Senior Project Proposal

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# Scripture

Doctrine and Covenants 115:15 And if my people build it not according to the pattern which I shall show unto their presidency, I will not accept it at their hands.

# Abstract

The focus of this project is image processing on a mobile device or more specifically optical character recognition (OCR) using a mobile phone. The images that will be processed are QR Codes found while participating in a scavenger hunt. The scavenger hunt will be hosted on a server the game master will hide several QR Codes and the players will find those QR Codes and using their mobile phone they will read the code and upload the results to the server. If the player found the right QR Code the server will send them the hints to find the next QR Code and so on until that player has found all the QR Codes. Once all players are finished the server will publish the rankings of the players, thus, completing the game.

# Background

As I have been searching for a senior project my thoughts were continually drawn to something involving development on a mobile phone such as an Android or i-Phone. I have also been interested in the idea of image processing. A few years back when the Android phones were just released I had read of a project where someone had used the Android to take a picture of a barcode and from that barcode they would return to the user a list of prices and locations for the product they were examining. I though this idea would be fun because it would involve development on a mobile device and also image processing through the form of OCR. However it seemed to me that the task of creating the database with products and prices would end up being the most time consuming task of the project and also the most difficult which wasn’t my intent. As mentioned the focus of this project is image processing and development on a mobile phone.

When the idea of a mobile scavenger hunt came to me I realized it had closer priorities to what I wanted to do. It involved development on a mobile phone and also provided image processing through decoding barcodes. It also avoided the negative aspects of having to build a large database and figuring out how to interface with other companies product databases.

## Definitions

1D barcode – A one dimensional barcode that is similar to one found on a package in a grocery store. [2]

2D barcode – A two dimensional barcode comprised of a pattern of dots, squares or other geometric shapes.

QR Code – a 2D barcode technology developed by Denso (a subsidiary of Toyota) in 1994. [1]

Game master – The creator of a game; in this instance the game master would be the person who prints off the QR Codes, hides them, and inputs the directions to each QR code into the server.

## Prior work by others

The QR Code was developed by Denso in 1994. Since then it has become recognized as a standard and is approved as an AIM Standard, JIS Standard, and an ISO standard. [3] I will be using this format for my barcodes. Also since my project isn’t focusing on any networking aspects I plan on using the built in libraries in Java to help as much as possible. Although the Android phone provides a QR Code reader I will not be using any part of it.

## Prior work by me

I am not planning on using any of my previous work for this project. Additionally I don’t believe any of my previous work will relate to this project with the exception of some client server code I had written in my web engineering and networking classes.

# Description

The main purpose of this project is to use a mobile phone to read QR Codes generated by a computer. This project uses the client server architecture. The client will be the mobile phones and the server will be a desktop located in the Linux lab. Since this project is going to be a game it will be easier to describe the game by describing what happens in the pre-game, game, and post-game states.

## Pre-game

During the pre-game state the game master will use the server to create several unique QR Codes and will then hide those barcodes in various places. He will then be able to log back onto the server and enter a brief description for each QR Code that describes how to find it. These descriptions will be QR Code search order independent. For example the sentence “go 10 feet to the left to find the next barcode” will not work because each player will be given a unique order in which to find the QR Codes. The only step required of the Clients in the pre-game state will be to register their phone with the server so they can receive their unique instructions and inform the server when they have found the QR Codes in game.

## Game

The game will start after all clients are registered with the server. The server will send each client the hint to help them find their first QR Code this may be different for each client as all clients will have a unique order in which they are to find the QR Codes. For the rest of the game the server will keep track of how long a client has been playing for and will validate if the client has found the correct QR Code. If the client has found the correct QR Code the server will send a message letting them know they have found it. If the client hasn’t found the correct QR Code the server will send a message letting them know they haven’t found the correct QR Code and will continue to wait for the client to send them the results for the correct QR Code. The game state for the server will be over when all clients have found all QR Codes or the game master manually ends the game. During the game state the client will display the instructions, received from the server, needed to find the QR Code. It will also decode the QR Codes when the user finds them and submit the decoded QR Code to the server. If the client sent the correct decoded QR Code to the server the client will then display the next set of instructions that it received from the server. If the client send the wrong decoded QR Code to the server it will display a message to the user letting them know to keep looking and will then show the same instructions it had been displaying previously. This process will continue until the server informs the client that they have found their last QR Code. Once the client has found all QR codes it will then display a message to the user letting them know in which place the finished. If the game master ended the game before the client found the last QR Code the client will go directly to the post-game state.

## Post-game

Once all clients have found all QR Codes the server will then send to each client the ranking of the clients and how long it took for each client to finish. In the event that the game master ended the game before all clients finished the clients who didn’t finish will not have a rank when the ranking is sent out. The finish time for the clients who didn’t finish will be the time from when the game had started to when the game master ended the game. Once the server has sent out the ranking and times to all the clients the server will then give the game master the option to delete the game or restart it. If the game master decides to restart the game the server will unregister all mobile devices and wait for mobile devices to register for the new game. The post-game for the client starts at the same time as for the server. During the post-game the client will display the ranking and times for all the players until the user closes the application.

## What Defines a Successful Project

This project will be considered a success if the client is able to successfully decode 80% of the QR Codes it attempts, the clients are able to communicate with the server and vice versa under normal conditions, and a complete game is able to be carried out.

## Tasks Required

This project can be broken down into six tasks preliminary research and proposal preparation, research, requirements specification, design, coding, and testing. Although each of these phases may be broken down into subtasks later, they will for now comprise all the tasks required to complete this project.

