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Android Gym Application Utilizing Near Field Communications (NFC) CM0343

INTERIM REPORT
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Abstract

This report focuses on the gathering of required research to fully understand what needs to be undertaken in order to create a versatile Android Gym Application that uses NFC technology, looking at databases in android, how does NFC work? And use user feedback through surveys and focus groups to determine the deliverables in the final report.

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Introduction

The project is based on creating a more stream line approach to people recording their gym workouts by creating an android gym application utilizing Near Field Communications (NFC) technology.

A current problem that many gym users find is that when they wish to record their gym workout regime to a phone application they often find themselves spending more time looking for a particular exercise to add to the day's diary then they do focusing on the actual workout. If users have to manually search for exercises each time they wish to add to their diary this can work to a lot of wasted time in the gym. More often than not many exercises are not in a particular gym application.

The aim is to solve this problem is to create a versatile android application that has the ability to add and change database entries so users can also add their own exercises. By utilizing NFC technology you would be able to simply swipe your phone near an NFC tag that would be located on or near exercise

equipment already be loaded with the required information the application would then add that exercise to the phone. Users would be able to go around the gym from one machine or exercise to another and with a simple swipe of the phone add that workout to the day's diary. This will make a gym users experience more streamlined as they will no longer be searching for exercises to add to their phone as they can now simply swipe their phone near an NFC chip to add the data to the diary.

The goals of this project are to produce an efficient android gym application that does not hinder a gym users experience while recording exercise regimes. Allows for flexibility to add and change exercises found within the application.

Key beneficiaries of this application will especially be new and advanced gym users alike, as it will provide new users with a platform to start from, It will offer a variety of preset exercise programs in which to get new gym goers started, But will also serve as a key aid for the advanced gym user as they have the ability to streamline workouts while adding new diary entries keeping time spent on the phone to a minimum.

The scope of the project is to create an application that not only serves as a device for recording entries of a gym workout but also a tool which can be used to improve a gym user's progress within the gym. This application is intended to act as a base to a wider end goal in creating gyms that incorporate NFC technology so that users can simply take their android NFC enabled phone to the gym to begin recording gym activities with the more efficient NFC technology.

The Approach to solve this problem will be to establish a gym users' needs for an application and derive from this key functional and non-functional requirements. This will be done through the use of effective research and surveys to the gym community. Utilizing NFC technology within android will allow the application the ability to be used on any NFC enabled android phone which is currently has the largest market share of phone users.

Outcomes will be use case designed system that fits the majority of the gym community's ideals for the mobile application and key assumptions will be the ability to get an NFC reader working on the phone that can read in external NFC tags.

Background

Why Android?
The first requirement is to justify why Google's Android was chosen as the key development platform over apple's iOS and Microsoft's Mobile windows operating system (OS). This is due in large to the market share that each mobile OS currently has. It makes sense to develop an application with the largest market share but also another key point to add was at the current time in the market Apple's iOS and Google's Android have the largest market shares by a fair margin. The problem is that Android and Windows are the only OS's that offer NFC chip integration in their hardware so Apple's iOS does not fit hardware requirements for this project. The Android OS is considerably larger than Windows mobile OS so this was the logical lead platform to choose for development.

Let's look at some keys statistics to determine which Android OS to set as the minimum my application should be compatible with;

Current Distribution

The following pie chart and table is based on the number of Android devices that have accessed Google Play within a 14-day period ending on the data collection date noted below.

Version	Codename	API	Distribution
1.5	Cupcake	3	0.1%
1.6	Donut	4	0.3%
2.1	Eclair	7	2.7%
2.2	Froyo	8	10.3%
2.3 - 2.3.2	Gingerbread	9	0.2%
2.3.3 - 2.3.7		10	50.6%
3.1	Honeycomb	12	0.4%
3.2		13	1.2%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	27.5%
4.1	Jelly Bean	16	5.9%
4.2		17	0.8%

