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Mobile application: expert systems model for disease prevention

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ABSTRACT

In recent years, both locally and globally, many citizens are cornered by different diseases which grates a lot of concern in the person, due to the collapse of different medical centers, it is necessary to use information systems. The objective of the research is to develop a mobile application that allows detecting what type of disease a patient suffers from and maintaining communication with the expert in the field using an expert system such as azure machine learning studio that allows detecting the deadliest diseases. For the development of this research, the rup methodology was applied, which allows the use of different techniques where the necessary activities can be carried out with efficient communication. For the validation of this project, a survey was used for the experts with a questionnaire of questions, giving a positive result in the implementation of this project. The result was an acceptance of 83.3% in a high way in their survey responses. In conclusion, this mobile application was successfully designed, benefiting many people and, above all, preventing dangerous diseases that can even lead to death.

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1. INTRODUCTION

Currently, there are different types of diseases that cause severe damage to patients. This leads to many different factors that influence the condition of these. Taking into account that the main cardiovascular diseases are the consequence of a high rate of morbidity and mortality presented in different parts of the world [1]. The different diseases detected have certain clinical characteristics. Intervention in the results is of the utmost importance because it can determine and find the appropriate treatment for such a disease. Patient outcomes for clinical status in COVID-19 patients were analyzed using fisher tests and also using wilcoxon rank sum tests, including 319 patients where symptoms such as fever, dyspnea, weakness, chills, fatigue, and detected dry cough among other symptoms associated with contracting the COVID-19 disease [2], [3]. Detection of infectious diseases such as COVID-19 is important to reduce its spread. Technologies today allow us to track infected people thanks to smartphones and watches. Then isolate them in quarantine and not spread the disease. This epidemic model was used to determine the cases of COVID by tracking the cell phone of the infected person, all these thanks to the aforementioned smart cell phones with the aim of being able to contain the spread of the virus infection [4].

On the other hand, medical care for patients has become a concern in different hospitals, especially in older adults, since the great congestion of people has triggered great chaos in waiting times and interaction

with nurses to go to the office [5]. It has been determined that the quality of life for older adults in hospitals has generated a high percentage of diseases such as stress and depression, for which important factors such as multiple linear regression have been analyzed to determine the factors associated with this problem since the implemented model resulted in the following variables depression and dependency and it was concluded that 25.7% of hospitalized patients presented these problems since the most vulnerable population were the elderly [6]. Other investigations determine that these problems are very common in hospitals in terms of medical care since the large amount of information handled has allowed the consolidation of different databases that seek a solution to the determining problem in medical centers. Regarding medical appointments, delays in them also generate certain inconveniences on the part of users, since the implementation of a quantitative study allows comparing data in the evaluation of quality in hospital care [7].

In another area, there is a large percentage of diseases due to malnutrition in Indonesia, since these data were analyzed, resulting in 3.4% of the population suffering from this disease. It is important to consider that malnutrition is the trigger for other diseases linked to malnutrition since this often affects the life and growth of the child in their intellectual development in their growth stage [8]. For this, it was planned to develop an expert system that performs the work of detecting children in an age range of 1 to 3 years, for which an algorithm called naive bayes classifier was used [9].

The objective of the research work is to determine what kind of diseases people suffer from according to different factors that influence such prognosis established with the azure machine learning platform. That is why different tests and the implementation of the topic are replicated in a mobile application. It is intended to implement different forms of solution for the evaluation of such prognostic diseases and consultations with experts in the given specialty.

2. LITERATURE REVIEW

In the following paragraphs collect the necessary information that allows us to associate a raised topic with the opinion of different authors in the management of different information systems related to the suffering of different diseases and their symptoms that cause it to consolidate the necessary treatment prescribed by the doctor. To do this, different articles of information related to the topic to be discussed are consulted. Then the information implemented in the following paragraphs is presented.

A study carried out on alzheimer's disease; states that this disease has become very common worldwide [10]. Where the main objective of the research is to determine those diseases associated with alzheimer's that carry a greater risk of contracting said disease. Reaching the conclusion that different medications to combat different triggering symptoms of alzheimer's have shown positive results with quality clinical management.

In pandemic situations due to the COVID-19 virus, a study carried out in Belgium analyzed different cases presented during the initial phases of the global epidemic [11]. Where the symptoms presented were analyzed to differentiate whether a person is prone to or has COVID-19 disease. Using binomial models for the introduction of analytical data is introduced as a covariate in the analysis of such disease, for which the main objective of this study is basically reflected in predicting the different symptoms presented by people with a high risk of contagion of said disease. Where it was concluded that this research will be of great help to detect different groups of considerably large people using the techniques mentioned above.

The fact that there are different types of problems regarding the monitoring and evaluation of health in different areas of hospitals since hospital centers handle large volumes of information that lead to a disorder in their management [12]. For this reason, it is difficult to diagnose innumerable dangerous diseases in any person who attends hospital services for consultations [13]. The objective of the research is the implementation of a platform for big data analysis, taking into account different techniques in data analysis using mathematical algorithms.

