

Design of a Web System for the Control of Anemia Patients under the Agile Scrum Methodology, Lima - Peru

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ABSTRACT

The present article shows the design of a web system for the administration of patients with anemia using adobe XD through the SCRUM methodology in the Growth Control and Development service of the health facility El Progreso in Lima - Peru, where the records of patients and micronutrients are done manually causing the loss of data or unnecessary duplication of it. The design method used was the Trello tool in conjunction with Adobe XD and the SCRUM agile methodology. As a case study, the present one was carried out through 4 fundamental stages according to the agile method: the stories of the users were planned, the design was developed, the sprints were reviewed and finally the sprint was retrospective. According to the results, the system entry module, the patient and micronutrient registration module, and a treatment progress report module were designed. These results could help health authorities make better decisions to combat anemia through optimal data organization.

Key words : Adobe XD, Anemia, Design, Scrum, Web System.

1. INTRODUCTION

Health and nutrition are key elements in the development of individuals; therefore, medical facilities have a micronutrient treatment that is essential especially for pregnant women and children. Therefore, anemia, which is the most common blood disorder affecting about a quarter of the world's population, is a major concern worldwide [1]. According to the World Health Organization (WHO), the prevalence of anemia in children under 5 has decreased from 51.4% in 1990 to 41.7% in 2016 [2]. However, 43.6% of children between the ages of six and 36 months in Peru are affected by anemia, with the most common age group being between six and 18 months [3]. Among its many consequences, anemia can affect the health of women during pregnancy [4]. Although iron supplements are not the only solution to childhood anemia [5]. Consequently, the patient does not comply with the correct dosage, so the professional in charge has to maintain control; however, there is another reality: there is not a correct record of the patient's data nor is there enough computer technology to be able to deal with this deficiency that affects many children in the Peruvian context [6].

The scrum methodology is used for this work since this structure is well suited to the small scale of development projects, where the team is small in size and location and has easy access to the client [7]. Currently, there is a wide variety of methodologies that can be adapted to the case study, so respondents identified the methodologies used in their software development projects from a list of methods commonly associated with development, ranging from generic frameworks (e.g. Scrum, Prince) to more specialized frameworks [8]. Processes/techniques (e.g., feature-based development, extreme programming). Notably, the cascade methodology development life cycle was the most widely used methodology cited by 32.0% of respondents. Other popular methodologies were the Unified Agile Process (UAP) and Test Driven Development (TDD), which were used in 28.1%, 20.3% and 19.6% of developing countries. Respectively, neither methodology was dominant nor the cascade methodology continues to play an active role in the industry [8].

The research will be carried out at El Progreso Maternal and Child Centre located in the district of Carabayllo, Lima - Peru. It is currently in the service called the Control of Growth and Development (CRED in its Spanish acronym), which is a periodic and systematic activity of attention to children from birth, in order to detect changes and risks in the evolution of their growth and state of health, among others. Monitoring the administration of medication for anemia [9], lacks a computerized tool to properly manage the information of patients admitted to this service on a daily basis. Therefore, the record is made manually and then entered into an Excel table, causing the loss or duplication of data, moreover, there is no adequate follow-up for controls, and so micronutrients are provided to children and pregnant women.

The objective of the present work is to design a computer system to carry out adequate registrations of patients in a short time, as well as to control the doses of the products in the users, through the programmed appointments and to notify the patient in a systematic way, showing at the same time reports where they show the general status of the evolution of the treatment.

The structure is as follows: section 2 will describe in more detail the methodology used for the design of the system. Section 3 will show the results obtained. Moreover, section 4 will discuss the results obtained and finally, section 5 will present the conclusions.

2. METHODOLOGY

SCRUM methodology will be used, which was developed by Jeff Sutherland in 1993 and whose objective is to become a development and management organization that follows the principles of agile methodology [10]. It offers a customized way of working in different projects, which have a variety of conditions, and advantages such as flexible selection of requirements for sprints and the absence of specific procedures to follow [11], that reduces time and makes the project adaptable to requirements [12].

As an agile method:

- The development is more adjusted.
- It is more aimed at humans rather than processes.
- Its way of building is incremental based on deliverables and revisions [13].

