Department of Computer Science
The University of Hong Kong
Final Year Project

ACCESS EVERYTHING.
ANYWHERE. **INSTANTLY.**

Mobile Document Management System

INTERIM REPORT

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ABSTRACT

Document Management is of paramount importance in a company. Following the advancement in mobile technology, mobile document management system (MDMS) has gradually become an indispensable part of a company. It is a system that utilizes the convenience of technology to let users track, manage and store documents at any time everywhere. Most of the existing MDMS on the market are mainly for personal use rather than for business use, so what benefits might be realized if a tailor-made MDMS can be developed for small companies? This report provides information about the functionalities, objectives, methodology and current development progress of MDMS that are specifically made for small companies to let them manage huge amount of data in a more cost-effective and convenient way. Google Cloud Storage, Database, Apache HTTP server will be the main technologies in the MDMS for handling user's requests. On this stage, we have completed the background research and studies on open source DMS API. Both user interface and functional design have been carried out and we are now working on server and database setup. A wide spectrum of basic functions and business-oriented functions will be implemented in the next stage. By implementing a user-friendly and tailor-made mobile document management system with unique features added, it is hoped that document management efficiency, productivity among colleagues, workflow management of the company can be enhanced and optimized.

ACKNOWLEDGEMENT

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ABBREVIATIONS

API: Application Programming Interface
DMS: Document Management System
FTP: File Transfer Protocol
GUI: Graphical User Interface
HTTP: Hypertext Transfer Protocol
MDMS: Mobile Document Management System
PDF: Portable Document Format
PHP: Hypertext Preprocessor
SMTP: Simple Mail Transfer Protocol
SSL: Secure Sockets Layer
UI: User Interface
WYSIWYG: What You See Is What You Get

1. Introduction

Document management system (DMS) is an application used to access, manage and store electronic documents in an effective way. With an increased need for workplace flexibility and instant management of document in the modern business, the idea of mobile document management system (MDMS) has been introduced to enhance DMS and make up the deficiencies of the traditional DMS. MDMS is an application to support document management at any time and place. Instant upload, fast access and easy-to-retrieve of document anywhere are most in-demand functions for companies. In the era of mobile devices, with the help of handheld mobile device equipped with different hardware and apps, this mobility can be easily achieved by installing a MDMS app on the mobile device.

Although there are some existing file storage services like Google Doc, DropBox and other MDMS apps like Document 5 and Briefcase that are open for all users, most of them do not deal with the following issues:

i.   Lack of business workflow support
     Currently, most of MDMS apps in market are for personal purpose and cannot meet the business requirement well. Business workflow management is one of the issues that companies are encountering but the existing MDMS apps do not support. Take invoice approval as the example of business workflow. Traditionally, an employee need to fill out a form including the item specifics and cost. Next, the form will pass to their manager who approves it and then sends to the accounting department. In the accounting department, this request may be also passed along to another manager. When finally approved, the form will be sent back to the employee who initiated the request. It is easy to see how documents could get lost in this shuffle while finding a lost document will cost a company $122 on average and it is also estimated that 7.5% of all company documents are lost completely. [1] If MDMS can support this kind of document workflow process, this cost loss will be definitely mitigated.

ii. Loss of mobile device
     Most of MDMS apps do not limit the number of mobile devices that can access the system per user. According to Leikums from International Association of Computer Science and Information Technology, this is a serious security risk when many workers are able to use their own mobile devices to access the resources and information of the organization. [2] One of the potential problem is loss of mobile device. In 2014, 5.2 million smartphones were lost or stolen in the U.S. [3] So, when more mobile devices can access documents of the company, the risk of confidential information leakage will be increased if the devices are lost.

In addition to the problems of existing MDMS apps, low adoption rate of DMS in small businesses is also worthy of attention. According to a global survey in 2012, document challenges like searching the document they need or damage of document account for 21.3% of productivity loss. [4] However, a survey conducted by M-Files Software and Sage Small Business Panel repoFrted that 77% of small businesses are still storing and managing paper records in an inefficient manner. [5] This may be due to the extra cost for buying a DMS and additional effort on document management. Therefore, there is still a large market on document management for them.

Therefore, to solve these problems and streamline the process of document management in small businesses, this project aims to design and develop MDMS for small companies, for easy to achieve, retrieval, mobile access and workflow support with high usability and security. The purpose of this paper is to give an interim report of developing MDMS by suggesting its objectives. Then, after evaluation of current MDMS, it will refine the scope of the system and discuss how the system to be implemented in different aspects. Finally, it will give the detail about project deliverables, and report the current status and future plan with accessing potential difficulties in this project.

2. Project objectives

In light of the problems mentioned above, it is hoped that the situation can be improved through our project. By implementing a tailor-made mobile document management system, the small companies can benefit in the following aspects:

i. Convenience and enhanced user experience
Document management is now not confined to desktop computers. Users can do their document management at any moment regardless of device used. More importantly, a simple and self-explanatory user interface will be adopted to provide even better user experience. Our application will make good use of touch-friendly features of mobile device so that user can simply view or send a document by drag and drop. Not only will various business functions be incorporated, we will also ensure the usability and simplicity of our application.

ii. Streamlined business workflow
In a company, many documents need to be sent to others for reviewing or seeking approval. Sometimes the document may be lost during the circulation. Our application let users trace the route of the document and enable senior members to sign on and approve the document in a fast and efficient manner.

For example, an employee wants to fill in a claim form and ask his manager to sign on it. He can just simply capture the invoice by using the built-in camera and attach the invoice into the claim form. The claim form is then sent to the manager and the manager can sign on it. Finally, the finance department will receive the document with the signature of the manager and pay for the expense. The entire process can be done instantly without any paper transfer. In this case, time is saved and streamlined business workflow is achieved.

iii. Document management with high security level
Different security strategies will be implemented to prevent unauthorized access to the documents. First, there will be a log in function together with a permission setting function so that only the selected users are allowed to access the document. Second, Advanced Encryption Standard (AES) will be adopted to encrypt the document. In this case, documents can be archived and retrieved with high security level. Chances of document leakage are greatly reduced.

iv. Increase employee productivity
Using the MDMS, users can gain access to their documents anywhere whenever they want. Employees can work on and modify their documents even when they are out of office.

Moreover, they can share documents with colleagues and cooperate with each other. It results in better collaboration among teammates. Recent research shows that nearly 10% of an average office worker's day is to locate information and documents.[6] If there is a MDMS, employees can allocate more time to work. All these result in increase in employee productivity.

3. Previous works in the field

DMS is an application used to store, manage and track digital documents. Documents are not necessarily in a paper or printed word. Image, music, video and other formats of data can also be documents in DMS. In the early days of document management, all the files and documents in a company had to be kept in filing cabinets, which was inefficient. Without the assistance of cloud storage, DMS was still not operated perfectly as large amount of digital memories were needed and the cost of physical storage was enormous. The procedure to get the document from the system was still time consuming and troublesome due to slow loading and accessing to server. Nowadays, DMS becomes an essential part in every company and our daily life. Not only do they spend fewer resources on the storage of documents, they also can search and access the document in a swift manner. In the trend of paperless office, DMS plays a vital role for every business to operate at top efficiency.

DMS generally performs storing of documents, keeping the history tracing of documents, sorting documents in specific order, retrieving documents from the server and protecting documents by complex security locks. However, before the birth of smart phone, DMS was based on the computer to run. Without a computer, it was impossible to retrieve anything stored on the server. Therefore, MDMS is developed for users to access documents anywhere and anytime with a portable smart phone.

