Universidad Autónoma de Nuevo León

Facultad de Ingeniería Mecánica y Eléctrica

Master degree on
Information Technology Engineering

Master's degree project

Sihapp Web. Cloud medical record system management

By
Rolando Valdemar Domínguez Lozano

San Nicolás de los Garza, August 2018

Dedicatoria

En memoria de

Adriana Martha Garza Villareal.
José Rolando Domínguez Hernández.
Dr. Joel Garza García.
Ing. Ángel Valdemar Lozano Chaires.

En donde quiera que se encuentren, espero se sientan orgullosos y felices por este logro…

Special thanks to my mom Adriana Lozano and my brother Angel Domínguez, who helps me to translate this work from spanish to english . I will always be grateful for your support at all times.

With love: Rola

Index

Resume

Currently, information technologies have had an evolution compared to the last 10 years, as we can see in the environment that surrounds us, processes are becoming more automated, making life easier for all of us; However, it is common that in clinics, private offices or even hospitals many processes are still carried out on paper, the most notorious as patients (at least in Mexico), is the schedule of appointments that are recorded on paper, but what happens if the information is lost? What have we written on physical media? Could the information fall into the wrong hands? Based on these questions, a web/mobile development has been started to avoid situations that could lead to mismanagement of hospitals, clinics or offices, even to malpractice.

Introduction

It is easy to see looking around us how the way we communicate is not the same as 10 years ago; emails, messaging applications, social networks, cloud applications, all of this seemed very distant in those years and possibly very few people imagined the great advance that information technologies would have.

A cloud application allows us to access information at any time quickly and reliably, it gradually replaces local servers, which can be difficult to maintain and could be vulnerable in certain cases, the best way to manage information in recent years is dispose the information on the cloud [1].

Background

The use of mobile technologies to support the achievement of health goals (mHealth) has the potential to transform the delivery of health services around the world, this includes the rapid advances in technology and the exponential growth of mobile applications , which brings new opportunities for the integration of mobile health in health services [2]. Despite this, one of the reasons why the IT doesn´t evolve, it's because the administration of hospitals or clinics doesn´t believe that it is necessary to implement servers and networks, as well as installable programs and technological infrastructure that were involved at the beginning of this century [3].

Previously, the implementation of computer systems was related to the maintenance of on-site servers, server maintenance, physical security infrastructure and expensive geographic replication [4].

Cloud computing has dramatically reduced system maintenance costs, making the sustainability of centralized systems, as well as security and 24/7 availability, increasingly easier [5].

Problem definition

If we observe daily, currently the administration of appointments, consultations and confidential data of patients in private practices in Mexico is carried out on paper or at most in computerized spreadsheets, which can cause the following problems.

- Confidential patient information in the wrong hands (Security) [6].

- Spliced appointments in case there are no validations in the doctor´s agenda.

- Misplacing files, which can cause malpractice or misdiagnosis

- Loss of information, both electronic due to computer or memory breakdown, as well as physical paper due to carelessness or poor protection.

Approach

Create an application in which the patient can be informed with his doctor (or medical staff) about the scheduling of appointments and follow-up of treatments, this in order to prevent the patient from falling into misinformation and use tools that promise to be very useful but could have repercussions on the patient's health by advising home remedies instead of encouraging communication with their doctor. [7]

This application will be able to organize appointments without interfering with each other according to the profile of the health professional, it will send reminders via email, save images in the patient's files, and any need that arises with the use of users through of feedback.

Substantiation

It is of great importance to develop an application to store sensitive patient information safely and protected with the appropriate security mechanisms. The loss of files or confusion between them could cause a misdiagnosis and malpractice.

Objectives

The main objective is to build an application protected by Microsoft Azure [8].

This application must handle the information in a secure manner, guaranteeing the privacy of patients' agendas and medical records, as well as patient follow-up [9].

Scope

This project is made thinking about the way in which health professionals can organize their agenda, send reminders and save files safely in the cloud, from scheduling a consultation to sending reminders via email, as well as saving the electronically and export it in physical or digital format by selecting all or part of the information. This application will also be able to generate account statements for patients to see the income of the clinic or entrepreneurs who wish to set up their office, limiting themselves only to what is generated through consultations. At no time is it suggested that the application make diagnoses automatically, scan images to predict diseases or substitute treatments. The protection of data such as passwords and exported files will be the sole responsibility of the health professional, adhering to the conditions of use of the platform [10].

Framework

For the software development methodology of this project, SCRUM supported by KANBAN will be used, which will be used in a modified way by the number of people in the team.

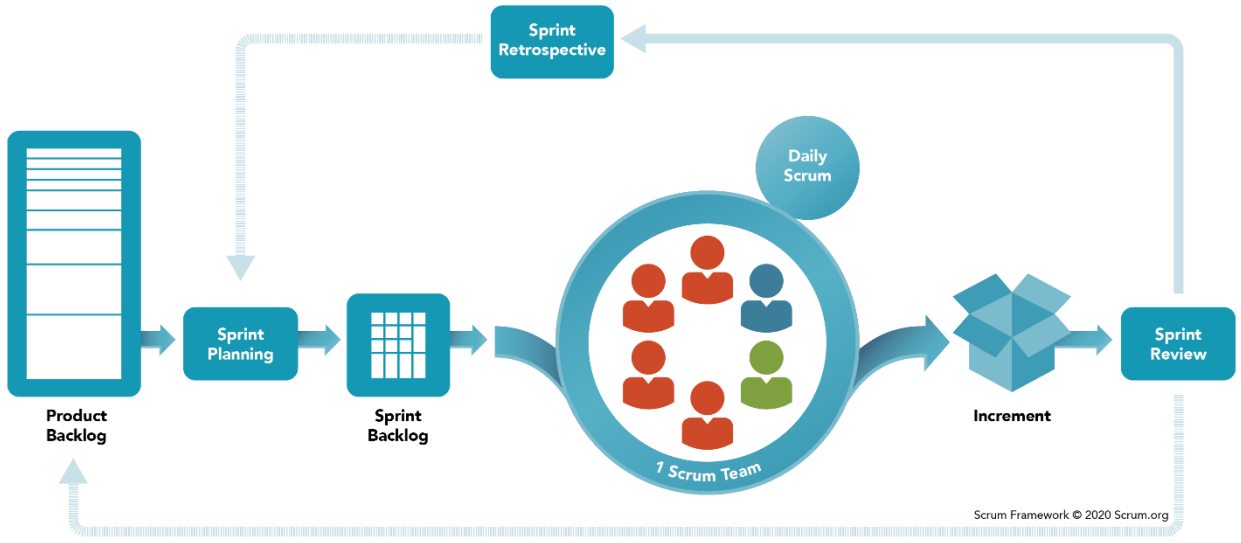
SCRUM normally divides the organization into small, self-organized, inter-disciplined teams, divides activities into a list of small deliverables, and organizes them by priority and effort of each of them [11].

This framework focuses on the management of projects in which it is difficult to predict the future of the project, the development is carried out through planned phases called “Sprints”, in which in each of these elements there is a list containing the tasks to be carried out to cover characteristics and deliverables of the system (backlog list) [12].

Each backlog item will need the following items.

- Id: Unique identifier with which we can uniquely identify the task to be performed.
- Name: A descriptive name that reflects what this deliverable should concretely do
- Importance: The importance of this task in the project. (Priority can be quantitative or qualitative)
- Initial estimate: Time (in hours, days, weeks, sprints) or difficulty (eg function points) that it will take us to carry out said work in an estimated manner.
- Notes: All notes that can be used to reproduce the tests or behavior of the deliverable made.

These constitute the basis for each task proposed in the backlog list [13]. So we can define the SCRUM cycles or sprints as follows.



Picture 1. *SCRUM graphical implementation [14].*

We start from an initial stack of the product where we have each and every one of the functionalities that our software must carry out, made up of the inputs of the end users, clients and stakeholders, later the sprint planning meeting is held where the SCRUM team, made up of developers and the SCRUM master commit to carry out the pertinent tasks to form the sprint, which is an iterative process that can last from 1 to 4 weeks, in which, on a daily basis, a meeting is held where mainly answers to 3 questions: What did I do yesterday? What impediments do I have to carry out my work today? What am I going to do today? Finally, product increments are delivered and go through reviews. At the end of the Sprint, a retrospective meeting is held to see what has been successful and what has failed, in this way collects statistical and historical information.

Implementation

In this case, due to the scope of the project, only the organization of the SPRINTS will be taken from the SCRUM methodology, and the functionality of each role that uses this methodology will be omitted. Each sprint will be two months of work, these sprints will be divided into two parts; the first where we will build the base application, and the second where we will develop specific functionalities required by end users.

Complementing SCRUM, we will use Kanban for the organization of the phases of each task; Kanban is based on work processes, limited to when something should start and when it should be delivered, it is organized through "cards" that imply a visual signal that indicates the flow of work, as a result, Kanban makes us visualize the deliveries of each of the elements with which we are working [15].

For this project, each backlog item will be pass with next stages.