While completing the preliminary research and proposal preparation task I will come up with several different project ideas and choose the idea that will be best suited for this project. This judgment will be based on how long the project will take, if the main portion of the project is outside of the curriculum, if the project is feasible, and how well I like the idea. These idea will be compiled from searches on the internet, suggestions made to me by others and ideas that I have come up with.

While completing the research task I will figure out how to create and decode QR Codes. I will research methods and algorithms required to manipulate an image such that I can extract the QR Code from it with the possibility of the QR Code having any orientation (i.e. sideways, upside down…). I will also figure out how to extract the QR Code from an image. I will primarily be searching in the IEEE and ACM digital libraries however I plan on using any other reputable source that will assist me. I will research how to program on the Android platform.

While completing the requirements specification task I will define what my project shall do, what it will do, and what it may do. Also to complete this task I will provide a traceability matrix.

For the design task to be considered complete the following will be required. I will need to have decided on how the data will flow through the program; this includes specifying a protocol that will be used by the client devices and the server. I will need to decide how I will correct skew with the QR Codes I process. I will need to decide how I will extract the data from the QR Codes. I will need to design the UI for both the server and the client. Most of these designs will be in the form of pictures of whiteboards or scanned handwritten papers. This will allow all the design documentation to be in a digital format.

The coding task will be complete once the design is implemented and the code compiles and runs without any major issues. This project will be coded in Java using the NetBeans IDE. The UI will not be created using a GUI editor but will be coded mostly using the MIG layout.

While completing the testing task I will be using primarily black box testing. The exception will be in making sure that users are not able to cheat by submitting a decoded QR Code without having first taken a picture of the QR Code. As bugs are found they will be submitted to a bug tracking system and ranked according to their severity. The most severe bugs will be fixed first.

# Scope

There will be two types of applications pertaining to this project clients and server. The server will be able to communicate with the clients over TCP/IP transmissions and with a printer through the operating system. The server will be written to run on the operating system currently installed in the Linux lab and will not be specifically designed to run on any other operating system. A game master will be able to save games, not currently being played, onto the server’s hard disk. A game master will also be able to load a game from disk and play it. A game master will be able to modify a game that is not currently being played and doesn’t have any users registered to it. A game master will be able to boot any client from the server. The game master will be able to manually end a game before all players have found all QR Codes. This project will not provide any means of chat or voice communication between clients or between client and server. The client will only be able to decode QR Codes. Any other form of barcode will not be recognized. A client can only participate in one game at a time. A client can join another game after completing a game without having to restart the application.

# Tasks and Schedule

The schedule that I will follow for this project will be as follows.

|  |  |  |  |
| --- | --- | --- | --- |
| Task | Start Date | End Date | Hours to Completion |
| Preliminary Research and Proposal Preparation | 01/03/11 | 01/14/11 | 12 |
| Research | 01/12/11 | 01/29/11 | 30 |
| Requirements Specification | 01/29/11 | 02/02/11 | 8 |
| Design | 02/02/11 | 02/23/11 | 36 |
| Coding | 02/24/11 | 03/14/11 | 31 |
| Testing | 03/14/11 | 04/06/11 | 40 |
| Total Time spent on project |  |  | 157 |

# Deliverables

The following are items that will be provided throughout and upon the completion of this project.

* Proposal
* Requirements Specification
* Design Documentation
* Source Code

# Applicability

This project incorporates a bit of the current curriculum of the BYU-Idaho Computer Science program. The ways in which this project incorporates the current curriculum is that it will be written in Java which is reminiscent of Software Design and Development. This project will also require a client server architecture which relates to the curriculum taught in the networking class.

This project is also exclusive of the Computer Science curriculum in that most of the processing will be done on a mobile device; also the most of the processing involves image manipulation.

# Required Resources with Costs

The following is a list of resources that I will need for this project.

* Use of one of the computers in the Linux lab for a server (not exclusive).
* An Android mobile phone.
* Reference material to learn how to code and decode QR Codes.
* Reference material about image manipulation and processing.

The use of the Linux lab computer for my server will have little to no cost associated with it. From what I can see the only change that I will need on the server is to have a port open for clients to connect with the server. It will also need to be accessible through the Internet.

I currently don’t own an Android phone I am planning on buying one at the end of February. The cost of the phone will be most likely about $50 however it may range up to $150 (not likely). I will purchase this phone and I don’t expect the university to pay for either the phone or service.

I expect the university to provide all reference material. I expect that most all of the reference material I will need the university already owns or has access to. Since I don’t have any specific reference material that I require at this time the additional cost for this material will be $0

# References

[1] Gao, J.Z.; Prakash, L.; Jagatesan, R.; , "Understanding 2D-BarCode Technology and Applications in M-Commerce - Design and Implementation of A 2D Barcode Processing Solution," Computer Software and Applications Conference, 2007. COMPSAC 2007. 31st Annual International, vol.2, no., pp.49-56, 24-27 July 2007 doi: 10.1109/COMPSAC.2007.229 URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4291101&isnumber=4291085

[2] Ohbuchi, E.; Hanaizumi, H.; Hock, L.A.;, "Barcode readers using the camera device in mobile phones," Cyberworlds, 2004 International Conference on , vol., no., pp. 260- 265, 18-20 Nov. 2004 doi: 10.1109/CW.2004.23 URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1366183&isnumber=29917

[3] Yue Liu; Ju Yang; Mingjun Liu;, "Recognition of QR Code with mobile phones," Control and Decision Conference, 2008. CCDC 2008. Chinese, vol., no., pp.203-206, 2-4 July 2008 doi: 10.1109/CCDC.2008.4597299 URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4597299&isnumber=4597261