

iSurveillance

Interactive Surveillance Video Query Apps for iPad

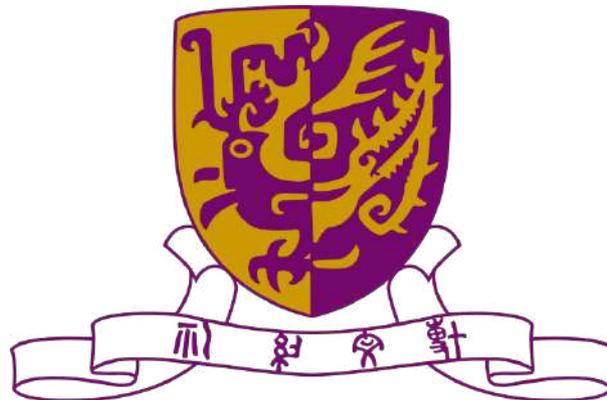
FYP Report Fall Semester 2011-2012

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Final Year Project Report (1st Term)

LYU1104
iSurveillance – Interactive Surveillance Video Query Apps for iPad

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Abstract

Our FYP goal is to develop an iOS application for a security guard. We hope that our FYP product can be an auxiliary tool for Security Guards - To assist their daily jobs, Make their jobs become easier.

This report covers our study and progress of our FYP development. It begins with an introduction about our project; we will give some background information and talk about the motivation of our FYP idea (where do our idea come from).

And then a case study on a security company has carried out in order to know more about security works and have a better understanding.

After that, we would have a chapter on system review; to introduce what features our product has and the mechanism behinds. While for the product design part, we will give an overview of our system architecture; briefly explain how our system is construed and in what way.

In the aspect of user interface implementation, chapter 5 is to report how was our UI designed and what concerns have been taken into consideration in between.

Last but not least, we are going to share what difficulties we encountered during the development and how did we solve it. And finally to look ahead of the future, to expect what are we going to do for the next semester.

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Chapter 1 Introduction

1.1 Overview

In this chapter, we are going to see the importance of safeguarding, how does it play a crucial role among our daily life; and after that we will have a brief study on the current surveillance systems to discuss the deficiencies and limitations current systems have. We then turn to propose our FYP idea, discuss how our proposed system is better than the current one. We would use a simulated example to explain how does our system work better and mechanism behinds. Finally, we will talk about the reason why we decide to develop our application on iOS platform and the advantages behind it.

1.2 Background

The Importance of Safeguarding

When it comes to a building management, safeguarding must come to a great concern and play a crucial role among it. As a matter of fact, security control is of paramount importance and become indispensable to our daily life; not only does it protect our property and wealth, but also give us a place of serenity (where we can no longer worry about thieves and burglars) so that we can focus on our work.

And now, you can see that how important security is for to us; the real question we concern here is - the one who take all those responsibilities. However, in most reality case among our daily life, all these important work fall into one hand only - our security guard, making our security guards bear a great burden. They are in a great responsibility of safeguarding our wealth and life and hence have to be very careful at every single moment.

Unfortunately the fact is, most of the securing work is monotonous and mechanical (like watching a surveillance video over a front desk 12 hours like), it is not easy for them to sharpen their vigilance all time long and they maybe overlook the details when there is a burglary or theft really happen. Hence there is a potential security breach we can't risk.

With today's advanced Information technology, you can see that I.T. has already been deployed in various fields as an auxiliary tool to lift down mankind workload. So, when it comes to security field; we are asking the same question, how can we make a great use of I.T. to help a security guard? What technology can we use to facilitate the work for security personnel? This comes to our FYP topic - iSurveillance; a project aims to develop a mobile application so as to facilitate the work of a security guard. After all, we believe that the ultimate I.T. goal is to make a better life for human.

1.3 Studying on Current Surveillance System

In the following, we are going to investigate the current surveillance system to have a grasp of how does current systems operate and to see what are the disadvantages within.

1.3.1 Current System

What does the Current System look like?

The most common and traditional way is 24-hours CCTV-Monitoring (manly based) and a fixed patrol schedule. For that, the security company would hire a security personal to sit over on a front desk for monitoring the surveillance cam during his/her shift (which usually at least 10 hours long). As we have discussed before, this method is very inefficient; cause most of the surveillance video is monotonous and boring, they can't heighten their vigilance all day long and easy to overlook and not notice the details when there is really a burglary or theft happen.



Figure 1.1 Traditional Security Control Room

For a better security company (which is usually at a bigger scale, like a security team for an entire business building, a mall or a casino), they would have a better framework of labor division and adopt some software programs for their security control. For instance, the security framework is divided into frontend patrolling team and backend controlling team. The frontend security personnel are mainly for patrolling while the backend security control central is for CCTV-Monitoring and communication.



Figure 1.2 Professional Security Control Room

However, this kind of security deployment always involves lots of resources and money, not that every building can afford to. And still, this method is still in a passive way. When there is really a burglary or theft happen; a prompt and decisive action is required, a division framework like this may result in a communication problem; the communication may not give a clear and decisive order to the fronted patrolling in time.

1.3.2 Problems

Deficiency of Current Systems

In a nutshell, we can see that there are some deficiencies from the current systems.

For a small-scale and traditional security company, the way that they adopt a 24-hours (manly based) CCTV-surveillance is not efficient enough; safety guards may easy to relax their vigilance due to the mechanicalness of video watching and hence poses a security beach.

And, for the second security system mentioned above, the security deployment that a bigger security company adopted always involves lots of resources and money; not that every building can afford to. It is so hard to popularize. And still it is in a passive way; when there is really a burglary or theft happen; a prompt and decisive action cannot be achieved in a short time, because there is a potential communication problem between two ends.

1.4 Proposed System

What will we Do and How?

Given the deficiencies of current systems we have investigated, we are going to see if there is a way we can do to improve the situation.

Fortunately, View Lab (The VIEW Technologies Laboratory), which is partly founded by our FYP professor Michael R. Lyu, has developed a backend visual computer program which analyze a recorded video based on the photo chromatography and algorithm input to compute and analyze the data required, for instance, to calculate how many people has occurred at a particular point within the video.

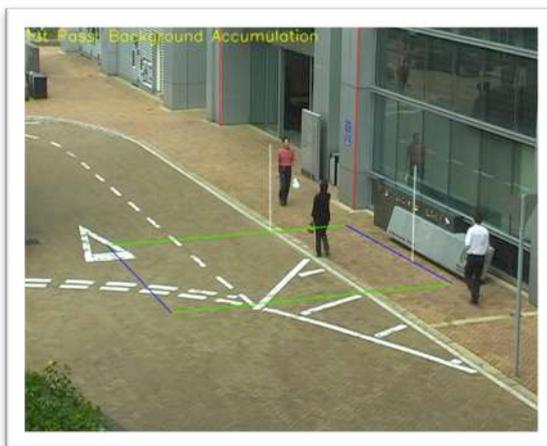


Figure 1.3 Backend Program

And, we thought it would be a good idea to co-operate with this backend system and put it into practice. So, we decide that our FYP aim is to construct a frontend software application that fully works with this visual program so as to make it useful to a security company.

And after the characteristic and properties of security works have been taken into consideration, we decided to orientate our FYP topic into a mobile application because of its' popularity, mobility, ease of usage and user-friendliness; it all fits to the field of security works. In other word, it is absolutely suitable for a security guard to use it.

For a first glance, we would like our product to have the following functions:

1. Live streaming playback
2. Video analysis (for searching) with time line and optimized thumbnail
3. Region of Interest for a quick video searching
4. Multiple cams for target tacking
5. Query searching by an Image

The details of the functions mentioned above will be described in the next chapter.

1.4.1 Advantage

Then, we are about to evaluate the benefit of our proposed system and give a simulated example as a demonstration for a better understanding.

Why need us?

As discussed before, it is clear that in the most reality case, whenever there is a security alert, a prompt and decisive action has to been taken at a very soon time. And with our product functions facilitating the work, a security guard can easily get what he/she wants and hence make a quick and right decision in time. For instance, when there is a security alert, the security personal will be immediately noticed through our system, and he/she can then do a quick video searching through our application to find out the suspect and the relevant information; what is more, to even facilitate the video searching process, he/she can do a Region of Interest search to further narrow the range down.

In the other aspect, when it comes to the cost, it is certainly cheaper than the big-scale security deployment we have mentioned above.

1.4.2 Simulated Example

For a better understanding of our system, please take a look of the following example.

Imagine you are a security guard and there has just happened a burglary case; you are informed through our software application. After you have arrived to the event location, you can then use our application to list out how many cams that are nearby and may capture the image you want. You can then take a quick playback from the interested camera and do a video analyzing program. The video analyzing program will give you back a scatter chart and a thumbnail array that representing how many people has appeared and the time they appeared during the specific period.

So, you can make use of those results to do a primary searching. Like, you can tap on the thumbnail of the pedestrians and the relevant surveillance video will be shown automatically on the video player.

After you have spotted out the suspect or you want a more refined search, you can undergo “Region of Interest searching”; you just have to draw a square box on the screen to indicate your interested area, and our system will then filter the result and give back the only required information you want.

Furthermore, if you want for an assistance or share the information to your colleague, you can use our communication box and just drag the thumbnail to the message box.

1.4.3 Development Platform and Device

Why Mobile Platform?

We decided to orientate our FYP topic into a mobile platform because we have to consider the nature of securing work.

Given the characteristic and properties of security works, our application have to be popular, portable, easy to use, user-friendly and with lots of API and libraries supported.

We decided to develop our software application on a mobile platform because we think that the current mobile platform is mature enough and fits all the requirements we needs.



Figure 1.4 iPad2

Why iOS?

iOS is a popular mobile operating system nowadays and even create the iProducts Mania. According to the Nielsen survey, Apple owns the second largest market-share on the smart phone market, following the Android developed by Google Inc. And the number is expected to be further increased in the future.

The statistic mentioned above doesn't include iPad and other iProducts. Therefore the total number of iOS distribution is much higher than the statistic.

Besides, when it comes to iOS' development environment, there are also many good things to talk about.

The development environment of iOS is very mature. The IDE, Xcode has been developed for a long time since the releasing of Mac OS X; and the base frameworks, like Cocoa Touch, Cocoa Animation, Cocoa Media, Cocoa Quartz are very useful and powerful; easy to use and implement. Besides, the documentation supported by Apple Inc. is well beyond sufficient. All the frameworks and technical details are documented on the paper; some of them are even recorded in a video.

Moreover, what attracted us most is, there are a lot of 3rd party libraries that have been developed to support iOS. Most of them are open-source, that means, it is free of charge.



Figure 1.5 iOS5 Logo

Why iPad?

Choosing iPad as our FYP platform is not a rush decision, we have taken a holistic and comprehensive consideration for each options of choice. The following table summarizes the comparison.