- Backlog list: List of functionalities that are intended to be delivered in the iteration
- Progress: Marks when an item in the backlog list is in progress, being developed and tested in a very general way.
- Testing: When the deliverable has been completed, then it is thoroughly tested to ensure that the deliverable has good quality, also at this stage any bug generated by the task that affects the system is fixed.
- Deployed: This activity refers to the deployment and backup of the code in the repository.
- Done: Mark when the deliverable has been 100% completed

The realization of each sprint and the control of activities with Kanban will be carried out with the Trello tool, which helps us visually see our tasks through each stage through work consoles organized by stages [16].

Each task is estimated by function points: The values used to represent complexity in this project do not have an absolute value, but rather their value is a function of their position on the scale.

The Fibonacci series is used: 1,2,3,5,8,13,21, ..., although it should be noted that it may not necessarily be a numerical scale, in some cases it is denoted nominally: Medium, Large, Extra Large[17].

Sprints list.

Here are the Sprints that were made for the development of the application, a Task column, which refers to the requirement to be implemented, the comments column where the work to be done is specified, and finally the ***Points of Estimated Function** and ***Real Effort Function Points**. This makes a comparison between the estimates before making the requirement and the points that actually involved carrying out the task.

We can understand the estimates if we translate the point estimates into (approximate) working hours, which we can see in the following table.

Function Point Interpretation Table

Function points	Working hours estimate
1	1 a 20 minutes
2	1 hour - 2 hours
3	2 hours - 2 hours and a half
5	2 hours and a half - 4 hours
8	4 hours - 4 hours and a half
13	5 hours - 5 hours and a half
21	More than 6 hours

The estimate was calculated with the empirical experience of previous projects and work projects, the real effort was based on the total time it took to develop each of the requirements in the sprints.

Sprint 1

Task	Aceptance Criteria	*FP Estimation	*FP Real.
Microsoft Identity Configuración	Identity 2.0 Configuration and integration with authentication	5	13
Database creation	Identity tables and initial structure for auth for the app	3	5
Login System. Identity Microsoft	Connection between main app and auth system.	5	5
Microsoft Azure Account Management	Opened a free one-year subscription account to the Visual	2	3

	Studio Developer Advantage program.		
Login implementation	Clinic number and logic between user and clinic	5	5
Deployment SQL Database Azure	Deploy the local database to Azure SQL	3	3
Production Connection String	Testing phases are on the local DB and performance test on cloud DB	2	2
Register form for new clinic and users	The registration form is created so that health professionals have Clinic number, username and password	5	8
	Total PF	**30 Estimate**	**44 Final effort**

Sprint 2

Task	Aceptance Criteria	*FP Estimation	*FP Real.
Main tables creation	Scripts for tables Patients, ClinicMen, Auxiliar Staff. Appointments and Consults	3	2
App Layout	Logged user information on web layout	2	3
Angular JS integration	AngularJS and Typescript were installed to work efficiently with MVC architecture in ASP Net using also TypeLite	5	5
Implementation of a master key to access accounts	A master key has been created, with which you can enter any account created in Sihapp for technical support purposes only	5	3
Patients list creation	Patients catalog view	5	5
Users list creation	In this view, we can locate 3 types of user: Auxiliar Staff, Medical personal and Patients	2	2
Add Auxiliar Staff user from users pannel	Add basic information in the form from this entity and internally assign to the clinic number	2	2

Add new Clinic Man (medical personal) from users pannel	Add basic information in the form from this entity and internally assign to the clinic number	1	1
Appointment list grid view	In this grid we can filter data by dates and patients	2	2
Appointment time validations	By default, the system gives a consultation time of 5 minutes and appointments cannot be made 5 minutes before or after the scheduled time for the consultation.	5	5
Grouped appointment report	The appointments are grouped by day during the month in list form.	3	3
Appointment view validation depending on the logged in user	The patient type user can only view their own appointments, and cannot see other modules.	2	3
Redirect button to start the medical consult	Start medical consult button, redirect to patient consult page when the appointment is selected	2	2
Medical consult view	This view must contain a blank “paper sheet” where Medical professional makes the main notes	3	5
	Total PF	**42 Estimate**	**43 Final effort**

Sprint 3

Task	Aceptance Criteria	*FP Estimation	*FP Real.
Svn migration repository to Microsoft Git Visual Studio Online	Migrate current code at this point to Git from Visual Studio Online	3	8
Images on medical consult	Allow to upload 3 images in the patient medical consult view	21	21
Deploy on production	Deploy to a App Service from Azure http://sihapp.azurewebsites.net/	13	13

Medical appointment reminder via e-mail	Send an e-mail triggered by staff or medical personal to patient.	5	8
	Total PF	**42 Estimate**	**50** Final effort

Sprint 4

Task	Aceptance Criteria	*FP Estimation	*FP Real.
Website publication date integration	At the page foot, must be appear last deployment date of the system	1	2
Login layout change	Login layout change for a better UX	5	3
Manager Page View	With this view, in a certain super admin account, you can see the new registrations of new users to follow up	21	21
Sihapp official logo	The new Logo was created and incorporated into the system views	3	3
Authentication system simplification	Clinic number was removed from the login form, now users can anter only with user name and password	5	8
Welcome email	A welcome email its triggered and sended to the new user when a new clinic account has been created	3	2
	Total PF	**38 Estimate**	**39 Final effort**

Sprint 5

Task	Aceptance Criteria	*FP Estimation	*FP Real.

Validation of number of images in medical consult	The number of images in the medical consult is now with server-side validation in backend	13	21
Exception handling on server with Ajax	With this setting the exceptions on the server side can be observed on the client side	21	21
	Total PF	**34 Estimate**	**42 Final effort**

Sprint 6

Task	Aceptance Criteria	*FP Estimation	*FP Real.
View enhancements	Paging controls have been coupled on the server, information will only be requested according to the information requested from the client side	21	21
User logged IP record	The IP is recorded on database every time when the user makes a log on	13	13
	Total PF	**34 Estimate**	**34 Final effort**

Sprint 7

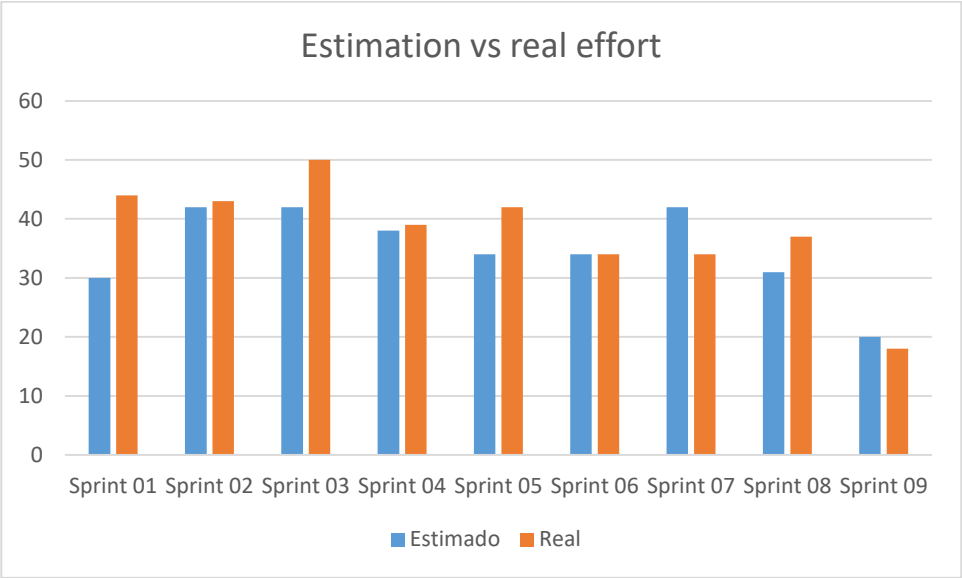
Task	Aceptance Criteria	*FP Estimation	*FP Real.
In detail of patient print PDF with result and dates of consultations	In the patient's record you can download the PDF with the results of the patient's consultations including images	21	21
User module refactor	Inheritance and polymorphism were used to abstract the 3 different types of users	21	13
	Total PF	**42 Estimate**	**34** Final effort

Sprint 8

Task	Aceptance Criteria	*FP Estimation	*FP Real.
Autocomplete component in patients appointment	This component allows you to search patients more quickly when you want to register an appointment	13	8
Pantient´s account status view	This screen allows you to see the payments made by the patients and the outstanding balance of each of them.	13	21
Finish record detail screen	File details finished like pictures and date of medical consult	5	8
	Total PF	**31 Estimate**	**37 Final effort**

Sprint 9

Tarea	Comentarios	*PF Est	*PF Ef.
Payment receipts in the system	Save the patient's payment at the end of the medical consult	2	2
Payments by patient view	Screen that shows by dates what the patient owes and has paid	5	3
Payment deletes	Payments can be deleted, amounts must be updated in the database when deleting payments	5	5
Print PDF Receipts	Print remission notes and payment notes in PDF format	8	8
		20 Estimate	**17 Final effort**



Picture 2. *Estimate points versus real effort points*

As we can see, in some Sprints the estimate value was lower than the real effort, the estimates are not always exact, since these gaps can arise thanks to technical problems, code problems, and even general mishaps related to the suppliers that make the development of the project possible.

