

# **DeeBee, the diabetic bee**

(<http://ldt.stanford.edu/~chaoyc/deebee/index.html>)

**CS 147 HCI**

**Friday section with Heidy Maldonado**

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## **Goals of DeeBee**

DeeBee™ aims to help diabetic children ages 5-7 years old understand 1) the consequences of too high and too low blood sugar and 2) the correlation of consuming too much sugar or not taking proper amounts of insulin to blood sugar levels and 3) the relationship between physical symptoms and blood sugar levels. DeeBee, the diabetic bee, also strives to offer the user companionship and enjoyment.

Usually, children with diabetes acquire it from birth or at a really young age. It is between the ages of 5-7 years old that children begin understanding more about the human body, reasoning and empathy. It is often difficult for children this age to understand why pricking their finger several times a day is necessary. DeeBee offers a unique way for children to understand their illness. As one of our users explained, “...(you) act like the bee is you.”

The educational goal of DeeBee is to teach children about the importance of maintaining their blood sugar level between low and high limits. In addition, DeeBee teaches children about the temporal relationship between these limits, food, and insulin. Finally, DeeBee aims to help the user better understand the physical symptoms and behaviors associated with varying blood sugar levels.

The age range of our intended users, five to seven year olds, captures the period when children start to take more responsibility for monitoring their blood sugar levels. One father showed his support for the idea of DeeBee, “...anything to try and encourage them to do the testing.” The aim of DeeBee is to make monitoring blood sugar levels and understanding the relationship of blood levels to food and insulin accessible and fun. This virtual diabetic friend not only needs the child's care and attention, but also offers companionship and comfort.

In addition to serving an educational purpose, DeeBee serves a specific function, one that all diabetic children must practice regularly. It has a built-in glucometer that measures and records the

child's blood sugar level. The child puts the strip with a drop of his/her blood into the glucometer and the glucometer provides a reading.

### **Existing Inspirational Systems**

We combined various design concepts from several products on the market to create DeeBee. We feel that the synthesis of these design elements creates an effective and successful design for DeeBee.

*Tamagotchi:* We borrowed the physicality of Tamagotchi in our design of DeeBee to create a small, lightweight product. Given that our intended user, a diabetic child between the ages 5-7 years old, must continually monitor his/her blood sugar level, we strived to design DeeBee to be portable. In this way, the user could carry DeeBee everywhere to ensure proper care of this companion and him/herself. Since the interface of Tamagotchi is rather primitive, we added new user control devices while attempting to maintain the interface simplicity for our audience. We also added a cord so that the child could carry DeeBee around his/her neck.

*iPod:* In trying to create a minimalist, intuitive interface design for DeeBee we turned to the recently released iPod. The circular user control device is easy to use and natural. We designed the circular control to surround the screen in an attempt to embed (even more) the control device in the product, allowing for seamless design. The circular control device is the appropriate size and color for our intended users' motor capabilities. The different color of the control device visibly signals the user that the piece serves a distinct function. The color scheme is very different from iPod's slick, all white design because we felt the circular control in the iPod was too hidden for our intended audience.

*Portable Glucometers:* We researched available glucometers to fully understand their functionality. We used the existing feature of a slot for inserting stripes with a blood sample. We incorporated an additional feature – the opportunity for users to estimate their current blood sugar level based on their body's signs prior to the reading. In this way, children can refine their ability to monitor and predict

blood levels. Given we are targeting children, we added DeeBee, a virtual bee, to make learning and practicing healthy decisions fun and engaging.

### **Design Priorities**

(Please refer to DeeBee mockup version 1.0, <http://ldt.stanford.edu/~chaoyc/deebie/index.html>)

### ***Satisfaction***

Since our intent is for DeeBee to be used over an extended period of time, our main design priority was satisfaction. Given that the main goal of DeeBee is to teach children about the relationship between blood sugar levels, behaviors, and treatment (food and insulin), it is crucial that children use DeeBee consistently over a significant period of time. The second goal of DeeBee is to provide comfort and companionship for a diabetic child. To achieve our goals, DeeBee needs to be fun! First, we ensured that the animated bee displays a cute and lovable personality. DeeBee flutters around the screen, in and out of his beehive, and is always ready to play. Second, our design strives to closely match DeeBee's behaviors and feelings to those that a diabetic child experiences. For instance, similar to a child, when a DeeBee's blood sugar is too high, DeeBee will have no energy to buzz around the screen and be very thirsty. If DeeBee's blood sugar is too low, DeeBee will be shaky, dizzy, grouchy, and sweaty. Our design is such that the bee is capable of a wide range of behaviors and expressions. The variety of actions will maintain the user's interest and engagement.



**A few of DeeBee's moods**

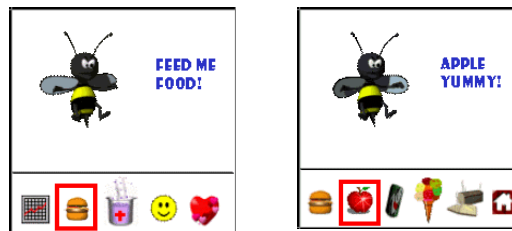
### ***Functionality***

In order for learning to occur, our target audience must be able to easily operate DeeBee. It is important to point out that given our audience and goals, we determined that it is not crucial for users

to, at first, to be able to intuitively operate DeeBee, without any initial guidance. We assume that parents will show their child DeeBee's controls and features in the beginning, if needed.

