# Rehabilitation's patient tracking application

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## 1. Summary

One of the most valuable things inside an hospital is the time of the personal stuff working on it. It is so relevant that many tools developed and implemented in their workstations have the only objective of reducing their time performing daily tasks. From management to final diagnosis, all are key in the process of work inside hospital.

So, having this general impression of what is the main purpose for an engineer when trying to help in this sector, We came up with the idea of creating this application.

It has to be considered additionally, as a tool of the many used in the rehabilitation section of the hospital, with the aim of getting two purposes: Picking up the information of the visual analysis from the physician and storing it. This lead to the physician being able to review it and have the chance of visual interpretations from the development of the rehab itself.

It is still a prototype but in the following points you will see the five sections that compose this application. The state of art, where the problem is presented, as the explanation on why we choose this project and some project references that treat more likely this theme. The materials and method used to develop this work. And the experiment itself, explaining step by step the application with its correspondent displays.

In addition, future implementations will be presented as some interesting ones are already taken into consideration. Like for example, automatization and enhancements of the measures from the limbs and forces made by the patient/user of the prothesis with the implement of cameras like Kinect from Microsoft.

## 2. State of art

In 2020, we had the chance of seeing which are the main steps that the workers have to follow when a patient visit the place in order to talk about their condition of rehabilitation's need and so on.

Considering all the important staff that they showed me, one stands out from the engineering point of view. Which is the procedure of creating notes and using the standard protocol for storing all the metrics information made to the patient when performing the first visual inspection and later on the rehabilitation visits in the gym or areas specialized on.

This process, from what We could see, was slow and did not give any help for the physician in order to perform the task in a better way and no visual interpretation for the assistance of measuring the patient while their progress.

So We decided that one of the best manners to help the team would be creating a network application which will aid to the physician collecting the measures made by them so that They can have a proper tool where store all this information more visually and easy to manage, review the patient data created before in case of any need, search any relevant information and lastly, aimed to the progress of a specific patient, having relevant graphs of the numerical measurements so that the evaluation of the headway's patient can be assess by a visual interpretation of the visits performed each week or month, studying the development of the patient.

Works related to this idea proposed, generally can be seen on the Hospital itself as the already tool used daily or even in many algorithms created by other researchers as the RecuperApp [1], created by José Miguel Sánchez Sanabria for the Hospital San Ignacio and focussed on tracking rehab patients with a cardiac pathology.

This project of master is aimed to the use of itself in correlation with the telemedicine. As it looks like a fitness application, it recaps important data easy measurable in the daily activities so that the professional from any distant can store this information and check the status of the person.

## 3. Materials and methods

In this section We will explain each of the main technologies implemented in the project. They consist of:

- MySQL
- XAMPP
- Hypertext Markup Language (HTML)
- JavaScript
- Hypertext Pre-processor (Php)

First the project, before any handing of real data, as We were working with a prototype, it was a real need to create a database that mimics this information that could have the hospital so that we can evaluate the application and look for errors if exist.

For this reason, we introduced MySQL. This tool is a freely available open-source Relational Database Management System that uses Structured Query Language. With the use of this implement, we were able to create a source of information, from the references that Hospital gave to me, which would be composed by random identifications

corresponding to simulated patients, which each of them would have also heuristic data in each of the columns, which are the important features considered from the physician when performing rehabilitation inspections.

These characteristics mentioned, will be the hearth of the project as we will try to save it, manipulate it, search it and lastly implement if in a reliable visual format.

The features are organized in:

- Nivel de amputación
- Vida basal previa :
  - Deambulación previa
  - Independencia o no
  - Vive solo o no
  - Vivienda con ascensor
  - Alteraciones de la vista
  - Deterioro cognitivo
- Estado general del paciente
- Grado de colaboración
- Miembros superiores :
  - Deformidades
  - Rango articular
  - Balance muscular global
  - Manos
- Miembros inferiores :
  - No amputado:
    - Funcionalidad no amputada
    - Presencia de flexos
    - Presencia dolor articulaciones
    - Balance muscular
    - Pulsos arteriales distales
  - Amputado:
    - Nivel
    - Muñón: inspección, conformación, longitud Transfemoral y Transtibial, edemas, presencia de espícula ósea, actitud y hallazgos añadibles.
    - Rango articular
    - Balance muscular
    - Miembro fantasma
    - Valor equilibrio unipodal



*Figure 1 MySQL data base*

After creating the database **[Figure.1]**, it will be needed to proceed to the creation of the code that will be the base of the network pages which are supported by XAMP servers.

