GYNAPP: UNA APLICACIÓN MÓVIL PARA LA ORGANIZACIÓN Y CONTROL DE ESTUDIOS GINECOLÓGICOS

GYNAPP: A MOBILE APPLICATION FOR THE ORGANIZATION AND CONTROL OF GYNECOLOGICAL STUDIES

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Resumen

El cáncer de mama y el cervicouterino se encuentran entre las principales causas de muerte de mujeres en México. La tasa de mortalidad por estas enfermedades es alarmante, aunque ha habido muchas campañas para que las personas sean conscientes de la importancia de realizar estudios ginecológicos para una prevención y detección oportunas, esto no ha sido suficiente. Este artículo presenta una aplicación móvil para organizar y controlar los estudios ginecológicos con el fin de ayudar e incentivar a las mujeres a cuidar su cuerpo y su salud. Se presenta el proceso de análisis y diseño de la aplicación móvil, junto con todos los pasos realizados, siguiendo una metodología de diseño centrada en el usuario.

Abstract

Breast and cervical cancer are among the leading causes of death of women in Mexico. The mortality rate for these diseases are alarming, even though there have been many campaigns for making people self-aware of the importance of conducting gynecological studies for a timely prevention and detection, these have not been enough. This paper presents a mobile application for organizing and controlling gynecological studies in order to help and boost women to take care of their bodies and health. The process of analyzing and designing the mobile application is presented, along with all the steps carried out by following a user-centered design methodology.

1 INTRODUCTION

The number of deaths in Mexico due to breast and cervical cancer are shocking. In order to prevent and detect these diseases on time, it is fundamental for women to conduct gynecological studies periodically. Although there have been several campaigns for making women self-aware of the importance of this problem, these have not been enough. For this reason, it is necessary to have tools for helping and boosting women to take care of their bodies and health.

This paper presents the analysis and design of *GynApp*, a mobile application that was thought for solving some of the needs detected through a series of interviews. The application described in this paper aims to increase the number of gynecological studies conducted by Mexican women, with the objective of preventing and detecting breast and cervical cancer on time.

GynApp will try to combat some of the cultural barriers described above, such as eliminating the taboo on breast self-exploration, explaining the importance of it, showing how it is done and reminding women of the days when they should do so. In order to avoid conflict with husbands who do not allow another man to touch or see his wife, *GynApp* will provide options for clinics where care is provided only by women. On the idea that gynecological studies are for promiscuous women, there will be videos that explain what it is and in what cases each gynecological study is indicated, making it clear that not only promiscuous women can suffer from cancer.

The rest of the paper is organized as follows. Section 2 describes three existing applications that are similar to the one proposed in this paper. The description of the problem is presented in Section 3. Section 4 introduces the analysis performed to obtain the user needs and

profiles for the mobile application. Section 5 is dedicated to the design process of the mobile application, which includes a brainstorm, a story-board, a paper prototype and a digital prototype. Finally, Section 6 presents conclusions and further work.

2   EXISTING APPLICATIONS

This section describes three existing applications similar to the one proposed.

iGyno [1] is a mobile application that helps to manage different aspects of the female health, such as the menstrual cycle, fertile days, body temperature, hormonal levels, among others. These are shown on the mobile application by using a graph. Given that the main aim of *iGyno* is to prevent breast cancer, it includes a video tutorial where it explains how to do a breast self-examination appropriately. Some of the drawbacks of this mobile application are that its interface is not very friendly because has saturation of information, and the graphs shown are not understandable.

Breast self exam [2] is a mobile application that helps to register the results of a breast self-examination. It provides a brief tutorial that explains how to perform a breast self-examination through animated images, which help women to have basic knowledge. The results are registered using an animated image for its representation and there is also the possibility for the user to upload a photo. The registration of these photos in the mobile application allows the user to carry out a visual comparison of current with past tests.

