Design of a Mobile Application to Improve the Lifestyle of Patients with Diabetes

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Abstract—Diabetes is a disease that is increasing worldwide, the main causes are: a sedentary lifestyle, aging population and economic factors. On the other hand, in Peru there is also prevalence of diabetes, especially in older adults, due to this problem, in this research work a mobile application is designed to motivate and improve the state of patience with diabetes, this seeks to help these people to improve their quality of life. The Agile Scrum methodology was used for the design because of its constant meetings that better involve the team in the project, in addition to having tools that better organize the information. For the development of the design a survey was conducted to 25 university medical students, thanks to their answers we obtained the requirements of the application, which were taken as a guide to develop its functionality, finally the work includes the design of an interactive mobile application, intuitive and easy to use, in addition to having tools capable of motivating and informing the patient about diabetes, this research seeks to solve the problem found in the background, which is that currently there are a variety of applications oriented to help patients with diabetes, however have shortcomings in the design, as indicated by the studies.

Keywords—diabetes, design, application, scrum methodology, survey

1 Introduction

Diabetes is caused by insufficient insulin production due to high blood glucose, which can occur due to various factors such as an unhealthy diet, sedentary lifestyle or the aging of the population are the main factors responsible for the growing epidemic of diabetes [1]. This disease is present globally, affecting both economically and in the health of all nations. In recent years people with diabetes have increased worldwide, Asia is the key epicenter of the emerging epi-demic of diabetes. China and India are the two nations with the most reported cases of patients with diabetes [2].

In the last 2-3 decades, it is a fact that the disease has reached high epidemic levels worldwide, as it is considered a crisis. This epidemic has been mainly driven by urbanization, rapid industrialization and sedentary lifestyle, rapid economic growth and lifestyle changes are the main reasons for the increasing prevalence of diabetes [2].

On the other hand, in Peru the scenario is the same, the reasons are due to different factors and coincide with the economic growth occurred in the last 20 years, also the

adoption of an unhealthy lifestyle leads to obesity, therefore, we are more vulnerable to this disease. In Peru there is little information available on the prevalence of the complications of diabetes, such as nephropathy, neuropathy and retinopathy [3]. On the other hand, studies show that more traditional diets were associated with a lower prevalence of three common chronic diseases, while the prevalence of these diseases was higher with a diet high in processed foods and low in vegetables [4] [5], This fact gives us indications of the aspects that must be addressed, such as nutrition to combat this disease, as well as public health efforts to implement new measures or develop interventions focused on people at higher risk of diabetes [6].On the other hand, not only physical health is affected, but also mental health. Research shows that patients with diabetes suffer from depression and anxiety, which if not treated in time can cause a progressive increase in the disease, aggravating the patient's situation and affecting his or her quality of life [7].

Therefore, the objective of this research work is to present the design of a mobile application that helps to inform, motivate and improve the lifestyle of patients with diabetes, thereby seeking to mitigate the prevalence of diabetes in Peru and inform patients who already have the disease, also seeks to present an attractive, interactive and intuitive design, where the user adapts to the use of all the features of the application in the shortest possible time, thus seeking to reach the largest number of users and help them fight diabetes.

This research paper is composed as follows: Section 2 presents the literature review. Section 3 defines the methodology to be applied to the project. Section 4 describes the Results and discussions, finally, Section 5 shows the Conclusions and Future Work.

2 Literature review

This stage will highlight research related to the creation of applications related to diabetes and how they applied this technology to contribute to this problem.

In the following research, the authors conducted a study with the aim of analyzing the most popular diabetes apps and investigating the association between their use and patient behavior. To do this they conducted a survey in which people aged 18 years and older participated, to recruit them they relied on patient forums and Facebook groups, then collected information on their demographic, clinical and self-care characteristics of patients, as well as the use of diabetes apps, in case of the application they were asked to list the applications they have used for diabetes self-management. As a result, "mySugr" and monitoring apps such as "Dexcom", "Freestyle Libre" and "Xdrip+" were the most mentioned. Finally, it is concluded that the use of this application helped patients to improve self-management and self-care, and that the applications can support lifestyle changes and glucose monitoring in patients with diabetes [8].

