CHAPTER 3
METHODOLOGY

3.1 Introduction

This chapter discusses the details and project methodology that will be used to complete the project. This methodology will be as guidance for the project development so that the project can be complete by following the timeline. Software Development Life Cycle (SDLC) methodology will be implement in order to make the project follow accordingly to the timeline. The SDLC method that is used for this project is iterative waterfall model where it is the enhancement for currently waterfall model. There are five stages in this methodology which are requirements analysis, system and software design, implementation, integration and system testing and finally operation and maintenance. This chapter will elaborate in details on every phase of the methodology.

3.2 Project Methodology

3.2.1 Iterative Waterfall Model Methodology

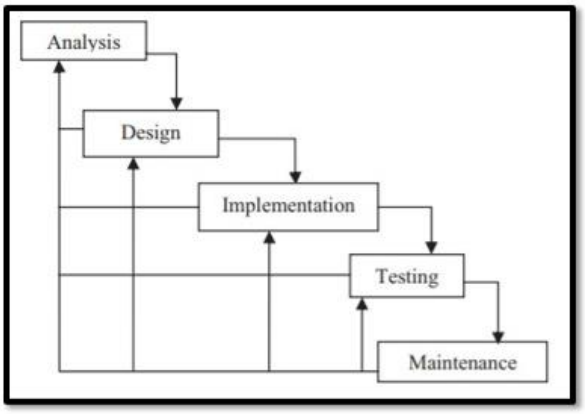

Figure 3.1 Iterative Waterfall Model

Figure 3.1 above shows the iterative waterfall model that is used to develop this "Secure Exam Management System Based On Blockchain Technology" project in order to achieve the objective that were stated previously in chapter 1. Iterative waterfall methodology is the upgraded for the waterfall methodology, where it provides more suitable methodology to be utilized for the project. In order to make sure this project development go smoothly as planned, following the methodology is necessary. This methodology will act as guidance in order to complete the development of the project.

There are 5 phases inside this methodology to ensure the development processes are according to plan. Each of these phases has their own process for the development of the project. The details of the requirement for each phase need to specific and followed during the development process as it could cause a huge impact on time management if it does not plan properly. The first phase which is requirement analysis is a phase where gathering information and details about the project. In this phases the problem statements, scope of the project, objective and as well as the significance of this project will be determined and record. It is also appropriate to include the current issues, situation and the environment as it will be the strength for the development of the project.

The second phase in this methodology is the system and software design where the graphical design and the logical design such as flow chart of the project is provide to illustrate how the system will operate. For this project, flow chart would be the logical designs that are going to be used to explain the flow of the project in graphical view. In the physical design, the blueprint of the project will be create to elaborate more on the technology used and detail of the implementation. Next is the implementation phase which is also the third phase in the methodology. In this phase the implementation or the development of the project will be explain in details. This phase will cover from the hardware requirement to software requirement that are going to be implement and use for the system.

The fourth phase which is the integration and system testing, it will focus more on the setup of the system and the testing process to check the functionality of the project satisfy the scope and the objective that have been stated. Lastly, the final phase of this methodology is the operation and maintenance. In the final phase of this

methodology, it will cover the maintenance part where if there is any update to the system application. The documentation of the system is crucial as it provide the official information on the implementation of the system and the status of the system testing.

Table 3. 1 Details Extended Waterfall Methodology

Phases	Activities	Deliverables
Analysis	▪ Getting information on related work from the information on research paper, online journal, website, and article. ▪ Identify the problem statement based on the current issues. ▪ Identify the objectives that are reasonable to develop the system. ▪ Identify the scope and limitation of the project. ▪ Identify the significance based on the problems statement.	▪ Gathering information about blockchain technology and examination system. ▪ List of problem statement. ▪ List the project objective. ▪ List the scope and limitation. ▪ List the significance of the project.
System and Software Design	Figure out the suitable hardware and software that are required to develop the project. ▪ Identify the hardware and software. ▪ Design the flowchart of the project. ▪ Design the case diagram. ▪ Design the physical diagram. ▪ Identify the programming language and the text editor software to be used in the project development.	▪ Identify the hardware that is appropriate and suitable for the project. ▪ Identify the software for the development of the project. ▪ Determine the techniques. ▪ Elaboration of the literature review. ▪ Create a design that satisfies the requirements in analysis phase.
Implementation	Develop the website functionality and implement it on Ethereum blockchain technology.	Prototype of the system with the complete setup

Integration and System Testing	▪ Test the functionality of the web application; make sure it fulfills the functions on the development phase. ▪ Verify the user transaction in the local blockchain	▪ Test whether the smart contract is successfully deployed. ▪ Test the upload function. ▪ Test the send hash function. ▪ Test the receive hash function. ▪ Verify the user transaction in the local blockchain
Operation and Maintenance	Record all the data and document the result in the form of report that are going to be used as an official report for the project.	Submission of the final year project report.