Breast cancer prevention [3] is a mobile application developed by Roche laboratories, which main objective is the cancer prevention auto test. The test is divided in three different stages: calendar, self-examination and tips. The application requests the menstrual information with the start and the end date. Later, it gives a recommended date for the self-examination. It also shows images and instructions to carry out the auto examination appropriately. Finally, the application offers tips to help on the detection of anomalies, advices for prevention, and what to do in case of having questions.

Table 1 shows a comparison of features among the three previously analyzed applications and *GynApp*. *A1* corresponds to *iGyno*, *A2* to *Breast Self Exam*, *A3* to *Breast cancer prevention*, and *GA* to *GynApp*. The tick indicates that the application has the feature, and the cross indicates that the application does not have it. A brief description of the features is also provided.

Gynecological studies agenda. This feature corresponds to the ability to manually or automatically schedule the gynecological studies that a woman must perform at certain time, such as pap smears, colposcopy, mammography and breast ultrasound.

Breast self-exploration calendar. This calendar allows a woman to manually or automatically schedule the days it is recommended to perform breast self-examination.

Table 1 Features of the applications analyzed.

Features	A1	A2	A3	GA
Gynecological studies agenda	✘	✘	✘	✔
Breast self-exploration calendar	✘	✘	✔	✔
History of gynecological studies	✘	✘	✘	✔
List of gynecological clinics	✘	✘	✘	✔
Video tutorial of self-exploration	✔	✔	✔	✔
Explanatory videos about studies	✘	✘	✘	✔
Tips to prevent or treat cancer	✘	✘	✔	✔
Management of menstrual cycles	✔	✘	✘	✘
Photo registration	✘	✔	✘	✘

History of gynecological studies. The history stores information about each gynecological study previously performed. This information indicates the study performed, the date of completion, the clinic at which it was performed, the result of the study, and where appropriate, the treatment that the doctor indicated, as well as any comments that the user considers important to be registered.

List of gynecological clinics. This feature shows a list of gynecological clinics, prioritizing those in which medical care is given only by female doctors.

Video tutorial of breast self-exploration. The video tutorial shows the proper way to perform a breast self-examination.

Explanatory videos about gynecological studies. These videos explain the procedure that is followed for performing different gynecological studies (pap smears, colposcopy, breast mammography and ultrasound), and specify in which cases these studies should be carried out.

Tips to prevent or treat cancer. This feature consists of tips that women register in the application to support other women who suffer from cancer or who wish to prevent it. Tips can be very diverse, such as food, exercise, habits, therapies, among others.

Management of menstrual cycles. This feature refers to different aspects of women, such as the prediction of dates of the menstrual cycle, fertile days, body temperature, hormone levels, reminders of contraceptive intake, among others.

Photo registration. This feature allows the possibility of storing photos corresponding to a breast self-exploration, in order to be able to compare the appearance of the breasts, in case of finding any anomaly.

3   PROBLEM DESCRIPTION

Since 2006, breast cancer occupies the first place of mortality in Mexican women due to malignant neoplasms, with a rate of 16.1 deaths for each one hundred thousand women aged 25 years old or more. Concerning cervical cancer, it is the second place of mortality in the country,

with a rate of twelve deaths for each one hundred thousand women aged 25 years old or more [4].

There are several factors that contribute to the development of breast cancer, although there is not a key factor alone that causes it, instead the combination of factors are the cause of this disease. Regarding cervical cancer, there are also many factors, but in this case, they are more precise, such as smoking, suffering human papillomavirus (HPV), taking contraceptive pills for more than five years, among others.

A timely detection of breast and cervical cancer helps to get greater possibilities of survival and total recovery, after having the necessary treatment. On the other hand, in a late detection there are less possibilities of survival. For this reason, it is of vital importance a timely detection. In order to accomplish this, it is necessary to conduct gynecological studies periodically, such as pap smear, colposcopy, mastography and breast self-examination.

Several studies [4, 5, 6, 7, 8] have revealed that Mexican women do not conduct prevention studies, such as pap smear, colposcopy, or mastography. Mexican women say this is because several reasons, among the following: they do not consider it necessary, they do not have time, they forget to conduct these studies periodically, they feel fear to the procedure, they feel pain or shame, doctors do not ask for these studies, among other reasons.

