

COMSATS University

Islamabad Sahiwal, Pakistan

MarkDown Depreciation Fraud

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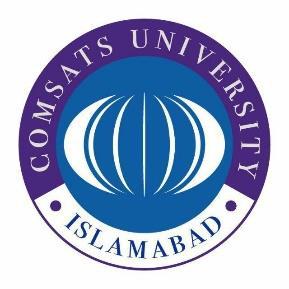
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*Bachelor of Science in Computer Science (2016-2020)*

The candidate confirms that the work submitted is their own, and appropriate credit has been given where reference has been made to the work of others.



COMSATS University Islamabad, Sahiwal Pakistan

MarkDown Depreciation Fraud

A project presented to

COMSATS Institute of Information Technology, Islamabad

In partial fulfillment

of the requirement for the degree of

*Bachelor of Science in Computer Science (2016-2020)*

By

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CERTIFICATE OF APPROVAL

It is to certify that the final year project of B.S. (S.E.) “MarkDown Depreciation Fraud” was developed by M. Usama Meraj (CIIT/FA16-BSE-065), Rana Ahmad Raza (CIIT/FA16-BSE-073) and Sabir Hussain (CIIT/FA16-BSE-080) under the supervision of “Dr. Muhammad Farhan (A.P)” and co-supervisor “Mam Raheela” and that in their opinion; it is fully adequate, in scope and quality for the degree of Bachelors of Science in Computer Sciences.

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Supervisor

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# **Executive Summary**

Nowadays, financial fraud has become a usual activity. Dealing with depreciation fraud is a topic of critical interest because it is a non-cash expense and effects net income. Depreciation is the value of fixed assets that decreases with the passage of time, usage, and change in technology. Depreciation fraud involves changes in depreciation method, but according to standard rules and regulations of finance, companies aren’t allowed to manipulate the depreciation method to calculate depreciation of fixed assets without any solid reason. There are several approaches to deal with depreciation fraud by experts like Beneish Model, but these approaches involve human errors and time-consuming factors.

As the manual calculation of hundreds of records is a difficult task without any human error, so the proposed system will provide an automated approach to process the financial documents and provide support to financial experts by indicating areas where companies manipulate with depreciation method to increase or decrease salvage value of an asset to avoid taxes or show high worth of the company.

For dealing with such frauds, neural networks and data mining techniques are used to reduce time consumption and increase accuracy by reducing human errors as it is an important task to calculate thousands of records by a human without any human error. The purposed system is providing a software tool that supports detecting depreciation fraud to financial experts by calculating the depreciation of fixed assets using the same depreciation method used by the company then performs analysis on both results, companies’ calculations and software calculations respectively.

Acknowledgment

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge under which we were able to accomplish this challenging task.

We are greatly indebted to our project supervisor, “Dr. Muhammad Farhan (A.P)” and our Co-Supervisor “Mam Raheela.” Without their supervision, advice, and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to them for their encouragement and continual help during this work.

And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us the values of honesty & hard work.

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|  |  |
| --- | --- |
|  | Abbreviations |
|  |  |
| SRS | Software Require Specification |
|  |  |
| ACL | Audit Command Language |
|  |  |
| SDD | Software Design Description |
| UML | Unified Modeling Language |
| NLP | Natural language processing |

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# **Introduction**

Nowadays, financial fraud has become a usual activity. Dealing with the depreciation fraud is a topic of critical interest because it is non-cash expense and effects net income actually depreciation is the value of fixed assets that decreased with time, usage, and change in technology. Depreciation fraud involves changes in depreciation method, but according to standard rules and regulations of finance, companies aren’t allowed to manipulate the depreciation method to calculate depreciation of fixed assets without any solid reason. There are several approaches to deal with depreciation fraud by experts like the Beneish model, but these approaches involve human errors and time-consuming factors. For dealing with such frauds, data mining and neural network can reduce time-consuming and increase accuracy by reducing human errors. The purposed system is providing a software tool that supports detecting depreciation fraud to financial experts by calculating the depreciation of fixed assets using the same depreciation method used by the company then perform analysis on both results, companies’ calculations and software calculations respectively. (Peterson, 2002)

**Brief**

This purposed system has a specific area of work, which is fraud detection in financial statements. It’s a difficult task to detect depreciation fraud manually and requires lots of effort. This purposed system is a software tool that will support financial experts to detect depreciation fraud and analyze results. It will reduce the time consumption, human efforts, and will increase the efficiency of the work of financial experts.

As it is a difficult task to calculate the financial documents without having any human error, this software tool will provide support by indicating areas where companies manipulated the depreciation method to increase or decrease the salvage value of an asset to avoid taxes or show high worth of the company. The software tool will use neural networks and data mining techniques to indicate the red flag in financial documents. With the help of these techniques, the user will get different reports like depreciation value report, salvage value report, report of rates values applied on assets, and comparison report regarding uploaded documents. (Bhowmik, 2011)

**Relevance to Course Modules**

The basic purpose of the proposed system is to automate the working of financial experts with the help of a software tool. So, it is related to two fields at a time, Computer Science and Financial Accounting. As the tools, methods used to create this project are related to computer science, and the problem is related to financial accounting. It assists financial experts to reduce their workload and chances of errors.

**Project Background**

As described earlier that it is quite common now that companies manipulate their financial documents by changing or manipulating the depreciation methods for their profits. As it is not legal to change the depreciation methods of financial documents under a specific time duration, and still, companies are manipulating with their documents. It is a difficult task to find those frauds manually as it requires a lot of human efforts and time to calculate those documents, which provides us with the opportunity to overcome this problem by providing financial experts with a software solution to do their work more efficiently. (Al-Khatib, 2012)

**Literature Review**

The purpose of our application is to provide support to financial experts in the detection of depreciation fraud in financial documents of companies. At the current moment, there is no such application that is related to detecting financial fraud. Still, there are some other software or applications which assist the financial experts in other matters. (Nigrini, 2011)

Table 1: Related System Analysis for Proposed Project

|  |  |  |
| --- | --- | --- |
| Application Name | Weakness | Proposed Project Solution |
| Kount | It is dealing with fraud at an abstract level. | Dealing with all fraud at an abstract level not dealing with deprecation fraud deeply |
| Audit Command Language  Developed by ACL Service Ltd ([www.acl.com](http://www.acl.com)) | Too much complicated and required expertise. | Auditing language for financial experts |

**Analysis from Literature Review**

With the rapid advancement in technology, financial frauds are also getting more complex, and it requires an advanced solution that meets with the requirements. In this era, computer-assisted fraud detection mechanisms will be more efficient and effective as it will reduce a lot of problems for financial experts in this matter. The financial fraud involves the publishing of false and manipulated financial documents, and this has become a severe social and economic problem. The fraud detection techniques are based on Data Mining (like neural networks, decision trees, regression). But these techniques also have their limitations and require self-adaptive frameworks to enhance their abilities. The rapid increase in financial fraud has become a major problem, and a lot of research is done to identify the major points through which companies can do fraud. Some of them are rapid growth in assets, an increase in cash needs, and external financing. These are some directly related to financial fraud. Internal versus external ownership of shares and control of the board of directors is also linked with the increase in the incidence of financial statement frauds. But the increase in the independent members in the audit committee is not related to the increase in the financial statement frauds. (Bhowmik, 2011)The difference between the fraud firms and no-fraud firms is calculated by checking and verifying the test variables and samples of their statements by applying the techniques of data mining and neural networks. This software also uses such techniques to identify fraud in financial statements. Such techniques are tested on datasets involving fraud and no-fraud data to find a clear difference between them. The system will detect the manipulated depreciation values, rates applied on assets value, salvage values, and will indicate the red flags.