3.3 Analysis

Analysis is the initial process in developing a system that involves an information gathering process. This very first stage is crucial, as it will give a better understanding on the project. More than fifteen journal and past researches about the related works to develop a secure examination paper management based on the blockchain technology. Information on these researches was collected from articles, book and online journals, observation and other trusted resources. The main objective of collecting this related work and information is to find the comparison and get the best solution. Therefore, the best software and method that are going to be use can be identify to make the system more efficient compare to the other. This phase also focused on the project background, the problem statement on current issues, objectives and the scope of the project.

3.3.1 Feasibility Study

In order to help the UiTM staffs in the exams paper management, specifically to provide a secured environment for the process of handling the exams paper and a system that can replace the current trend that they are using now. The system proposed will be show in this Secure Exams Question Management development process. The current issues of question paper leakage and various other factors that happened couple of times in the past is the sole objective to develop this system. These projects will implement a decentralized web application on top of the blockchain technology to ensure the data integrity and performance of the system. The system will also provide all the features that are needed by the user. Software such as React App, Ganache CLI, Metamask, Sublime Text Editor and NodeJs are going to be used to develop the system. The programming languages that are going to be used for the coding are HTML, CSS, solidity and java.

3.3.2 The Research Background and Problem Statement

The current trend of handling the exams paper in their drafting process, which is physically or stored digitally in a thumb drive poses a lot of threat and weaknesses such as the paper might be misplaced or lost during the process, stolen and modify or leak by unauthorized person. If the unwanted incident did happen, the process of drafting the exam paper need to be repeat in order to create a new question paper. This without a doubt is time consuming because there is a lot of procedure need to be followed during the process. And most of the current system, which provide an online examination system that use and algorithm to create an auto-generate question paper have a few weakness such as the server that act as the question paper bank are exposed to security breach. Not only that, the current model of the system that used a client- server model also have a few weaknesses such as the system might be down due to the excessive user using the system.

3.4 System and Software Design

The second phase which is the process of designing and determine the hardware and software requirement for the development process of this project. Within this process, the logical design, storyboard, and the physical design will be provide to illustrate how the propose system work.

To create a system that is decentralized and work on top of the blockchain technology, this project will use sublime text editor that provides a features to store downloaded libraries to build, test and debug the coding of system. The sublime text editor can be run on the Windows, Linux or Mac platform, which make it reliable, better performance and easy to use. The requirement hardware for this project is a laptop for the programming and the installation of the dependencies.

3.4.1 Software Requirement

In order to develop a better and efficient system, it is required to have a suitable software to ensure the process flow is smooth and according to plan. The table 3.2 shows the list of application that will be used for programming the website and smart contract. There is also a few other application that are required for the project development.

Table 3.2 Software Requirement

Description	Software	Function / Features
Operating System	Ubuntu 16.04.4 LTS	▪ Used in VM for the programming, development and testing process. ▪ Support varieties of software application that needs to be run in order to develop the project.
Programming Language	Solidity	For programming of the smart contract on Remix IDE
	JavaScript	Provide an interactive web page on the front end of the web application.
	HTML	Provide an interactive web page on the front end of the web application.

	CSS	▪ For describing the presentation of a document written in a markup language like HTML. ▪ Enable the separation of presentation and content, including layout, colors, and fonts.
Application	VMWARE	Provide an environment for the development and testing purposes
	Microsoft Word	Used for the documentation of the project in the form of report
	Sublime Text Editor	Used to write and save all the programming work for the web application
	Metamask	▪ Convert the modern web browser into a blockchain browser. ▪ Allows the chrome browser to "talk" to the blockchain.
	InterPlanetary File System	Connect the browser to a distributed file system to store files that were uploaded.
	Remix IDE	Used to write, save and deploy the smart contract.

