FoodFit, a newly designed web application to illustrate food and physical activity choices

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Introduction

With growing concern over increasing diabetes prevalence[10] and the current reality of numerous debilitating complications (one of which includes death), prevention is one of the most powerful tactics in this ongoing battle. Of particular concern is the rate of type 2 diabetes diagnosis among youth in what was once considered an illness affecting predominantly the adult population. If people, especially those at risk, can change their lifestyles to include, for example, more physical activity and less high-calorie, processed foods, incidence of type 2 diabetes and obesity could decrease.

Treatment adherence for those already diabetic[5] or obese is also a problem. Some ignore the diagnosis or simply do not fully understand their body, the condition, or what to do on a daily basis. Advice given and lessons learned in the clinical setting often do not persist until the next visit, let alone beyond the hospital doors. Physiological symptoms can be easily ignored on a daily basis (except for people with type 1 diabetes whose glucose fluctuations have a strong physical manifestation), making it easy to overlook the problem until it's too late and severe complications have set it. Lack of motivation and comprehension of the seriousness of the disease *right now* aggravate the situation.

In response to all these concerns, we have developed FoodFit, a web application to illustrate food and activity choices. It is designed as an educational tool through which users can construct hypothetical (or actual) activity and food events, analyze their caloric balance and nutrient content, and track their progress with saved reports and planners.

In contrast to the many calorie counting websites, FoodFit enables the user to observe how food will affect blood glucose levels by remaining connected to the previously developed GlucoSim (Figure 1) glucose-insulin dynamics simulation software[4]. It also improves upon the

Meals nutritional analysis component of GlucoSim and adds activity analysis functions, making it a completely different platform.

Materials and Methods

Since FoodFit is a web application, the research lies mostly in examining other web applications to capture insight on their best (and worst) capabilities and how to implement them in our development environment. Sites ranged from highly commercial, limited free-use features sodden with advertisements to government affiliated with educational purposes.

Of much inspiration were the United States Department of Agriculture's (USDA) *MyPyramid Tracker*[6] for its accurate depiction of caloric expenditure and consumption based on the most recent publications, and categories of nutritional analysis (e.g. food groups, percent daily value); *Calorie Counter*[2] for its layout and presentation of nutritional data and reports; and *FoodFacts*[3] for its user accessibility to a food database. Many sites that are not nutrition or fitness oriented were also referenced for effective interaction mechanisms and current web standards (e.g. how to display errors, what should happen when the cursor hovers over this region). By doing so, it ensures that FoodFit is easy and intuitive to use because it is the little things that can confuse or frustrate a user, causing them to leave the site and negate any available services.

Once the best layout and interactions were designed, research was focused on how to implement these plans in ASP.NET using Microsoft Visual Studio 2005 and Microsoft SQL Enterprise Manager for database control. As would be expected, many unexpected problems arose that required extra research on the web to fix or find an alternative way to perform the task. Obstacles like this slowed the progress of the project and resulted in a few significant design changes.

Results

FoodFit offers a new approach to food and activity analysis as a means to establish healthy lifestyle habits. From the index page (Figure 2), the user can login, register (to be able to save information), or simply "try out" the software (e.g. for those concerned about storing personal information, or reluctant to fully invest themselves in the software, or to demonstrate how FoodFit works to a new student or patient).

Once the user gives the required basic Profile information, interaction with the Planner (Figure 3) can begin. Example scenarios of food and activity planners, Frequent Lists, and Food Today will initially load, depending on the user's profile (e.g. child/student, working adult, retired/at-home adult). Alternatively, everything can be cleared and the user can begin with a blank slate or, if the user is registered, a saved setup can be loaded. Here meal and activity events can be added to the Planner at the specified start time in the form of "bubbles" like many modern calendar programs.

For an activity, the duration needs to be specified (can be done by resizing the bubble), and the intensity and type of exercise need to be chosen from a default Frequent List or the database.[1] This information will be used for Metabolic Equivalent (MET) calculations of energy expenditure and the final computation of Estimated Energy Requirement (EER)[7] for the daily caloric balance analysis. FoodFit's EER calculations also include those for youth (<18 yrs), a distinguishing feature from many commercial sites.

For a food event, the user can choose an item to Food Today from the default Frequent Lists or add one from our implementation of the USDA's Nutrient Database.[8] There are separate tabs for each type of meal for Food Today and Frequent Lists, a space-saving presentation.