Analysis of Existing Mobile Document Management System:

Functionality/App	Document 5 – File manager, PDF reader and browser	Document Manager + Video Player	Briefcase – File manager & document pdf reader	Air Transfer – Easy file and document sharing between PC and iPhone/iPad	Document Management - Zoho Docs
	[7]	[8]	[9]	[10]	[11]
Document storage	✓	✓ *Download or upload documents from Google Docs, Box, Dropbox, FTP and sync with iCloud*	✓ *Import files from Mac or PC via Wi-Fi or iTunes* *Download and upload files from Dropbox, Google Drive, SkyDrive, Box*	✓	✓
Document retrieval	✓ *Open and view common type of document*	✓ *Open files in other apps*	✓ *Support viewing PDF file, Microsoft Office documents*	✓ *Built-in Document Reader*	✓ *Access online versions of Zoho Writer, Sheet, Show & Docs*
Document distribution	✓ *Mail, zip, unzip, upload, merge, send to another app*	✓ *Send a file by email*	✓ *Share files via "Wi-Fi Sharing" function*	✗	✗
Document operation, e.g. editing	✓ *Edit document like highlight, strike-out, underline text and change font and font size of the whole document*	✓ *Edit and add folders including move, zip, delete and rename folder*	✗	✗	✗
Security	✗	✗	✗	✗	✗
Collaboration	✗	✗	✗	✗	✗

Versioning	✘	✘	✘	✘	✘
Searching	✓ * Search and bookmark in the document	✘	✘	✓ * Search by category	✘
Workflow	✘	✘	✘	✘	✘
Capturing	✘	✓ * Record sound as a file * Scan photo to as image or PDF	✘	✘	✘
Other features	* Files will remember the last viewed page and zoom level	-	-	* Move what you're seeing or playing on Mac/PC to your iPhone/iPad with just single drag & drop * Auto-classified files into 7 categories: 1) Text Memo 2) Website 3) Images 4) Music 5) Movies 6) Documents 7) Etc...	* Remembers your account information so you can avoid frequent logins

Table 1. Comparison of existing MDMS apps

DMS apps are found in Apple App Store and Google Play Store. Our research is based on apps available in Hong Kong only. Most of them achieve some parts of functions of our MDMS. Also, by inspecting the existing applications, improvement or remarks are analyzed for our application development so as to avoid the same problems.

Keyword "document management" was searched in both the Google Play store and Apple App Store on 26 September 2016 and a list of apps were recommended. Since our MDMS is provided without charge, free apps are our main focus, including those with in-App Purchases. The below table only shows the five most popular apps sorted by the order recommended by the store, including four apps from Apple App Store and an app from Google Play Store (from left to right). Some apps performing similar functions are omitted. Apps selected from Apple App Store have a higher proportional than apps from Google Play Store due to the similarity in functions between those apps and our MDMS. Comments are made to analyze the features of the app. It is hoped that based on the analysis of these existing works, the quality of our application development can be improved.

Through our experience on using these 5 apps, the 4 left apps are for personal use and the rightmost one, Document Management - Zoho Docs, is somehow similar to our MDMS, for business internal use. In general, the apps which are for personal use provide a variety of functions which our MDMS should be supported. For instance, documents supported should include Microsoft Office, iWork, PDF, Google documents, music, image, video, zip files and even some programming text files for developers. However, some business oriented features such as security, collaboration, versioning and workflow are not achieved. Some usable functions like searching, capturing and document editing are not supported in all apps. Furthermore, these apps cannot carry some internal circulation for the small business company like what our MDMS will perform. For fast data retrieval and stronger security network, our MDMS is developed based on circulation per small business company. Figure 1 illustrates how our MDMS links to users in one company. Documents for Company A should be viewed by users in Company A only. Users from Company B should not be allowed to access MDMS in Company A. To achieve the separation, User ID is needed to differentiate users. For MDMS which is targeted for personal use, all documents are stored in the same system and can be accessed when the user clicks the app.
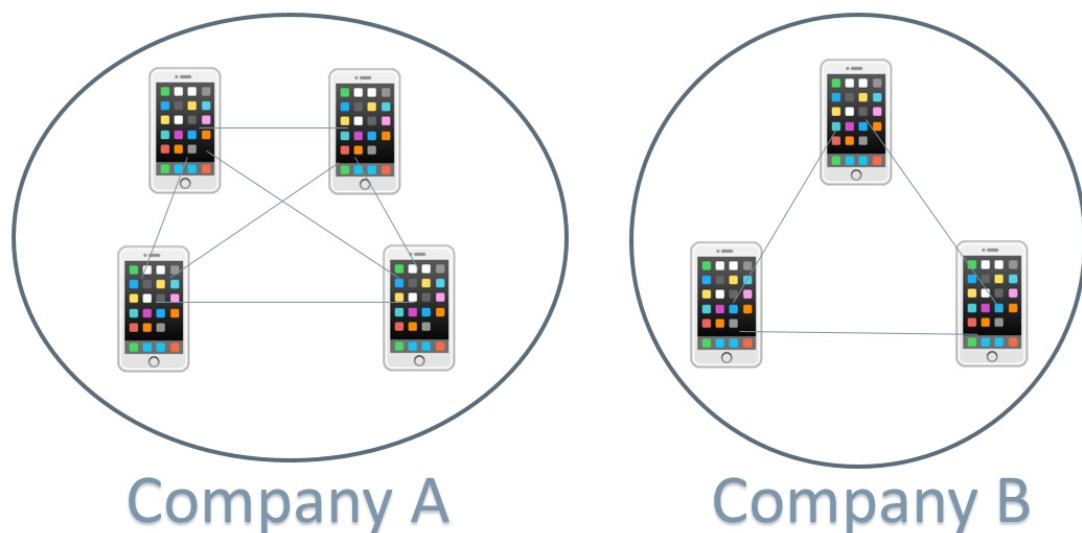
Figure 1. Separation of MDMS for different users

Compared with Document Management - Zoho Docs, our MDMS is an all-in-one application which means transferring, editing, creating and storing are performed within one app. Document Management - Zoho Docs needs to cooperate with other apps like Zoho Writer, Zoho Sheet and Zoho Show, which are developed by the same company, to execute other functions of different documents. Document Management - Zoho Docs only performs storing and viewing documents. It has to collaborate with other Zoho apps to achieve the greatest performance.

Therefore, our document management system introduced for small business company should still have its market value and uniqueness among the existing applications.

4. Project scope

Based on the above evaluation, our system is going to have the basic functionality of DMS with additional mobile and business features listed as follow:

4.1 Basic functionality
i.   Document storage
        - Store various document types, including word-processing files, emails, PDFs, images and spreadsheets
ii.   Searching an entire storage space by keywords and tags
        - Search the content of file and fast retrieval of the searching result
iii.   Monitoring who is viewing documents and when
        - Track and report edits being made to documents by statistic
iv.   Versioning of edited documents
        - Backup and retrieve previous versions of edited documents for failure recovery
        - Represent editing history of a document by a graphical tree

4.2 Unique features
i.   Defining and managing business workflow
        - Define a route that document will send to and the action needed to follow like comment and signature with a specific deadline
        - Allow user to trace the progress and where the document is like checking parcels in TAO BAO
ii.   Mobile oriented document operations
        - Simple user interface with large document icon and button
        - View document with a larger font size
        - Make use of touch-friendly features of mobile device, user can simply send and upload documents with the flick of your finger like drag and drag
        - Generate QR code to share document to external user instantly
        - Support user to capture documents by camera and classify them by tagging
        - Wi-Fi printing
        - Collaborative editing
        - To fit with the size of the mobile device, instant document editing features like merging and slicing will be provided
iii.   Security
        - User login
        - Restricting access to certain documents by permission setting
        - Encrypt document while uploading
        - Auto log out when the app is idle for too long
        - Limit the number of device allowed to use the system for each user, e.g. each user is only allowed to register at most 2 mobile devices
iv.   Calendar and user preference
        - All deadlines of the document that need to handle will be shown in a calendar to fully utilize the business workflow
        - Have notification to remind user when the deadline approaches
        - Allow user to prioritize the documents and sort files by tag, name or date

