Biomedical and Health Informatics (BIOM9450)
Major Project: A Web-based Vital Signs Database

Due: Monday 25th November 11:59 pm – Submitted online

Tasks

In this project you are required to design web-based software for managing research data related to vital signs (continuous electrocardiogram (ECG), continuous photoplethysmography (PPG), average heart rate (HR) extracted from the ECG, and blood pressure (BP) values – systolic, diastolic and mean). The underlying database, as well as all web pages in your application should be ***your own*** design. Essential user information must be entered and validated and the referential integrity of the data maintained. You will not be given in-depth details on how the tasks are to be achieved: that is up to your ingenuity, creativity and perseverance. Make sure you ***read*** the criteria given below ***very carefully*** as marks are allocated for each one of them.

As a starting point, a database 'BIOM9450Vitals.mdb' has been placed on Moodle. This database contains three tables. The first table 'Subject' contains records from 18 unique subjects. It includes demographic subject data (name, birthdate, sex). A second 'Activity' table includes a relationship to the Subject table, a test date and a description of the test performed. In this case the descriptions capture four different types of tests related to changes in the subject's cardiovascular system, including baseline data, a head-up tilt test and a lower body suction test at two different suction levels. A third table 'Physiological_data' is linked to the Activity table and may contain sets of vital signs measurements for each activity. In most cases this will be ECG, PPG, heart rate and BP but in some cases either some or all vital signs data may be missing for an activity. Likewise, not all subjects need to have activities.

The ECG and PPG data are sampled at 50 Hz encoded as a string comprising a series of numbers separated by spaces. ECG data are in mV. PPG data are stored in 10 bit offset binary, scaled between 0 and 4095. The average heart rate record is in units of beats per minute. BP data comprises three numbers, systolic, diastolic and mean pressure in units of mmHg.

Note that the database ***is not necessarily normalised and you may choose to create your own normalised set of tables*** with appropriate primary and foreign keys, relationships and indexes as part of the project requirements. The database should be placed in your root directory and be named `project.mdb` in order for it to be connected to the ODBC alias that has been created for you in PHP.

You **must also include** a 'Researcher' table. Each Subject is to be associated with one or more researchers. As part of this design there should be user name and a password for maintaining security. Confidentiality of data is to be maintained via a secure login feature whereby a username and password are entered. The login must be adequately secure such that if a person was to know the URL of a page (not necessarily the initial logon page) then they would be denied access unless they had gone through appropriate authentication. There should be two levels of access. A login entry should be possible for a 'researcher/practitioner' so that they can view data and generate reports on ***their assigned*** subjects. Note that it is possible for one subject to have multiple researchers associated with them. An administrator login should also be possible to have universal access to data as well as to assign subjects to a particular researcher and perform other database administration functions.

More specifically, researchers should be able to insert new subject data (not data in the physiological or activity tables though) into the database, as well as search, browse and edit data for only those subjects that are part of their research trials. When viewing data, researchers should be able to view a list of subjects and be able to 'drill down' using hyperlinks to a ***detailed display of that subject's physiological data if it exists***. These data should be graphed using TeeChart and all existing physiological data for all activities for that subject should be either plotted (for ECG and/or PPG) or tabulated (for BP or HR) along with appropriate labels and annotations.

In contrast, administrators should be able to search and browse the data for all subjects in the database. In addition, they must be able to add new researchers into the database or update/change details for existing researchers, as well as be able to assign an existing subject to a new researcher.

One additional report that the administrator (only) can link to is a graph of responses to activity. This graph should plot mean and standard deviation of the HR against age (for all subjects), categorized by activity type (i.e. one of the four listed activities).

Server-side validation of data should be performed using PHP and database integrity enforced using appropriate database rules. You may choose to also perform some client-side data validation using JavaScript in order to improve the user experience.

Report

You are expected to hand in a complete report detailing the tasks undertaken and the approaches adopted, including database design and user interface descriptions. This should include a brief "user's manual". It is not necessary to print your PHP/Javascript code (unless there are particular code snippets that you want to make mention of) as we will be accessing this from the server.

Ideally, the system should be complete and bug free. If sections of your program do not work as expected, you should explain where and why the bug(s) occurred, and what attempts you have made to track the source of the error.

Please make sure as part of the user manual you provide sample login usernames and passwords so we can easily check you design. Also, if you are coding the project offsite ensure it works fully on the computers in the laboratory!

Marking Schema

The broad marking schema will comprise the following sections (marks per section given in parentheses):

- Database design (20): check that required data is stored, appropriate normalisation, keys, relationships and indexes are in place, design is justified in report, adherence to project requirements.
- Web functionality (30): login/logout functionality, patient, practitioner and administrator portals are fully functional, charts and statistical analysis are functional, appropriate navigation, security.
- Error checking and validation (15): applied to all data entry, SQL errors handled for incorrect data entry, appropriate error messages, combination of Javascript, PHP and database rules.
- Web interface, design (aesthetics, ease of use, inventiveness), presentation (20)
- Report (15)

NB: A non-plagiarism declaration form must be attached to your hand-in report.