# **Methodology and Software Lifecycle for This Project**

As the software process models, design methodologies help us to improve quality and produce reliable design methodology and software process model for the purposed system. As the purposed application is dealing with a real-world problem, we used object-oriented software methodology for the development of the software system. There are several other approaches, but the object-oriented approach is suitable for such applications that involve real objects because it provides support for modeling them. (Otero, 2017)

A close up of a device

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Figure 1: Software Design Methodology

**Software Process Model**

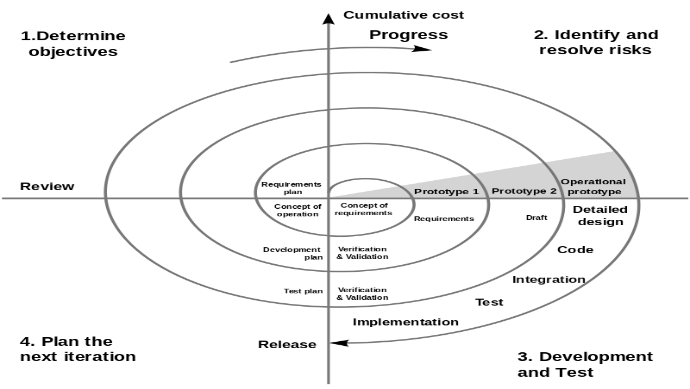
This purposed system is a finance software that aimed to find fraud attempted by companies with manipulation of the method used to calculated depreciation. The purposed approach is a deep and thorough calculation approach with involves risk as the system involves risks, complications, ambiguous requirement and less domain knowledge, so the best fit for such kind of project is the spiral model with rapid development. The following is an abstract diagram of the process model. (B, 2000)

Figure 2: Software Process Model

**The rationale behind Selected Methodology**

As the proposed system is based on a new idea and there is a lot of unclear and complex information, that’s why it was important to find the best methodology and process model to make the project more efficient. There are several process methods for designing software. (Otero, 2017)The best approach for our software is the object-oriented approach. It involves real objects because it provides support for modeling them. The reasons for using this methodology are:

1. Because it is a new software so new features will be added in the future, and this methodology supports this feature very well.
2. It is acceptable to tackle difficult problems first.
3. It allows effective management of software complexity under modularity.

The Process model used for this project is the Spiral Model because of the following reasons:

1. Requirements are unclear and complex
2. The risk is high
3. Changes are possible to be made in the future.

# **Problem Definition**

**Problem Statement**

Financial frauds are increased day by day as perpetrators are using collision and forgery to perform and hide them. One of them is depreciation fraud that is hard to detect, consumes a lot of time and effort, and involves human errors.

**Deliverables and Development Requirements**

The proposed system is aimed to markdown the fraud attempted by financial companies by manipulating the method that they use to calculate the depreciation for their fixed assets. This purposed system has a specific area of work, which is fraud detection in financial statements. Provided system is a utility software tool for financial experts to ensure their correctness and completeness while dealing with fraud attempted by manipulating the method of depreciation as there are thousands of fixed assets in companies. For manually verifying their depreciation is too hard and time taking task and involves the risk of human error. So, the purposed system will cover all the above-described problems. (Peterson, 2002)

**The current system**

There are some softwares related to our project, which also deals with fraud detection in financial documents, but they do not specifically deal with the depreciation fraud deeply. Softwares like Riskified, Emailage, FRISS are also dealing with financial frauds. (Al-Khatib, 2012)

# **Requirement Analysis**

The following parts of the Software Requirements Specification (SRS) report should be included in this chapter.

**Use Cases Diagram(s)**

Use case diagram for this purposed system describing actors, use cases, and their relationship is shown below:

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Figure 3: Use Case Diagram

**Detailed Use Case**

There are following descriptions of use cases describing use cases in detail with pre and postconditions.

**Upload Documents**

Users may upload documents for processing documents to check specific details from the documents like checking red flags etc.

Use Case Description 1: Upload Documents

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 1 |
| Name: | Upload Documents |
| Actors: | User |
| Description: | User uploads financial documents, including depreciation accounts, to check red flags, this is the main task, but the user can perform other tasks too after this, like tracking a single asset. |
| Trigger: | It indicates that the user wants to process a document to check consistency in the depreciation method. |
| Precondition: | Users must select the type of document. |
| Postcondition: | Document upload to the system and ready for processing. |
| Normal Flow: | 1. Go to upload the documents page of the application. 2. Select the type of documents. 3. Select documents from the local system. 4. Upload documents. |
| Alternative Flow: | 1. Go to upload the documents page of the application. 2. Select the type of documents. 3. Select documents from the local system. 4. Provide rate of depreciation, if any, for specific assets or class of assets. 5. Upload documents. |
| Exceptions: | Invalid format of documents  Documents failed to upload  PDF is not convertible to .xlsx file |
| Business Rules: | Documents should be of continues period like 2012-2019  Documents must include a separate calculation of depreciation for all assets or classes of assets  Application is only covering two methods straight line and reducing balance method.  The application is valid if depreciation is calculated with a standard rate. |
| Assumptions: | Documents is in .xlsx format |

**Generate Red Flag Report**

The main task of the purpose system is to generate a report that will indicate the red flag in the provided documents.

Use Case Description 2: Generate Red Flag Report

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 2 |
| Name: | Generate Red Flags Report |
| Actors: | User |
| Description: | Process uploaded documents to check each asset and their documented depreciation thoroughly to identify if there is any manipulation with the method of calculation of deprecation throughout the period. |
| Trigger: | Print a complete report indicating red flags (where manipulation with deprecation method is detected) or View on the screen and visualize. |
| Precondition: | Documents must upload |
| Postcondition: | Generated reports of red flags (where manipulation with deprecation method is detected) in companies documents. |
| Normal Flow: | 1. Upload documents 2. Click on “generate report” on the user interface. |
| Exceptions: | Invalid documents |
| Business Rules: | Companies using a standard of financial accounting in their calculation  Depreciation against each asset is provided in documents  Companies are not allowed to manipulate with the calculation method |
| Assumptions: | There is no manipulation with depreciation method in provided documents |

**Tract Red Flag**

Users may track any specific red flag for checking relevant detail about the red flag indicated by the purposed system.

Use Case Description 3: Tract Red Flag

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 3 |
| Name: | Track Red Flag |
| Actors: | User |
| Description: | The user needs to track a particular red flag to check detail about the manipulation of the calculation method throughout the period. |
| Trigger: | Generate report of description to print out for a particular red flag indicating the manipulation of the calculation method for depreciation on a particular asset. |
| Precondition: | A report of red flags must be generated. |
| Postcondition: | A report of a description of a particular red flag is generated. |
| Normal Flow: | 1. Upload Documents 2. Select a particular asset 3. Click on view particular red flag description. |
| Alternative Flow: | 1. Upload Documents 2. Select a particular asset 3. Select a particular time period 4. Click on view particular red flag description. |
| Exceptions: | Invalid asset provided. |
| Business Rules: | Assets should be fixed asset  Assets should be mentioned in uploaded documents |
| Assumptions: | The provided asset is included in uploaded documents |

**View List of Salvage Value**

The purpose system also finds the salvage value of the asset both companies calculated and system calculated. Users may view them to analyze further.