***User's language, minimize user's memory load, and consistency***

To ensure functionality, we designed user controls to be appropriately sized for the motor capabilities of five to seven year olds. Since our users are beginning readers, the design seeks to speak the user's language by only incorporating consistent icons or graphical depictions throughout the interface. Our user testing highlighted the importance of natural, guessable icons. Also, given our audience, the design aims to minimize the user's memory load by progressively disclosing options. The main screen displays six icons representing the following choices: check blood sugar level, food, insulin, mood, exercise, and love. The child uses the dial to scroll through the six options. Upon selecting one, another specific menu of options appears. So, if the child chooses food, a menu appears on the screen containing an apple, a soda, an ice cream cone, and bread.



Main menu

Food Menu

**Version 1.0 Icons**

***Feedback***

To aid in functionality, the user receives immediate feedback both visual and audio for every action performed. For instance, by rotating the circular control menu icons are highlighted and accompanied with an audio description of the option. When the user requests that DeeBee's blood be checked, the user receives feedback in the form of an animated sequence of DeeBee's limb being pricked and the strip being inserted into a glucometer. When the user feeds DeeBee a snack, DeeBee's tummy bulges

and, based on the choice, DeeBee either buzzes around the screen in delight or flutters to rest.

DeeBee's action after eating the chosen food serves as feedback, helping children understand some of the consequences of food choices.

### *Appropriate error messages*

The delicate and serious consequences of diabetes demand an interface that only includes appropriate error messages. Simply explained, DeeBee will never die. If the user fails to provide adequate care and attention to DeeBee, the user will receive various signals. For instance, a nurse may visit DeeBee and intervene with the proper care. The design aims to provide positive reinforcement for proper care of DeeBee. If DeeBee's blood sugar level is maintained at a stable level for consecutive days, DeeBee will become 'Super DeeBee!' and perform a variety of amusing dances and expressions.

### *Visible clues*

DeeBee offers educational opportunities for the user to understand very real issues. Specifically, DeeBee encourages the user to interpret symptoms and take appropriate action. To meet the educational objectives, DeeBee offers a wealth of visible clues to scaffold the user in this learning experience. DeeBee's behaviors, expressions, and verbal comments create an engaging learning environment.

### **Most Interesting Feature of the Interface**

The most interesting feature of DeeBee for a five to seven year old is the fun, cute bee! Our user testing confirmed that there was a need for a way to make frequent blood sugar testing less uncomfortable. The bee accomplishes this goal. The bee not only offers satisfaction and companionship, but also serves as a unique way to teach diabetic children about their illness. The bee's changing moods and behaviors give the bee a distinct personality, compelling users to want to

provide good care. By providing good care for DeeBee, the user will achieve our educational objectives.

## **User Testing**

*Goals of testing:* We wanted to uncover which set of controls the children preferred (buttons or circular dial), the usability of the interface navigation, and the general understanding of the concept.

*Methodology:* The user testing was performed in the pediatric diabetes clinic. Due to the unpredictable structure of the walk-in diabetic clinic, we were unable to find users in our targeted age range. However, the older children provided excellent feedback because of their ability to clearly articulate their thoughts and perspectives.

Our three subjects were all insulin dependent diabetics between the ages of 8 and 14 who use a glucometer at least once per day and up three times a day. They were diagnosed with diabetes from the age of 26 months to five years.

Each subject was placed in a controlled environment and asked to go through the following sequence of testing. Subjects were asked to pretend they were five years old again. Due to patient privacy issues no videotaping was allowed.

### *Testing Process*

- 1) Subjects were given the mock up front boards to play with.
- 2) Mock up boards were placed over the screen shot, with the screen shot appearing in the cut out area.
- 3) After familiarization with the buttons, simple navigation tasks were tested to access the affordances of the buttons/dial. The subject pressed the buttons or rotated the dial on the physical mockup and the tester controlled the screen correspondingly.

- 4) Similar simple tasks were tested with the icons, initially familiarity and subsequently presumed functionality.
- 5) Voice feedback was accessed subjectively.
- 6) General pleasure of use and interactivity was also subjectively tested.

### *The findings*

*Concept:* All of the users understood and liked the concept of DeeBee. One girl said, “It gets you more into what you should be doing.” Another user, a male, said DeeBee would make the process of testing blood sugar “...more calm for them...” and that with DeeBee you wouldn’t “have parents constantly telling you what to do.” Two fathers agreed that the concept was useful. One father said, “...anything to try and encourage them (the children) to do the testing.” Another father said DeeBee would help because often “...the concepts don’t sink in.” Betsy, the directing nurse at the clinic, reinforced that the use of the bee was familiar and appropriate. She showed us a product on the market that used a cute bee attached to a lancet to prick a child’s finger.

