

Health Information System: Final Report

This project aims to develop a Health Information System oriented to the Cardiology area of a Hospital. This is the final report where we describe the structure and functionalities of this System.

1. System Description:

As described before, we have developed a Health Information System for a hospital specialized in Cardiology. This system is designed with the purpose of keeping track of all the patients of the hospital. With this purpose, we will collect, store and manage useful information as patients profiles, investigations, diagnosis and cardiograms. We can identify the next main actors of the system:

- **Hospital Staff:** Doctors and nurses. They are able to add, edit and remove the information of the system such as patients, diagnosis, investigations and cardiograms.
- **Patients:** Main actor of the system. Patients will have access to the information (profile, diagnosis, investigations and cardiograms) related to them.
- **Diagnosis:** We can store the patient diagnosis following the specific SNOMED CT nomenclature for cardiology. The system will allow to attach comments and images to the diagnosis.
- **Investigations:** It stores patient investigations with information such as temperature, heart rate and symptoms.
- **Cardiograms:** Cardiogram uses heart rate data to predict and prevent heart diseases. The system will store cardiograms and provide some basic utilities to manipulate them.

2. Functionalities

The main purpose of this system is keeping track of patient clinical health history. In order to achieve this, the system allows to store: Patient information and Diagnosis, Investigations and Cardiograms related to the Patient. We have implemented the next functionalities in our system:

- Based on role access, we divided the functionalities and information displayed to patients and staff personnel.
- Patients can view their clinical history (Diagnosis, Investigations and Cardiograms)

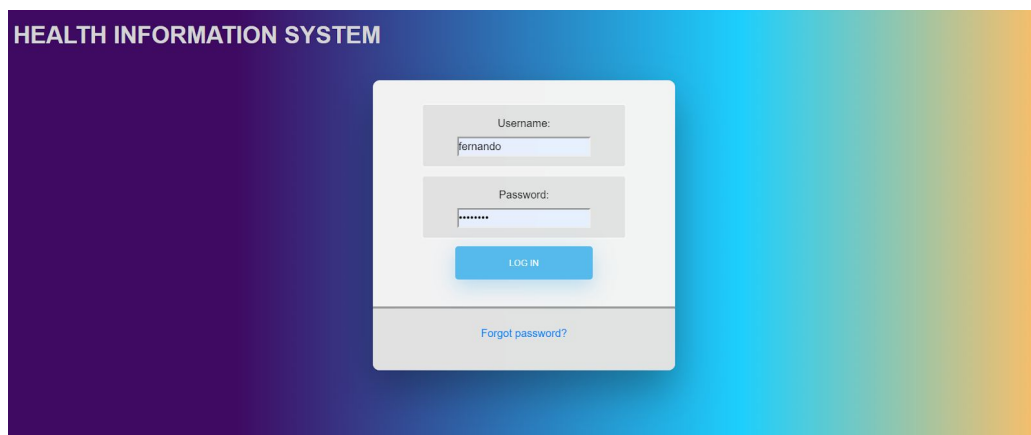
- Staff personnel can register, edit and delete Patients, Diagnosis, Investigations and Cardigrams
- Staff personnel can view the clinical history of each patient.
- Staff personnel can upload, edit, display and manipulate Cardigrams.
- Staff personnel can filter Cardigrams.
- Staff personnel can find QRS points and Heart rate from a cardiogram.

3. Navigation

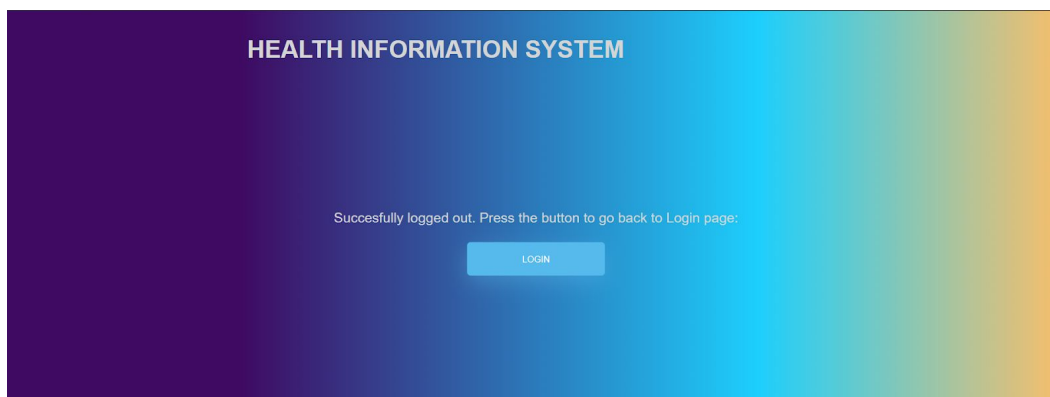
In order to understand the basic operation of the system, we will do a basic tour:

3.1. Login and Logout pages:

The first view is the logging page where the user must Log In. We have a role based access system that only allows Staff group member (Doctors and Nurses) to access, edit and delete the information of the System. After logging in, regular patients access to a view where he/she can see all the information related to him/herself.



After users log out from the system they will see a log out confirmation view that allows the user to return to the Log In page.



3.2. Patient Homepage

Once the patient is logged in, the information (profile, diagnosis, investigations and cardiograms) related with himself/herself will be displayed:

The screenshot shows the 'HEALTH INFORMATION SYSTEM' interface for a patient. The user is identified as 'Berto Romero' with a 'LOG OUT' button. The page is divided into four main sections: Patient details, Patient diagnosis, Patient investigations, and Cardiograms.

Patient details:

Name	Gender	Birth Date	Nationality	Email	Visit Date
Berto Romero	Other	June 8, 1979	spanish	berito@vub.be	March 12, 2020

Patient diagnosis:

Diagnosis ID	Diagnosis Date
14	March 29, 2020

Patient investigations:

Temperature	Heart Rate	Symptoms	Experienced Before
37.9	102		False
38.5	85		False
38.6	98		False
38.7	123		False

Cardiograms:

They also have access to a detailed view of their diagnosis and cardiograms.

Patients accounts are generated automatically after a patient is added to the system:

- User: email
- Password: name + "_" + last_name

3.3. Staff Homepage

Once a Staff member logs in he/she will see the Home Page where the basic information of the system will be displayed: number of patients, diagnosis and investigations. The Staff member will have access to the different main sections of the System using a sidebar. These sections are Home, Patients, Diagnosis, Investigations and Cardiograms. The user will have access in all views to the Logout button.

The screenshot shows the 'HEALTH INFORMATION SYSTEM' interface for a staff member. The user is identified as 'Fernando Loro' with a 'LOG OUT' button. The page features a sidebar on the left with navigation links: Home, Patients, Diagnosis, Investigations, and Cardiograms. The main content area displays the 'Home Page' with summary statistics.

Home Page

Number of patients, diagnosis, investigations and cardiograms:

- Patients: 3
- Diagnosis: 3
- Investigations: 12
- Cardiograms: 3

Logged in as: Fernando Loro

Views counter: 1

3.4. Patients, Diagnosis, Investigations and Cardiograms List

Each main section list the respective actor records. In the next figure we can see an example for Patients. In this view, we can also add new records (Patients, Investigations, Diagnosis or Cardiograms). Finally, we can select a record to see it in detail by clicking on it ID. We will see later how a detailed view look like. If the number of records is elevated, we paginate the elements of the list as it is shown in the Investigations example:

ID	Patient Name
25	Ignatius Farray
26	Ignatius Farray
27	David Broncano
28	Berto Romero
29	Berto Romero
30	Ignatius Farray
31	David Broncano
32	Ignatius Farray
33	Berto Romero
34	David Broncano

3.5. Add new Patient, Diagnosis, Investigation and Cardiogram

When pressing the Add New (Patient, Investigation, Diagnosis, Cardiogram) button the user will see the next view (New Diagnosis example):

HEALTH INFORMATION SYSTEM

User: Fernando Loro
LOG OUT

Add new diagnosis:

Patient:

Diagnosis:

Additional comments:

Diagnosis date: January 1 2020

Image: Seleccionar archivo Ningún archivo seleccionado

Image: Seleccionar archivo Ningún archivo seleccionado

Logged in as: Fernando Loro

Views counter: 5

In this view we can fill the form for adding a new record to the database. For the Diagnosis we can select a Patient from the already existing patients. In the Diagnosis selector, we can select a Diagnosis between all the cardiology diagnosis listed on the SNOMED CT terminology. We can also add until two images to the diagnosis. If we want to make changes effective we press the Save Data button. If we press the Cancel button the new element won't be added and we will be redirected to the respective Patient, Diagnosis, Investigations or Cardiograms list.

