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Professor Debra Satterfield
HCI 595X - Visual Design of HCI
August 6th, 2012

EzBG System

An Enable•IT Product

Objective

My goal in this project was to design a product for people with the chronic illness diabetes. The product was designed to promote the health and well being of the user while respecting their personal autonomy in which they would be able to make choices about their own care. Also, I designed a product that didn't embarrass or draw attention to the frailties inherit with this ailment.

Research

Diabetes mellitus, or commonly known as just diabetes, is a group of metabolic diseases that are characterized by high levels of glucose (sugar) in the blood. People with diabetes have these high levels of glucose either as a result of insufficient insulin production or their cells do not properly respond to the insulin that is produced. Insulin is a hormone produced by the pancreas and is needed to move glucose into cells where it is stored and later used for energy ("Standards of Medical Care in Diabetes," 2011).

Diabetes is classified into the three main clinical types:

1. Type 1 diabetes results from the body not producing insulin and is usually diagnosed in children or young adults. Type 1 diabetes is not as common as Type 2 diabetes.

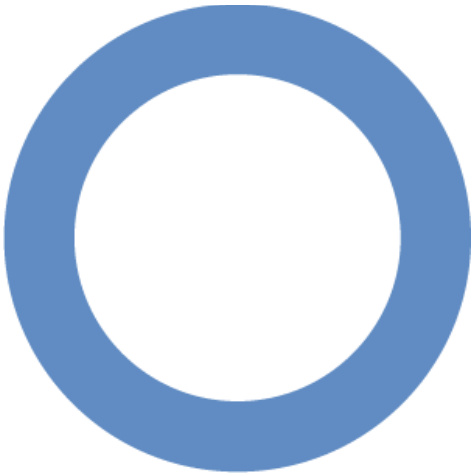
2. Type 2 diabetes is the most common form of diabetes that results from either the body not producing enough insulin or the cells in the body becoming insulin resistance. People that are overweight and obese have a much higher risk of developing Type 2 diabetes. Especially people with a lot of central fat in the abdominal area otherwise known as belly fat.

3. Gestational diabetes mellitus can be developed by women during pregnancy. Gestational diabetes can usually be controlled with exercise and diet, however, if uncontrolled it raises the risk of complications during childbirth.

Visuals Associated with Diabetes

The blue circle is the universal symbol for diabetes and was originally developed for the campaign that resulted in the passage of United Nations Resolution 61/225, "World Diabetes Day." In 2006 the icon was established as the official symbol to give diabetes a common identity and to raise awareness about diabetes.

The circle symbolizes unity, indicating that only through our combined strength will people be able to make a difference. The color blue reflects the color of the sky and the flag of the United Nations (“Blue Circle,” n.d).



The diabetes awareness ribbon is a gray ribbon often accented with a red drop of blood or red lettering.

Susceptibility to Diabetes

Older adults are particularly vulnerable to the onset of diabetes where almost 25% of adults over the age of 60 have diabetes and 17% of new cases are individuals age 65 and older. It is important to help older adults with diabetes better manage their disease through glycemic control in order to prevent serious long-term complications. Diabetes is the leading cause of kidney failure, lower-limb amputations, and new cases of blindness among US adults (“Diabetes Self Management Training Initiative,” n.d).

A 2007 study in the *Annals of Internal Medicine* indicated that women with diabetes have it worse than men. Death rates of men with diabetes decreased between 1971 and 2000 while the death rates of women remained the same. Additionally, men with diabetes live on average

almost a year longer than women. The data from the study indicated that women with diabetes had a greater chance than men with diabetes of getting heart disease, kidney disease, having high blood pressure and unhealthy cholesterol levels (Gebel, 2011).

Managing Diabetes

The key factors for a person with diabetes in lowering their chances of having a heart attack, stroke, or other related problems is managing the results of their A1C test as well as their blood pressure and cholesterol. Most people with diabetes should have an A1C result below 7 and blood pressure below 130/80. As for Cholesterol most people with diabetes should have an LDL goal of below 100 and an HDL goal of around 40 for men and 50 for women. All people with diabetes need to make healthy food choices and stay at a healthy weight.

The recommended blood sugar range for people with diabetes is 70-130 mg/dL (milligrams per deciliter) before meals and less than 180 mg/dL one to two hours after a meal. One should be concerned and call their healthcare provider if your blood sugar is less than 70 mg/dL and you have more than one unexplained low blood sugar reaction in one week or if your blood sugar is more than 180 mg/dL for more than a week. One should also call their healthcare provider if you have two consecutive readings greater than 300 mg/dL.

Emerging Technologies in Managing Diabetes

Continuous glucose monitoring is a new advancement that should make a patient's life a lot easier. Many people with diabetes lance their finger two or more times a day but with continuous glucose monitoring a patient can get a glucose reading every 5 minutes which is 288 readings in 24 hours. A patient could essentially monitor their glucose levels in real-time 24-hours a day. With this level of precision a patient can make more informed decisions as to when to eat or to inject insulin. With continuous glucose monitoring the patient can be alerted if levels become too high or too low (Hoeks, Greven, de Valk, 2011).

A continuous glucose monitoring system would eliminate the need for painful finger sticks. The continuous glucose monitors that have been developed use sensors that measure tissue fluid, not blood, through a disposable needle inserted under abdominal skin. Also, a continuous glucose monitor could also be combined with an insulin pump which could emulate an artificial pancreas to measure glucose and automatically deliver insulin (Kam, 2009).

A new generation of insulin pumps are being developed. These insulin pumps are small, disposable, can be concealed under clothing and are worn directly on the skin. Insulin is delivered from this device through a small cannula inserted under the skin and the insulin injection can be delivered wirelessly from a handheld device. These pumps can be worn for several days before needing to be replaced. In fact even smaller pumps are being developed in which everything is miniaturized where the size of future pumps may be just slightly larger than a Band-Aid (Kam, 2009).

Software programs are being developed that take in data from glucose monitors and enable patients to analyze trends in their blood glucose levels. These applications can produce graphs and charts that show the percentage of time a patients glucose levels were above or below the normal range. This aggregation of data can also be digitally transferred to the patient's doctor to help guide treatment. Also with two to three months worth of data some home monitoring systems can determine HgA1c levels in minutes (Kam, 2009).

According to an interview with Kathy Bessey, who is a member of my target audience, her biggest complaint about managing her diabetes is just needing to continually keep to the schedule of testing her blood each day every day. Also, when she tests her blood it is difficult to determine, because it is a manual infrequent process, whether her glucose levels are actually rising or falling. She could see a definite benefit in an automated system that tests her blood on a more frequent basis that could calculate the rate of change of her glucose levels. (personal communication, July 22, 2012).

Target Audience

Based on my research I decided to focus on women who are older than 60 years of age with type 2 diabetes. This is because type 2 is the most common form of diabetes and the group most susceptible to developing type 2 diabetes are adults 60 years and older. Also, based on my research, women seem to be more dramatically impacted by the disease.

Product Concept

The purpose of my EnableIT product is to enable a person with diabetes to more easily manage their illness. The design of my product is based on emerging technologies I uncovered in my research. By incorporating these frontier technologies in my design I will explore how to utilize the benefits of these technologies while hopefully identifying and mitigating negative effects unproven technologies may have on user experience.

One goal of my product is to utilize technology to make a patient's life easier by enabling them to automate the management of their illness. Another goal of my product is to promote healthy choices through equipping the patient with an effortless method to monitor and evaluate the state of their health while protecting the privacy of their data. The final goal of my product is to allow the patient to use the information gathered about their health to augment and facilitate better communication with their caregiver.

My product consists of a system of devices working together to automatically regulate the patient's insulin levels and essentially act as an artificial pancreas. The three elements of the system include a glucose sensor, an insulin pocket and a hand held management device that controls the system and provides diagnostic information to the user. The glucose sensor is implanted under the skin and continuously sends glucose readings to the management device every five minutes. Based on the readings received from the glucose sensor, the management device, which is about the size of a smartphone, will instruct the insulin pocket to deliver insulin to the patient.

The glucose sensor is a bio-implant that, according to my research, could be good for several years before needing to be replaced. The insulin pocket is a waterproof container that has everything needed to deliver insulin to the patient including the pump, cannula, needle, and insulin reservoir. The adhesive on the bottom of the insulin pocket allows it be attached virtually anywhere on the body. Once the pocket is attached to the body the user instructs the pump to get into the ready state in which the pump quickly and painlessly inserts the small needle underneath the skin. Now that the pump is in the ready state the management device can be placed into auto-monitor mode in which it receives glucose readings from the glucose sensor

and instructs the insulin pump to deliver insulin based on those readings.

