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Original Article

Implementation of a Mobile Application with Artificial Intelligence in the Health Sector

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Abstract *- Nowadays, medical attention in the public sector is very deficient; it maintains a too-old system, which is a great obstacle and does not allow fast and optimal work. That is why when providing patient care, the response time and analysis takes between 3 to 6 months depending on the availability of people in service; this is increasingly complicated because people do not have adequate service, and attention to a diagnosed disease can even last longer because the resolution andmedical appointments to the specialty also go through the same process. The main reason to develop a mobile application is to achieve the correct patient care management. For this, we used the Scrum methodology that gives us a correct order,scalable progress, and, above all, constant communication between all team participants. We also used different technologies which will allow the implementation and development of the mobile application, especially to help improve medical care.*

Keywords *- Optimum, Analysis, Mobile application, Management, Scrum.*

1. Introduction

Currently, in the public sector, they use tools to process patient data and information on a constant basis, but they do not offer quality service as it is deficient. Nowadays, the use of sophisticated technological tools and software for the health sector is important. The author [1] mentions that mobile applications provide support in the different activities performed by a human being, and above all, it is increasingly accessible; it is expected that in approximately 4 years, a large percentage of the population will have access and therefore there will be a great demand for applications.

According to the article [2], using artificial intelligence allows one to enjoy many improvements and efficiency in all areas since it can be applied in all situations, such as applying predictions, among others [3]. In Peru, health centers still do not have sophisticated processing tools for the health sector, where the response time for processing is very short [4]. The response time for data processing is one of the most important factors for detecting and treating viral or pathological diseases. Thus, the project carried out to carry out the research project for the development of a mobile application with artificial intelligence in the health sector, which allows to enter the information easily and obtain the results of the analysis.

Nowadays, going to a medical institution is a constant regret and a waste of time since they are not able to supply the number of people that they can [5]. The insured starts the attention with the call or visit the medical institution to request an appointment. Then, the staff validates the data and verifies the schedule depending on the specialty and the availability of the doctors in charge. The schedule is usually 15 to 20 working days since they do not have immediate availability; sometimes, it can take even months.

On the day of the appointment, the doctor validates the data, enters to see the patient's history and proceeds to listen to the patient's symptoms, reviews the patient, records the data in the system and requests discard tests, provides the documents to the patient and then the patient has to go to the appointment center to request the laboratory appointment again. This process also takes 15 to 20 days.

On the day of the laboratory appointment, the health personnel validate the data, draw blood, place a code manually, and place it in a deposit, which can be combined since they wait for this deposit to be full until they accumulate approximately 10 to 15 tests.

When the patient's tests are finished, he/she has to wait 20 days to call and make an appointment with the doctor of the specialty with a wait of 15 to 20 additional days; once the patient is at the appointment, the attending physician validates the data and verifies the results in the system and indicates to the patient if he/she has any disease or any treatment to be followed, the estimated time to obtain an answer is 2 to 3 months depending on the availability of the establishment [6].

Within the proposed solution, the client will have an easy-access mobile application that can be downloaded on cell phones and/or tablets with an Android operating system in which the user can register and log in to access its contents, within the same make inquiries, fill out surveys and forms that are evaluated through artificial intelligence with machine learning. The processing through decision-making and predictive algorithms for personalized results to the user with suggestions, recommendations, and treatments according to the user's condition; the application will be connected to a local database and a database in the cloud to ensure security and support to customer needs.

As mentioned by [7], AI is the automation of activities reflected in human thought processes in which it helps solve problems; that is why its use is becoming more and more frequent. Nowadays, more and more applications or systems are being implemented that are attributed to the use of it to facilitate frequent tasks.

2. Literature Review

This section reviews the literature on mobile applications similar to the present research, which continues to participate in the study and provides the necessary resources to make this study work and oriented to the implementation of mobile applications.