Deep learning (DL) is one of the tools used through biomedical images to diagnose diseases of all kinds [14], very commonly used to detect heart diseases among others. The objective of the research is to carry out a structuring in the segmentation of DL implementing a neural network to obtain information on the symptoms of said disease. Where it was concluded that the experimental results for cardiac diagnosis show that positive results have been obtained and that this method can be extended to computer-assisted diagnosis.

Different topics such as cloud computing associated with artificial intelligence (AI), brought a great change in traditional medical care where the objective of this research was to find a way to introduce different technologies in the health sector [15]. Presenting a different disease diagnosis modeling, using these technologies in terms of heart disease and diabetes, through these technologies different stages were presented such as data acquisition processing. Classification and adjustment of parameters using portable devices and sensors performing obtaining the data through these tools and it was concluded that 0.96% and 0.97% were diagnosed with heart disease and diabetes. Where the proposed proposal of a model used as an effective tool for the diagnosis of these diseases is a great help.

Diseases of the ear, nose, and throat, for which the construction of an expert system was carried out for the detection of diseases associated with the subject and thus minimize the delay in the necessary treatments to control the disease [16]. For the said study, an algorithmic method called naive bayes with forward chaining inference was used, implementing 14 different diseases in the system, complemented with 42 symptoms consulted by specialists in the subject. Reaching the conclusion that in 25 patients in which the expert system was used in which the results were that 0.88 are influenced by the number of symptoms prescribed by said system, so it is proposed to develop a much more accurate system for the diagnosis of otorhinolaryngological diseases.

The field of health with the advancement of technology has been increasing as AI has been able to trigger different capabilities of human thinking, taking into account this premise [17]. The main objective of this research is to propose the implementation of an expert system which, by means of classified information will detect such stomach diseases to detect the type of disease. Its symptoms and the necessary treatments that should be considered to control the disease. Concluding that this system will determine the current state of the stomach in each patient who comes to consultation.

The information obtained in different investigations consulted in scientific articles leads us to the conclusion that information systems today are a great contribution in the evolution of technology since with this an optimal processing of information. Can be carried out in the sciences of health since this prevents dangerous diseases that can even lead the patient to death. With the management of these information systems, it is essential to consider that the expert in the area will have the capacity to provide the necessary information that is needed to have a more precise system in the results.

3. METHOD

In this section, the agile rup method was applied, which is most useful in software engineering. Many of the projects carried out with this methodology allow us to carry out interactions with those involved in a project following different phases, compared to other rup methodologies it is easier to use since the procedures used in this methodology bring positive benefits such as reliability, usability and quality of the software developed with the objective of customer satisfaction [18]. The rup group consists of 4 important members of which the rup master is the key member since he is in charge of maintaining continuous communication with the owner of the business thanks to him the doubts or obstacles that arise in the team are dissolved work, each member shares their particularities when carrying out their activities for a better understanding according to the ability of each member. Rup teams use organized meetings where different points such as progress, planning, and problems that arise when developing their activities are discussed, these sprints conclude with the review of the project or product to make adjustments or improvements in terms of the quality of the work done [19].

3.1. Rup method

The rup method is a technique for the proper management of a software development project using different processes considered as a tool for process management [20]. In Figure 1, the steps of the rup methodology are shown as the first step the beginning, then the elaboration, the construction and finally the transition. These steps will allow or obtain the proposed objective of the research work.

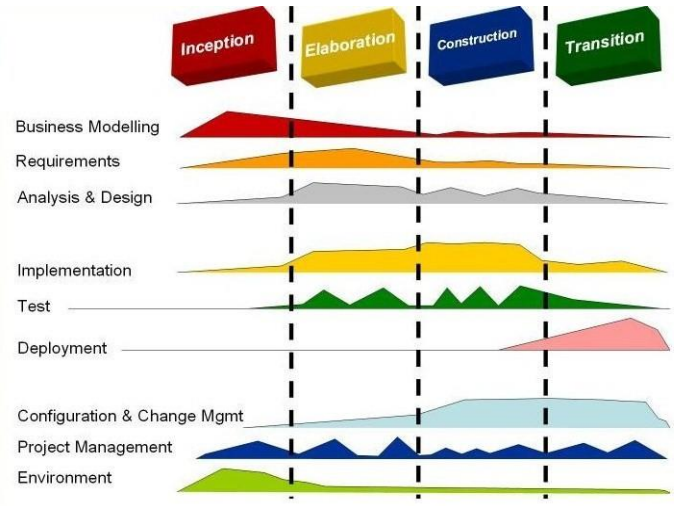


Figure 1. Agile rup method

3.2. Phases of the Rup method

The objective of the phases of the rup methodology is to analyze and search for the solution to the problem. Creating the architecture base, for good development of the project plan and thus eliminating the major risks, of the proposed works. The following are the different phases used in the rup method.