If the management device detects an issue with the system including low levels of insulin in the pocket or if it is no longer receiving readings from the glucose sensor then it can notify the user with an indicator icon. If the management device detects a severe issue such as very low or high glucose levels then it can alert the patient to the problem via an alarm. This alarm system will protect the patient while they sleep from dropping into a coma due to low blood sugar levels.

In addition to automatically receiving glucose readings from the glucose sensor the management device has a test strip port available for the user to manually test their blood. This provides a backup method for the user to monitor their blood in the event that the glucose sensor implant is no-longer working.

The management device has an LCD touch screen which allows the user to access the history of glucose readings and insulin injections. Also the management device can wirelessly transfer all the data it has recorded to software on a computer. This software can be used to analyze trends in the user's glucose levels over extended periods of time. Also, this software can securely transfer the data to the patient's health care provider in order to help guide care.

Keywords

- easy
- simple
- empowering
- smart
- intuitive
- comprehensive
- organic
- human
- painless
- healthy
- freedom
- autonomy

Mind Map

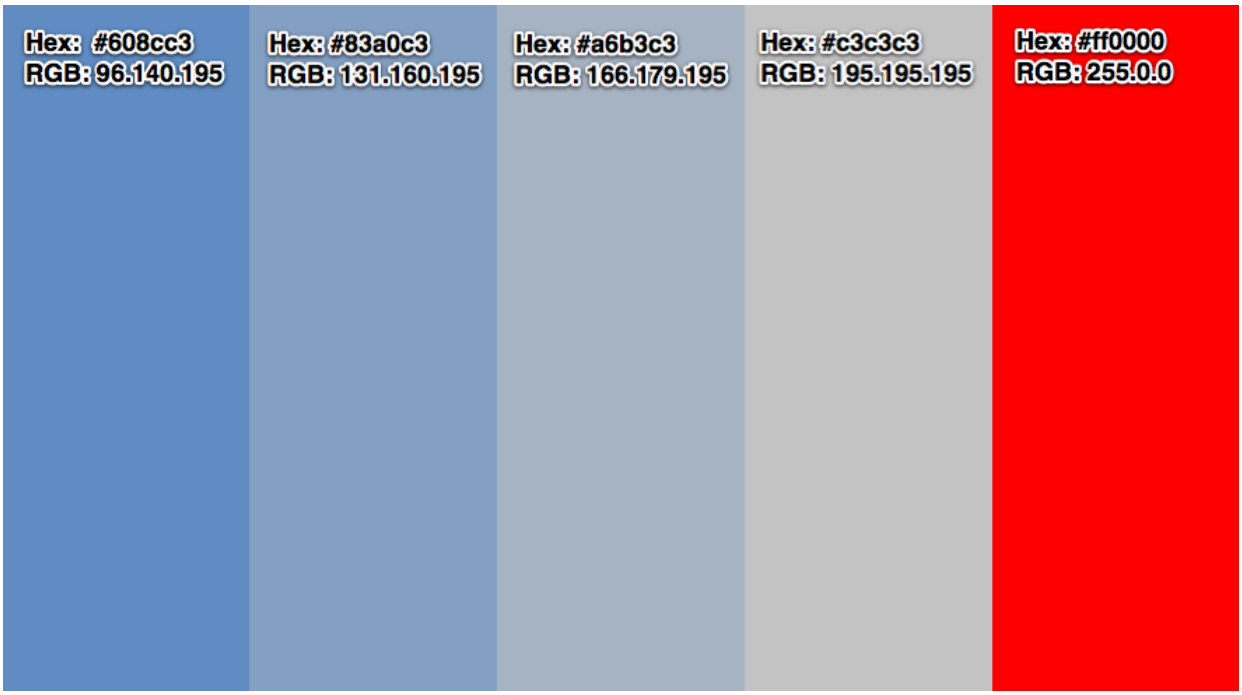
The following is the mind map flowchart I generated to explore all the content and materials needed in to produce the EzBG System.

Color Exploration

Given that my target audience has diabetes, diabetes awareness is very important to them. The official colors of diabetes awareness is gray, blue and red. Because these colors are strongly associated with diabetes and would be very familiar to my target audience, I decided to use the same colors within my design's color palette. In order to have a full color palette of five colors I used variations in hue and saturation to compose two additional colors based on the diabetes blue and the diabetes gray. The addition of these two colors to the color palette provided a

gradual visual transition from the blue to the gray.

The tool I used to compose my color pallet was ColorSchemer for Mac:
http://www.colorschemer.com/osx_info.php



Typography Exploration

I evaluated 6 different font families when deciding on the typography to use within my design. Of these font families 3 were sans-serif fonts and 3 were serif fonts. I evaluated each font by labeling it with three descriptive words which I felt best represented the emotional properties it conveyed. I ultimately decided on three fonts to use in my design based on how well their descriptive words matched the keywords I associated with my product.

Sans-serif Fonts

EzBG System

The EzBG System is designed to make your life easier by enabling you to automate the management of your diabetes. The system incorporates the latest technology in diabetes management which includes a bio-implant glucose sensor, insulin pocket and a hand held management device. The management device, insulin pocket and sensor work together to automate the regulation of your glucose levels and essentially act as an artificial pancreas. The management device controls the system and provides you with diagnostic information.

Font-family: **Amaranth**

- organic
- friendly
- squeezable

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Font-family: **Play**

- digital
- futuristic
- inflexible

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Font-family: **Quicksand**

- delicate
- simple
- sterile

Serif Fonts

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Font-family: **Merriweather**

- casual
- relaxed
- common

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Font-family: **Junge**

- spacious
- formal
- smart

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Font-family: **Kotta One**

- dynamic
- compact
- fluid

Example with the Most Appropriate Fonts

- **Amaranth**
- **Quicksand**
- **Junge**

EzBG System

Summary

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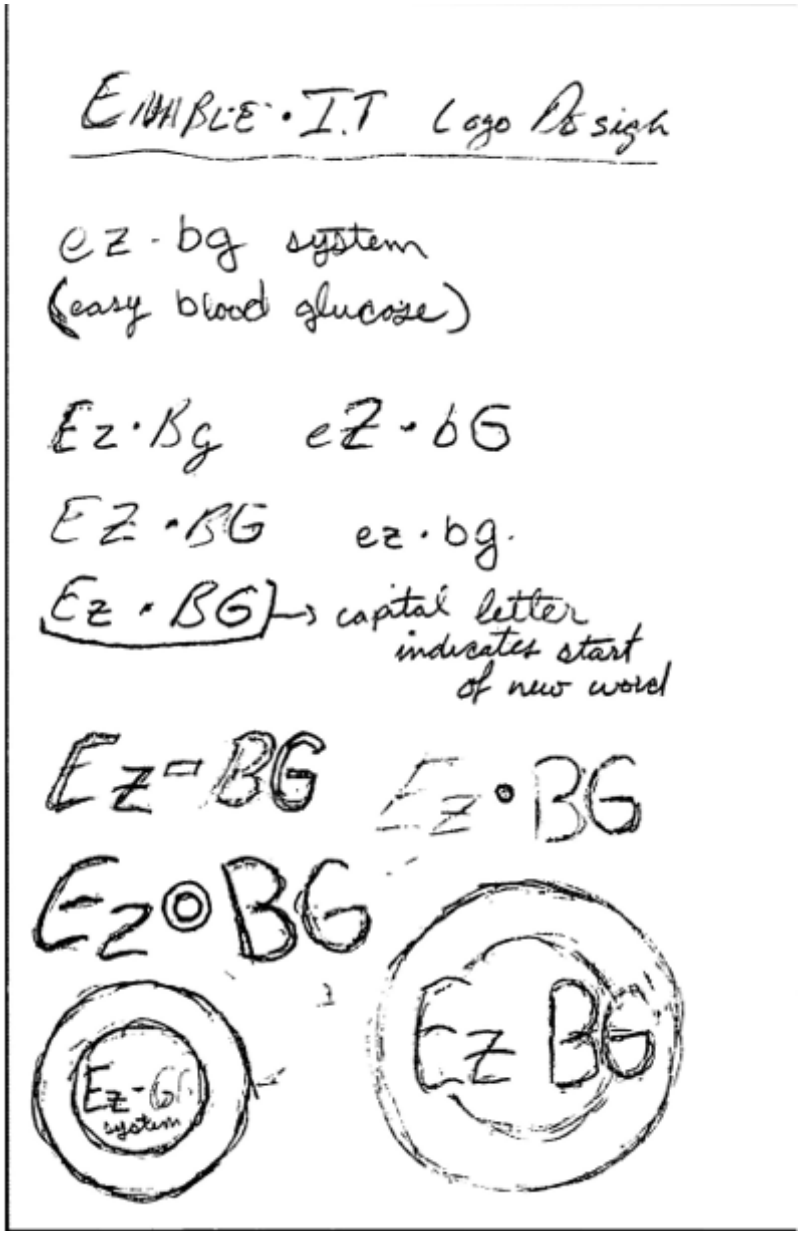
Logo Sketches

First Iteration

In my first iteration I explored several different options but ultimately I focused in on two different concepts.