There are also cultural barriers, which influence on the late detection of cancer. The report "Social process of breast cancer in Mexico. Perspective of diagnosed women, her couples, and health service providers" [7] highlights some cultural barriers:

a) Fear of the disease: cancer is synonymous with death.
b) Fear that her partner will abandon her.
c) Children and husband are always before the woman's own health.
d) There is no culture of self-exploration: there are many taboos about touching your own body.
e) Husbands do not want them to be touched by male doctors.
f) Gynecological studies are for promiscuous women.

The truth is that there are several campaigns to make women aware of their health care, but then why the mortality rate for these diseases does not decrease? In order to answer this question an interview with five women of different ages and occupations was carried out. In this way, the next section describes the analysis performed to obtain the user needs and user profiles for the mobile application. The first part of the analysis was to design an interview, which was carried out with five women. The user needs were obtained from the results of the interview. Finally, the user profiles were based on the needs detected.

4 ANALYSIS

The following work is based on the User-Centered Design (UCD) process [9, 10], which outlines the phases throughout the analysis, design and development life-cycle while focusing on the understanding of the user needs.

The analysis phase was composed of interviews and an ethnographic study in order to detect the needs of Mexican women. The ethnographic study implies the observation as the main activity to analyze the users.

4.1 Interview

The interview was composed of nineteen questions, which are shown in Table 2.

Table 2 Questions asked to women in the interviews carried out.

#	Question
1	Have you heard about breast cancer?
2	Have you heard about cervical cancer?
3	Have you received information about these topics through any type of media?
4	Have you investigated about these topics?
5	Do you know the reasons why a woman gets breast cancer?
6	Do you know the reasons why a woman gets cervical cancer?
7	Do you know what studies must be conducted to diagnose breast cancer?
8	Do you know what studies must be conducted to diagnose cervical cancer?
In case of having answered YES to any of the last two questions	
9	Do you know how regularly these studies must be conducted?
10	Have you taken any of these studies?
In case of having answered YES to the last question, please answer questions 11 to 15	
11	How often do you take these studies?
12	When was the first time you took these studies?
13	Where have you taken these studies (clinic, hospital or laboratory)?
14	What opinion do you have about these studies (treatment of the staff, discomfort of the studies, religion, among others)?
15	Do you know when is the best time to take a breast self-examination?
16	Do you think there is enough information about these topics?
17	Do you think there should have something to help improving the communication of this information?
18	What types of tools or media do you think it should be?
19	Would you say that people around your environment are well informed about these topics?

4.2 Detection of Needs

Based on the results of the interviews a set of needs were detected, which are shown in Table 3.

Table 3 Needs detected based on the interviews carried out.

#	Need
1	Informative talks
2	Informative leaflets with images
3	Explanation videos
4	General information
5	Sexual education
6	Advice from experts and other women
7	Agenda for studies already carried out and future studies
8	Gynecological studies card
9	How to carry out the breast self-examination
10	Overcome fear of conducting studies and their results
11	Believe and trust in the doctors in charge of the studies
12	Trustworthy health service and available for everyone
13	Talk to someone about these diseases
14	Share experiences with other women
15	Family support
16	Partner support

Taking into consideration the list of needs shown in Table 3, it was observed that it was not possible to solve all of them but some, such as: advices, agenda, explanation videos, studies card, and how to carry out the breast self-examination. Given these needs and their solutions, it was decided to design a mobile application, due to its easy access and mobility.

Once the needs were identified, it was required to define a user profile, which described precisely the features of the person that will use the mobile application. It should be noted that the women interviewed comply with the user profile defined in the next subsection.

4.3 User Profiles

In order to analyze the possible solutions, three user profiles of different women and one scenario for each of them were defined. Each profile takes into consideration three of the needs mentioned previously. Only one user profile is shown in this paper, due to space restrictions.