Use Case Description 4: View List of Salvage Value

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 4 |
| Name: | View List of Salvage Value |
| Actors: | User |
| Description: | The user views the list of salvage values of each asset, both systems calculated and documented by companies in uploaded documents. |
| Trigger: | Print report of salvage values. |
| Precondition: | A red flag report must be generated. |
| Postcondition: | Generates a list of including asset, the system calculated salvage value and documented value |
| Normal Flow: | 1. Upload Documents 2. Select generate salvage value report from an operation. |
| Alternative Flow: | 1. Upload Documents 2. Select generate salvage value report from an operation. 3. Select either to generated documented salvage value or system-generated or both |
| Exceptions: | Life period is not completed for a particular asset |
| Business Rules: | The life period of an asset is completed.  Calculation of depreciation of an asset is provided. |
| Assumptions: | The life period for each asset is completed. |

**View Comparison of Depreciation**

Users may view a comparison of depreciation between computer calculation and companies documented depreciation to analyze differences between then for taking further initiative.

Use Case Description 5: View Comparison of Depreciation

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 5 |
| Name: | View Comparison of Depreciation. |
| Actors: | User |
| Description: | User views a list of assets with their documented depreciation and system calculated deprecation to visualize the difference between amounts. |
| Trigger: | Print generated comparison report. |
| Precondition: | Red Flag Report must be generated. |
| Postcondition: | Generated report of comparison of depreciations |
| Normal Flow: | 1. Upload Documents 2. Select generated depreciation comparison report from operations |
| Alternative Flow: | Select generated depreciation comparison report from operations  Selects a particular fixed asset |
| Exceptions: | Selects invalid assets |
| Business Rules: | Documents must include a separate calculation of depreciation for all assets or classes of assets  The system must calculate the depreciation of each fixed asset. |

**Track Single Fixed Asset**

Users may perform tracking of a single asset for checking red flags throughout the period.

Use Case Description 6: Track Single Fixed Asset

|  |  |
| --- | --- |
| Use Case ID: | Use Case – 6 |
| Name: | Track Single Fixed Asset |
| Actors: | User |
| Description: | Users may check details of calculation of depreciation for any particular single fixed asset to analyze any particular asset. |
| Trigger: | Print report of particular fixed asset with its depreciation and red flags (if any) |
| Precondition: | Documents upload |
| Postcondition: | The generated reports of a fixed asset with its depreciation and red flags. |
| Normal Flow: | 1. Upload Document 2. Select Track Single Fixed Asset 3. Provide Details of Fixed Asset |
| Alternative Flow: | 1. Upload Document 2. Select Track Multiple Fixed Assets 3. Provide Details of Fixed Assets |
| Exceptions: | 1. Invalid detail of Fixed Asset 2. No such Fixed Asset in Provided Documents |
| Business Rules: | 1. Assets must be fixed asset 2. Deprecation calculation must follow financial standard |

**Functional Requirements**

There is the following list of functional requirements that the system needs to satisfy.

**Document Upload**

The purposed system will provide document upload function for user to upload their financial document because the system is dependent upon a document to check fraud in documents.

Functional Requirement 1: Upload Document

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 1 |
| Title | Document Upload |
| Requirements | The user will upload documents for processing. These can be PDF or DOC format. |
| Source | For a list of fixed assets and their documented depreciation accounts documents for a particular company is needed and provided by users to the system. |
| Rationale | The system requires a list of all fixed assets and their depreciation, and for such purpose accounts, documents are used for extraction of them. |
| Business Rules | Each asset or class of assert must have documented value of depreciation  Documents of a continuous period |
| Dependencies | Functional Requirement – 5  Functional Requirement – 7  Functional Requirement – 9 |
| Priority | High |

**View Fixed Assets and Their Depreciation Method or Rate**

The purposed system will let the user to view fixed assets and their depreciation method or rate of the depreciation of the asset.

Functional Requirement 2: View Fixed Assets and Their Depreciation Method of Rate

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 2 |
| Title | View Fixed Assets and Their Depreciation Method or Rate |
| Requirements | Users can view the list of all fixed assets or classes of assets extracted from the uploaded documents and their corresponding method of calculation for depreciation. |
| Source | For user visualization of fixed assets and their depreciation to check any irrelevant pattern. |
| Rationale | To show the user about the method of depreciation for each asset followed by the company according to their documents |
| Business Rules | Each fixed asset must have its separated depreciation provided in documents.  Depreciation method must be according to the standard for financial accounting |
| Dependencies | Functional Requirement – 1  Functional Requirement – 3 |
| Priority | Low |

**Find All Fixed Assets and Their Depreciation Method or Rate**

The purposed system will allow the user to find all fixed assets and their depreciation method or rate of the depreciation to visualized by the user for analysis.

Functional Requirement 3: Fine Fixed Assets and Their Depreciation Method of Rate

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 3 |
| Title | Find All Fixed Assets and Their Depreciation Method or Rate |
| Requirements | Extract each fixed asset and the method of calculation of the depreciation for each asset from the uploaded document. |
| Source | For tracking change in depreciation, the system needs to have each fixed asset and method of calculation or rate of depreciation. |
| Rationale | For checking the manipulation of the deprecation method, it needs to check each asset with its calculated deprecation thoroughly for each year in the provided period. |
| Business Rules | Each fixed asset must have its separated depreciation provided in documents.  Depreciation method must be according to the standard for financial accounting |
| Dependencies | Functional Requirement – 1 |
| Priority | High |

**Generate Red Flag Report**

Generating a red flag report by analysis of the providing documents is the main functionality of the system. Users can generate a report that will provide information about red flags in documents by considering the manipulation of the depreciation method.

Functional Requirement 4: View Fixed Assets and Their Depreciation Method of Rate

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 4 |
| Title | Generate Red Flag Report |
| Requirements | Generate a report that will indicate the areas where the company attempt to manipulate with the method of calculation of depreciation of an asset. |
| Source | For list company’s fraudulent activity that involves the manipulation of the method used to calculate the depreciation of a particular asset to take the initiative for further verifications. |
| Rationale | Prevent the company’s fraudulent activity to avoid taxes and show less net income. |
| Business Rules | Each fixed asset must have its separated depreciation provided in documents.  The depreciation method must be according to the standard for financial accounting.  They may be different calculation method for depreciation  Deal each asset separately  Mention exact document where manipulation detected |
| Dependencies | Functional Requirement – 3 |
| Priority | High |

**Set Negligible Percentage**

There may be several causes; the company’s calculations may vary, so allow the user to put some percentage to make comparison more flexible purposed system will let the user set negligible percentage.

Functional Requirement 5: Set Negligible Percentage

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 5 |
| Title | Set Negligible Percentage |
| Requirements | Users set a percentage while uploaded documents that will be used when comparing system calculations and documented calculations. |
| Source | Financial accounting involves Materiality. So, avoid such a difference that may occur system with make comparison flexible to some percentage if provided. |
| Rationale | Materiality concept of financial accounting. |
| Priority | High |

**Track Single Asset**

Users may track and analysis of the individual asset. So purposed solution will allow the user to track a single asset and let the user to view reports about the asset, including red flags (if any).

Functional Requirement 6: Track Single Asset

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 6 |
| Title | Track Single Asset |
| Requirements | User will able to check track detail of a single fixed asset for a provided period to check red flags for particular fixed asset and further details like the difference in amount before and after manipulation with the method of calculation |
| Source | For detailed visualization of each fixed asset. |
| Rationale | For the further investigation to check if the company provides a valid reason to manipulate the depreciation method. |
| Dependencies | Functional Requirement – 4 |
| Priority | Medium |

**Provides Depreciation Rate or Calculation Method**

Users may checklist of allow method or rates of depreciation to calculate depreciation. The purposed system will also let the user generate such a list.