Enable·IT Logo Design

Ez-BG

Ez-BG Ez-BG

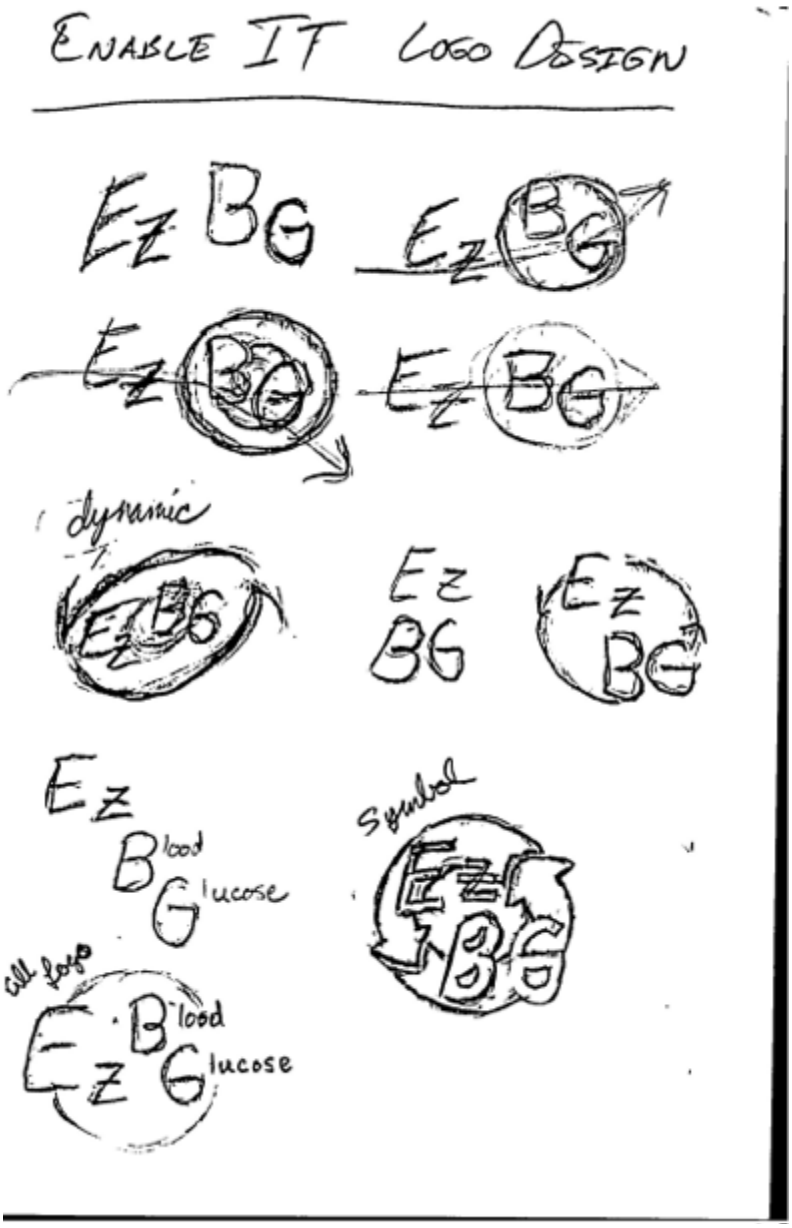
The B looks angry

Ez-BG

Ez BG — Blood Glucose

Ez Blood Glucose

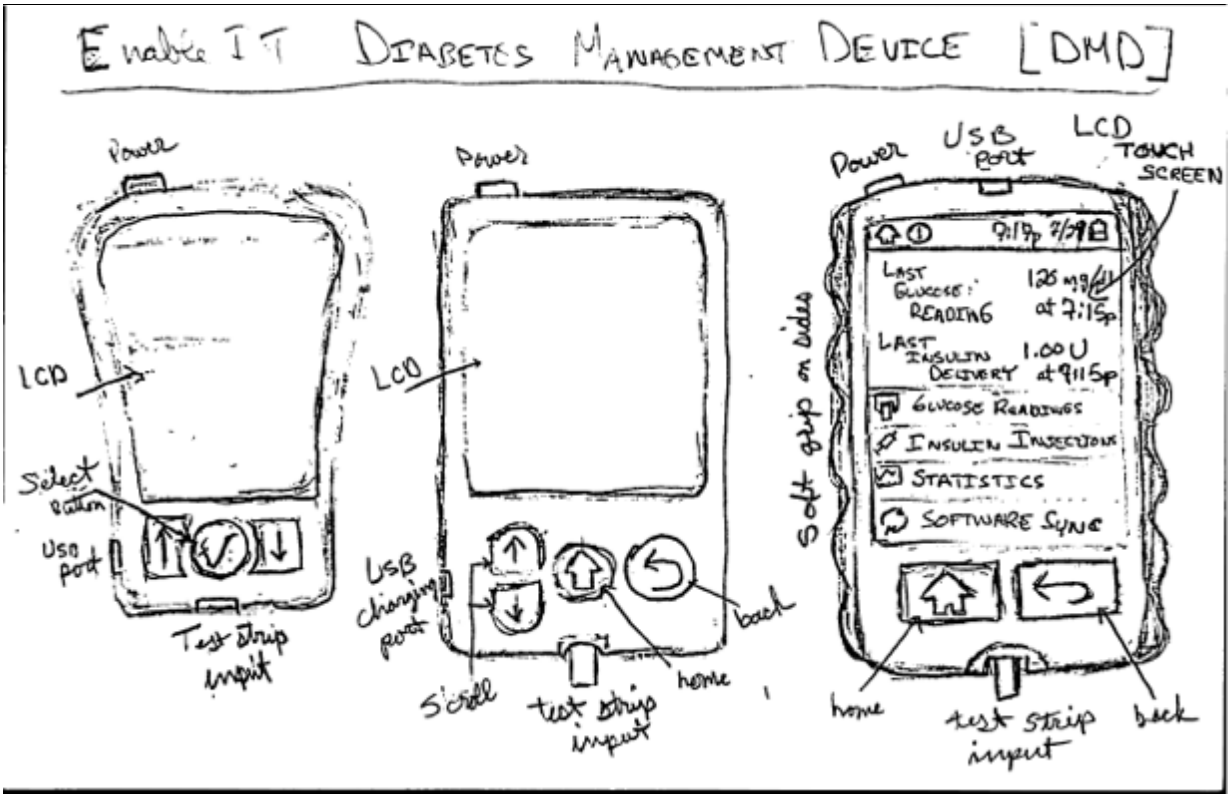
Second Iteration



