ISSN 2278-3091
Volume 9, No.5, September - October 2020
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse150952020.pdf
https://doi.org/10.30534/ijatcse/2020/150952020

Wearables Design for Heart and Respiratory Disease Prevention with Internet of Things

Enrique Lee Huamaní[1],Alexi Delgado[2] ,Luis Jara-monge[3], Melvyn Rodriguez-Tolentino[4]
[1]Image Processing Research Laboratory, Universidad de Ciencias y Humanidades, Lima-Perú, ehuamaniu@uch.edu.pe
[2]Mining Engineering Section, Pontificia Universidad Católica del Perú, Lima-Perú, kdelgadov@pucp.edu
[3]Systems Engineering Program, Universidad de Ciencias y Humanidades, Lima-Perú, luijararm@uch.pe
[4]Systems Engineering Program, Universidad de Ciencias y Humanidades, Lima-Perú, melrodriguezt@uch.pe
[4]Systems Engineering Program, Universidad de Ciencias y Humanidades, Lima-Perú, danjustol@uch.pe

ABSTRACT

Health has become a concern for the appearance of new diseases and their evolution. Thousands of people are dying worldwide from various causes. Today there are various ways to avoid them, however, this requires recourse to hospitals, but constant attention is not always present. The traditional Scrum methodology was chosen to carry out the research, as it meets almost all the requirements for successful completion of the work. In the face of this, the results could be beneficial to users. That's why it became important the early detection of symptoms such as heart and respiratory deficiency that can occur in children, adults and elderly, to know how to combat them, will use the use of wearables, the internet of things, and Android Studio.

Key words: Internet of things; Wearable; Disease prevention; Technology; Respiratory heart.

1. INTRODUCTION

Health today is a privilege that we do not all enjoy, so it is important to take care of it and technology is responsible for facilitating human needs, however, having to go to the health center becomes tedious because there is no good administration and to have the results and diagnoses are not always delivered the same day and is not optimal because it could make the patient worse. [1]. In different countries, technological devices such as wearables are used to monitor the patient in real time. However, they work independently, that is, they only have one function and there is no communication between them, which would facilitate the use of information and rapid diagnostic care. It can be used for different functionalities, and could even replace hospital appointments, taking into account that in the next decades the model will be transformed from the present hospital-medical model that we commonly know to a health model totally centered in the home [1]. On the other hand, it is important that the person performs routine health checks for the early detection of diseases [2]**.**Agile research has been used to achieve faster results in software development without diminishing its quality [3]. The methodologies that could be most similar for its development are Scrum and Extreme Programming (XP), although XP is the most complete methodology, the research covers the design before the codification. Two important features of Scrum is that the research is based on 30 day interactions and also meetings throughout the project, so that we have constant feedback and can solve any problems. This is why this methodology was used to have an agile development and to work in increments the development of the research work [3].

The application is geared towards children and senior citizens. It will allow to capture information from devices such as wearables. Real-time biometric sensors and chips with IOT internet of things [3]. In simultaneous with Android study that will serve us to manage this information with its own database through its mobile application, the user will be able to access their information, in addition to customize it and access to weekly, monthly and annual reports.

The objective of this research project is to design a system for the prevention of heart and respiratory diseases with the use of IOT and Android wearables study.

In the present investigation in section I we see a presentation introducing the research, section II we describe the methodology that was carried out in this project, followed by section III where we define the case study presenting the application and prototype. Finally, in section IV are the results and discussions of the project.

2. METHODOLOGY

One of the methodologies that is most similar and that can contribute explicitly under a reduced time frame to the presentation of the research, is Scrum. One of the reasons is that it is one of the best valued and most used methodologies, with good quality software responses in a short time, and another reason is that Scrum works cyclically in the interaction between the client and the developer, that is: the prototype being developed, the user or client can already be using it, so new requirements will be added to the research or removed if necessary and among its advantages we have: customer satisfaction, delivery of quality products, quick solution to problems, transparency in the development process [8]. Given the basic explanation of Scrum, below we will detail its sequence applied to the research of wearables.

2.1 Requirements

Usually for all the prototypes or big software are made requirements of a client, that way the program will be able to execute without complications what is needed, in this case, the basic requirements of this device will be the determination or control of cardiac signs and breathing. Among other requirements that significantly contribute to the user carrier. The following technological devices shown in table 1 will be required for the execution.

Table 1: Attributes of Cleveland dataset

Name	Use
Laptop / Personal Computer	Programming of the physical device / mobile application.
*SQL Server Management.	Storage of registered user information
Mini Microphone signal detector.	He'll get the cardiac and respiratory signals.
Sensors	They will issue alerts in case of risk.