3.2.1. System modeling

This section will show the development of the different methodologies that were used for the modeling of the system. In which different tools were used to model the application logic. Different diagrams will be shown that will allow a better understanding of what the development of the objective for the application aims at.

3.2.2. Use case diagram (CU)

In this phase, the information systems require a strict evaluation and ordering of the information. Where the use case diagrams allow us to build the interaction of the system between the different actors through the activities that each actor performs and their interaction in the system as shown in Figure 2. Resulting in the consolidation of all the information that is handled in a computer system [21].

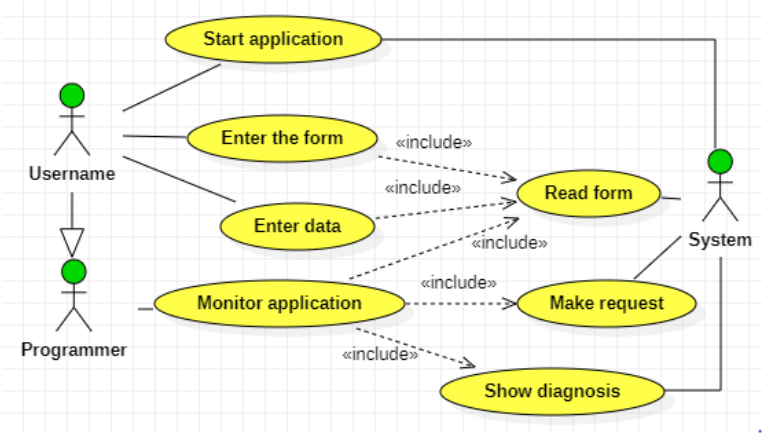


Figure 2. Use case diagram

3.2.3. Non-functional requirements

Non-FR arise from user needs, due to budgetary constraints. Organizational policies and the need for interoperability with other software or hardware systemsare mentioned. External factors such as security standards and privacy policies [22], as shown in Table 1.

Table 1. Non-functional requirements

No.	Tipo	Description
		Usability
1	RNF001	Dynamic system that easily interacts with the user.
2	RNF002	system adequate system and technical support available.
		Confidentiality
3	RNF003	Ease of use in placing the prescribed symptoms in the system
4	RNF004	Developments applied to continuous improvements of the system according to requirements.
5	RNF005	System analysis by chronic disease experts.
		Maintainability
6	RNF006	Improvement in the answers of the diagnoses by means of the expert.
7	RNF007	Conclude in an accurate diagnosis by consulting with the person's care expert.

3.2.4. Functional requirements

In software and systems engineering, FR. They can range from high-level abstract statements of driver requirements to detailed specifications of mathematical FR. Software FR help to capture the expected behavior of the system mentioned in Table 2 [23].

Table 2. Functional requirements

	Description of FR	Use case	Name of CUS
Code of the FR	Requirement description	Code CU	Put the name of the CUS
RNF001	Income in the application	CU S001	Start application
RNF002	Write data	CUS002	Enter the form
RNF003	Describe symptoms	CUS003	Enter symptoms
RNF004	Tracking of system	CUS004	Application monitoring
RNF005	Analyze informationn	CUS005	Read form
RNF006	Ask for reply	CUS006	Do request to Azure
RNF007	Show results	CUS007	show diagnosis

3.2.5. Activities diagram

BPM business process diagrams allow describing the different processes of a business based on their activities as shown in Figure 3. Seeking to implement different business processes and integration into an information system, giving as a response the structured organization in terms of system requirements such as databases, and use case diagrams, among others [24]. A task is always divided into different components for a better understanding of the flow of the diagram defining the detail of the activities [25].

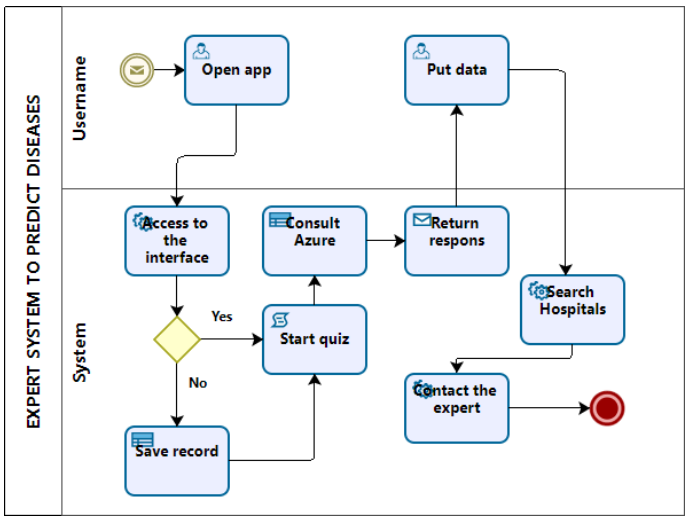


Figure 3. Activities diagram

3.2.6. Class diagram

Class diagrams are a set of objects that communicate with each other, through relationships. That is, they are components that act within a system performing activities as shown in Figure 4. Since the different modeling languages represent a developed software system, for good performance and security of the project [26].