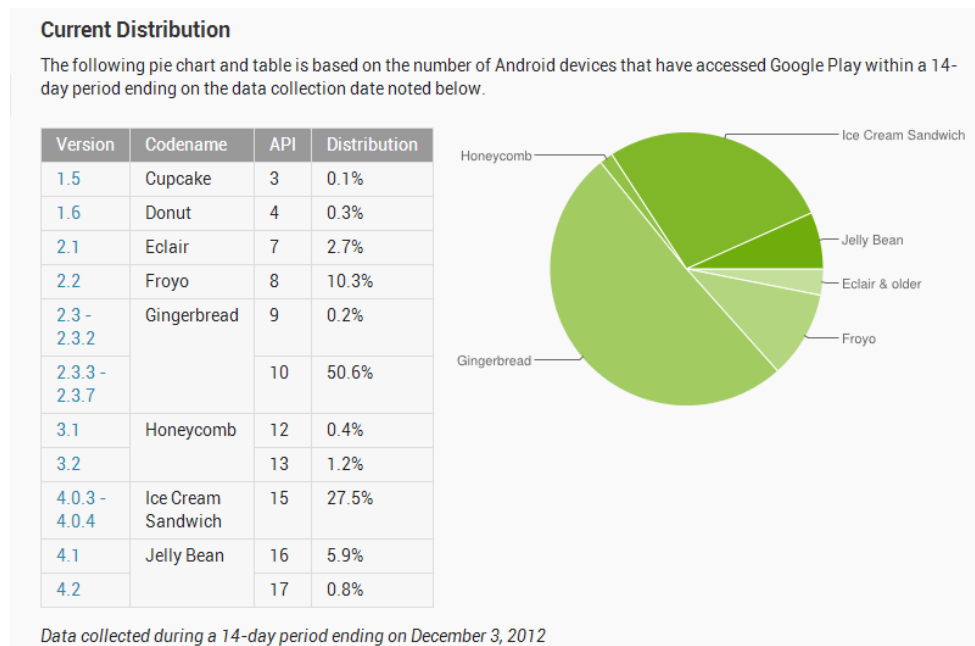Data collected during a 14-day period ending on December 3, 2012

Fig [1]

As the image above shows a vast amount of Android users have the gingerbread OS so I will be designing my application to be backwards compatible to Gingerbread version 2.3.3. The reason for this is because this was when the first NFC Application Programming Interface (API) became available for android which allowed the phones to read in and write NFC tags and set up peer to peer connections with other NFC enabled devices. This will allow the use of NFC enabled phones From Gingerbread 2.3.3 through to Jellybean's 4.2 to be able to use this application.

The Android OS is programmed with the Java coding language which has a huge support network online for creating applications on mobiles and solving coding problems.

The device that will be used to test the Android Gym Application will be a Samsung Galaxy S3 model GT-I9300. This is one of the higher end Android phones and features in built NFC technology and by current sales will be one of the leading android devices commonly used.

Near field Communication Technology

NFC is a short range wireless communication technology. That was designed to allow the transfer of data between devices such as an NFC enabled phone and NFC tag. This interaction is very simple and intuitive as it only requires the devices to be in close proximity to transmit data to each other. NFC is based on the Radio Frequency Identification (RFID), it uses magnetic field induction to allow communication between devices. NFC operates at 13.56 MHz spectrum and allows data speeds of up to 848 kbit/s. The distance typically is maximum of 10cms away between devices. (This is designed so NFC chips will not be scanned by accident) –Tags will only be read if the user intends.

Devices that are NFC enabled will typically have this logo.

Fig [2]

NFC can be used for a variety of different services, it's used to pass data from one device to another such as contactless payments, product identification, advertisements and many more.

NFC Tags

NFC Tags are essentially very small memory devices with antennas attached this allows the transmission of data wirelessly. NFC tags have no internal power source to run, the power comes from the NFC reading device such as a mobile phone being in close proximity this comes from the radio signal which powers the chip inside the NFC tag. The tags can come in a variety of different shapes and sizes. More often than not a sticker as shown below. But can also be hidden in key fobs or plastic casings.

Fig [3] - This Image shows several different types of NFC tag as I plan to test to see which type will be most efficient for my application. Each chip can store various amounts of data and has different scan strengths which mean they can be scanned from a limited distance- this could prove useful in the gym environment.

NFC has been designed to be as simple as possible so has little impact on a user's ability to use NFC technology. Devices are simply held near or swiped by each other in order to transmit data. Due to the NFC chips being very small in size they typically cannot store much data. They are primarily used to store small data segments such as a web address (URLs) and small amount of text, they can also be used to open and close applications. Due to the NFC chip being powered by radio signal from the phone it only allows for reading a small amount of data at a time. The technology is rapidly growing due to its simplicity, it doesn't require additional software downloads to work or need a camera to scan in QR codes.

The tags are encoded using an application on the NFC enabled phone or computer these can be re written until the NFC tag is locked then the data cannot be changed. Due to the low cost and easy configuration of NFC chips they will serve as an ideal tool to implement within my Android application.

For coding the chips I will use a third party application as they serve the purpose of the simple task of writing information to the NFC Tag more than well. There is no point adding an NFC Tag editor within my application as it is designed for users to go to the gym and use the NFC Tags already located around the Gym. By including an NFC editor only bulks out the application which is designed to be sleek and slim line and efficient for ease of use.

Research

Before application development can begin I have established that Java will be the primary programing language featuring the use of SQLite. This is because the application is intended to be able to store a variety of different exercises and routines that can easily be edited such as adding or deleting. This is easiest realized in Java through the use of a SQLite embedded database. This will keep the data being read in and out of the application in check and uniform by using rows and coulombs to store fields of data and the ability to dynamically edit the database.