2.2 Planning

As the to-do list of the sprint, or the tasks to be performed will require the use of the different programming languages: python, the algorithmic coding for the execution of processes will be digitized in the Visual Code source code editor, as it is convenient to work with. One of the most specific programming languages for smartphones in Android Studio is Kotlin, because there the designs of the registry format, reports, etc. will be made. Since it will be necessary to implement an application in a mobile device, these will make an interaction and data exchange, which will show the information that the user requests. Finally, the use of the intelligent self-learning platform offered by Machine Learning, together with Python, will establish some additional coding for the optimal development of the signal receiving device.

2.3 Implementation

After having the tasks that were decided upon, the planning will continue within approximately two weeks. A flow chart with Figure 1 will be shown below. Using the application.

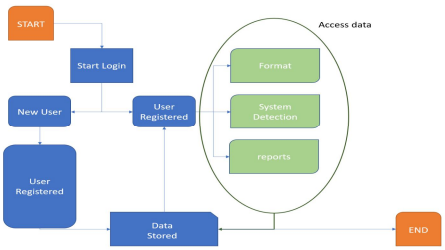

Figure 1: Flowchart. Use of the application from the beginning to the end of the use

When the new or existing user enters the mobile application, he will find the option to Register or if he is already registered he will be able to directly access the options made in the different programming languages mentioned above, otherwise he will have to register as a new user, then his data will be stored in the Database, once his data is secured, the user will have access to data as can be seen in the oval.

The formats previously programmed by Kotlin, will show the information that was being stored since the beginning of the application, in case you want to modify some information you will do it from there. The detection system, is the additional information that will have in active response of emergency in case a user (patient) has more serious cardiac or respiratory problems, in summary, will emit a direct signal with the physical device to alarm the relatives. And the reports, are the samples: of days, weeks, years, achievements, etc. It also informs about the patient's health, unlike formats, is that it can not be modified at all.

After appreciating the flowchart of the application use, the general flowchart between the mobile application and the physical device receiving the signals will be shown. General Flowchart shown in Figure 2.

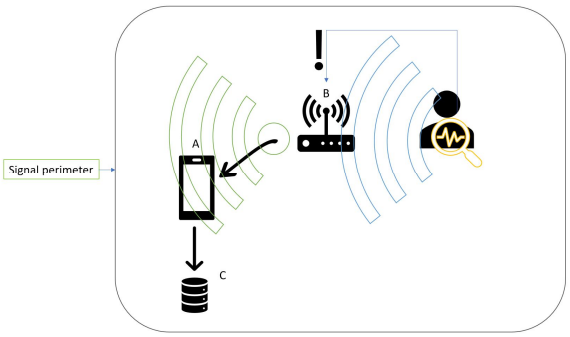

Figure 2: Receiving cardiac or respiratory signs through the device and sending data to the cell phone.

The cardiac or respiratory sounds emitted by the user (patient) will be received by the device, internally the configuration of the codes, will make an analysis on each patient. In the same way, the emitted signals will be sent to the smartphone, it will store them in the database, then it will give warning about

possible health anomalies. The same device has a built-in alarm in case of a critical situation that may arise in the event that a person has shortness of breath or a serious heart problem. The sequence occurs within a perimeter, a practical example: as a wifi signal. In the case that it is outside the perimeter, it will only send a pop-up alarm to a family phone.

2.4 Retrospective

In this phase we will see the details that could suffer the devices in the accomplishment of the first tasks, errors will be corrected, and also new requirements will be added that are requested.

3. APPLICATION

3.1 Product Backlog

We start with the list of requirements or functionality requirements that the client gives us so that it is their final product.

- The system will allow the user to register in order to enter the system.
- The system will validate the data to be able to enter the application.
- The system will allow to register routines.
- The system will allow the user to register the type of alert and manage the time.
- The system will be able to generate a report to have a control of the registered users.
- The system will allow to generate a report to have a control of the alerts generated by user.
- The system will allow you to generate a report to have a control of diagnosis.

3.2 Application Architecture

In the architecture of our mobile application you can see the cycle from start to end of detection through the use of wearables as shown in Figure 3.

Figure 3: Distribution diagram

3.3 Prototype Design

The design of the mobile application was developed with the Android Studio application, which will be in charge of receiving the synchronized information from the wearables, sensors and chips that will be sent to the mobile device so that the user can visualize the results by using the application.

3.4 Sprint Backlog

The design of the mobile application was developed with the Android Studio application, which will be in charge of receiving the synchronized information from the wearables, sensors and chips that will be sent to the mobile device so that the user can visualize the results by using the application.