Gizmodo's Guide to Upcoming Slates						
	Apple iPad	HP Slate	JooJoo	Notion Ink Adam	Dell Mini 5	Archos 7 Android
Screen	9.7-inch 4:3 IPS LCD (1024x768)	10-inch LCD	12-inch LCD (1366x768)	10-inch transreflective Pixel Qi LCD (1024x600)	5-inch LCD	7-inch LCD (800x480)
OS	iPhone OS 3.2	Windows 7	JooJoo OS	Android	Android	Android
Browser	Mobile Safari	Whichever you want	WebKit-based	Android browser	Android browser	Android browser
Adobe Flash Support	No	Yes	Yes	No	No	No
Ebook Client	Yes	Yes	No	Yes	Yes	Yes
Apps	App Store, with new iPad apps	HP TouchSmart, Windows apps	Web-based, more like shortcuts	Android Market	Android Market	Android Market
Multitasking	No	Yes	No	Yes	Yes	Yes
Multitouch	Yes	Yes	Yes	Yes	Yes	Yes
Camera	No	Yes	Yes, 1.3MP	Yes, 3MP	5MP; MAYBE second front-facing cam	Yes
I/O	30-pin; camera-only USB add-on	USB	USB	USB, HDMI	USB	USB
Processor	1GHz Apple A4	MAYBE: Intel z540 Atom 1.86GHz*	1.6GHz Atom with Nvidia Ion	Nvidia Tegra 2 (up to 1GHz)	Qualcomm 1GHz Snapdragon	MAYBE: ARM CortexTM-A8 600MHz
Storage	16, 32 or 64GB	MAYBE: 32GB, 64GB*	4GB	16 or 32GB	Unknown	8GB
Expandable Memory	Optional SD dongle MAY add storage	Not according to pics	Probably not	Yes, SD	Dual microSD slots, possibly internal	Yes, MicroSD
Wireless	Wi-Fi, 3G (HSPA/GSM), Bluetooth	Wi-Fi, Bluetooth	Wi-Fi, Bluetooth	Wi-Fi, 3G (HSPA/GSM), Bluetooth	Wi-Fi, 3G (HSPA/GSM), Bluetooth	Wi-Fi, Bluetooth
Weight	1.5 pounds	Unknown	2.4 pounds	1.7 pounds	Unknown	Unknown
Battery Life	10 hours, 1 month standby	Unknown	5 hours	16 hours web, 8 video, 48 standby	Unknown	Unknown
Availability	April (Wi-Fi), May (3G)	Sometime in 2010	February-March	Spring	Unknown	March
Price	\$500 to \$830	MAYBE: \$500 to \$600*	\$500	Unknown	Unknown	\$240

*HP Slate specs from tipster... Thanks!

Figure 1.6 Comparison between iPad and other devices

Based on the popularity over the current market, we finally ruled out other options and left Android and iOS for final consideration.

Why Not Android?

Android is not always designed for the device and too free and liberal for development, in most case, the Android device you see on the web page may or may not have been designed for that particular hardware.

The best example to elaborate this maybe, the Android tablets that you can buy on current market today may not always follow the standard specification. What does it mean, take a tablet as an example, despite Google recommends that tablet should be run on a particular OS version, let say (Android version 3), you can still find that tablets may run on different version with varying degrees of usability, because different telecommunications companies have different target aim. Since Android is an open-source project, there is no tight restriction over it. Sometimes, some tight restrictions are good for development in an overall and a long time aspect.

In comparison, iOS is hardware specific on its release data. You quickly know which devices are compatible, and which ones are not, as recommended by Apple.

So, choosing iOS may leave us less concern over the OS compatibility. We can ensure that if we follow the development guidance Apple Inc. suggested, we can always achieve the best performance for the application need no to consider the particular OS system case by case.



Figure 1.7 iPhone vs Android

Multi-Touch Technology

It is simple. As Apple's slogan said:

“Everything’s at your fingertips.”

With iPad, you can use your fingers to do everything. And thanks to advanced and mature Multi-Touch technology, everything is easier and much faster. When a security guard touch the display, it senses them using electrical fields and instantly transforms the taps, swipes, pinches, and flicks into lifelike actions. So, it is easy and effective.

And we believe that such gesture would be very useful and can facilitate the work of a security personal, and as a result to achieve user-friendliness.



Figure 1.8 iPad Multi-Touch Gesture

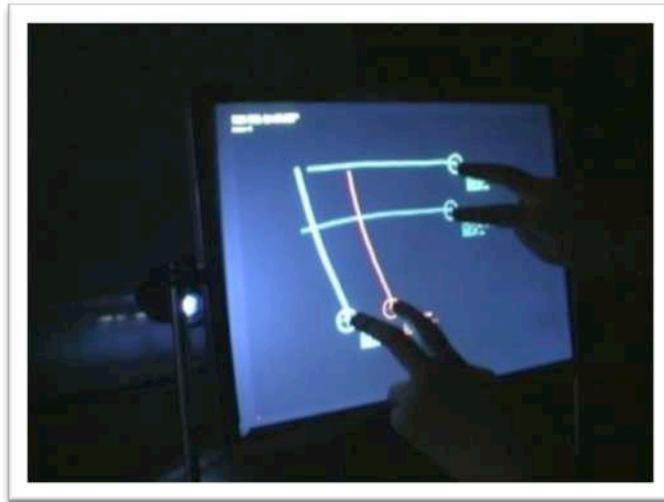


Figure 1.9 iPad Multi-Touch Gesture

Such interactive multi-touch technology can bring the user an interactive experience. User will be more rejoice to use it and feel much more comfortable.

Chapter 2 Case Study on Current Surveillance System

2.1 Overview

Our FYP topic is about securing. So, it is essential for us to know more about security works. To have a better understanding on what the nature of securing is, what would it look like and how can we make use of I.T. to assist their work. All of these questions are very important, we have to figure it out before implementing our FYP; only that can make our FYP be practical and achieve the goal we want at the first place. So, given that there are some security companies doing similar things on the current market, it would be a good idea to have a case study about them.

And our target is Motorola's Solution.



Figure 2.1 Motorola Solutions Logo

2.2 Motorola's Solution

What Motorola's Solution is?

Motorola's solution is a consulting and technology company that one of its many businesses is security consulting, and its' video surveillance solutions is very famous.

Why our case study is Motorola's Solution?

First of all, Motorola security has over 65 years experience and always plays the leading role in the security field. It is undoubtedly that this company is professional and experienced in security work.

Also, Motorola's video surveillance solution deploys lots of advanced technologies, we can say that this company always keep up to the modest technology and use it in the security field. Like, they transform video security systems from the passivity (just simple video surveillance monitoring) to a more active, collaborative and intelligent way. It needs the nature of security; from being passive to active.

And we think that, what this company has done is very similar to our FYP idea; we may take this opportunity to study their experience and expertise, to take a reference from these. We sure that a case-study likes that would help our FYP a lot, it must be a good lesson.

2.2.1 Architecture

It is comprehensive, holistic, advanced and end-to-end.

Basically, Motorola security architecture includes applications at the backend office, devices in the field and a broadband transport networks.

And combining all of these components plus the components introduced below, it can provide an advanced video security solution, which will be more than just simple video surveillance. Again, his security architecture and ultimate goals are very similar to our FYP idea, the only difference is - the technology/resources involved and development cost are far beyond our FYP.

Video Back Office:

One of the components, to integrate different disparate systems and gathers information from multiple cams. So it aims for easy access and cost-effective storage.



Figure 2.2 Video Back Office

Video Transport:

Optimally distributes and shares video content over wire line and wireless transport networks to and from the video back office.

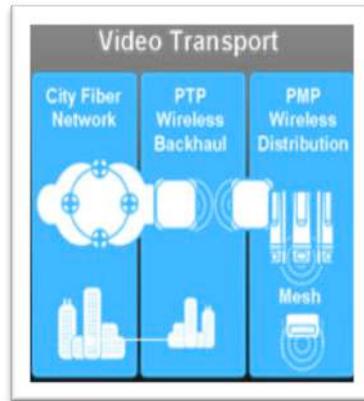


Figure 2.3 Video Transport

Video Edge:

Like our FYP, in this case, Motorola's remote computing devices, like PDA, cell phone.



Figure 2.4 Video Edge

2.2.2 Comparison

Comparison between Motorola's Security System and our FYP

Now, we are going to take a look of its features components and to see how are these features similar to our FYP design.

1. Both have Video Analytics Engine

The whole surveillance system is more than just capture what's happening at given locations, but also to interpret the information of the captured video using computers' artificial intelligence. That means, using the pre-determined criteria as a parameter data; with the help of sophisticated algorithms, the system can easily to customize the captured video we want. And it is obvious to say, such video analytics enables faster problem recognition, and can achieve to an effective problem solving.

ALPR VS our Backend Video-Analyzing program

Motorola's ALPR

Automatic License Plate Recognition (ALPR) delivers the ability to read vehicle license plates and check them against an installed database for rapid identity verification. The license plate recognition system has been used to locate stolen or wanted vehicles and identify parking-ticket scofflaws.

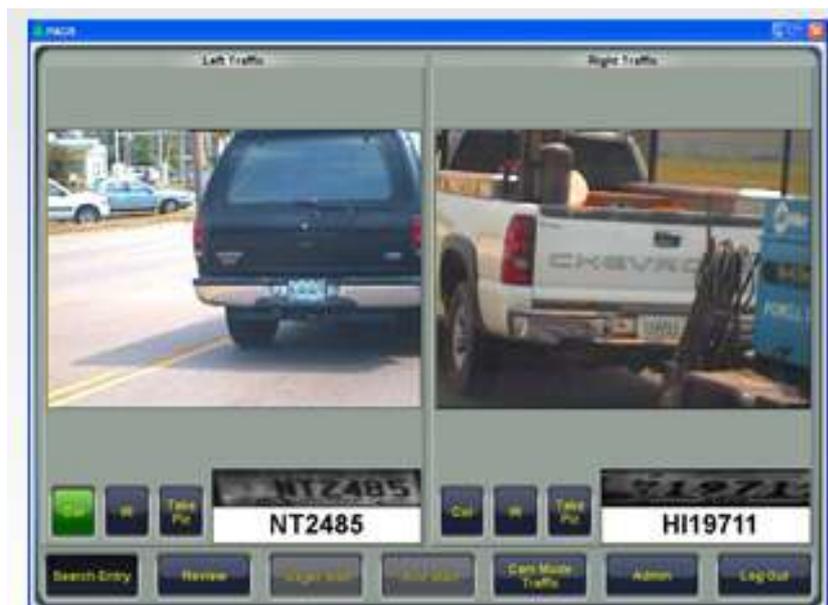


Figure 2.5 ALPR

Our backend video-analyzing program

A visual computer program, which analyzes a recorded video, based on the photo chromatography and algorithm input to compute and analyze the data required, for instance, to calculate how many people has occurred at a particular point within the video.

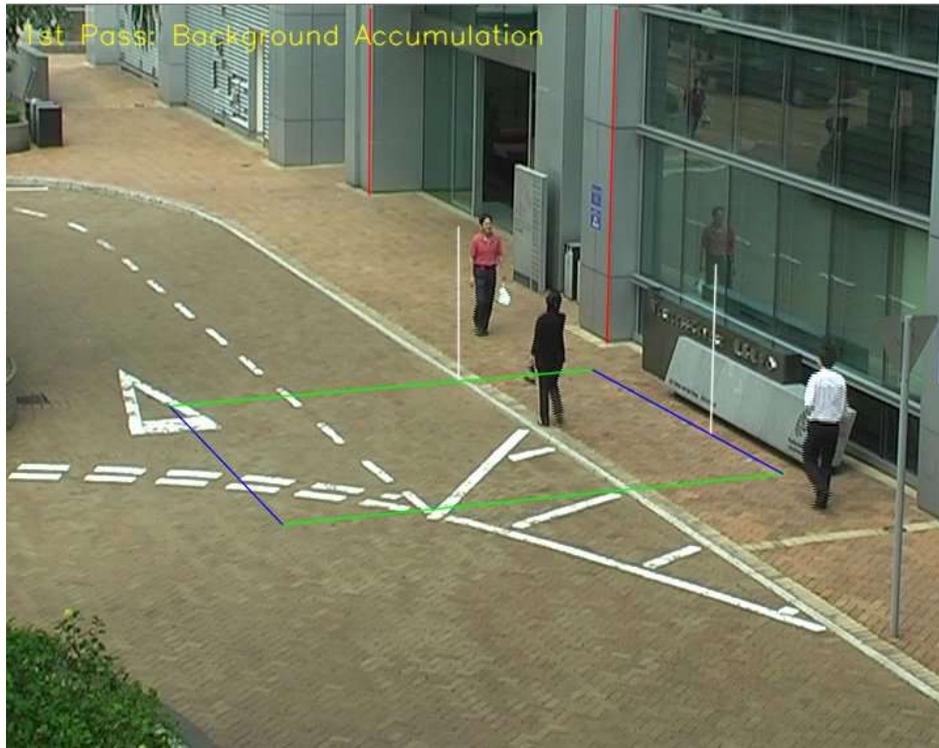


Figure 2.6 Backend System

2. Both have real time inquire functions

Motorola's Wireless Network

His system able a quick security-inquire though wireless network they own.