Potential problems that could arise during the building of the application could be NFC integration from reading information from a chip into the SQLite database. As new exercises stored on the NFC chips will need to be read into the phone and store accordingly. Reassuringly there is a large coding community found online with many guides to help with problems and troubleshooting that may arise from the integration of NFC technology inside the Gym Application. I will be following a guide found at http://www.vogella.com/articles/AndroidSQLite/article.html which will aid in implementing the SQLite database within android.

First let's look at other applications that feature the use of NFC technology found on the Google Play store. Upon inspection of the online store there are no apps that incorporate my idea of implementing NFC technology with a Gym application. So now to see what NFC enabled apps are available. There are 100s of applications that are designed to write data to an NFC Tag. Some of the more specialist applications such as NFC Task Launcher shown below.
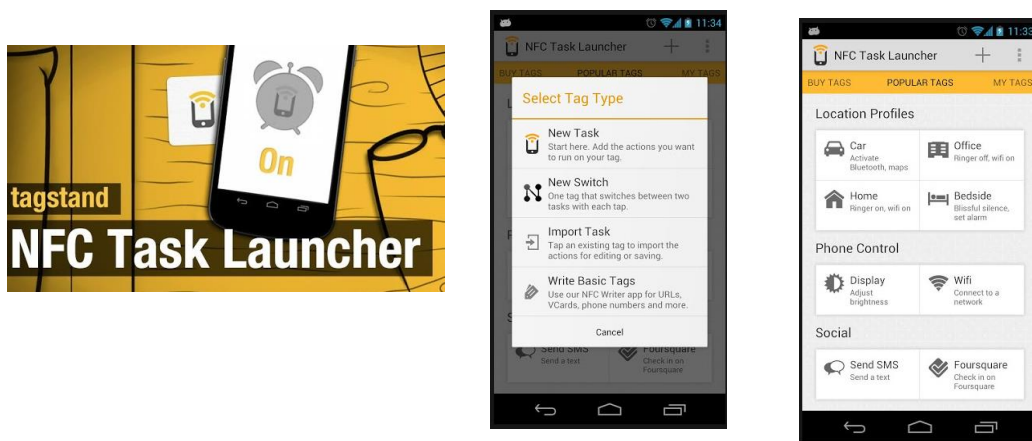
Fig [4] this applications primary use is to create profiles for the phone that are switched to and from through the use of NFC technology. For example an NFC tag may be in the user's car so upon entering the phone reads in the NFC tag and now instantly switches the phone to car mode without the need to manually change the settings. This same rule also applies for when the user enters their home there could be another NFC tag that switches the phone back to normal mode. This applications use of NFC technology highlights that not only can chips be used to read information from but can also read in commands that will alter the phones state.

Constraints that are found within the NFC technology are distance, a user cannot scan an NFC chip from across the room they have to be within close proximity. This also serves as a plus for its intended use within the project Android gym application. This is because the NFC tags will be placed around the gym on and around equipment and if they were accessible from many meters away there could be issues

with interference as a user may simply wish to scan one tag but the phone may pick up any number of tags. Because the NFC chips have a typical scan strength of much less than 10cm distance away, it means that NFC Tags will not be accidently read into the phone, only ones that the user has intended to.