On the other hand, the following research identified the barriers that are present in diabetic patients with respect to the use of mobile applications, for this they conducted an analysis in which patients with type 1 and type 2 diabetes participated, as main tests they used the two best known applications on diabetes, finally it was obtained as a result

that the applications presented usability problems in data entry, in addition it is recommended to train patients so that they adapt in the best way to the application [9].

Likewise, mobile applications have proven to be able to satisfactorily help patients with chronic diseases, currently there is a wide catalog of health applications, however there is an application called mHealth which is frequently used for diabetes self-management, that is why the researchers reviewed the features found in the application and which functions are the most used by patients. The Apple iOS app store and the Google search engine were chosen as the search method. Using the term "Diabetes Apps," in addition to ranking them by consumer reviews and key features for diabetes management, we finally reviewed 12 mHealth apps, concluding that the Glucose Buddy Diabetes Tracker app emerged as the most used app in the store [10].

In another study, a problem is addressed about the variety of diabetes applications that exist, however, the rate of usability is low, which is why they conducted an analysis of the four most commercial applications (OnTrack, mySugr, Glucose Buddy and MyNetDiary), where they evaluated the recording of data, their autonomy, the connection it may have with health centers or average care and finally the blood glucose analysis it performs. With the help of experts they classified the usability of the applications where the most frequently violated heuristic principle was "Help and documentation", followed by "Error prevention" and "Aesthetic and minimalistic design", in conclusion four of the best and most known diabetes applications were classified as "Marginally acceptable" to "Completely unacceptable", which is why they recommend that in the future the design of diabetes oriented applications should aim at patient motivation and incorporate a guidance system to improve the usability of the user [11].

Following this line of research, in the following investigation, tests were conducted on patients for 2 weeks in adults with type 2 diabetes, these tests consisted of using the applications Glucose Buddy and mySurgr, at the end of the tests the patients reported the following problems, first they did not observe changes in self-care to disease beliefs in any of the groups, only the blood glucose tests, in general they concluded that both applications are acceptable, however they were time consuming and difficult to use.

Finally, they recommend more clinical support and when designing use motivational support techniques to provide value to users [12]. On the other hand, the following research addressed the needs of patients with diabetes, i.e. what are their attitudes and perspectives of patients with diabetes and diabetologists, as well as the needs regarding mobile applications, this research seeks to help developers to improve their design to meet the basic needs of patients, for this 1276 people from 30 regions were surveyed, where the significant results were the following: the reasons why patients stopped using the applications was because of limited time, In the case of diabetologists, the problems were limited time, legal problems, patient distrust and billing problems. In conclusion, the use of applications to control diabetes is low, and it is recommended to direct the design of future applications to different patient needs, and it is essential to test the applications with patients before they are marketed in order to improve their usability [13].

In the following research, a survey was conducted to 5 adolescents diagnosed with type 1 diabetes about the design of a mobile application for people with diabetes, for this the adolescents appreciated the design and interface of the application, then stated

that the application only partially met some of their needs, they also noted that they would like to implement a social platform, they also suggested that it should be compatible with their monitors and blood glucose pumps so they can continue to use it [14]. Finally, it is concluded that in health applications it is important to highlight the implementation of a social platform where the patient can interact and share their experiences with respect to the disease, and the application should also focus on clearly informing patients about its use and the risks of the disease. The medications used for the control of diabetes are fundamental elements during treatment, which is why there are applications that support the self-management of diabetes, which is why the following research aims to analyze whether the applications comply with maintaining self-control or how it is managed with respect to diabetes medications.

To do so, they searched for applications in Google play and Apple Store, downloaded applications that help the administrative functions of medication and blood glucose, were then evaluated following the international guidelines for medication and diabetes management. As a result, the search yielded 3369 relevant apps between both stores, of which 143 apps (81 Android, 62 iOS) met the inclusion criteria and were evaluated, more than half had the functionality to remind medication intake, 16% implemented the function to check medication adherence, only 5.6% provided information about medications and only 4.2% included motivational messages to encourage medication consumption [15]. Finally, it was concluded that the applications lacked features to improve medication adherence and safety, which is why it is recommended that more emphasis be placed on these aspects when developing the design of future applications aimed at diabetes management.

