

Prototype design of a mobile app oriented to adults with obesity

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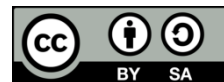
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ABSTRACT

Obesity in adults is a worldwide problem, which is why different countries, through their health-related agencies, implement policies to fight this disease. One of the tools is the use of a mobile application that controls obesity. In this sense, the prototype was designed taking into account different items such as physical activities, body mass index, calorie intake, and food options, among others. The objective of the research is to design a mobile app that allows us to control of obesity in adults. The methodology used is design thinking which allows us to use a systematic approach to reach the objective. An interview was conducted to identify the needs of the user and obtain information regarding their essential needs. In addition, a survey was carried out, the outcome shows satisfaction with a 58% acceptance rate. The beneficiaries of this research are adults who suffer from obesity and healthcare centers. Likewise, research has a positive impact since it focuses on solving problems directly related to health issues.

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1. INTRODUCTION

The prevalence of obesity is growing worldwide and is the cause of many noncommunicable diseases [1]. Overweight and obesity have been associated with several serious medical conditions and health issues. Given that more than 25% of young people around the world have excess weight, obesity health effects in this age group can be material. Health apps (mHealth) that promote and support healthy behaviors have the potential to produce better outcomes [2]; being that young people could access the app, as that age group, 10 to 24 years old, is almost completely dependent on their mobile phones. Likewise, adults are not oblivious to obesity or suffering from said diseases, nor the use of mobile technologies in their daily lives. Additionally, the prevalence of obesity in India is increasing alarmingly rapidly [3]; this was a great opportunity to disseminate information about obesity through the mHealth app. mHealth apps are very useful worldwide to share information about different health-related problems such as diabetes control [4], nutrition education [5], and physical aptitude [6].

In Peru, one of the factors that affect health is obesity, in such a way that its rate has increased among Peruvians, ranking as one of the main public health issues. In addition, the Ministry of Health (Minsa) stated in 2022 that 62% of the Peruvian population over the age of 15 years old were overweight and obese, also this increased during the pandemic. Minsa presented guidelines with the aim of improving the health status of the Peruvian population in order to mitigate obesity.

Research on obesity is very important, as high blood pressure and abnormal cholesterol levels are risk factors for heart disease, and obesity increases the likelihood of these conditions [7]. Moreover, obesity

is a chronic condition that affects the quality of life of patients and their families, so multidisciplinary prevention programs are essential to mitigate this health issue, since they allow the integration of healthy habits at an early age [8]; as current methods to treat obesity often make a strong emphasis on the individual's responsibility, diet, and exercise without regard to the complexity of the condition or the need for a system-wide approach [9]. Worldwide, solutions that apply different technologies such as mobile apps are presented; since, in today's society, mobile technology is widespread, mobile apps can be used for various purposes [10], such as a tool to help make better food choices which are enhanced by weight loss programs [11], a user-centered design and development app, eCoach, that promotes a healthy lifestyle with personalized activity suggestions [12]; thus maintaining adequate nutrition, healthy eating habits and avoiding long-term chronic diseases. In addition, Slazus *et al.* [13] explores the use of health mobile apps for self-monitoring diets and their potential to influence food preferences. On the other hand, Odenigbo *et al.* [14] present a gamified mobile app with augmented reality (AR) to promote physical activity in young adults, therefore helping them improve their well-being. Similarly, in research [15] it combines the advantages of good nutrition with mobile technology designed to produce personalized meal plans based on people's diets, allergies, or calorie intake; thus, producing a reliable source of information for food management. These viable solutions to counteract the obesity problem are of vital importance because they allow the patient to have self-control over their health.

On the other hand, the proposed solution of this research is the design of a mobile app that helps people to lead a healthy lifestyle through tips and recipes to have a healthy diet. Also, tips for physical activities to reduce the risk of having any diseases and stay in shape. In this way, promoting healthy habits and lifestyles in adults. In addition, maintaining a healthy lifestyle is of great importance, since it helps get physical, emotional, and social well-being.