5. Project methodology

5.1 Equipment and technology
The following equipment and technology will be used during the system development:

i.   Google Cloud Platform
Google Cloud Platform is responsible for document storage space in the system. It is an internet-based computing that stores, manages, and processes data using a remote server hosted on the Internet rather than a local server or a personal computer.
Cloud computing has become one of the most popular trends in document management because of its always-on availability. As Cloud ensures that documents are available at anytime and anywhere, as long as workers have an Internet connection, it can fulfill the requirement of MDMS – instant access. Also, Cloud computing is more cost effective compared to traditional computing. Companies don't have to purchase equipment and build out and operate a data center that can save significant money on hardware, facilities, utilities and other aspects of operations. So, Cloud computing is best suited technology for MDMS.
Currently, Google Drive and Google Cloud Platform are two most popular cloud storage solutions providing online storage with API for application integration. In term of price, Google Drive is much cheaper that needs $1.99 for 100GB while Google Cloud Platform needs $2.6. [12] However, the reason to use Google Cloud Platform in our system is that Google Cloud Platform is a platform for enterprise while Google drive is merely a personal platform. Only Google Cloud Platform supports advanced data management features and high security that ensure document's confidentiality and integrity. It also provides durable, highly available storage with fast performance, and well developed REST API support for advanced service and business apps integration. [13] Therefore, Google Cloud Platform is more suitable for document management for small and medium businesses focusing on the more extensive, functional and secure Google Cloud Storage service.

ii.   MySQL
MySQL is an open source relational database management system that is used for storing user information and metadata of the document being stored in the cloud, like the editing history and owner of a document, to associate with the Cloud storage for document management.
Compared to other major and important open-source relational database management systems like, SQLite and PostgreSQL, MySQL is feature rich and the most popular one of all the large-scale database servers. Getting started with MySQL is relatively easy for developers to access to a massive array of information regarding the database on the internet. Among SQLite and PostgreSQL, MySQL is more secure that it provides security features with reliable protection for data-access in a simple way. For example, MySQL implements SSL library to provide connection encryption. All endpoints require their own set of private keys and certificates to be able to use encryption. [14][15] Hence, it is beneficial for consolidating the protection on document and user data.

iii.   Apache HTTP server
Apache HTTP server is the most used web server software in the world. It serves user for listening and responding to the document management request like uploading and retrieving document from the MDMS app.
As an open source software, Apache is a powerful Web server program with features that compare to other high-priced competitors. The software includes an administration control panel, customizable error messages and authentication schemes that enhance server management and system integration. Also, other standard features are included in the installation package that are useful for manipulating the MDMS server such as Simple Mail Transfer Protocol (SMTP) for sending message/email to other users and File Transfer Protocol (FTP) for downloading and uploading document. The vibrant Apache developer community also produces frequent updates so developers always have access to the latest features and security patches. [16]

iv.   Xamarin
Xamarin is a cross-platform integrated development environment that used to build native apps. The advantage of using Xamarin is that developer can write native Android, iOS, and Windows apps with native user interfaces at the same time and share code across multiple platforms based on a shared C# codebase. Normally, when building an app, developer needs specific development tool for each mobile platform, like Android Studio for Android and Xcode for iOS. However, using Xamarin is not necessary to make an app for different platforms by developing multiple times and going native in each platform. Another reason is that it provides Drag-and-drop WYSIWYG (What You See Is What You Get) GUI designer. Developer can easily build a user interface by drag and drop UI elements like button to the console rather than purely code-driven UI. It Simplifies mobile app design with its Android and iOS designers. So, these features are beneficial in reducing the implementation time. [17]

v.   C#
C# is a general-purpose, object-oriented programming language used in Xamarin to develop MDMS app. It is one of the best languages for mobile app development that supports most of the features provided by other programming languages for mobile app development like Objective-C, Swift, and Java.

vi.   PHP
PHP is a popular, simple and easy-to-use programming language executed on the sever side to handle the request from user. PHP is a powerful open source software for making dynamic and interactive application that can run efficiently on different platforms and is compatible with almost all servers used today.

5.2 System architecture design

External

Server side

Client side

Document manager
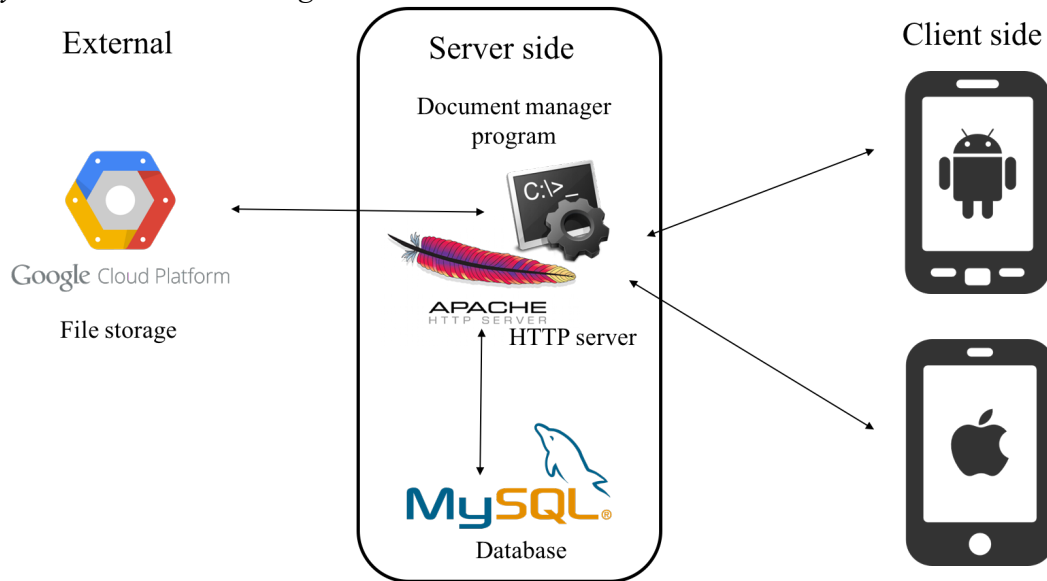program

HTTP server

Database

File storage

Figure 2. System architecture

To achieve instant access of document with its related information in MDMS, Client-server architecture will be applied that an always-on central server will listen to the document handling request from the client.

There are several components integrated in our system. Both Cloud from remote server and database from local server will connect to a program called "Document manger" resided in the HTTP server. "Document manger" will listen and response to the request from the mobile device.

The difference between database and Cloud is that database is used to store the metadata about the document while Cloud is the document storage space to store the actual document. To retrieve a particular document, both Cloud and database are needed. The reason of using this approach is that Cloud storage is just a space to storage the document and the document can be only retrieved by document id. However, it is insufficient to tell which document the id refers to. Therefore, database is needed to associate with Cloud for identifying the document. There is a table in database to match the information of the document with the document id so that the server can identify the required document in Cloud.

