (DGEP consultation module, August 19, 2021).

The objective of this work is to reduce the time of attention to consultations from an average of 4 hours to be attended immediately and thus increase the satisfaction of the users in this process. The results were very encouraging since, in addition to achieving the desired objectives, it was achieved that, as recorded in the DGEP consultation module, the number of applicants in these two years of pandemic has increased significantly, from 4109 in 2019 (face-to-face attention) to 5333 in 2020 (virtual attention) and 5883 in 2021 (virtual attention) which, as shown in Figure 1, is equivalent to a growth of 30% in the period 2019-2020 and growth of 10% in the period 2020-2021.

A. Conceptual Framework

1) Chatbots

For [2] a chatbot tries to mimic the conversation of a real human, in the context of interacting with a business, the

conversations can be of a wide topic, from a generic conversation to a particular one of the product or service provided, the type of conversation will determine the scope of the questions and the chatbot knowledge or human assistance it needs to interact with a customer. For [3] the external appearance of the chatbot comes to be an important factor that influences the quality standard of its implementation, it clearly points out the benefit of using faces, both animated and non-animated. They should be given the appearance of a live person, which increases user engagement. In addition, we should keep in mind that, according to [4] the key characteristics of a chatbot that facilitate the development of user relationships include that "the chatbot being seen as accepting, understanding and non-judgmental". According to [5], the chatbot stores all data, information in a knowledge base, so it should be properly managed to have an optimal functioning of the chatbot. Figure 2 shows the hierarchical structure of some chatbot.

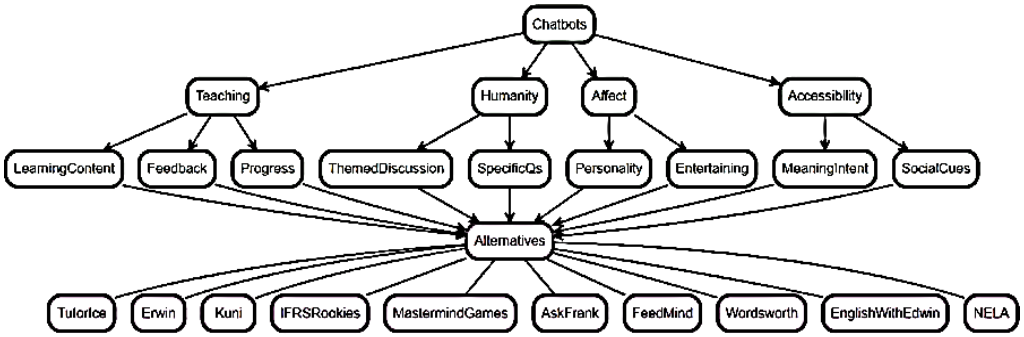

Fig. 2. Hierarchical structure of some chatbots. [6].

2) BotMan

According to [7], BotMan is a PHP library designed to simplify the task of developing innovative bots for multiple messaging platforms, which includes Slack, Telegram, Microsoft Bot Framework, HipChat, Facebook Messenger among others.

3) Industry 4.0

According to (concienciaeco.com, 2017) the concept of industry 4.0 consists of the introduction of digital technologies to industries in the processes of production, management and administration of resources seeking to increase efficiency, automation, virtualization, instantaneity, and modularization.

The goal is to reach all public and private sectors of the economy in a collaborative framework [8]. Figure 3 shows the main technologies that converge in industry 4.0.

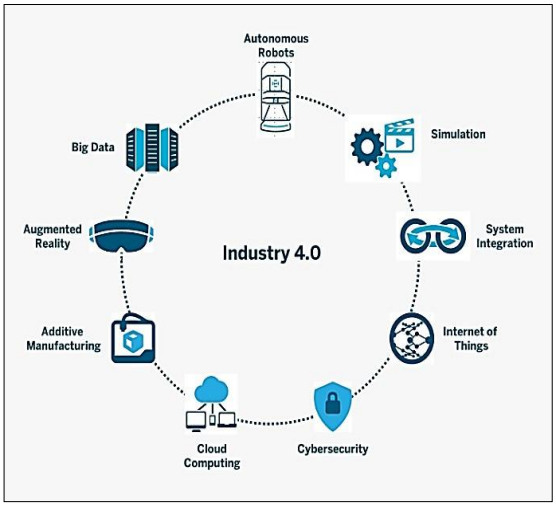

Fig. 3. Technologies contributing to Industry 4.0. [8].