Microsoft Identity 2.0 Authentication System

The most used authentication system for ASP.NET applications was Membership, this system was replaced by ASP.NET Identity, which is a proposal that allows us to authenticate whether we use Web Forms, Web Pages, MVC, API or SignaIR, even mobile applications.

The ASP.NET membership system was introduced with ASP.NET 2.0 in 2005, and since then there have been many changes to the way web applications typically handle authentication and authorization. ASP.NET Identity is a new take on what the membership system should be when you're building modern apps for the web, phone, or tablet.

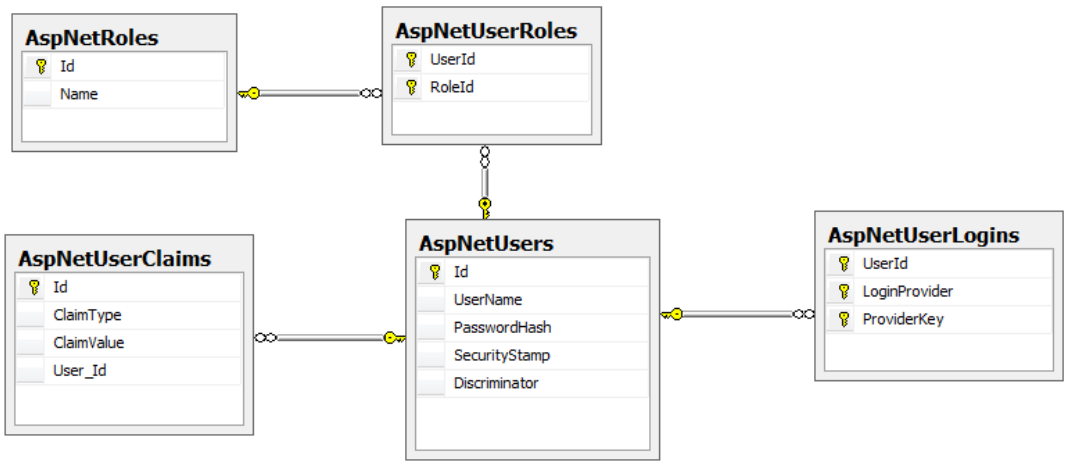
With identity we have 3 packages that are essential:

- Microsoft.AspNet.Identity.EntityFramework: this allows you to persist your users' information in a SQL Server database. It is where we are going to register the users, roles, etc.

- Microsoft.AspNet.Identity.Core: Contains the interfaces to persist information in places other than a SQL Server database. It could well be in Azure, NOSql Database.

- Microsoft.AspNet.Identity.OWIN: It is responsible for managing the authentication, in our case it implements the Cookie.

The database schema was designed for SQL Server and cannot be changed. We can add profile information, but the additional data is added in a separate table, making it difficult to access by any means except through the Profile Provider API. In this case, the information of the health professionals and patients had to be put in other tables that were related to the Identity tables.



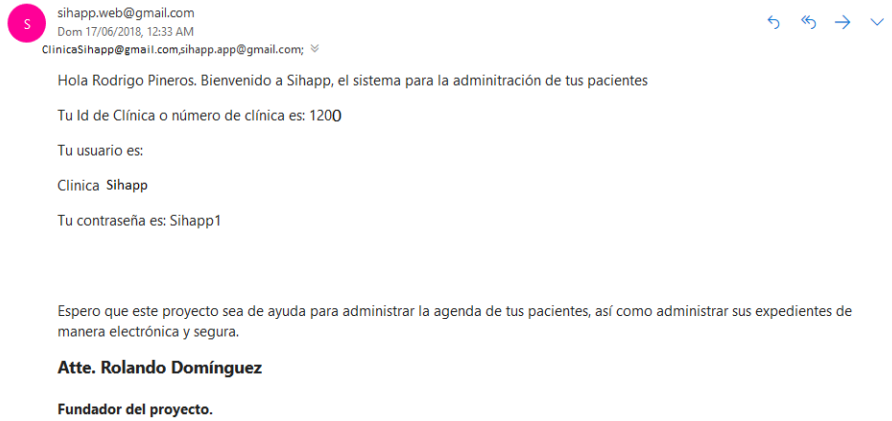
Picture 3. *Entity relationship diagram of the Identity 2.0 authentication system*

Integration Tests.

The integration tests were done directly in the production domain and were done by modules. We tried to reproduce as many cases as possible.

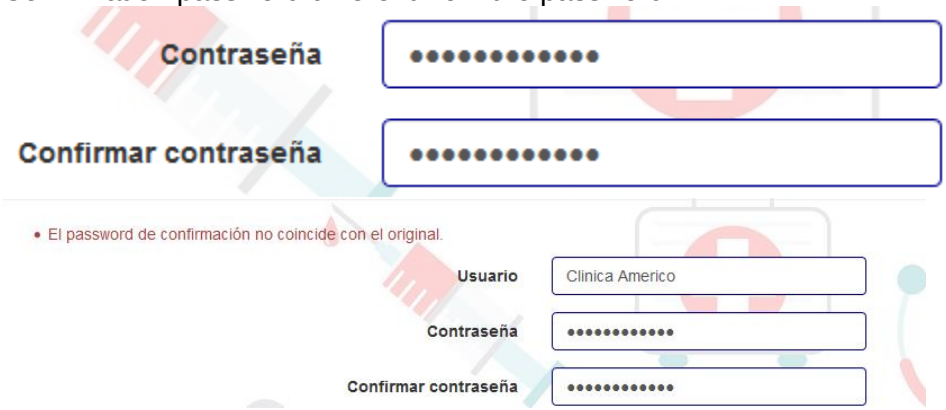
Module 1. Sign up and Sign in

1.1 – Create a new clinic	
	**Inputs** • Username • Password • Password confirmation • Clinic Name • Medical professional name • First Name • Last Name • Birthdate • Address • Phone • E-mail
	**Outputs** User has been registered on the system and appears on the user´s panel

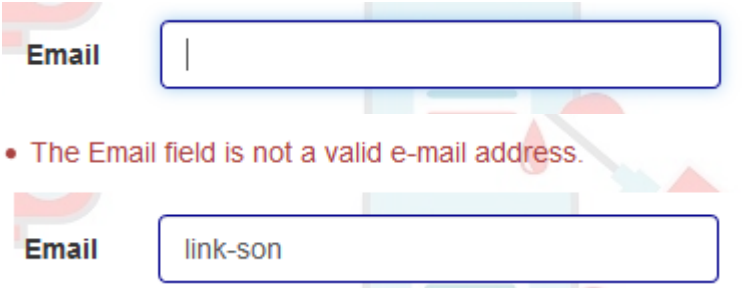
	**Outputs** Confirmation e-mail was sent to new user
1.2- Login	
	**Inputs:** • User name • Password
	**Output** Welcome screen on the system

Errors management on module 1.

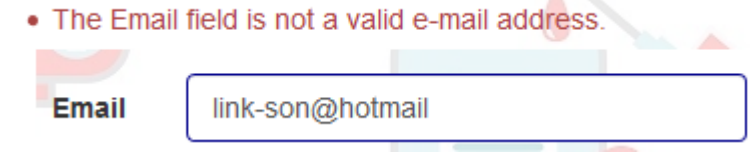
Confirmation password different from the password



Enter an incorrect format email



Sin formato del correo



Enter a wrong password for the user

Module 2. Patients

2.1 – Add new patient

Inputs

Add new patient

- Name
- First Name
- Last Name
- Brithdate

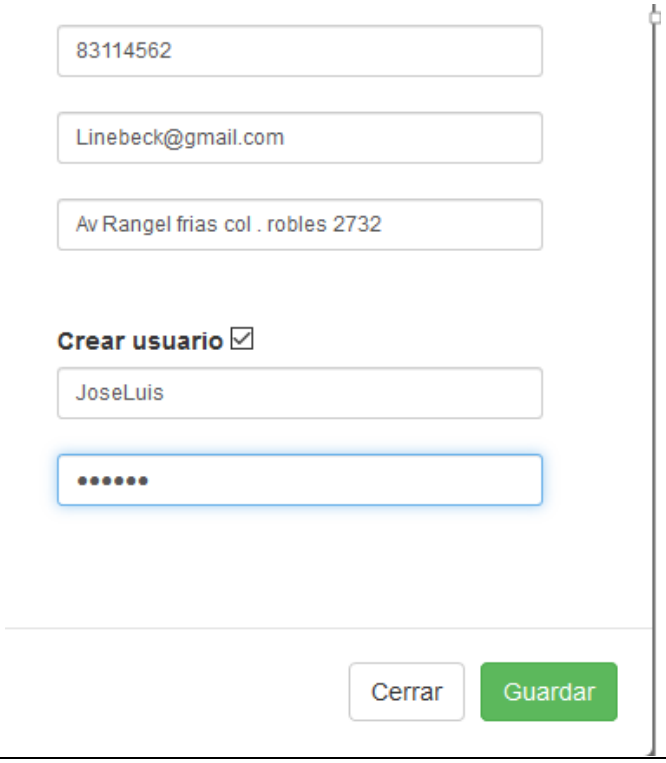
- Weight
- Height
- Phone
- E-mail
- Address