Other applications such as a Business card Holder application use the NFC chip to store an electronic business card that can simply be scanned again and again to different devices. NFC time tracking applications such as the one below;
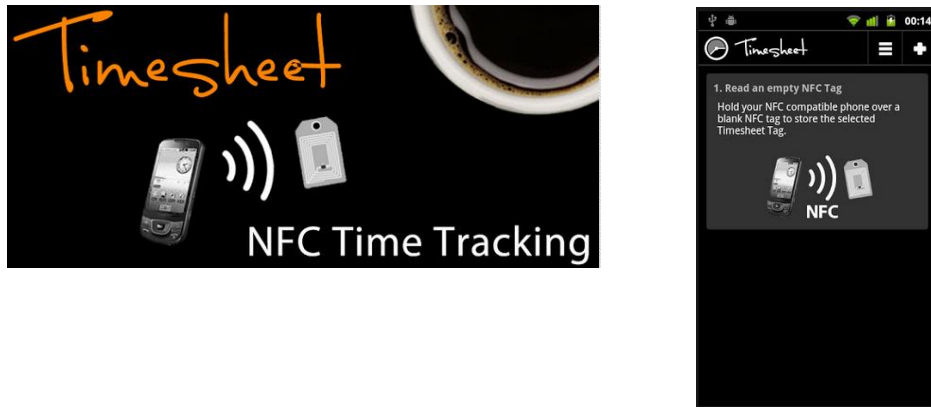
Fig [5] - NFC application design for keeping track of time spent on projects. This is done by recording the name and start date of the project this is then logged in the app. This use of NFC could prove useful within my application as users may wish to see how long they took to complete an exercise such as using the treadmill. One application that incorporates features intended for my Gym app is FMC12 NFC Pro.
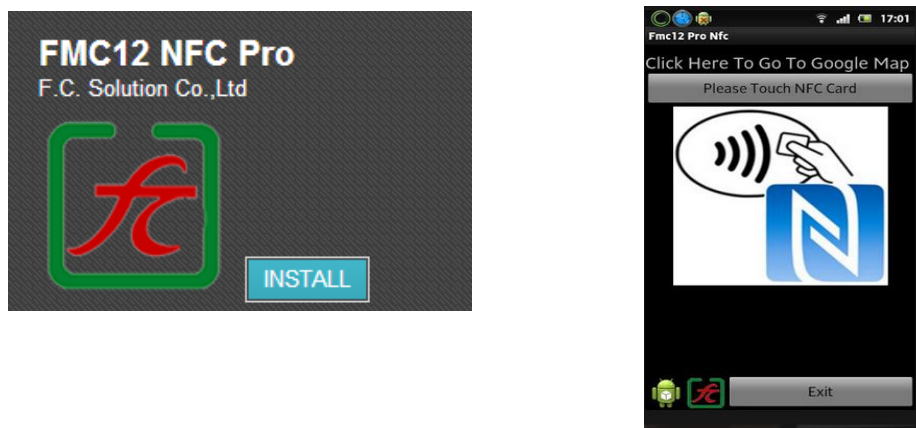
Fig [5] - This application allows data to be read in and stored to an online SQLite database. Its primary purpose is to record service staff tracking, security tracking in real time and used as a time sheet for attendance of staff. The way in which this application reads in the data from the chip and stores it to a database proves that this functionality is possible to implement with in my application.

Now let's look at current gym applications already out on the Android market Google play. A quick search shows there are 1000s of Gym application that cover everything from diet plans to specialist

training techniques. The applications that best fit what the Android Gym application specifications will be used as guide to see what features are currently implemented.
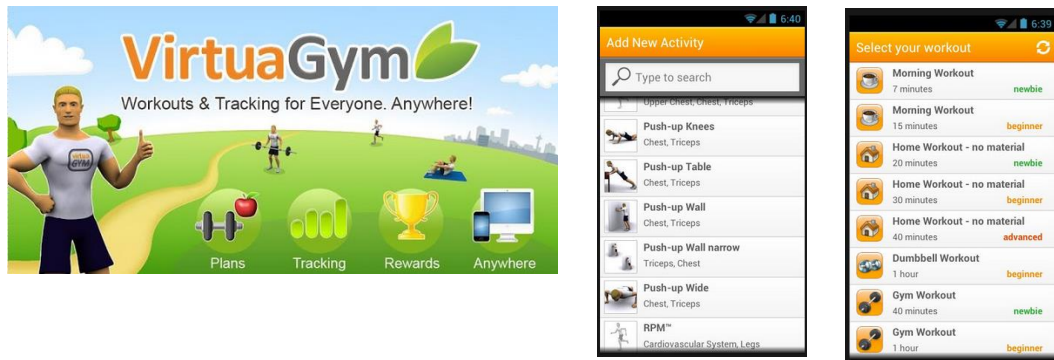
Fig [6] - VirtuaGym application comes in two versions free and paid. The free version offers limited functionality and the paid app offers full intended functionality.

This application has many useful features such as a calendar in which to keep track of gym activity, the ability to add and edit exercises within the application. Users can pull up graphs to track muscle mass gain and weight loss. There is also GPS implementation that allows for tracking a user distance traveled. This could be something that could be incorporated into my application design if I get ahead of schedule during the implementation phase. A key feature of this application is all the exercises are illustrated through the use of 3d models.