3.4.2 Hardware Requirement

In order to develop the SEQM system, hardware such as laptop or pc are required for the programming and testing purposes. The lists of hardware used are shown in table 3.3:

Table 3.3 Hardware Requirement

Hardware	Specification
Laptop	▪ Intel Core i3-6006U ▪ 8GB DDR4 Memory ▪ 1000 GB HDD ▪ Windows 10

3.4.3 Use Case Diagram

Figure 3.2 below show the use case diagram of the user that will be using the system, which is the UiTM's staff. The use case diagram elaborates on the user functionality such as input or output to or from the system. In figure 3.2, the staffs are able to upload the exams paper to system, get the transaction and file hash. The staffs are also able to share the uploaded file hash and transaction hash, view the exams paper that has been sent or received through the file hash and download the file through the IPFS.

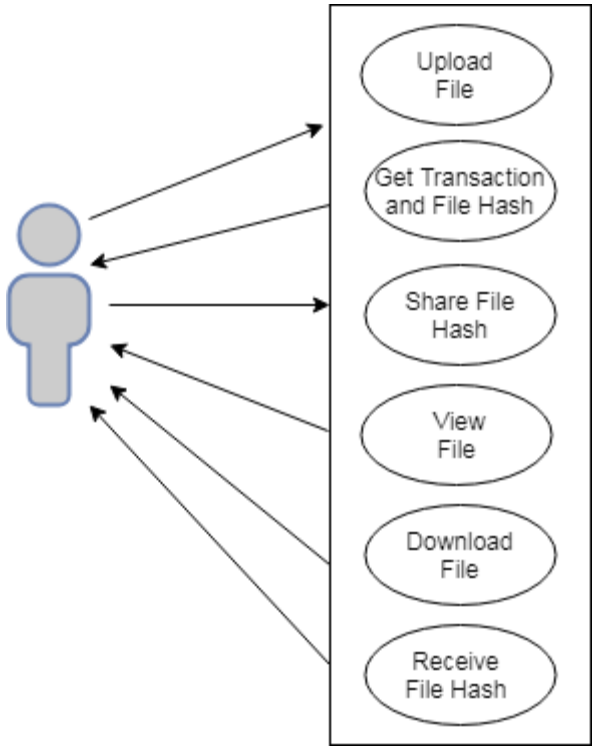

Figure 3.2 Use Case Diagram

3.4.4 Physical Design

Figure 3.3 below illustrate the flow process of the project in physical design. In this figure, it explained the flow process of the front end and the back end of the website application that was designed based on the ethereum blockchain. From the top it depicted the user uploading a file and the file will be store to InterPlanetary File System (IPFS). IPFS will generate a hash value and the hash value will be passed to the smart contracts so that it can be stored on the ethreum blockchain. The user will have to confirm the transaction in order to get the transaction receipt and the file hash. The user are also able to send the file hash to another user and the recipient will receive the file hash alongside with the transaction hash to verify whether it is the same as the ones written on the smart contracts for integrity purposes. Lastly, the system use InterPlanetary File System (IPFS) to store the document file for viewing and downloading the file. This is to satisfy the purposes of making the system decentralized because it used the peer- to-peer method to store the file. Therefore, there is no single point of failure like centralized database to the file.