The XAMP is just the open-source web server that will work for hosting in a localhost the code generated afterwards.

As standard language for the web browser to display the code, we will use HTML. Its main definition tells that is the set of markup symbols or codes inserted into a file intended for display on the Internet. The markup tells web browsers how to display a web page's words and images **[2]**.

Later, for the programming part that will create the interaction between the XAMPP server and the client, in this case the physician, it will be used JavaScript **[3]**. This language will belong to the CCS sections implemented in the HTML code.

And lastly, PHP. A method to create the built-in functions by me so that the personalised queries from the physician to the MySQL server can be full filled **[4]**.

## 4.    Experiments and results

The creation of the whole code has been performed by the consultation of the referential links **[5,6,7,8,9]**.

In this section we will review each point of interest from the application, explaining it and giving visual examples of how It would be seen. The app is divided in these five pages:

- Home page.
- Insert page.
- Search patient by id page.
- Search patients by value.
- Graph page.

First, the home menu where you, as user, can access to any of these four links of interest where you will find the optimal function for you purpose **[Figure.2]**.

*Figure 2*



*Figure 3*

If you click in the first option, you will be guided to the Insert page, where will be pop out all the options from the reference metrics in order to be completed by the expert.

There are some special inputs like Rango articular and Balance muscular, where you will be able to put the value by moving the yellow point to the desired point as it is shown the value below the cell. **[Figures.3-4]**



*Figure 4*

So, after completing the corresponding cells (those forgotten by the expert or no completed, will be filled in by zero or none in the case of being a string variable), you will have the option of saving the information into the database mentioned previously or clear all **[Figure.5]**. Then you can click to home button to go backwards.



*Figure 5*

As second link, you have the option of searching patients in order to see their corresponding values measured by putting their respective ID. **[Figure.6]**



*Figure 6*

After writing down the identification, it will appear all the dates of the visits made by the person which are available from the database. **[Figure.7]**



*Figure 7*

Then, the corresponding values of the date choose will be shown so that any editing can happen. Finally, the save option down below the page in order to keep the changes made in the database, replacing the previous values **[Figure.8]**
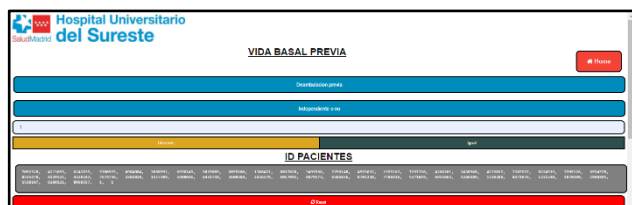


*Figure 8*

As third option, you can select searching patients (Id) by looking to specific values and conditions **[Figure.9]**.

For example, if we are interested in looking for the patients that are above specific value, we just have to go to the corresponding variable, put the value and select "Mayor que".

In the image below **[Figure.10]**, it is shown an example of the patients whose value of having an elevator in their home is different to 1 (which implies being equal to 0 = not having elevator)



*Figure 9*

*Figure 10*

Finally, as the last feature of the application, you can select the fourth option. It will lead you to the page where you can look for the graphical interpretation of the patient of interest when studying their progress with respect to the numerical variables. This metrics correspond to Rango articular, balance muscular and edema.
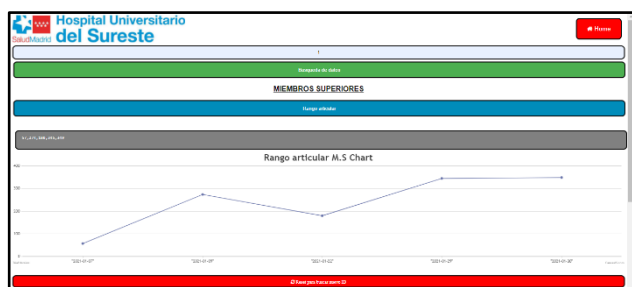
For getting these visuals, you just need to insert the identification of the patient to study, so that numerical variables appear, and then clicking in the one of interest, or even more if it is required or wanted. **[Figure.11-13]**