The objective of the research is to design a prototype mobile app oriented for adults with obesity. For this, the design thinking methodology was used, which allows an analysis through its phases from searching information regarding the users' needs to the evaluation. In this way, designing the prototype based on the users' needs contributes to the population affected by obesity.

2. METHOD

In general, this is an iterative process that receives feedback in order to improve the end result. The process should restart after identifying, during the review phase, the areas that need improvement and addressing them [16]. Also, the sequential order of the steps is not always followed as this is not an exact science. Depending on the needs of the project, the team will skip, change, or create steps simultaneously [17]. In the same way, you can follow their example and modify the approach to adapt it to the user's needs. In other words, the design thinking methodology can be applied in various ways.

2.1. Phases of the methodology

Figure 1 shows the five phases of design thinking such as empathize, define, ideate, prototype and test. The first phase, empathize, is based on researching and understanding the problem for which we are trying to find a solution. Listening and empathizing are both essential [18]. In the second phase, define, the problem is stated, and solutions begin to be brought up by establishing an objective [19]. During the third phase, ideate, the objective is to collect various ideas and seek new solutions to problems [20]. Regarding the prototype phase, it is about creating prototypes based on obtained ideas and their development [21]. Finally, in the testing phase, interviews or tests are carried out and discussion groups and team dynamics are used.

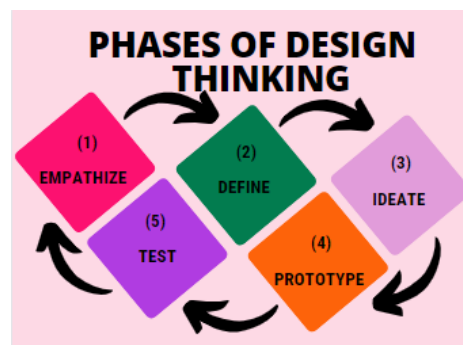


Figure 1. Phases of design thinking

2.2. Development tools

In order to meet the objectives proposed in this research, several tools were used, such as Java, which is one of the most popular programming and development platforms as it reduces costs, accelerates software development, encourages creativity, and improves application services. Also, Balsamiq which helped to visually organize the concepts to produce user interface prototypes that are still in the development phase [22]. Likewise, the Android tool as it is an open-source mobile operating system based on the Linux kernel, which was created for mobile devices with a touch screen, such as smartphones and tablets [23]. The open-source programming language of JetBrains was used as well, this has gained popularity because allows creating apps for Android [24]. Firebase is used as the database, which provides storage in the cloud for free [25].

3. RESULTS AND DISCUSSION

3.1. Empathize

In this phase, the purpose is to satisfy the user's needs. To find a solution, we put ourselves in the place of the people whose problems we intend to solve. The focus is on the people and their problems, so the greatest amount of information about the user's needs must be obtained; only then this strategy can be successfully applied. For this reason, interviews with obese adults are conducted, to fully understand the needs of the user. Table 1 shows the four questions asked of the interviewees.

Table 1. Questionnaire

No	Questions
1	Mention a type of physical activity you frequently do.
2	Do you think there is awareness regarding the consequences of obesity?
3	Would you like to have a nutritional care plan to control obesity?
4	What is your opinion about the use of a mobile app to reduce obesity?

Figure 2 shows that the interview was conducted using ATLAS.ti 22. Regarding physical activity, they answered that it is not done frequently, but they go on walks sometimes. Also, it was mentioned that they have a sedentary life at work. In addition, about raising awareness, they are informed of the consequences of obesity, such as respiratory diseases, and heart attacks, among others. But they know that this can be prevented beforehand to avoid these consequences that can lead to death. Regarding the nutritional diet, they must respect the diet based on the doctor's prescription and must have adequate control of their food intake with the guidance of a doctor. It is highly suggested to drink at least 6 glasses of water. Regarding the use of the mobile app, this must be user-friendly so they can use it without any trouble. In other words, the mobile app must be intuitive and motivating. As a result of a qualitative analysis using ATLAS.ti 22, people with obesity should be more conscious and better look after their health through physical activity and rigid control of the nutritional diet guided by their doctor. The word mobile app is taken as a complement and help since this tool can contribute by placing appropriate content and making it accessible to the user.

