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Tesis

Development of a Web Application to Improve Price Quotation of Pledge Items in San Martín de Pangoa City, Peru

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Abstract— **A business application is related to everything that helps improve the business flow of a company, optimizing its processes and strategies. In this paper we discuss the project that was put into practice with a business application developed to improve the services provided by the company "Créditos, Negociaciones e Inversiones Cesar SAC". The software was developed following the incremental methodology based on its analysis, planning, development, and testing phases. As a result, it was obtained an increase of 13.14% of the total income generated equivalent to 12,360 Peruvian soles, taking as criteria the annual amounts of the year 2020 and 2021, using the software in this last period as a complementary tool for the development of business processes of the company.**

Keywords—MVC architecture, incremental development, CMMI, business application

Introduction

The development of the project started from the problems and the current situation of the company "Créditos, Negociaciones e Inversiones Cesar SAC" which had issues related to the process of customer service in an efficient manner because it has become somewhat annoying and/or inconvenient, since it generates time losses during the respective verification process of the guarantee that the client has. Likewise, the situation generated by the Covid-19 virus also caused problems for the operations of said company to be carried out in person. Therefore, there was the need to develop a software application in order to address these problems, given the current situation of the company at a local and international level.

This paper is divided as follows: in section II some theoretical definitions that serve as the foundation of the development of the application are described. Next, in section III it is explained the software methodology used to develop the app. Then, in section IV the results of the impact of the application on the business alongside with some relevant findings are analyzed. Finally, in section V some conclusions and general remarks for further research are given.

Theoretical Framework

MVC Architecture

The model-view-controller design pattern is a software architecture that appeared in its primitive form in 1979 [1] where the author defines the concepts of thing, model, view, and editor. This ultimately led to the three layers that compose the MVC architecture as known today.

These three layers works as follow. The model takes care of handling the data and the operations associated with it. The view defines how the data is presented to the user. The controller works as a link between the model and the view and, also deals with the interactions of the user with the system (keyboard, mouse, etc.) and sends these interactions back to the model and to the view [2]. This can be modeled graphically as follows in figure 1.
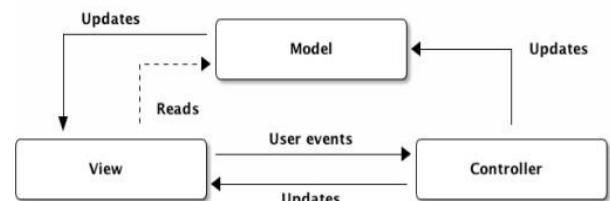

Fig. 1. MVC design architectural pattern

Among most important advantages of this architecture is the ease of unit testing because each layer of the software has a unique and well-established responsibility. This ultimately allows a team of developers to work simultaneously in an MVC application [3].

Currently this architecture is used in different web development frameworks such as Ruby on Rails, ASP.Net MVC, Laravel, etc.

Incremental Software Development

This methodology is a combination between the waterfall and agile methodologies for software development. The basic premise around this model is that an initial version of the app is developed and then this is refined incrementally on different iterations based on user feedback and its requirements [2]. Therefore, each stage establishes which increments to the software will be applied based on the value goal and the needs of the customer. This process continues iteratively until all requirements, both functional and non-functional, have been completed. [2]

Usually, the early version of the software contains the most important requirements, so the user knows upfront if the development of the application is going on the right track. [4]

CMMI

The Capability Maturity Model Integration is a process improvement model used in software development to increase the quality of the software which focuses on productivity and decrease of time and costs, as well as risks through the life cycle of the software development [5]. In order to do so, this model evaluates the maturity of risk management that an organization poses, as well as how well mitigates risk factors. Alongside this evaluation, CMMI offers guidance of how to improve the processes involved in software development through five stages of maturity levels from initial to optimizing [6]. This is shown next in Fig. 2.
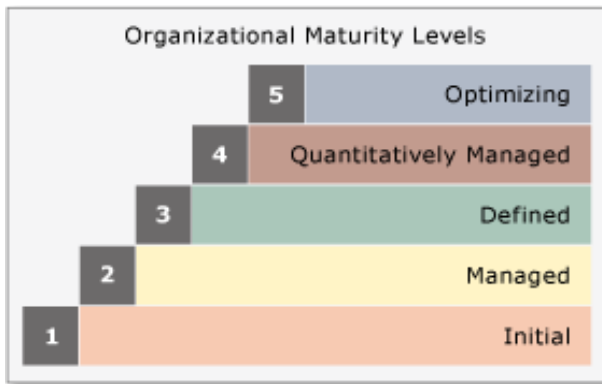

Fig. 2. CMMI five stages of maturity.