The authors [8] indicate that mobile applications are a direct way to provide health information and a form of communication service delivery for all people in general. The constant need to prevent disease and manage the congestion of people seeking care [9] in a medical center is what encourages the search for tools, hence the rise of artificial intelligence that allows computer-assisted diagnosis for the rapid detection of diseases The use of technological tools such as a mobile device to gain full access [10] and a large universe of resources provided to us through sophisticated apps with software specifically designed for health care plays a fundamental role today. [11].

Apps can assist consumers in various health tasks to manage chronic diseases, support lifestyle changes, and self-diagnosis. For clinicians, they can improve access to patient information and clinical decision-support tools at the point of care [12]. Processing-level research has today evolved the way information is handled at global levels and widely promotes the production and innovation of uncommon tools [13].

Since the beginning of the pandemic, various projects focused on remote work or work without the need to be in the same environment began to be developed, which is why several work options have also been implemented in the medical sector, where there is now telemedicine [14]. Process optimization and rapid visualization of results through an application is the most innovative method nowadays and is more implemented in health centers [15].

Processing with predictive algorithms is more efficient with corrected modeling and training [16]. Likewise, the author [17] indicates that the use of mobile applications is a means that provides greater reach to the population and better-quality medical care.

Your.MD is a mobile application implemented with artificial intelligence in order to provide personalized advice on symptoms and provide recommendations with lists of suggestions and steps to follow; it serves as additional medical assistance to the professional with interactions through the user and experiences and/or searches performed by the user within the application [18].

SkinVision is an application oriented to the early detection of skin cancer with the use of artificial intelligence through deep learning algorithms and computational comparison methods for image processing where the application can provide information about the degree of lesions or skin spots to provide recommendations for specific tests and treatments based on the information and images provided by the user [19].

Cardiio is a mobile application that uses a learning algorithm, with the help of the phone's camera, allows the analysis of the camera data and provides information about the heart rate; this helps to measure the frequency and seeks to provide recommendations on the cardiovascular health of each patient [20]. Welltory is a mobile application that allows the analysis of data on the health and lifestyle of each user with the help of artificial intelligence, which can identify heart rate, stress, and type of physical activity of the user and also provides recommendations for overall wellness according to their data [21].

In conclusion, a bibliographic review of different research works was carried out since each author has different viewpoints, methodologies and ways of use. In addition, all the research is based on implementing mobile applications applied to health and with the help of predictive analysis, which is why this work is very important for advancing research.

3. Materials and Methods

For the development of the project, it is necessary to implement a methodology that allows to advance regularly and according to each stage; for this reason, it is important that the methodology adapts to the way of working and to different types of unforeseen events that may occur along the way; the agile scrum methodology was the most convenient option for this research.

3.1 Scrum

Scrum is a management technique that reduces the complexity of solving customer problems. Scrum management and groups share requirements and innovations

to teach elements through step-by-step experiments. Scrum is a process, framework, or framework used by teams working on complex projects [22]. An agile working methodology oriented to add value in the short term, based on the three pillars of transparency, audit and adaptation. Scrum is a process, system or structure used within a group to eliminate complex activities. A smart work strategy means offering short-term incentives while respecting the three pillars of simplicity, recognition and adaptation. Scrum is based on aspects such as flexibility to adapt to changes and new requirements during complex projects, the human factor, collaboration and interaction with customers and iterative development as a way to ensure good results.

Figure 1 shows the Scrum model structure for implementing mobile applications and project development.

3.2. Process Map

The definition of the process map of a company or organization is taken into account when creating a strategic business plan. It aims at an ever-deeper knowledge of the functioning and performance of the processes and activities in which the company or organization is involved, paying special attention to explaining its important aspects. According to the concept of a process map, each company can have strategic and tactical plans with the purpose of understanding its processes and activities, particular or similar activities and interests [23]. Just as there are traditional project management practices such as the one proposed by the Project Management Institute (R) known as PMI(R), there is another area of project management known as Agile. Agile software development is nothing more than an adaptive management methodology that allows software development projects to run, adapt to change and evolve with the software. Agile development is a set of growth guidelines popular with customers because the software is very fast to deliver, and the development guidelines focus on providing analysis and design.