POST https://mdms/upload
/storage?uploadType=docx
&documentid=001
ContentType: txt/docx
ContentLength: size of document
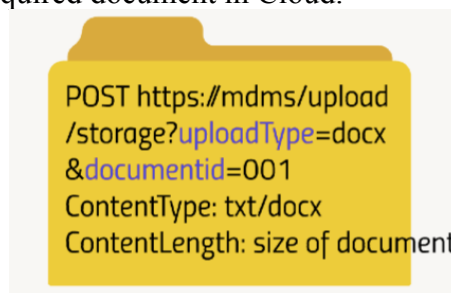
Figure 3. HTTP POST request header

In terms of uploading and accessing the document, restful web service will be acted as a bridge between client and server. There are 2 types of HTTP request which are HTTP POST for uploading document and HTTP GET for retrieving document. For example, to upload the document from the client to the server, a HTTP POST request package will be generated and sent out to the server. In the package header, the request will specify the link of the server with

the parameters like the type of the document. Moreover, the whole document being uploaded will be included in the content of the package. [18]

Figure 4. The flow of retrieving document

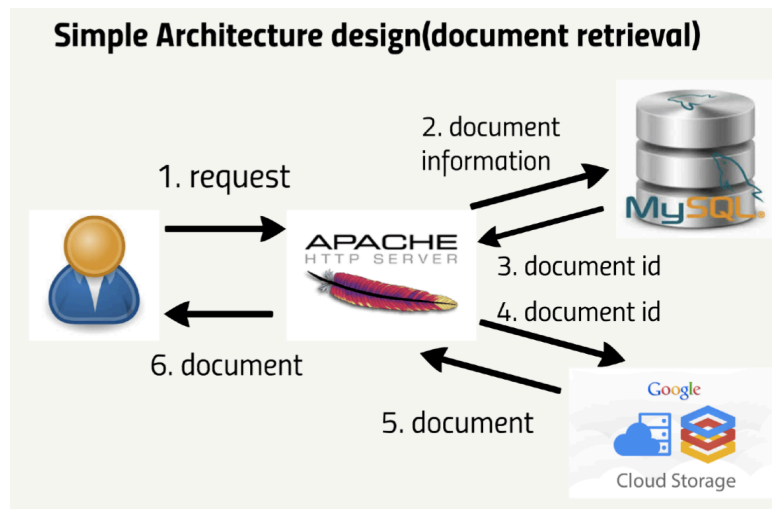Here is an example to explain the interaction between different components in the system for retrieving a document. When user sends a request for retrieving a document from a mobile device, "Document manager" will handle the request and use the information in the request such as name of the document, version number, modified date and name of the owner to look up for the document id of the requested document in database. The database will return the document id and detailed information of the document like editing history and its workflow to the server. Then, the server will make a further request to Cloud to retrieve the document using the document id. Finally, the server will send back the document with its information to the user.

5.3 Development process
To develop the application systematically and qualitatively, software development lifecycles will be used in the project. The following are the five main stages and relative tasks in our software development.

Figure 5. Software development process

Stages	Tasks
i. Requirement gathering	• Background research • Evaluate existing MDMS apps • Define functionality of our product
ii. Design	• Evaluate the equipment and technology can be used in the development • System architecture design • User interface design • Cloud and database design
iii. Implementation	Phase 1: • Set up server, database and Cloud • refer to and make use of existing open source DMS, like Kimios DMS and OpenDocMan to develop a mobile app version of DMS • build a prototype with the basic DMS functions, like uploading, preview and editing of the document qualitatively and efficiently based on those well-developed open source DMSs Phase 2: • add more mobile and our special features to the app like camera capturing, defining business workflow and tailor-made mobile device user interface with higher usability • Optimize system performance
iv. Testing	• Test the product in term of usability, system performance, security and correctness by different test cases and tasks
v. Launch	• Present and demonstrate the product in final presentation

Table 2. Tasks in each development stages

5.4 User interface design

Because of the limited screen size of mobile devices, increasing usability by customizing the app with mobile features is one of the main focuses in this project. Here are the drafts of user interface design on some system functions to illustrate the ideas of enhancing usability:

      i.   Login
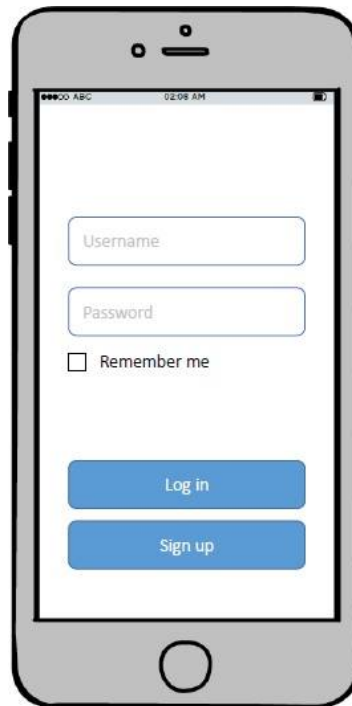
Figure 6. Screen of login

"Remember me" option is provided for users so that the system will save it username and password. So, they just have to login the system once for subsequent access. Also, to prevent information leakage due to mobile device lost, User can untick the option if they just access the system once on a non-frequently use device.

ii.   Sending documents
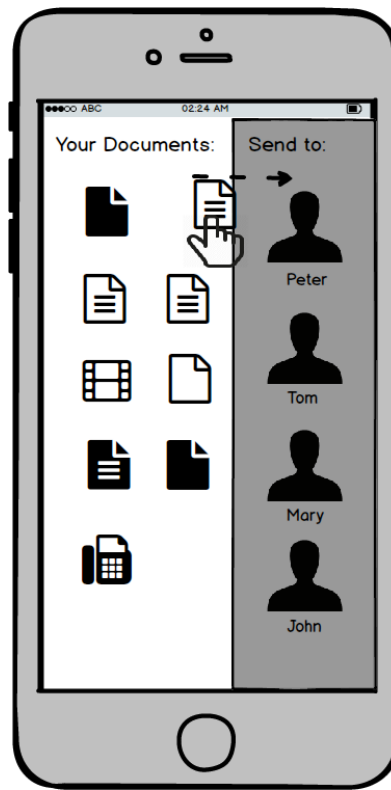
Figure 7. Screen of Sending documents

Make use of touch-friendly features of mobile device, users can send document to the particular receiver by drag and drop. A receiver list will be popped up automatically when a document is dragged so that user does not need to enter the receiver name at each time.

iii.   Managing business workflow
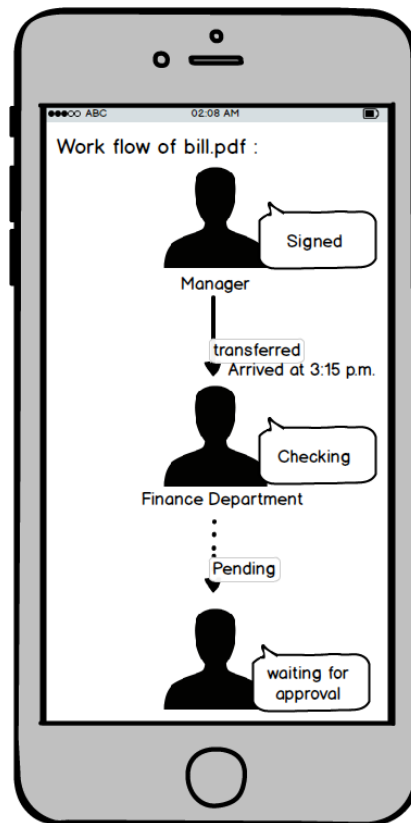
Figure 8. Screen of managing business workflow

By using the concept of parcel delivery, the screen of workflow progress will be designed as similar as checking parcels in TAO BAO that user can get familiar with. It is believed that user can easily understand the progress of the workflow, the received time and where the document currently is.

iv.   Viewing editing history of a document
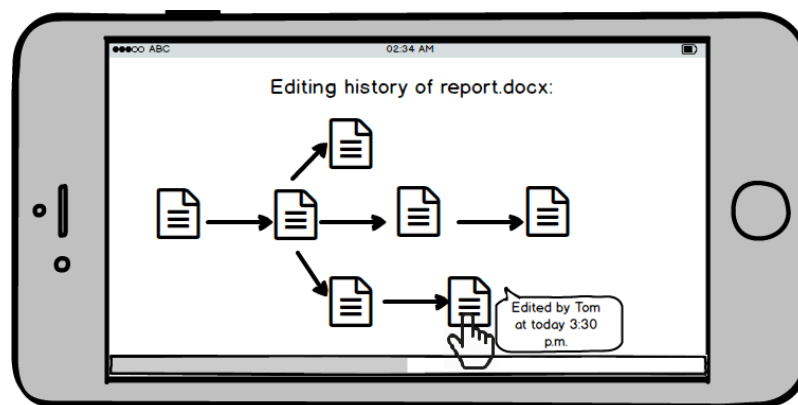
Figure 9. Screen of Viewing editing history of a document

By using a graphical tree to represent editing history of a document, it is easier for user to check the history visually and restore the previous document by simply tapping the document icon.