*Figure 11*



*Figure 12*



*Figure 13*

## 5. Conclusions and future projects

The whole sets of programming codes, languages, and tools to complement them as XAMPP, where the project was made of has been giving problems to me personally day after day. The reason of this is because this type of algorithms has not been usually used in my course (Biomedical engineering), so my knowledge of it was not the best and still has more gap to improve.

Nevertheless, thanks to the help from my tutor and the links provided by him, we think that the project has reach to the minimum point and beyond, thanks to the graph extension,

so that the application could function as the ideal replacement for the Hospital with respect to their standard tools when managing the data from the rehabilitation's patient is considered.

We both think that the whole work has full fill the expectations that we were looking when trying to find out an optimal application with the primary tasks of providing an efficient and reliable way of:

- Storing the information
- Creating new one
- Having the possibility of editing it
- And finally, help in the diagnosis and evaluation when dealing with the progress of the patient.
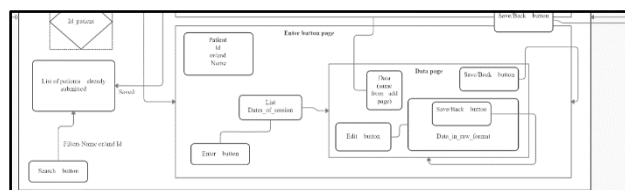
In the following images [**Figure.14-16**], you can see the first concept of the diagram that we had in mind when we were thinking about this idea of project.
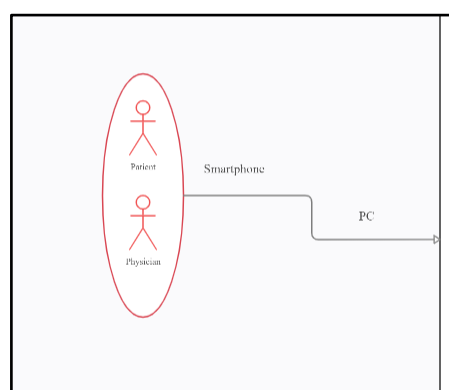


*Figure 14. Left part of diagram*
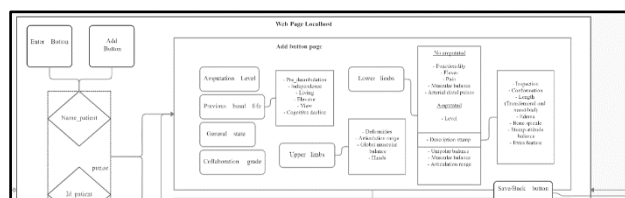


*Figure 15. Upper part of diagram*



*Figure 16. Lower part of diagram*

This representation was performed in the simplest way so that We could approach this concept to the reality without the risk of returning possible errors or having to putting limitations to the application.

This "easy approach" does not have to influence negatively to the project itself. It makes clearer to understand the roots of the project and all the branches. This type of things is important in the case of anyone wanting to add extra options and tools to the algorithm, so having the chance of

reding the original code and understand it clearly, makes this simpler and more painless.

Some ideas that are already active research areas, are the automatization of measuring each of the numerical variables, related to lower and upper limbs. This is made by the connection between the posture of the patient and the capturing method which pick up the information and process it so that it can measure the coordinates of points of interest (like the extreme of the limbs) and perform for example gait analysis, or even the range of the articulation as the reference metric of this project.

Nowadays, the most used method for capturing this data is the Kinect of Microsoft due to its accessibility, both economically and when creating algorithms around this device. **[10]**

Despite there are still some limitations in this process, like which movements of the motor systems can be captured or the skill of differentiating between the incapacities of the patient, there are some studies that prove the reliability **[11]**.

So, moving on this kind of method from the research areas to the clinical ones, will be a big step in assisted diagnosis for the rehabilitation area of the hospital

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