Output

Patient has been registered

Output
Patient record

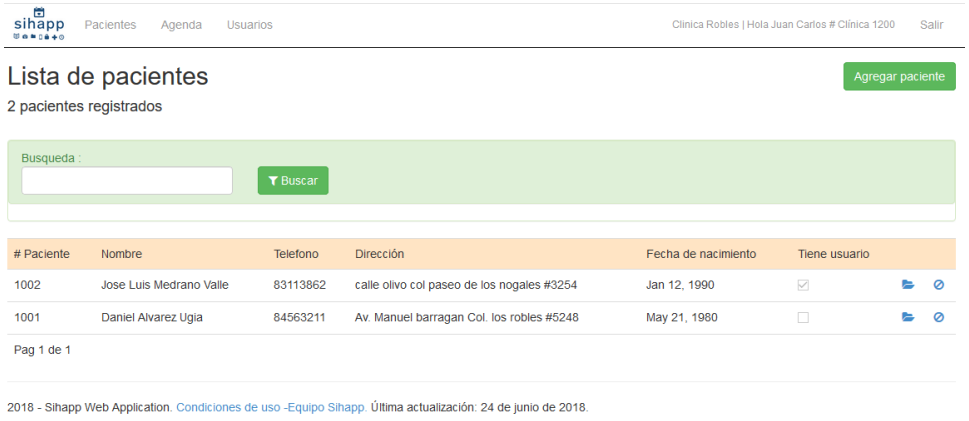
2.2- Add new patient with user profile



Entradas:

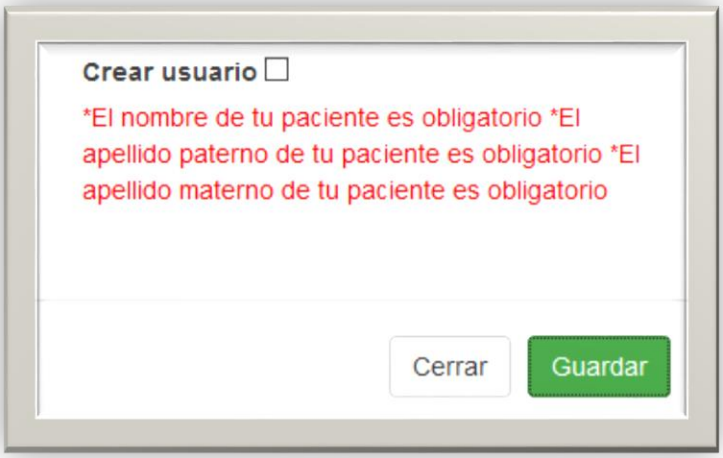
- Name
- First Name
- Last Name
- Brithdate

- Weight
- Height
- Phone
- E-mail
- Address
- User
- Password

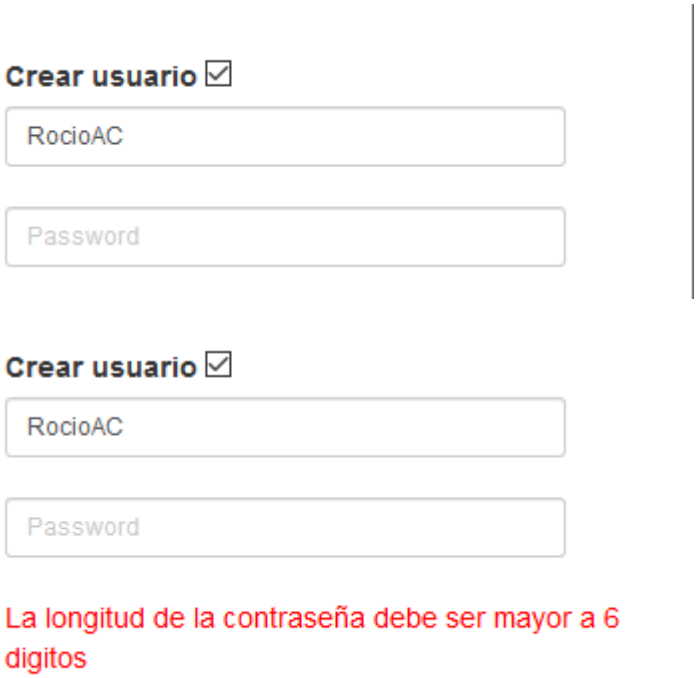
	**Output** Patient with user profile
	**Output** Patient can access with his user name and user

Errors management in module 2.

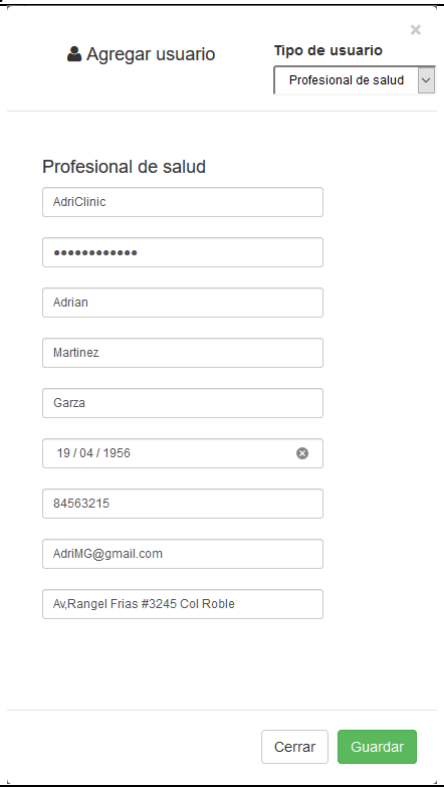
Patient name missing



Password for user name missing

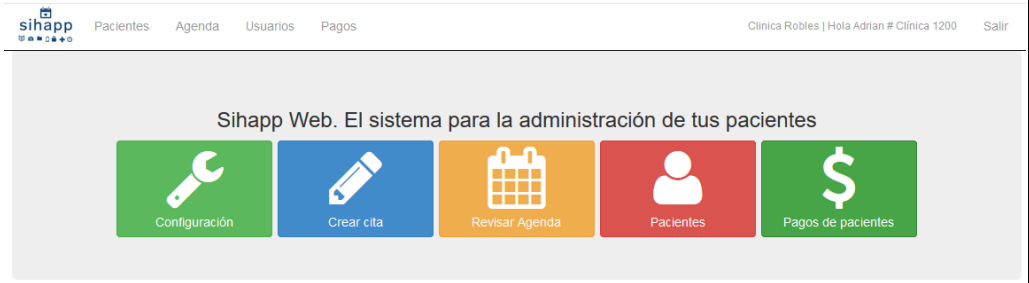


Module 3. User

3.1 Add medical professional	
	**Input** **Add as user** • Username • Password • Password confirmation • professional name • First Name • Last Name • Birthdate • Address • Phone • E-mail