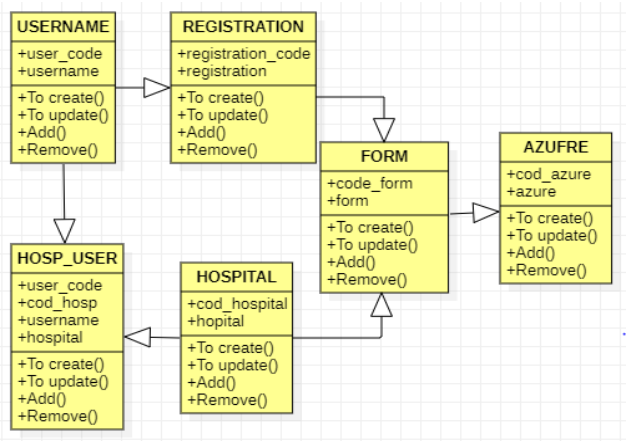


Figure 4. Class diagram

3.2.7. Diagram of the sequence

Sequence diagrams are a set of representative objects that allow maintaining the communication between objects through modeling tools. Since in this way the information is ordered for its understanding. Performing any type of modification of the components [27]. As shown in Figure 5, the sequence diagram is formed by the user, graph, data, and azure machine learning.

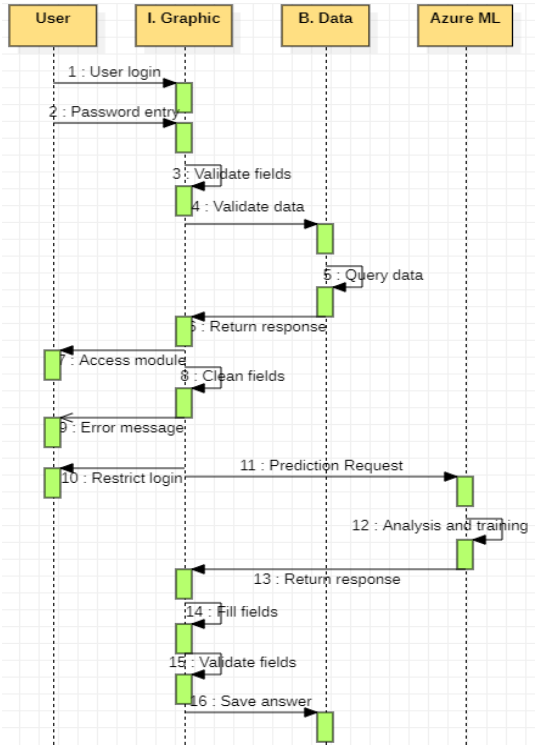


Figure 5. Diagram of sequence

3.2.8. Database

Databases are highly demanded in information systems, database management performs an important task in business life. That is, large volumes of data are stored daily where important data is extracted using other technologies as displayed in Figure 6. Such as AI that seeks to analyze this collected data [28].

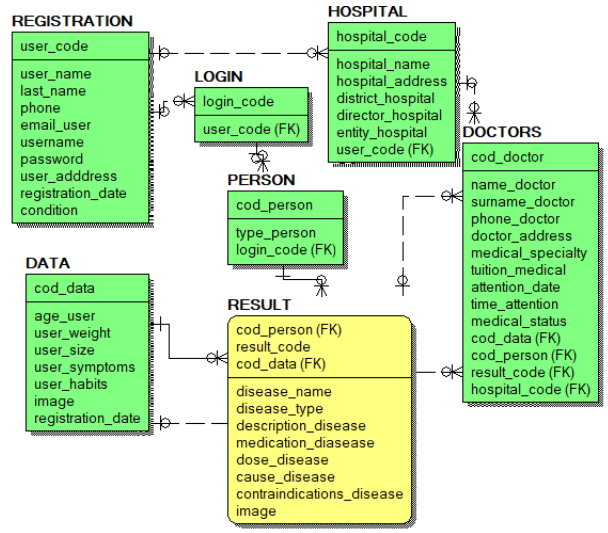


Figure 6. System database

3.2.9. Deployment diagram

Currently, there are different types of diagrams for modeling information systems. Among them is the deployment diagram, the importance of this diagram is to be able to obtain the interaction of the system components, but at the hardware level. Since the interaction between them makes possible the interaction also of the system components. As shown in Figure 7, the system database.