*Controls:* Our first user, a female, thought that the push button controls would be easier for a seven year old to manipulate. However, the other two users felt that the circular control device would be better suited for five to seven year olds because they both thought it was more fun. A user explained, “...probably more fun with that one (circular dial) because you get to turn it.” One father commented that the device was too large and bulky and suggested the design be smaller since children or their parents need to always carry a glucometer.

*Usability of the Interface:* All the users were able to easily navigate through the menu options. They all quickly understood the function of the select button. A few of the icons and their functions were confusing to all three users. The insulin, mood, and love icon were not naturally clear. Betsy suggested a syringe to represent the insulin option. Betsy also explained that diabetic children must

distinguish between appropriate snack foods and meals and must also take the time of day into account. One user suggested incorporating a child's voice for the audio.

**Redesign** *(Please refer to DeeBee mockup version 2.0)*

Our user testing showed that the circular control device would be most appropriate for our intended users and design priorities. Our redesign implemented the findings of our user testing to include more natural and familiar icons and improve DeeBee's movements and facial expressions to better match DeeBee's varying moods and conditions. We wanted to ensure that DeeBee's behaviors provided direct feedback to the users. In line with the Gestalt notions of proximity and similarity, we redesigned the main menu options to be grouped by similarities, the left three controls relate to blood sugar levels and treatment, the right three controls relate to DeeBee's mental state of mind.

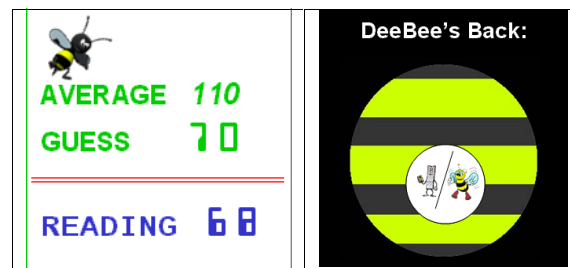
Our user testing and continued research revealed that exercise was an important part of a diabetic child's life. So, we added a new feature, 'sport' (represented by the football icon), to make the learning more comprehensive and increase the satisfaction of playing with DeeBee. This new feature will teach diabetic children the effects of exercise on blood sugar levels.



**Version 2.0 Icons**

We expanded the glucometer feature of DeeBee, to include a buzzing noise to signal the user that it is time to check their own blood sugar level. This feature can be programmed by the user (or the user's parent) and be switched off at any time. The user can switch to the glucometer mode by pushing the button on the back of DeeBee. In this mode, the user will be able to estimate his/her blood sugar level,

insert a strip with his/her blood, and receive the reading. The user will receive positive reinforcement when his/her estimate is within a close range to the actual reading. Estimates, readings and the date and time will be stored in memory. To return to the bee mode, the user can either press the button again or wait five minutes and DeeBee will automatically appear.



**Glucometer screen and DeeBee's back**

### **Pedagogical Methods and Principles**

DeeBee's design reflects a combination of cognitive, situative, and behaviorist theories. The child begins the exchange with DeeBee by monitoring DeeBee's behaviors. By caring for DeeBee the user learns problem solving and reasoning skills in the realm of diabetic healthcare. The user needs to interpret DeeBee's behavior, decide on the appropriate action, and reflect if the suitable action was taken. In line with the situative perspective, children learn in a game environment that closely resembles their own situation.

The design is also behaviorist in nature because the child, through repeated use, learns to make connections between stimuli and responses. The child can actively explore (without any serious, fatal consequences) the affects certain food choices can have on DeeBee when DeeBee's blood sugar level is at different points. The constant and immediate feedback, another characteristic of behaviorist theory, reinforces the child's understanding.

Vygotsky's work states that for learning to occur children should engage in authentic activities. In essence, by having the user take care of diabetic DeeBee, the user learns about taking care of

him/herself. Making smart food choices based on behavioral clues is at the center of a diabetic child's world. DeeBee models typical diabetic behaviors, encouraging the user to recognize patterns, and build problem solving skills.

**How were the pedagogical goals reinforced or hindered by the interaction techniques that were available for your prototype?**

Our conversation with Betsy, an expert in diabetic healthcare, highlighted the complexities of blood sugar levels and food choices. She explained that food choices involve not only the amount and type of sugar but also the amount of fat and protein in different foods. Also, the time of day determines which snack would be most suitable. We realized that we could not effectively represent all the complexities within the content because of our minimal screen size and target audience. However, at our user's age, simplification of these complex concepts is desirable and necessary to achieve our goal of awareness and learning.

Given the time frame and our limited capabilities in product development, our physical mock up was not fully functioning for our user testing. Our users needed to stretch their imagination to understand how the controls functioned. However, by placing the foam mock up over the computer screen, users were able to visualize how DeeBee would work. We were unable to test whether children learned the concepts from interacting with the device because DeeBee is designed to be used over an extended period of time. The time frame for this project was too limited to fully explore and test the learning. However, we were able to test a portion of the scaffolding by asking our users about the audio clues. Feedback from two fathers and users comments like, "... (you) act like the bee is you" show that users do understand the learning goals we are trying to achieve.