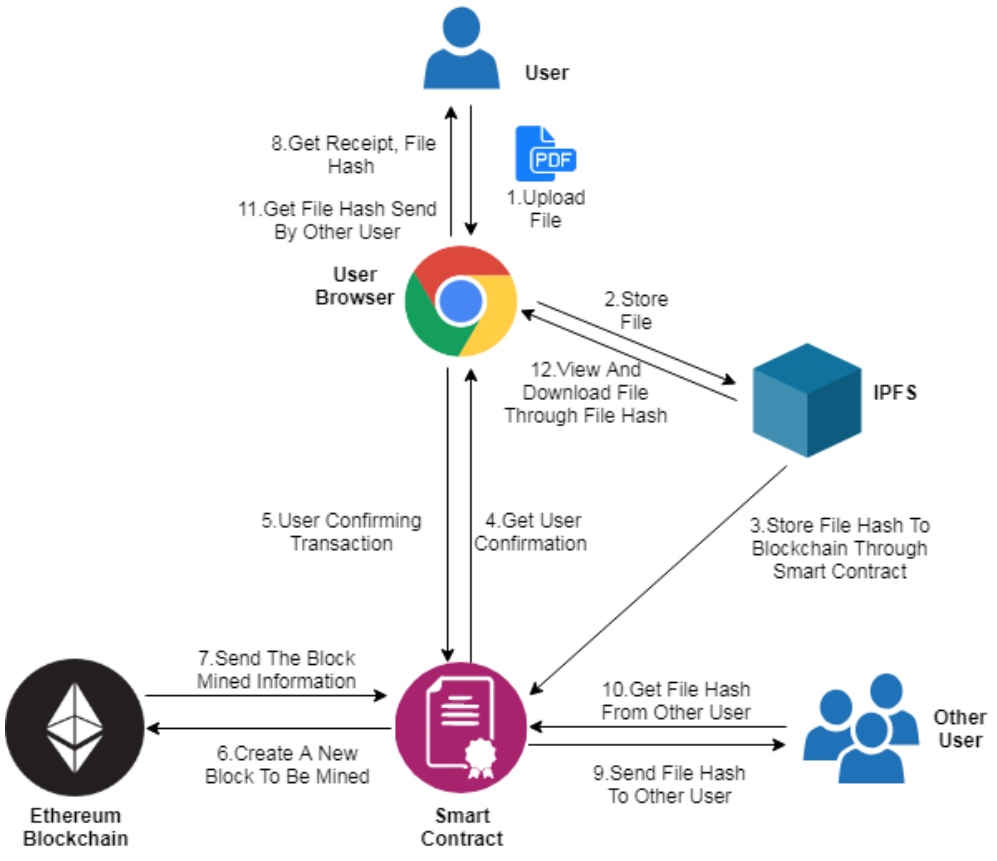

Figure 3.3 Physical Design

3.4.5 Flowchart

Flowchart is graphic explanation to the flow process of the Secure Examination System Based on the Blockchain Technology. There are three flowchart involved in how the system works, which is how the system store the information about the uploaded file and sharing the uploaded file and transaction hash using smart contract. And finally, how the user interact with the system to upload, download, view the exam papers, share the file hash and the uploaded file transaction hash with other user.