Functional Requirement 7: Provides Depreciation Rate or Calculation Method

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 7 |
| Title | Provides Depreciation Rate or Calculation Method |
| Requirements | Users may provide a rate or calculation method for a particular asset to support the system or for any specific reason. |
| Source | Some assets may have a specific rate for calculation of depreciation instead of any standard method. |
| Rationale | Depreciation of some assets or classes of assets may be calculated by the company at a specific rate. |
| Priority | Low |

**Take Print of Any Report**

For taking the hard form of generated reports, the user may take print of the report.

Functional Requirement 8: Take Print of Any Report

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 8 |
| Title | Take Print of Any Report |
| Requirements | Use may take print of any generated report by the system for further use of the system’s results. |
| Source | For the record and further analysis of the particular issue, the hard form of the generated result may be required. |
| Rationale | Discuss the results of the system with other experts for analysis. |
| Dependencies | Functional Requirement – 4  Functional Requirement – 2 |
| Priority | High |

**View Salvage Value of Assets**

Salvage is the value of an asset, the current value of the asset after use of some period. Users may view the salvage value of assets.

Functional Requirement 9: View Salvage Value of Assets

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 9 |
| Title | View Salvage Value of Assets |
| Requirements | User may view the salvage value of the asset both companies documented, and system-generated to visualize the difference in amount. |
| Source | Visualization of difference lets the user analyze unexpected patterns further. |
| Rationale | The company may increase salvage to show high worth or decrease salvage to reduce taxes. |
| Priority | High |

**Select Type of Document**

Users may select the type of document from the allowed type of documents like XLSX.

Functional Requirement 10: Select the Type of Document

|  |  |
| --- | --- |
| Identifier | Functional Requirement – 10 |
| Title | Select Type of Document |
| Requirements | The user will select which is the type of documents that the system needs to be uploaded. |
| Source | Avoid more computation to detect and convert the document and make flexibility for a user to upload a multi-formatted document |
| Rationale | Before the extraction of data, the system needs to convert a document into XLSX format, so if documents are already in the XLSX format system will avoid extra conversions. |
| Priority | High |

**Non-Functional Requirements**

The non-functional requirement of the system will tell us about how the system will operate. It includes quality attributes for a software system, for example, performance, flexibility, etc.

**Usability requirement**

The system must be easy to use by a user by providing the following:

1. User-friendly GUI
2. Well formatted reports

**Scalability requirement**

The system must be scalable to support new functionalities.

1. There may more method of calculation of deprecation is added
2. Other areas of fraud with non-cash expense may be targeted

**Reliability requirement**

The system must pervade the identification of red flags by manipulation of the depreciation method in financial documents.

1. The system will generate a report of red flags for covered two main methods of depreciation

**Performance requirement**

For every modern system, performance is crucial, so the purposed system will provide the speed of response, throughput, execution time as consideration as accepted by standards.

1. Result of the system will be more than 90 percent correct

**Correctness requirement**

Most imported quality of such system is correctness

1. The system will calculate the correct deprecation of each asset using the detection method of calculation of deprecation or rate of depreciation
2. The system will perform an error comparison of depreciation, the company documented, and system calculated.

# **Design and Architecture**

The following parts of the Software Design Description (SDD) report should be included in this chapter. (Bell, 2008)

**System Architecture**

As an approach to divide the system into a dependent subsystem provides support to the development of complex applications. The purposed system is divided into subsystems as following:

1. Generation of red flag report
2. Generation of a red flag for a single asset
3. Show detail of the single red flag
4. Calculation of the list of salvage value
5. Show Comparison of Depreciations

The following is the architectural design of the purposed system:

A screenshot of a cell phone

Description automatically generated

Figure 4: Software Architecture Diagram

**Data Flow Diagram**

The following diagram describes the flow of the data, and it elaborates how data will flow throughout processes

A close up of a map

Description automatically generated

Figure 5: Data Flow Diagram

**Sequence Diagrams**

There are the following sequence diagrams that elaborate on how each functionality is performed by considering a sequence of processing.

### Sequence Diagram of Find Rates of Depreciation

There is the following sequence diagram for finding the rate of depreciation for each asset.

A screenshot of a social media post

Description automatically generated

Figure 6: Sequence Diagram of Find Rates of Depreciation

### Sequence Diagram of Show Single Fixed Asset

There is the following diagram of the show sequence of operation for obtaining details of a single fixed asset.

A screenshot of a social media post

Description automatically generated

Figure 7: Sequence Diagram of Show Single Fixed Asset

### Sequence Diagram of Generate Red Flags Report

There is the following diagram show the sequence of operation for generating a red flags report.

A screenshot of a social media post

Description automatically generated

Figure 8: Sequence Diagram of Generate Red Flag Report

### Sequence Diagram for Finding Salvage Values

A screenshot of a social media post

Description automatically generatedThere is the following diagram elaborates on the sequence of operation for finding salvage values.

Figure 9: Sequence Diagram for Finding Salvage Values

### Sequence Diagram for Showing Difference of Depreciations

A screenshot of a social media post

Description automatically generatedThere is the following diagram that shows different operations will be performed to show the difference of depreciations.

Figure 10: Sequence Diagram for Showing Difference of Depreciations

**Process Flow/Representation**

The purposed system is providing the following responses to the user:

1. Upload Documents
2. Process the whole document for the red flag
3. Process document for old salvage values
4. Find new salvage values
5. Calculate new depreciation
6. Comparison of depreciations
7. Find rates of depreciation
8. Show detail of rates of depreciation

These above activities performed in a follow to provide results to the user as fast as possible with ensuring correctness of business rules. There following is an activity diagram of the purposed system elaborates on how activities will be performed and their relationship with each other.

A close up of a map

Description automatically generated

Figure 11: Software Activity Diagram

**State Transition Diagram**

A screenshot of a cell phone

Description automatically generatedThere is the following state diagram of the purposed system that describes how states of the system will be changed.

Figure 12: State Transition Diagram

**Class Diagram**

A screenshot of a cell phone

Description automatically generatedThere is the following class diagram for the purposed system that is showing classes, attributes, operations, and their relationship.

Figure 13: Class Diagram

# **Implementation**

This chapter will discuss implementation details supported by UML diagrams (if applicable). You will not put your source code here. Any of the following sections may be included based on your project. (Chabert, 2012)

**Algorithm**

The purposed system involves several functions to achieve goad. There are the following algorithms for more complex and used functions.

**Algorithm for extraction of data**

A screenshot of a cell phone

Description automatically generatedThe following algorithm is used in the purposed system to extract data from documents.

Figure 14: Algorithm for Extraction of Data

**Algorithm for Extraction of assets and deprecations**

A screenshot of a cell phone

Description automatically generatedThe following algorithms used for the extraction of assets and depreciation from extracted data are as follows

Figure 15: Algorithm for the Extraction of Assets and Depreciations

**Algorithm for Extraction of single asset and depreciation**

A screenshot of a cell phone

Description automatically generatedThe Following algorithms used to extract a single fixed asset and its depreciation amount.

Figure 16: Algorithm for Extraction of Single Fixed Asset

**Algorithm for Extraction of assets and finding new deprecations**

A screenshot of a cell phone

Description automatically generatedThe following algorithm is used to find new depreciation values of all fixed assets for comparison with old depreciation values.

Figure 17: Algorithm for Finding New Depreciations

**Algorithm for Comparison of Depreciation**

The following algorithm is used to compare the depreciation of the fixed asset.