Another popular application on the Google Play store is Gym Book Workout Notebook. This application is designed for power lifters and features preset work out regimes that a user can do and also edit and amend their own. It offers charting and mapping of change in the workouts each week. The User interface (UI) is very simple large buttons are used, This is a design point to consider as if the buttons are too small users may not be able to select what they intended on the application.
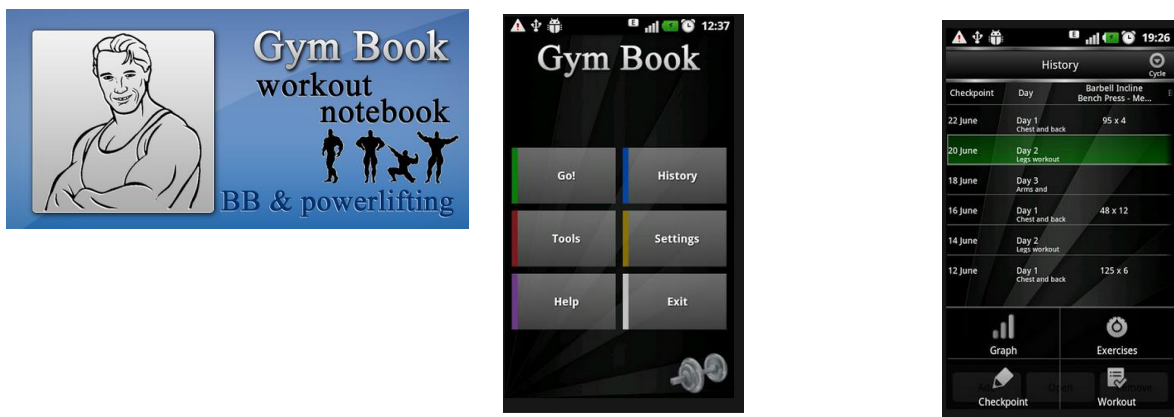
Fig [7] - The Gym book application has a much simpler UI, Its design is solely geared towards user functionality, and it's simple and clean, Easy to navigate. The colours used are very generic but colour schemes should be taken into account when designing the application. It's designed to increase weights each week by providing users goals based on their previous data entered.

Upon analysis of a variety of different android applications no one app, features a comprehensive gym aid application integrated with NFC technology. I aim to fill this deficiency

buy creating an efficient application that incorporates both. After extensive research on various gym applications I have created a rough set of key requirements and features.

With the features that I intend to implement I will use the Android SDK as this is one of the best coding platforms that offers plenty of support especially when coding for older versions of their Android OS such as gingerbread. When programming this I will be making full use of classes to reduce code being repeated, and make the application more efficient. I will be using SQLite to create the database of exercises within the application. The NFC integration will be the most problematic, getting the phone to read in the data isn't a problem it will be reading in that data and storing to a database. Due to the size and scope of the project I will not be creating an NFC Tag Program

In summary from the background research I have discovered that there are key functional requirements and non-key functional requirements to consider while making the application.

To further enhance the potential success of my application fitting user requirements, I created questionnaires to give to gym users/ gym workers. This would allow me to analyze my target sample group and glean from them their ideals that they would like to see in an Android Gym application. The results from the questionnaire did not produce any outlandish results, most of my suspicions on what would be needed to create a worthy gym application were confirmed. Please see appendix for questionnaire.

The number of questionnaires filled out was 30.The sample audience was 80% male. Who went to the gym on average 3 times a week and played a sport for the university. 65% had an android phone capable of NFC data transmission. 55% of users take their phone to the gym while working out. This in turn helped to create a list of key functional requirements this was derived from the answers of the questionnaire;

- NFC integration is paramount as this is the key focus of this project.
- Ability to store exercise entries in SQLite database with in the application.
- Ability to edit the database through the use of queries.
- Ability to read data in from the NFC tags and store into the database.
- Android development platform.

  Non- functional requirements
- Workout planner.
- Interval timer.
- Beginners guide – basic workouts.
- Advanced fully customizable workouts.
- Guide to compound exercises.
- Calendar implementation.

Additional extras if possible.

- QR Code/Bar code scanner.
- Calories Counters.
- GPS integration.
- Photo Progress.

The problem with the application is attempting to solve is implementing NFC technology within an android gym application that utilizes SQLite to store and retrieve database entries of the exercises

Requirements

Comparing requirements from a few of the apps looked at earlier shows where the Android Gym Application fills a void that is currently in the market. Having a one stop gym application that offers versatility by implementing NFC technology.

Features	NFC Pro	Gym Book	VirtuaGym	My Android Gym Application using NFC
NFC reading capability	√	x	x	√
Dynamic SQLite database	√	√	√	√
Ability To create workouts	x	√	√	√
Workout guides	x	√	x	√
calendar	x	x	√	√
Ability to read data in from the NFC tags and store into the database	√	x	x	√
Interval timer	x	x	x	√

Approach/design

After questionnaires I then began the process of setting the building blocks down in which to build my application. Downloading the latest Android SDK. In which ensuring to select the newer of the gingerbread builds. To ensure backwards compatibility for a large size of android devices.

Before any coding could take place I was using user centered design approach for create my application. So this meant talking with intended users and discussing various styles for creating the application. I showed some preliminary mockups as shown below. To decide which home page menu design would best suit the application.