Figure 2.7 Motorola's Wireless Network

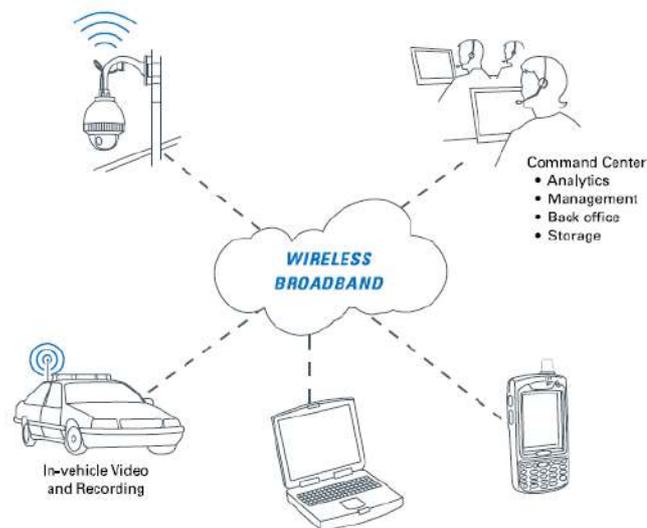


Figure 2.8 Wireless Broadband

Our Frontend Application

If our user want for an assistance or share the information to his/her colleague, he/she can use our image query module and just drag the suspect's thumbnail to the module. (Please refer to the later chapter; there will be more details about it)

What did we gain?

There are many to learn after we have studied the Motorola's surveillance system and we can't write them down here. But some issues are particularly useful and valued.

Quality Vs. affordability

Video quality and bandwidth affordability is two conflicting problems. How can we balance between them and hence maximum the application performance? This issue never came to our mind before we did our case study. And the following table list out the trade off.

Option	Result/Implication
Increase Bandwidth	Reduces cost but provides less detail
Reduce Frame Rate	Reduces cost but results in choppy motion
User Digital Compression Techniques	Essential to all modern digital surveillance solutions to help balance quality and bandwidth needs

What Resolution should we use?

Resolution defines the size and sharpness of the picture. Most of the time, we don't need a very sharp image. Because, for most time, a security guard only need to monitor a video to see if there is anyone pass by and they don't need to recognize whom it is. They just need to know if there really is someone's there and be able to dispatch a response team. So, in such case, a high resolution filming is not required.

However, for the case like traffic monitoring or investigating a burglary, high resolution is need. Suspect's faces should be recognizable and license plates should be readable. So, it becomes a problem to decide what resolution should a cam use.



Figure 2.9 Resolutions Algorithm

Chapter 3 System Review

3.1 Overview

There are five main function modules in our FYP application. We are going to introduce them in this chapter.

TimeLine Module

A module that represents the data (data like how many passengers pass by and when) into a bar/scatter chart; when the user taps the points on the chart, it communicates with the video player and jump that playback time.

Video Playback/Streaming Module

A video player for playing the surveillance video

Multiple Cameras Module

An auxiliary tool module, system will gather the all cameras' information; user can then switch cam to cam more easily

Image Query Module

One of the inquiry module; user can drag a thumbnail image into the designated area, and an automatic search will be done then.

ROI Module

One of the inquiry modules; user can draw a rectangle over the video screen to indicate the area he/she interested for an advanced search

After that, we would talk about what APIs have we used and have a quick study on them.

3.2 Implementation

There are five modules in our system, they are:

1. TimeLine Module
2. Video Playback/Streaming Module
3. Multiple Cameras Module
4. Image Query Module
5. ROI Module

Main Screen

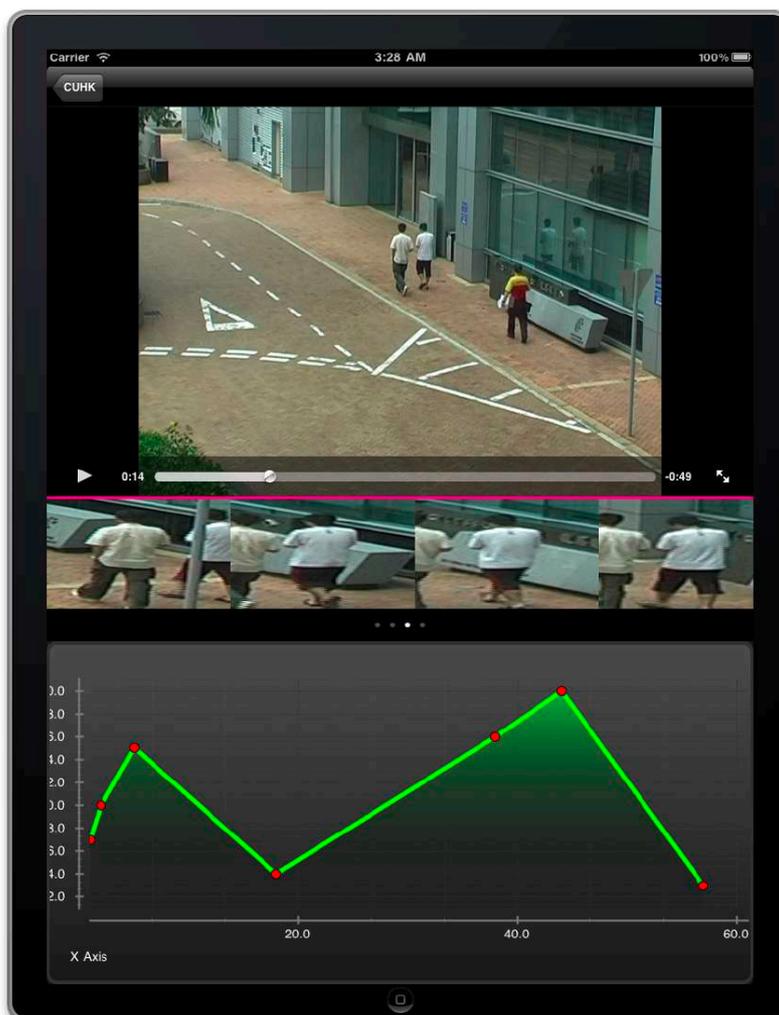


Figure 3.1 Main Screen

The following is the Description of functions in each module.

TimeLine Module



Figure 3.2 TimeLine Module (Line Chart)

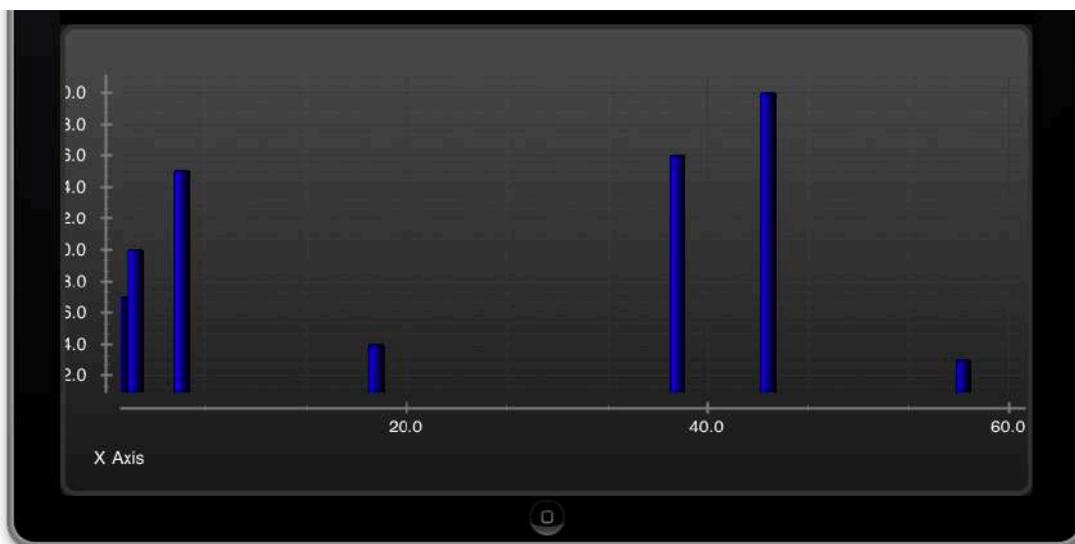


Figure 3.3 TimeLine Module (Bar Chart)

The graph in the timeline represent the amount of people appears in a second. There are two types of chart can let the user to choose, one is bar chart and another one is line chart. It depends on the user's interest. When the user touches the point of the graph, the video player will jump to the corresponding time, so that can let the user immediately to find out the target.

Video Playback/Streaming Module



Figure 3.4 Video Playback/Streaming Module

User can easily to use our application to play the video by using the movie player. The movie player let the user jump to any point of the video, also it allows user to view the video in full screen mode.

Multiple Cameras Module (Prototype)



Figure 3.5 Multiple Cameras Module (Prototype)

User can click on any direction, and then the main camera screen will be change by follow the direction. It can help the user to follow the target no matter where did he/she go.

Image Query Module (Prototype)



Drag a thumbnail into the designated area

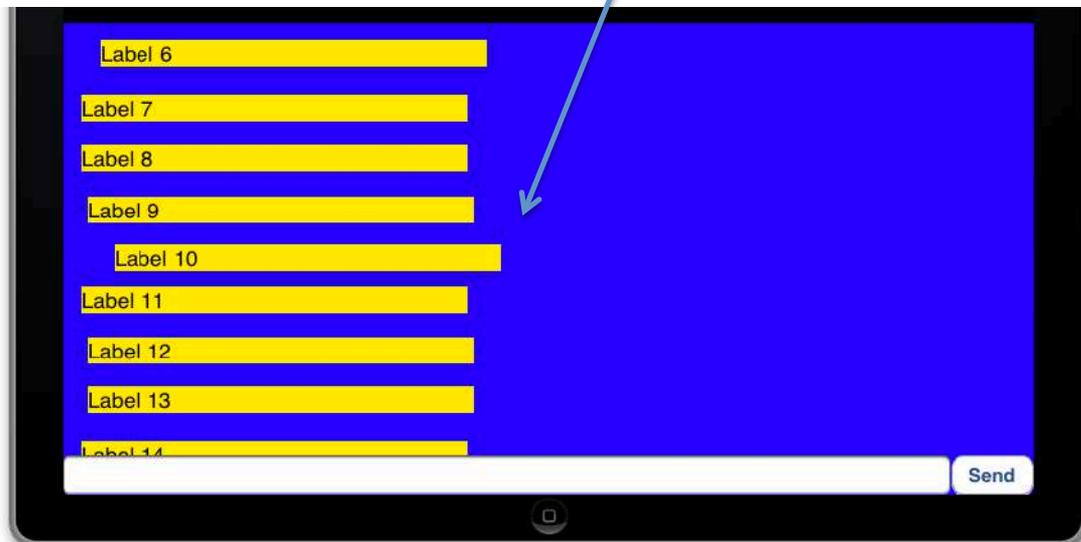


Figure 3.6 Image Query Module (Prototype)

When the user find a suspicious people in the video, he/she can drags the image into the Image Query fields, and then click the send button, which will submit the image to the server, and then the server will search all the cameras see whether the image is inside it. To conclude, Image Query Module is one of the inquiry modules; user can drag a thumbnail image into the designated area, and an automatic search will be done then.