B. Research Background

A chatbot can provide information to students; these responses could be either voice or text. If the query generates an invalid result, the user has the option to report that query to the administrator. [9].

The administrator module will contain the list of invalid queries that are reported by the users and the administrator can insert new queries and their corresponding answers in the database.

The processes performed by the chatbot to handle a query are:

- Capturing the user's query
- Preprocessing, empty words are removed, e.g.: "What is the university timetable", non-meaningful words such as "is" and "the" are removed.
- Obtain the only remaining keywords from the query.
- Match the obtained keywords with the keywords in the knowledge base and provide an appropriate answer.
- Return the query answer as an output to the user.

An important contribution of this application is the feedback that can be given by the users so that the chatbot is constantly improving and performing, thus allowing it to learn and serve the user queries better and better, the other important contribution is the concept of preprocessing.

It is important to mention that the interaction of technology users in an educational environment requires constant feedback to provide, in a timely manner, physical and logical support to the processes [10].

Figure 4 shows the use case diagram of the application.

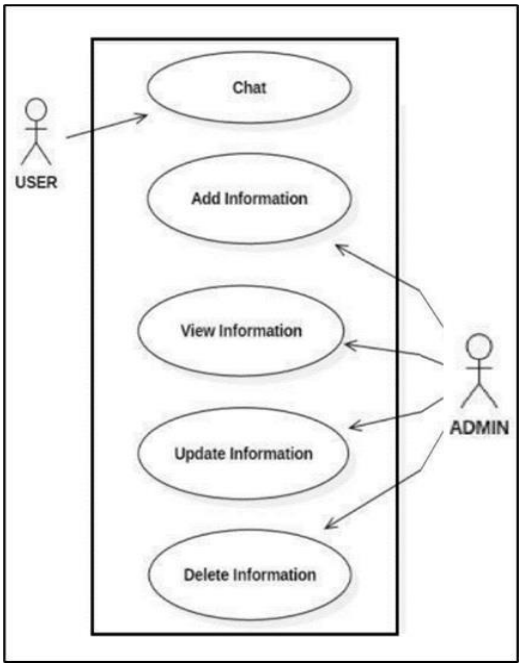

Fig. 4. Diagram of Use Cases of the system. [9].

According to [11], the use of monitoring systems allows knowing in real time and in geographical spaces the concerns of users, which allows the constant improvement of the system. [12] mentions that considering the COVID-19 pandemic, it is essential to consider citizen participation using web technologies for decision making to improve the services provided. [13] mentions that, after the analysis of the data obtained in the surveys conducted, it is concluded that the factor that most influences virtual learning is the quality of virtual platforms.

The implementation of intelligent systems in processes that generate large amounts of data allows the recognition of behavioral patterns and the optimization of these processes, especially in the factors of time and precision [14], [15], [16]. Many businesses usually provide their services to customers in the immediate physical environment, but it is important for managers to face the challenge of expanding borders and even globalizing the business, but this necessarily requires the use of virtual platforms [17].

In this sense, computing and specifically artificial intelligence provide algorithms and methodologies that facilitate the development of interactive, intuitive and user-friendly computational systems, which are fundamental characteristics in educational environments [18], [19].

[20] presents an intelligent assistance chatbot called DINA to provide answers to queries about admission services to Dian Nuswantoro University, and it was developed with a knowledge-based approach with production rule-based reasoning as seen in Figure 5.

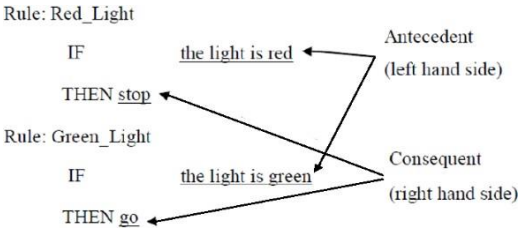

Fig. 5. Knowledge-based approach: rule-based reasoning. [20].