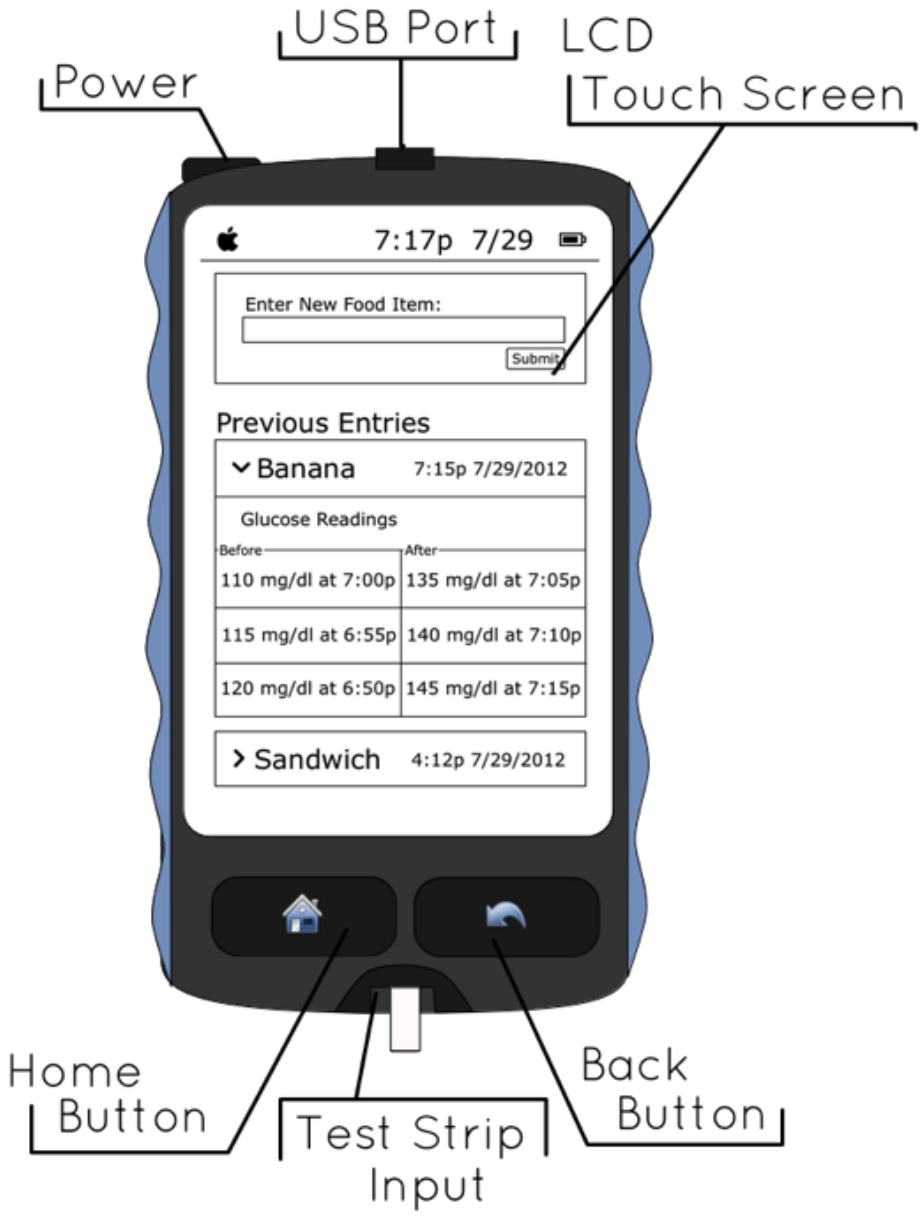
Logo Rendering

Management Device Sketches

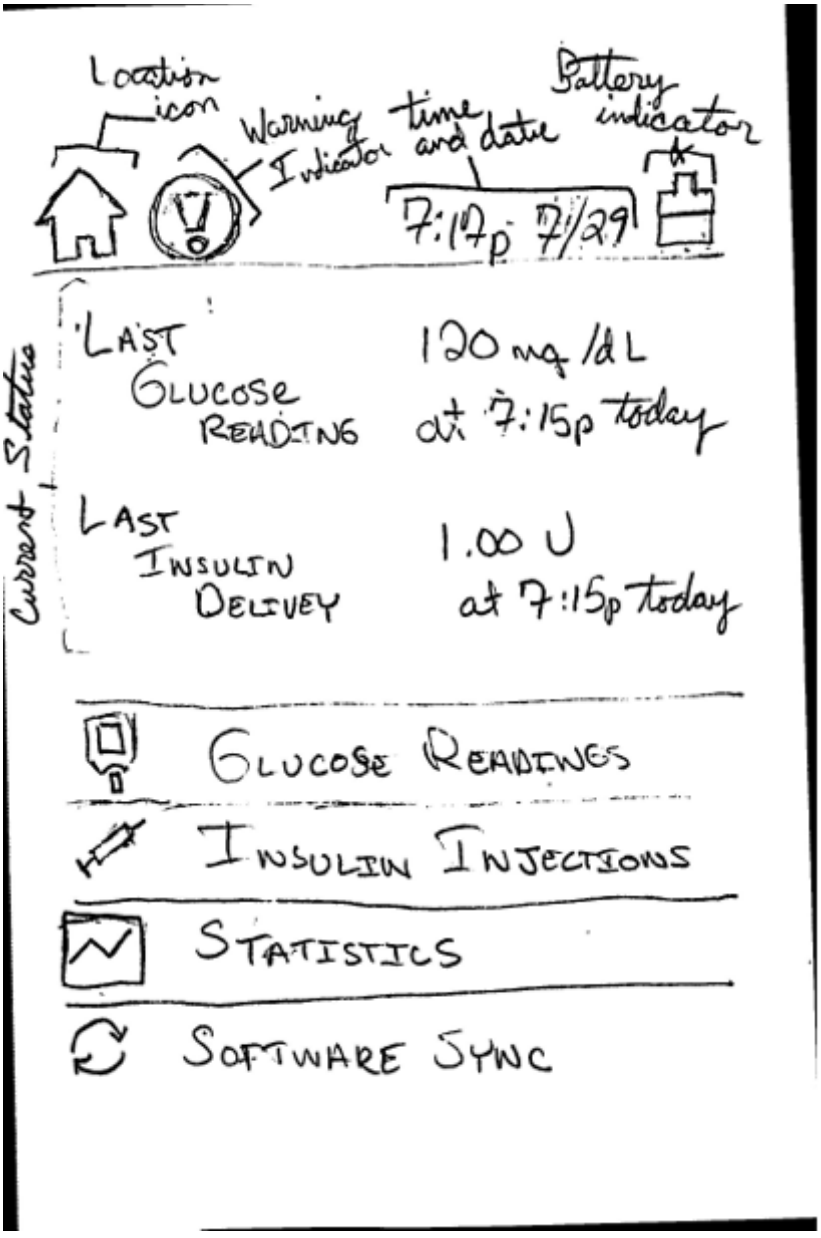
I explored three different options for the Diabetes Management Device. I ended up liking the last one I produced best.