A   B   C
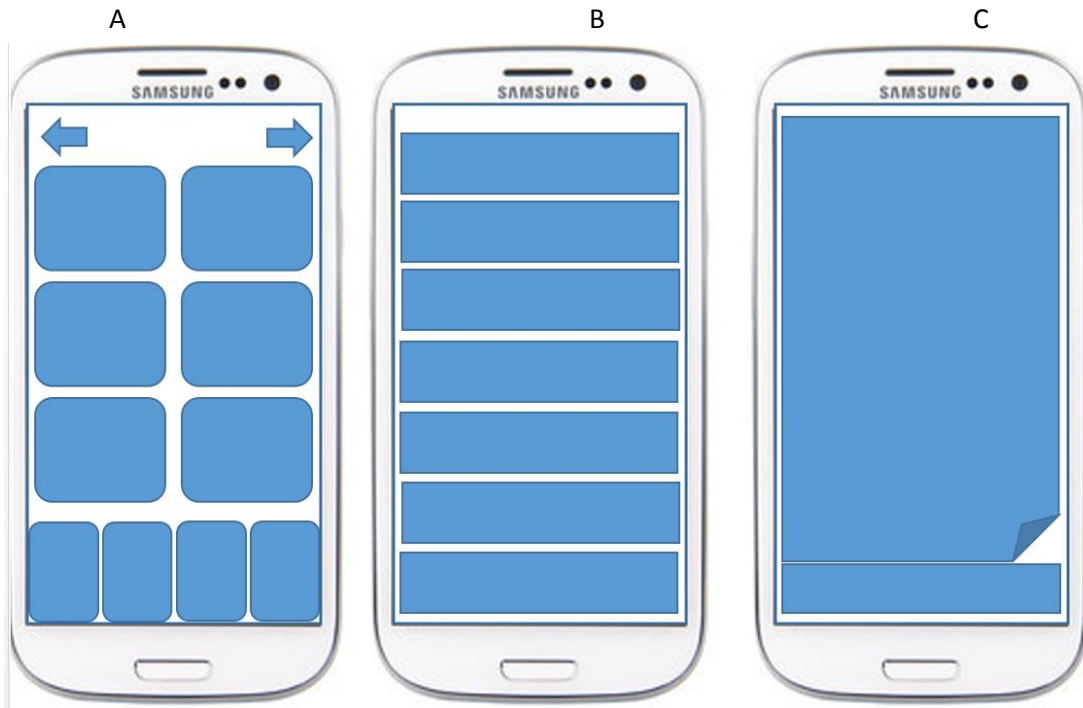
Fig [8]

My focus group unanimously voted for A as they felt the front page should be clean simple buttons and forwards and back options on the screen. This will allow users to easily navigate through pages. They really like C's design for the actual pages that contain information on each button. There was talk of having each screen of the app display instantly, but instead they voted for a dynamic display. Mocked up below.
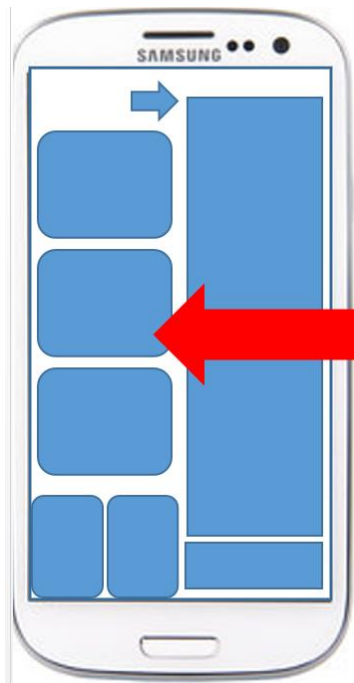
Fig [9] - showing when a button is clicked the menu will slide across, to reveal selected tab.

By using this method it will allow the application to fit the needs of its intended users as opposed to forcing the user to change the way they want to view / edit data on the application.

Key main buttons will be;

1. Calendar
2. Workouts
3. NFC settings
4. Progress
5. Timer
6. Settings

Also additional forwards and backwards buttons for navigating previously selected menus.

The NFC has 3 different states as shown below.
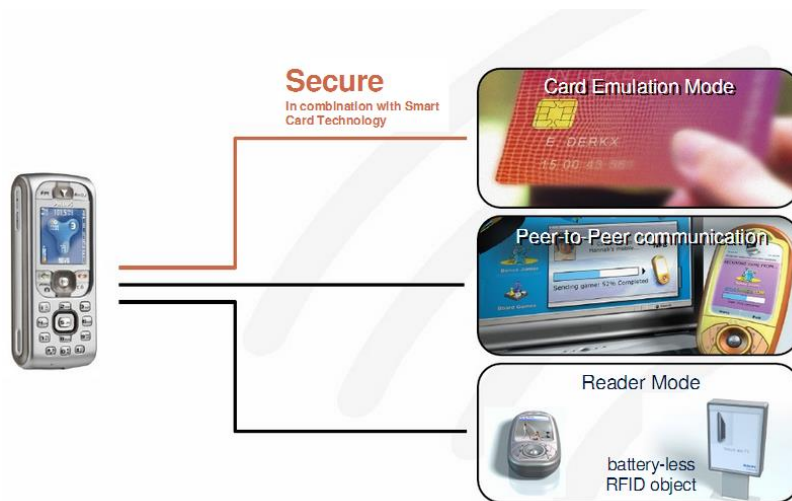
Fig [10] - 3 States that an NFC chip can be used for.