3.2. Define

At this point, the problem or challenges that we intend to solve are defined. In this phase, possible solutions to the problem in question are evaluated, considering both the experience and the data collected from the previous phase. Also, the stakeholders can indicate a transformation from the current to the future situation. As shown in Table 2, the current situation was identified, and Table 3 shows a future situation as a potential for improvement.

3.3. Ideate

This phase involves brainstorming to achieve the transformation to the future situation, so we can have a wide variety of options to choose from. Creativity is used as there is a need to find an answer or solution for this situation; in other words, new solutions for old problems are sought. Also, it is essential to take into account the team's points of view whilst developing this concept. In the same way, it is crucial to keep an open mind to new ideas. In many cases, multiple ideas can lead to a useful and original solution; that is why eight activities were proposed, as shown in Table 4. The prioritization was done by applying the 100 points method, where the stakeholders give the highest score to the highest priority based on their criteria. In this way, it was put in order and placed by prioritization, placing the one with the highest score first. The activities that did not add any value were eliminated and the related activities were merged.

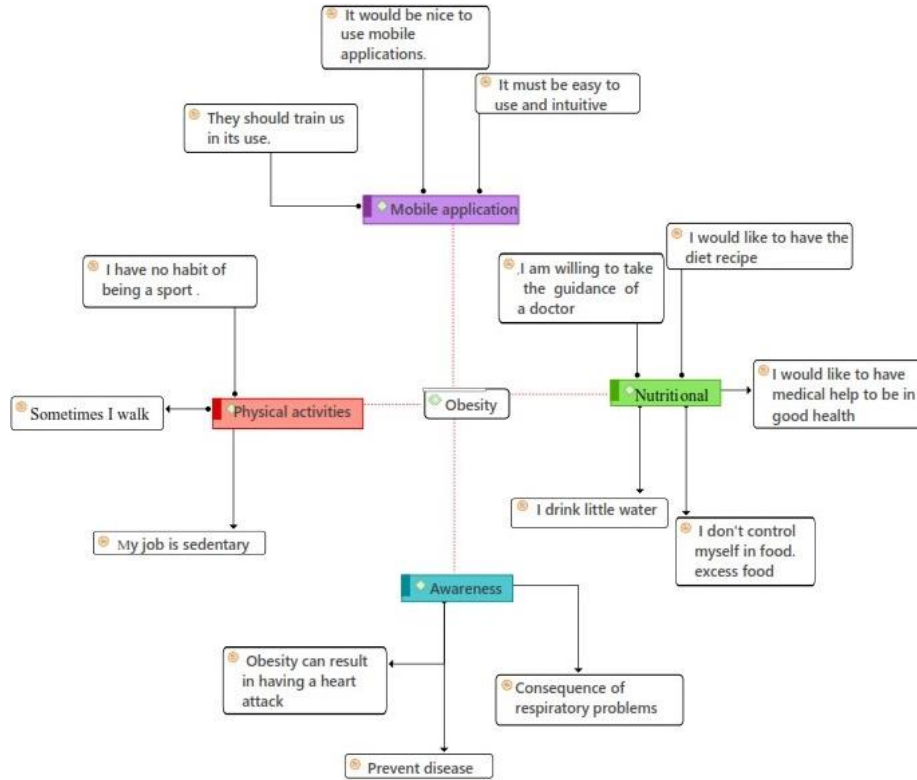


Figure 2. Interview analysis

Table 2. Identifying the current situation

No	Current situation
1	Lack of physical activity through sports.
2	Lack of healthy foods in their daily diet.
3	Lack of awareness regarding the consequences of obesity.
4	Use of a mobile app for people with overweight and obesity.

Table 3. Future situation

No	Future situation
1	The mobile app provides instructions for physical activities.
2	The mobile app provides healthy meal plans.
3	Create awareness regarding overweight and obesity in adults.
4	Build an intuitive mobile app.

Table 4. Prioritization of activities

Prioritization	Activities
1	Implementation of a mobile app to control obesity and promote a healthy lifestyle.
2	Raise awareness among adults regarding the use of mobile phones.
3	Create an intuitive mobile app for adults with obesity.
4	Provide training for adults to use this mobile app.
5	Create a mobile app to follow a healthy lifestyle.
6	Create a mobile app to calculate.
7	Design a mobile app that provides healthy recipes.
8	Design a mobile app that provides workout options.