Next, the user can chose to save their activity and food planners into the Journal for later use or analyze and create a Report of the current scenario. The Journal is divided into food and activity collections, organized with tabs stating user-defined titles for each food or activity planner module. From this setting the user can also analyze any food module (as identified with a tab) with any activity one, the exchange of which will illustrate an effect on the caloric balance. Finally, a Report can be generated from this combination to be stored and referenced at a later time or printed.

Discussion

Prevention is a highly effective means to combating the increasing incidence of diabetes and obesity, and their undesirable complications. Knowledge and increased awareness are helpful for improving glycemic control in type 1 diabetes to prevent long-term complications. Education and awareness are examples of two preventative measures FoodFit addresses. FoodFit is an interactive food and activity journal to illustrate food and activity choices, and their effect on daily energy balance.

Since it is internet-based, FoodFit is easily accessible outside the clinical exam room (to increase treatment adherence) and for classroom use. Its user-friendly environment encourages discovery about nutrition and exercise to internalize healthy choices and preventative activity.

Currently there are many similar products to FoodFit available on the internet, but none are targeted at youth or concerned with issues beyond weight loss (e.g. stating the amount of activity needed to burn the calories from a specific food item). FoodFit also is unique in its approach to balancing calories—it integrates activity and food events into one, cohesive page from the beginning so as to appropriately link thoughts about food and activity together. If other sites do this simultaneous comparison, it is done like an afterthought when analyzing the data,

missing the purpose of showing the complete picture and encouraging long-term, lifestyle change.

The features include: nutritional analysis, examining total calories, food group distribution, and percent of daily values of micronutrients like sodium, cholesterol, and saturated fat; a fun game to guess whether or not the created scenario would lead to weight loss/gain; storage of frequently eaten foods and performed activities to make it easier for more advanced users; example scenarios of food and activity planner entries to introduce the system and allow teachers to quickly demonstrate healthy behavior in the classroom; ability to save planner entries in journal and interchange sets of meals with activity entries to see the effect on daily caloric balance; and printable, saved reports incorporating all of the previously discussed food and activity analysis. These features are all important for learning healthier behaviors to prevent type 2 diabetes, obesity, and geriatric complications, and assist people with type 1 diabetes in glycemic control to decrease long-term complication risk.

Having state-of-the-art technical features unconsciously increases the user's respect of the system and ease of interaction. They include: an Outlook-like planner-interface (e.g. resizable boxes representing events) for activity and food entries; tab organization of Food Today, saved reports and planners in the journal, and frequent meal and activity lists; Lightbox-like profile status (whereby the main screen is shaded over when a new window appears, immediately focusing the new content without fully leaving the prior screen's environment); standardized Portable Document Format (PDF) reports for easy printing and saving from the site onto other devices; and an intelligent search feature for the food and activity databases to partner with the expandable/collapsible lists for browsing, like in Windows Explorer. All of these features are implemented in Hypertext Markup Language (HTML) and Cascading Style Sheete

(CSS), and supported by the relatively new technology of Asynchronous Javascript And XML (AJAX), which allows smoother client interaction because information can be sent back and forth to the server without refreshing the page.

Though FoodFit is under development, it is still a powerful and effective tool to teach healthy, preventative behaviors. Students of all ages and, perhaps in the future, clinics (both in-patient and out-patient settings) could use the application as a means of preventing type 2 diabetes, obesity, and geriatric complications in the type 1 diabetes and general populations.

Ethics

While developing FoodFit, consideration was given to computer coding ethics. Copying and pasting another programmer's code without testing it or giving proper attribution as specified by the author are two common ethical faults in this field. Much care was taken when using the web as an aid and the majority of the code is written from scratch or recycled from other internally-developed projects. Fortunately, much of the computer science and coding community relies on and thrives upon taking code from other programmers and slightly modifying it to do their specific task and to do it *better*; sharing code is not only ethically accepted, but encouraged.

FoodFit's instruction about food and activity choices is not a unique feature, so many of our ideas came from other commercial and non-profit organizations' websites. Whether or not it was appropriate to take inspiration from such sites could be an ethical issue (similar to a patent infringement), but great care has been taken to assure that it is not a problem.

Although it is clearly stated in many locations that all our web applications are for educational use only, ethical consideration must be still be taken. For example, the energy balance portion of the analysis may consistently report that the user is expending more calories

than he/she consumes and thus should be trending towards weight loss; but if that is not the case, then the software could be blamed. Or if the website crashes and loses all the saved information for that user who relies on it to make and plan healthy choices—what happens?