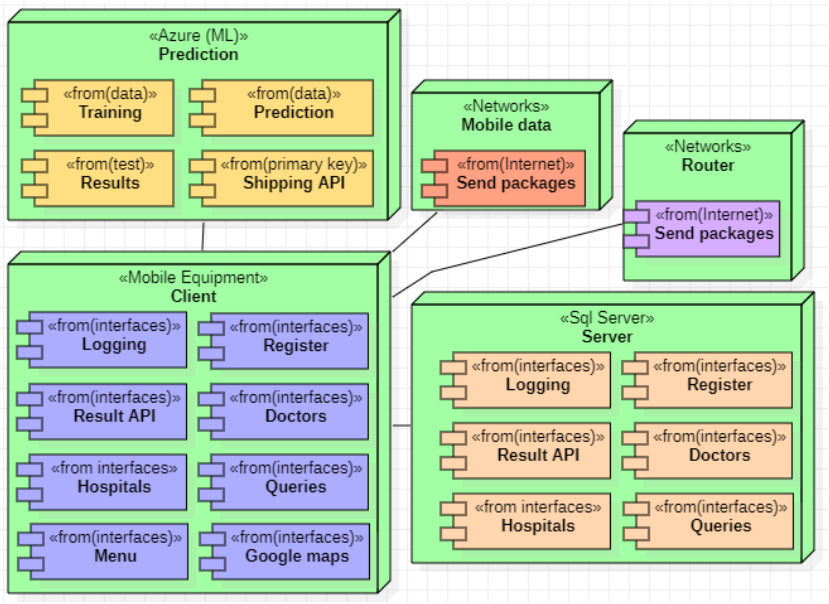
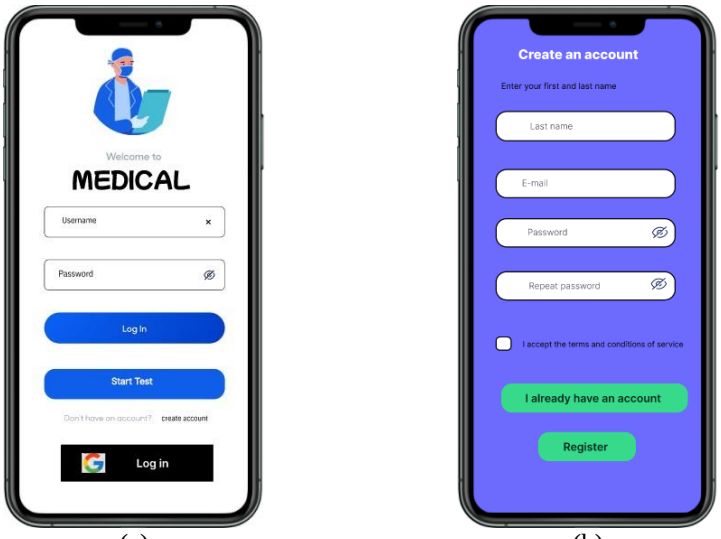


Figure 7. Deployment diagram

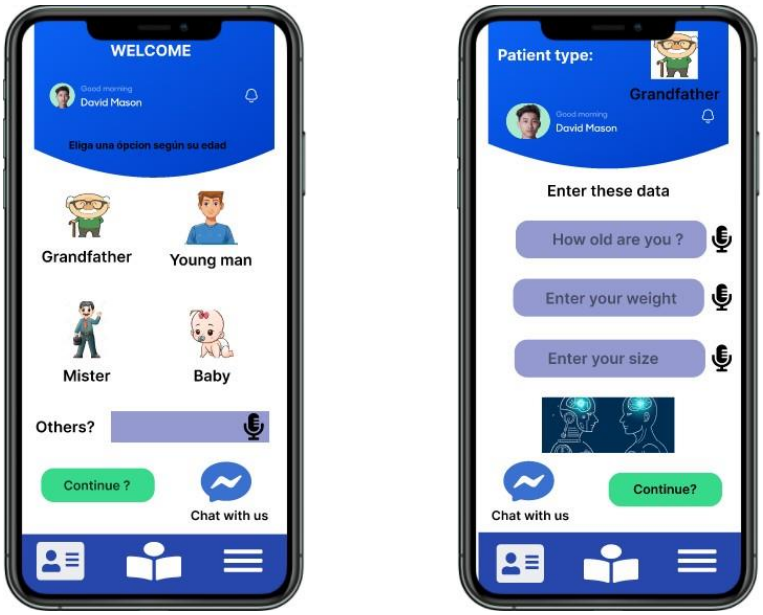
Figure 8 shows the mobile application for a model of expert systems for disease prevention. As shown in Figure 8(a) the initial interface was made, which has as components a registration login that allows access to the system once registered. While in Figure 8(b) a registration form can be seen where the data of the user who wishes to register will be placed [29].

Figure 9 shows the application of the start menu and to enter patient data. Likewise, Figure 9(a) shows the start menu in which the types of people to whom the prediction will be made are classified, it also shows a chat to make any consultation with the expert about their disease. While in the same Figure 9(b) shows the form to enter the necessary data for the prediction of the disease such as age, height, and eight which will be essential to make the prediction using these data.