ROI Module (Prototype)

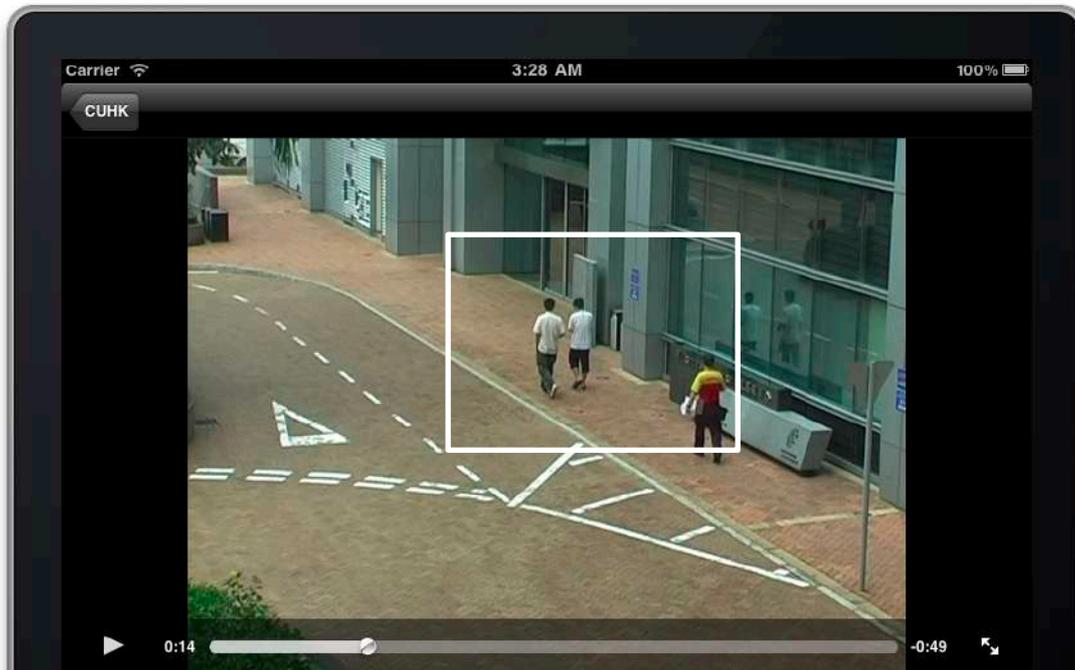


Figure 3.7 ROI Module (Prototype)

User can easily by using two fingers to set the area to crop. After the user finish the cropping, just tap the screen, the cropped will be sent to the server, and then the server will return the corresponding area information back to the application.

After ROI, the data will be filtered; only information that fits the interested area will be shown. So, it helps a security guard doing his/her investigation.



Figure3.8 After ROI

3.3 API Study

In our FYP, frameworks of Core-Plot and JSON were used.



Figure 3.9 JSON Logo

JSON was used as a way of data interchange between the server side and the client side.



Figure 3.10 Core-Plot Logo

Core-Plot was chosen for plotting graph. In the TimeLine Module, the time that pedestrians passed by are collected in a data array; and those data are used to plot a bar chart and a scatter chart.

3.3.1 Core-Plot

What Core-Plot is?

Core-Plot is a third party open-source library developed for IOS enhancement. It is a plotting framework for Mac OS X and iOS. It provides 2D visualization of data, and is tightly integrated with Apple technologies like Core Animation, Core Data, and Cocoa Bindings.

Structure

```
@interface CPTGraph : CPTBorderedLayer
{
    @private
    CPTPlotAreaFrame *plotAreaFrame;
    NSMutableArray *plots;
    NSMutableArray *plotSpaces;
    NSString *title;
    CPTTextStyle *titleTextStyle;
    CPTRectAnchor titlePlotAreaFrameAnchor;
    CGPoint titleDisplacement;
    CPTLayerAnnotation *titleAnnotation;
    CPTLegend *legend;
    CPTLayerAnnotation *legendAnnotation;
    CPTRectAnchor legendAnchor;
    CGPoint legendDisplacement;
}

@property (nonatomic, readwrite, copy) NSString *title;
@property (nonatomic, readwrite, copy) CPTTextStyle *titleTextStyle;
@property (nonatomic, readwrite, assign) CGPoint titleDisplacement;
@property (nonatomic, readwrite, assign) CPTRectAnchor titlePlotAreaFrameAnchor;
@property (nonatomic, readwrite, retain) CPTAxisSet *axisSet;
@property (nonatomic, readwrite, retain) CPTPlotAreaFrame *plotAreaFrame;
@property (nonatomic, readonly, retain) CPTPlotSpace *defaultPlotSpace;
@property (nonatomic, readwrite, retain) NSArray *topDownLayerOrder;
@property (nonatomic, readwrite, retain) CPTLegend *legend;
@property (nonatomic, readwrite, assign) CPTRectAnchor legendAnchor;
@property (nonatomic, readwrite, assign) CGPoint legendDisplacement;

-(void)reloadData;
-(void)reloadDataIfNeeded;

-(NSArray *)allPlots;
-(CPTPlot *)plotAtIndex:(NSUInteger)index;
-(CPTPlot *)plotWithIdentifier:(id <NSCopying>)identifier;
```

```
-(void)addPlot:(CPTPlot *)plot;
-(void)addPlot:(CPTPlot *)plot toPlotSpace:(CPTPlotSpace *)space;
-(void)removePlot:(CPTPlot *)plot;
-(void)removePlotWithIdentifier:(id <NSCopying>)identifier;
-(void)insertPlot:(CPTPlot *)plot atIndex:(NSUInteger)index;
-(void)insertPlot:(CPTPlot *)plot atIndex:(NSUInteger)index
intoPlotSpace:(CPTPlotSpace *)space;

-(NSArray *)allPlotSpaces;
-(CPTPlotSpace *)plotSpaceAtIndex:(NSUInteger)index;
-(CPTPlotSpace *)plotSpaceWithIdentifier:(id <NSCopying>)identifier;
-(void)addPlotSpace:(CPTPlotSpace *)space;
-(void)removePlotSpace:(CPTPlotSpace *)plotSpace;
-(void)applyTheme:(CPTTheme *)theme;

@end
```

Class Diagram

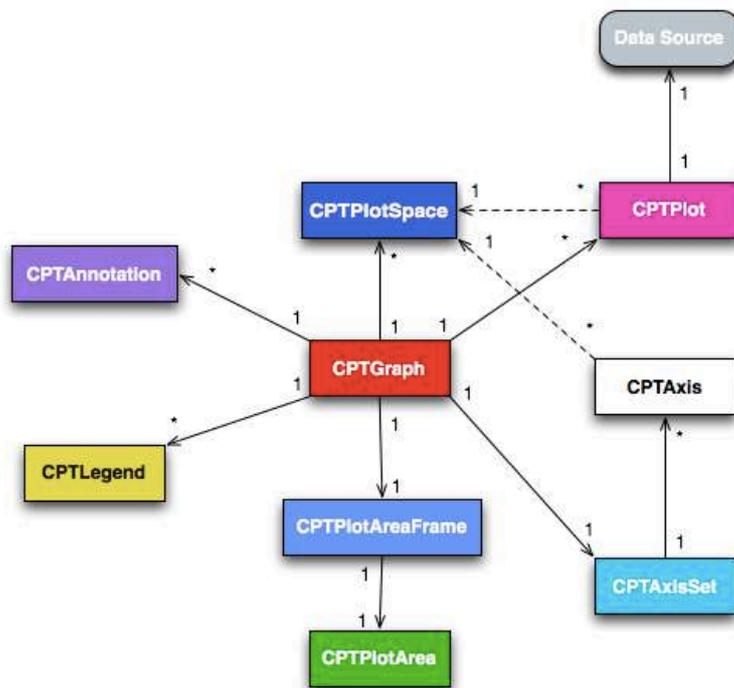


Figure 3.11 Core-Plot Class Diagram

Objects and Layers

This diagram shows run time relationships between objects (right) together with layers in the Core Animation layer tree (left). Color-coding shows the correspondence between objects and their corresponding layers.

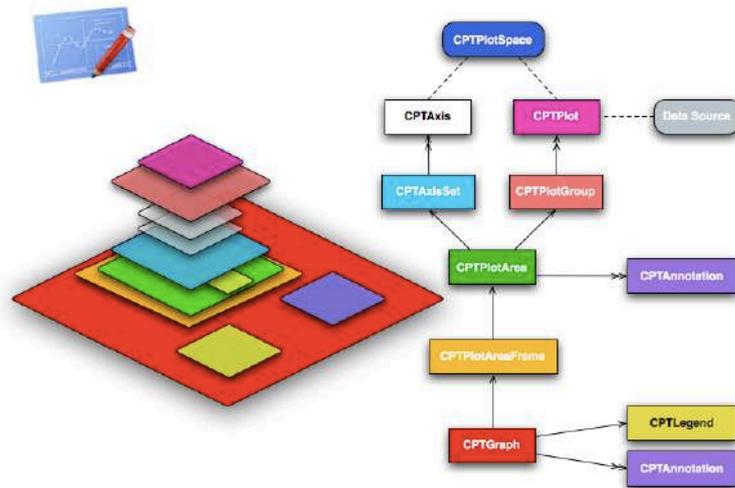


Figure 3.12 Object and Layers

Porting Library to iOS

A step-by-step approach has been used to port the library; First it is being ported to Mac OS X then porting to iOS.

A step-by-step porting strategy is used because Core-Plot is a very complicated and large-scale library, we want to have a better understanding first before implement it on iOS.

The first step is quite straightforward, cause Mac OS Lion has lots of OS function to co-operate with Core-Plot. It is not so hard.

However, the second move didn't go so well at first. Because iOS has relatively limited libraries call to work with (when compared to Mac OS), so we have to limit our design to "fit in". For example, it is okay for Core-Plot to generate the plot dynamically without saving the data in an array; however this is not the same on iOS. We have to do modify our code, to save the data first.



Figure 3.13 Module Diagram

Limitation

Core-Plot is limited to iOS specification. Thanks to the strict specification and configuration Apple Inc. set for iOS. Core-Plot can't provide a dynamic linked Library (a DLL file), only a static library is provided instead. So, if you want to use Core-Plot, you have to include the whole package into your Xcode and set up the system configuration for compiling and releasing. And all those work are very complicated and bothering.

3.3.2 JSON

Why JSON?

There is another text notation that has all of the advantages of XML, but is much better suited to data-interchange. That notation is JavaScript Object Notation (JSON).

Why not XML?

XML is not well suited to data-interchange, much as a wrench is not well suited to driving nails. It carries a lot of baggage, and it doesn't match the data model of most programming languages. When most programmers saw XML for the first time, they were shocked at how ugly and inefficient it was. It turns out that that first reaction was the correct one.

Let's compare XML and JSON on the attributes that the XML community considers important.

Simplicity

JSON is much simpler than XML. JSON has a much smaller grammar and maps more directly onto the data structures used in modern programming languages.

Extensibility

JSON is not extensible because it does not need to be. JSON is not a document markup language, so it is not necessary to define new tags or attributes to represent data in it.

Interoperability

JSON has the same interoperability potential as XML.

Openness

JSON is at least as open as XML, perhaps more so because it is not in the center of corporate/political standardization struggles.

Chapter 4 System Design

4.1 Overview

In this chapter, we mainly focus on the design issues; on to explain how our FYP system is design and why do we design it in such way. We would go through the whole explanation process through the aid of different system diagram and modules descriptions.

For different modules our FYP consists of, we would talk about how did it be implemented and the principle behinds. What is more, we then turn our focus to the server side; have a look on the design issue about it.

Last but not least, at the end of this chapter, two System Component diagrams are shown to have an overall grasp on how our system would work in a well-ground and comprehensive way.

