

GlucScreen-C: Smartphone Test Strips for Health Screening User Experience Demo

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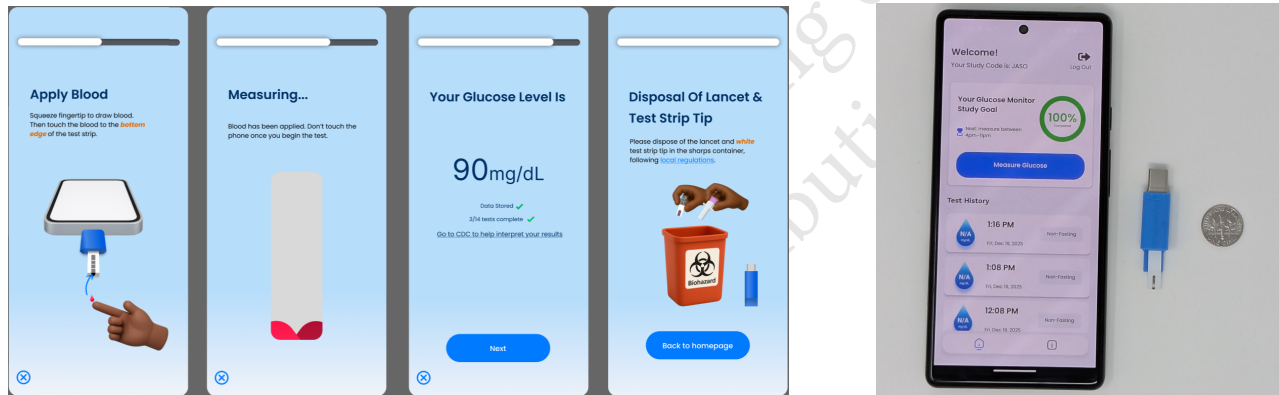


Figure 1: The GlucScreen-C system includes a custom test strip that works directly with the smartphone and accompanying custom app that walks the user through a test. The demo will involve users experiencing a test for their first time.

Abstract

GlucScreen-C, as a novel platform for smartphone-based test strips for biomarker screening, moves minimal hardware from the reader into the test strip device, allowing it to communicate the result of electrochemical biomarker detection reactions to the phone without incurring high cost or requiring extra hardware (beyond the test strip itself). This is the first of its kind, and starts to enable a new vision for healthcare where the smartphone becomes the center of testing. With its common sensors, large touchscreen user interface, and familiar interaction patterns, this can become a much more approachable form of Rapid Diagnostic Testing (RDT) in the future.

We invite the CHI community to try our prototype demo and share their thoughts and ideas about the future of remote healthcare.

CCS Concepts

• **Applied computing** → **Consumer health**; • **Hardware** → **Biology-related information processing**; • **Human-centered computing** → **Smartphones**.

Keywords

prediabetes, healthcare diagnostics, population health, rapid diagnostic testing, low-power, smartphones, ubiquitous computing

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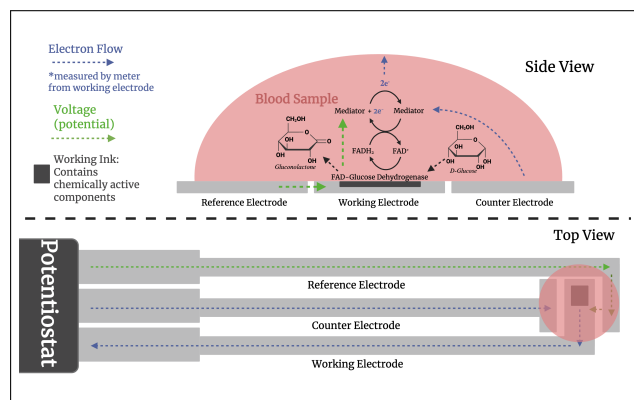


Figure 2: 2nd gen FAD-glucose dehydrogenase pathway

1 Introduction

GlucoScreen-C is a new test strip that builds on earlier work on smartphone-based test strips to leverage the growing ubiquity of USB-C (which the iPhone adopted in 2024) and the audio channel of input to the phone's microphone to develop the cheapest proven transmission of an electrochemical signal generated by a biomarker test strip directly to the phone. It is small and intuitive to use, with a USB end and a sample end, connected by minimal circuitry.

Typical hardware for communicating data over USB-C requires a microcontroller to communicate the protocol. However, lower cost methods can potentially enable one-time-use accessories for the smartphone that can help us gather more data about our health. In our prototype test strip, we leverage the hardware of USB-C without the associated circuitry that increases cost. The first biomarker to be validated with this system in this study is glucose, but other electrochemical biomarkers are theoretically compatible with the system and could be developed.

2 Methods

2.1 Test Strip Hardware Design and Rationale

The test strip hardware has been designed towards the lowest-cost method to accurately transduce the signal from an electrochemical reaction to a smartphone via commodity sensors. USB-C was chosen as both the mechanical interface and power source because it is found on virtually all smartphones and provides stable power via USB default mode. For the prototype, commercially available test strips (True Metrix) were used and placed in contact with PCB traces. For volume production, it would be feasible to glue the biochemical reaction chamber and directly onto the PCB traces using conductive adhesive, creating a one-time use test strip and further reducing the cost of production.

We have a new circuit design that it is a standalone test strip design that translates an electrochemical reaction that responds to glucose in a sample to a format that a smartphone can read via an app and common smartphone sensor [2]. However, the signal for the new GlucoScreen-C test strip differs from prior work in its compact form and ease of use, enabled by its novel method of transmission: audio. By transforming the electrochemical signal

from the glucose test strip reaction end into an audio signal, it can theoretically be designed to be more compact and lower cost. The signal is transduced via a potentiostat into a speaker driver that is filtered prior to emission. The emitted sound is at a high frequency which enables it to be outside the typical audible range for humans. This frequency is adjustable via interchanging resistor and capacitor values to fit regulations and comfort from user testing and further development.

3 Results

3.1 Accuracy Testing Results

A small amount of data was collected in lab to validate basic hardware and software pipeline functionality. As seen in Figure ??, we are able to visually distinguish the signals emitted by the test strip at different concentrations on repeated replicates. Further work on gathering more data and developing automated machine learning methods will allow accuracy validation against standards, such as the FDA guidelines [1].

3.2 The Demo

We have a few working prototypes of our test strip device, and we would like to share them with the community to try out the next generation test strips. We believe the hardware, combined with software animations in close proximity to the action, can improve the experience of using the test strips to gather important information about users' health.

We will have a table set up with phones and strips, as well as a QR code to access the app on your own phone to try it out. In addition, we'll be on hand to discuss the demo and chat with attendees about how the device could be thought about in the context of their own health journey.

4 Discussion

This demonstration of prototype technology for healthcare represents the first step into universal smartphone-based test strips. We hope that a demo and subsequent user reflection will help us hone the design and direction of the project and enable this project and authors to empower users to collect data about their own health one day.

Acknowledgments

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