IPRO It takes a team
INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 315
Web-Based Tools that Support People
with Diabetes and Educate Others

FINAL REPORT
Fall 2005

Faculty Advisors
Dr. Ali Cinar
Dr. Emmanuel Opara
Prof. Raymond Trygstad

Graduate Adivsor
Meriyan Eren

Students
Russell Derrick
Michael Addis
Niyanta Arora
Elizabeth Bauer
Tina Chiu
Byung Kim
Jungmin Kim
Salman Mohiuddin
Benson Okeiyi
Floriann H. Stankovich
Shailvi Tyagi
David Zaboli

December 14th, 2005

Table of contents

Introduction

Diabetes mellitus is a deadly disease. Although it does not cause immediate death, it is a slow killer. An estimated 18.2 million people in the United States have Diabetes. Diabetes kills more than 182,000 Americans each year. It incurs $92 billion for direct medical costs and $40 billion for indirect costs. Thus, in this IPRO we have chosen to focus our attention to this disease as a whole; to educate people, both with and without diabetes, about the disease and how to plan a proper diet as means of management of diabetes.

Background

There are two major types of diabetes, Type 1 diabetes and Type 2 diabetes. Type 1 diabetes is a genetic, autoimmune disease beyond the control of an individual at risk for developing the disease. In contrast, Type 2 diabetes, in spite of a genetic predisposition, is caused by the body's increased resistance to insulin action, but the risk of developing the disease can be significantly altered by an individual's lifestyle choices, including poor diet and lack of exercise. Patients with Type 2 diabetes can manage the course of their disease with proper diet and exercise. A major aspect of treatment for Type 2 Diabetes is therefore educating patients about their disease and empowering them to make better dietary choices.

The GlucoSim website was initially designed to serve as an educational tool to help educate users with or without the condition of diabetes to understand the essentials of the disease, making them aware of the implications of eating different kinds of foods by indicating resulting glucose levels in various parts of the body, the risk factors and ways to prevent it. Previously the website focused on the various aspects of the GlucoSim simulator in place, a web-based educational simulation package for glucose-insulin levels in the human body.

The framework for the software and some of the tools aimed at helping diabetes patients were already available online on a fully functional web-site created by Dr. Cinar and his graduate students. The software was made using ASP code, Perl, HTML, and Access database. The web site currently exists on a server managed by the Process Modeling, Monitoring, and Control Research Group at IIT. It was our group's task to make the website more informative and user friendly.

The online nutrition meal-planner was created to help users to better manage their diabetes and understand more about the disease. It is hoped that users will become more aware of the implications of eating different foods by allowing them to view the nutritional values of each food consumed. There is a meal planning capability that allows you to plan and save each meal you eat thus allowing you to monitor your diet by showing the nutritional composition of each food. Sample meals are also shown along with recommended values of proteins, carbohydrates and fats that have proven to be healthy daily amounts.

In the last decade, more focus has been on the types of carbohydrates consumed rather than the amounts of carbohydrates. This research has lead to the development of glycemic index. Glycemic index is the measure of total blood glucose measured every 15 minutes over a two-hour span after 50 grams of carbohydrates of a specific food has been consumed. The values calculated are then compared to the test results from when the subject consumed 50 grams of pure glucose, and from there a value from zero to 100 is assigned to the specific food. Foods with low glycemic index decrease the average amount of glucose in the blood over time and therefore increase the sensitivity to insulin.

Purpose

There were many goals that the IPRO set forth to accomplish over the semester. There was a guideline of what needed to be done to the website set by the advisors, but the goals were designed by each of the four subgroups: Nutrition, Glycemic Index, GlucoSim, and Software. The break down of members in each group will be discussed in the next sections.

The nutrition group wanted to make their website more user friendly by modifying the look, increasing content about diabetes, including a glossary of terms, and to assist users in meal planning. To accomplish these objectives they made the following goals: survey an eclectic group of students to get feedback about the website, make changes to the website based off the surveys, create a Body Mass Index calculator, make the meal planner easier to use, and to have warnings when the meals plan exceed dietary standards.

Informing the user more about glycemic index and incorporating the value into the meal planning were the main objectives of the glycemic index group. They goals consisted of: adding glycemic index values for as many foods as possible into the database, displaying the glycemic index values on the meal planner for both individual foodstuffs and the entire meal, compile glycemic load values, modify the GlucoSim model to incorporate glycemic index values within it to make a more complete model, and to add an information page to the nutrition website explaining glycemic index and load and their importance to glucose monitoring and diabetes.

Keeping in mind the current layout and complexities faced by the users using the simulator, the GlucoSim decided to make the website more attractive, user-friendly and informative. A principal objective was to formulate a tutorial on the know-how of diabetes mellitus. A second objective was to frame a visual in the form of an animation and a power point presentation on the key players of diabetes to educate viewers better. After educating viewers about the disorder itself, we thought that a third objective would then be to make a power-point as well as a video tutorial on how to use the GlucoSim software. One of our last objectives would then to be change the layout of the current website to make information more accessible and easy to interpret.