A screenshot of a cell phone

Description automatically generated

Figure 18: Algorithm for Comparison of Depreciations

**Algorithm for Finding Red Flags**

The following algorithm compares old and new depreciation and finds where the difference occurs.

A screenshot of a cell phone

Description automatically generated

Figure 19: Algorithm for Finding Red Flags

**Algorithm for Finding Salvage Values**

The following algorithm is used to find the salvage values of the fixed assets.

A screenshot of a cell phone

Description automatically generated

Figure 20: Algorithm for Finding Salvage Values

**Algorithm for Finding Rates of Depreciation**

A screenshot of a cell phone

Description automatically generatedThe following algorithm is used to find rates of deprecation.

Figure 21: Algorithm for Finding Rates of Depreciation

# **User Interface**

Here are the details about the user interface with their descriptions.

**Sign-up**

The first step in our software is to create a new user account by entering the required field like username, e-mail address, password, and re-write password.

A screenshot of a cell phone

Description automatically generated

Figure 22: Signup Page

**Login**

At this page, the user can log in to the system by entering his/her “username” and “password.”

A screenshot of a cell phone

Description automatically generated

Figure 23: Login Page

**Dashboard**

After login into the system, the dashboard will appear through which the user can perform multiple actions according to his/her needs like upload files, view files, view reports, view current profile data, and the user can also update his/her profiles.

A screenshot of a cell phone

Description automatically generated

Figure 24: Dashboard

**Upload File**

In this section of the software, the user can upload a financial document into the system for further analysis by filling the required fields.

A screenshot of a cell phone

Description automatically generated

Figure 25: Upload File

**Manage (View All)**

This page will allow the user to view all the uploaded documents and will give them access to download those documents by clicking on the “Download” button at the end of the document row.

A screenshot of a computer

Description automatically generated

Figure 26: View All

**Manage (View Specific)**

In this section, the user can view a specific document at a time with its complete entries after filling the fields like “Document Name” and “Date” and pressing on the “Submit” button. This page also allows downloading that searched document by clicking on the “Download Table Data” button.

A screenshot of a cell phone

Description automatically generated

Figure 27: View Specific

**Depreciation Report (Extract Documented)**

With the help of this interface, the user can extract the depreciation values of assets as it is on the uploaded documents. The data can be gathered after filling the company name, starting financial period, and “ending financial period.” The user can also download that specific report and search for a specific asset.

A screenshot of a social media post

Description automatically generated

Figure 28: Depreciation Report (Extract Documented)

**Depreciation Report (Generate New)**

This interface will allow the user to generate a new report of an uploaded document. It will provide the depreciation values of assets computed by the application. The user can generate it by providing the required information like company name, starting, and ending financial period. The user can search for a specific asset detail and can also download the generated report.

A screenshot of a social media post

Description automatically generated

Figure 29: Depreciation Report (Generate New)

**Salvage Report (Extract Documented)**

The report of salvage values of assets can be extracted with the help of this interface. The report will be extracted from the document uploaded by the user as it is. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

A screenshot of a cell phone

Description automatically generated

Figure 30: Salvage Report (Extract Documented)

**Salvage Report (Generate New)**

With the help of this interface, the user can generate a new report of salvage values of assets of an uploaded document. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

A screenshot of a social media post

Description automatically generated

Figure 31: Salvage Report (Generate New)

**Rates Report (Extract Documented)**

This interface will allow the user to extract the report about depreciation rates applied to assets. This report is extracted from the uploaded document as it is of a specific time period. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

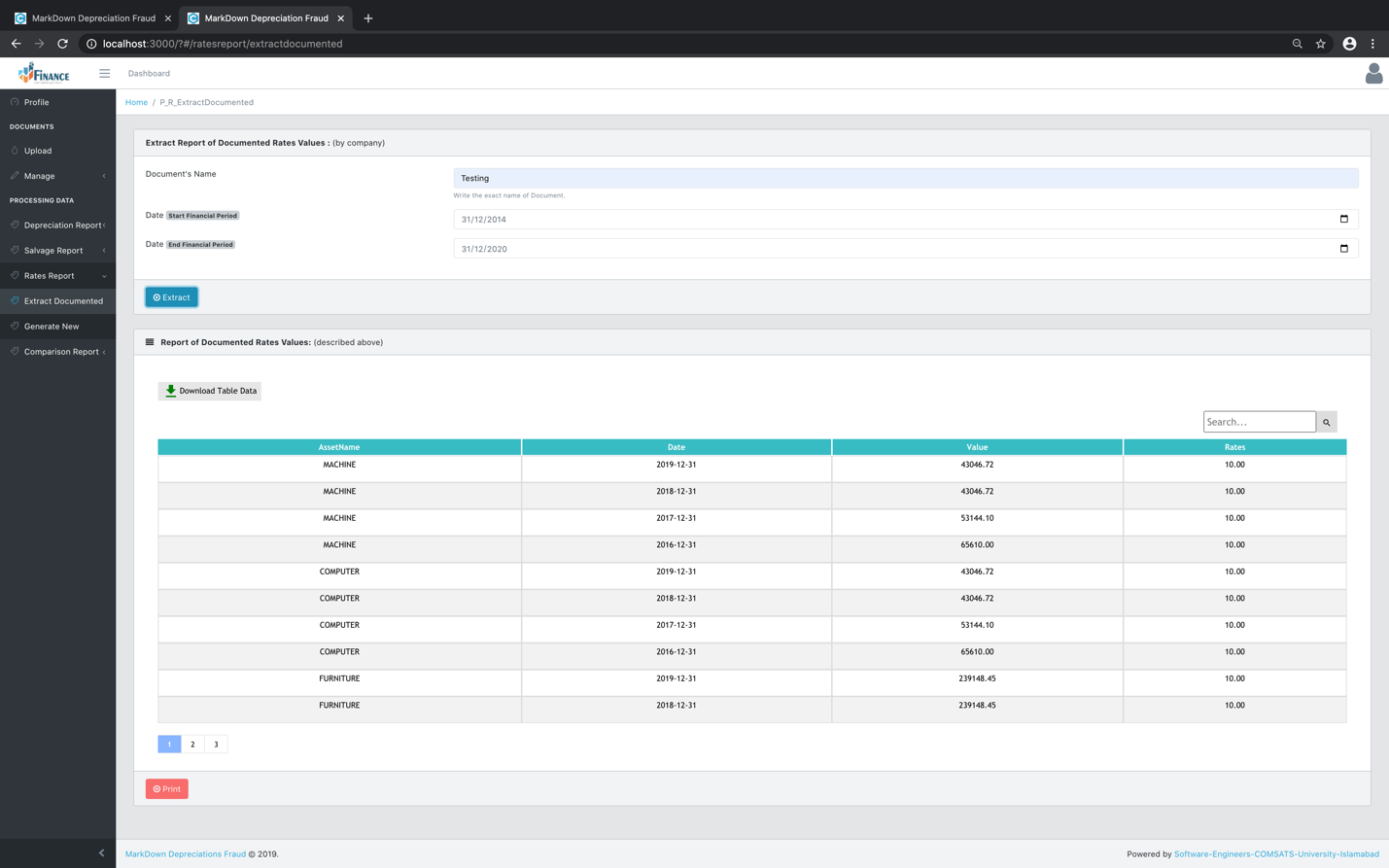


Figure 32: Rates Report (Extract Documented)

**Rates Report (Generate New)**

The user can generate a new report of rates applied on assets of an uploaded document. The system will provide the user with the computed report of rates applied to the assets. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