Output

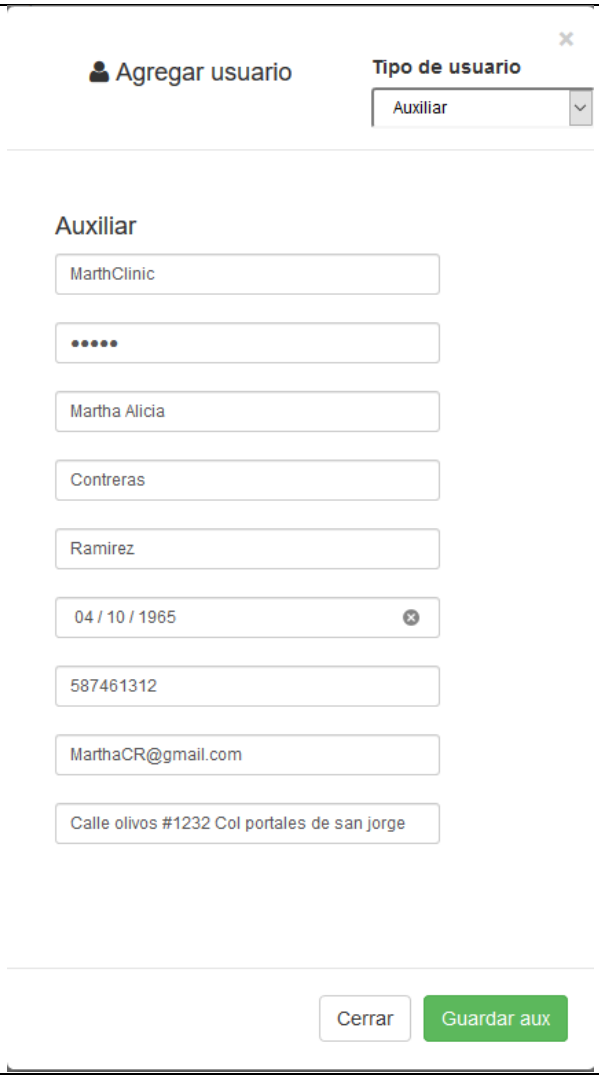
New user on the panel



Output

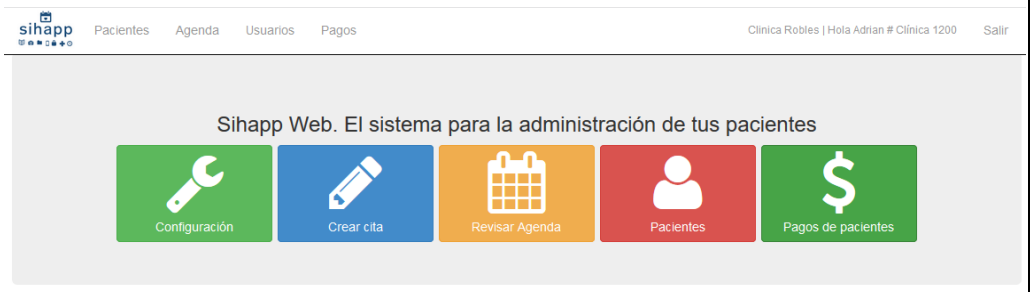
User log on in the system

3.2 New clinic staff auxiliar



Input
Add as user

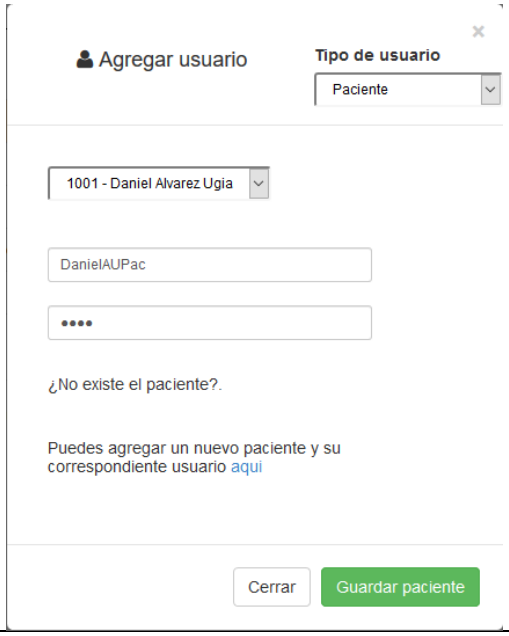
- Username
- Password
- Password confirmation
- Staff medical name
- First Name
- Last Name
- Birthdate
- Address
- Phone



Output

New user log on in system

3.3- Asing user to patient

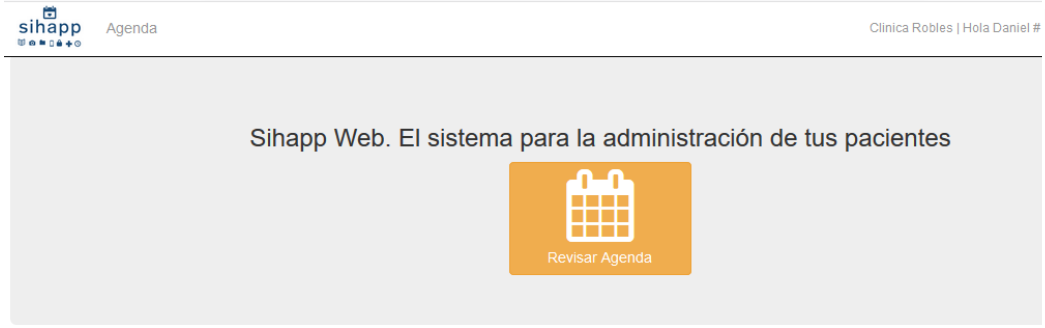


Input

- User already existing from catalog
- User name
- Password

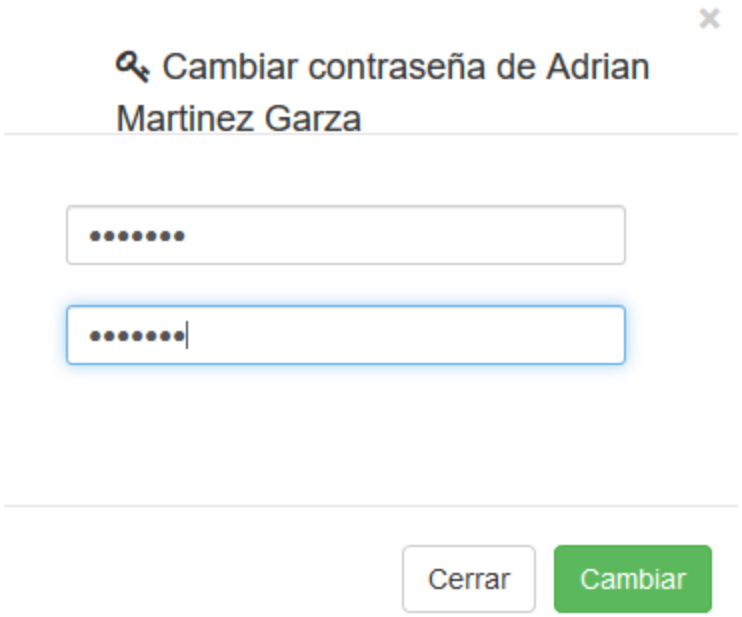
Output

User in panel



Output
User log on in system

3.4 User password change

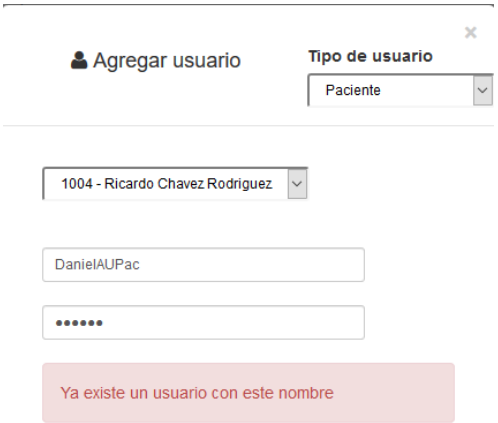


Datos de entrada

- New Password
- Password confirmation

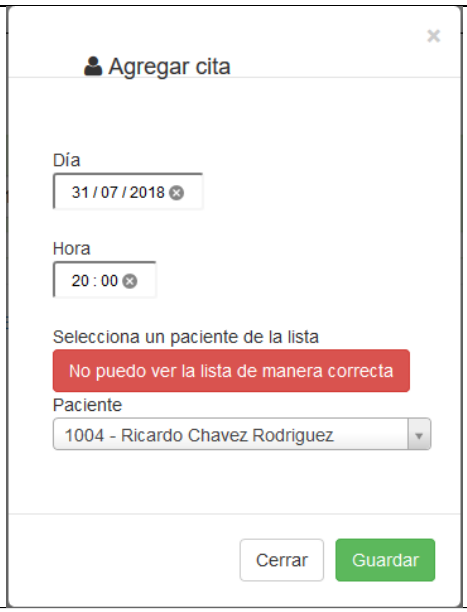
Errors management in module 3.

User name already exist



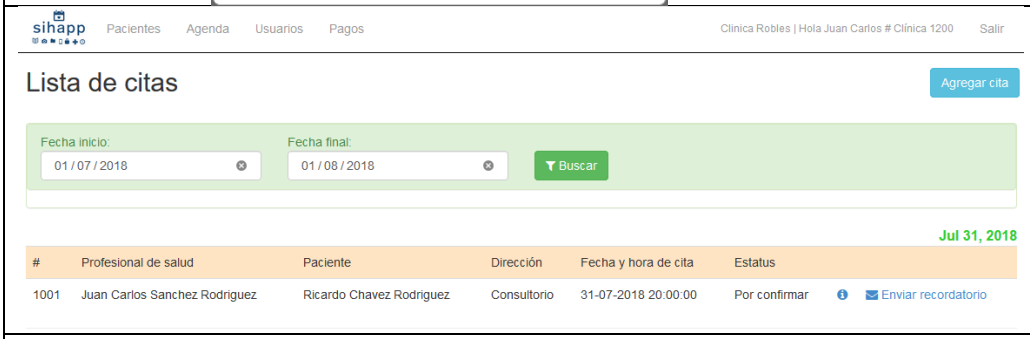
Module 4. Appointment and medical consultations