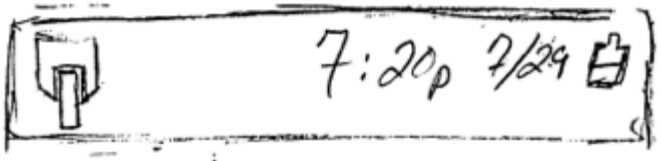


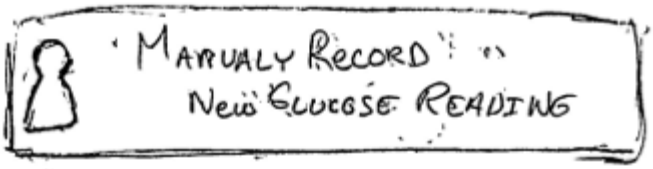
Management Device Rendering



Management Device Screen Sketches

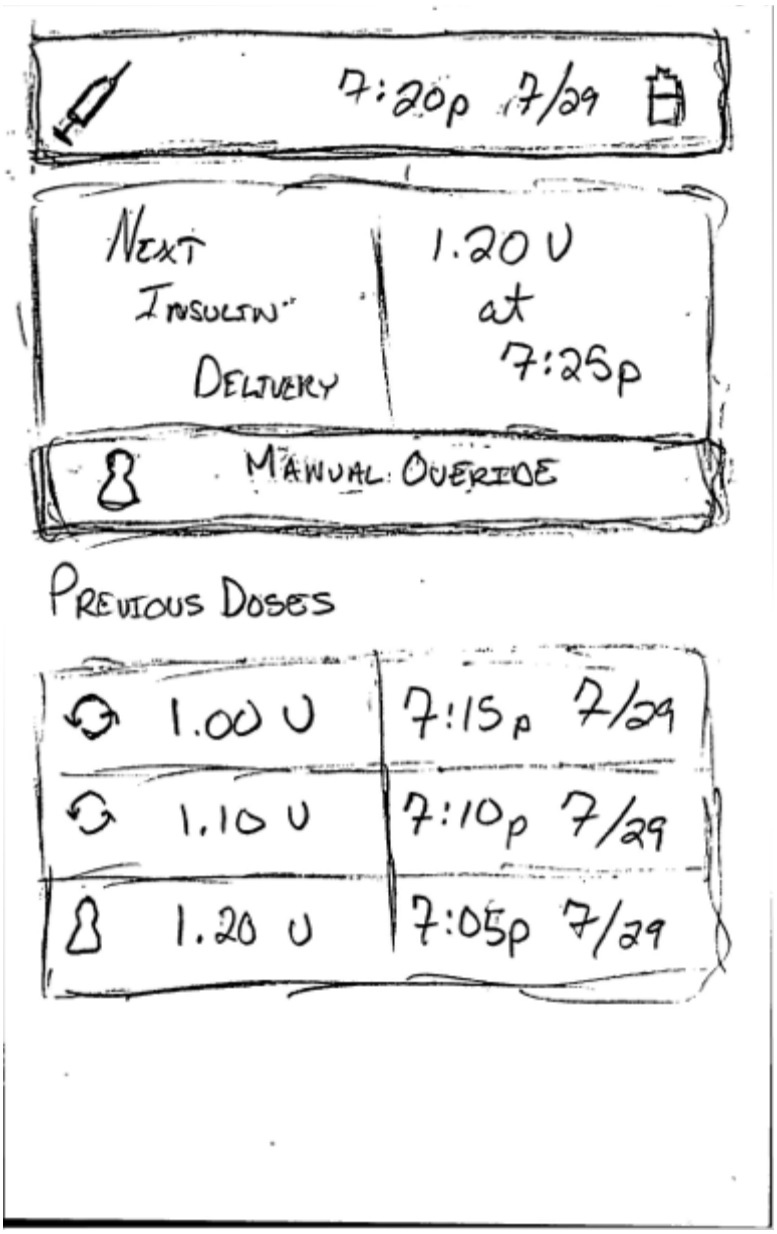


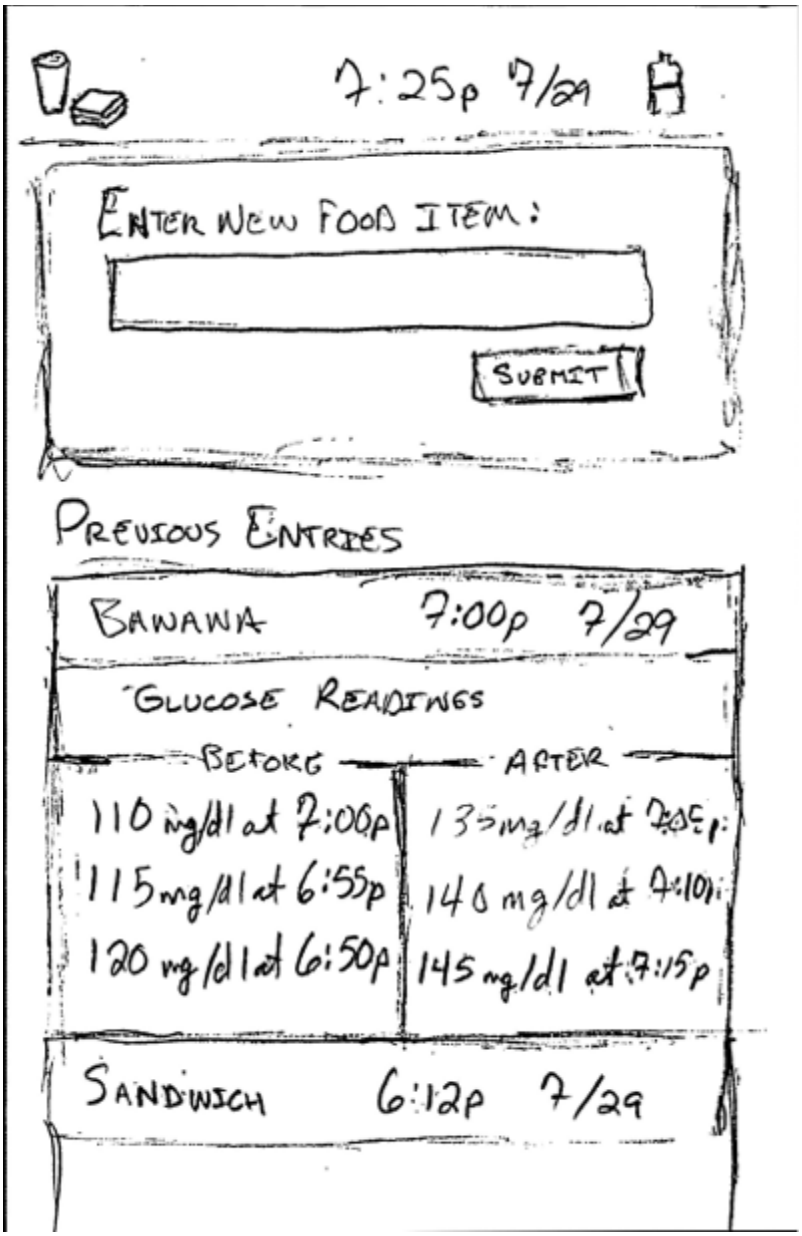




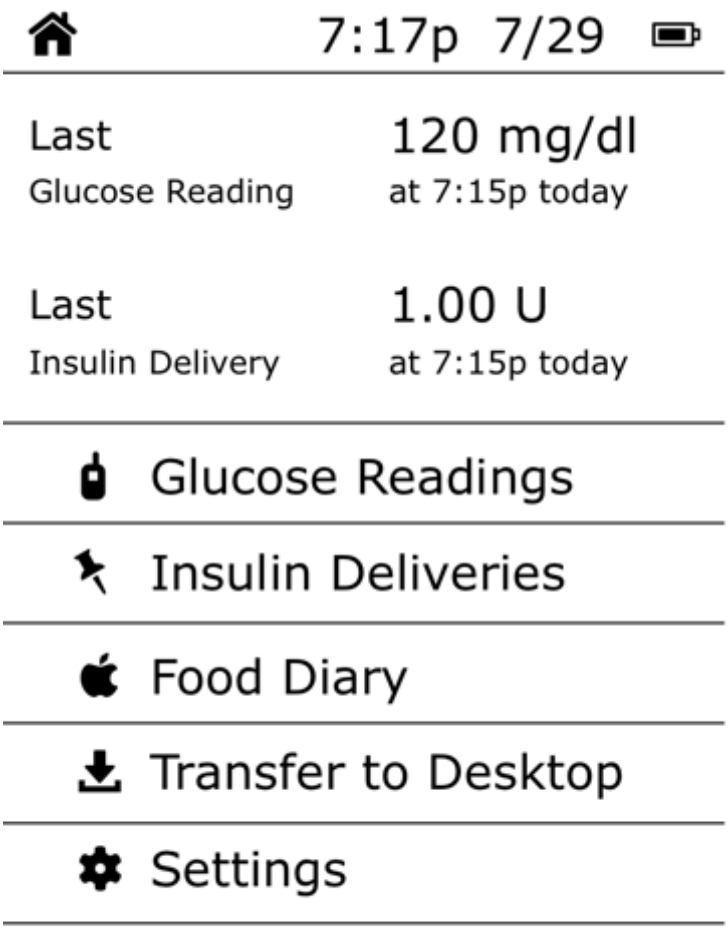
Previous Readings

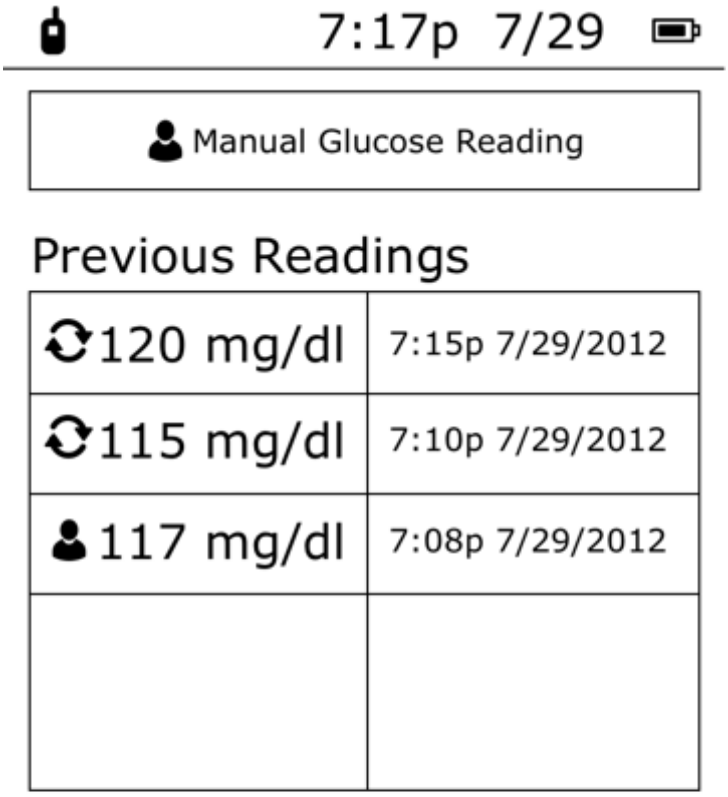
G 120 mg/dl	7:15p 7/29/2012
G 115 mg/dl	7:10p 7/29/2012
117 mg/dl	7:08p 7/29/2012