4.2 Convention

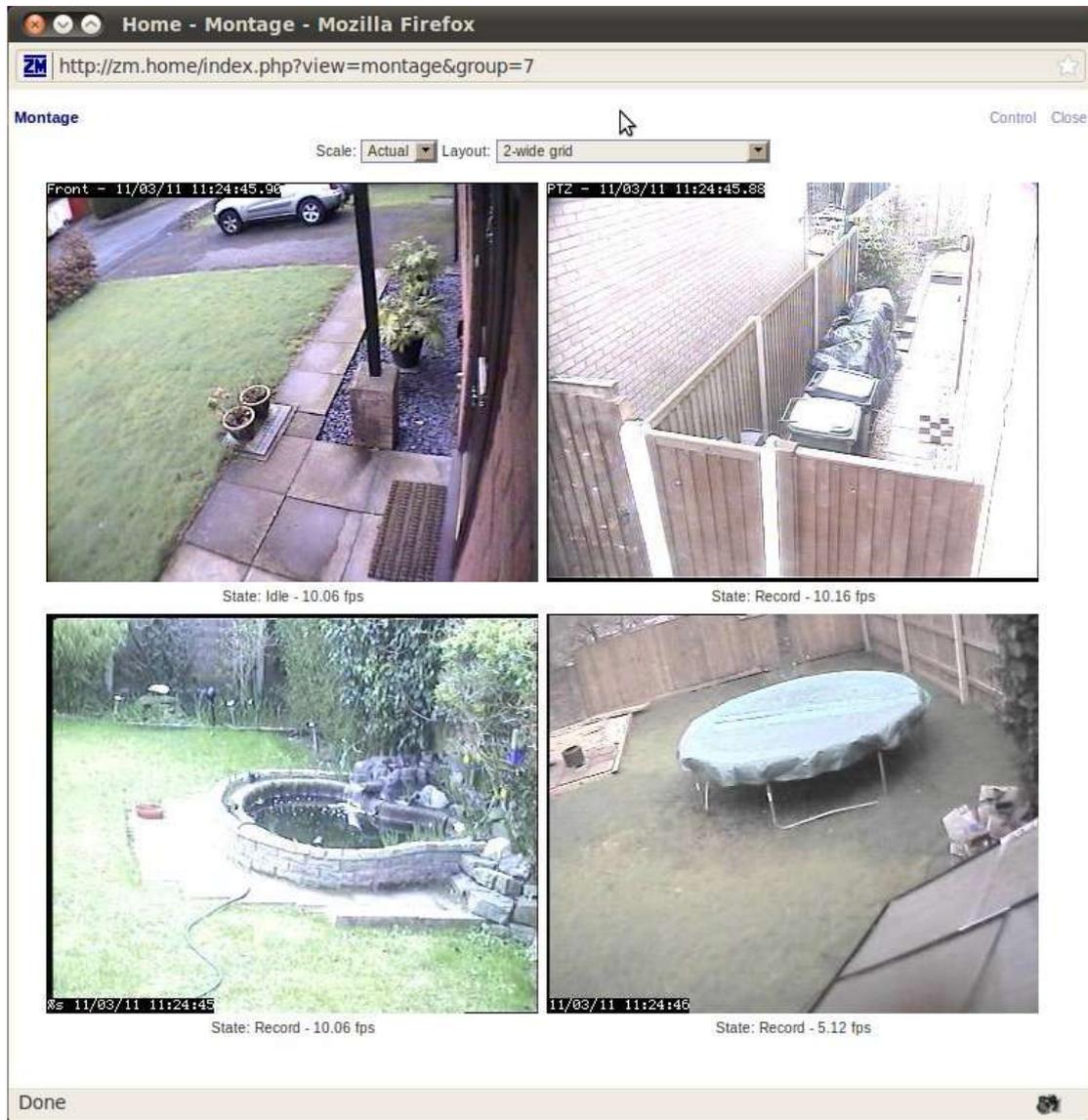


Figure 4.1 Modern Security System

Traditionally, most of the surveillance system only provides a screen monitoring for the security guard, and the function of it is only can show the past video, incase there is a crime happen, it is very hard to find a suspicious people in the video.

4.3 System Architecture Design

4.3.1 System Block Diagram

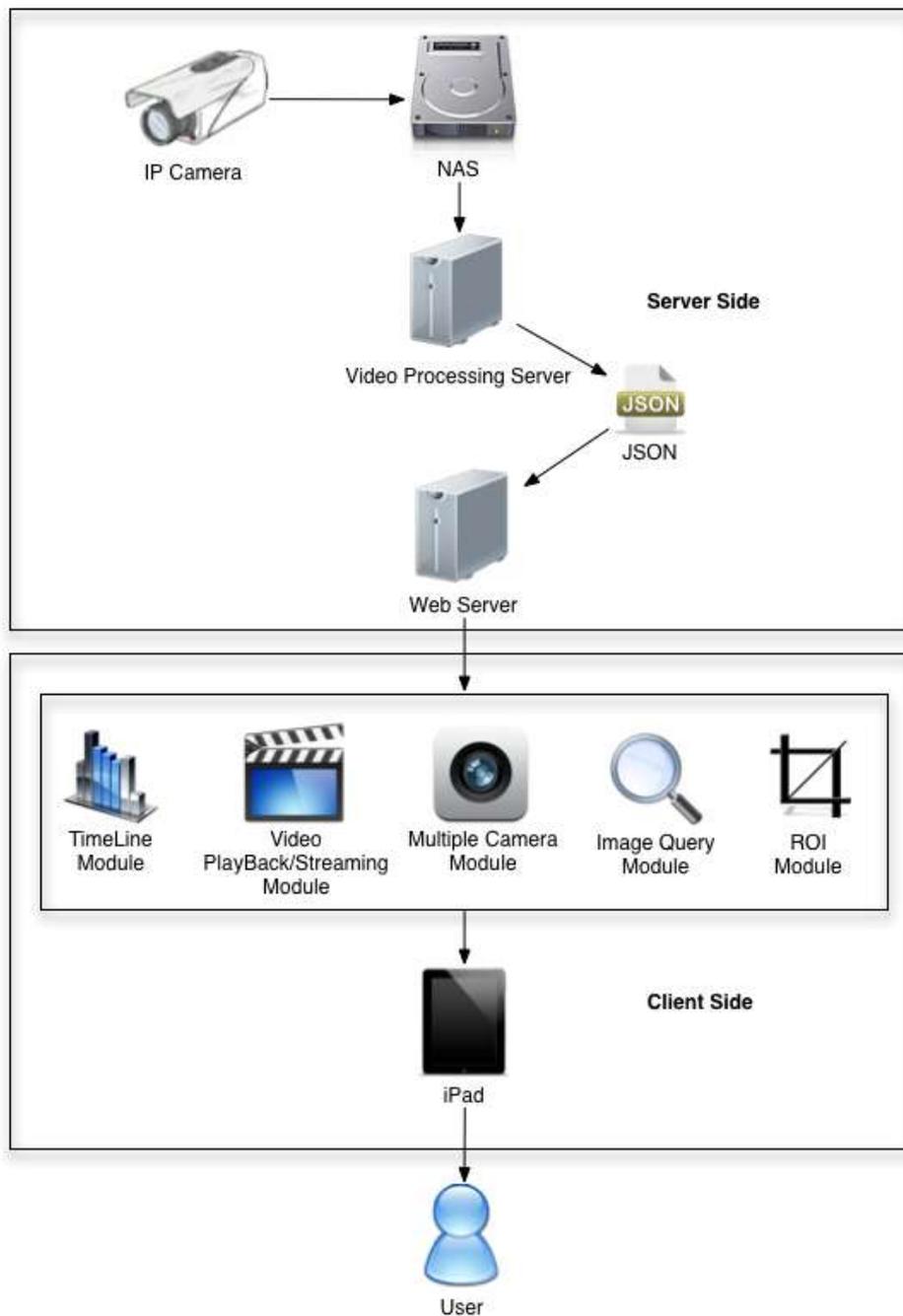


Figure 4.2 System Block Diagram

Description of each module

TimeLine Module

TimeLine Module
-(void) load
-(void) connect_CorePlot
-(void) parseJSON
-(IBAction) tap

Figure 4.3 TimeLine Module

The Timeline Module is consists of four methods. The first one is load, which is used to initial all the instance variables, class variables and all the environment settings. The second one is connect_CorePlot, which is used to plot the timeline graph so that it can display the information passed by the JSON file, and we have chosen the Core-Plot framework for drawing the graph. More about Core-Plot framework will be discussed in the next chapter. The third one is parseJSON, which is used to parse the JSON file that is downloaded from the Web Server, and the JSON file stored all the necessary data about the video. The fourth one is tap, which is an event handler, when the user touches the timeline module, it will trigger the “tap” function, which will bring the movie to the appropriate time.

Video Playback/Streaming Module

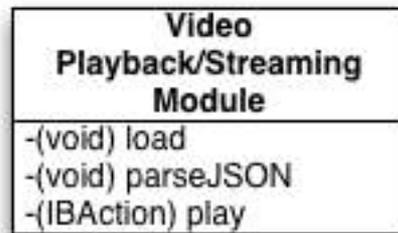


Figure 4.4 Video Playback/Streaming Module

The Video Playback/Streaming Module is consists of three methods. The first one is load, which is used to initial all the instance variables, class variables and all the environment settings. The second one is parseJSON, which is used to parse the JSON file that is downloaded from the Web Server, and the JSON file stored all the necessary data about the video. The third one is play, which is an event handler, when the user touches the Video Playback/Steaming Module, it will trigger the “play” function, which will play the video.

Multiple Cameras Module

Multiple Camera Module
-(void) load
-(void) parseJSON
-(IBAction) up
-(IBAction) down
-(IBAction) left
-(IBAction) right

Figure 4.5 Multiple Cameras Module

The Multiple Cameras Module is consists of six methods. The first one is load, which is used to initial all the instance variables, class variables and all the environment settings. The second one is parseJSON, which is used to parse the JSON file that is downloaded from the Web Server, and the JSON file stored all the necessary data about the video. The third, fourth, fifth and sixth are up, down, left and right which is an event handler, when the user touches the Multiple Cameras Module, it will trigger the “up” or “down” or “left” or “right” function, which will jump to the corresponding camera.

Image Query Module

Image Query Module
-(void) load
-(void) parseJSON
-(IBAction) submit

Figure 4.6 Image Query Module

The Image Query Module consists of three methods. The first one is load, which is used to initialize the entire instance variables, class variables and all the environment settings. The second one is parseJSON, which is used to parse the JSON file that is downloaded from the Web Server, and the JSON file stores all the necessary data about the video. The third one is submit, which is an event handler, when the user touches the Image Query Module, it will trigger the “submit” function, which will submit the image to the server, and then the server will search all the cameras to see whether the image is inside it.

ROI Module

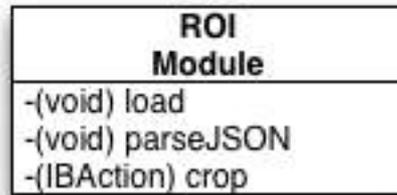


Figure 4.7 ROI Module

The ROI Module is consists of three methods. The first one is load, which is used to initial the entire instance variables, class variables and all the environment settings. The second one is parseJSON, which is used to parse the JSON file that is downloaded from the Web Server, and the JSON file stored all the necessary data about the video. The third one is crop, which is an event handler, when the user touches the ROI Module, it will trigger the “crop” function, which will crop the image and send it to the server, and then the server return the corresponding area information back to the application.

Web Server

The main role of the web server is to store the json file that is generated by the Video Processing Server. The web server will use Apache to process request from the iSurveillance to download the json file. Why Apache?

Apache is famous and well developed tools. There are lots of documentations in the Internet so we can get support in a very easy way. Also there are many popular modules and libraries in Apache, this will make the development time become shorter. Moreover, there are lots of research in apache optimization has been done in these few years.

Video Processing Server

The server will run a visual computer program, which analyzes a recorded video, based on the photo chromatography and algorithm input to compute and analyze the data required, for instance, to calculate how many people has occurred at a particular point within the video. After that, it will out output a JSON file send to the web server.

The output JSON has a simple structure shown as follows, where the branch represents the level of the node.

The following is the structure of JSON file.