4.1 New appointment



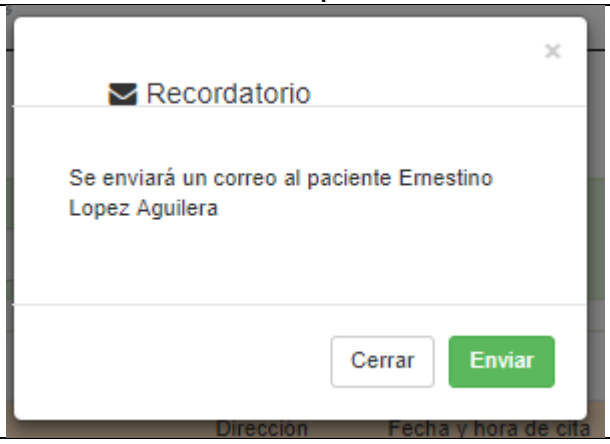
Inputs

- Date
- Time
- Patient from existing catalog



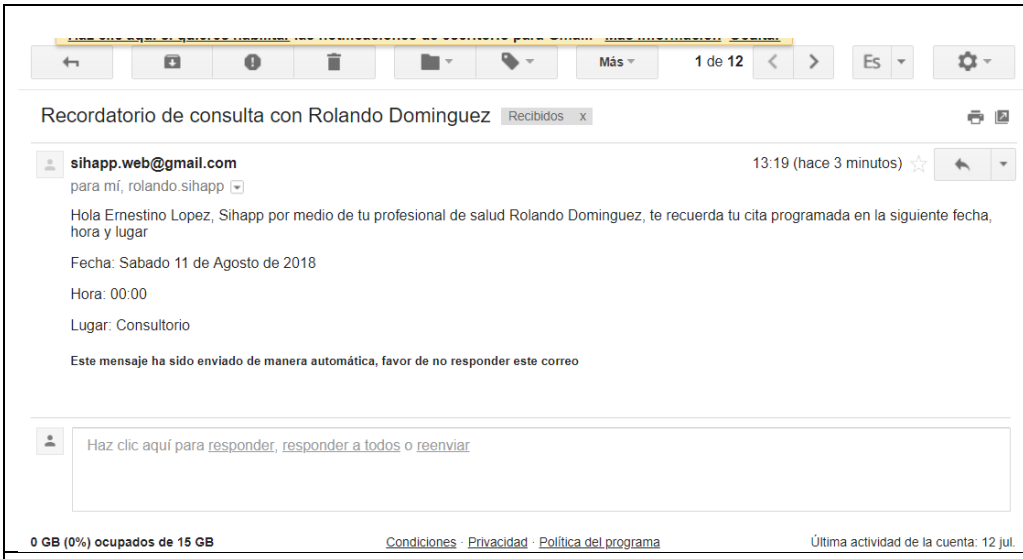
Outputs
Appointment in agenda

4.2 Send e-mail reminder to patient



Inputs

- Select appointment from grid



Output
Email delivered to patient´s email

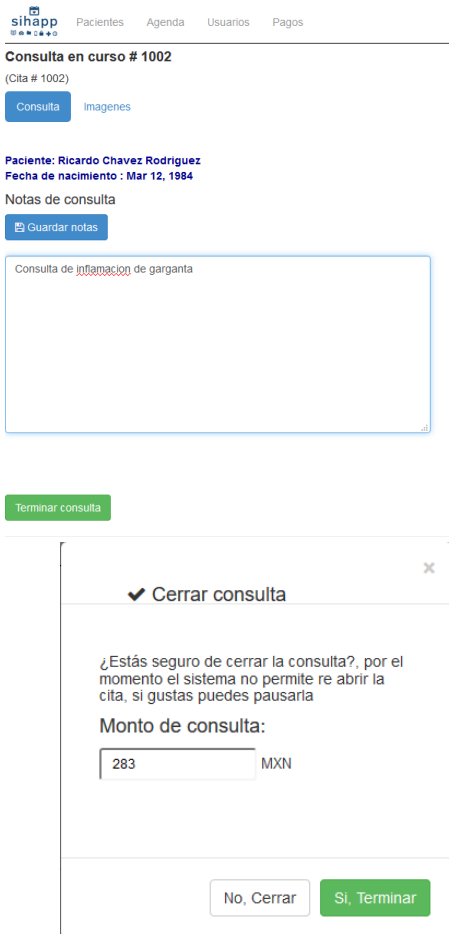
4.3 Load image on medical consult

Inputs

- Medical consultation in progress
- Image from device

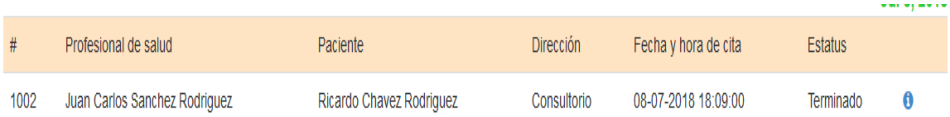
Output
Image saved on Images tab on medical consultation progress

4.4 Save notes for medical consultation



Input

- Select current medical consultation
- Notes
- Ammount to pay



#	Profesional de salud	Paciente	Dirección	Fecha y hora de cita	Estatus
1002	Juan Carlos Sanchez Rodriguez	Ricardo Chavez Rodriguez	Consultorio	08-07-2018 18:09:00	Terminado

Output

Finished medical consult

4.5 Time configuration for medical consult

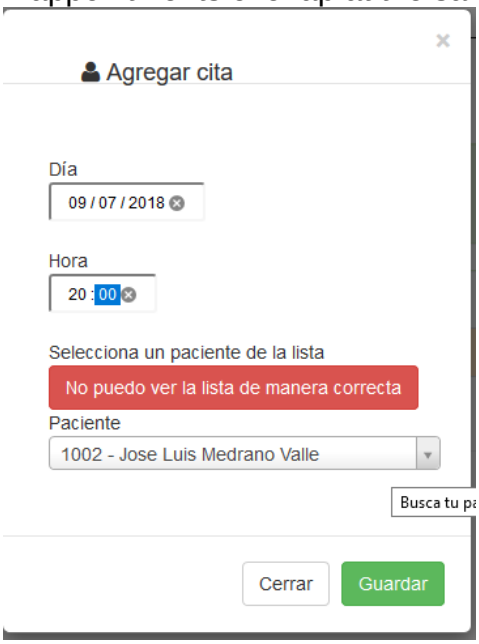
Inputs

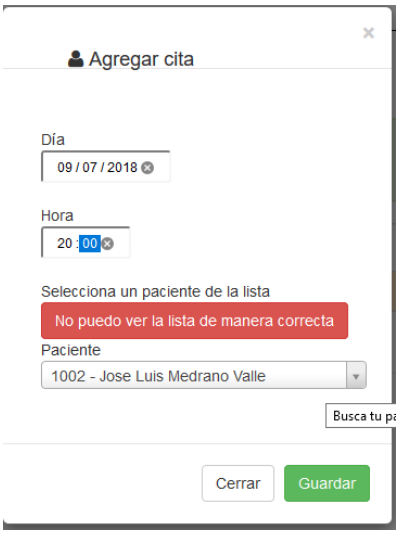
- Logged user (non patient user)

Outputs
Minutes setting up

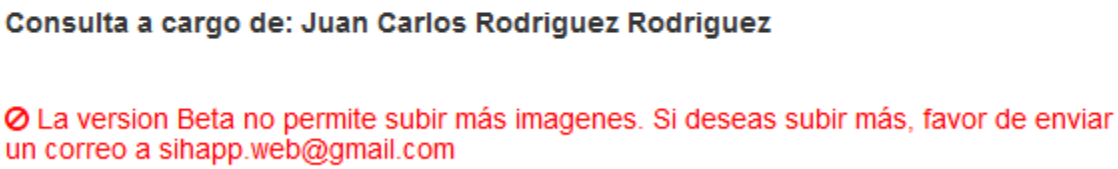
Errors management in module 4.