Finally, in the following research, augmented reality was used as a method of learning for children, this technology proved to be effective in their learning, as it draws the immediate attention of children, which is why the results indicated that 85% of students who used virtual reality as a teaching method showed a greater interest of the student to learn more about the subject [16], [17].

In conclusion, thanks to the research shown, we know that there is a large number of mobile applications oriented to the use of people with diabetes, however in several studies it has been noted deficiencies in the design, as it usually has complex interfaces which prevent a correct use of the application, therefore the user ends up leaving use, followed by the problem of usability, since the patient does not get to know all the features presented by the application, which is why it is recommended to improve in these aspects, which is why this research work seeks to improve these aspects, presenting minimalist and interactive designs to motivate the use of the application to users, on the other hand, the use of virtual reality in mobile applications is a technology that could be implemented in future updates, it would be a great tool to take into account to teach patients about their disease

3 Methodology

3.1 Scrum

As a methodology to develop the design of the application we chose to use the agile methodology Scrum, since being agile implies flexibility which allows the team to self-organize around the work. As well as constant feedback with both the team and the client. [18], this characteristic will be reflected in the present research work, Figure 1 shows the Scrum flow.

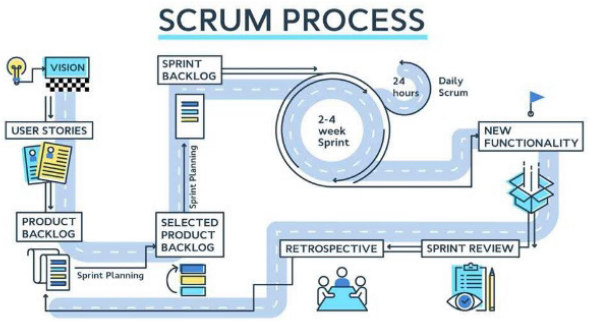

Fig. 1. Scrum flow

Roles. This methodology was chosen for its speed and also for the roles assigned to each team member, there are three roles, the Product Owner who will be responsible for defining the needs prioritizing the business requirements or objective, as it will then be used to create the Product Backlog, which is facilitated by the Scrum Master, and finally the entire development process of the activities presented in the Product Backlog will be performed by the Development Team [19] [20].

Planning. In this stage, the project planning is carried out, the activities to be performed are defined, as well as the number of deliverables and finally the execution time of each activity, for which meetings are held with the participation of the entire Scrum team [21][22].

Development. In this stage the deliverables planned in the previous stage will be developed, that is to say, the results of each Sprint will be shown, the proposed designs of the mobile application will be shown [23].

Review and Retrospective. In this last stage of the methodology, work meetings are held with the participation of the entire Scrum team in order to review all the progress made during the Sprint stage, propose improvements [24], share the complications that arose and finally define strategies to be taken to improve the development of the next deliverables.

3.2 Software tools

Kotlin. Kotlin is a programming language that can be seen as an alternative to Java, not only that, but both can coexist in the same application, however, recent surveys obtained a better valuation by programmers when using Kotlin, that is why it is advisable to use this language when developing the design of the application [25].

Android Studio. Android studio is a software, a development environment where you can design and create mobile applications for Android, in it you can find functions that will facilitate you when programming [26].

FireBase. Firebase is a platform oriented to the use with mobile applications, it is used to increase the user base, all the information is stored in the cloud and is available for iOS, Android and web. In addition, it is adaptable according to the needs of the application.

Marvel App. It is a web platform where you can create different designs, it allows you to create interfaces for platforms such as desktop applications, web, Android, iOS, etc.

4 Results and discussions

4.1 Roles

To define the roles of the team, a meeting was held to test the capabilities of each team member, with the objective of assigning him/her a role in which he/she can perform at his/her best. Table 1 shows the role of each team member.

Table 1. Team Roles

Roles	Responsible
Scrum Master	Laberiano Andrade
Product Owner	Laberiano Andrade
Development Team	Ricardo Leon Ayala
Development Team	Sebastian

4.2 Planning

For this stage, having already established the roles for each member, a new meeting was held where the user stories were determined and the amount of Sprint that the project will have been determined.