3.4. Prototype

Prototype is the process of giving shape to ideas. Before giving a final answer or product, there is an intermediate step called a prototype. Trying new concepts, creating something, communicating it, and considering the possibilities. Figure 3 shows the registration and login interface prototypes, it is a requirement that users fill out all required data in order to access the app for adults with obesity. In

Figure 3(a) this mobile app gives you the option to register by using your Gmail account or entering your personal information based on the required fields. It is necessary to enter information such as name, surname, ID number, and cell phone number, to create your own profile. Likewise, Figure 3(b) shows the login interface, where you can access the account by using the login credentials. Finally, once you press enter, you can enjoy the benefits that the mobile app offers. Figure 4 shows the welcome interface of the app for adults with obesity and provides tips for a healthy lifestyle. In Figure 4(a) the app welcomes the user to the world of health and nutrition resources. This section shows healthy recipes for breakfast, lunch, and dinner and even offers healthy snack options which will help improve people's diets. In the same way, Figure 4(b) provides advice for a healthy lifestyle. Likewise, it shows several tools such as the calculator to measure the body mass index (BMI), the calculator for the basal metabolic rate (BMR), also the ability to calculate the calorie deficit, the ideal body weight, proteins, and finally, the body fat calculator. These tools will help adults with obesity to have a better and healthy lifestyle.

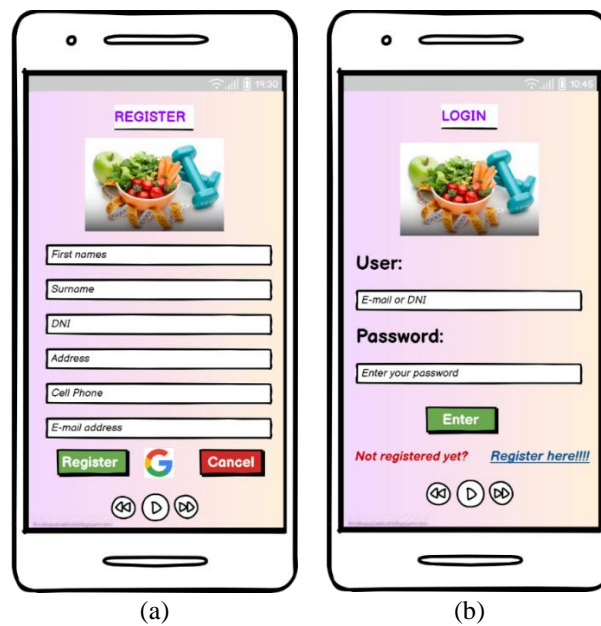


Figure 3. Mobile app for adults with obesity (a) registration and (b) login interface

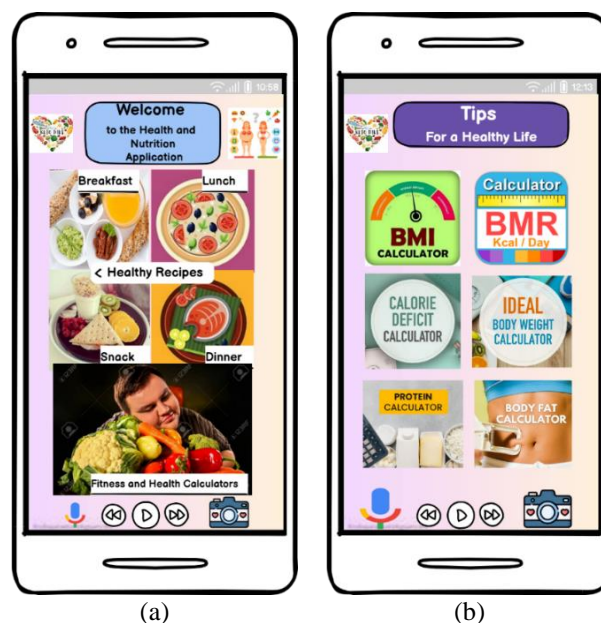


Figure 4. Mobile app para to promote a healthy lifestyle (a) welcome and (b) tips interface