For the software group, it was felt that to make the web-site more open to public, it needed to be made more user-friendly and containing more information which would be useful to the general public. Some changes were also demanded aimed at the enhancement of the software to make it more suitable for use. Some conceptual changes of the software were also required, which allowed the user to obtain the information more easily. It was decided to make the website more visually appealing, contain more information, contain easier navigational styles, and include more dependable resources.

Assignments

To get everyone involved, each group member was assigned to one of four sub-groups: Nutrition, GlucoSim, Glycemic Index and Software. The following are the sub-groupings with the sub-group leader denoted in bold.

I. Nutrition:
    1)   **David Zaboli**
    2)   Elizabeth Bauer
    3)   Salman Mohiuddin

For all the aforementioned objectives and goals set by the nutrition group, there were no individual assignments to get them accomplished. Rather the members worked together to complete what they set out to undertake.

II. Glycemic Index:
   1)   Benson Okeiyi
   2)   Tina Chiu
   3)   Russell Derrick

Much like the nutrition sub-group, the tasks were completed as a group, rather than individuals with his or her own duties. The only exception was that Tina Chiu worked exclusively on the glycemic index information page.

III. GlucoSim
   1)   Floriann H. Stankovich
   2)   Michael Addis
   3)   Niyanta Arora

Floriann H. Stankovich and Niyanta collectively worked on the visuals and tutorials mentioned above. They concentrated their efforts on the layout and design of the GlucoSim web page, which includes a clickable body. Michael Addis spent time compiling the video tutorial that detailed using the software and addressing diabetes as a disorder itself.

IV. Software:
   1)   Shailvi Tyagi
   2)   Byung Kim
   3)   Jung Kim

Each of the software team-members was assigned to a separate group instead of the whole team being collectively responsible for all the software updates. This was to ensure that no groups needs got ignored. Shailvi was assigned to the Nutrition group, Jungmin was assigned to the Glycemic Index group, and Byung was assigned to the GlucoSim group

Research Methodology

For the software group, one of the big parts of this project was learning totally new coding languages that we were unfamiliar with. The software used ASP extensively and the research team decided to spend a portion of their time trying to get familiar with this language so that we may be comfortable using coding later on. A lot of reading and experimenting with ASP code was done. A number of resources were sought to help in easier understanding of the language. Implementing the movies, such as interviews and animation, was also a challenge. In order to provide the information without having the users to download software that supports the format of the movies, the movies had to be formatted into a single type, flash movie.

The GlucoSim team adopted various research methodologies to compile the information for the tutorials and the design for the website. The website of the GlucoSim software was required to provide information on diabetes as well as tutorials on how to use the software. This information was compiled by the using the internet and our renowned faculty as a resource. We tallied the information collected before adding it onto the website.

Visuals in the form of a power-point presentation and an animation explaining the details of the interaction of key players like glucose and insulin in healthy persons and people with diabetes were also completed after much effort was spent on gaining the right pictures and the information.

For the document addressing frequently asked questions about diabetes, the WebMd website was used as a resource. Again, the information was tallied with our faculty. Finally, to come up with a new design for the GlucoSim website, the layout of several similar websites was researched.

To get all the values for glycemic index, extensive research was done on the internet. Many online journals and abstracts were consulted to find the values and equations. These sites were also used to gather the appropriate information about glycemic index for the information page.

To get appropriate feedback about the website, the nutrition group had to create a survey. To get a complete response, a diverse group of students were surveyed. The survey results were compiled and effect changes were made accordingly.

To gather the necessary knowledge about diabetes and meal planning, numerous websites were consulted. These websites were also used to gather information about body mass index and dietary needs for both healthy and obese persons.

Obstacles

The software team experienced difficulties in making several of the recommended changes. The team was not familiar with ASP, and therefore had to learn the new language. Furthermore, the previous programmers did not include charting (descriptions of what the computer coding is for), which made reading their code harder and more difficult to edit.

Another one of the problems that the software team faced was while they were testing out the code. The ASP and CVI (perl) parts could only be viewed on the main server to which we had limited access. It was also a little time consuming to keep switching computers, as the server had no editing software for security reasons.

We resolved this problem by testing out huge chunks of code at a time to reduce the transition time between the testing, analyzing and correction phase. We also tried to test small changes manually (eg. Through notepad using which required a larger understanding of code) instead of using the editing software (like DreamWeaver)

Another problem we faced was getting conflicting information from different members stating what they wanted the new look of the website. We solved this problem by discussing the merits and demerits of each proposed change with the people who suggested them and thereby coming to a common conclusion

Another major obstacle was encountered in trying to create customized meal plans for persons based on whether they had Type 1 Diabetes, Type 2 Diabetes, were obese, or healthy, and on their body-mass-index. Given all of the variables, we were unable to create customized meal plans, and instead created the meal plan based on a 2,000 calorie diet for a diabetic individual.

For the GlucoSim sub-group, they faced a lot of different problems in completing their objectives, mostly due to technical issues. As regards the PowerPoint tutorial on diabetes mellitus itself, data gathering proved to be tedious and time consuming. The information that we needed was either hard to find or contradictory. The consultation with at least four separate sources to verify the information was performed. Some of the sources had different opinions, but we confirmed the information we compiled for various books on the same subject.