The user profile presented defines a woman aged between 25 to 50 years old, with active sex life, housewife, with high school or university studies. She has a mobile phone with Internet access and has experience using several mobile applications. An example of this user profile is shown in Table 4.

5 DESIGN OF THE MOBILE APPLICATION

This section describes the process of designing a gynecological mobile application, which is composed of a brainstorm, a storyboard, a paper prototype, and a digital prototype.

Table 4 An example of the user profile defined.

Feature	Description or value
Name	Andrea
Age	45
Occupation	Housewife and saleswoman
Brief description	Andrea manages her family's home and sells catalogue products. During weekends on her free time she goes out with her family, does exercise, goes shopping and goes to the cinema. She uses the following applications: *Whatsapp*, *Pinterest*, *Google*, *Waze* and *Youtube*. She also likes to register her product orders and appointments on the calendar of her mobile phone.
Scenario	Andrea receives a notification on her mobile phone that indicates the date of her last study of mastography, which was conducted a year ago approximately, and advises that she should carry out the study again. The application shows her the catalogue of clinics, that are close to her, that conduct the mastography study. Andrea chooses the clinic and calls to make an appointment. Once Andrea has taken the study, she registers the date in which the study was conducted and its results. If there is something abnormal in the study, it will be registered along with the date of detection, the treatment given and the indications; this information will help her in future gynecological appointments.

5.1 Brainstorm

The design of the mobile application started with a brainstorm, this means the generation of words, images, sentences and concepts that could help to get inspiration in order to make an appropriate design according to the role of the mobile application. Some of the ideas and words that came out in the brainstorm were the following: healthy, colorful, easy, attractive, tranquility, feminine, simple, wellness, and control.

The sentences that stood out were the following: 1) illustrations are more attractive than the text and easier to understand; 2) having reminders of dates facilitates a better planning and control; 3) historical data would help to have a registry of studies, diagnoses and treatments taken; and 4) a simple graphical user interface would be easier to use and would demonstrate seriousness and confidence.

A point of view was also defined, which expresses clearly a problem and opportunity, and specifies what a good solution should accomplish. The point of view was defined as follows: With an application that reminds women to conduct gynecological studies, they would not forget to carry out them on time and take care of their health.

5.2 Storyboard

The design of the mobile application continued with a storyboard, which is a technique focused on producing

rapid prototypes, by identifying tasks (actions) that will help users to solve their needs. It should be noticed that users will always appear in the process of prototyping.

A storyboard consists of simulating a scenario where a task is required to be done, it shows the steps to be followed to accomplish the task required, and finishes when the task has been successfully completed. A storyboard helps in the design stage to identify problems and also possible solutions.

Figure 1 shows one of the storyboards that were produced in the analysis stage, in which a woman is making use of a mobile application to know how to conduct a self-study. It should be noticed that the messages shown in the storyboard are written in Spanish. The characters used in the storyboards were taken from the drawings made by Agustina Guerrero, who is an Argentinean graphic designer and illustrator [11].

Once the tasks to be done have been identified, the next step is to design the user interface in paper, in which it is easier to shape the ideas and make the necessary arrangements before making a digital user interface. Next subsection presents the paper prototyping carried out for the mobile application.

Figure 1 Storyboard that shows a woman making use of a mobile application to know how to conduct a self-study.

5.3 Paper Prototyping

Paper prototyping is a technique that consists of creating hand drawings of user interfaces in order to rapidly design them. The paper prototype should contain the structure and organization of the information (text, images, buttons, among other elements); the arrangement of those elements on the screen; the simulation of the actions

performed by the buttons with the execution of certain tasks and their results, which is very useful for a first test with users.