(a) (b)

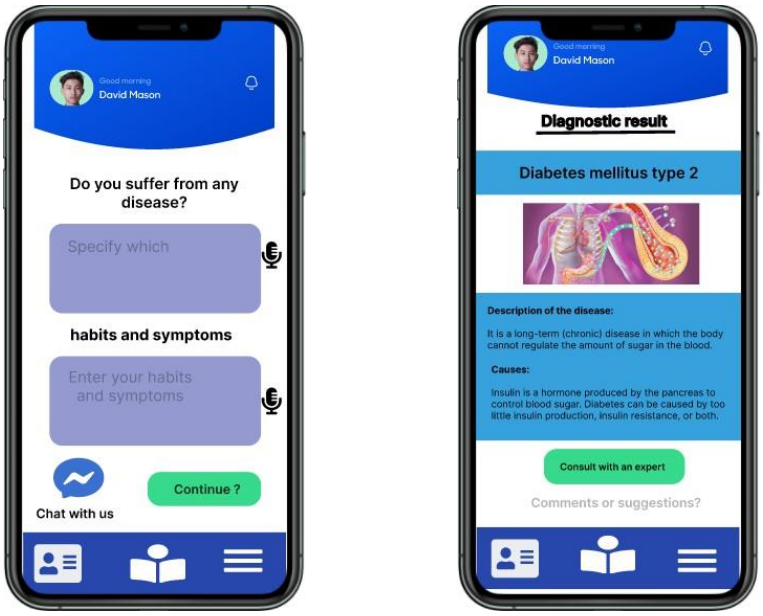
Figure 8. Identify, (a) login and (b) register



(a) (b)

Figure 9. Welcome, (a) start menu and (b) data

Figure 10 shows the application of the form of communication and the result of the patient's predictions. In the same way, Figure 10(a) continues with a form of questions where the symptoms of eating habits that a person has will be specified in detail, for which. Through this information in Figure 10(b), the result of the test will be shown. The system through a previous analysis of the azure machine learning studio tool.



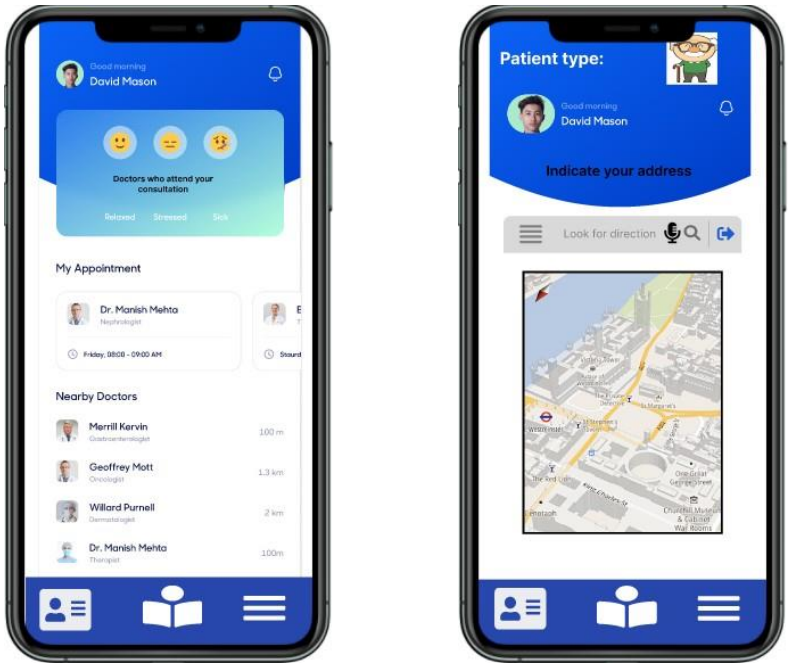
(a) (b)

Figure 10. Communication, (a) form and (b) prediction result

Figure 11 shows the application of the list of doctors and their location so that patients have knowledge of the specialties of each doctor. Figure 11(a) considers a list of expert doctors in each medical specialty

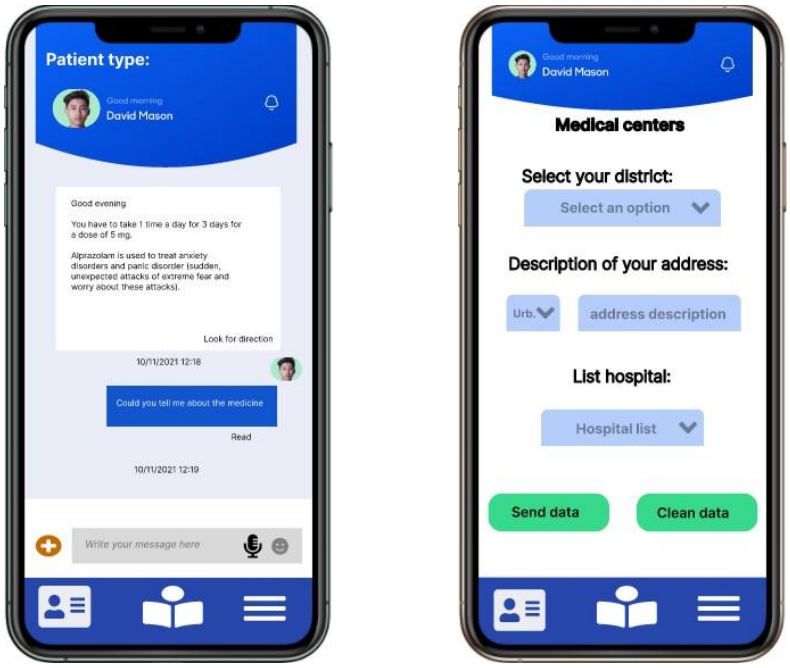
according to the disease presented by the user. While Figure 11(b) shows a map indicating the address of the hospitals where the specialty expert is located.