The author also mentions that the DINA chatbot uses a modular architecture to respond to user input. Each module includes a knowledge-based initialization mechanism and logic to handle user requests.

Figure 6 shows the DINA architecture that is divided into two parts, the first is the integration part that is responsible for processing user queries and providing answers using the knowledge base; the second part is the configuration section, where the ontology module includes the logic to handle the dialog flow model; therefore, both modules must communicate and interact with the web server.

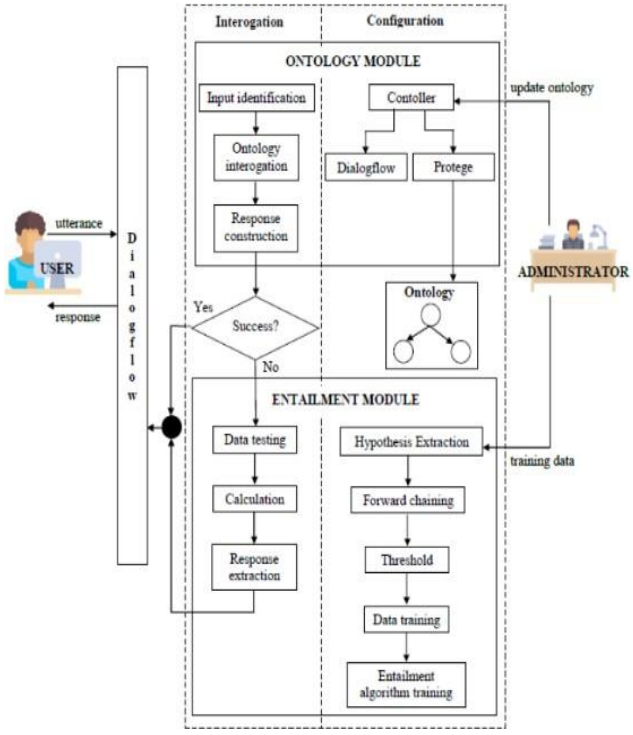

Fig. 6. DINA architecture. Source: [20].

[21] states that the best method of understanding employed by a chatbot is the analysis of the dialogue patterns employed by its human interlocutor. It also addresses the advantages of building a chatbot compatible with PHP, PHP supports connection to different types of database servers such as: Oracle, MySQL, Microsoft SQL Server, having especially easy interaction with MySQL, and it is Open Source, making it an easily accessible alternative for users, it allows sending personalized emails, and allows file management by FTP protocols.

It proposes a client-server architecture for the construction of a virtual agent. As shown in Figure 7, the web client part consists of two main parts, the interface, and the input validation section. HTML5, CSS and JQuery have been used for this purpose. As far as input validation is concerned, it uses AJAX, JQuery and JavaScript for the asynchronous update of the view, which sends the question to the server and waits for its response. For this purpose, the use of AJAX allows to make changes on the web page without having the need to reload it again, which improves the interactivity, and the speed of the system.

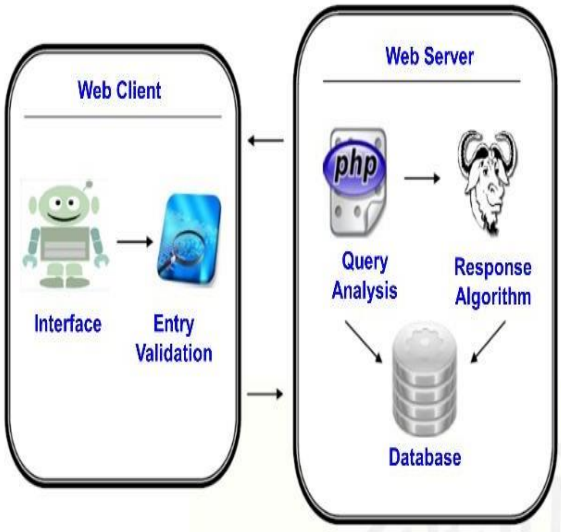

Fig. 7. Client-server architecture for the construction of a virtual agent. [21].