 UML
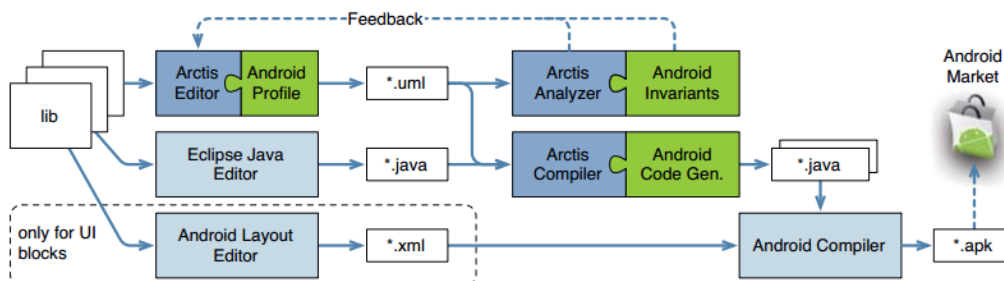
Fig [11] – F.A Kraemer – showing the Android SDK implied workflow.

Here shows the workflow for creating a mobile application in the android SDK.

Specification

Is to produce a working android gym application that has the ability to read in NFC tags that contain data of exercise equipment into the application's SQLite database. Without the need for the user to type which exercise to add. Deliverables are a competent app featuring NFC technology and maintain key functional requirements.

The application will be navigated through a series of large buttons, upon selecting the buttons the screen will swipe to the selected section. Each menu button has series of sub commands which will interact with the integrated NFC technology or the SQLite database. Users will be able to store and retrieve planned workouts, edit the workouts as they see fit. Upon selected exercises they can select a timer in which to time the exercise they are currently doing.

The application will allow the user to turn off the NFC if they do not wish to use it. This allows the application to fit a wider audience as some users are still weary of the new technology that is becoming the for front of the mobile industry.

Conclusions

The conclusions should be a summary of the main results and the aims of your interim report. You can also mention your future work, intended to be executed for the final report, and to link it to the final report. In Some cases you may also wish to provide an update time plan, from the initial plan, describing how you are continuing the project until the final report submission.

Findings from this report are that the project should be very feasible within the current time scale. I've laid the foundations for my knowledge on programming in Java. The basics of implementing a SQLite data base which will be sued to dynamically control the exercises found on the application. I have done extensive research on applications that share a similar nature, but what this app will do is amalgamate two different types of app in to one. Thus making it the superior app as will now offer both the functionality of NFC but also a fully functioning android gym application. Deliverable for the interim report where design phase begin, learn the basics of NFC integration and SQLite database implementation. Also conducting a use case study with focus groups to decide on the design of the application was another key delivery through the use of paper prototypes. So far I think I'm pretty much on schedule, but I would have liked to have shown the NFC reader reading the chip proving that the technology works but unfortunately ran out of time. I have included the Gantt chart so you can see that I am currently still on schedule.

Goals for Final report

- Finalized design and implementation.
- Working prototype
- NFC working
- Finished Android application
- Possible Improvements.

Table Of abbreviations

NFC- Near field Communication
OS- Operating system
UI- User Interface
SQLite- ACID-compliant embedded relational database management system.
QR codes- is a matrix barcode (or two-dimensional code), readable by QR scanners.
SDK- Software Development Kits