Stages of the SCRUM methodology are as follows:

2.1 Stage I: Sprint Planning

It is developed at patient data level for this we will divide into four sub stages (4 sprints).

2.2 Stage II: Development

The second event, the daily scrum, is intended to encourage a brief and intense exchange of more critical information about the development project [14]. In stage II the development team will have to synchronize activities and create a plan for the inspection of the daily scrum, for this we will make use of the following tools:

A. Trello

This is an information system that controls the state of construction, its purpose for the present research is to create a product or the realization of a project offering functionalities to keep informed all the members of the project team specifying the tasks of each individual [15].

B. Adobe Xd Mockup

This is a recent edition of the growing list of creative clouds and services. Adobe XD helps user experience designers to quickly create and iterate mobile application and website design [16]. Adobe Mockups is an AIR application designed to help us create our wireframes quickly and easily. This is accomplished through a drag-and-drop system of predefined components that define how the project process will be performed. This program will help us recreate models of the interfaces of the system, as it will facilitate visual design decisions, so that we can clearly see how the final product will appear.

C. Sublime Text

It is a versatile text editor that is used to update pages in Moodle, as well as XML configuration files within Moodle. It is developed in Python and C++ published in 2008 [17]. It is the lightest of all programming code editors, and one of its main features is that it is multiplatform. It also helps a lot within the design, color, the elegance of painting the syntax and the ease of use to enter code without getting distracted.

D. PHP

It is a language to enter programming code of a high level, the execution is done next to the server. This language is widely used for the dynamic development of web portals [18], its main advantage is that it can be executed on different web servers.

E. MySQL

This tool is a relational database manager, MySQL is registered as the most used data storage for web applications due to its data reading speed. The popularity of MySQL also relies on its low implementation cost and is usually free and an open source project [19]. Its biggest advantage is that it can run on any hosting server for free where you can do all the maintenance of both creating, modifying and deleting the stored information.

F. JavaScript

It is a rapidly evolving language as it is the only purpose-oriented language in the set of standards that define the content technology of the World Wide Web, any change in the language has a very broad impact potential [20].

G. MVC Architecture (Controller View Model)

As an MVC (Model View Controller) design architecture, user processing and output are sorted by data input. The view layer represents the user interface, and for the first event involves the planning of the sprint. The agile research literature has already investigated the applicability of sprint planning, both for the development of new services and for the development of new products in separation [14]. In this stage user stories will be written and grouped to define the functionality in the planned increment WEB applications that can be HTML, JSP, XML and Applet [21]. MVC-based view processing is limited to data acquisition and processing and user requests rather than the view business process. The function of the model layer is to process the business and make business rules [21].

It accepts the requested data from the view layer and returns the final results that are being processed. This layer is the core of the MVC design method that does not provide the model, which organizes and manages these models to facilitate reconstruction and improve models reuse [21].

2.3 Stage III: Sprint Review

At this stage the lessons learned are already applied in the course of the project. On the other hand, in traditional development literature, examination and reflection on the underlying process takes place after the completion of the project [22].

2.4 Stage IV: Sprint Retrospective

At the last stage the work team will have the opportunity to reflect on the problems that occurred during the development process, as well as to create an improvement plan for future sprints [23]. In Figure 1, all the phases of the SCRUM methodology are shown, along with the tools proposed to be used to achieve the deliveries of the Sprint adapted to the

design and in the future to the development of the system.

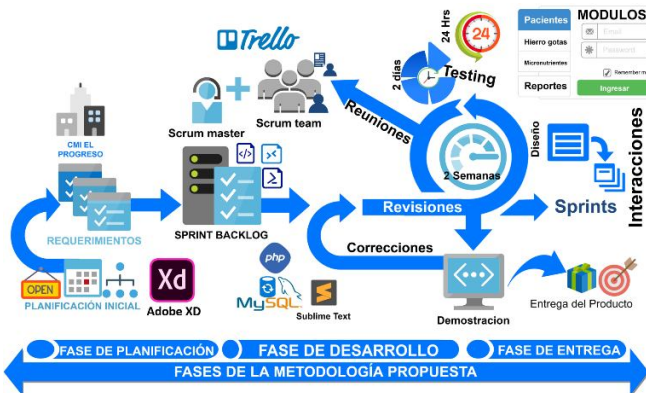


Figure 1: Phases of the proposed methodology with the tools to carry out the design

3. APPLICATION

3.1 Stage I: Sprint Planning

In this stage the user stories will be described and grouped to define the functionality in the planned increment, the sprints are detailed in Table 1.