The web server consists of three parts, the analysis module, which is programmed in PHP, the answer algorithm, which is programmed with the morphological module Flex, and the database where the data of the questions are stored.

C. Implementation

1) System architecture

Figure 8 shows the architecture used for the implementation of this application.

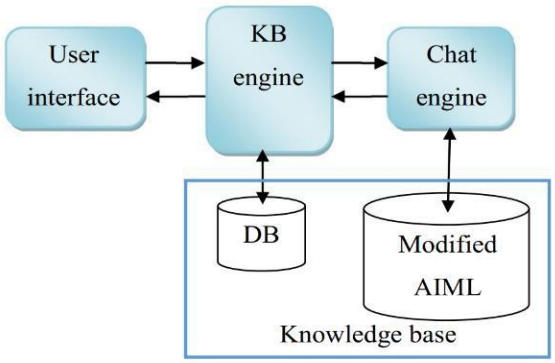

Fig. 8. System Architecture. [22]

2) Knowledge base engine (KBE)

The KBE allows to identify the missing data and generate the inquisitive query to the user, as well as to process the answer for the question provided by the user [22].

3) System use cases

Figure 9 shows the System Use Case Diagram.

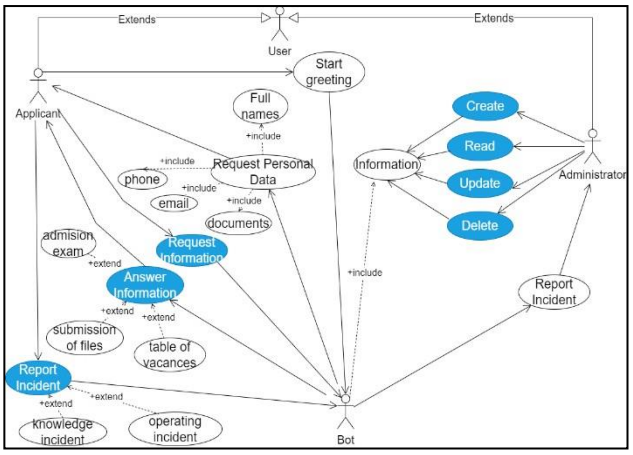

Fig. 9. System Use Case Diagram

4) Application interfaces

Next, the interfaces of the different implemented modules that were generated from the use cases presented in Figure 8 are shown, for this purpose the interfaces presented by [23] and [24] were taken as a reference. Figure 10 shows the main page of the DGEP, on the right is the virtual assistant icon where the chatbot pre-sents itself with a greeting message and asks the user for his name and the type of his identity document.

Fig. 10. Chatbot interaction

As shown in Figure 11, the chatbot requests a cell phone number and an email address.

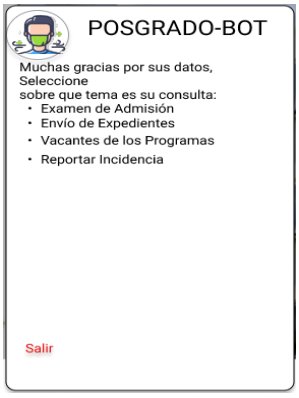

Fig. 11. Request for personal data.

After registering their data, the user can make their queries on the various topics considered in the list shown in Figure 12.

Fig. 12. Topics to be consulted.

For each of these options the chatbot will present the subsequent alternatives that the user can select; for example, if the Admission Test option is selected, the new list shown in Figure 13 is presented with the topics that can be consulted on the admission test.

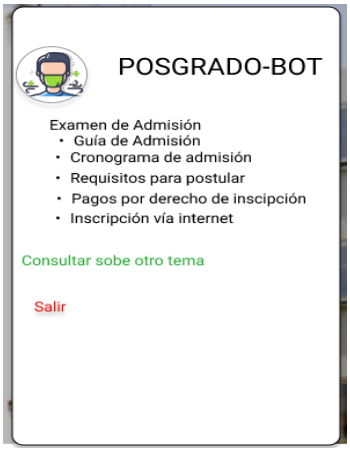

Fig. 13. Admission Examination Consultations.