Figure 5 shows the prototype of the app for the calculation of body mass index and calorie (BMI) intake. Figure 5(a) shows a calculator to measure body mass index (BMI), it requires the user to enter data such as age, height in centimeters, and weight in kilograms. Also, it provides the BMI classification, so you can verify the range you belong to. Figure 5(b) shows a calorie intake calculator where you can enter information such as age, weight, and height, adding two features, gender, and physical activity level. Once you press calculate, it will give the calorie intake information.

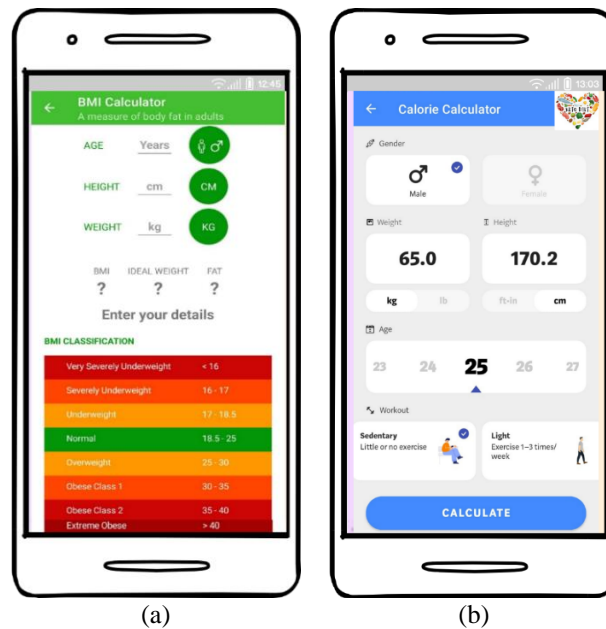


Figure 5. Mobile app to calculate (a) BMI and (b) calorie intake

Figure 6 shows healthy meal options that provide essential nutrients the body needs to maintain proper body function, preserve, or restore overall health, and minimize the risk for disease. In the same way, Figure 6(a) shows various recipe options for breakfast, such as fish tacos, vegan banana bread, also regular banana bread with oatmeal, and Guntur chicken. These are very healthy recipes that should be part of everyone's diet. Additionally, as shown in Figure 6(b), the app offers healthy and tasty lunch options that do not affect a balanced diet, like a vegan egg salad sandwich, vegan chili, and many other healthy and nutritious meals.

Figure 7 shows physical activity plans as they help to maintain a great thinking capacity, learning, and judgment over time. It can also reduce the risk of obesity. Likewise, Figure 7(a) shows a series of workout activities based on gender, age, height, and weight; this will help improve the metabolism and physique of the user as long they are consistent. Likewise, Figure 7(b) shows a variety of workout options based on gender, this interface shows a workout plan for women, such as wall push-ups, squats, and leg raise, including the sets and repetitions requested. This tool promotes a healthy lifestyle, making people's life healthier, as in addition to having healthy eating habits, they have an active life by exercising properly.

3.5. Test

As this is the last phase, we evaluated the effectiveness of the obtained results. Immersive experiences were created in similar environments to those in which the solutions will be used. If they are not the same, then to help people understand the solutions suggested, the prototype design will be improved. A survey for the design team is carried out regarding the prototypes and target audience. This can provide useful information and a new perspective that might lead to restarting the iterative process of design thinking. Either interviews or tests are conducted in order to assess the proposed solution. Also, discussion groups and team dynamics were used for the mobile app oriented to adults with obesity. Lastly, the prototype design was evaluated by expert judgment. There were eight experts who evaluated the design of the mobile app, considering the five criteria shown in Table 5. The criteria average is high, greater than 75%; therefore, it is considered approved by expert judgment.