Table 1: Sprints according to User Stories

Sprints	Guidelines
Sprint 1: Log in	In order to access to the system, the medical personnel will have permissions by means of a user name and password.
Sprint 2: Patient Registration	Register patients by their medical history, and search by DNI (national identity card in Peru), data such as first and last names and sex from the RENIEC (National Registry of Identification and Marital Status) database as well as register the exact address to track the user, such as telephone number and email preference.
Sprint 3: Registration and control of iron in droplets, iron in syrups and micronutrients	This module registers the treatment by number of vials, prescriber, place of care, weight of the patient, height and search for the patient through the ID card number. In order to register the product and see its availability, it is necessary to link to the pharmacy system in order to give the treatment according to the real stock available in the Health Establishment.
Sprint 4: Queries and reports	According to the needs, it is required to follow up the patient according to the type of product, delivery report by dates and quantity of product, by prescriptions and doses per day, total prescriptions attended per day and report by patients pending of appointment to coordinate home visit and make a communication by email or phone call

3.2 Stage II: Development

Trello and Adobe XD were used to develop the system design.

A. Trello

For a planned communication this tool was used as shown in Figure 2. All stages of the design are planned, this shows an overview of the whole project as recommended by the agile method.

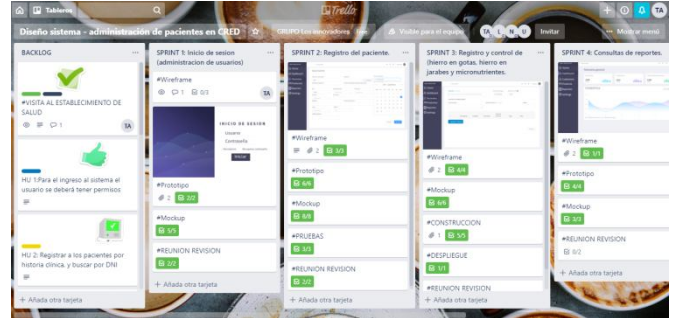


Figure 2: Trello tool board with sprint and assigned to each team member

B. Prototype Design

The development part of the module design was adobe XD as it has the important function of integrating the feedback, in addition to sending the finished product to the development partners with a single click. Likewise, it automatically creates programming code such as styles, classes and subclasses. The frames of the system design are shown in Figure 3 to Figure 7.

In the work area of the Adobe XD platform, some frames that were designed to define the most important thing for this project are shown in Figure 3.

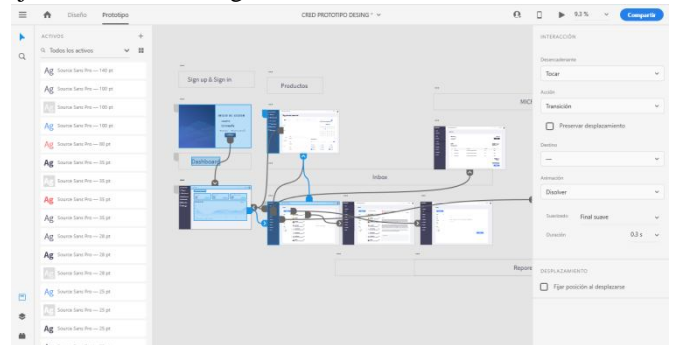


Figure 3: Wireframes of the prototype in Adobe XD

Medical personnel must log in through an authentication to log in to the information system as it is seen in Figure 4.