Basically, this model allows organizations to have predictable, measurable, and manageable processes related to software development with the end goal of high-quality products [7].

Line of Business Application

It is an application designed to automatize the business tasks of a company in order to increase the performance and to reduce costs. It is usually deployed through a web server with an Internet connection. [8]

METHODOLOGY

Analysis Phase

In this phase the objectives, criteria and development stages of the project were defined. As well as the methodology to use allowing the team to build a development sequence and maintain effective communication with project stakeholders and among developers of said team, which is shown in detail in Fig. 3.

As a general objective of the system, it was fixed the goal of increase the net profits of the company and as specific objectives, optimize business processes, and improve the main business flow. [9]
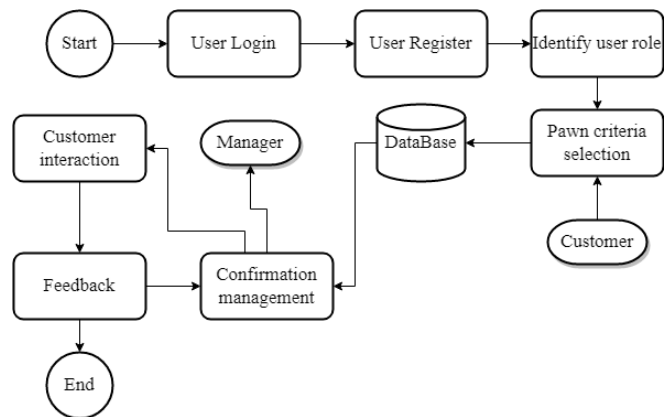

Fig. 3. System design flowchart

Planning Phase

The engineering of the project was developed based on the time stipulated by the stakeholders and developers based on the previously determined objectives and the business flow of the company.

Requeriments Definition: The requirements defined in the elaboration of the project were written as temporary logical formulas, expressing the needs of the interested parties in an easily understood language [10]. These user requirements were diversified into use cases, which are show in Table I.

USE CASES

Use Case Identifier	Use Cases	Deliverable		
		1	2	3
2020-UC-001	Register user	X		
2020-UC-002	Show company contact information	X		
2020-UC-003	Show list of services provided by the company	X		
2020-UC-004	Show catalog of uploaded garments	X		
2020-UC-005	Record company contact information	X		
2020-UC-006	Edit company contact information	X		
2020-UC-007	Register services provided by the company	X		

Use Case Identifier	Use Cases	Deliverable		
		1	2	3
2020-UC-008	Edit services provided by the company	X		
2020-UC-009	Register catalog of uploaded garments	X		
2020-UC-010	Edit catalog of uploaded garments	X		
2020-UC-011	Upload media		X	
2020-UC-012	Record user contact details		X	
2020-UC-013	Record item details		X	
2020-UC-014	Edit garment information		X	
2020-UC-015	Edit user contact information		X	
2020-UC-016	Notify the submission of the loan application			X
2020-UC-017	Notify the acceptance of the loan application			X
2020-UC-018	Notify the rejection of the loan request			X
2020-UC-019	Notify about the sale of the garment			X

Architecture Design: It was decided to develop the software based on the model-view-controller architecture, in order to allow to have a modularized project and generate independence between the operations of the web page [3]. In this architecture the browser acts as the end user, whereas the controllers process http requests (POST, GET, PUT, etc.). On the other hand, the views take care of rendering and displaying the associate html to the user, as well as sending events to the controllers. Finally, the models contain the business logic of the application and interact with the underlying database which allow them to send notifications of change of data to the corresponding views. This is shown in Fig. 4.
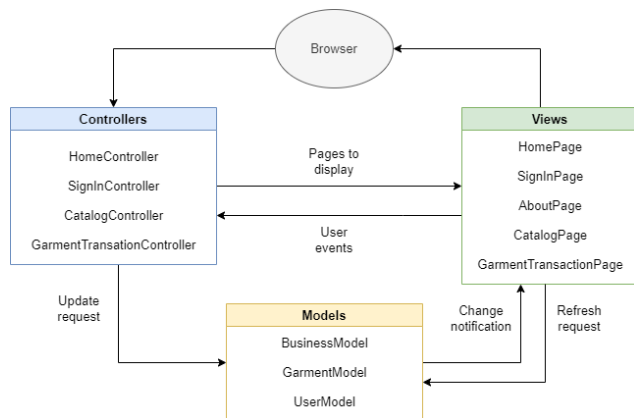

Fig. 4. MVC architecture for the web application

Technologies: The team chose to use the IDE Visual Studio 2019 for the development of the application and the SQL Server 2014 Management Studio as a database environment, likewise Smarter ASP.NET was used as a hosting service, in order to favor the development of the project and speed up the integration of technologies. Similarly, it was used the

framework ASP.Net core together with JavaScript and C# as programming languages to deal with the business logic of the sofware both in the front-end and back-end. For the markup and styling of the web pages HTML 5 and CSS 3 were used.