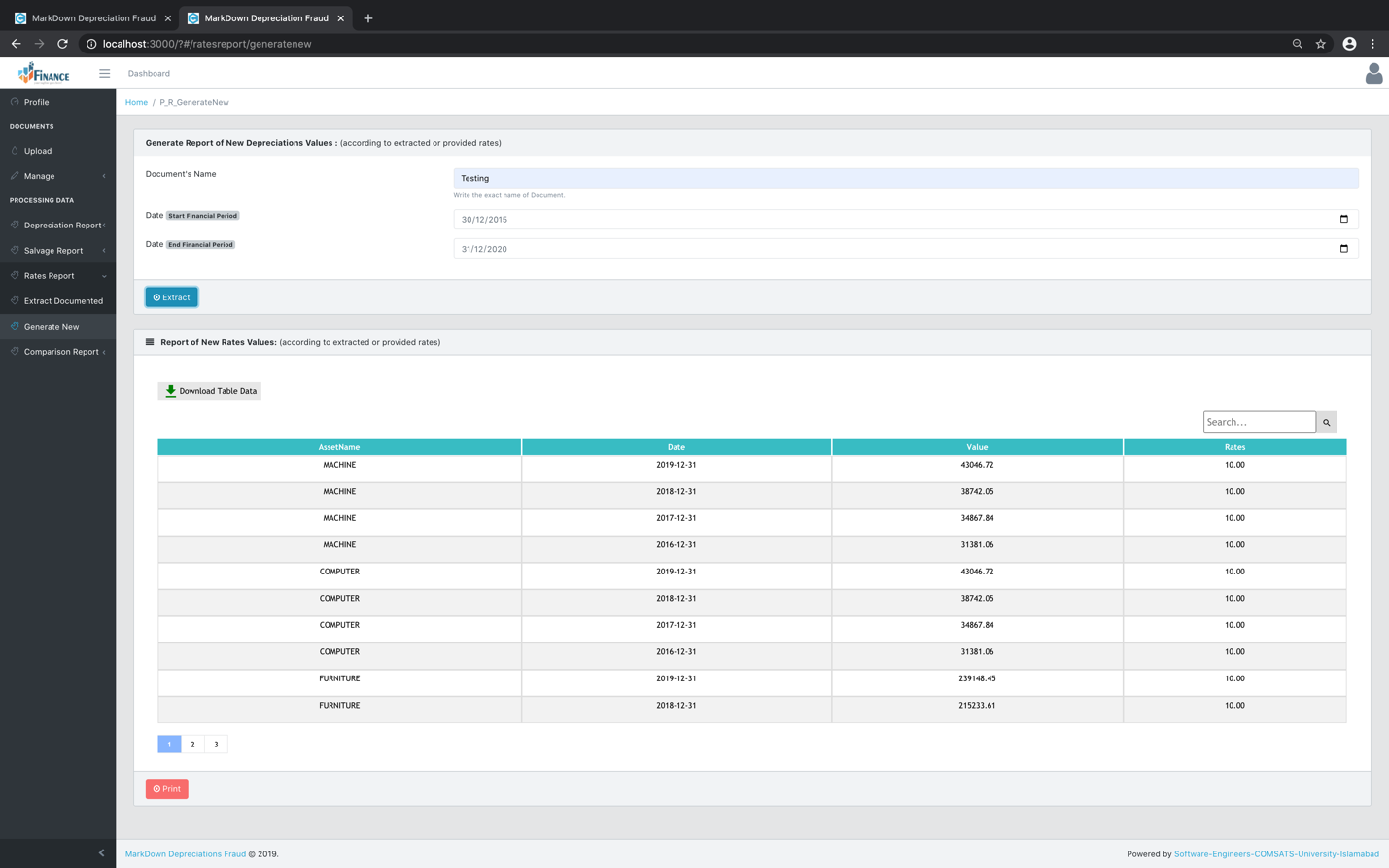


Figure 33: Rates Report (Generate New)

**Comparison Report (Depreciations)**

The user can get a comparison report of depreciation of assets provided by uploading documents. The comparison will be between the actual depreciation and computed depreciation applied on assets and the difference between actual and computed values and documented and computed depreciation. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

A screenshot of a computer

Description automatically generated

Figure 34: Comparison Report (Depreciations)

**Comparison Report (Salvages)**

This interface will allow the user to get the comparison report of salvage values of assets. The comparison will show the difference between the actual value and salvage value of assets of documented and computed documents. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

A screenshot of a computer

Description automatically generated

Figure 35: Comparison Report (Salvages)

**Comparison Report (Rates)**

This interface will provide a comparison report on rates applied to assets. The difference will be shown between documented values and computed values. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

A screenshot of a cell phone

Description automatically generated

Figure 36: Comparison Report (Rates)

**Comparison Report (Red Flags)**

The user can get a comparison report of those assets which are manipulated. This report will provide a comparison between documented and computed values, rates, and depreciation values of those manipulated assets. It can be done by filling the required data like Company name, starting, and ending financial period. The user can download the generated report of a specific time period and can also search for a specific asset.