5.5 Flow design

To illustrate the interaction between users and system, here are the activity diagrams to represent the process of business workflow management.

    i.   Create new workflow of the document
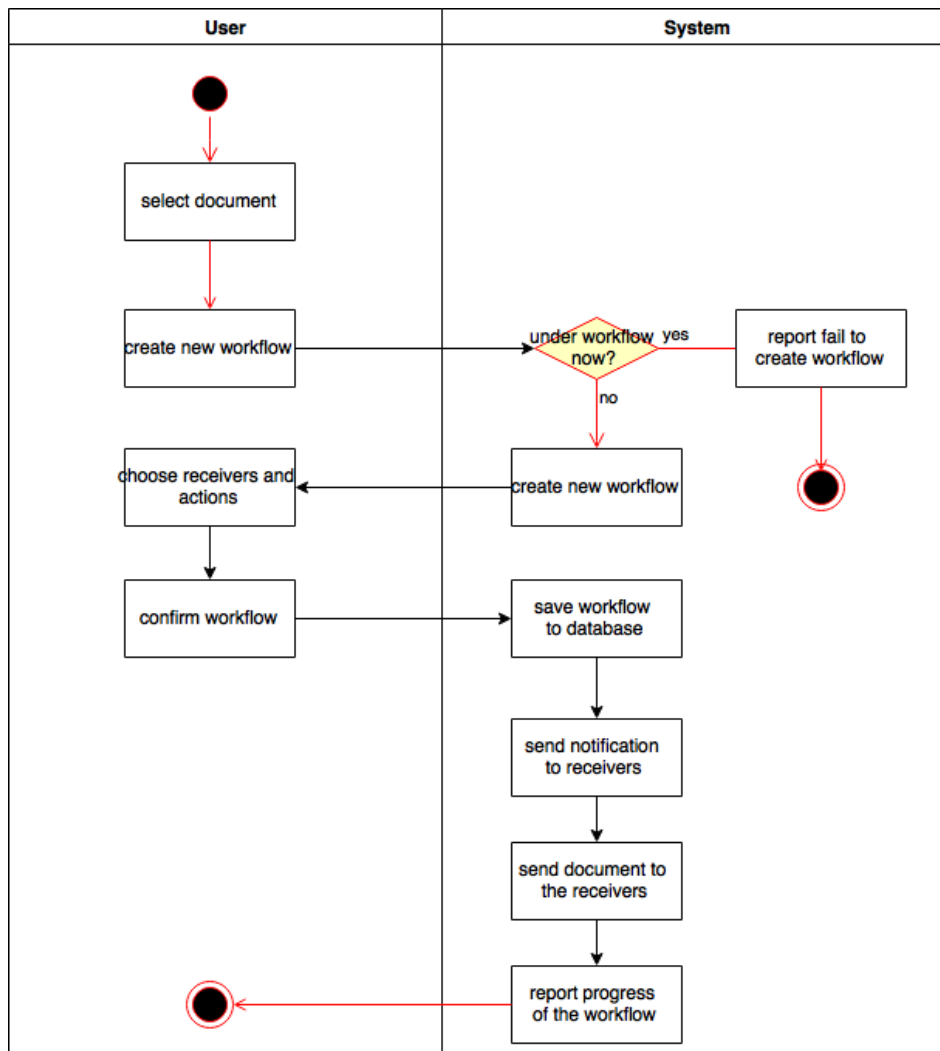
Figure 10. Activity diagram of creating new workflow of the document

1. When user wants to create a new workflow for a document, user needs to select the document and click 'create new workflow' first.
2. Then, the system will check whether the document is already being processed in a workflow. If so, the system will not allow user to create a new workflow. If not, the system will create a new workflow entry for the document.
3. Then, user can set up a path and choose receiver at each point with the follow-up document action.

4. After user confirms the setup of the workflow, system will record it in database and send notification to each user involved in the path to remind user that there is a new task need to follow.
5. Finally, the system will start to send the document to the first receiver and report the progress of the workflow to the sender.

ii.   Transfer document in the workflow

To understand the flow of document transfer between users, here is an example: when User 1 needs to submit an essay to User 4, it is also necessary for User 2 to proofread the essay and grant the approval from User 3.
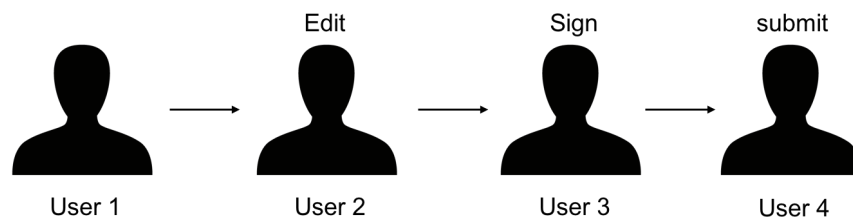
Figure 11. Use case of workflow