Sprint 1. Sprint 1 focused on the central design of the application, in order to show an intuitive and easy to use design, then the functions were created based on user requirements. As shown in Table 2, the user stories belonging to Sprint 1:

Table 2. Sprint 1 User Stories

User Stories
As an administrator, I want the application to have an intuitive and interactive design so that I can access each functionality quickly.
As a user, I want the application to help me in my treatment, reminding me of the activities I need to do during the day in order to better manage my time.
As a user, I would like the application to have a section where I can search for medicines so that I can be more informed about the doses I should take.

Sprint 2. Sprint 2 focused on designing the news section, since it was a requirement of the users and thanks to the research carried out, it was decided to create this section, as well as a social network within the application where the user can share their experiences and see the publications of others. As shown in Table 3, the user stories belonging to Sprint 2:

Table 3. Sprint 2 User Stories

User Stories
As a user, I want the application to have a diabetes news and information section to keep me informed about the disease and the treatments currently being used.
As a user, I want the application to have a social network to allow me to share my experiences and communicate with people or doctors specializing in diabetes.

Sprint 3. Sprint 3 focused on designing a chat within the social network to allow users to share their experiences and ask questions, both to patients and special doctors, and finally it was decided to include a guide manual to help users improve their usability within the application. As shown in Table 4, the user stories belonging to Sprint 3:

Table 4. Sprint 3 User Stories

User Stories
As a user, I want the application to have a chat to be able to communicate with people or special lists related to the disease.
I as a user want the application to have a guide manual to quickly learn about the functions of the application.

4.3 Development

Development of Sprint 1. As shown in Table 2, Sprint 1 was developed following these user stories, as we can see in Figure 2, the main interface was designed, which has 5 functionalities, in "Activities" helps the user to create the activities that are pending during the day. Then "Medications" is a function that includes a database with all the information about medications for people with diabetes. In "New Diabetes" the user can see the news related to health, in "Social" the user can interact with other patients connected to the application. Finally, in "User Guide" the user can enter to learn more about the functionalities of the application in order to improve the usability of the user.

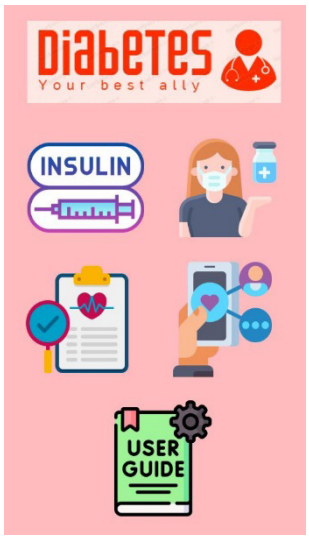

Fig. 2. Start of the application

In Figure 3, you enter from the main menu from the "Activities" function, and within it you can create the activities that the user requires, this function was implemented so that the user can better organize their time in daily activities, such as taking their medications.

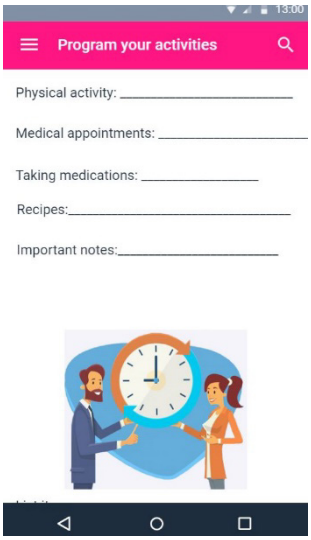

Fig. 3. Recall activities

Figure 4 is the "Medications" section, where the user can search for medications related to diabetes, the application will inform about their correct use and the amount

of intake required, in addition to suggesting popular medications, with the aim of keeping the patient informed about the different medications available to treat diabetes.

Fig. 4. Consult medications

Development of Sprint 2. As shown in Table 3, Sprint 2 was developed following these user stories, as we can see in Figure 5, the "New Diabetes" section was designed, where the user can enter to review the news of the week, this information will be updated, thus seeking to keep the user informed about the disease and important events that have occurred at present. As shown in Figure 5.