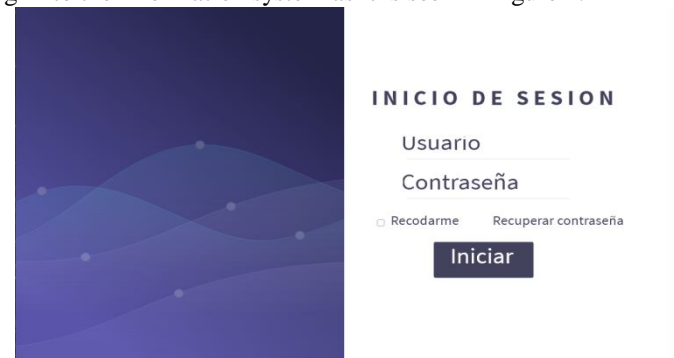


Figure 4: Home screen of the prototype made in Adobe XD

In this module, general reports are designed such as: Total products dispensed to patients, total patients, patient appointment status, product availability, and total anemia patients, for a better appreciation see Figure 5.

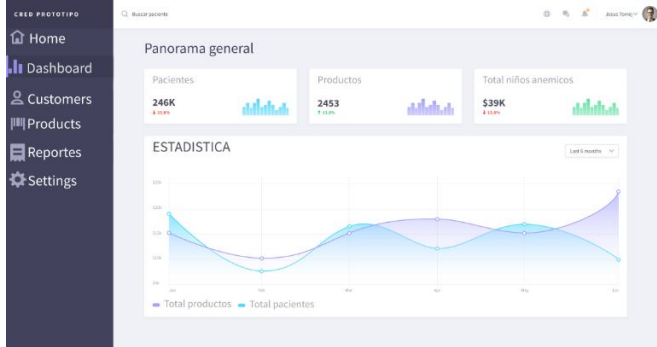


Figure 5: Prototype screen system reports developed in Adobe XD

In this module, it is designed the patient record, adding an option to capture data from the RENIEC, to make the record faster as visualized in Figure 6.

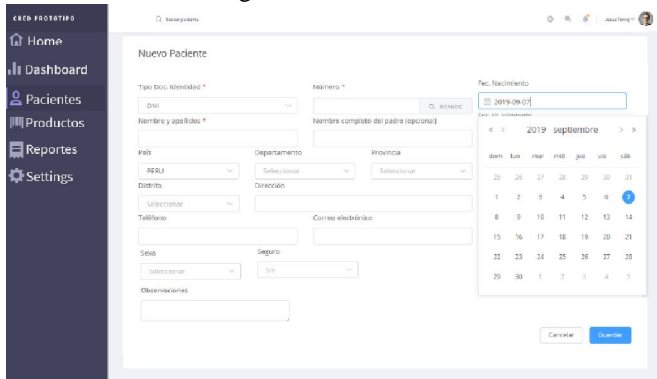


Figure 6: Patient record screen, prototype in Adobe XD

In this module, the record of the doses given to the patient was designed, as well as home visits and the option of adding micronutrients such as iron, according to the available presentations, among other micronutrients, as it appears in Figure 7.

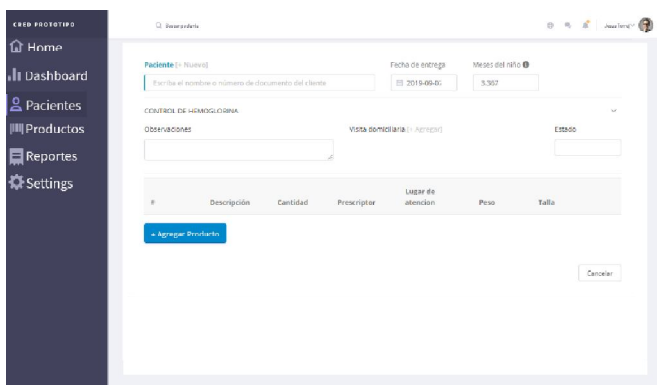


Figure 7: Record and control screen elaborated in Adobe XD

3.3 Stage III: Sprint Review

This third stage consists of the revision of the Sprint, for this reason the following elements were considered:

- The development team and key stakeholders would invite CRED service licensees to participate as users of the system.
- The system user will verify the capacity of use consequently.
- The team analyzes the efficiency of the Sprint process, what inconveniences arose and how they were resolved, and logs them in the occurrence book for future rapid solutions.
- The entire group collaborates to offer equitable contributions for future meetings.

3.4 Stage IV: Sprint Retrospective

In the last stage, the team gathered to reflect on the drawbacks that occurred during the development process and to develop a mechanism for improvements for future sprints. The aim of the Sprint retrospective is:

- Verify the story of the last Sprint, in which people were incorporated, as well as the tools and processes that were used.
- Rank which of the most critical issues were successful along with all the improvements.
- Develop a plan with the improvements obtained by the development team.