While framing the visual, we also faced different software issues. We initially used Microsoft Paint to create and modify many of our images. Owing to the fact that it was a very tedious job and Microsoft Paint did not offer a variety of graphic design tools, we explored and learnt other software like Adobe Illustrator and Macromedia fireworks to complete the visuals. Framing the layout of the GlucoSim website also involved pain-staking efforts. After researching various websites' layouts, ideas were formulated and a new design was generated.

Arranging the equipment (video camera, microphone) as well as the environment where the video will be shot was an effort altogether. We worked out the logistics of the tutorial, and awaited our professors' availability to record this tutorial.

The problems faced by the glycemic index subgroup were the lack of available data on the values. It took many websites and many sources to find the limited about of values for the foods listed in the USDA food database used by the software. All the values that could be found were inputted. No

equations to incorporate glycemic index were found in all the text searched on the internet and in journals. So the GlucoSim equations do not incorporate the value of glycemic index to calculate the level of glucose in the bloodstream and remain solely based on carbohydrates intake.

Results

The nutrition subgroup of this IPRO worked to improve the meal planner website. This included the addition of new features, such as information pages, links to the other IPRO projects, a glossary, a body-mass-index calculator, and Glycemic index entries. Several sample meals were created for users to view as a guideline in preparing their own Diabetic meals. A warning was created to alert users if their meal is above or below the recommended values for the major food groups (fat, protein, carbohydrate). In addition, several changes were made to improve the 'user-friendliness' of the site.

Going about the research in the aforementioned manner, the GlucoSim subgroup completed all of the objectives they set forth to accomplish. The subgroup successfully compiled the video and PowerPoint tutorials and made the website both informative and user-friendly at the same time.

The glycemic index subgroup created an information page that teaches about the value and its importance of glycemic index from a dietary aspect. More than 1500 values of glycemic index were entered into the food database as a means to aid in meal planning. The subgroup learned the difficulty in researching relatively new data and how to maximize the available resources to get the tasks accomplished.

The software subgroup was successful in updating all the software with comments so that the next group of people who work on the software fully understand what each aspect of the code is doing. They also updated the webpages to incorporate all the information the other subgroups acquired. A new computer language and database handler was also learned in the process of updating everything. All this was accomplished by individual effort to find and use the sources necessary to complete what was asked of them. The subgroup learned more about security in software, server handling and database management.

Recommendations

There was much accomplished over this semester, but there are aspects that still can created or improved upon for the website. From the nutrition aspect, the meal planner could be tailored to be more specific to the individual. The individual inputs his or her BMI, diabetes type and insulin responsiveness when he or she first logs onto the website. However, the meal planner makes generic meals for an average person.

Incorporating glycemic index into the program is useful as it gives a value to each foodstuff that incorporates the time of consumption in correlation to pure glucose. However, of the all the foodstuff entries in the database, only about 25% of the values have actually been determined. Ongoing research is needed to incorporate the missing values, to make the database more complete. This aspect could take a longer time since the glycemic index values are determined experimentally.

Research could be done to find out the effects of preparation on foods and how it relates to the glycemic index value. It is known that nutrients can be lost during the preparation and cooking of certain foods, and glycemic index could equally be effected.

The incorporation of glycemic load into the database and meal planner could be easily added. The value for glycemic load is simple manipulation of the already available data in the database. Displaying this information can make it easier for the user to have a more complete tracking of their nutritional intake.

To make the GlucoSim software more complete, incorporation of glycemic index into the equations is necessary. The currente equations are solely based off carbohydrates values; but as previously mentioned, the glycemic index is a more accurate representation of glucose in the blood stream. Much research is going to be needed to find and incorporate the appropriate equations to make the simulation work.

Minor details of the website and the software need to be fine-tuned. These are not for the functionality of the software and website, but to make them more visually pleasing.

Once all of these aspects have been incorporated, GlucoSim and the meal planner should be marketed and commercialized for public use as an educational tool on diabetes and meal planning.

References
Information on Diabetes:
American Association of Diabetes Educators
http://www.diabeteseducator.org/

American Diabetes Association
http://www.diabetes.org

Diabetes Information

http://www.diabetes.com/

Diabetes Glossary
http://www.joslin.org/Diabetes_words_phrases.asp

Diabetes Self-Management
http://www.diabetesselfmanagement.com/

Food and Drug Administration
http://www.fda.gov/diabetes/

National Diabetes Information Clearinghouse
http://diabetes.niddk.nih.gov

WedMD
http://www.webmd.com/medical_information/condition_centers/default.htm

Software Help:
www.w3schools.com

Meal planning:
Fast and Simple Diabetic Menus
http://www.diabetessymptom.net/news/news_item.cfm?NewsID=150

Diabetes Food Pyramid
http://www.ndep.nih.gov/diabetes/MealPlanner/pyramid.htm

Glycemic Index:
Information and Values:
http://www.mendosa.com/gilists.htm
http://www.glycemicindex.com/

Acknowledgements