Development Phase

By applying the incremental development methodology, there was a technical emphasis on communication and teamwork, which was necessary to maintain the deliverables in good condition and quality, and also helped to add functional features and bug fixes to each project deliverable. The development of the project was based on three increments with their defined goal - value, each one presenting the phases shown in Table II.

DEVELOPMENT PHASES

Development Phases
Communication
Planification
Modelling
Implementation
Deployment

This sequence of deliverables is marked in the time stipulated by the interested parties and governed by the general and specific objectives; this is shown in more detail in Fig. 5. [9]
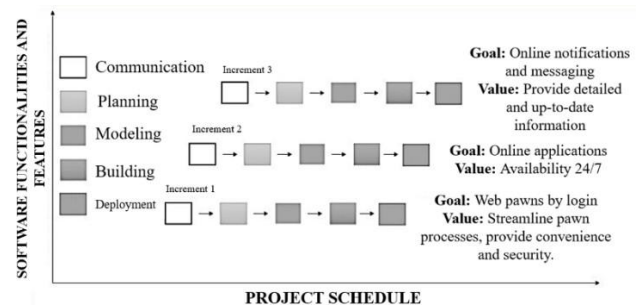

Fig. 5. Project Schedule

Deliverable 1: The goal considered in the first deliverable consists of web pawns per login, as well as the defined value, which consists of speeding up the pawn process, providing ease of use and security.

Deliverable 2: The goal considered in the second deliverable consists of online requests, as well as the defined value, consisting of providing 24/7 availability for the service.

Deliverable 3: The goal considered in the third deliverable consists of online notifications and messaging, as well as the defined value, consisting of providing detailed and updated information of each loan process.

Testing Phase

In a beginning, the web page was implemented in a local version for the review and verification of the company "Créditos, Negociaciones e Inversiones Cesar SAC". Then, it was planned to deploy the web application using the Smarter ASP.NET hosting service in order to run the software in a

production environment that allowed the employees of the company to use the app. For example, Fig. 6 shows the manager of the business using the web application.

Fig. 6. Manager using the software, courtesy of "Créditos, Negociaciones e Inversiones Cesar SAC"

At the same time, the validation of the software functionalities was given, as well as the validation of the software as a tool within the business flow of the company. For the validation of functionalities, the SciTools Understand software was used which allowed the team to evaluate the metrics and source code of the project, evidencing a good practice and satisfactory results. These results are shown summarized in Fig. 7.
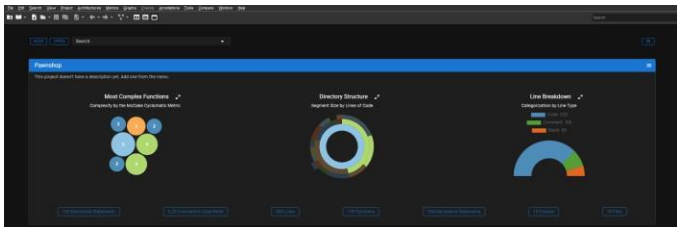
Fig. 7. Metrics Summary – Understand

Likewise, the use cases were verified according to the developed test plan. This plan is shown in Table III.

TEST PLAN

Use cases	Input data	Expected result	Abnormal input data	Abnormal expected result
Deliverable 1				
Register user	• User email • Password • Password confirmation	• Registered user.	• Email not available. • Blank data (email, password).	• Unregistered user.
Edit services provided by the company	• Data entered correctly (name).	• Edited service.	• Blank data.	• Unregistered service.
Register catalog of uploaded garments	• Product name. • Kind of product. • Product condition. • Price.	• Registered item.	• Blank data.	• Unregistered item.
Edit catalog of uploaded garments	• Data entered correctly (name, type, condition, price).	• Edited garment.	• Blank data.	• Unedited item.
Deliverable 2				
Upload media	• Media files	• User uploads their multimedia files (image and/or video).	• Media file of unknown format. Corrupt media file.	• User does not upload their multimedia files (image and/or video)
Record user contact details	• Selecting the "create account" button	• The user can register their contact details.	• No selection of the "create account" button.	• The user can register their contact details.
Record item details	• Selecting the "register item" button.	• The user registers the details of the garment.	• No selection of the "register item" button.	• The user does not register the details of the garment.
Deliverable 3				
Notify the submission of the loan application	• Generation of a notification for the loan application.	• Notification is correctly delivered to the user.	• No generation of a notification for the loan application.	• The user is not notified about the loan application.
Notify the acceptance of the loan application	• Generation of a notification for the acceptance of the loan application.	• Notification is correctly delivered to the user	• No generation of a notification for the acceptance of the loan application.	• The user is not notified about the acceptance of the loan application.
Notify the rejection of the loan request	• Generation of a notification for rejection of the loan request.	• Notification is correctly delivered to the user.	• No generation of a notification for the rejection of the loan request.	• The user is not notified about the rejection of the loan request.