Figures 2 and 3 illustrate four of the screenshots of the paper prototype created for the gynecological mobile application. The first screenshot of Figure 2 shows the menu of the application, while the second screenshot represents the screen to register a result of a study. The first screenshot of Figure 3 shows how to register a treatment, and the second screenshot presents the registration screen completely filled. It should be noted that all the texts shown in the paper prototypes of Figures 2 and 3 are in Spanish.
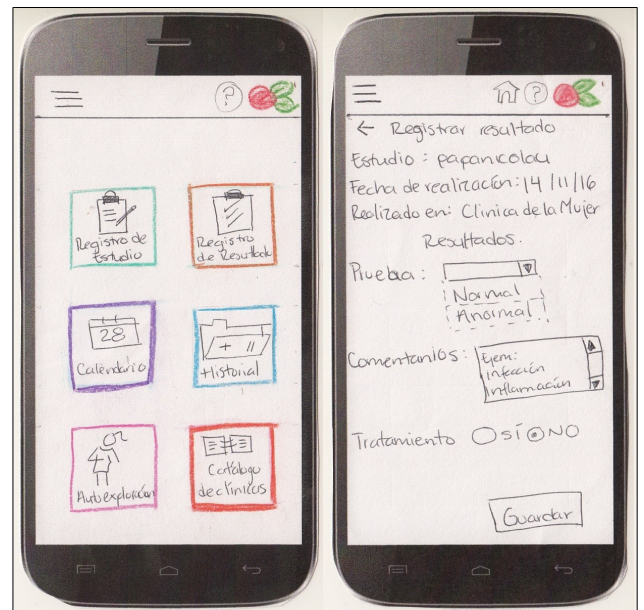

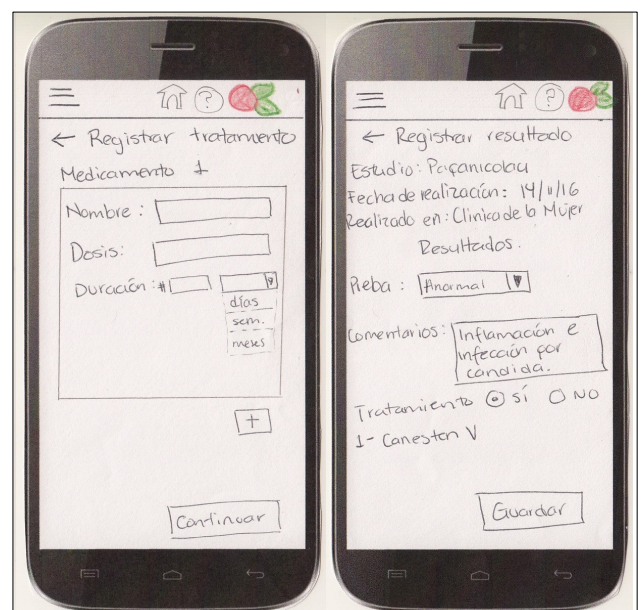**Figure** 2 Paper prototype for the mobile application: menu and registration of result for a study.

Figure 3 Paper prototype for the mobile application: registration of a treatment and registration form filled.

The paper prototype was tested with five women, the same that were interviewed, according to the ten usability heuristics for user interface design defined by Jacob

Nielsen [12], which are the following: "1) visibility of system status; 2) Match between system and the real world; 3) User control and freedom; 4) Consistency and standards; 5) Error prevention; 6) Recognition rather than recall; 7) Flexibility and efficiency of use; 8) Aesthetic and minimalist design; 9) Help users recognize, diagnose, and recover from errors; 10) Help and documentation" [13]. The results of the tests are shown in Table 5.

Table 5 Results of the tests using the heuristics defined by Nielsen.