When adding a new cardiogram, we have to select the cardiogram file. This file must be a .mat file, the binary file format used by MATLAB in order to be able to manipulate it. In the project folder there are three cardiograms in .mat file format that can be used for creating a new cardiogram report.

3.6. Patient, Diagnosis, Investigation and Cardiogram Detail

In this page we can see a detailed view of the record. In the next picture we can observe a patient in detail with his/her personal information and all the the diagnosis, investigations and cardiograms associated to him/her. For a more detailed view of the diagnosis or cardiograms we can click on the diagnosis or cardiogram ID. In this view we can also edit or delete the Patient, Investigation Diagnosis or Cardiogram. Pressing the Back button we will go back to the respective main section.

The screenshot displays the 'HEALTH INFORMATION SYSTEM' interface. On the left is a sidebar with navigation links: Home, Patients (selected), Diagnosis, Investigations, and Cardiograms. The main content area is divided into sections for Patient details, Patient diagnosis, Patient investigations, and Cardiograms. The Patient details section shows information for David Broncano. The Patient diagnosis section shows a single diagnosis with ID 13. The Patient investigations section shows three records of temperature, heart rate, symptoms, and whether the patient has experienced the symptoms before. The Cardiograms section is currently empty.

Name	Gender	Birth Date	Nationality	Email	Visit Date
David Broncano	Male	Oct. 17, 1984	spanish	david@vub.be	June 1, 2020

Diagnosis ID	Diagnosis Date
13	March 18, 2020

Temperature	Heart Rate	Symptoms	Experienced Before
37.4	94	Lack of air	True
37.2	108		False
38.4	94		True

ID	Patient Name	Cardiogram
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3.7. Edit and Delete Patient, Diagnosis, Investigation or Cardiogram

In this view we can edit an already existing Patient, Diagnosis, Investigation or Cardiogram. As we can see in the example, we can modify the record using a form where the actual attributes of the record are loaded.

Home

Patients

Diagnosis

Investigations

Cardiograms

HEALTH INFORMATION SYSTEM

Edit investigation:

Patient: Ignatius Faray

Temperature: 36.7

Heart rate: 124

Symptoms: High heart rhythm without intense activitie

Experienced before: ☒ SAVE DATA

BACK

Logged in as: Fernando Loro

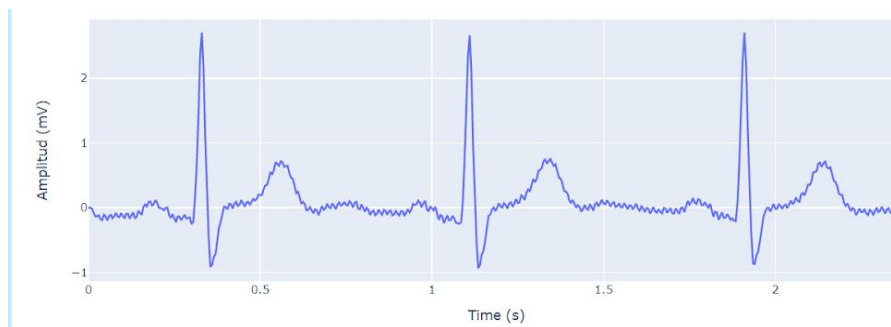
Views counter: 14

User: Fernando Loro

LOG OUT

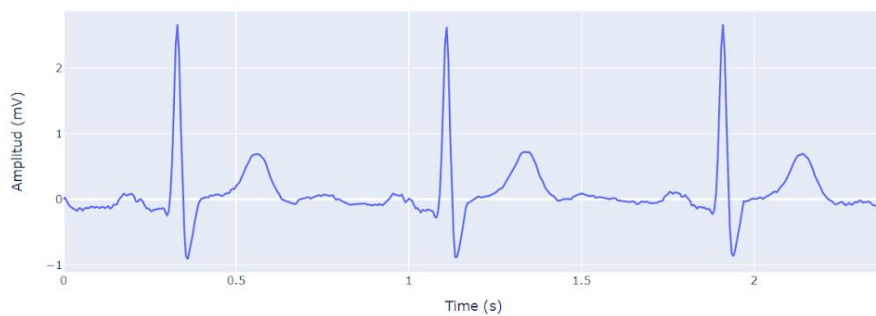
3.8. Filter and Find QRS Points from a Cardiogram

The cardiogram detail view displays the original cardiogram uploaded to the system:



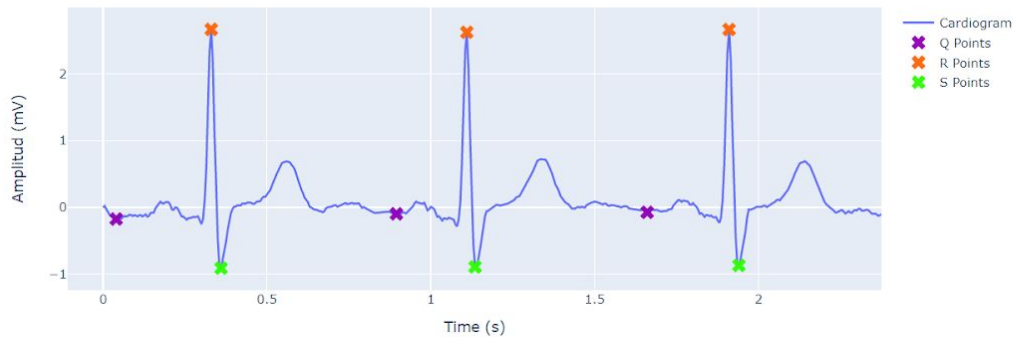
This cardiograms may have noise that can be filtered, using the Filter Button.

Cardiogram Plot in Time Domain



Finally, we can find the QRS points and calculate the Heart Rate using the Find QRS Points Button:

Cardiogram Plot in Time Domain



Heart rate: 76.92

4. Additional Information

In order to get a better understanding of the Health Information System operation, we consider important to add the next remarks:

4.1. Accessing and authentication

The starting page when accessing the HIS is the login page that can be found in the next direction:

/cardioapp/accounts/login/

The administration web page of the system can be found:

/admin/login/

The administrator of the system has the next credentials:

- User: fernando
- Password: fernando

The system authentication uses the default django authentication. This authentication uses User and Groups tables in order to manage accounts and permissions. In this project we have only used two groups (Patients and Staff) in order to differentiate patients from hospital personnel.

There already exist created the next set of users:

Doctor:

- User: doctor_01
- Password: the_professional

Nurse:

- User: nurse_01
- Password: the_professional

Patients:

Ignatius Farray:

- User: ignatius@vub.be
- Password: Ingantius_Farray

David Broncano:

- User: david@vub.be
- Password: David_Broncano

Berto Romero:

- User: berto@vub.be
- Password: Berto_Romero

It is important to remark that when we register a new patient in the system, a new account will be created automatically with the next credentials:

- User: email
- Password: name + "_" + last_name

This allows the patient to access their information once he/she has been registered as a hospital patient.

4.2. SNOMED CT Terminology

The SNOMED CT terminology is loaded from the pymedtermino database. This is a big database that we cannot include in the project, so we have only imported the required terminology. The code used for populating the system database table that stores the SNOMED CT terminology can be found:

HealthInformationApp\CardioApp\SNOMED_populate.py

4.3. Cardiogram Functionalities

It is also important to remark that the code implemented for manipulating cardiograms require the next libraries installed in the Python environment:

- Plotly
- Numpy
- Scipy

These utilities are implemented in an additional python file that can be found in:

HealthInformationApp\CardioApp\cardiogramutilities.py