Discreet Diabetes Glucose Monitor and Insulin Delivery System

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Introduction

Type 1 diabetes is a devastating autoimmune disease that destroys the body’s ability to produce insulin. People usually monitor glucose levels and administer insulin through these bulky finger-pricking devices and it is currently the only practical option. Many researchers have found ways to non-invasively access glucose, but none have been rendered effective in the United States. For our project, we theorized a convenient and discreet device that effectively resolves the negatives of pricking one’s finger to obtain blood sugar levels.

Need Statement

A non-invasive, discreet device that measures and reports glucose concentration in the blood as well as delivers insulin to promote more organized monitoring of blood sugar levels for type 1 diabetics.

Need Specifications

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<th>Must Haves</th>
<th>Nice to Haves</th>
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<td>Data can be interpreted by the average user</td>
<td>Readings are very quick and efficient</td>
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<td>A noninvasive nature, essentially omitting the pain/discomfort of the conventional device (i.e. finger pricking)</td>
<td>Mobile compatibility with the device to enhance user convenience (i.e. Smartphones, Tablets, etc.)</td>
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<td>Portability that does not render the device as cumbersome/awkward to carry around</td>
<td>Relatively cheap to acquire/utilize</td>
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<td>A system that effectively motivates/reminds the user to monitor their glucose levels</td>
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Competitor Analysis

Blood Lancets
- Relatively affordable; a typical starter kit retails for around $90
- Currently the only FDA-approved devices for diabetes monitoring
- Cause pain & discomfort through finger-pricking

GlucoWatch
- Noninvasive technology launched in 2002
- Still had to use finger pricks
- FDA approved, but manufacturing stopped completely soon after due to complications
- Caused skin irritation and inaccuracy

Prototype

- Focused the mobile component of our device
- Created on MIT App Inventor
- Captures photos of the patch
- Spectrum of intensities (different shades of blue, can choose which matches to photo of patch)
- Each intensity matches with a blood sugar level
- Enter levels into another screen on the app that tells you if your glucose levels are too high or too low
- Produces a daily graph to show blood sugar level changes

Concept Analysis

- Uses the patch’s penetrating abilities to pull glucose out of interstitial fluid
- Reacts with a polymer comprised of glucose reacting enzymes and color changing dye (from white to blue)
- Higher color intensity when the concentration of blood sugar increases; lower intensity when the concentration of blood sugar decreases
- Mobile app scans patch to translate its intensity into numerical concentration

Conclusions

- Goal of our prototype: improve reader interpretation of their glucose levels
- Somewhat accomplished when we visualized a convenient method through an interactive glucometer app
- Future studies include developing the patch itself with Dr. Jayakumar Rajadas and programming the app to match color intensity rather than having the user choose the color match

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References