Heuristic	Person1	Person2	Person3	Person4	Person5
1	✓	✓	✓	✓	✓
2	✓	✓	✗	✓	✗
3	✗	✗	✓	✗	✗
4	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	✓
7	✓	✓	✓	✓	✓
8	✗	✓	✓	✗	✓
9	✓	✓	✗	✓	✓
10	✓	✓	✓	✓	✓

The test consisted first in explaining to the women what Jacob Nielsen's heuristics consisted of, then the prototype was shown on paper and they were asked to interact with it, and finally they were provided with a format where they should indicate whether the heuristic was fulfilled or not, according to the prototype shown. Additionally, they were asked to provide suggestions about the prototype. The suggestions obtained are described below:

a) It would be good to have a history of studies carried out in the past.
b) A message should be shown indicating that the medication information of the treatment has been saved successfully. There is no message and leaves uncertainty.
c) Events should be seen by clicking on the calendar numbers.
d) The colors of the calendars should be changed, to more alive ones.
e) The underline of some titles should be removed; it gives the appearance that they are links.
f) A previously saved study should be able to be eliminated or modified.
g) The text "No events" should be changed to something like "No studies registered".
h) An error should be indicated when the form is not filled completed.

With the feedback obtained from the tests carried out with users the digital prototype was developed, which is described in next subsection.

5.4 Digital Prototyping

The digital prototype was developed based on the suggestions of the users, once they tested the paper prototype. The first version of the digital prototype was also tested with users and new feedback was obtained to modify the digital prototype again. Figures 4, 5, 6 and 7 illustrate eight screenshots of the final version of the digital prototype.

The first screenshot of Figure 4 shows a calendar for keeping track of the dates for studies and results, the green circle means that a study has already been taken and results have been registered; the yellow circle means that a study has been taken, but the result is not ready yet. The second screenshot of Figure 4 shows the menu that is displayed for the mobile application, where it is composed of the following options: *Home*, *Add Study*, *Add Result* and *History*. The first screenshot of Figure 5 is the *Add Result* screen, where the user can add the necessary information for the result of a study (result of the study, notes or comments about the study, and whether the study requires treatment or not). The second screenshot of Figure 5 shows the *Add Treatment* screen, where the user can add the necessary information for the treatment, in case it was prescripted by the doctor (medicine to be taken, dose, and duration of the treatment). It should be noted that these screenshots were designed based on the paper prototype described in the previous subsection. The texts and messages shown in all the digital prototypes are in Spanish.

The first screenshot of Figure 6 shows the *Add Result* screen after the result has been saved. The second screenshot of Figure 6 shows the confirmation screen after a result has been successfully saved. The first screenshot of Figure 7 illustrates the *Add Study* functionality, where the user can provide the necessary information to register a new study (name of the study, date when the study will be taken, and clinic where the study will be carried out). Finally, the second screenshot of Figure 7 shows the *View Study* screen, where the user can view all the information of a study, such as the type of study, the date, the clinic where it was taken, the results, some comments and the treatment.

Figure 4 Calendar and menu screenshots.

Figure 5 Add result and add treatment screenshots.

Figure 6 Add result and result saved screenshots.

Figure 7 Add study and view study screenshots.

The final version of the digital prototype shown in Figures 4, 5, 6 and 7 represents a functional gynecological mobile application to be used by women that fulfills the user profile defined previously in this paper. It should be noted that the tool used for creating the digital prototype was *Axure* [14].

6 CONCLUSIONS AND FURTHER WORK

This paper presented the process to analyze and design a gynecological mobile application, taking into consideration the users in every step of the process. This UCD methodology was very helpful to develop such application, because the user was involved in all the tasks carried out, and the final version of the prototype was designed according to the real needs detected in the analysis process.

Further work is needed to implement this mobile application for an Android platform, because all the users involved in the process use this platform. It should be noted that the implementation of the application would not be a difficult step, given that all the screenshots have been developed and tested by the users. The implementation would involve the translation of the screenshots to the appropriate programming language and the creation of a database for storing and retrieving data. The functionality and usability tests would be minimal, because they were already done during the process of developing the prototype.

In summary, *GynApp* will help to remember the dates in which a study should be carried out, in addition to suggest specialized clinics for its realization; clinics where the service is provided only by women, a registry of the results obtained in each study and advice for the prevention and detection of cancer, as well as advice from women who have suffered cancer. There will also be an explanation in video format about how each study is carried out, as well as specifying in which cases these studies should be carried out.

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