3.3. Incremental model

The definition of the process map of a company or organization is taken into account when creating a strategic business plan. It aims at an ever deeper understanding of the functioning and performance of the processes and activities in which the company or organization is involved, paying special attention to explaining its important aspects [24].

3.4. Android Studio

In short, Android Studio is the premier development environment for building Android applications. It provides a wide range of features and tools that help developers build applications efficiently and productively. In short, Android Studio is essential for developing Android applications efficiently. Its benefits include a comprehensive development environment, advanced debugging and testing features, integration with Google services, and a streamlined workflow that improves developer productivity [25].

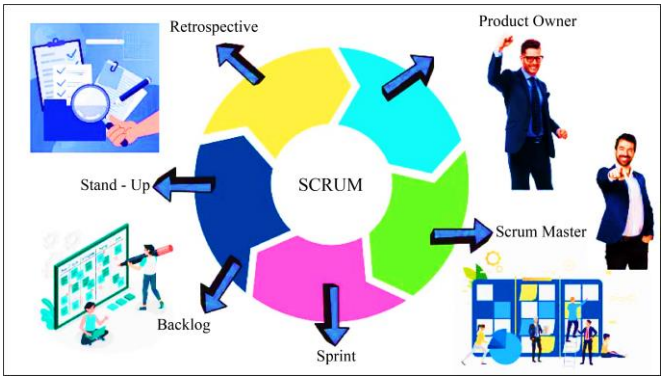

Fig. 1 Scrum methodology

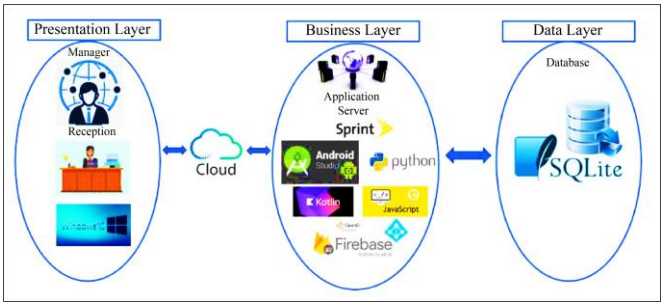

Fig. 2 System architecture

3.5. System Architecture

The system architecture will allow the development of a mobile application and demonstrate different types of services, such as the cloud, to optimize the management and configuration of services, as shown in Figure 2.

4. Results and Discussions

4.1. Sprint

Mobile applications now give us a great reach to any type of person and anywhere in the world as long as you have a smartphone with an app store that allows you to communicate with a medical expert or extract information that allows you to provide a medical diagnosis without having to go to a health center. Within the Sprint, it was divided into 3 functional increments for the realization of the proposed project.

4.1.1. Increment1

In increment 1, you will find the user registration with the user module where you will be able to log in.

4.1.2. Increment2

The client will be able to make queries and interact with the application through the panels assigned by the user role.

4.1.3. Increment3

Within this increase, data is presented through reports, diagnostics and statistical tables applied with artificial intelligence for personalized attention to provide a better experience to the end user.

Table 1 shows the detailed estimation according to work periods and distribution of modules, which will allow the project to be carried out in an orderly and periodic manner.

Figure 3 shows the health care process in the current situation and shows the workflow to identify how the health care process works in a public health center.

Table 1. System sprint

NAME	DURATION	DATE END
System	49 Days	09/06/2023
User registration	1 week	02/04/2023
User module	2 Week	05/05/2023
Report Management	1 week	09/05/2023
Reporting Module	2 Week	09/06/2023

