

Design Document: Tactile Graphics with a Voice

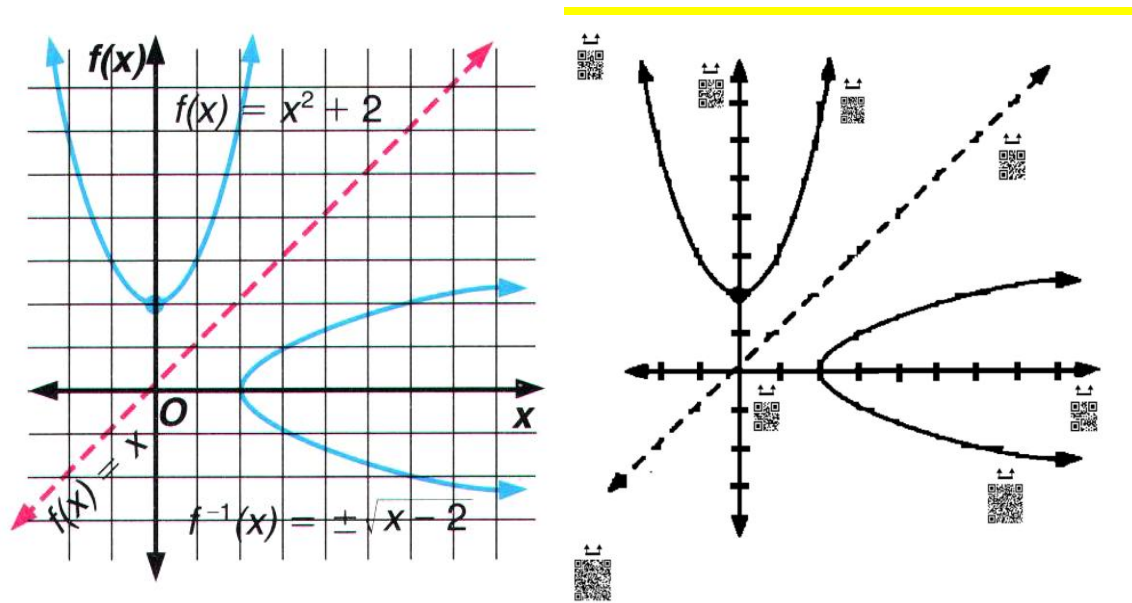
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Purpose and Description

This note gives the design for an iOS app named TGV, an accessible scanner for low-vision, blind and sighted users to use for reading QR codes for tactile graphics. Using QR codes to encode textual information instead of Braille could be useful if the text is too long to be easily placed in the image or to make graphics accessible to those who are not fluent in Braille.

Use Case

The TGV app can be used in conjunction with audio tactile graphics (such as a graph or illustration of an equation) in which the text has been removed from the image and encoded within a QR code (see Figure 1 below). When possible the spatial location of the text in the image can be preserved by placing the QR code in the image in the same location as the text was.



(a) (b)
Figure 1: (a) Image of original graph with text. (b) Image of tactile graphic (black lines are raised in actual tactile graphic) with QR codes. There are tactile markers above each QR code to aid in finding it.

Background

There has been work done on aiding people who are blind with photography.^{1,2} In work by Jayant et al.¹, the authors use both speech and haptic feedback to help people take portraits by announcing the number of faces on screen and vibrating when the faces are touched on screen. In work by Vázquez et al.², the authors evaluated three forms of feedback: silent, speech and tone (tone increases in pitch as object becomes more centered) and found that speech was preferred over silent and tone. In our design, we allow for both speech and tone feedback.

Requirements

TGV is intended to be used on a small device such as an iPhone or iPod Touch. A small device is easier to use as a hand-held scanner, and the small size also increases the specificity of its scans. That is, it makes it easier to pick out one particular QR code when there are several near each other.

In our testing, we've found that TGV works best on a device that can focus quite close to the page. It seems to be less useful with some older models of iPod Touch, which have a fixed-focus camera.

User Interface

The user interface is relatively simple. The initial screen has three tabs. One tab shows results of previous scans, one tab is for scanning, and one is for setting preferences. The user navigates to the scanning tab to begin the scan. She has some knowledge of where the QR code is located based on the tactile markers, so she can point the camera at that general location. The camera uses computer vision to determine where the QR code is centered and provides audio feedback to the user as to how to move the camera. This feedback can either be verbal feedback (e.g. "move the camera to the right") or tonal (the camera beeps more quickly as the QR code gets closer to the center).