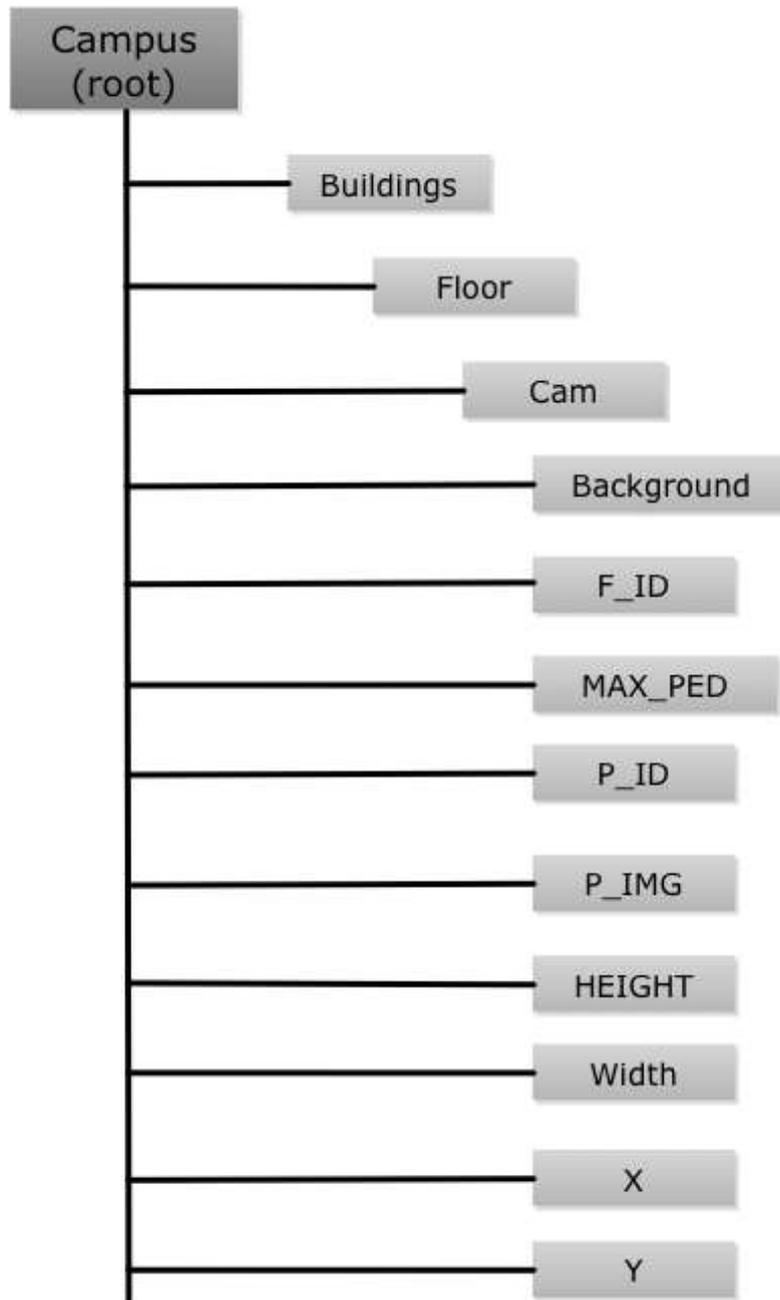


Figure 4.8 JSON Structure Diagram

4.3.2 System Component Diagram

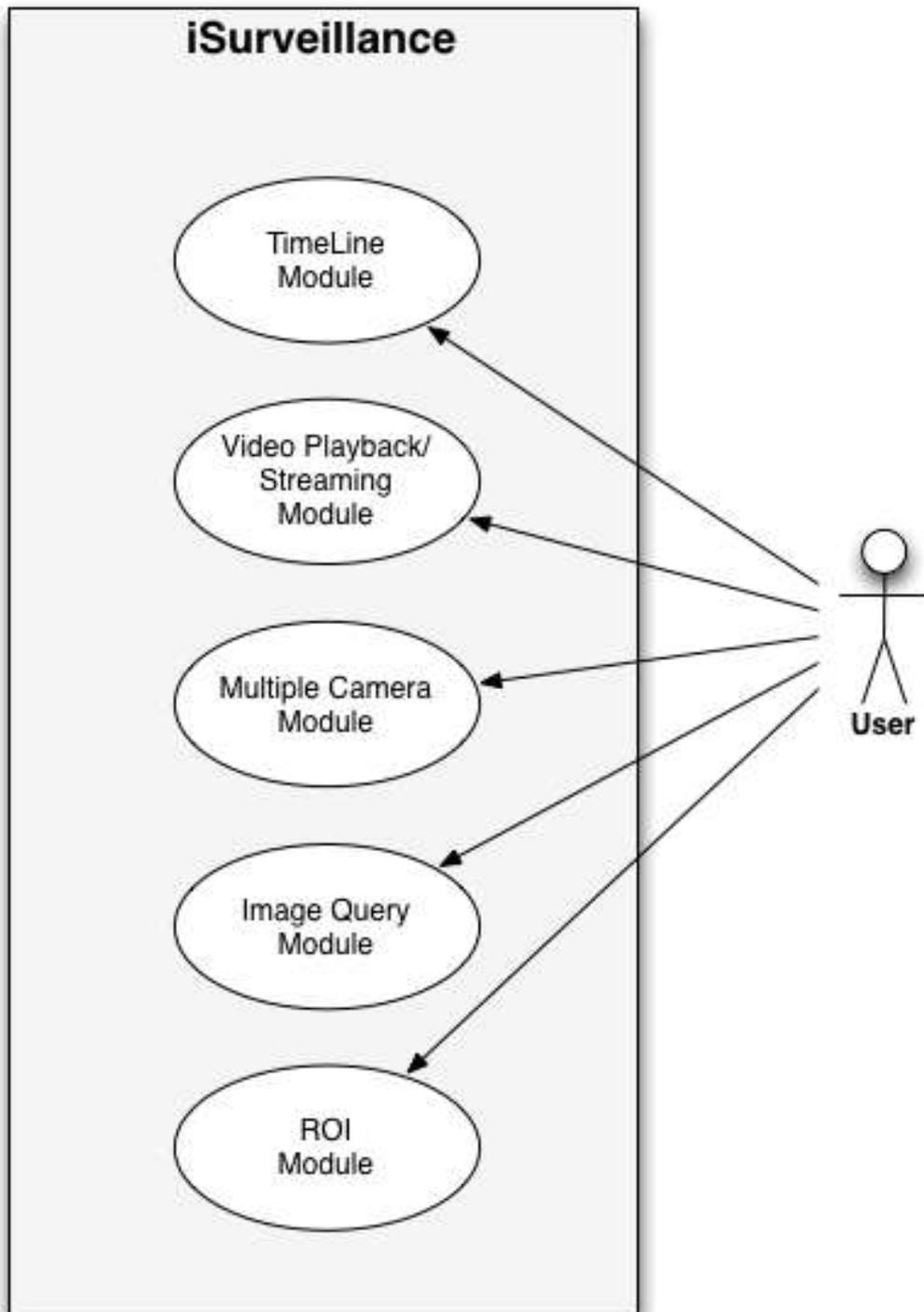


Figure 4.9 System Component Diagram

4.3.3 System Sequence Diagram

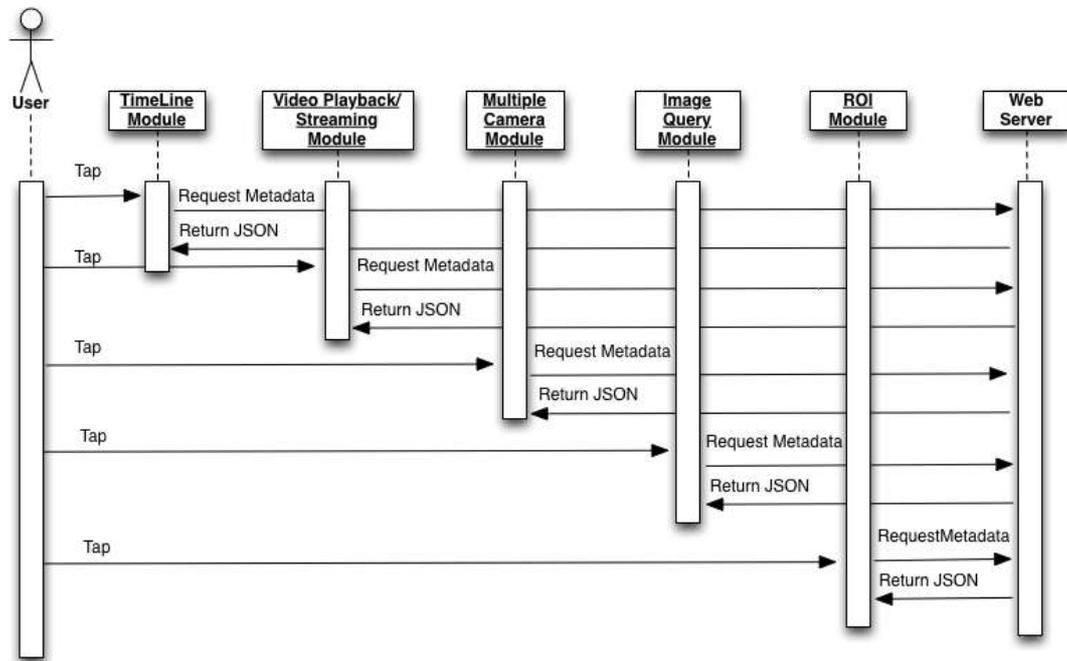


Figure 4.10 System Sequence Diagram

Chapter 5 User Interface Design

5.1 Overview

In this chapter, we are going to report how did our user-interface be designed, what concerns have been taken into consideration and what software have been used during UI design process. We would also talk about where do we gain the UI design knowledge and then briefly describe our whole design process.

5.2 User Interface Design Process

5.2.1 Creating a Design Document

At first, like most of application developers, we were reluctant write a design document and leap directly to writing code without any sort of specification of how our application will look and behave.

However, after we have read the UI-Design books introduced above, all of them claim that it is of a extreme importance for writing a design specification before you do your coding.

As a matter of fact, we turned out and found that we can really benefit from having a specification early in the FYP project. Jotting down the behaviors of the application into documentation before you do anything, it does help!

Because it will force you to think about the complicated interactions and intricate relationship between different modules and components, so it prevent you from falling into a dark hole - which is a situation that you are difficult to make a correction because you have to dig out thousands of lines of code for just a one tiny modification.

In a nutshell, we all believe that a good design specification is the backbone of our application and will help us to make vital decisions quickly and cheaply, before they become too expensive to fix later.

So, we have jotted down a list that records the advantages and disadvantages, the various strengths and weaknesses of every feature and how a decision would affect it. These lists helped us to cross out the obvious poor choices before we ever started to do any implementation.

5.2.2 Diving into the Code other Details Concerns

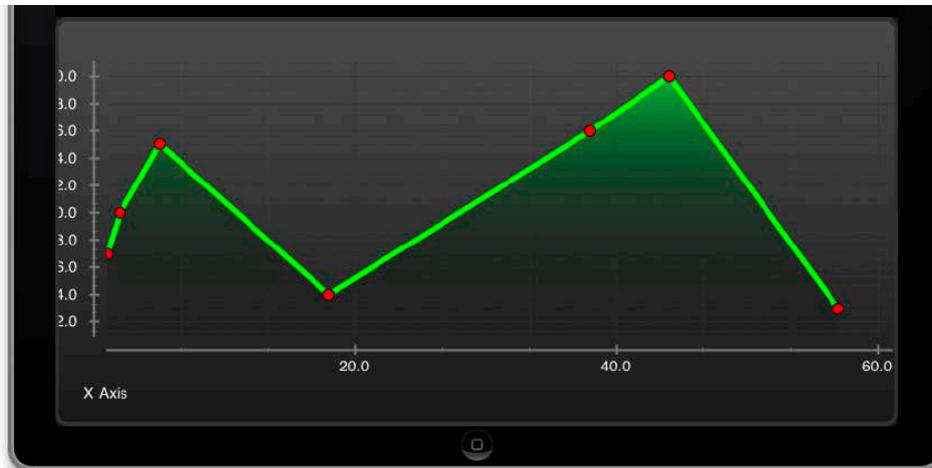


Figure 5.1 TimeLine Module

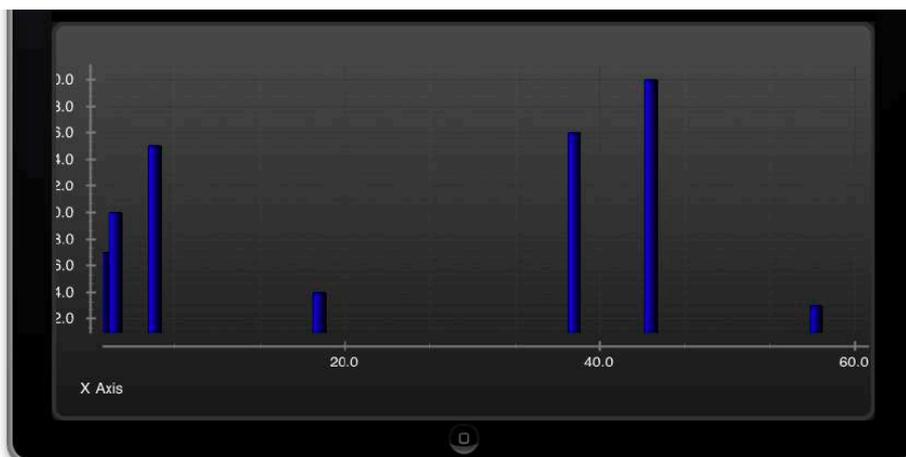


Figure 5.2 TimeLine Module

We first study on how large our plot should be for displaying on the screen, what kinds of plot should we use to achieve the best representation. Pie chart or scatter chart or bar chart? Luckily, using Core-Plot make plot generating easier;

Core-Plot has different API for generating different kinds of plot, so we tried them all. Finally, scatter chart or bar chart are used because we think they can give a best data representation.