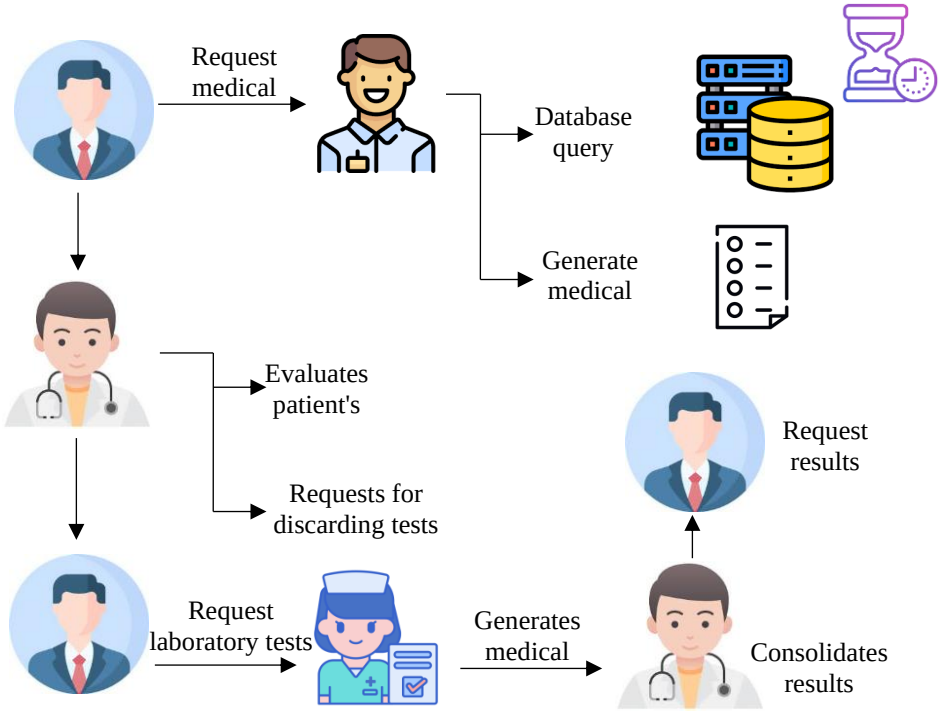

Fig. 3 Current situation

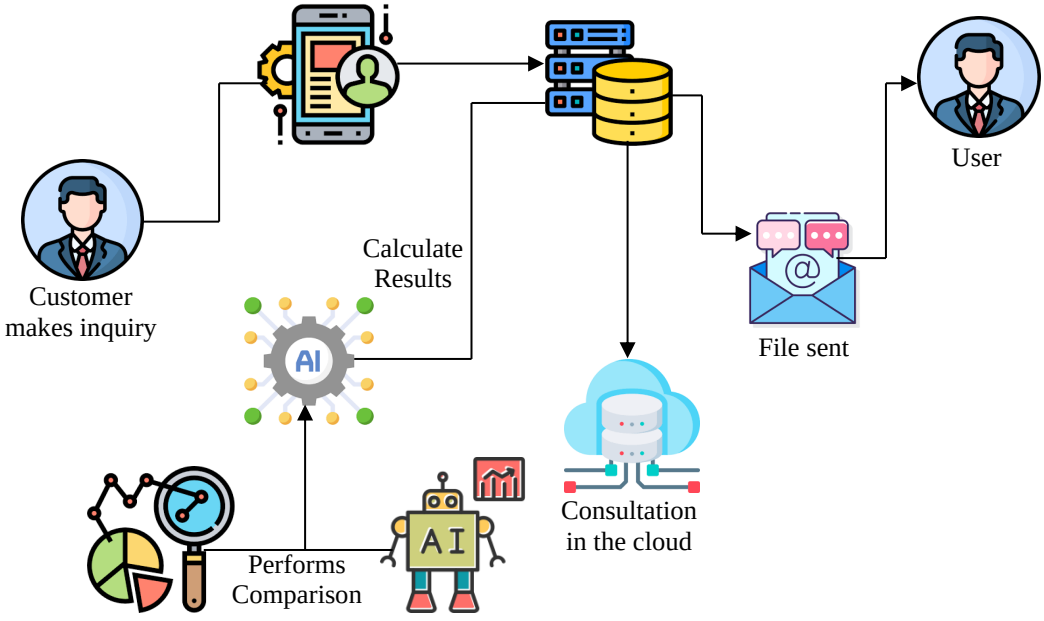

Fig. 4 Proposed solution

Figure 4 shows the medical care process with the proposed solution and how the workflow would improve with the implementation of the mobile application, which will streamline care and analysis.