Figure 12 shows the application for consultation according to the type of disease the patient suffers from and the list of medical centers. Likewise, Figure 12(a) shows a conversation interface between the expert specialist and the user to carry out any consultation he/she may have. While Figure 12(b) shows a form where the user will enter his/her address data to locate the nearest doctor.



(a) (b)

Figure 11. Location, (a) list of doctors and (b) address



(a) (b)

Figure 12. Classification, (a) patient type and (b) data

The algorithm used called decision forest is a mathematical model whose function is to classify different prediction variables, that is, the obtained results are taking different results as a reference, generating various related models as shown in Figure 13. Table 3 shows the variable to consider in order to deal with the diseases adequately. In addition, Table 4 shows the registry of fatal diseases, classifying and describing each of them.

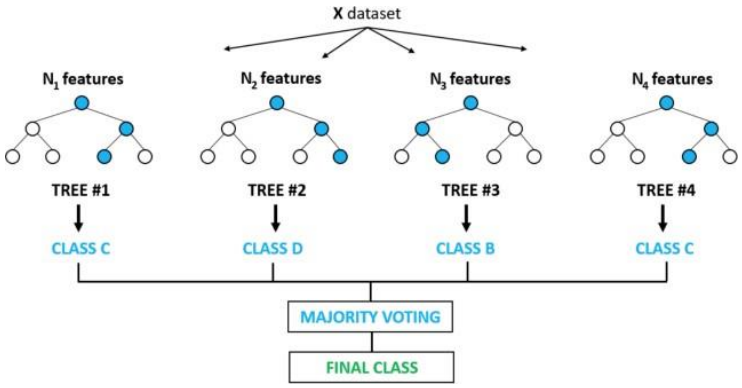


Figure 13. Class decision algorithm

Table 3. Variables

Description	Variables	Range
Application to detect diseases	Age, weight, height, complication, habits and symptoms	Children, adults, seniors

Table 4. Fatal disease registry

N	Description	Classification
1	Ischemic heart disease	Cardiovascular
2	Stroke	Brain diseasel
3	Obstructive pulmonary disease	Pulmonary
4	Respiratory system infections	Infectious
5	Neonatal conditions	Birth problems
6	Cancer	Cell
7	Mellitus diabetes	Hormonal
8	Kidney diseases	Renal
9	VIH Sida	Viral
10	Acute bronchitis	Viral
11	Common cold	Viral
12	Ear infection	Viral
13	Influenza	Mucous membrane
14	Sinusitis	Nasal
15	skin infections	Infectious
16	Throat pain	Infectious
17	Urinary infection	Urinary tract infection
18	Gota	Articular
19	Hypertension	Cardiac
20	Obesity	Food

4. RESULTS AND DISCUSSION

4.1. Evaluation by expert judgment

Based on the data obtained from the form of questions asked to experts in the field with the objective of collecting information and opinion data from the experts for the validation of the system. The survey form consists of 3 dimensions in which 4 questions were classified for each dimension "design", "content" and "security" closed questions were also formulated as 1=very satisfied, 2=satisfied, 3=dissatisfied, 4=very dissatisfied, 5=no opinion, 6=yes, 7=no. The project was evaluated by the expert judgment by professionals in data science and emerging technologies, different important points were evaluated. Such as the implementation of the azure machine learning platform where each procedure for data training was performed. The predictive analysis and finally the result obtained in an API for which the qualification in the results has had a high scale, finally obtaining the approval of the project.

4.2. User surveys

In the end, a questionnaire of 12 questions was made to 52 users who benefited from our application (see Table 5). Taking into account the structure by which it was divided into 3 dimensions for greater classification and understanding, the first dimension" design", the second dimension" content" and the third dimension security". Considering these aspects as important for the user who uses the application (see Table 6).

Table 5. Survey questions

	Questions
	Design
Q-1	Regarding the design of the application, do you feel satisfied with the colors and the interactivity of the design of the application?
Q-2	About its functionality. Do you want some additional options to be added to the movel application?
Q-3	Does the developed mobile application meet your requirements and expectations?
	Contents
Q-4	Would you recommend this mobile application with your acquaintances or relatives?
Q-5	About the prediction in the application Do you think that the mobile application is accurate when it comes to predicting results?
Q-6	In the interface where the symptoms are placed, do you consider that other components should be placed?
Q-7	Do you think you would have to contact a specialist to make the consultation about your disease more beneficial?
Q-8	Is the patient record clear and accurate?
	Security
Q-9	About the security of your data Do you feel safe when registering your data in the mobile application?
Q-10	About the prediction of your disease Do you think that the symptoms you enter in the system are confidential?
Q-11	Do you consider that more reliable security measures will have to be taken in the system?
Q-12	Would you have the need to accept that your data is with your consent?

