BIOPEN: A PROPOSED WEB APPLICATION FOR IMPLEMENTING THE BIOLOGICAL ELECTRONIC PROTOCOL SYSTEM OF ENTEROPATHOGENS CHARACTERIZATION

Personalized Web Sites and Services

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Abstract: In the present work, we have developed a Biological Electronic Protocol System for Enteropathogens Characterization (BIOPEN) with a Web Application interface that allows users to query data for characterization and analysis of pathogens through an integrated management of accurate collection, storage and retrieval of data, which aids decisions in health actions to combat diseases caused by these microorganisms. The proposed tool is an electronic protocol that aims to facilitate data sharing in health care, using a structured database to store information concerning about clinical assays and molecular characterizations of pathogenic strains and clinical isolates. BIOPEN was developed using open source facilities and is freely distributed, allowing a particular laboratory create a customized, reliable, and low cost database. Thus, the principal contribution of this work is to provide a tool that store and integrate results of physiological, biochemical, and molecular clinical tests that can help researchers in taxonomic identification of clinical isolates and prospective epidemiological studies.

1 INTRODUCTION

The objective of this research is the development of a web application called BIOPEN which stand for Biological Electronic Protocol System of Enteropathogens Characterization as a research tool. This project presents an integrated uniform interface for sharing biological data among researchers in the Internet about characterization of Enteropathgens organisms for medical evaluation. The development of this system has been done through a shared electronic protocol, by implementing a web platform for integration of researchers and professionals in various areas, such as medicine, biology, technology and information systems, biochemistry and bioinformatics. The web resources allow the connection to multiple remote locations and advanced research centers (Gorga et al., 2002). And so, the use of technology is relevant for providing the information to improve care for diseases that have high priority in health systems.

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(Young et al., 2007) suggests the use of the software for storage, communication, treatment and available of biological and medical information. The strategies should be developed, for example, creating electronic information or records of electronic protocol. The use of web technologies, integrating medical information clinical and laboratory treatment allow a fast distribution. Then, using information technology is the key to success of health organizations.

Currently, the health sector is experiencing an accelerated growth of implementations of computational systems, including software development, network design and communication tools and so creating the need for new strategies of information management in health centers (Young et al., 2007). Moreover, (Doebbeling et al., 2006) comment that the traditional forms of information storage, retrieval and analysis tools are inadequate in the health's area because the majority of investments in information technology also have focused only on the administrative part.

However, (Uslu and Stausberg, 2008) failed to define the economic benefits of cost-effectiveness of

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electronic protocol. The authors based on two basic factors proposed by (Berg et al., 1998): First, protocols should not be overly structured or have a degree of complexity to not generate problems of usability and second, the system must ensure immediate benefits for primary users. As these factors were insufficient for research, (Bean and Martin, 2001) proposed a system whose data generated by health electronic protocol provides a mechanism of action in the public health system that can quickly identify problems and take necessary measures to prevent the spread of disease. Therefore, (Druszcz, 2006) declared that the use of electronic protocols can provide greater credibility to clinical data and, consequently, improve the methods of scientific research.

(Aranha Junior et al., 2009) and (Pinto, 2006) and (Doebbeling et al., 2006) define the protocol as an appropriate resource of information technology used in the medical field for capturing, storing and searching data effectively and becoming a high relevant tool for clinical studies.

On the other hand, (Bean and Martin, 2001) alerts that the implementation of health electronic protocols can be effective if planned previously. The biggest challenge for implementing these protocols is to improve the electronic interface to facilitate communication among users of the practice of infectious diseases in public health (Wurtz and Cameron, 2005).

The pathogens used in this project are the enterobacteria. These organisms have their importance in disease infectious, especially in diarrhea which is a major cause of death in developing countries as reported by (UNICEF/WHO, 2009). Considering the difficulty in identifying these pathogens and their importance as a cause of diseases in humans, this research aims to assist the map-reading of data, after characterization of these species, sharing the contents of these data to researchers and professionals through the creation of an efficient electronic protocol. This project has been built based on the integration project electronic protocols called SINPE (Integrated System Protocols Electronics) proposed by (Aranha Junior et al., 2009).

Such analysis will generate various types of data for identification and characterization of these pathogens. Several biochemical and molecular tests are used, such as tests of resistance to antibiotics and characterization exams of species, for example RFLP (Restriction Fragment Length Polymorphism) among others (Aguilera-Arreola et al., 2007). Hence storing in a systematic, objective and secure way, allowing the user to recover the data and further analysis is important.

Therefore, the present research proposes the BIOPEN. This project is a data management with electronic protocol using data coming from laboratory analysis and the characterization of pathogens by the molecular tests for prospective epidemiological studies. For this reason, the protocol resources and integration of electronic databases are our main contribution of this research.

2 PROPOSED METHODOLOGY

Four steps were followed to achieve the objectives. The first step involved the architecture and definition of data modeling; in the second step an interface for the electronic protocol was designed; in the third step, it illustrates the implementation of planned application and in the fourth step tests were performed to validate the proposed system.

2.1 Results of Step 1: Architecture and Data Modeling

This step is the definition of the data modeling, using a tool to describe the input and output and relational modeling to identify all the system's information based on literature.

This data modeling is relational and has been built using twenty-seven tables as illustrated in Figure 1.

Figure 1 shows the visualization and sequencing of the tables used in the database. The sequencia table and organism table are the main reference. The first is related to the taxonomies of bacteria (domain, kingdom, phylum, class, order, family, genus, species, besides the classification of a more specific using the nitrogenous bases (adenine, cytosine, guanine, thymine and uracil) as gene, isolated, read and sequence of a gene. In the second table, which makes the base of the database, will be stored tests and results of laboratory analysis in addition to the registration administration.