A. Increment 1: User Registration

This increment will present the records of users that can be a doctor or a user, Figure 4 and in Figure 5 the login.

B. Increment 2: Report Management

In this increment we will have the verification of the data and allows the user to generate reports, diagnostics, statistical tables, Figure 6.

C. Sprint Planning Meeting

In this phase we will see the planning of the sprints and how long each one lasts as shown in Table 2.

Table 2: System Sprints

Name	Duration	Start	Finished
Disease Detection System	49 days	14/04/2020	2/06/2020
User Registration	1 week	15/04/2020	22/24/2020
User Module	2 weeks	23/04/2020	07/05/2020
Report Management	1 week	08/05/2020	15/05/2020
Reporting Module	2 weeks	16/05/2020	30/05/2020

3.5 Prototype application

Next, the prototypes in Android will be shown for the visualization of system interfaces.

3.6 Retrospective

This phase is important to guarantee the correct operation and correct errors and inconveniences that can arise after the implementation, there is not a perfect system but we can go perfecting it guaranteeing the security for the users [5].

In this diagram shown in Figure 7 you can see the cycle of the retrospective and feedback of the scrum methodology in a system, fundamental part for the growth of the software and continuous improvement of it evolves.

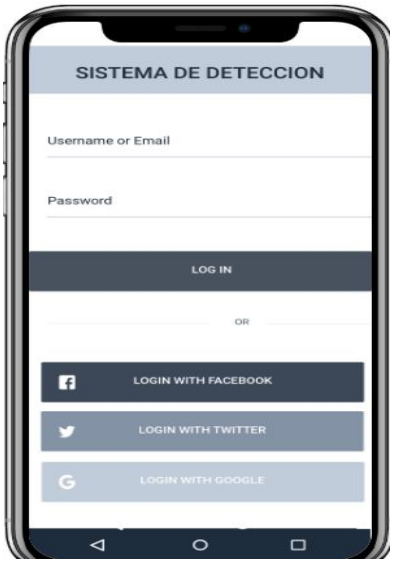

Figure 4: Sing up

Figure 5: Login

Figure 6: Report

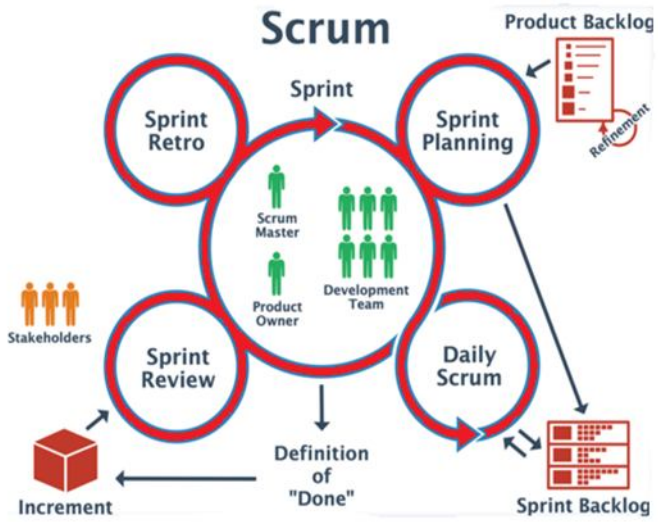

Figure 7: Hindsight and feedback diagram

4. RESULT AND DISCUSSION

4.1 In the Application

The prototype design of the Android information management system with wearables through IOT was completed for the constant monitoring of users.

A. Comparison

In comparison with a web based platform for clients and designers for prototype websites or Android [6], what we can see is that we have developed the pappers with the software Balsamiq Mockups for the prototypes our work, another comparison is that this papper has created a process to create prototype and have client to server communication and obtain client feedback, in comparison with our work we have also developed an architecture for client and server communication with the Android language and Mqtt protocol.

In comparison to the SWS Smart wearable systems, they are mainly used in health care and wellness monitoring. These systems offer support for groups such as the elderly, especially those living alone, patients who need to monitor the recovery process after surgery [12]. However, these systems work individually and the process of handling information becomes tedious, so an intermediary and manager, as a mobile application, is important for information management.

Portable sensors can be useful in healthcare solutions, improving the continuous monitoring and management of patients. This document focuses on the solution available for motion analysis, providing a description of the characteristics of human movement that can be measured using portable sensors [13].

Comparisons could also be made with a surface electromyography device, capable of recording the signal emitted by the muscles in order to detect certain muscular pathologies or injuries and nerve dysfunctions [8].