7:20p 7/29
NEXT INSULIN DELIVERY
1.20 U at 7:25p
MANUAL OVERIDE
PREVIOUS DOSES
1.00 U
7:15p 7/29
1.10 U
7:10p 7/29
1.20 U
7:05p 7/29


7:25p 7/29
ENTER NEW FOOD ITEM:
SUBMIT
PREVIOUS ENTRIES
BANANA 7:00p 7/29
GLUCOSE READINGS
BEFORE
AFTER
110 mg/dl at 7:00p
135 mg/dl at 7:05p
115 mg/dl at 6:55p
140 mg/dl at 7:10p
120 mg/dl at 6:50p
145 mg/dl at 7:15p
SANDWICH 6:12p 7/29

Management Device Screen Renderings




7:17p 7/29
Manual Glucose Reading
Previous Readings
120 mg/dl
7:15p 7/29/2012
115 mg/dl
7:10p 7/29/2012
117 mg/dl
7:08p 7/29/2012

7:17p 7/29

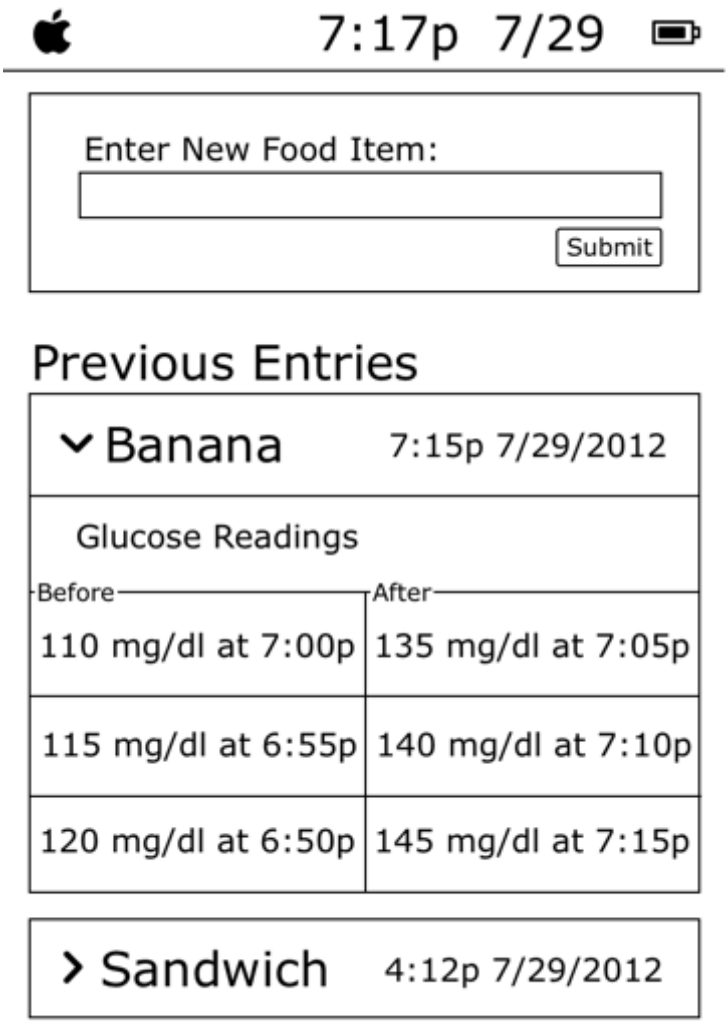
Last Insulin Delivery

1.20 U at 7:12p today

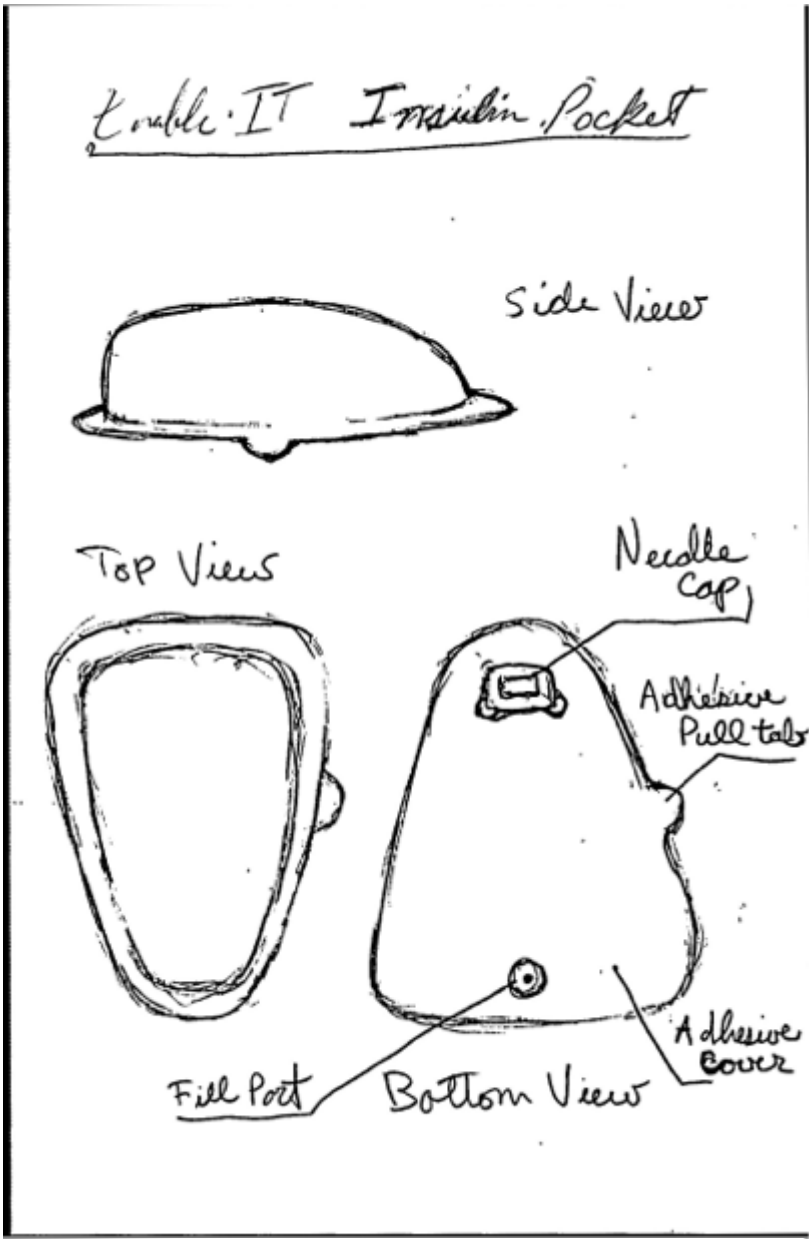
 Manual Insulin Delivery

Previous Deliveries

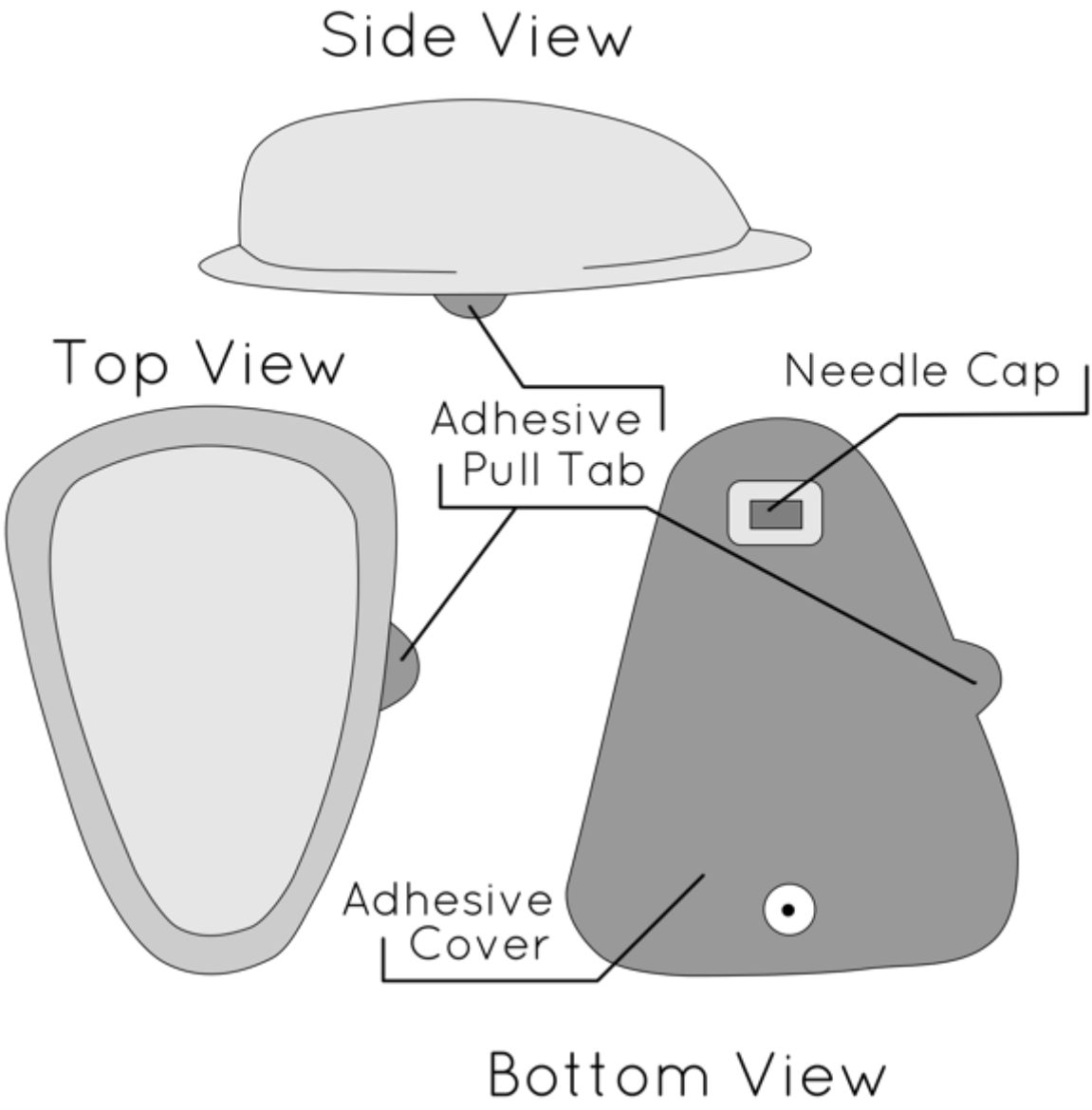
1.00 U	7:15p 7/29/2012
1.10 U	7:10p 7/29/2012
1.20 U	7:05p 7/29/2012


7:17p 7/29
Enter New Food Item:
Submit
Previous Entries
Banana
7:15p 7/29/2012
Glucose Readings
Before
After
110 mg/dl at 7:00p
135 mg/dl at 7:05p
115 mg/dl at 6:55p
140 mg/dl at 7:10p
120 mg/dl at 6:50p
145 mg/dl at 7:15p
Sandwich
4:12p 7/29/2012