Figure 5.3 Thumbnail

This part is about the resolution problem as we have previously mentioned on chapter 2. What resolution should we use? For a thumbnail like this, not a high resolution is required; the thumbnail here is just to display the basic shape of the image. However, when a security guard is investigating a burglary, high resolution is needed. Suspect's faces should be recognizable and readable when the guard taps the thumbnail images. So, it becomes a problem on the UI design issue, when there is a tap on the thumbnail, what should we do? To pop up a new window to show a sharper image or just refresh the image at the same location with a higher resolution one? And these are the details we have to concern. Again, it maybe trivial but means a lot in the point of view of user experience.

16:9



Figure 5.4 Video Player

For a video player, how large should it be come to our first mind? We want it as larger as it can be. However, we have to balance different factors involved; we have to consider the resolution and the ratio of the video source. We tried our best to make the video player in a ratio of 16:9 large so that it can fully utilize its area without wasting.

Format of the video source

Different format would have different properties and perfromacane; we have to take care of what format should our video source should. And as we know, m4v is very suitable and optimized under iOS platform; it would be one of our best choices. However, since the visual-analyzing backend program is not fully finished yet, the only RMVB is currently available, but it would okay for us to change into m4v in semester 2.

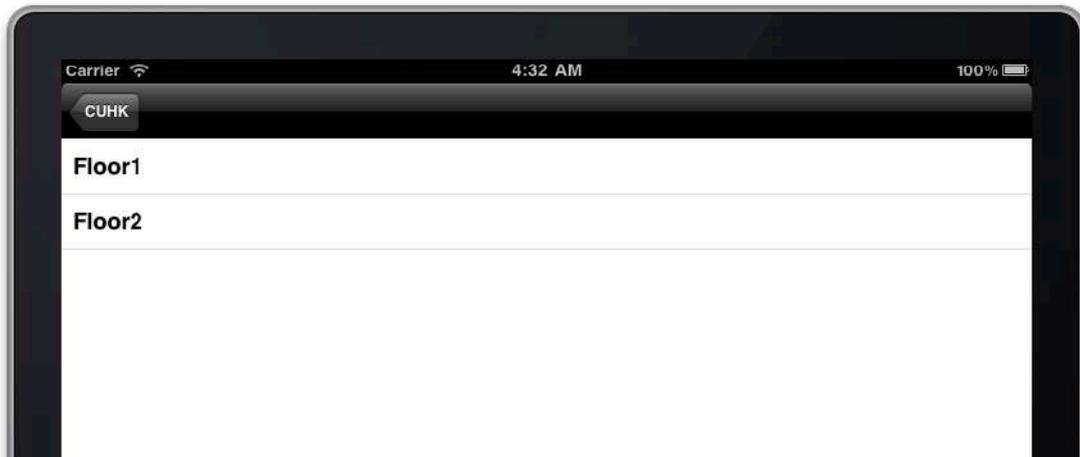


Figure 5.5 Floor List

This part comes straight forward. We know that UITableView structure should be used for sure.

UITableView is a means for displaying and editing hierarchical lists of information. In fact, UITableView is a data presenting technique developed by Apple Inc and provided in iOS. It is basic and simple, but useful and effective. Managing the Editing of Table Cells in UITableView is very developer-friendly. For example: to Inserting, Deleting, selecting, and Moving a Row in the tablelist, lots of functions is provided:

- beginUpdates
- endUpdates
- insertRowsAtIndexPaths:withRowAnimation:
- deleteRowsAtIndexPaths:withRowAnimation:
- moveRowAtIndexPath:toIndexPath:
- insertSections:withRowAnimation:
- deleteSections:withRowAnimation:
- moveSection:toSection:

5.2.3 Tuning Process

As we all know, touch screen interface is one of the most unique and prominent properties iPad has. And using the touch-based gestures requires a thoughtful tuning so that an application can “feels right”. We have to take an extra care of many tiny things, for example, we have to think about how large the button we should use, not too large to waste the screen space and not too small to hinder the touch-sensitivity.

Also, we have to consider the size and the color of each component so that they can work in a perfect harmony.

5.3 User Interface Design Tools

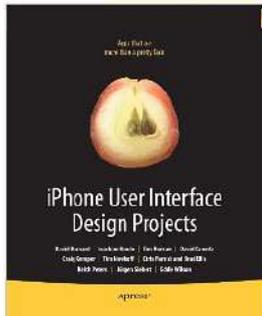
We have used a fairly large list of developer, media, and graphics applications to design and build our application, the following is the list:

- Photoshop
- Illustrator
- Xcode
- iPhone Simulator
- iPhoto

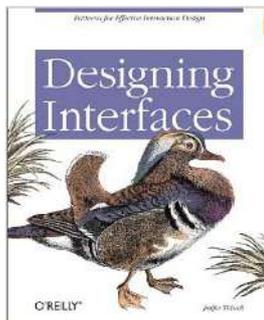


5.4 Books Reference

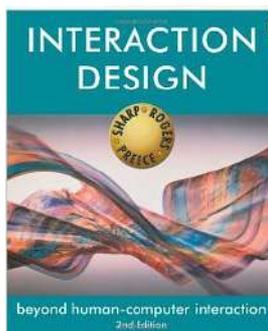
Where we learnt how to make a good design.



iPhone User Interface Design Projects by Mark



Designing Interfaces: Patterns for Effective Interaction Design by Jenifer Tidwell



Interaction Design: Beyond Human-Computer Interaction by Helen Sharp

After read the above reference books, we can conclude some principles for good User Interface Design.

1. Consistency
2. Follow the standards
3. Listen to your stakeholders
4. Explain the rules
5. User interface items is important
6. Screen size is important
7. Make labels clear
8. Understand the UI widgets
9. Color appropriately
10. Follow the contrast rule
11. Align all the fields effectively
12. Accept users to make mistake
13. Use data appropriately
14. Indubitable design
15. Don't create complicate design
16. Take an evolutionary approach

5.5 Chapter Summary

Putting all of our ideas together to build and develop our FYP product is really hard and involves tonnes of work.

Not only did we need to care about each and every component on our screen, but also need to consider which kind of animation, presentation-methodology should we adopt in order to make every component in our apps work in perfect harmony.

And we always think hard about the user's expectations and their preconceived notions; to put ourselves into their shoes, like, what do the user expects to see and what do the user would like to have.

Sometimes, we just have to push the boundaries of the technology we are developing with, for instance, we have overwrote the basic page-scrolling design framework Apple provided and changed it into a more "fancy" side-scrolling page.

However, sometimes when there was really a difficulty and having considered that the time is limited, we just had to throw away the idea we love and start over with a simpler method. Like, we supposed to have a three-finger swipe function; however, it is so hard for us to finish that within a limited time, so we turned out to resort to the original page-swipe function Apple provided.

To conclude, to us, a best UI design is not only about how good your interface-design is, but also how you can manage your time and limited resource you have.

Chapter 6 Limitations and Difficulties

6.1 Overview

In this chapter, we are going to see what the difficulties we encountered during the development phase. The difficulties are mainly come from backend system and frontend application; and can be further divided into two types - software problem and hardware issue. We would talk through the difficulties one by one and to discuss how did we find a way to out of the morass we fell into.

6.2 Backend Limitations

Live Stream video analyzing is not supported

The video analyzing backend system developed by ViewLab only supported a recorded video at the moment; an analysis for a live-stream video is not supported yet. So, if we want to expand our features into a live-analyzing; it would be a problem. And, due to the fact that we are not the development team of the video analyzing program, we just co-operate with it; we can do nothing about it. We just have to wait for the system's breakthrough at the future.

Developed in different platform

The video analyzing backend system was developed under Linux system using programming language C++ while our application is constructed by Objective C for iOS usage. A different platform can't communicate directly, so instead, we use a http request and a .json file as communication. Our application send a http request for data-query and system return a json file as a result.

6.3 Frontend Limitations

Limited resources and background knowledge

This is our first time to write an iOS apps; before that, we have no background knowledge and experience. We started from zero; it would be our great problem. We don't know if our idea is tangible and feasible; can our idea really put into practice? We don't know what limitation of iOS and objective c is. So, we have to self-study for a very long time to learn better what the advantages and disadvantages iOS and objective C have before starting coding.

And, what is more, we only have one iPad for testing. Sometimes, it became a bottleneck if we want to multitask our FYP; to solve the problem --- we tried to make use of the iPad simulator provided by Xcode as much as possible. However, when it comes to a concrete action, like zooming through multi-touching or GPS localization, it is impossible in simulator; we just have to wait.

Limited computational power of iPad

iPad is just a mobile device and its' computation power is still very limited (even the continuous growth of mobile device's technology) when compared to a real desktop computer. Says, even we use the latest model iPad2, it only have 1G CPU and 512 MB memory. So, we have put a lot of effort on optimization: we have modified the codes, adopt different protocols that suits iOS most, for example, we change our video format from rmvb to m4v after we know iOS perform better for a .m4v video. All these modifications are just to make sure that our application can run fine under the iOS environment.

	iPad	iPad 2
Display	9.7-inch LED-backlit LCD screen	9.7-inch LED-backlit LCD screen
Resolution	1024 x 768 pixel resolution	1024 x 768 pixel resolution
Operating System	iOS 4.3	iOS 4.3
Processor	1 GHz Apple A4 processor	1GHz dual-core Apple A5 processor
Wi-Fi	Yes	Yes
3G Connectivity	Only Wi-Fi + 3G models	Only Wi-Fi + 3G models
Bluetooth	Yes, v2.1 + EDR	Yes, v2.1 + EDR
Camera (Rear)	No	Yes, still camera with 5x digital zoom HD (720p) video recording up to 30 frames per second with audio
Camera (Front)	No	Yes, VGA-quality still camera VGA video recording up to 30 frames per second with audio
HDMI Video Out	No	Yes, (1080p) via optional accessory
Storage	16, 32 and 64 GB	16, 32 and 64 GB
Expandable Storage	No	No
Battery	25 watt hour rechargeable lithium-polymer battery	25 watt hour rechargeable lithium-polymer battery
Weight	Wi-Fi: 1.5 pounds (680 g) Wi-Fi + 3G: 1.6 pounds (730 g)	Wi-Fi: 1.33 pounds (601 g) Wi-Fi + 3G: 1.35 pounds (613 g)
Size	Height: 9.56 in (243 mm) Width: 7.47 in (190 mm) Depth: 0.5 in (13 mm)	Height: 9.50 inches (241 mm) Width: 7.31 inches (185.7 mm) Depth: 0.34 inch (8.8 mm)
Other features	Multi-touch Headset controls Proximity sensor Ambient light sensors Accelerometer Magnetometer	Multi-touch Headset controls Proximity sensor Ambient light sensors Accelerometer Magnetometer Three-axis Gyro Photo and video geotagging over Wi-Fi

Figure 6.1 iPad Specification

Limitations on Objective C/ iOS

One of the intimidating things about Objective C (a programming language used in iOS) is its' memory management. Unlike some language such as Java or C++ which provides an automatic garbage collection scheme; Objective C does not have support these kind of method; rather it is by a primitive reference counting technique.