4. RESULTS AND DISCUSSIONS

The Login module, patient registration and micronutrients module was designed, as well as a module for treatment evolution reports, to administer micronutrients in patients in the Control of Growth and Development area, in El Progreso health center in the district of Carabayllo.

4.1 About the Case Study

- The results of this project contribute to the medical, economic and social aspects in the given population.
- In addition, the workers of the CRED area save time by recording the facts as well as contribute to having a correct record of the patients with anemia, in this way, the compliance with the doses is followed up, in order to have safe and healthy children, knowing the exact date of their next appointment to continue the treatment.
- Compared to a previous case study regarding the design of an administration system for children under 5 years of age in the Ilave health facility in Puno – Peru [24], it was determined that the difference is that the Extreme Agile Programming (XP) methodology was used instead of the SCRUM methodology. And although this study developed the implementation of the project, both turn out to be a beneficial advance that contributes to the development of data recording in the medical field.

4.2 About the Methodology

For this project the SCRUM methodology was used, the advantages and disadvantages are presented below according to [25]–[27].

A. Advantages:

- Total control and monitoring of all stages of the project.
- Easy to plan with the team.
- Optimizes the use of resources.
- Better control of lessons learned, in addition to the documentation of the occurrence book.
- Constant communications with the client and the team.
- Guarantees the delivery period according to the schedule in conjunction with the required quality according to the specifications.
- Includes the notions of continual improvements and feasible minimum products in order to achieve immediate feedback from users, rather than holding back until a project is completed.

B. Disadvantages:

- It cannot be used for large-scale projects.
- Sprints may be affected by a team member to meet the delivery date if there is not a proper follow-up.
- If a person resigns from the team, the project may be affected, resulting in a delay for final delivery.
- Many meetings sometimes cause discomfort for some members of the project.

5. CONCLUSIONS

The design of the patient management system made it possible to implement the modules and fields of the system, with the aim of establishing the most user-friendly mechanism when registering a patient and treating anemia.

Regarding the methodology, it was demonstrated that the Scrum methodology can be applied to the case study since the Sprints were correctly executed and it is also one of the most used agile methodologies in this sort of projects.

Given that the design was defined as a future work, it can be used to implement the system and once developed, it would serve as a solution to be implemented in all areas of Growth Control and Development of health facilities throughout Peru.