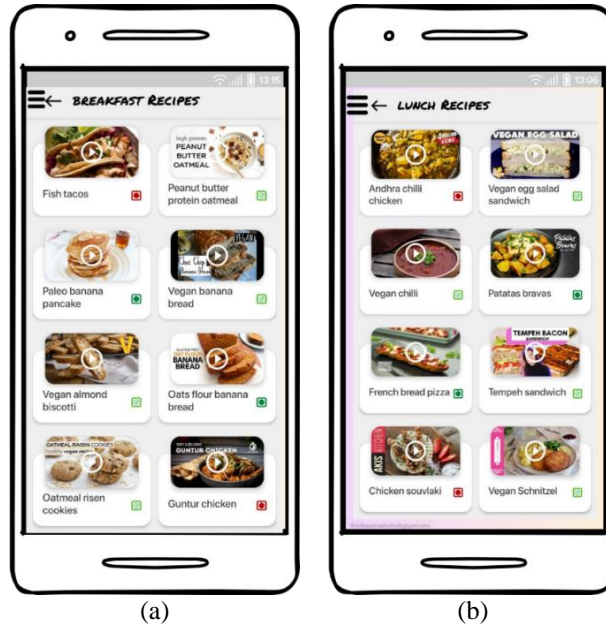


Figure 6. Mobile app to promote a healthy lifestyle (a) breakfast recipes and (b) lunch recipes

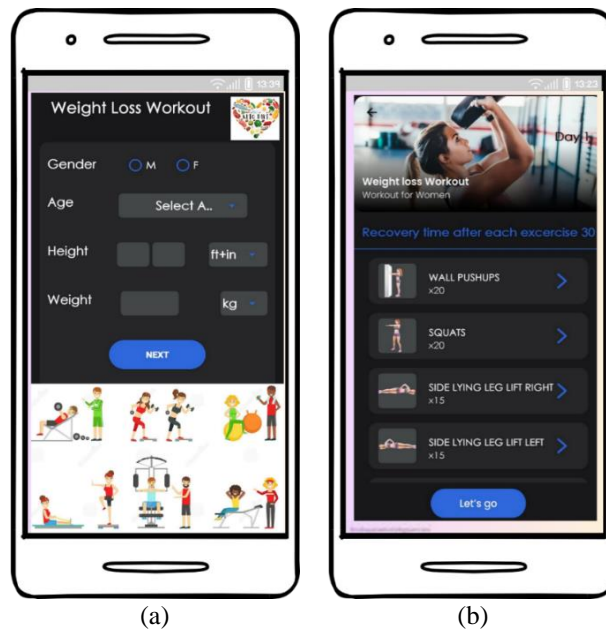


Figure 7. Mobile app to promote physical activities (a) enter personal information and (b) workout plan

Table 5. Expert evaluations

Criteria	E1	E2	E3	E4	E5	E6	E7	E8	Average
Functionality	70	70	90	80	80	90	70	80	78.75%
Integration	80	80	80	90	80	90	90	90	85%
Security	90	90	80	90	80	80	90	90	86.25%
Reliable	80	90	70	70	90	70	80	70	77.5%
Accessible	90	90	80	90	80	80	80	90	85%

Table 6 shows four questions that were asked to one hundred users. This shows that there is satisfaction regarding the design of the mobile app with 58%. The low satisfaction rate is minimal, the regular and high acceptance rates are acceptable.

Table 6. Satisfaction survey

Questions	Low %	Regular %	High %	Total %
1. Are you satisfied with the mobile app design?	12	30	58	100
2. Is the mobile app intuitive?	20	35	45	100
3. Is the information regarding obesity accurate?	10	40	50	100
4. Would you recommend this mobile app?	15	45	40	100

4. CONCLUSION

According to the expert evaluation, the mobile app was optimally designed based on all the criteria. Regarding the survey carried out, it is concluded that the user is satisfied with the implementation of the mobile app; from the interview, we got information such as how relevant is the use of the mobile app. Regarding the methodology used, it allowed an organization in its development in a systematic way. The limitation of the research was the lack of time to carry out the interviews as adults have a busy schedule due to work. It is suggested for future research include the participation of healthcare professionals. Also, the research must be multidisciplinary and interdisciplinary. Likewise, it is suggested to implement the design as a pilot test to get feedback. The use of other emerging technologies will allow and contribute to solving health issues such as obesity.





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