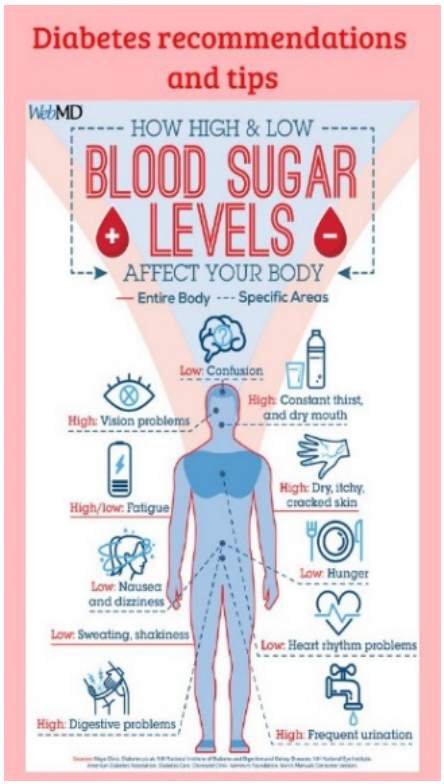

Fig. 5. Diabetes news section

Then the social network was designed within the application, starting with the creation of profiles, where the user can register from their Facebook account or through Gmail, this function allows the user to make publications in order to share their experiences related to diabetes, thus seeking to motivate patients, observing the case of others. All this is shown in Figure 6.

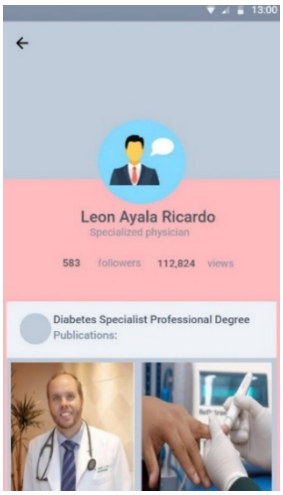

Fig. 6. Patient or specialist profile design

Development of Sprint 3. Finally, as shown in Table 4, Sprint 3 focused on developing a chat, included in the social network, which will allow the user to consult or interact with patients or specialists on the subject of Diabetes, in order to continue motivating the patient or to learn more about the disease and the different cases that may exist. All this is shown in Figure 7.

Fig. 7. Chat section with the patient or specialist

Finally, thanks to the research reviewed on the applications created for diabetes, it was decided to include a Guide Manual section where the user can enter to review all the functionalities and possibilities offered by the application in order to improve the

usability of the user, additionally motivational videos and images were included, which will be updated weekly, in order to continue motivating the patient. All this is shown in Figure 8.

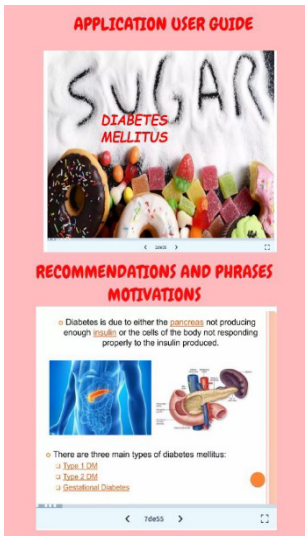

Fig. 8. Guidance and recommendations section

Survey of medical students for the creation of requirements. Through Google Forms, a survey was created with the participation of 25 medical students from the University of Sciences and Humanities, the Universidad Privada del Norte and the César Vallejo University. Thanks to your feedback, we were able to gather the requirements that helped in the creation of the design of this application. All this is show in Table 5.

Table 5. Survey Questions

	Survey questions to the 25 students
1	From 1 to 5, how much do you consider your knowledge about diabetes to be?
2	Do you know or have you used any health-related apps?
3	Which app did you use? Did you find it easy or difficult to use?
4	Do you think it is important to remind patients with diabetes of the activities they should do?
5	Do you consider it necessary to inform patients with diabetes about medications, dosages or risks of the disease?
6	Do you know people with diabetes?
7	The patient you know uses social media, if so? which ones do you use?
8	Do you consider it important for a patient with diabetes to interact with other patients who also have the same condition?
9	How important do you think it is to inform a person with diabetes about this disease?
10	Do you think it is important to include a User Manual of the application for elderly patients?

In question 1, only 32% had greater knowledge of diabetes, as shown in Figure 9.