2 appointments overlap at the same time

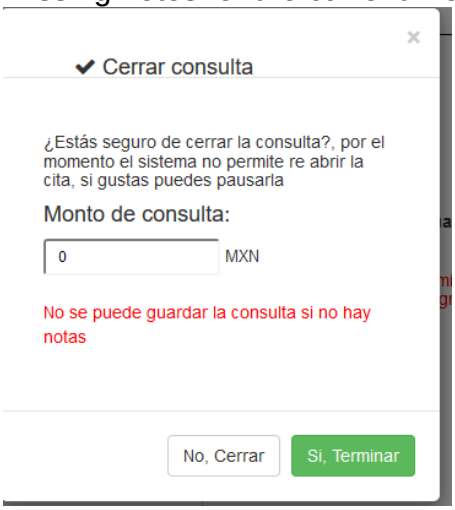




Triying to upload more than 2 image on same medical consultation



Missing notes for the current medical consultation at close time

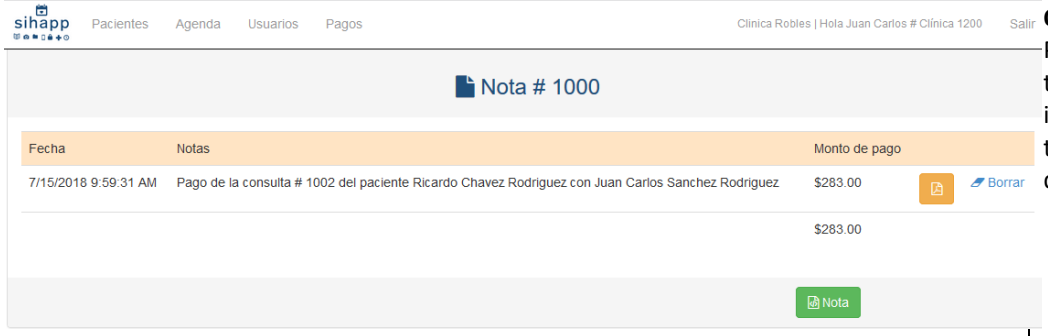


Module 5. Patient payments

5.1 Total payment income for medical consult

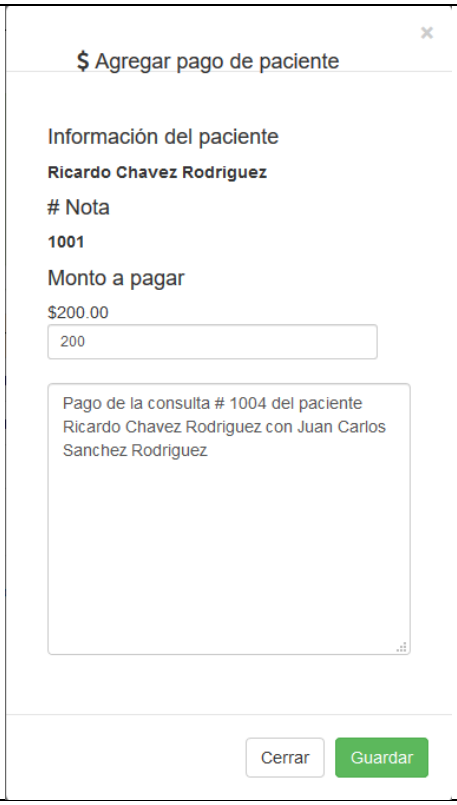
Inputs

- Selected medical consult
- Ammount
- Comments



Output

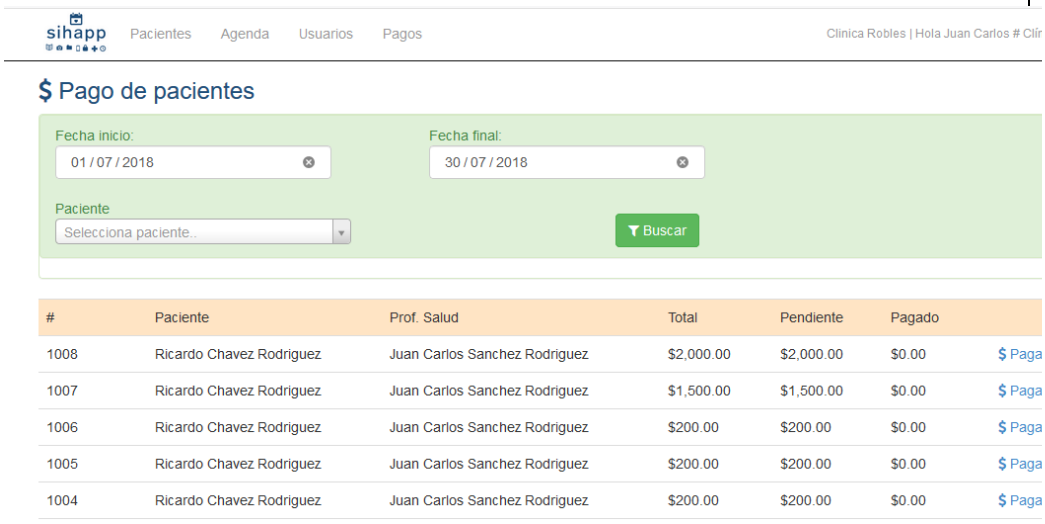
Payment receipt list in the detail of the note, it will only be a PDF of the payment in the detail of the note

4.2 Partial payment income for medical consult	
	**Inputs** • Selected medical consult • Ammount • Comments
	**Outputs** List of 2 payments in the detail of the note PDF of each of the payments

Erros management in module 5.

Income payment exceedes total.

Módulo 6. Expediente del paciente

6.1 Watch patient record	
	**Inputs** • Patient with medical consults

sihapp

Clinica o consultorio: Clinica Robles

Expediente Ricardo Chavez Rodriguez	
Edad: 34	Fecha de nacimiento:12/03/1984
Fecha de actualización de expediente: 7/29/2018 7:03:12 AM	jajaja@gmail.com

Total de consultas: 8
Ultima consulta: 7/29/2018 6:59:20 AM

Consulta # 1010 a cargo de: Juan Carlos Sanchez Rodriguez

Comienzo 7/29/2018 6:59:20 AM Final: 7/29/2018 6:59:42 AM
Notas: enfermedad en cavidad del esofago

Consulta # 1009 a cargo de: Juan Carlos Sanchez Rodriguez

Comienzo 7/29/2018 6:58:55 AM Final: 7/29/2018 6:59:06 AM
Notas: saklcfghasklchnas,mncas,mc la

Consulta # 1008 a cargo de: Juan Carlos Sanchez Rodriguez

Comienzo 7/29/2018 6:57:58 AM Final: 7/29/2018 6:58:12 AM
Notas: kasljdgfkasd.ljgvasdzmfgvñladj.lvad

Outputs
Patient record in PDF file

Errors management in module 6.

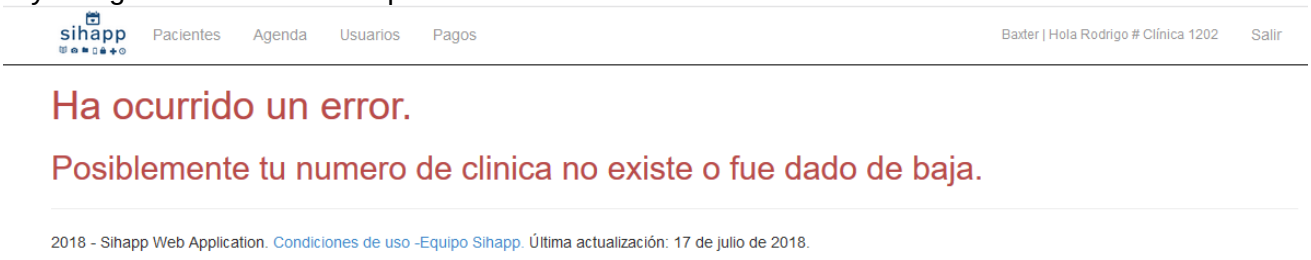
Patients with no medical consults.

Clinica o consultorio: Clinica Robles

Expediente Rolando Dominguez Lozano	
Edad: 25	Fecha de nacimiento:29/11/1992
Fecha de actualización de expediente: 7/29/2018 11:53:20 PM	rolando.fcfm@gmail.com

Total de consultas: 0
Ultima consulta: NA

Tryin to get the another clinic patient record from URL



Results obtained.

People who practice their profession have been interviewed and talked about, and based on the needs, the base or prototype application has been created that contains the most basic and simple processes such as patient catalog, appointment scheduling and user management.

The storage of photographs was also integrated, which although it was not requested, is an added value in the application, since it could be used by health professionals to observe and monitor the progress of their patients.

The application has been used by people close to the professions dedicated to health and the necessary feedback has been given so that this application can be used and marketed in the medium-term future.

Campaigns on social networks are of great importance to publicize this type of new systems, since although similar systems already exist, this one in particular can offer simplicity and quick implementation in practices of any size.

Final conclussions

The realization of this application made it clear to me that information technologies can be used in our favor, as long as they are focused on optimization processes and our benefit, either to make our work easier or for healthy entertainment purposes.

Personally, it is a satisfaction to start the venture doing something that can help others and that I like to do, it is also an intellectual satisfaction, because the development of an application of this type requires a taste for programming and the exponentiation of thought. abstract.

I have mixed most of the knowledge obtained in my bachelor's and master's studies, as well as what my working life has given me, these tools are enough to create technological and cutting-edge tools to provide computational solutions to the community in general. , schools, hospitals, companies and any branch in which information technologies can be applied.

Bibliography

[1]. Francisco Rueda F. ¿Qué es la computación en la nube? Universidad de Los Andes. DEA Informática, Universidad de Grenoble. Revista Sistemas.

[2]. Alonso-Arévalo, Julio DBD . Aplicaciones móviles en medicina y salud. Artículos del Departamento de Biblioteconomía y Documentación APDIS Abril de 2016

[3]. Mtra. Florina Gatica Lara Mtro. Fernando J. Fernández Puerto México. Sistema de Información Hospitalaria Universidad Nacional Autónoma de México Facultad de Medicina Departamento de Servicios de Cómputo, D.F., 2003

[4]. Luis Iribarne. Pasado, Presente y Futuro de los Sistemas de Información Distribuidos. Departamento de Lenguajes y Computación, Universidad de Almería Ctra. Sacramento s/n, 04120, Almería, 2001

[5]. Oscar Ávila Mejía. Computación en la nube. Depto. de ingeniería Electrónica. UAM-I

[6]. Torre Díez, Isabel de la. Desarrollo y evaluación de un algoritmo de seguridad para una app de salud en el campo de la Cardiología. Trabajos Fin de Master Uva Universidad de Valladolid. Escuela Técnica Superior de Ingenieros de Telecomunicación Año: 2017

[7]. José Martínez Casas. Apps de Salud: Nuevas Herramientas para el cuidado del Paciente Cardiológico. Comité Editorial de enfermería en cardiología 2015

[8]. Rick Rainey. Microsoft Azure Essentials Azure Web Apps for Developers 19 de junio de 2015

[9]. Yuri Diogenes . Microsoft Azure Security Infrastructure Debra Shinder, 2015

[9]. Rolando Domínguez, María Hernández 2017http://sihappinfo.azurewebsites.net/Home/Contact. Condiciones de uso Sihapp Web 2017

[11]. Henrik Kniberg & Mattias Skarin. Kanban y Scrum –obteniendo lo mejor de ambos. C4Media Inc. editores de InfoQ.com. 2010

[12]. Yohn Daniel, Amaya Balaguera. Metodologías ágiles en el desarrollo de aplicaciones para dispositivos móviles. Estado actual. Universidad Pedagógica y Tecnológica de Colombia, sede Tunja. 2013

[13]. Henrik Kniberg. SCRUM Y XP DESDE LAS TRINCHERAS Cómo hacemos Scrum C4Media, editor de InfoQ.com. 2007

[14]. Pete Deemer, Gabrielle Benefield, Craig Larman, Bas Vodde. INFORMACIÓN BÁSICA DE SCRUM (THE SCRUM PRIMER) Certified Scrum Training Worldwide, 2009

[15]. Marcus Hammarberg, Joakim Sunden. Kanban in Action. Manning Publications Co. 2014
Trello Quick Guide. 2015.