To complete this workflow automatically, each user will follow the steps below in the system:
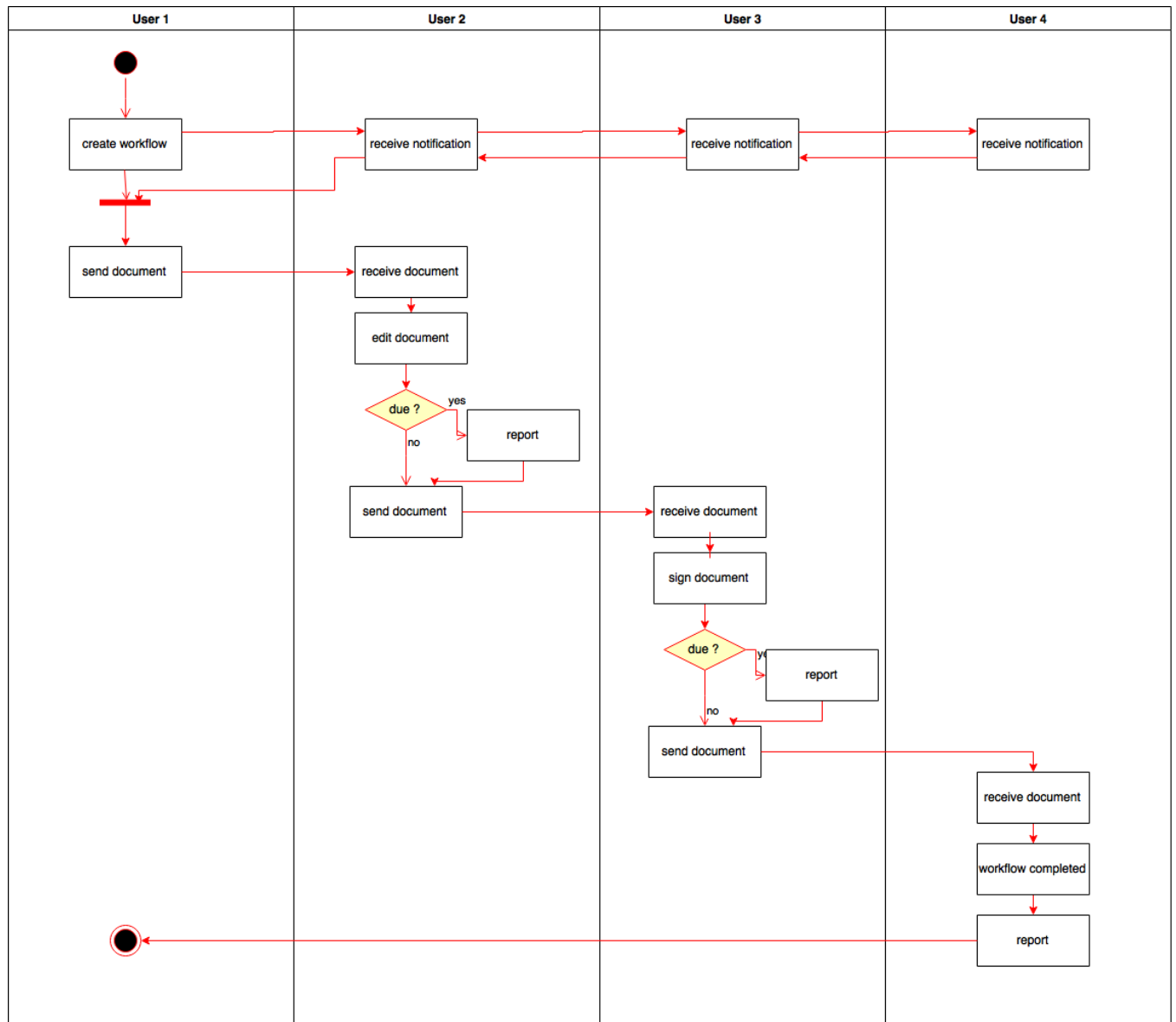
Figure 12. Activity diagram of document transfer in the workflow

1. After the workflow is created by User 1, the system will send a notification to each user in the path first and starts to send document to User 2.
2. Then, when User 2 receives it, he can perform the action defined in the workflow
3. When the task is finished, the system will check if the task is due based on the deadline specified by User 1. If so, it will report back to User 1 first.
4. After that, the document will be passed to the next user and the system will repeat the same steps in step 2 and 3 until the document arrive at the destination.
5. When last receiver obtains the document, the workflow will be completed and the system will report back to User 1 for successful document transfer.

5.6 Database design

Concerning the current database design, there are four entities, which are user, document, version and route respectively. For user, it refers to a member in the company. For document, it is the uploaded document by a particular owner. Each user can have many documents. There can be many versions for one document. For route, it is a path showing how the document is passed. As many users can gain access to the document, there may be more than one route for each document. Further details can be seen from the ER diagram below. The relationship between each entity together with the attributes in each entity is shown. The database design has not been finalized yet. However, at this stage, this ER diagram will serve as a starting point for us to start our implementation and unit-testing. It may be modified in the near future.
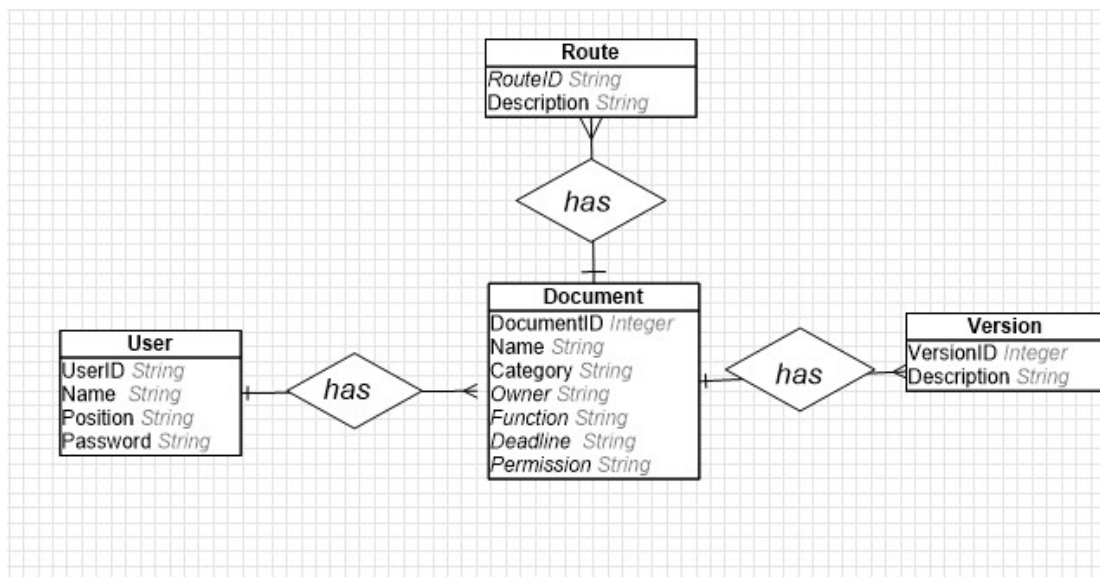
Figure 13. ER diagram of database design

6. Project deliverables

In our project, the main product is the MDMS with both Android and iOS versions. Also, the following deliverables will be released in different phases so that users are able to know more about our app and interested parties can realize the progress of our project.

Phase	Deliverable	Purpose/Description
Phase 1	Detailed project plan	• Describe project background and propose the project objectives • Suggest how the project would be implemented and project schedule
	Project website	• Introduce the project • Update the progress of the project • Upload project documentation • Provide help by contacting us
Phase 2	Interim report	• Report what has been changed and accomplished in the first semester

		• Report what will be done in the second semester
	System prototype	• Demonstrate basic functionality of our system in the first presentation
	First presentation	• Present the objectives of the project • Report the project progress • Demonstrate the system prototype
Phase 3	Mobile Document Management System application	• An app with Android and iOS version with full functionality
	Final report	• Report the entire development process • Release the project result • Suggest what can be improved in the future
	Final presentation	• Present the project result • Demonstrate Mobile Document Management System application
	Project poster	• Summarize the idea of the project in the poster for project exhibition
	Project exhibition	• Demonstrate Mobile Document Management System application • Explain the idea to interested parties

Table 3. Project deliverables in each phase
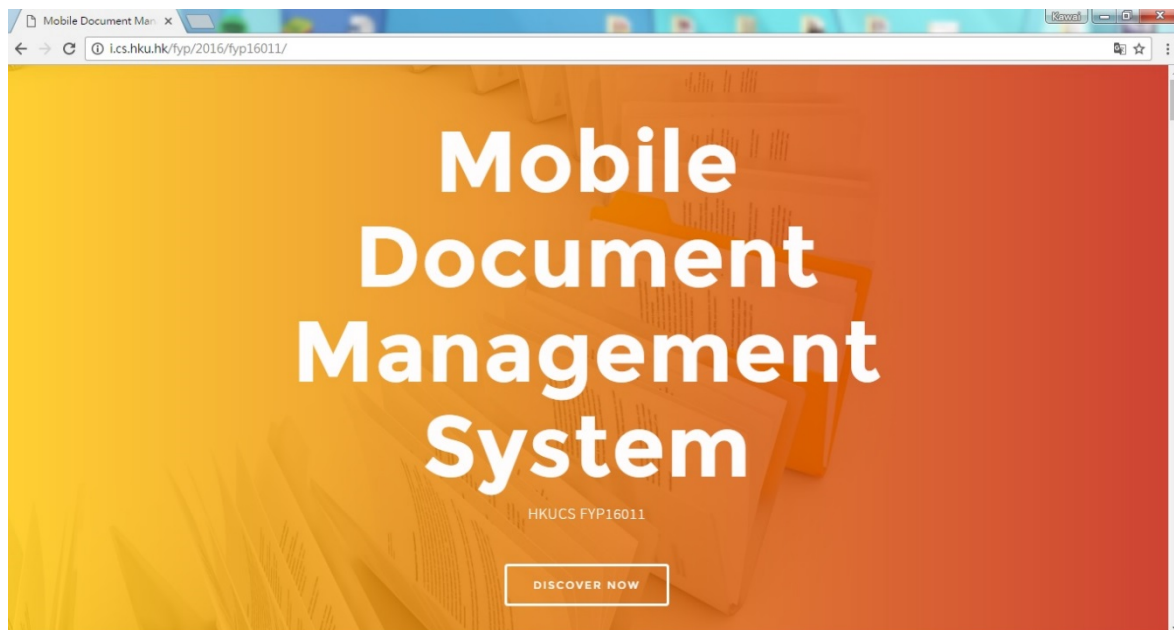
Figure 14. Project website
Link of the project website: http://i.cs.hku.hk/fyp/2016/fyp16011/