Appendices

Chant chart

ID	Task Mode	Task Name	Duration	Start	Finish	W	S	T	M
1		week 1 - project proposal	5 days	Mon 10/1/12	Fri 10/5/12				
2		week 2	5 days	Mon 10/8/12	Fri 10/12/12				
3		week 3 initial plan repot due	5 days	Mon 10/15/12	Fri 10/19/12				
4		week 4 -reseach gym apps	5 days	Mon 10/22/12	Fri 10/26/12				
5		week 5 -reseach - gym surveys	5 days	Mon 10/29/12	Fri 11/2/12				
6		week 6-research - NFC technology	5 days	Mon 11/5/12	Fri 11/9/12				
7		week 7 Finishing off research coding options	5 days	Mon 11/12/12	Fri 11/16/12				
8		week 8-Design - establish requirements	5 days	Mon 11/19/12	Fri 11/23/12				
9		week 9 -Design user centered design approach	5 days	Mon 11/26/12	Fri 11/30/12				
10		week 10-Design- paper prototypes	5 days	Mon 12/3/12	Fri 12/7/12				
11		week 11-interim report anaysis of research	5 days	Mon 12/10/12	Fri 12/14/12				
12		xmas break	16 days	Mon 12/17/12	Mon 1/7/13				
13		exam period	14 days	Tue 1/8/13	Fri 1/25/13				
14		week 1- begin implementation	5 days	Mon 1/28/13	Fri 2/1/13				
15		week 2 coding database	5 days	Mon 2/4/13	Fri 2/8/13				
16		week 3 layout of app	5 days	Mon 2/11/13	Fri 2/15/13				
17		week 4adding additional features	5 days	Mon 2/18/13	Fri 2/22/13				
18		week 5 nfc integration	5 days	Mon 2/25/13	Fri 3/1/13				
19		nfc continued	5 days	Mon 3/4/13	Fri 3/8/13				
20		week 7nfc tag programing	5 days	Mon 3/11/13	Fri 3/15/13				
21		week 8 potential prototype finished	5 days	Mon 3/18/13	Fri 3/22/13				
22		easter break - 3 week overlap can be used if behind shedule	15 days	Mon 3/25/13	Fri 4/12/13				
23		week 9 finalising code	5 days	Mon 4/15/13	Fri 4/19/13				
24		week 10 evaluation of finished code	5 days	Mon 4/22/13	Fri 4/26/13				
25		week 11 final report hand in	5 days	Mon 4/29/13	Fri 5/3/13				

	Task		Inactive Summary		
	Split		Manual Task		
	Milestone	◆	Duration-only		
	Summary		Manual Summary Rollup		
Project: final year project gannt ch	Project Summary		Manual Summary		
Date: Fri 10/19/12	External Tasks		Start-only	[	
	External Milestone	◆	Finish-only	]	
	Inactive Task		Deadline	↓	
	Inactive Milestone	◇	Progress		

	Oct 14, '12			Oct 28, '12			Nov 11, '12			Nov 25, '12			Dec 9, '12			Dec 23, '12			Jan 6, '13			Jan 2
F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S	W	S

Task	▬▬▬▬▬	Inactive Summary
Split	....	Manual Task
Milestone	◆	Duration-only
Summary	▬▬▬▬▬	Manual Summary Rollup
Project Summary	▽▬▬▬▽	Manual Summary
External Tasks	▬▬▬▬▬	Start-only
External Milestone	◈	Finish-only
Inactive Task	▭▭▭▭	Deadline
Inactive Milestone	◇	Progress

Project: final year project gannt ch
Date: Fri 10/19/12

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20, '13			Feb 3, '13				Feb 17, '13				Mar 3, '13				Mar 17, '13				Mar 31, '13				Apr 14, '13				Apr 28, '13		
T	M	F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S

Task	▬▬▬▬▬	Inactive Summary
Split	··················	Manual Task
Milestone	◆	Duration-only
Summary	▼▬▬▬▼	Manual Summary Rollup
Project Summary	▽▬▬▽	Manual Summary
External Tasks	▬▬▬▬	Start-only
External Milestone	◈	Finish-only
Inactive Task	▭	Deadline
Inactive Milestone	◇	Progress

Project: final year project gannt ch
Date: Fri 10/19/12

Questionnaire

Questionnaire on using your phone in the gym to record exercises.

Hi there I am looking at creating a new gym application that incorporates Near Field Communications (NFC) technology and would love to get some feedback from Gym users and Workers alike.

Please take your time and answer the few short questions.

Please circle the answer most applicable top you.

a) Are you male or female?

b) How many times a week do you go the gym <1   <2   <3   <4   5+

c) Do you play sport for the university? Yes   no

d) What smart phone do you own? Apple   Android   Windows   Other

e) Does your phone have Near Field Communications?   Yes   No

f) Do you currently bring your phone the gym? yes   no

g) Do you use a gym applications? Yes   no

h) If yes Please state which ones _____

i) Would you bring your phone if there was an app that incorporated all the features you would need? Yes   no

j) What key features do you think current gym applications are missing?
_____

k) Do you like preset workouts?   Or prefer to create your own?

Thank you for taking the time to fill out this questionnaire. Please leave at the front desk.

References

Benyo, B. et al. (2007) NFC Technology. *The design of NFC based applications*, Available at: http://www.academia.edu/1917418/The_design_of_NFC_based_applications# [Accessed: 12/12/12].

Kraemer, K. (2012) Engineering Android Applications Based on UML Activities. Available at: http://research.cs.queensu.ca/~dingel/cisc836_F11/androidWithActivities.pdf [Accessed: 12/12/12].

Rapidnfc.com (2012) *What is NFC ?*. [online] Available at: http://rapidnfc.com/what_is_nfc [Accessed: 12 Dec 2012].