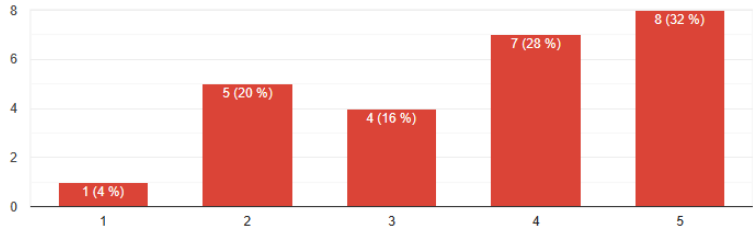

Fig. 9. Answer to question 1

Another important question is whether respondents have already used health-related applications, the result is shown in Figure 10, where we observe that 56% have used health-related applications.

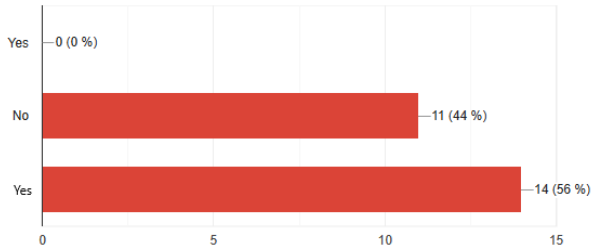

Fig. 10. Graph of question 2

Finally, in question 8, 72% approval was obtained, where it is considered important for the patient to interact with people with the same condition as shown in Figure 11, in question 9, 76% consider that the patient should be well informed about the disease, this is shown in Figure 12 and finally in question 10 consider that it is necessary to include a guide manual to improve the management of the enlargement, as shown in Figure 13.

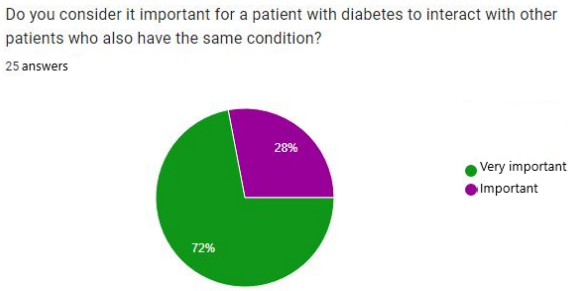

Fig. 11. Answer to question 8

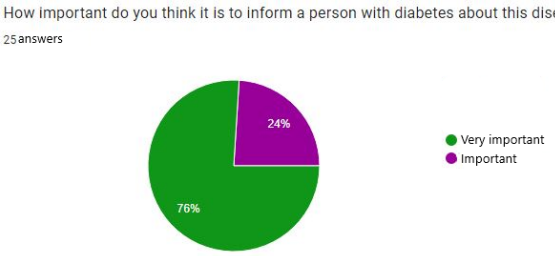

Fig. 12. Answer to question 9

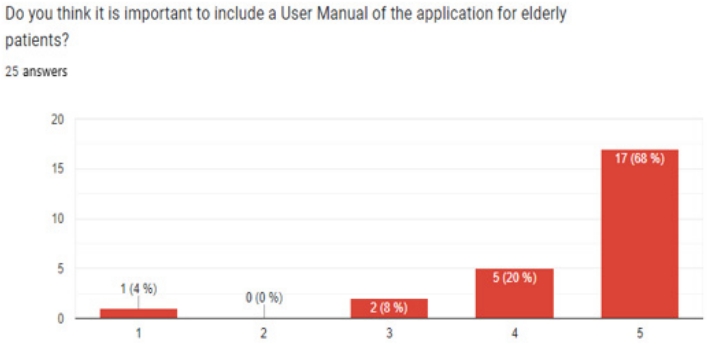

Fig. 13. Answer to question 10

5 Conclusions

In conclusion, it was possible to create the design of a mobile application capable of supporting the patient with diabetes, informing and motivating them to continue with their treatment, on the other hand, with the help of the Marvel App tool, the which has as objective that the user can adapt in less time to all the functionalities of the application. Likewise, thanks to the survey carried out with the medical students, it was possible to collect the necessary requirements for the development of the functionalities, supported by the Scrum methodology, it helped the team to become more involved with the project, since meetings were constantly held. where the following activities were planned. Finally, it is recommended to continue researching on the subject, since the health area is wide and it has already been proven that it is possible to use applications to improve the experience and support those patients who need it.

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