7. Current status

7.1 Completed and in progress works

Stage	Duration	Tasks	Progress
Phase 1	1/9/2016 - 2/10/2016	• Background research • Requirement gathering • Detailed project plan • Project web site	✓ ✓ ✓ ✓
Design and analysis	3/10/2016 - 3/11/2016	• Refine system requirements • Study of open source DMS API and Google Cloud Platform API • System design • User interface design and prototype	✓ ✓ ✓ ✓
1ˢᵗ implementation phase	3/11/2016 - 3/1/2017	• Set up server, database and Cloud • Implement basic front end and back end functions of DMS	In progress In progress
Phase 2	20/12/2016 - 22/1/2017	• Interim report • System prototype with basic functions and some mobile featured functions • First presentation	-
2ⁿᵈ implementation phase	23/1/2017 - 30/3/2017	• System and project review • Implement business oriented functions • Optimize system performance • System testing (including QA testing, user acceptance testing and unit testing)	-
Phase 3	21/3/2017 - 2/5/2017	• All implementation of functions and testing • Final report • Final presentation • Project exhibition and project poster	-

Table 4. Current progress on each task

Following the project schedule, Phase 1 and "Design and analysis" stage have been completed. Our current process is in 1ˢᵗ implementation phase.

7.1.1 Phase 1

During the development in Phase 1, background research was conducted. The significance of document management system to a company was studied by having a meeting with founder of a start-up company, Mr. Wong. Current difficulties in DMS and inadequacy in functionalities on current MDMS were discussed. These problems would be solved in our MDMS app. Also, existing MDMS apps were evaluated and the result was revealed in "Previous works in the field" section. Some basic functions and merits of the existing MDMS apps would be used as reference in our development. Detailed project plan and project website were released in order to introduce and update the progress of the project.

7.1.2 Design and analysis
Throughout the Design and analysis stage, system requirement was refined by discussing the feasibility of functionality with our supervisor. Our main focus would be on business oriented functions. Security, collaboration, versioning and workflow aspects would be targeted to fulfill the business requirement. Some open source DMS API and Google Cloud Platform API were found in the internet for developers. Study and testing on the APIs were carried out. A public forum was found in the official website of Google Cloud Platform so as to solve any problems that developer would encounter. System design, user interface design and prototype were completed and the result was disclosed in the Methodology section.

7.1.3 1st implementation phase (Current status)
Our current status is in the middle of this stage. HTTP Apache server and MySQL database are being set up. Google Cloud Platform is purchased so Google SDK emulators are provided to simulate the services for local development, testing and validation. In this stage, integration among these 3 technologies is going to be implemented. Moreover, basic front end and back end functions of DMS is being implemented. Log in function which is the first interface of our app was completed. At this moment, local host server is used to test the functions implemented since no all technologies our MDMS needed are ready. Back end functions like storing and retrieving documents from the local host server and Google Cloud Platform are being developed. It is hoped that the response time for all basic functions is less than 3 seconds. It is believed that all the proposed tasks can be completed on time at this stage.

7.2 Changes made
The major change of the project is the coding development platform. In the project plan, Unity is proposed to develop mobile application since it is convenient to produce apps with Android and iOS version. C# and UnityScript are used in the app development in Unity. These two programming languages are new to our team and mastering a new language takes time. Also, Unity as a gaming development platform contains a variety of built-in gaming control functions which are not necessary for our project. Its supporting community is mainly for game developers and getting help is hard for our project. Therefore, Xamarin, which is developed by Microsoft, is chosen to replace Unity as a development platform. Not only Xamarin can build apps with Android and iOS version at the same time, it also can support more programming languages, such as Java, Swift and Objective-C, which are commonly known. Furthermore, Xamarin Forums which is developed for user support covers a wide range of situation that developers would confront and detailed solution. Apart from the forums, tutorials on how to implement basic functions for mobile application are provided by Xamarin University.

8. Limitations

8.1 Technical limitations

i. Difficulty in managing cloud and database at the same time
To retrieve a document, the server needs to first access the database to get the targeted document id and use the document id to extract the document from the Google Cloud. To ensure the performance of our functions, it is important to make sure that both the Cloud and database are always available. Any collapse or delay in either one of them will definitely lower the performance of document retrieval, which in turn results in longer waiting time of users.

Possible solutions: When database or Cloud disconnect from the server, we will capture the exceptions and report the case. To ensure the speed and performance of the document transfer, a cache will be implemented to store some frequently accessed data. For example, results of some queries to the database will be stored so that it is not necessary to gain access to both the Cloud and database for every document retrieval.

ii. Unfamiliar to Unity
Unity was chosen as our development platform. However, it only supports two programming language, which are C# and UnityScript respectively. Both the programming language and platform are new to our team. Moreover, Unity is mainly designed for making game applications. Our team find Unity not too suitable to use after two weeks of study.

Possible solutions: A new development platform, Xamarin is chosen to replace Unity. It is also cross-platform that applications of both IOS and Android versions can be built. More importantly, it supports a wide range of programming language including C#, Java and Swift and we have learnt Java and Swift in previous courses. Apart from this, there are many online tutorials about implementing mobile functions on Xamarin. Therefore, we can get used to using Xamarin in an easier manner and the object oriented approach of Java or C# can be used to model the document object.

iii. Complex database design
For a document management system, a huge amount of data need to be stored and managed in the database. The amount of data in the database will even be double for achieving some practical use cases like defining workflow and retrieving the previous version of a document. A lot of many-to-many relationships between entities will exist. It takes time for us to come up with a suitable and good design due to insufficient knowledge in database design. At worst, it may even hinder our progress.

Possible solutions: A preliminary database design has been made at this stage. Therefore, it can serve as a starting point for us to implement the basic functions and test them accordingly. At the same time, more studies on database design will be carried out. Consultations with supervisors will also be arranged for seeking design suggestions. Sufficient knowledge of database design should have been gained before the implementation of business-oriented functions. Therefore, the preliminary design can be further modified and made into a finalized one in implementation phase two. In this case, our progress will not be hindered by the database design.

8.2 Scope and Schedule Limitations

i Tight schedule with broad project scope
To fulfill the business needs for companies, it is expected that all the functionalities mentioned in section 4 have to be implemented. Apart from the final year project, our teammates still have to deal with other coursework. These result in a tight schedule together with a broad project scope.

Possible Solutions: First, each team member will be responsible for implementing different functions so that works can be done in parallel. Second, regular meetings will be held for measuring our development progress. Consultations with supervisors will also be arranged for seeking advice. More importantly, the functions listed in section 4 will be prioritized as follow based on their importance and functions with higher priority will be implemented first.