B. In the methodology

The methodology is confirmed as a fundamental part of the structure of an investigation, without it disorder would be unleashed. This type of methodology fits perfectly in environments with complex projects, i.e. projects that have to be ready in a short time and whose requirements are changing [11].

One of the advantages of the Scrum methodology is that the development team meets every day for approximately 15 minutes to complete some elements of the sprint backlog to be a review of the project to be presented [9].

One of the disadvantages would be that if you focus on large projects with several members the results would not be as good.

The difference is that the scrum methodology is for more agile projects but if we use the UML methodology it is for more extensive projects and also they are too heavy like the implementation of the Android system with wearables and IOT of the monitoring based on mobile devices in Semi Tani Shop [10].

5. CONCLUSIONS

The design of an Android System oriented to health care is very important nowadays and the correct control of information is fundamental for the management of personalized information for each client.

The Scrum Methodology helped us in a more agile way since it has 3 phases, and that it is executed in temporary cycles, since the Sprints have a duration between 2 to 4 weeks as a deadline of delivery of the project with the Sprints made and increases reflected in the project.

This article can be included for future research including technologies such as machine learning, Deep learning and artificial intelligence for the inclusion of a personalized virtual assistant for greater acceptance by users, including constant feedback with the use of machine learning and Deep learning to use tools such as facial recognition and voice recognition to make information management more secure and improve control of the application.

REFERENCES

1. P. Sanmartín Mendoza, K. Ávila Hernández, C. Vilora Núñez, and D. Jabba Molinares, “Internet de las cosas y la salud centrada en el hogar Internet of Things and Home-Centered Health,” Salud Uninorte, vol. 32, no. 2, pp. 337–351, 2016.
2. C. F. Restrepo Rusi, C. A. Rodriguez de Castro, and J. J. Rodríguez Gómez, “Sistemas móviles e inteligentes para el control de la salud utilizando aplicaciones M2M e IoT,” Univ. los Andes, p. 25, 2016.
3. A. Duarte Orjuela and M. Rojas C., “Las Metodologías de Desarrollo Ágil como una Oportunidad para la Ingeniería del Software Educativo The Methodologies of Agile Development like an Opportunity for the Engineering of Educative Software,” Rev. Av. en Sist. e Informática, vol. 55, no. 22, pp. 159–171, 2008.
4. F. R. Garrido, V. Torres, B. Vicente, and P. Ferragud, “Herramienta de usuario final para la composición de servicios en el IoT.”
5. A. J. Nathan and A. Scobell, “How China sees America,” Foreign Aff., vol. 91, no. 5, p. 287, 2012, doi: 10.1017/CBO9781107415324.004.
6. T. Soutome, D. K. Ling, M. Niibori, and M. Kamada, “A web-based platform for clients and designers to prototype web sites,” Proc. - 16th Int. Conf. Network-Based Inf. Syst. NBiS 2013, pp. 459–463, 2013, doi: 10.1109/NBiS.2013.76.
7. T. F. I. N. D. E. Grado, “Desarrollo de aplicación para pymes en tecnología ios,” 2016.
8. T. O. Mera, D. A. Heldman, A. J. Espay, M. Payne, and J. P. Giuffrida, “Feasibility of home-based automated Parkinson’s disease motor assessment,” J. Neurosci. Methods, vol. 203, no. 1, pp. 152–156, 2012, doi: https://doi.org/10.1016/j.jneumeth.2011.09.019.
9. R. J. MacAsaet, “Just in Time Demos in the Scrum Framework,” Proc. - 2018 3rd Int. Conf. Syst. Reliab. Safety, ICSRS 2018, pp. 21–24, 2019, doi: 10.1109/ICSRS.2018.8688864.
10. P. Pinto, "Uma abordagem para a condução de retrospectivas Scrum baseada nos conceitos de melhoria contínua e Lean Software Development", Repositorio.ufpe.br, 2020. [Online]. Available: https://repositorio.ufpe.br/handle/123456789/1675. [Accessed: 15- Jul- 2020].

11. H. Setyo and U. The, “Implementation of Mobile based monitiring sales system na,” pp. 1–5, 2017.
12. S. Corti, Impacto de dispositivos "wearables" en el monitoreo de la salud. Universidad de San Andrés. Escuela de Administración y Negocios; Argentina.: Universidad de San Andrés. Escuela de Administración y Negocios, 2016, p. 19.
13. T. O. Mera, D. A. Heldman, A. J. Espay, M. Payne, and J. P. Giuffrida, “Feasibility of home-based automated Parkinson’s disease motor assessment,” J. Neurosci. Methods, vol. 203, no. 1, pp. 152–156, 2012, doi: https://doi.org/10.1016/j.jneumeth.2011.09.019.