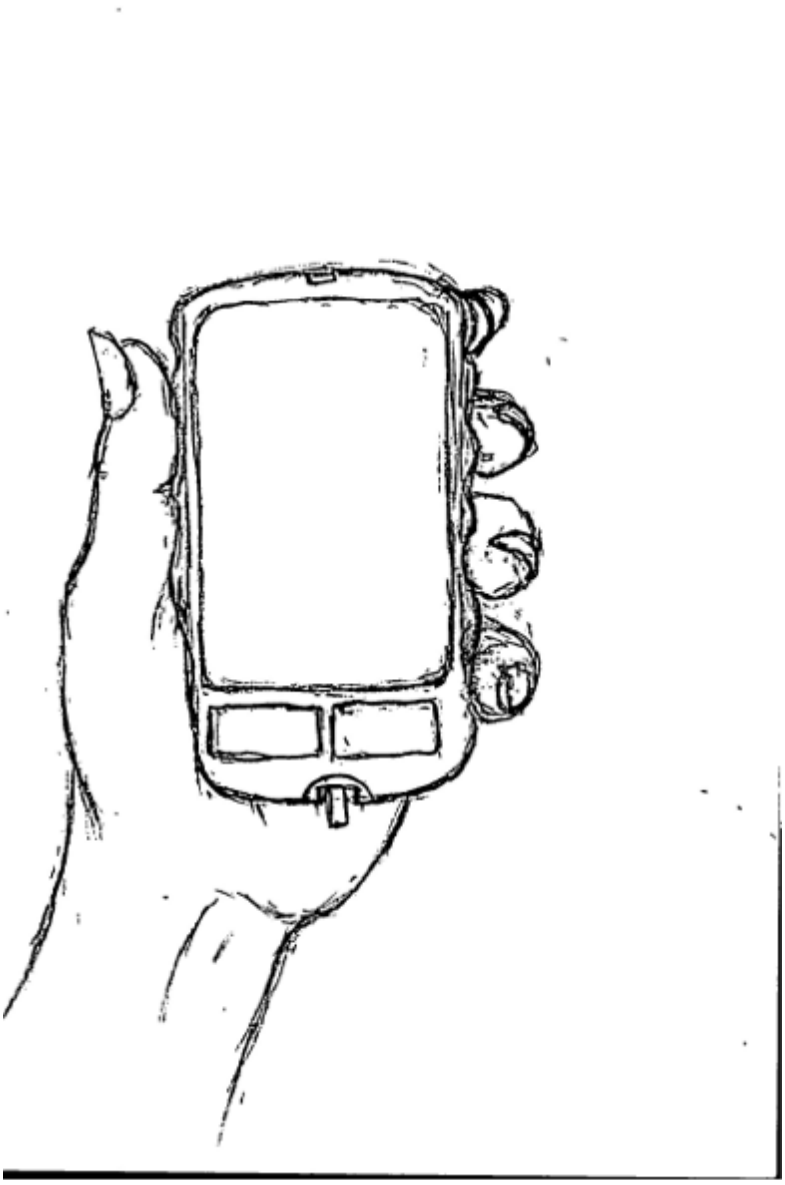
Insulin Pocket Sketches

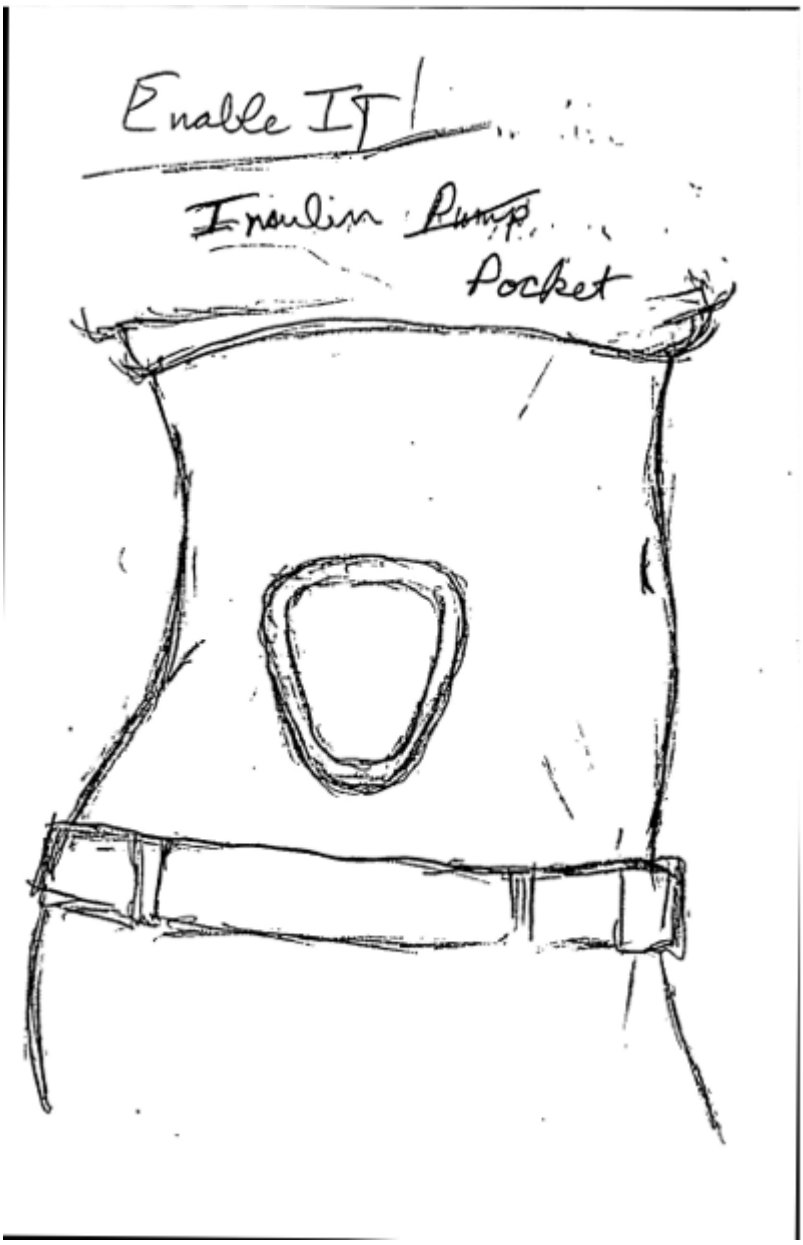


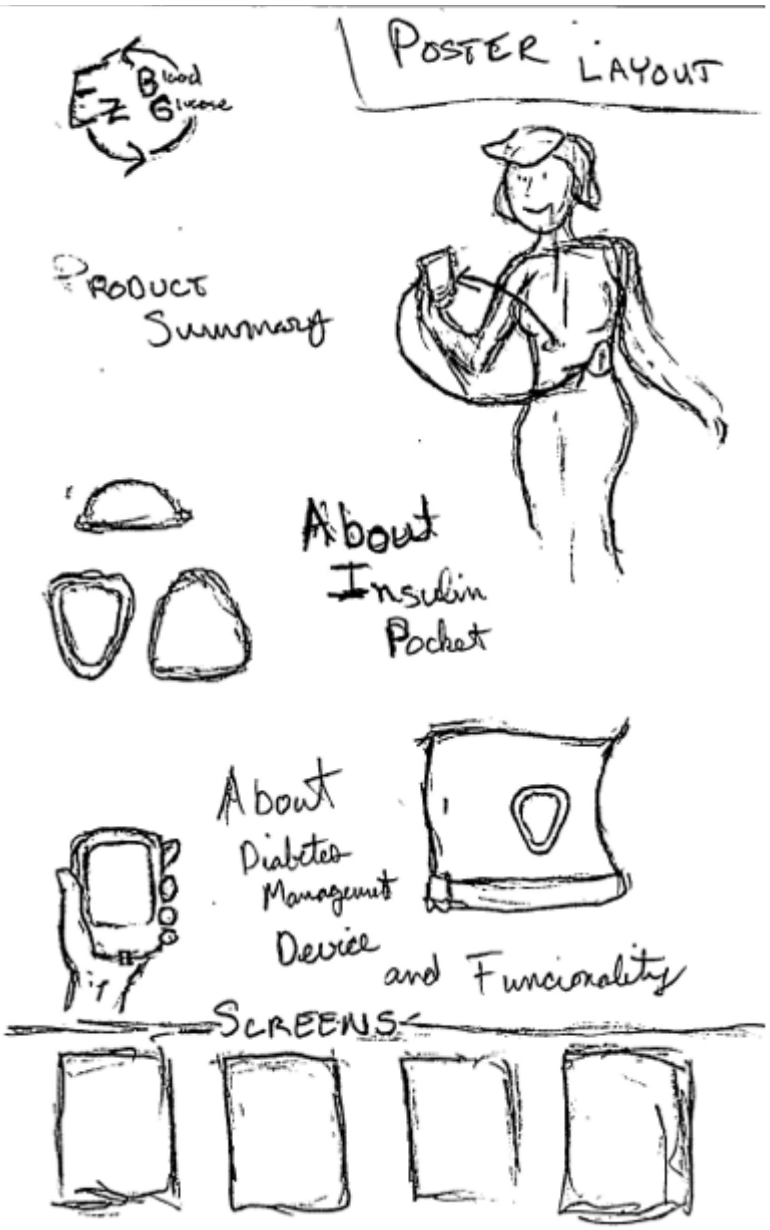
Insulin Pocket Rendering



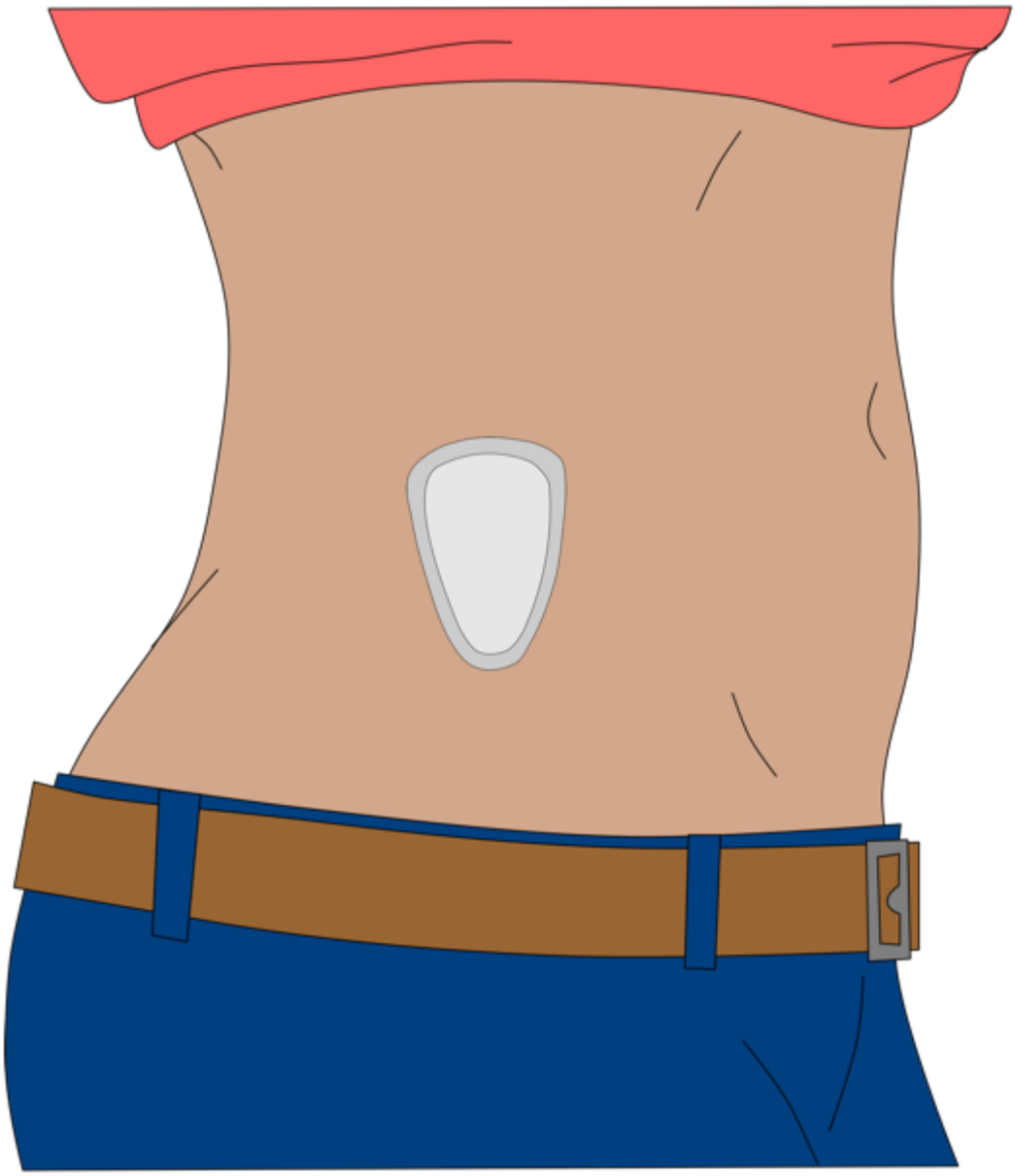
Poster Sketches




Enable It!
Insulin Pump
Pocket


EZ Blood Glucose
POSTER LAYOUT
PRODUCT Summary
About Insulin Pocket
About Diabetes Management Device
and Funcionality
SCREENS

Poster Renderings



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Hoeks, L. A., Greven, W. L., & de Valk, H. W. (2011). Real-time continuous glucose monitoring system for treatment of diabetes: a systematic review. *Diabetic Medicine*, *28*(4), 386-394. doi:10.1111/j.1464-5491.2010.03177.x

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