Figure 5, the first Sprint, shows prototype 1 of the front page and welcome screen for the user to access the service easily and directly.

Fig. 5 Login

Subsequently, Figure 6 shows Sprint 2, where the login prototype is shown, which allows the user to enter the application with the ability to have a username and password that identifies the user.

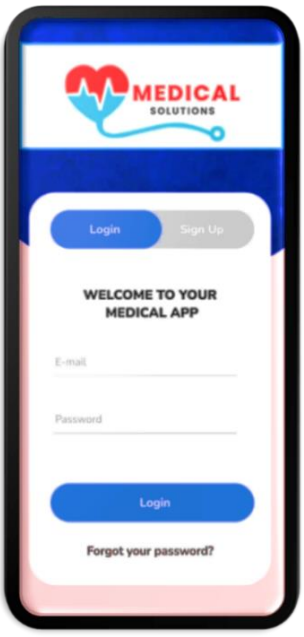

Fig. 6 Login Page

Figure 7 shows Sprint 3, which identifies the registration option if the person logging in is a new user.

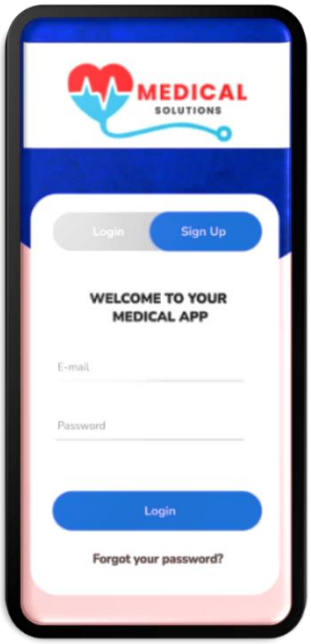

Fig. 7 Logging in a new user

Figure 8 identifies prototype 4, which shows a consultation module that will provide information according to medical specialty, among others.

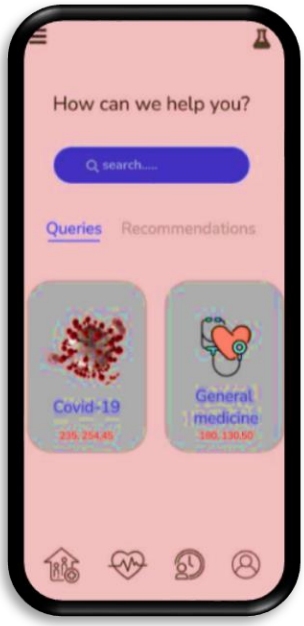

Fig. 8 Query module

Figure 9 shows prototype 5, which shows the Medical Record with the patient's data and the probability of any identified disease

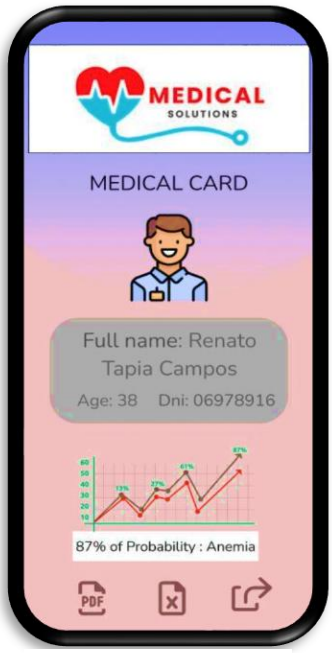

Fig. 9 Medical Record

Figure 10 shows the declaration of the variables that will allow the identification of a highly probable disease and will show the corresponding recommendations.

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

# Step 1: Load the training data
data = pd.read_csv("disease_data.csv")  # Replace "disease_data.csv" with th

# Step 2: Data preprocessing
X = data.drop("disease", axis=1)  # Features or attributes
y = data["disease"]  # Labels or diseases

# Step 3: Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, ran

# Step 4: Train the model
model = RandomForestClassifier()
model.fit(X_train, y_train)
```

Fig. 10 Variable declaration

```
# Step 5: Make predictions on the test set
predictions = model.predict(X_test)

# Step 6: Evaluate the model's accuracy
accuracy = accuracy_score(y_test, predictions)
print("Model accuracy: {:.2f}%".format(accuracy * 100))
```

Fig. 11 Matching statement

Figure 11 shows the statement of the matches and results according to the determination based on the information entered by the patient or user.