[16]. Adriana María Iglesias-Solano. Story Points y su importancia en la estimación de proyectos bajo el enfoque ágil. Universidad Simón Bolívar, Barranquilla-Colombia. Revista I+D en TIC.2011

Appendices

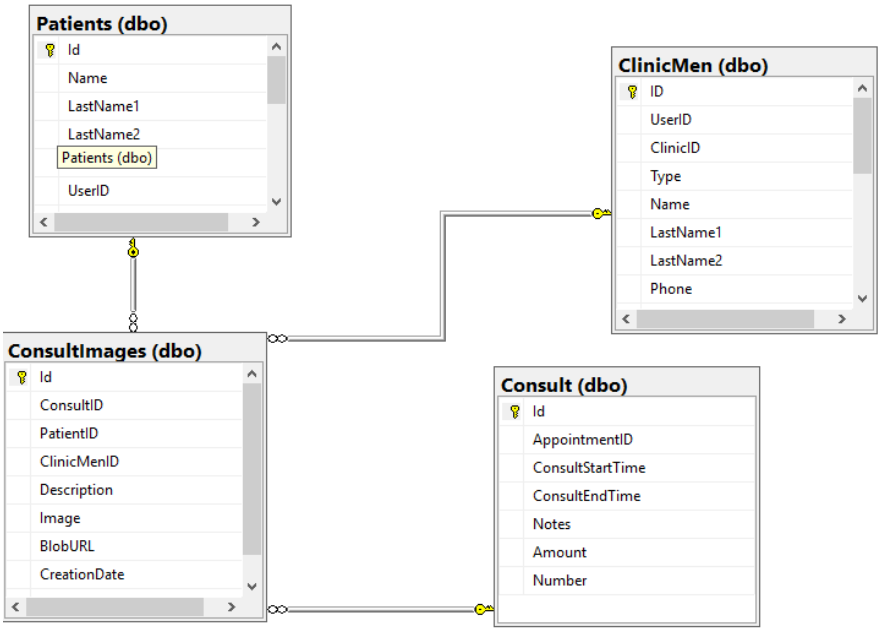
Timeline

SUMMARY	DTSTART-DATE
Microsoft Identity configuration	26/03/2017
Database creation	26/03/2017
Login Identity Microsoft System	02/04/2017
Microsoft Azure account	09/04/2017
Project repository	09/04/2017
User layout in system	16/04/2017
Deployment SQL Database Azure	22/04/2017
Conection String for production in cloud	22/04/2017
Register form integrated with identity	23/04/2017
Main tables creation (Clinics and medical professionals)	24/06/2017
Page header	02/07/2017
AngularJs integration	02/07/2017
Master key for any account with support purposes	02/07/2017
Logic status management for patients (patients delete)	06/07/2017
First patient grid version	08/07/2017
Add patient user from users panel	08/07/2017
DB first Entity Framework approach	12/07/2017
Add patient with the possibility to create a user for this one	13/07/2017
Refactor for user types	14/07/2017
Add new auxiliar staff clinic user	15/07/2017
Add new medical professional user	15/07/2017
Appoiments list view	16/07/2017
Appointments time validation	19/07/2017
Grouped patients appointments	22/07/2017
Button for begin medical consult	23/07/2017
Panel for adding a medical consultation	24/07/2017
Visual enhacecements Sihapp	26/07/2017
Svn migration to git	10/08/2017
Image load in medical consultation	19/08/2017
Image load in medical consultation	20/08/2017
Deployment portal in production	24/08/2017
Patient detele validations	29/08/2017
Deployment date integration	12/10/2017
Login redesing	19/10/2017
Sihapp manager creation	21/10/2017
Sihapp Official logo integration	08/11/2017

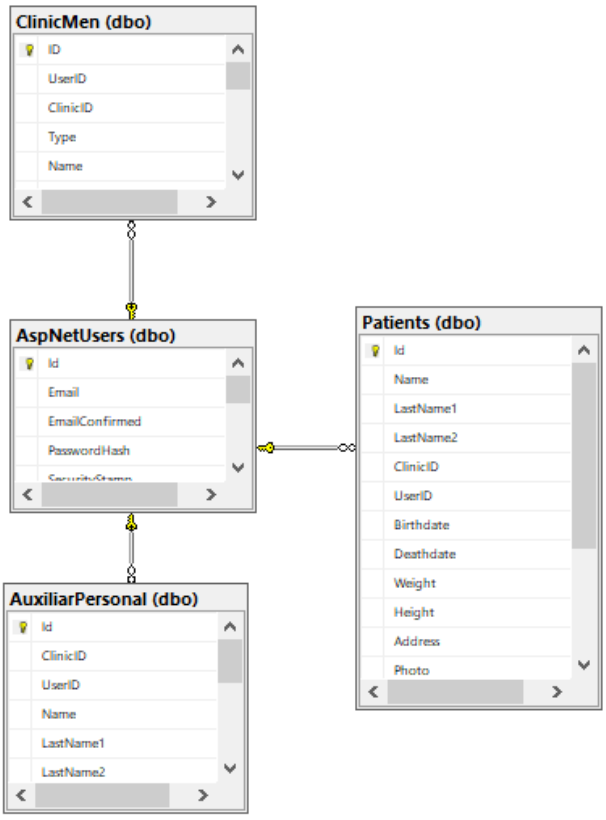
Login simplification	12/11/2017
Welcome email	19/11/2017
Image count validations on medical consult	09/12/2017
Ajax errors handle	24/01/2018
IP logged in DB	17/03/2018
In medical records appears details like dates and patient age	26/03/2018
Code refactor	21/04/2018
Autocomplete component for patients in medical appointments	19/05/2018
Autocomplete component for patients in medical appointments	20/05/2018
Autocomplete component for patients in medical appointments	24/05/2018
Account balance status screen per patient	26/05/2018
Account balance status screen per patient	27/05/2018
Account balance status screen per patient	02/06/2018
Account balance status screen per patient	03/06/2018
Account balance status screen per patient	09/06/2018
Finish file screen	10/06/2018
Final visual enhacements	16/06/2018
Final visual enhacements	17/06/2018
Integration tests	23/06/2018
Documentation	24/06/2018
Documentation	25/06/2018
Documentation	26/06/2018
Documentation	30/06/2018
Testing documentation	01/07/2018
Release of user manuals in information portal	07/07/2018

Entity – Relationship Diagrams

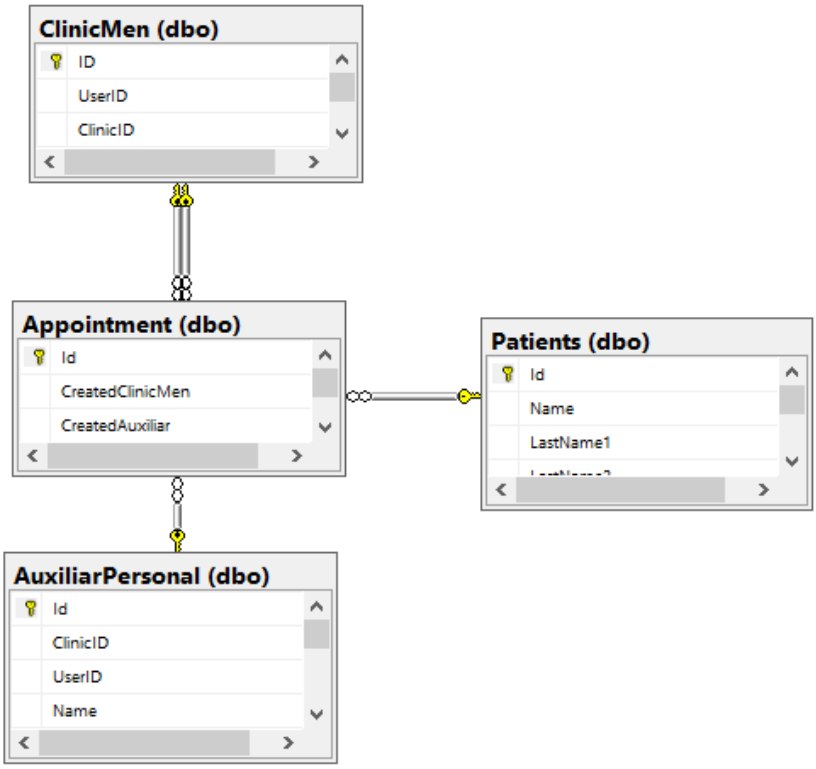
Medical consultation relationship, Consultation images, Health professional and Patients



Authentication Identity table and user types diagram



Relation between appointments and patients



Relation between medical consultation and appointment