REFERENCES

- [1] M. F. Shaik and M. M. Subashini, **Anemia diagnosis by fuzzy logic using Labview**, *Proc. 2017 Int. Conf. Intell. Comput. Control. I2C2 2017*, vol. 2018-Janua, pp. 1–5, 2018.
- [2] W. H. Organization., **Anaemia in children 5 years Estimates by WHO region, Estimates by country**, 2017.
- [3] W. y U. FAO, OPS, **Plan Nacional para la reducción y control de la anemia Materno Infantil y la Desnutrición Crónica Infantil en el Perú: 2017-2021**, 2018, p. 132, 2018.
- [4] C. Sotomayor-Beltran, G. W. Z. Segura, and D. Tarazona, **Anemia during pregnancy in Peru in 2017: A geographic information system study**, *Proc. 2018 IEEE 38th Cent. Am. Panama Conv. CONCAPAN 2018*, pp. 1–5, 2018.
- [5] C. Sotomayor-Beltran and G. Z. Segura, **A spatial assessment of anemia among Peruvian children aged 6 months to 5 years between 2016 and 2017**, *Congr. Argentino Ciencias la Inform. y Desarrollo. Investig. CACIDI 2018*, pp. 1–5, 2018.
- [6] A. Delgado and P. Nicolly Perez Ccance, **Where is the Highest Rate of Children with Anemia in Peru? An Answer using Grey Systems**, 2020.
- [7] A. Delgado, I. Romero, **Applying the Grey Systems Theory to Assess Social Impact from an Energy Project**, *Proceedings of the 2018 IEEE 25th International Conference on Electronics, Electrical Engineering and Computing, INTERCON 2018*, 8526372, 2015.
- [8] L. R. Vijayarathy and C. W. Butler, **Choice of Software Development Methodologies: Do Organizational, Project, and Team Characteristics Matter?**, *IEEE Softw.*, vol. 33, no. 5, pp. 86–94, 2016.
- [9] H. Mirinejad and T. Inanc, **Individualized anemia management using a radial basis function method**, 2015 *IEEE Gt. Lakes Biomed. Conf. GLBC 2015 - Proc.*, pp. 1–4, 2015.
- [10] P. Adi, **Scrum Method Implementation in a Software Development Project Management**, *Int. J. Adv. Comput. Sci. Appl.*, vol. 6, no. 9, pp. 198–204, 2015.
- [11] A. Srivastava, S. Bhardwaj, and S. Saraswat, **SCRUM model for agile methodology**, in *Proceeding - IEEE International Conference on Computing, Communication and Automation, ICCCA 2017*, 2017, vol. 2017-January, pp. 864–869.
- [12] A. Delgado and C. P. Antunez-Maguiña, **Web system design for human resources management in an SME in the textile sector**, *Int. J. Emerg. Trends Eng. Res.*, vol. 8, no. 4, pp. 1471–1476, 2020.
- [13] A. Estevan and V. Freddy, **Reservation System for Synthetic Soccer Fields Under the Scrum methodology**, *Iber. Conf. Inf. Syst. Technol.*, no. June, pp. 19–22, 2019.
- [14] R. Hernandez, D. Version, and R. Hernandez, **Applicability of Agile and Scrum to Product Service Systems**, *EurOMA Conf.*, pp. 1–10, 2019.
- [15] D. Parsons, R. Thorn, M. Inkila, and K. MacCallum, **Using Trello to Support Agile and Lean Learning with Scrum and Kanban in Teacher Professional Development**, in *Proceedings of 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering, TALE 2018*, 2019, pp. 720–724.
- [16] P. Consulting, **Adobe XD CC Streamlining User Experience Design**, pp. 1–6, 2017.
- [17] D. E. Marcial, J. M. N. Te, M. B. Onte, M. L. S. Curativo, and J. A. V. Forster, **LMS on sticks: Development of a handy learning management system**, *Proc. 7th Int. Conf. Conflu. 2017 Cloud Comput. Data Sci. Eng.*, pp. 782–787, 2017.
- [18] G. Wang, **Application of lightweight MVC like structure in PHP**, *BMEI 2011 - Proc. 2011 Int. Conf. Bus. Manag. Electron. Inf.*, vol. 2, pp. 74–77, 2011.
- [19] G. Ongo and G. P. Kusuma, **Hybrid Database System of MySQL and MongoDB in Web Application Development**, *Proc. 2018 Int. Conf. Inf. Manag.*

- Technol. ICIMTech 2018*, no. September, pp. 256–260, 2018.
- [20] S. Gude, M. Hafiz, and A. Wirfs-Brock, **JavaScript: The used parts**, *Proc. - Int. Comput. Softw. Appl. Conf.*, pp. 466–475, 2014.
- [21] Jin Pan and Yao Jun, **Design and realization of college service center system based on MVC**, pp. 1312–1315, 2014.
- [22] F. Editor and D. Strok, **Sprinting toward Open Source Development**, *Ieee Softw.*, 2007.
- [23] R. A. Bretschneider, **Communication Challenges in Design Sprint Workshops**, *2019 IEEE Int. Prof. Commun. Conf.*, pp. 262–263, 2019.
- [24] D. Ramírez Arenas, **Sistema de administración web para el control del crecimiento y desarrollo de niños menores de 5 años para el centro de salud metropolitano ILAVE 2016**, 2017.
- [25] V. Bax, W. Francesconi, A.K. Delgado, **Land-use conflicts between biodiversity conservation and extractive industries in the Peruvian Andes**, *Journal of Environmental Management*, 232, pp. 1028-1036.2019.
- [26] J. V. Sutherland and E. Mercado, *SCRUM: El arte de hacer el doble trabajo en la mitad de tiempo*. 2016.
- [27] J. Roche, **Adopting devOps practices in quality assurance**, *Commun. ACM*, vol. 56, no. 11, pp. 38–43.