The used tool for creating this data modeling is the DBDesigner. This tool is freeware and has resources for implementing of SQL codes.

For architecture modeling of electronic protocol, we are used the (JUDE, 2010). This modeling tool supports the software planning and specification by UML (Unified Modeling Language). This diagram represents a use case that describes the feature set of electronic protocol. The proposal of the electronic protocol structure is based on user interactions with the system, such as consultations accomplishment, maintenance of records, information generation and generation of statistical graphics.

The proposed system offers user registration, organism registration, records the test results, generates

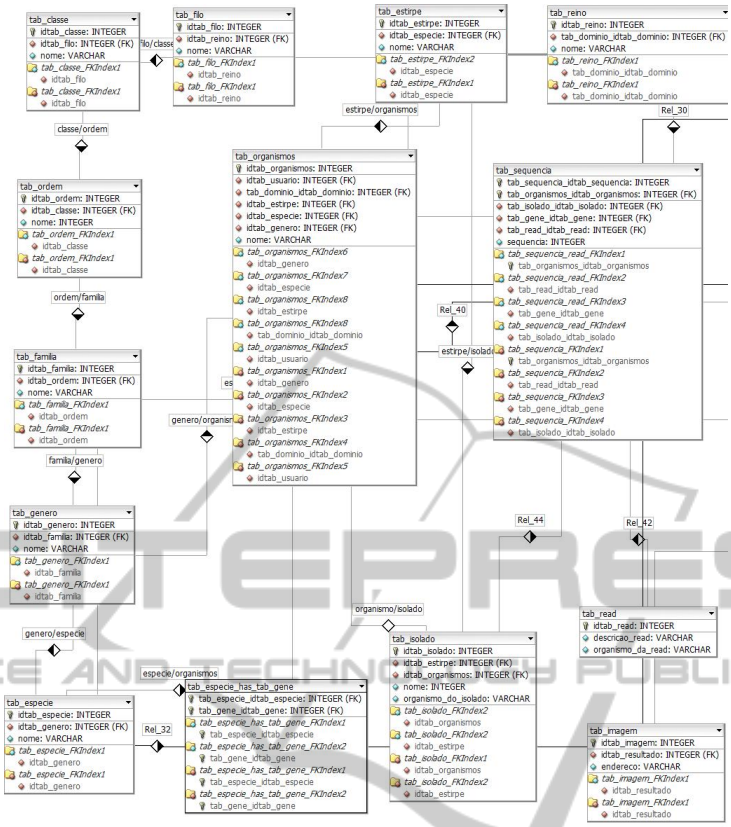

Figure 1: Data modeling of BIOPEN Project.

graphics based on these results and information retrieval according to the requirements of researchers.

Analyzing the protocol modeling, we have divided the information in six main groups that are: administrative data, operation control, history reports, and epidemiological control and test results. Each one has a detailed description in step 2.2 with its features. We have created sub-items like a division of the principal groups as illustrated in Figure 2.

Relating to its architecture, Figure 2 shows the concept of the screens and its links. This way, the user can easily navigate through several pages interactively. For example, the Figure 2 shows that the screens contain fields with selection logic and this becomes the user interface more friendly.

2.2 Results of Step 2: Conception of Interface Design

During stage 2.2, an user friendly interface has been implemented, similar to other reported web applications ((Aranha Junior et al., 2009) and (Porcides et al., 2010). (Porcides et al., 2010) propose a web application called SBIM (Shared Biological Image Manager). This project presents an integrated uniform interface for sharing biological images among researchers in the Internet.

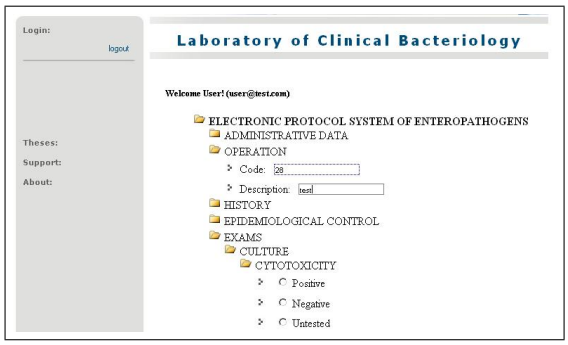

Figure 2: Main Screen of BIOPEN Project.

(Aranha Junior et al., 2009) propose the use of statistical graphs in SINPE project, showing data objectively and organized. This functionality is been implemented in this project.

2.3 Results of Step 3: Implementation

The third step consists in the computational implementation of the proposed system using the programming language PHP and the DBMS (Data Base Management System) PostgreSQL. Both are freeware tools. Currently, this phase is being implemented based on the proposed modeling in the previous steps.

2.4 Results of Step 4: Validation Tests

In the fourth step, tests were made to validate the proposed system. In this phase, the validation protocol is based on methods proposed by (Pressman, 1995), the use of a checklist to evaluate the user perception of the system and initial tests of database. As initial results of validation, tests were used to evaluate the database using the command truncate table and retrieval of results by the name of the exams, besides the positive and negative conditioning. The recovery of examinations and the names, and the names with the conditioning of positive and negative shows the average of 7503.2 ms and 5222.75 ms.

3 CONCLUSIONS

This project is in implementation stage. The relevance of BIOPEN project is to facilitate the availability of data about diseases caused by enteropathogens among laboratories of Bacteriology in web environment, becoming a public database of any research, reliable and secure information that could be used in prospective epidemiological studies. This is the principal contribution of this research. In future studies we will implement some other functionalities, as algorithms for data mining with pattern features for improved researches.

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