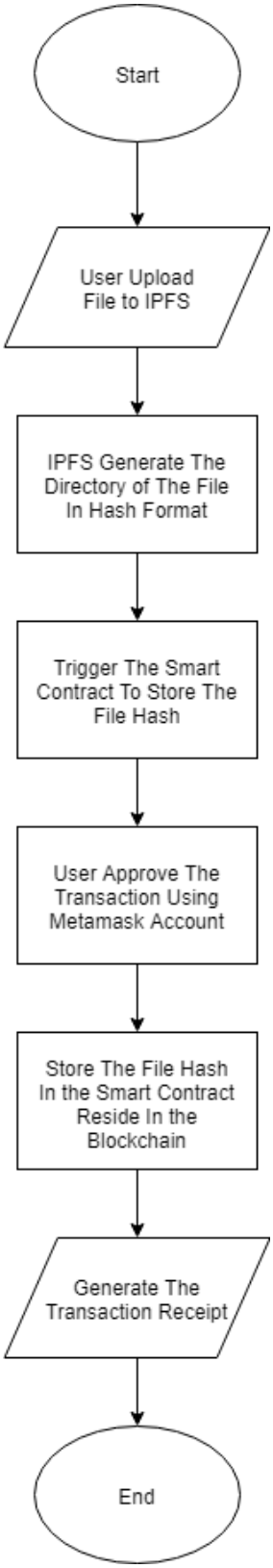

Figure 3.4 Smart Contract Flowchart for Uploading File

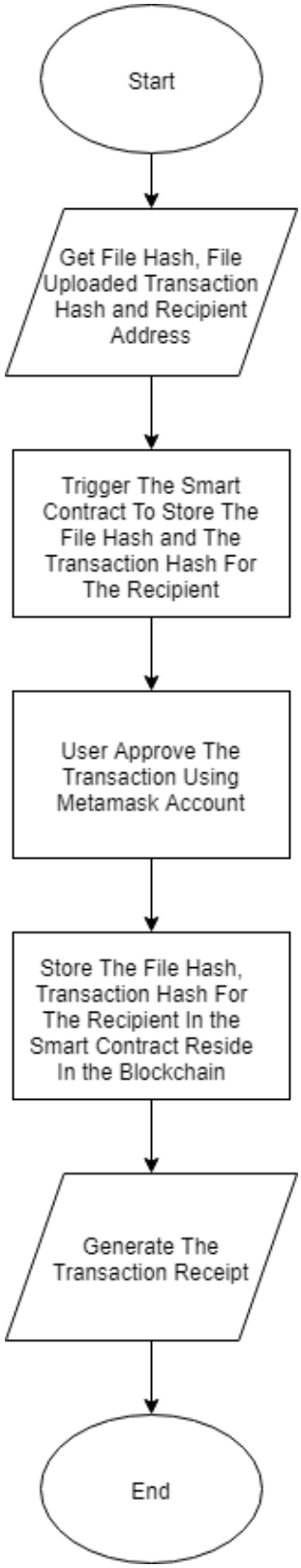

Figure 3.5 Smart Contract Flowchart for Sending Message to Other User

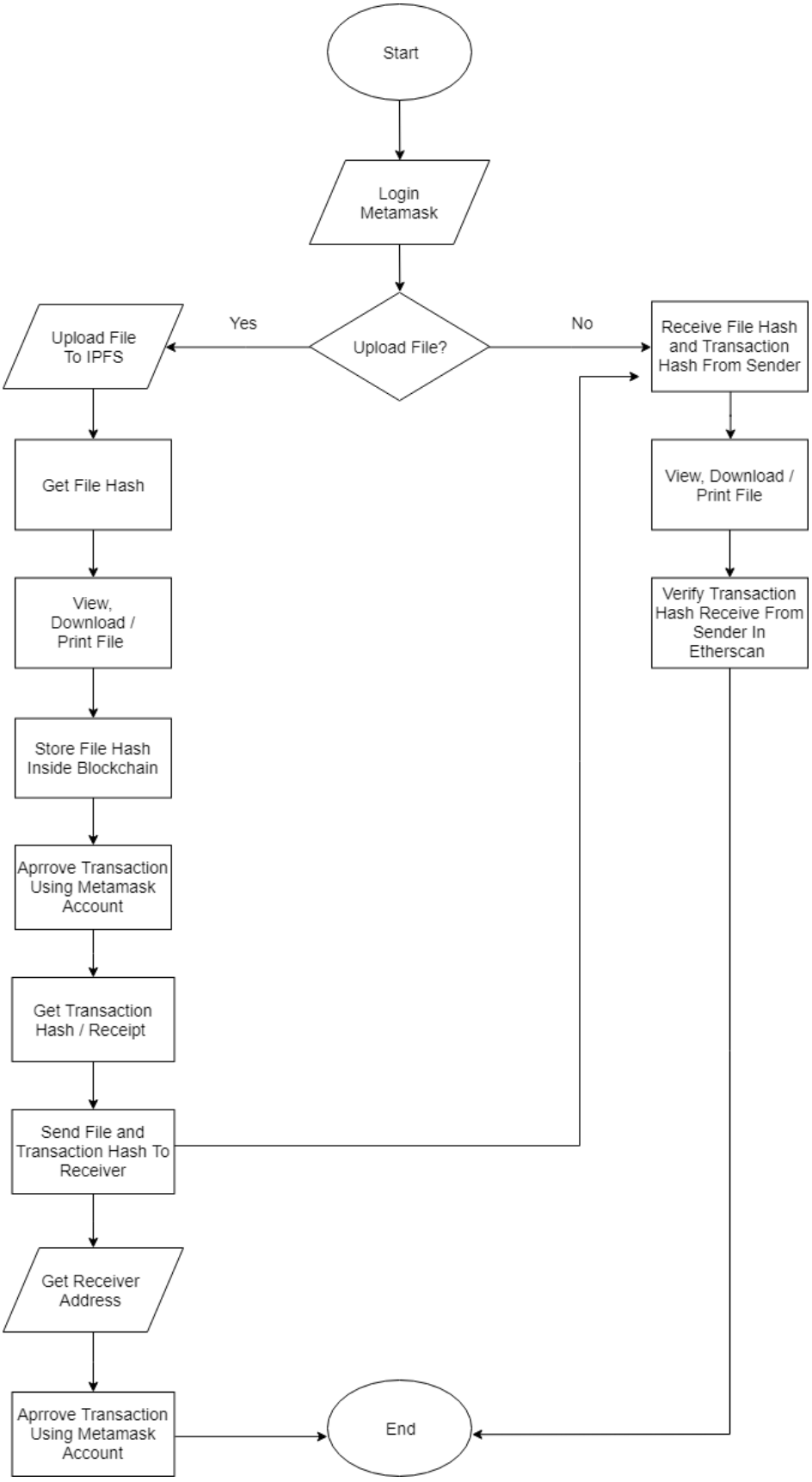

Figure 3.6 System Flowchart

3.4.6 Interface Design

All of the figures below illustrate the entire web site page for the user in the system.