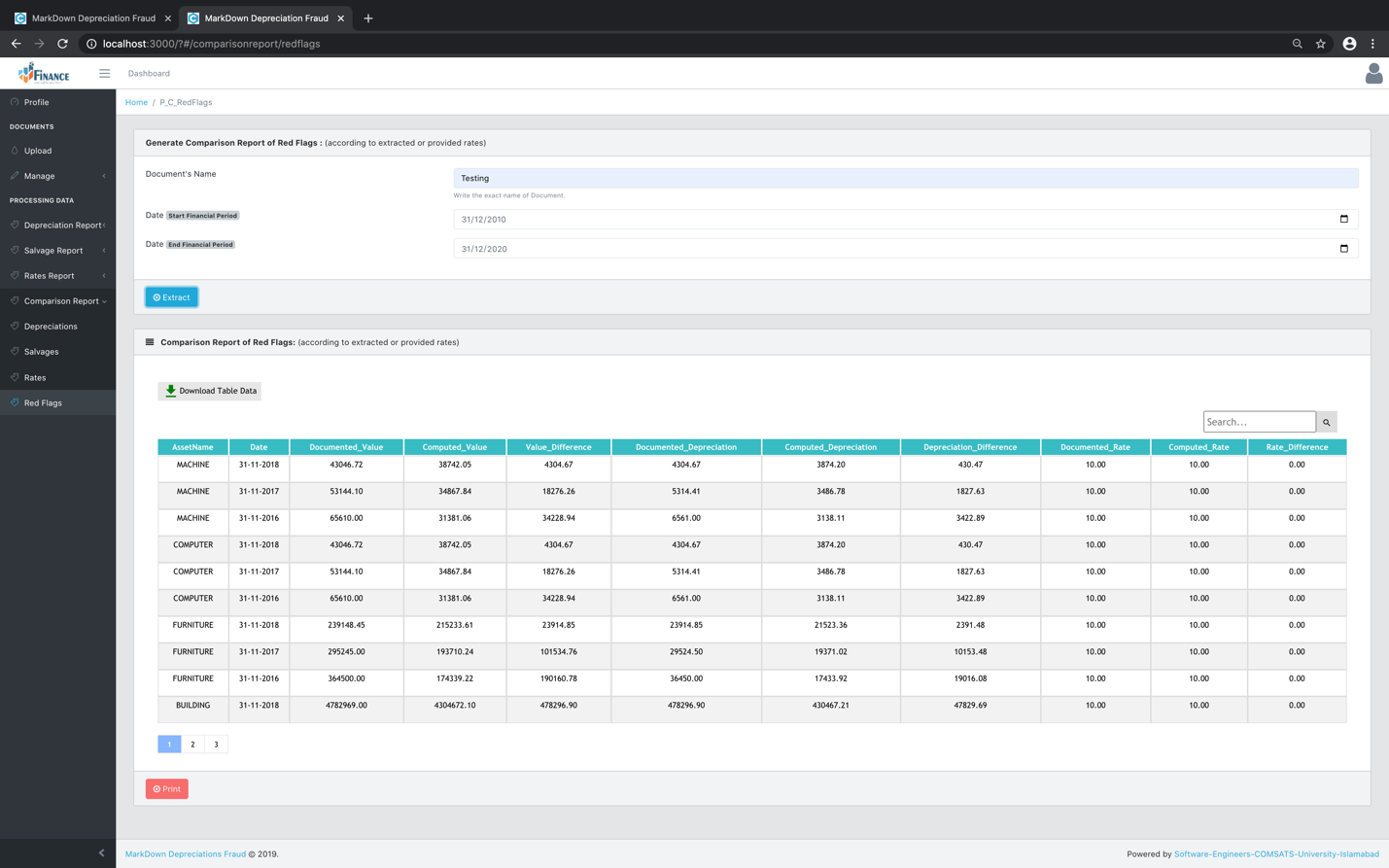


Figure 37: Comparison Report (Red Flags)

# **Testing and Evaluation**

This chapter may include the following sections. (Students are required to perform the testing both manually and automatedly). (Everatt & McLeod Jr., 2007)

**Manual Testing**

### System testing

After the successful development of the system, proper manual testing is performed to ensure that the system is working as intended. Testing is also done to check if the system meets the requirements stated earlier, as well as to find all possible errors which are hidden from the user. There are a few types of testing, which include unit testing, functional testing, and integration testing. All of these are performed to ensure the working of the software.

### Unit Testing

There are following unit tests that were conducted for the application.

Unit Testing 1: Login as a member

Testing Objective: To ensure the login form is working correctly

Test-Case 1: Login as a member

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Launch Web Application | <http://fyp-se-2020.herokuapp.com/#/login> | Login Page of application will appear. | Pass |
| 1 | Verify user login after a click on “Login” button on login form with correct input data | Username: Admin  Password: 1234 | Successful log into the main page “Dashboard” of the software as a member. | Pass |
| 2 | Verify user login after a click on the “Login” button on the login form with the wrong username. | Username: ABC  Password: 1234 | The system will show an “Error Message” regarding the wrong username or password. | Pass |
| 3 | Verify user login after a click on the “Login” button on the login form with the wrong password. | Username: Admin  Password: 0000 | The system will show an “Error Message” regarding the wrong username or password. | Pass |
| 4 | Verify user login after a click on the “Login” button on the login form with the wrong username and password. | Username: Admin  Password: 1234 | The system will show an “Error Message” regarding the wrong username or password. | Pass |

Unit Testing 2: Sign-Up

Testing Objective: To ensure the sign-up form is working properly.

Test-Case 2: Sign-Up

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Verify user signup after a click on the “Create Account” button on the signup form with correct input data | Username: Admin  E-mail:  abc@gmail.com  Password: 1234  Re-write Password:  1234 | Successfully created a new user account. | Pass |
| 2 | Verify user signup after a click on the “Create Account” button on the signup form with the wrong E-mail. | Username: Admin  E-mail:  abc.com  Designation:  Manager  Password: 1234 | The system will show an “Error Message” regarding invalid email. | Pass |
| 3 | Verify user signup after a click on the “Create Account” button on the signup form with an empty username field. | Username:  E-mail:  abc@gmail.com  Designation:  Manager  Password:  1234 | The system will show an “Error Message” regarding an empty input field. | Pass |
| 4 | Verify user signup after a click on the “Create Account” button on the signup form with an empty password field. | Username: Admin  E-mail:  abc@gmail.com  Designation:  Manager  Password: | The system will show an “Error Message” regarding an empty input field. | Pass |
| 5 | Verify user signup after a click on the “Create Account” button on the login form with an empty designation field. | Username: Admin  E-mail:  abc@gmail.com  Designation:  Password: 1234 | The system will show an “Error Message” regarding an empty input field. | Pass |

Unit Testing 3: Update user profile

Testing Objective: To ensure the update profile form is working properly.

Test-Case 3: Update user profile

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Update User profile after a click on the “Update” button with correct input data is entered. | Username: Admin  E-mail:  xyz@gmail.com  Designation:  Manager  Password: 1234 | The user profile successfully updated. | Pass |
| 2 | Update the User profile after clicking on the “Update” button with an empty “Username” textbox. | Username:  -  E-mail:  xyz@gmail.com  Designation:  Manager  Password: 1234 | The system will show an “Error Message” regarding invalid username. | Pass |
| 3 | Update the User profile after clicking on the “Update” button with an empty “email” textbox. | Username: Admin  E-mail:  -  Designation:  Manager  Password: 1234 | The system will show an “Error Message” regarding an empty input field. | Pass |
| 4 | Update the User profile after clicking on the “Update” button with the wrong “email” in the textbox. | Username: Admin  E-mail:  xyz.com  Designation:  Manager  Password: 1234 | The system will show an “Error Message” regarding invalid input data. | Pass |
| 5 | Update the User profile after clicking on the “Update” button with an empty “Designation” textbox. | Username: Admin  E-mail:  xyz@gmail.com  Designation:  -  Password: 1234 | The system will show an “Error Message” regarding an empty input field. | Pass |
| 6 | Update the User profile after clicking on the “Update” button with an empty “Password” textbox. | Username: Admin  E-mail:  xyz@gmail.com  Designation:  Manager  Password:  - | The system will show an “Error Message” regarding an empty input field. | Pass |

**Functional Testing**

Functional testing will take place after unit testing. In this functional testing, the functionality of each of the modules is tested. It is to ensure that the system produced meets the specifications and requirements.

Functional Testing 1: Upload Document

Objective: To ensure that the document is uploaded properly.

Test-Case 4: Upload Document

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Upload the document with correct input fields and correct file format by clicking on the “Submit” button. | Document Name:  ABC  Date:  05-01-2019  Optional Details:  XYZ  Depreciation Method:  Straight Line  File:  2019.xls | The document will be uploaded in the database correctly. | Pass |
| 2 | Upload the document with correct input fields and wrong file format by clicking on the “Submit” button. | Document Name:  ABC  Date:  05-01-2019  Optional Details:  XYZ  Depreciation Method:  ….  File:  2019.ppt | The document will not be uploaded in the database. | Pass |
| 3 | Upload the document with missing the “Document Name” field by clicking in the “Submit” button. | Document Name:  Date:  05-01-2019  Optional Details:  XYZ  Depreciation Method:  Straight Line  File:  2019.xls | The document will not be uploaded in the database. | Pass |
| 4 | Upload the document with missing the “Date” field by clicking in the “Submit” button. | Document Name:  ABC  Date:  Optional Details:  XYZ  Depreciation Method:  ….  File:  2019.ppt | The document will not be uploaded in the database. | Pass |
| 5 | Upload the document with missing the “File” field by clicking in the “Submit” button. | Document Name:  ABC  Date:  05-01-2019  Optional Details:  XYZ  Depreciation Method:  ….  File: | The document will not be uploaded in the database. | Pass |

Functional Testing 2: View Specific Document

Objective: To ensure that the document is shown properly.