Figure 14 shows the interface for sending files. Figure 15 shows the interface for reporting incidents, this option allows to obtain feedback on the functionality of the application and make the corresponding improvements.

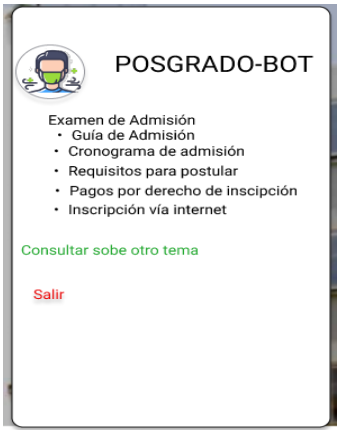

Fig. 14. Sending files.

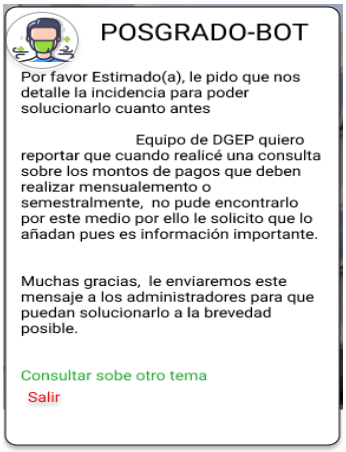

Fig. 15. Sending an incident.

Finally, when the user has no more queries, he/she presses the Exit button and the chatbot says goodbye with the exit message presented in Figure 16.

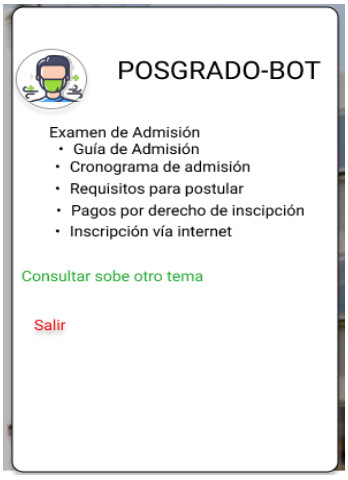

Fig. 16. Exit Message.

II. METRICS

The number of applicants was obtained from 2019 as the base where the project began, until 2022. See Table 1.

Table 1. Service applicants by year

Year	Applicants	% Increase
2019	4109	0%
2020	5333	30%
2021	5,883	43%
2022	5064	23%

There has been a significant increase in the number of applicants, with the highest increase in 2021 (43%).

To evaluate the degree of improvement in the quality of the service, 350 people who requested the service before the implementation of the bot were interviewed and the same number of service requesters who used the bot for their queries, the results are shown in Table 2.

Table 2. Level of satisfaction of users before and after the implementation of the Chatbot

Level	Before Bot	%	After Bot	%
Very satisfied	35	10	98	28
Satisfied	147	42	210	60
Unsatisfied	168	48	42	12
Total	350	100	350	100

III. RESULTS

The main results obtained are:

- In the DGEP unit, the implementation of the chatbot application has made it possible to migrate from a face-to-face consultation service to a completely virtual one, which not only avoids the risks of disease contagion but also allows the optimization of time and quality of response to consultations.
- We have been able to reduce the average waiting time for consultations from four hours to an online service.
- The number of applicants to postgraduate studies has increased by more than 40%.
- The percentage of very satisfied users increased from 10% to 28% and the percentage of satisfied users increased from 42% to 60%.

III. CONCLUSIONS

Based on the results obtained we conclude that:

- The implementation of a chatbot as a tool in the attention of queries is an adequate alternative for the optimization of the attention of queries by users.
- The optimization of user queries, through the implementation of a chatbot, allows an increase in satisfaction and therefore allows a substantial increase in sales of products or services of a business and therefore an increase in its profits.
- This tool can be used in other business or other departments of the University since it has been developed based on scalability and modularity of functions, objects, and information, to improve the user experience.

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