```python
from surprise import Dataset
from surprise import Reader
from surprise import KNNBasic
from surprise.model_selection import train_test_split

# Step 1: Load disease and recommendation data
# Let's assume you have a CSV file called 'recommendation_data.csv' that con

# Define the CSV file structure
reader = Reader(line_format='user item rating', sep=',', rating_scale=(1, 5)

# Load the data from the CSV file
data = Dataset.load_from_file('recommendation_data.csv', reader=reader)

# Step 2: Split the data into training and test sets
trainset, testset = train_test_split(data, test_size=0.2)

# Step 3: Train the recommendation model
algo = KNNBasic()
algo.fit(trainset)
```

Fig. 12 Logic programming

Figure 12 shows the patient's personal information, such as age and sex, among others. It determines the logistical part of the work, which will help continue the workflow and allow identification of each patient's relationship with their personal information. Declarations are important, and so are variables in order to more effectively find matching patterns in an algorithm.

Figure 13 shows the concatenation of the user or patient data to list the information and identify possible diseases; this will allow us to link the parameters and have an answer with a high probability thanks to the predictive analysis, which will analyze the data more extensively to provide the best accuracy and recommendations according to the high probability.

```
# Step 4: Get recommendations for a specific user
user_id = 'user_1'
num_recommendations = 5

# Get the items that the user has not rated yet
user_items = [item_id for item_id in data.item_ids() if item_id not in train

# Make recommendations
predictions = algo.test([(user_id, item_id, 0) for item_id in user_items])
top_recommendations = sorted(predictions, key=lambda x: x.est, reverse=True)

