Smartphone Application Development for Reading Nanoparticle-Based Inks

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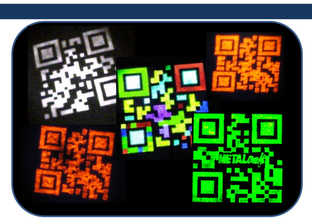
Abstract: Introduction

The wide-spread use of counterfeiting around the world has prompted research into various methods of product identification and authentication.



Covert QR codes printed at SPACT

Nanoparticle-based ink can be used to print invisible QR codes that are readable under a near-infrared laser.

Abstract: Objective

The objective of this project is to design a smartphone app capable of scanning covert QR codes for use with track and trace technologies. This objective will be fulfilled by designing an app with various features, such as scanning in low light and the ability to recognize barcodes printed in various colors.

Procedure

Create a User Interface for Smartphone App

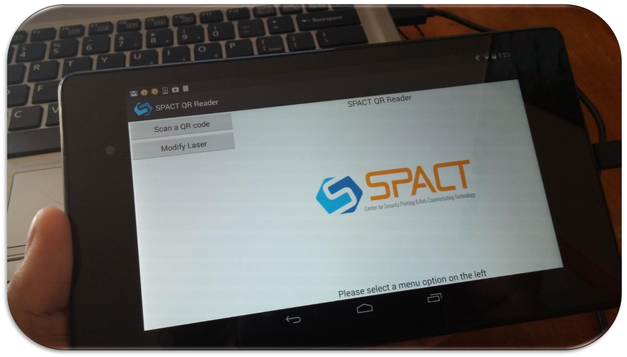
- Android UI allowing covert barcode scanning by pressing a button.

Improve Smartphone's ability to detect QR codes

- Design a scanner similar to commercial barcode scanning apps as the baseline.
- Adapt scanner to handle irregular QR codes containing minor printing errors, and QR codes printed on non-white backgrounds.

Control near-IR Laser with Smartphone App

- When the user is scanning, the near-infrared laser will be activated automatically by the app in order to upconvert the QR code.



SPACT QR Reader app running on a Nexus 7 tablet. Application design is not final.

Results: User Interface

The User Interface contains two scanning methods:

Scanning Mode uses the smartphone camera to scan and decode a QR code

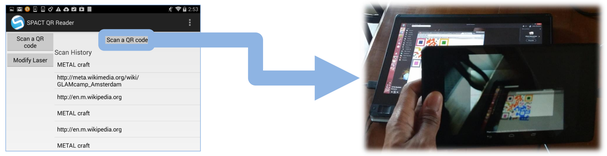
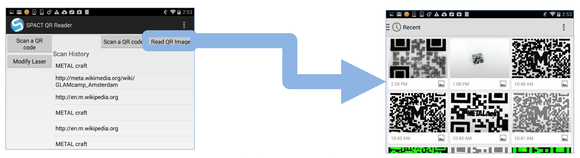


Image Mode takes a QR code image file stored on the smartphone and decodes the message



QR messages are stored in a database on the phone.

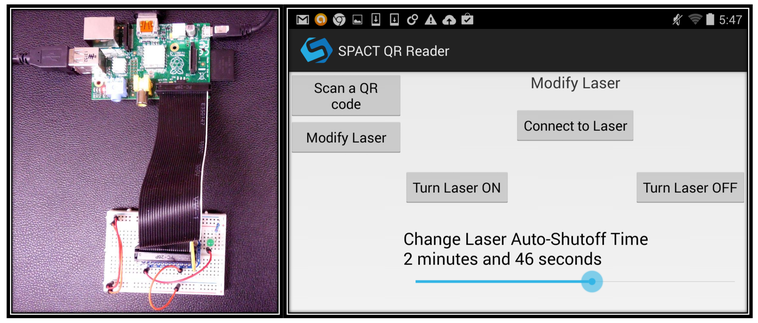
Results: Improving QR Code Readability

Smartphone barcode scanners are designed to look at QR images by distinguishing a background (white pixels) and foreground (non-white pixels). Taking QR codes printed using nanoparticle inks, image manipulation routines were performed to improve image readability for the app.

Increase Contrast — Reduce Saturation — Image Invert

Results: Laser Control

A Raspberry Pi micro-computer has been used as a proof-of-concept controller for the laser. Using a wireless adapter, communication between the Raspberry Pi and smartphone app can be established.



During testing, an LED is used instead of a near-IR laser diode. The application has settings to connect to the laser and adjust how long the laser can be on before shutting off to prevent overheating. The application uses SSH (Secure Shell) to communicate with the laser.

Future Work

Implement QR Readability on App

Currently, the image manipulations are done with an image editor on a computer. These procedures will be adapted to the application and applied to pictures taken on the phone camera.

Finish Laser Control

The next step for the laser control is to take the proof of concept design for wiring the near-IR laser and implement it on an actual laser diode.

Acknowledgements:
This work was made possible by the National Science Foundation REU Security Printing and Anti-Counterfeiting Site EEC-1263343
Thanks to Dr. Alfred Boysen, Dr. Jeevan M. Meruga, and David Langerman for their assistance with this project.