Test-Case 5: View Specific Document

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | The uploaded document can be seen by entering proper details and by clicking on the “Submit” button | Document Name:  ABC  Date:  05-01-2019 | The document’s details will be shown to the user. | Pass |
| 2 | Show the document by entering the wrong details and clicking on the “Submit” button | Document Name:  \*False Name  Date:  Wrong Date | The document’s details will not be shown to the user. | Pass |
| 3 | Show document while having missing “Document Name” and clicking on the “Submit” button | Document Name:  Date:  05-01-2019 | The document’s details will not be shown to the user. | Pass |
| 4 | Show document while having missing “Date” and clicking on the “Submit” button | Document Name:  ABC  Date: | The document’s details will not be shown to the user. | Pass |

Functional Testing 3: View All Document and download

Objective: To ensure that all documents are shown properly.

Test-Case 6: View all documents and download

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | The uploaded document can be seen by clicking on the “Manage - View All” button on the navbar. | - | The document’s details will be shown to the user. | Pass |
| 2 | Download the document by clicking on the “Download” button | - | The document will be downloaded from the application to the system. | Pass |

Functional Testing 4: Extract Report of Documented Depreciation Values

Objective: To ensure that documents can be extracted properly.

Test-Case 7: Extract Report of Documented Depreciation Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | The uploaded document can be extracted by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | The uploaded document can be extracted by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | The uploaded document can be extracted by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | The uploaded document can be extracted by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 5: Generate Report of New Depreciation Values

Objective: To ensure that report is generated properly for new depreciation values.

Test-Case 8: Generate Report of New Depreciation Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a new report of new depreciation values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a new report of new depreciation values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a new report of new depreciation values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a new report of new depreciation values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 6: Extract Report of Documented Salvage Values

Objective: To ensure that report is extracted properly of documented salvage values.

Test-Case 9: Extract Report of Documented Salvage Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Extract report of salvage values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Extract report of salvage values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Extract report of salvage values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Extract report of salvage values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 7: Generate a report of New Salvage Values

Objective: To ensure that report is generated properly of new salvage values.

Test-Case 10: Generate a report of New Salvage Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a new report of new salvage values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a new report of new salvage values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a new report of new salvage values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a new report of new salvage values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 8: Extract report of Documented Rates Values

Objective: To ensure that report is extracted properly of Documented rates values.

Test-Case 11: Extract report of Documented Rates Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Extract report of rates values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Extract report of rates values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Extract report of rates values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Extract report of rates values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 9: Generate a report of New Rates Values

Objective: To ensure that report is generated properly of new salvage values.

Test-Case 12: Generate a report of New Rates Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a new report of new rates values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a new report of new rates values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a new report of new rates values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a new report of new rates values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 10: Generate Comparison report of Depreciation Values

Objective: To ensure that the comparison report is generated properly of depreciation values.

Test-Case 13: Generate Comparison report of Depreciation Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a comparison report of depreciation values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a comparison report of depreciation values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a comparison report of depreciation values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a comparison report of depreciation values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 11: Generate Comparison report of Salvage Values

Objective: To ensure that the comparison report is generated properly of salvage values.

Test-Case 14: Generate Comparison report of Salvage Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a comparison report of salvage values by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a comparison report of salvage values by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a comparison report of salvage values by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a comparison report of salvage values by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 12: Generate Comparison report of Rates

Objective: To ensure that the comparison report is generated properly of rates.

Test-Case 15: Generate Comparison report of Rates

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a comparison report of rates by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a comparison report of rates by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a comparison report of rates by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a comparison report of rates by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

Functional Testing 13: Generate Comparison report of Red Flags

Objective: To ensure that the comparison report is generated properly of red flags

Test-Case 16: Generate Comparison report of Red Flags

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Generate a comparison report of red flags by providing correct “Company Name” and “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The document’s details will be shown in tabular form to the user. | Pass |
| 2 | Download the document by clicking on “Download Table Data” button | - | The document will be downloaded from the application to the system. | Pass |
| 3 | Generate a comparison report of red flags by providing wrong “Company Name” with correct “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  ABC  Start Financial Date:  12/31/2000  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |
| 4 | Generate a comparison report of red flags by providing correct “Company Name” with wrong “Start OR End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  10/15/2008  End Financial Date:  05/24-2001 | The Document will not be extracted or shown to the user. | Pass |
| 5 | Generate a comparison report of red flags by providing any missing value “Company Name” with “Start & End Financial Period” and Clicking on “Extract” Button | Company Name:  XYZ  Start Financial Date:  End Financial Date:  12/31-2009 | The Document will not be extracted or shown to the user. | Pass |

**Integration Testing**

The integration test of the purposed application was performed by the following test cases.

Test-Case 17: Integration Testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Cases | Attribute & Value | Expected Results | Results |
| 1 | Sign up as a new user by submitting the right information. | Username:  ABC  E-mail:  abc@gmail.com  Password:  123  Re-write Password:  123 | Successfully created a new user account. | Pass |
| 2 | Log in as a member | Username:  ABC  Password:  123 | Successfully logged in as a member of software, and a homepage of software appears with the user profile. | Pass |
| 3 | Upload a new document for analysis. | Company Name:  XYZ  Date (Financial Period):  12/31/2005  Optional Details:  (….)  Depreciation Method:  (if any assets have a different method)  Choose File:  12/31/2005.xlsx | Successfully uploaded a new document into the system. | Pass |
| 4 | View all uploaded documents. | - | The list of uploaded documents is shown on the screen. | Pass |
| 5 | View any specific document details/data. | Company Name:  XYZ  Date (Financial Period):  12/31/2005 | The details/data of the document is displayed on the screen. | Pass |
| 6 | Extract Report of Documented depreciation values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is extracted successfully, and data is displayed on the screen. | Pass |
| 7 | Generate reports of new depreciation values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is generated successfully, and data is shown on-screen successfully. | Pass |
| 8 | Extract report of Documented Salvage values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is extracted successfully, and data is displayed on the screen. | Pass |
| 9 | Generate a report of new salvage values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is extracted successfully, and data is displayed on the screen. | Pass |
| 10 | Extract report of Documented rate values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is extracted successfully, and data is displayed on the screen. | Pass |
| 11 | Generate a report of new rates values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The report is extracted successfully, and data is displayed on the screen. | Pass |
| 12 | Generate a comparison report of depreciation value. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The comparison report is generated successfully and displayed on the screen. | Pass |
| 13 | Generate a comparison report of salvage values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The comparison report is generated successfully and displayed on the screen. | Pass |
| 14 | Generate a comparison report of rates values. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The comparison report is generated successfully and displayed on the screen. | Pass |
| 15 | Generate a comparison report of red flags. | Company Name:  XYZ  Date (Start Financial  Period):  12/31/2002  Date (End Financial Period):  12/31/2005 | The comparison report is generated successfully and displayed on the screen. | Pass |
| 16 | Logout the user from the main screen of the software. | - | The user is logged out from the software, and the login page is displayed on the screen. | Pass |

# **Conclusion and Future Work**

Keeping in view the current problem, we have developed a web application which is a tool to assist financial experts to indicates red flags of manipulation in depreciation methods in the financial statement so that they can perform their work more quickly, efficiently and without any human error efficiency by using computational approaches involving data mining, neural networks and NPL (Natural Language Processing). This software will prove to be a good source of help for financial experts. With its amazing and effective features, this application will be an important part of the financial departments of any company.

We aim to improve the feature, design, accuracy, and applications of the technology being used based on user reviews. It will help us to improve our skills and make us master new variations and techniques to play with technology. For now, the software tool is working according to a specific financial document format, and our goal is to make it work for every financial document format. We will enhance the scope of the application from only depreciation fraud detection to other fraud detected techniques applied by different companies.

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