Our software is not intended to tell the user what to do and when to do it, but merely to offer suggestions about the timing of insulin with food or how much activity should be done to balance out intake. It can not verify that the user actually takes the insulin at the suggested time or that indeed *one* donut was eaten as reported; the system can only offer advice with the information it is given. Following the advice does not guarantee that a longer life will be lived or that blood glucose levels act as the graphs depict.

If FoodFit is ever to be used beyond the classroom setting and in a clinical setting for obese patients or people with diabetes, it is these ethical concerns of the software's physical as well as educational reliability that must be taken into consideration.

References

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Figures

Figure 1: Example screenshot of blood glucose and blood insulin simulations using the healthy person model with GlucoSim.

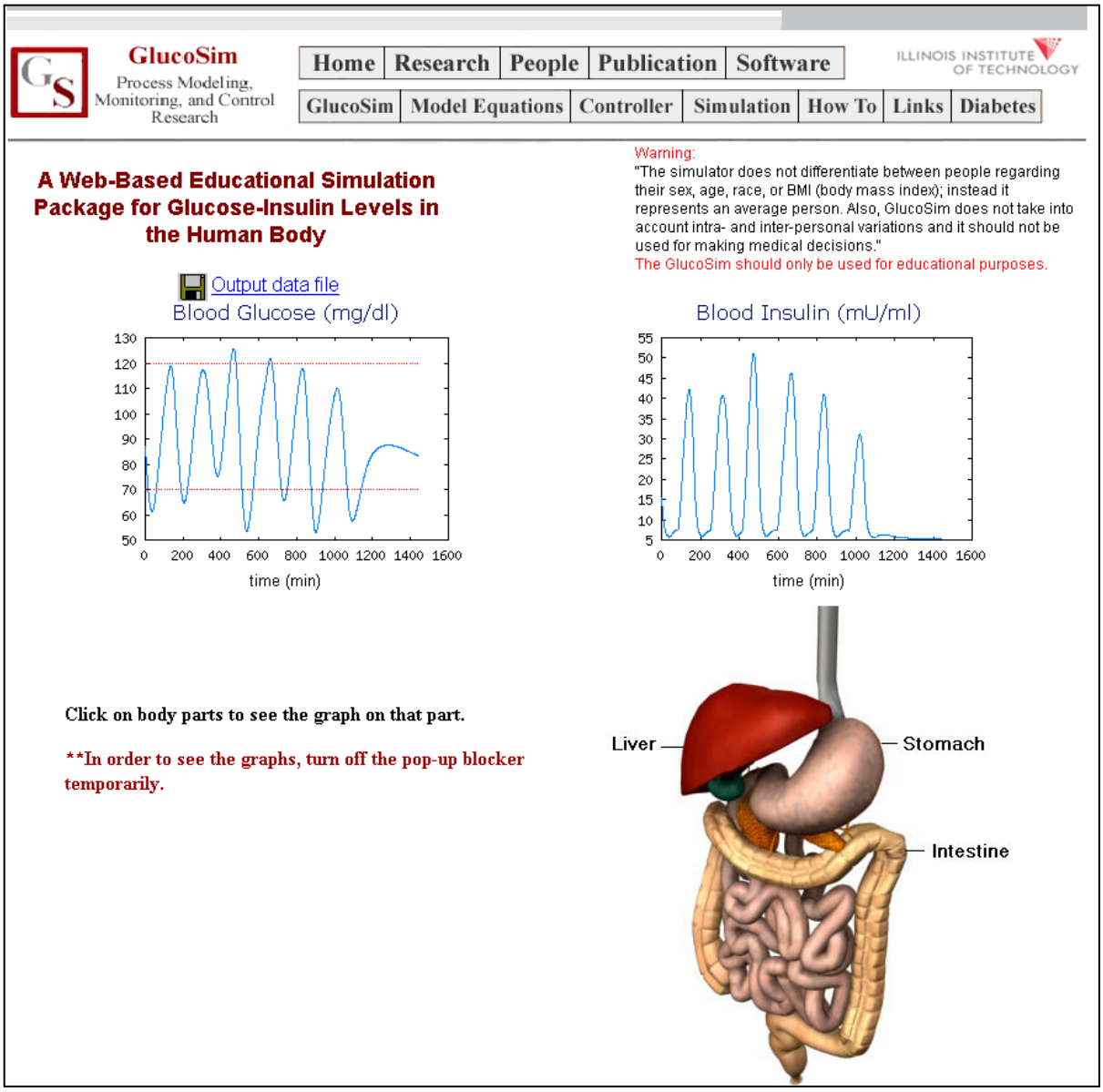

Figure 2: Screenshot of index page for FoodFit.

Figure 3: Screenshot of Planner page for FoodFit.