Figure 3.7 Home Page

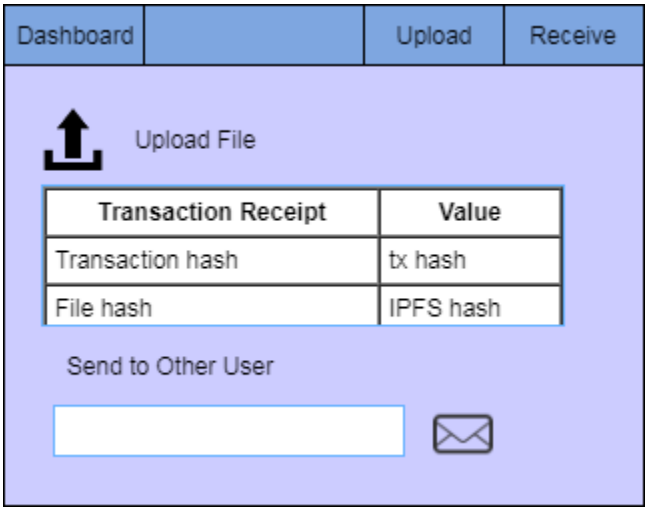

Figure 3.8 Upload File Page

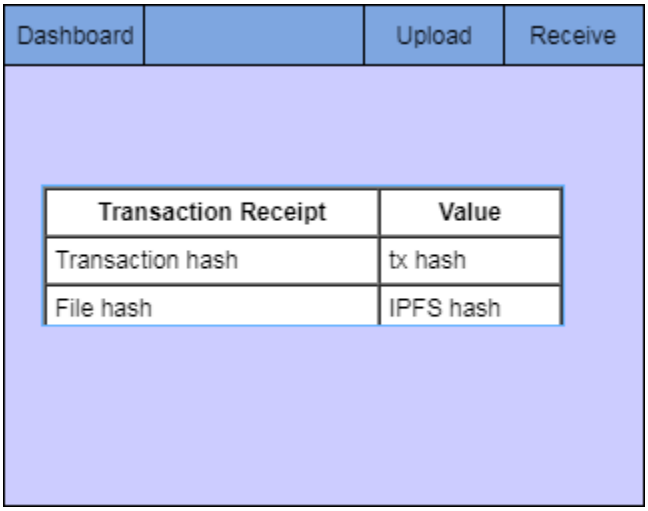

Figure 3.9 Receive File Hash and Transaction Hash Page

3.5 Implementation

In the third phase, the interface design and all of the previous phases that were purposed before will be implement on the system, the user functionality will also be configure to make the system operate correctly and ensure that the smart contracts stored the right hash value on the Ethereum.

After installing all the necessary software, Next, the smart contract can finally be programmed through the Remix IDE and deploy it to the Rinkeby Test Network. Finally, all of the programming regarding the web application can be done using Sublime Text Editor.

3.6 Integration and System Testing

After the implementation phases has been completed comes integration and system testing where the system will undergo a few functionality test. This phase is crucial to make sure that the system is working properly and no system failures in either hardware or software. In this phase, it will evaluate the system in the term of efficiency between the hardware and software management with the user. If failure or error is detect, the analysis, design or coding need to be review again to eliminate the error.

Here if the test that are going to be carried out to determine the functionality of the project:

I. Test whether the deployment of the smart contract is successful.

II. Test the web application to see if it runs perfectly.

III. Test whether the user are able to upload the file.

IV. Test whether the hash of the file was stored inside the blockchain.

V. Test whether the web display the transaction receipt.

VI. Test whether the user are able to view and download the file.

VII. Test whether the user can send the file hash and transaction hash to other user.

VIII. Test whether the recipient receive the file hash and transaction hash.

3.7 Operation Maintenance

The last phase in this methodology is the operation and maintenance phase where it will undergo documentation procedure. In the documentation procedure, all of the data and result from the system will be documented in blueprint and presented as final year project report. All result from the system will be compared with the objective of the project in order to evaluate either objective have been accomplished or did not accomplished. In the final report, it will elaborate and explain all the detail that have relation to project that are from analysis, design, implementation and result testing.

3.8 Summary

In conclusion, there are five crucial steps that needs to be followed in development phases of Secured Exams Question Management System Based on Blockchain Technology project, which are analysis, design, implementation, testing and maintenance. These steps need to be follow in order to satisfy the objective and scope of the project.