Table 6. Results

Criterion	Question	Media	Standard deviation	Scale
Design	Q-1	1.80	0.45	Low
	Q-2	6.20	0.44	High
	Q-3	6.20	6	High
Contents	Q-4	6.00	0	High
	Q-5	5.80	0.44	High
	Q-6	6.00	0	High
	Q-7	5.60	0.54	High
	Q-8	5.80	0.44	High
Security	Q-9	5.20	0.45	High
	Q-10	6.00	0	High
	Q-11	5.60	0.55	High
	Q-12	5.80	0.44	High

To determine the feasibility of the research, a scale measurement was carried out, classified by categories between low, high, and medium, to determine how feasible the project is. Through other factors such as the average, obtaining a minimum result of 1.80 for questions Q-1 and Q-4 while the minimum results in standard deviation were, 000. For question Q-5 and the maximum results for question Q-3 with a result of 6.00 (see Table 6). The result obtained was an acceptance of 83.3% high and 16.7% low, in the answers given by the respondents.

Thanks to the results and their rankings will be able to determine that the project is viable and used by the users. However, in order to create a more consistent system, constant updates should be maintained to improve the user experience. In terms of different factors such as the design or implementation of new functionalities, for the development of the application.

4.3. Method comparison

Table 7 shows the comparison of the three methodologies. Although it is true that today agile methodologies are frequently applied with their scrum framework, for documentation, the rup method is ideal. On the other hand, design thinking is oriented more toward business processes where creativity and innovation stand out. The rup methodology was chosen since it is adapted to the project proposal, is that you can view the diagrams of classes and activities. In addition, prototype designs can be directly displayed. It can be concluded that for agile projects the most recommended is the methodologies. They are based on products delivered by sprint. In this way, you can work with several of them according to the requirements of customers and users. The rup method it consists of certain phases that can be worked with functional and non-FR. Likewise, there is a broad vision of the project with its diagram of the use of the system and the business; having defined the

actors and workers. Finally, design thinking also has stages but they involve those involved with brainstorming, they are selected with the participation of all of them and business models are formed to later show it through designs. The selection of the method was carried out with 5 experts in the field and took into account criteria such as processes, documentation, optimization, and creativity. Resulting in a score of 20 points for the rup, followed by scrum with 18 points, and the last design thinking with 15 points.

Table 7. Methodologies

Rup method	Scrum method	Design thinking method
Allows interactive development by adapting to the business process	This methodology encourages team collaboration through team members	Is people-oriented, that is, its goal is to create products that people find useful and meet their needs
There is an effective collaboration between the project collaborators	An easy organization between the team collaborators controlling times and management	It seeks to attract the attention of the person through striking visual graphics creating experiences and telling sto-ries
A quality control is carried out in each process of the methodology	Scrum is a methodology is a flexible tool adaptable to the needs of the client	Another characteristic is that it is essential that the creative team is made up of people from different dis- ciplines according to the needs
The projects are carried out in iterated stages, that is, in each iteration, observations and opinions of the process are an- alyzed and given	It is possible to obtain anticipated results by the organization, detailing the business activities	It is important to integrate people in the development of the project product or services, make them participate in the process of each activity

5. DISCUSSION

The finding found in the present investigation was through a satisfaction survey, where it is shown that 72.5% believe that the expert system in the mobile application is accurate when it comes to predicting a disease. This coincides with the author [15], who performed an expert system and 88% of his patients were satisfied with the system and for being accurate in predicting disease. In addition, 76.5% of respondents felt that the expert system in the mobile application met their requirements and expectations, very similar to the author's research [14], which concludes that in 96.16 and 97.26 patients, the expert system helped them predict their disease, which determines the expert system as an effective tool for the diagnosis of these diseases. Also, the author's research [11] concludes that through data analysis it can be predicted if a person is prone to or has COVID-19 disease, this research is similar to the present research work because it also concluded that the expert system of the mobile application is accurate at the time of predicting results since the highest percentage of the analysis in the survey regarding the said topic was 72.5% and against it was 19.6%.

6. CONCLUSION

This mobile application, through its design, allowed us to determine what type of disease a person suffers from according to their symptoms. In addition, it was possible to develop and verify its effectiveness, which benefits many people who have the problem of going to a medical center for different reasons, facilitating speed and waiting in centers that are sometimes collapsed due to so much demand from patients. The rup method is appropriate for this research because this method clearly fits the needs of our implementation compared to methodologies such as scrum, and design thinking. For this, the implementation of an expert system is the solution for many problems present in our society since our recommendations for the future would be to carry out different programs applying expert systems in all areas in which it is applied, among other emerging technologies. It is suggested that it be followed researching with researchers from different specialties to be able to apply cutting-edge technologies and to use other different technologies.

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