# Print the recommendations
print("Recommendations for user {}: ".format(user_id))
for recommendation in top_recommendations:
    print("Item {}: Estimation {}".format(recommendation.iid, recommendation
```

Fig. 13 Concatenation of the user or patient data

4.2. Approval of Expert Prototypes

The prototypes made for the research were validated by experts, which were four experts among graduates and technology personnel who gave their point of view considering the following criteria: functionality, usability, consistency, and integration. This is to give their approval of the mobile application and thus obtain user satisfaction.

Table 2. Expert approval

Experts	Functionality	Usability	Consistency	Integration	Level
Criterion 1	95%	88%	90%	92%	High
Criterion 2	93%	90%	91%	93%	High
Criterion 3	91%	92%	92%	91%	High
Criterion 4	92%	89%	90%	90%	High
Average	93%	90%	91%	92%	High

The evaluation will be accepted with a low level, between 0% to 40%, moderate 51% to 80% and a high level of 81 to 100%, indicating that the application meets expectations and will be effective.

As shown in Table 2, the experts' score gives, as a result, a functionality of 93%, usability of 90%, consistency of 91%, and integration of 92%, allowing us to verify that the application has been approved.

4.3. Survey

In addition, a survey of 12 questions was conducted to 100 different people from family, friends from the University, and co-workers, among which three important questions were identified to demonstrate that implementing the mobile application will be very efficient and provides a high probability of use.

Question one, according to Figure 14, shows us the degree of acceptance of the proposed mobile application in the health sector.

Figure 15 shows the accuracy of artificial intelligence in providing a medical diagnosis and the high probability of the diagnosis.

Figure 16 shows the user's comfort when using the mobile application and the probability of use of the proposed mobile application. It also corresponds to the user experience according to the sample of the prototypes and explanation of the project's purpose.

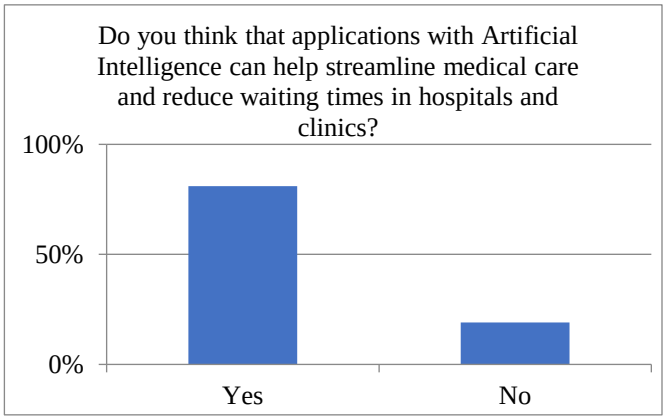

Fig. 14 Survey of acceptance

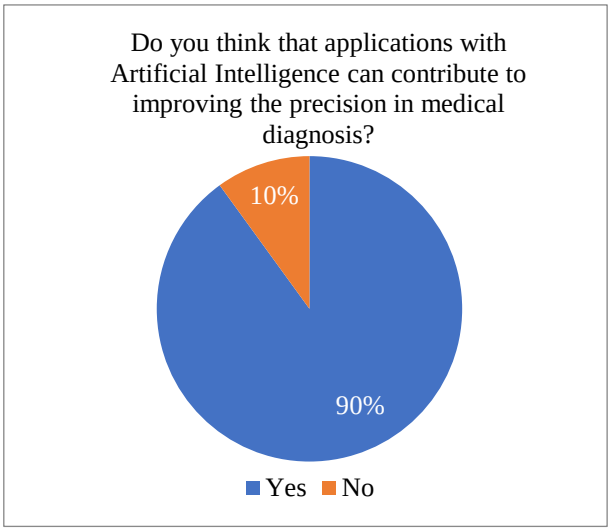

Fig. 15 Survey of contribution

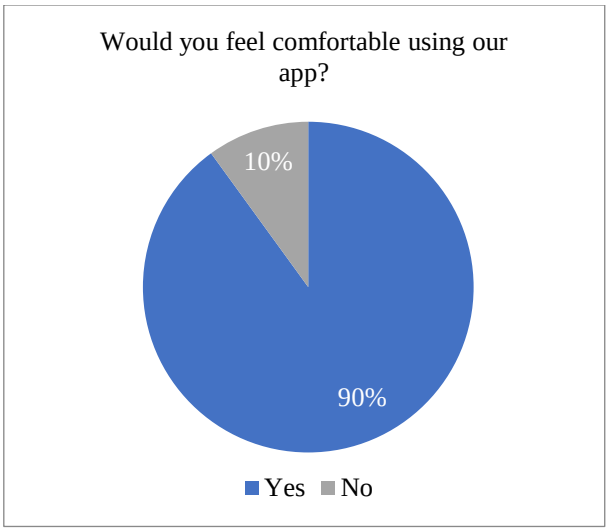

Fig. 16 Survey of application usage

According to the research carried out, many authors show the information according to their appreciation of technological progress and the need of people to automate each of the processes; however, in this research work, a survey has been conducted. The validation by experts has also been implemented, which gives us a more optimal experience of the proposal presented and gives us a better perspective on the improvements that can be made in the future to have a greater reach to the end user.

5. Results and Discussions

Finally, as seen in the prototypes, we sought to make the mobile application as easy and intuitive as possible to allow all types of users to access it without needing any training. The Scrum methodology, which was used to help develop the research, allowed orderly and incremental management, which improved the execution of the application. On the other hand, it is concluded that the implementation of the mobile application would help to diagnose diseases as soon as possible, which is what today plagues Peru and many Latin American countries because they do not have adequate medical care and many people take longer than necessary to enter into consideration if they have any disease. That is why future work is proposed to implement the medical history module, which allows the user to have a history of diagnoses. Predictive analysis can have more detailed information about the user and, thus, a higher percentage of probability that doctors can keep track of each patient. According to this, different types of possible treatments are identified; this will be carried out by the same software architecture and continue to conduct related research studies and provide more applications to help the implementation.

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