Priority	Functions
Height	4.1.i, 4.1.iv, 4.2.i, 4.2.ii
Medium	4.1.ii, 4.1.iii, 4.2.iii
Low	4.2.iv

Table 5. Priority of system functionality

9. Future plan and Schedule
The following table shows the tasks to be done in the future.

Task/Month	11		12		1		2		3		4		5
1ˢᵗ implementation phase													
- Set up server, database and Cloud		■	■	■									
- Implement preliminary front end and back end with basic functions of DMS		■	■	■									
Phase 2													
- System prototype				▦	▦	▦							
- Interim report				▦	▦	▦							
- First presentation						▦							
2ⁿᵈ implementation phase													
- System and project review							▦						
- Implement							▦	▦	▦				

Task														
more mobile featured functions							■	■	■					
- optimize user interface and system performance								■	■					
- System testing									■	■				
Phase 3														
- All implementation of functions and testing											■	■		
- Final report											■	■	■	
- Final presentation											■	■		
- Project exhibition and project poster														■

Table 6. Project schedule

i. Phase 2
In this stage, the first system prototyping will be started. After all the prototypes are ready, consultations with supervisors will be arranged for seeking advice according to the prototypes and to see if we are on the right track. Afterwards, there will be our first presentation. Detailed methodology and project progress will be demonstrated in the presentation.

ii. 2nd implementation phase
As the implementation of basic functions will be finished by the end of implementation phase one, we will start the implementation of business-oriented functions, which is our main focus in this stage. Functions will be implemented in the order of descending priority according to table 5. Throughout the development process, regular meetings with supervisors will be held to discuss the viability and effectiveness of the functionalities of the application. Group meetings will also be arranged for measuring our progress.

iii. Phase 3
It will be our final stage. After finishing all the implementation, strict testing measures such as quality assurance testing, unit testing, load test will be carried out to ensure the quality and the correctness of the application before we launch our application. System optimization will also be worked on to make our application be more user-friendly. After finishing all the development, there will be project exhibition for us to showcase our MDMS. We will also finish our final report and have our final presentation on the project.

10. Conclusion

In this report, the significance and need for a tailor-made mobile document management system in a company have been highlighted. This project utilizes the advantages of technology, Google Cloud Storage as well as the analysis on company's needs to help streamline the process of document management. By offering the aforementioned features on mobile devices, the application should be able to suit the needs for small and medium-sized enterprises (SME) by increasing the productivity among colleagues, enhancing the workflow management in companies and offering them with efficient document management. The proposed methodology and project scope with detailed functionalities have been explained in this report. Also, the current development progress together with our future plan has been clearly mentioned.

Although some difficulties were encountered during our development, we have carried out corresponding mitigation strategies and the situation is under control now. After finishing all the design work, we will start our function implementation. New features will still be added alongside our development. We will focus on testing and optimization of system performance after finishing all the implementation. Through collaboration of teammates, it is hoped that we can finally come up with a tailor-made MDMS that can truly help the companies to deal with their management issues and the business-oriented functions of the application can make our application a unique and outstanding one.

11. References

[1] The Paperless Project [Internet]. The Paperless Project: [cited 2016 Sep 16]. Available from: http://www.thepaperlessproject.com/the-impact-and-inefficiency-of-paper-in-the-office/

[2] Leikums T. Document Management System Mobility – Main Trend in Future Document Management. International Journal of Computer and Communication Engineering [Internet]. 2013 [cited 2016 Sep 13]; 2. Available from: http://www.ijcce.org/papers/236-W0025.pdf

[3] Airwatch [Internet]. Vmware Airwatch; [updated 2015 Oct 15; cited 2016 Sep 20]. Available from: http://blogs.air-watch.com/2015/10/23-disturbing-statistics-mobile-security/#http://blogs.air-watch.com/2015/10/23-disturbing-statistics-mobile-security/#

[4] Business [Internet].Business; [updated 2015 Dec 7; cited 2016 Sep 19]. Available from: http://www.business.com/document-management-software/7-statistics-that-will-make-you-rethink-your-document-management-strategy/

[5] LinkedIn [Internet].LinkedIn; [updated 2016 Jan 18; cited 2016 Sep 20]. Available from: https://www.linkedin.com/pulse/small-business-owners-do-you-still-store-manage-paper-matthew-ziegert

[6] The InfoRouter [Internet] The InfoRouter [cited 2016 Oct 25]. Available from: http://www.inforouter.com/WhyDocumentManagement.aspx\

[7] Documents 5 - File manager, PDF reader and browser [Internet]. iTunes; [updated 2016 Sep 26; cited 2016 Sep 26]. Available from https://itunes.apple.com/app/documents-by-readdle/id364901807?mt=8&ign-mpt=uo%3D4

[8] Document Manager + Video Player [Internet]. iTunes; [updated 2015 Sep 30; cited 2016 Sep 26]. Available from https://itunes.apple.com/us/app/document-manager-+-video-player/id507942038?mt=8

[9] Briefcase Pro - File manager, cloud drive, document & pdf reader and file sharing App [Internet]. iTunes; [updated 2015 Jun 5; cited 2016 Sep 26]. Available from https://itunes.apple.com/us/app/briefcase-pro-file-manager/id579224808?mt=8

[10] Air Transfer - Easy file and document sharing between PC and iPhone/iPad [Internet]. iTunes; [updated 2015 Feb 26; cited 2016 Sep 26]. Available from https://itunes.apple.com/us/app/air-transfer-easy-file-document/id521595136?mt=8

[11] Document Management - Zoho Docs [Internet]. Google Play; [cited 2016 Sep 26]. Available from https://play.google.com/store/apps/details?id=com.zoho.docs&hl=en

[12] Google Cloud Platform [Internet]. Google; [cited 2016 Sep 23]. Available from https://cloud.google.com/storage/

[13]   CloudBerry Lab Blog [Internet]. CloudBerry Lab Blog; [cited 2016 Oct 13]. Available from http://www.cloudberrylab.com/blog/choosing-online-backup-storage-google-cloud-storage-vs-google-drive/

[14]   DigitalOcean [Internet]. DigitalOcean Lab Blog; [cited 2016 Oct 14]. Available from https://www.digitalocean.com/community/tutorials/sqlite-vs-mysql-vs-postgresql-a-comparison-of-relational-database-management-systems

[15]   DBA Square [Internet]. DBA Square Lab Blog; [cited 2016 Oct 14]. Available from https://www.psce.com/blog/2013/02/06/mysql-security-overview-of-mysql-security-features/

[16]   Techwalla [Internet]. Techwalla; [cited 2016 Oct 14]. Available from https://www.techwalla.com/articles/advantages-of-apache-web-server

[17]   Xamarin [Internet]. Xamarin; [cited 2016 Nov 10]. Available from https://www.xamarin.com/platform

[18]   Performing a Simple Upload in Google Cloud [Internet]. Google; [cited 2016 Nov 11]. Available from https://cloud.google.com/storage/docs/json_api/v1/how-tos/simple-upload

Division of work:

Part	Charlae	Tony	Felix
Abstract		✔	
Acknowledgement		✔	
1. Introduction			✔
2. Project Objectives		✔	
3. Previous works in the field	✔		
4. Project scope			✔
5.1 Equipment and technology			✔
5.2 System architecture design			✔
5.3 Development process			✔
5.4 User interface design			✔
5.5 Flow design			✔
5.6 Database design	✔	✔	
6. Project deliverables	✔		
7.1 Current status(what have been done)	✔		
7.2 Changes	✔		
8. Difficulties/limitations		✔	
9. Future plan& schedule	✔	✔	
10. Conclusion		✔	