However, the primitive reference counting iOS used is prone to a memory leak problem. Objective C beginner like us, are easy to forget to retain or release an object when the program is complicated and in large-scale; thus a memory leak always happen and affect the application performance.

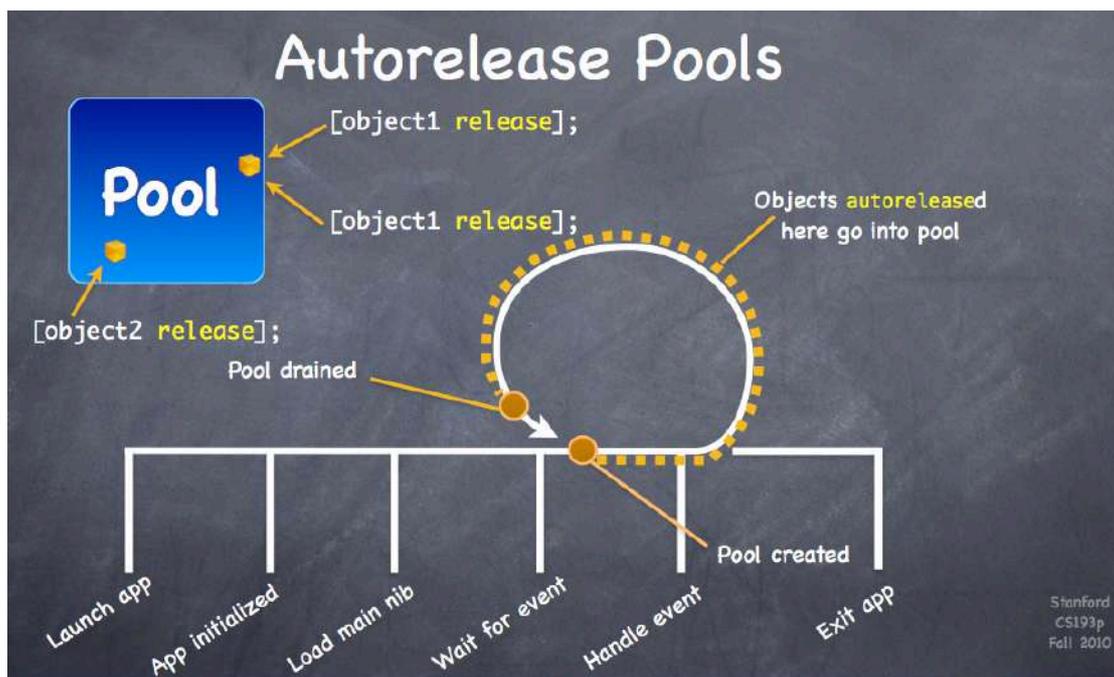


Figure 6.2 iOS Memory Management (Stanford University CS193P)

Insufficient Libraries and Documentation for 3rd party frameworks

Agreed, there are lots of 3rd party frameworks /projects are available on the Internet and most of them are useful to our FYP project. However, everything comes with its flaws, many of 3rd party frameworks are lack of guidelines and tutorial so a lot of time is spent to understand how to manipulate those frameworks and how to “fuse” them into our own products. It is really time taking; like, we have to figure out on our own how to install and use applications without sabotaging our data and hardware, system configuration.

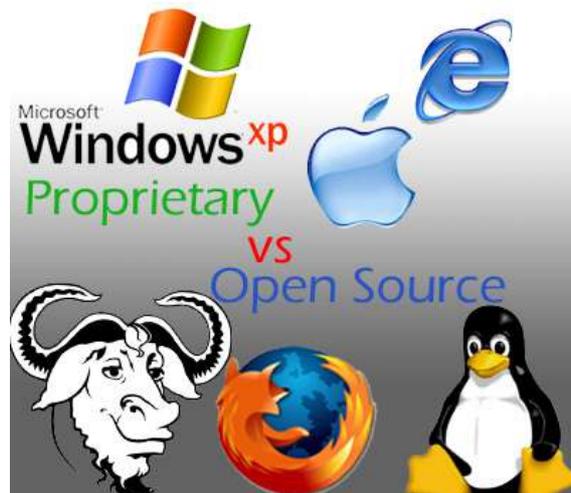


Figure 6.3 Open Source

Chapter 7 Conclusion

To conclude, this semester we have managed to put our idea into practice basically. We tested that it is feasible to build a frontend application to co-operate with the backend system. For now, we have finished the basic framework and structure, (which really is a major part of our project) and we have already implemented two out of five major feature components for our FYP product: ROI modules and Video player modules. We are satisfied with our work. The rest is going to be done in the coming semester.

What is more, during our FYP development process, we have encountered some difficulties and limitation we never thought about before; but luckily, most of them have a solution and our FYP is able to proceed to next step.

Other than work-related aspect, we learned a lot through this FYP. This is our first time to develop an iOS application; we have no background knowledge and experience before that; we started from zero. We have to self-study for a very long time to catch up what we missed. We thought it was a very good experience to us, cause we know situation like that may easily happen in reality. In a real working environment, you are always required to take up something you don't know in a very short time.

Besides, what we have to do for our FYP looks like a real business. We have to write a frontend application to co-operate with the backend system, to design and implement on our own selves, we have to consider many things like user-friendliness, performance optimization and even time-management; it all looks like a real business. We believe what we learned is very practical and invaluable.

Chapter 8 Future Works

8.1 Overview

In this chapter, we would take an overview on what haven't finished this semester and what we are going to do for the coming semester. In general, there are four features modules we haven't finished or there are still some rooms for improvement. They are Region of Interest, ChatBox, Live-stream surveillance and Drag-and-drop modules.

In this chapter, we will also to see the possibility to adopt more APIs / third party libraries. To see which open-source libraries we are interested in, how can they further enhance our system and discuss the possibility to "fuse" them into our product.

8.2 ROI Module

How can we further modify and enhance the ROI?

1.Circle the suspect out, no need to draw a rectangle

Now, our client able to draw a rectangle on the video screen to indicate his interested area for ROI video searching; this function is good and we want to keep it. However; drawing a rectangle is not user-friendly enough and maybe a little bit time-taking, So, instead of using a formal rectangle drawing as area indication, would it be a good idea to use other method to implement the same function. For example, instead of drawing a formal rectangle, it would be nice for a user to just circle the suspect out using their finger. This may be just a little modification, but we believe that it means a lot when it comes to user-friendliness.

However, this idea may seem easy, but there is a potential challenge. As far as we know, rectangle is the best shape for graphic-coordination calculation, a less error would be resulted if a rectangle is used. However, if a circle is drew by a finger, the shape may be informal and “ugly”, hard to define the area it intends to mean, hence pose a difficulty in calculation on graphic-coordination.

2.Multiple ROI at a time

Our current product only supports one ROI search at a time, no multiple searches are allowed. We think that it would be nice if we can extend the function so it can support multiple ROI searches simultaneously at one time.

8.3 ChatBox Module

We haven't implemented our ChatBox Module this semester; we would like to put this module into practice on the coming semester. ChatBox module looks like a WhatsApp or Facebook chatting system. It is complicated and hard to implement. For this reason, we think that it is a good idea to absorb an open-source API called three20.

Three20

Three20 is an open source Objective-C library constructed in Objective-C. Three20 is very popular and have been used by dozens of well-known brands in the App Store, like Facebook, Posterous, Pulse etc....

Three20 provides many powerful view controllers such as the Launcher, chat room module that fully fits our need. Moreover, the best thing about Three20 is the way it constructed; Three20's library is modular, you can choose extract what elements you want and include in your app, need not to integrate the whole codes. This design method is what we called 'extensions' from the community and is very popular nowadays.



Figure 8.1 Three20 Logo



Figure 8.2 WhatsApp

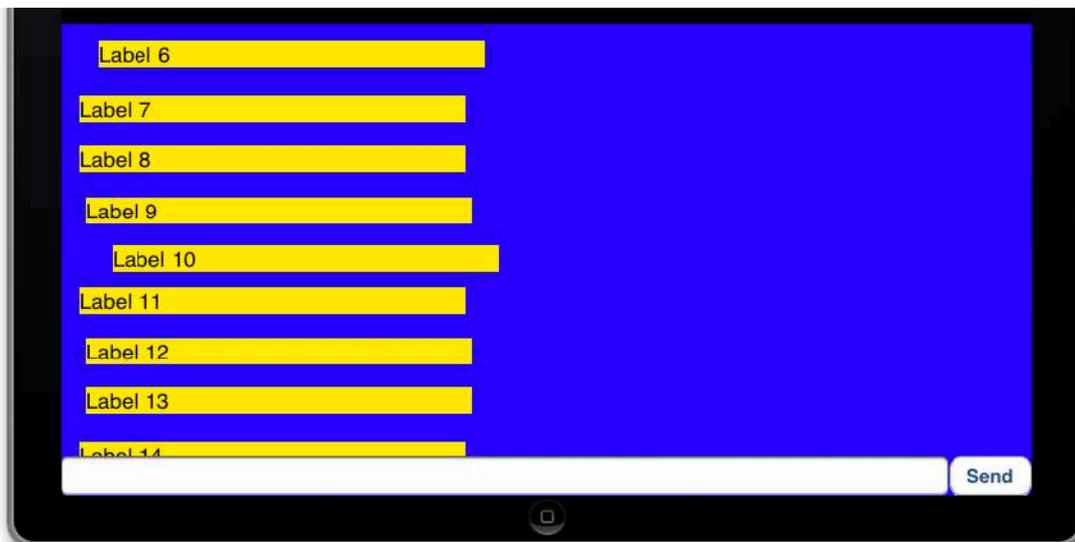


Figure 8.3 ChatBox Area

8.4 Live-Stream Video Module

We haven't implemented our Live-Stream Module this semester; we would like to put this module into practice on the coming semester. Live-Stream Video Module allows our system to play video in streaming way. We will use RTSP be our steaming protocol.

What RTSP is?

The Real Time Streaming Protocol (RTSP) is a network control protocol designed for use in entertainment and communications systems to control streaming media servers. The protocol is used for establishing and controlling media sessions between end points. Clients of media servers issue VCR-like commands, such as play and pause, to facilitate real-time control of playback of media files from the server.

8.5 Drag and Drop Image Inquire Module

We haven't implemented our Drag and Drop Image Inquire Module this semester; we would like to put this module into practice on the coming semester. This is one of the inquiry modules; user can drag a thumbnail image into the designated area, and an automatic search will be done then. We will use DragKit to implement this module.

What DragKit is?

DragKit is a way to make iPhone/iPad support the application of open source libraries drag operation. Just click the icon to pull the icon twice, you can see the drag of the instructions. Many examples of applications, one is to pull a song like album. Users can also drag buttons and toolbars.

Mobile device applications and desktop applications is generally the biggest difference is that you can present their intuitive operation interface, the user will not have the time and patience to read the instructions, then simple interface it is very important. This is to introduce the iPhone support drag operation DragKit.



Figure 8.4 dragKit Logo

Chapter 9 Acknowledgment

We would like take this rare opportunity to express our thanks to Prof. Michael Lyu, our supervisor of the final year project. Prof. Lyu gave us lots of invaluable suggestions and consultation over the past semester; the guidance he gave played a crucial role to our FYP.

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