On the other hand, for the validation of the company's business flow with the use of the website, we apply the Capability Maturity Model Integration (CMMI), performing validations on the business objectives of the company and goals set in the development of the project, obtaining as a result an optimal management with a degree of attachment of 80%, shown in more detail in Table IV.

CMMI EVALUATION

Category	Score Obtained	Total Score	Attachment group
Process management	15	15	100%
Project management	15	15	100
Engineering	25	35	71.43

Category	Score Obtained	Total Score	Attachment group
Support	25	35	71.43
TOTAL	80	100	80%

RESULTS AND DISCUSSIONS

The Peruvian banks loans tends to be made in a couple of days and involves a lot of paperwork [11]. This information serves as a reference for the company "Créditos, Negociaciones e Inversiones Cesar SAC", to offer the population of San Martin de Pangoa, an immediate pledge loan without much paperwork, with payment facilities, either monthly, fortnightly, or weekly; with an interest rate of 10% of the capital requested by the client. The net profit obtained before and after the application of the software in the company shows a significant improvement over the year, which is evidenced in Table V.

CREDIT GRANTED BETWEEN 2020 AND 2021

Year	Loan amount	Interest amount
2020	$306,878.00	$30,687.80
	$886,138.50	$115,380.85
	$747,968.00	$91,761.80
	$577,564.00	$70,197.40
2021	$629,213.00	$70,838.30
	$852,208.50	$113,872.85
	$740,051.00	$90,216.10
	$649,948.00	$79,697.80

The bar chart of Fig. 8 shows the quarterly comparison of the interest obtained in 2020 and 2021. Where it can be highlighted the increase in net income in 2021. Likewise, it can be observed that in the second and third quarter the yield has not been very favorable, this is due to the fact that there was a descent in the attention of clients due to the problem of Covid-19. For that reason, the manager decided to carry out the loan service to featured clients only, obtaining as a result a low utility of those months. (Management of the type of business by the company)
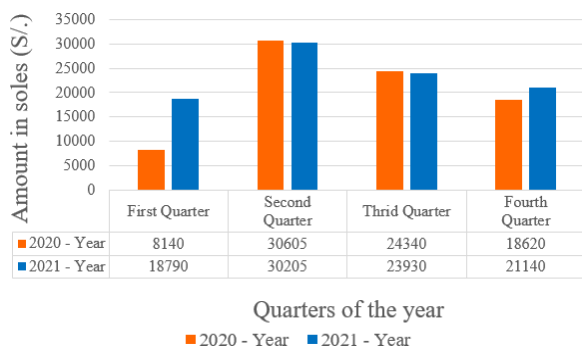

Fig. 8. Bar chart of total money by quarters

The bar graph of Fig. 9 shows the total interest obtained during the year 2020 and 2021. The comparison between these two years shows that the interest obtained after the implementation of the software during the year 2021 increased by 13.14% of the total, which is equivalent to 12,360 Peruvian soles.
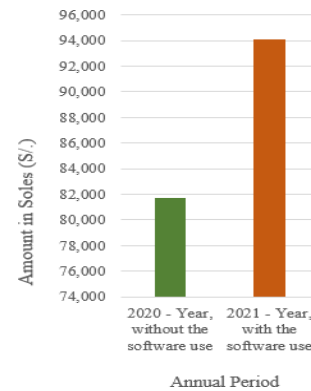

Fig. 9. Bar chart of total money by year

CONCLUSION

In the analysis phase, the general and specific objectives were specified, criteria and stages; as well as the methodology to be used, which allows an effective development sequence between the stakeholders and developers of the project.

In the planning phase, the requirements and architecture to be used in the development of the application were built, focusing on the modularity of the system and the optimization of the business flow of the company. The main technological tools that were used during this process were the Visual Studio 2019 development environment and SQL Server 2014 as a database environment.

In the development phase, three deliverables based on goal - value were elaborated, in order to generate minimum viable products beneficial for the stakeholders of the project.

In the test phase, the functionalities of the system and the system as a tool within the business flow of the company were validated obtaining beneficial results for the increase in net profit of the company.

Finally, this system can be considered as a complementary tool in the improvement of the pledge loan process of the company "Créditos, Negociaciones e Inversiones Cesar SAC", because there was an increase of 13.14% of the total net profit was evidenced by using the application during the year 2021.

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