The user can choose between two modes: **Speech** and **Tonal**. The first employs speech to give directions, the second issues tonal feedback for centering the QR code.

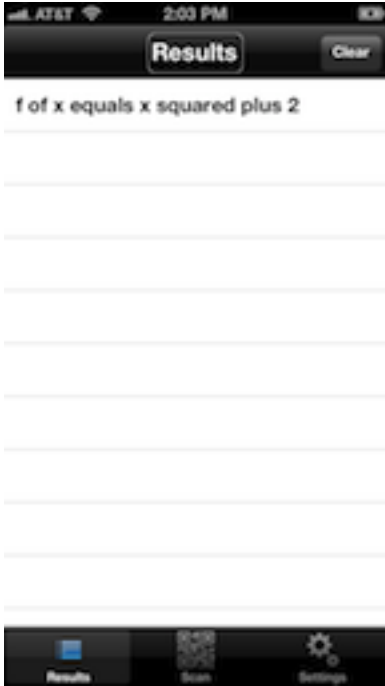
The following sections show screenshots and the associated speech and tonal feedback. To get the full feedback, the mobile device's visual assistance mode must be enabled. (Under iOS, the visual assistance mode is known as "VoiceOver.")

Initial Screen

¹ Chandrika Jayant, Hanjie Ji, Samuel White, and Jeffrey P. Bigham. 2011. Supporting blind photography. In *The proceedings of the 13th international ACM SIGACCESS conference on Computers and accessibility (ASSETS '11)*. ACM, New York, NY, USA, 203-210. DOI=10.1145/2049536.2049573 <http://doi.acm.org/10.1145/2049536.2049573>

² Marynel Vázquez, and Aaron Steinfeld. 2012. Helping Visually Impaired Users Properly Aim a Camera. In *The proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility (ASSETS '12)*. ACM, New York, NY, USA.

The initial screen is the results screen, which lists the recently scanned phrases. The most recently scanned phrase is at the top of the list. At the bottom of the screen are tabs for accessing the other parts of the interface. The user can access tabs by touching them, or can navigate to them using VoiceOver gestures.



Speech and Tonal Feedback: “TGV. Results. Heading.”

Scanning Screen

Switching to the scanning screen immediately begins the scan. The scanning screen shows the image currently seen by the camera (for partially sighted users or others).



Speech Feedback:

When other than one QR code is seen: “Zero,” “Two,” “Three,” “Many.”

When one QR code is seen, but camera needs to be repositioned: “Left,” “Right,” “Top,” “Bottom”, “Too close,” “Too far.”

When camera is positioned well and there is one QR code: “Focusing,” “One.” After a moment or two, the code will then be successfully scanned.

Tonal Feedback:

No sound when zero or more than one QR code is seen. Slow beeping when camera is far away or QR code is not near center. Beeping speed increases as QR code is closer to center.

In normal operation, the app will not attempt to scan a QR code until exactly one code is seen. This reduces the chance of accidentally scanning the wrong code. If desired, this behavior can be changed on the Settings page.

When the scan succeeds in either mode, there is a chordal sound, and the display changes automatically to the Results screen.

If no QR codes are seen for some time, and if the image appears non-empty, illumination is automatically turned on. This can be helpful to eliminate shadows that obscure the details of a QR code. The speech feedback says “Illumination is on.”

Results Screen



When there is a successful scan, the app switches automatically to the results screen and the scanned text is read aloud. The results screen shows the most recently scanned phrases, with the newest at the top. If the user scans the same thing twice, it will show up twice on the results screen.

The user can use gestures to navigate through the list of phrases, with each one being read aloud in turn.

There is a **Clear** button on the results screen that clears the accumulated results.

Settings Screen



The settings screen allows the user to choose between the speech mode and tonal mode. For tonal mode, “Guide With Beeps” is turned on.

The user can also choose whether to illuminate all scans, or to have illumination be turned on automatically when it seems it might help.

The user can choose to scan at all times, even when the app sees zero or more than one QR code. This might be useful when it is difficult to count QR codes, as when a QR code appears against a visually complex background. In normal use for tactile graphics there is a plain white background.

The user can also choose to suppress the vocal feedback when there are no codes visible. Rather than saying “zero”, the app simply says nothing.

The rest of the settings are intended for usability experiments. They wouldn't be activated in normal use.