MeDB: a Portable Clinical Historical Database

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Abstract. In medical structures it is very important to keep track of patient conditions in every moment: every exam they come to do, their pathologies and exemptions and their family condition. It is also important for them to have access to their medical history particularly for neurological diseases. This system proposes a web portal in conjunction with a MySQL database and an ad hoc hardware system to facilitate both the data acquisition and the availability of those data for the patient everywhere

Keywords. IoT, Open Science, FAIR data & services, Biomedical data research, Portable database

Introduction

Telemedicine and teleconsultation, which offer potential improved healthcare, are becoming possible by the improvement of IoT technologies. Design and creation of multimedia information management and medical communication technologies has been underway in several studies [Krishnan et al., 1997 Ingman, M., & Gyllensten 2006; Fincke et al., 2010]. The objective of these field has been to develop systems which provide the medical community with the necessary storage, processing and communication facilities. One of the key issues is the uniform and user-friendly handling of multimedia information.

1. Concept

The proposed system is composed of three main modules: a database, a web portal and an Arduino-based hardware. The MySQL Database module is responsible of data persistency. It is composed of ten tables, some of them contains lists of data used by the program to populate dropdown and, some of them contains users' information and the remaining are relationship tables created to model "many to many" relationship between records.

The Web Portal module, Figure 1, use a mixture of HTML, JavaScript and PHP. It connects to the MySQL module allowing the user to exec basic CRUD (Create, Read, Update, Delete) operations on tables, like adding or removing an User, an Exam, an Exemption, a Pathology or a Mutation. Through the portal it is also possible to add and remove the relation between those records in a fast and user-friendly way. It is possible to retrieve the last access of every patient for a specific exam and a specific date, to get all the first accesses in a specific time period, to know how many patients have a specific exemption code, how many patients have a specific disease and how many of them have a specific mutation. The latter provides a useful tool that automatically calculate the average arising age giving the researcher an "on the fly" information about a specific mutation.

Finally, an innovative tool that let rapidly create and assign a genetic pedigree to each user

Fig. 1
Web Portal module:
a) MySQL database,
b) genetic pedigree tree editor,
c) Hardware-Portal
communication console

of the system, is implemented and made accessible from the user card. This tree editor is a lightweight web-application written using a mixture of vanilla JavaScript and "p5.js" that let exporting the tree as a jpg or save it into the system to be modified later.

The Hardware module, Figure 2, is an Arduino-based system should be installed at the entrance of every exam room or in a medical doctor office. The same system is also used for the registration phase, in which an USB card is associated in a "one to one" relation with an User. After the registration, every time a user inserts his USB card in the device, it communicates with a central server through Wi-Fi; the server receives the ID of the patient and the ID of the exam and register a new access into the Database. It is important to empathize that this kind of system gives the medical structure the freedom to register patients by his own. This help categorize patients from different medical departments giving the possibility to collect data only from their field of interest.

Furthermore, the server sends updated personal and clinical information to the Hardware module, these data will be stored in the personal card. The advantage of such a system will be that the patient will have always the data with him and only medical doctors can access and modify the database. This will avoid the loss of information going through different medical doctors and environments and can help them to treat patients without a doubt about patient medical history in case of emergency.

2. Technologies

The proposed system has its foundation in the hearth of several main technologies: MySQL, PHP, HTML, JavaScript, C# and Arduino. These technologies have been chosen to create a product that is solid, fast, easy to use, install and maintain.
MySQL is a golden well-known standard in the field of databases and it has enormous capability to store and manipulate data.

PHP has been chosen to write the Web Portal module. This programming language is very fast and has a lot of built in functionalities to connect and execute query on a Database. HTML, the main language used to build the web portal. Php is a language that works in couple with HTML, it can be integrated inside of it using variables and database calls to create a dynamic web page. Furthermore, JavaScript has been used to create a more dynamic page: this programming language can act on the DOM (Document Object
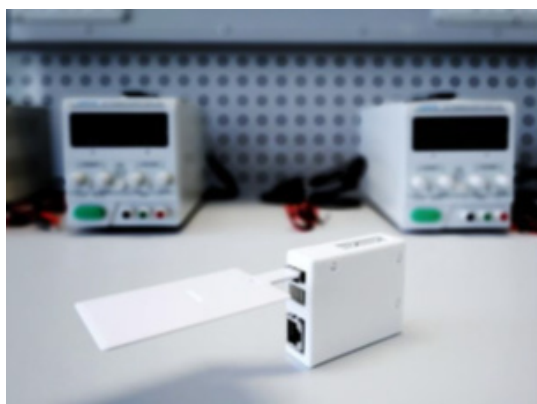
Model) elements of the pages changing their styles, their position or even injecting text inside them. In this web portal it is used to create a more user-friendly GUI (Graphic User Interface) in conjunction with CSS (cascade style sheet).

Complementarily C# has been used since it is a very powerful object-oriented programming language and make the system to be portable and fast. This language is used to build the server that will receive and dispatch information from the Arduino.

The hardware module for the identification of the patient and the storage of personal and clinical data consists of an Arduino YÚN together with an USB shield programmed using the specific Arduino Environment.

Arduino YÚN has been chosen since it is strictly designed for IoT world. It combines the power of Linux distribution based on OpenWrt with the ease of use of Arduino environment. Furthermore, the board has built-in Ethernet and Wi-Fi support. Finally, the system can be powered by plugging it with a plug or simply connecting it to a battery.

The developed software uses a conjunction of a series of libraries: "SPI.h", "Usb.h", "Process.h", "Bridge.h" and "BridgeClient.h". Those libraries are used by Arduino to access the USB card and read the vendor ID: a unique ID assigned from the factory to each pen. Furthermore, those libraries are used to create a Client to connect to the Server that will later associate this ID to an account on the Web Portal. If necessary, the hardware module can download updated information to the USB card that can be not only textual information but also medical images coming from medical devices.

3. Conclusions

The proposed solution aims to create an all-in-one system that is portable, easy to use and install, low-cost and that can be helpful for patients, medical doctor and researchers. It allows to easily access, manage and store crucial information about patients' medical history from everywhere letting researchers and medical doctors create ad-hoc optimum therapies. Furthermore, it permits statistical analysis on data helping the medical centres to focus their efforts on specific pathologies and needs.

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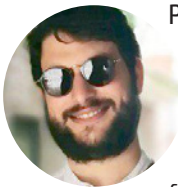
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