Laboratory Information Management System

Project Report

Sri Lanka Institute of Information Technology

IT2080 Information Technology Project

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May 2023

Declaration

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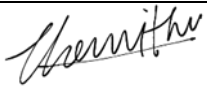
IT21237904	Gunawardana U.G.C.D	
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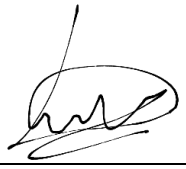
IT21219252	Senadheera S.A.A.D	

Date: 19/05/2023

Abstract

This report provides a detailed account of the solution developed to address the challenges faced by MediLine, a renowned laboratory. To accomplish this, an extensive review of relevant literature was conducted, followed by a thorough analysis of requirements. The project's objectives and goals are presented, along with an overview of the solution and the methodologies employed during its development.

By carefully examining the requirements, various processes, workflows, and databases were designed and developed to meet MediLine's needs. The report highlights the interconnectedness of these elements, showcasing how they work together seamlessly to ensure efficient operations.

To validate the solution's functionality, comprehensive testing was carried out. The results of these tests were then evaluated, providing valuable insights into the solution's strengths and areas for improvement. The report concludes with a thoughtful assessment of the findings, drawing meaningful conclusions about the solution's effectiveness in addressing MediLine's identified problems.

In essence, this report serves as a comprehensive record of the solution development process undertaken for MediLine. By combining a thorough literature review, a careful analysis of requirements, and a meticulous design and testing approach, this project not only tackles the identified problems but also lays the foundation for a promising future for MediLine.

Acknowledgement

We would like to express our sincere gratitude to all those who have contributed to the successful completion of this project. First and foremost, we would like to thank our esteemed lecturer, Mr. Harshanath for his invaluable guidance, support, and insightful feedback throughout the duration of this project. We are also extremely grateful to the stakeholders of the company, especially the owner, who provided us with essential information and went through interviews, making this project possible.

We would like to acknowledge the members of the MS Club for their valuable support and expertise in guiding us through the complexities of this project. Additionally, we would like to express our gratitude to NetNinja, a YouTube channel whose informative and educational videos on the MERN stack have been of great assistance to us in our learning.

Finally, we would like to extend our appreciation to all those who have contributed in one way or another to the successful completion of this project. Thank you all for your invaluable support and guidance.

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1. Introduction

1.1. Background

Medi Line is a small privately owned and operated medical laboratory in Athurugiriya. It was established in 2016. The laboratory focuses on providing routine clinical laboratory services which includes haematology, clinical chemistry, and biochemistry to the local community.
Haematology is the scientific study of blood including its composition, function, and diseases. Clinical chemistry uses chemical processes to measure levels of chemical components in body fluids and tissues, blood and urine being the most common specimens. It plays a crucial role in the diagnosis and management of a wide range of diseases, such as liver and kidney disease, diabetes, and certain cancers. Clinical biochemistry refers to the application of chemical and biochemical methods to the study of diseases. It includes a wide range of tests and techniques used to diagnose and monitor various medical conditions.
The medical laboratory at Medi Line is staffed by trained phlebotomists, who are medical professionals responsible for collecting blood samples from patients, and medical laboratory scientists and technicians who does the diagnostic testing of blood and body fluids. There is also a receptionist who interacts with the patients during the billing process.
In addition to performing in-house tests, Medi Line also outsources some tests to other laboratories. A courier from the outsourced laboratory will collect the samples from Medi Line and transport them for testing, then return the test results to the laboratory.
The laboratory is equipped with a range of instruments and machines, including syringes, microscopes, ECG machines, and haematology analysers. These tools are critical for accurately analysing samples and providing patients with accurate and timely test results.
Medi Line is dedicated to staying current and using the latest tools and techniques into their practices. This helps ensure that patients receive the highest quality care possible.

1.2.Problem and Motivation

At present Medi Line relies on a physical file-based system to manage their information and workflows. Although this approach seems more convenient for them, it has many drawbacks having a significant impact on efficiency and accuracy of their operations. Some of the draw backs include data redundancy, data inconsistency, limited data sharing and poor enforcement of standards.

1.2.1. Problems

- Re-registering patients
  When a patient comes to the premise with a prescription, the first thing they do is register the patient. And patients (mostly the elderly) seem to give them different information every time they come for a test. Pulling patient records and updating information can be a real hassle. Therefore, they re-register the patient on their demographics and contact information. This leads to data duplication.

- Difficulty in tracking samples
  With physical files, it can be difficult to access information quickly and easily about the status of a sample. This can lead to delays in processing and testing, as staff must manually search through files to find the necessary information. This will lead to lost or mislabelled samples resulting in delays in patient diagnosis and treatments.

- Archiving
  All records of tests are to be archived, so that even if a previous patient of theirs requests for a test report that was done years ago, it should be available. This will be a tedious task to search for previous records.

- High laboratory turnaround time
  Laboratory Turnaround Time (TAT) is a measure of the time it takes from receiving a sample to producing test results. Using a physical file system can negatively impact this as the staff has to share files between them which can lead to reduced productivity.

- No inventory management
  Having no inventory management can lead to increased costs. Lack of inventory control can result in waste due to overstocking, stock shortages, or expired materials, which can be costly. Without accurate inventory records, it can be difficult for the lab to plan for future needs, leading to additional costs and decreased efficiency.

- No statistical data
  Generating statistical data can be challenging for a medical laboratory without proper systems and processes in place. It will take more time and inaccuracy. Without access to statistical data, they won't be able to make informed decisions.

1.2.2. Motivation

The laboratory can make significant improvements by addressing the above problems mentioned.

- Improved efficiency
  By finding ways to better track samples and keeping an organized inventory, laboratories can work more efficiently and process samples more quickly. This means that results can be available sooner and with less delay.

- Enhanced productivity
  By implementing archiving systems, laboratories can store and retrieve samples more easily, which saves time and effort required to find and handle specific samples. This allows researchers and technicians to focus on other important tasks and ultimately increases productivity in the lab.

- Better data management
  By implementing statistical analysis tools, laboratories can gain a better understanding of their data, enabling them to make more informed decisions based on evidence. This, in turn, helps laboratories to optimize their processes and improve their overall performance.

- Compliance with regulations
  Regulatory agencies, such as the FDA or EPA, often require laboratories to accurately track and archive samples. By addressing difficulties in these areas, laboratories can meet regulatory requirements and avoid penalties or fines.

1.3. Literature Review

Table 1-1 LIMS's currently in the market compared.

Title	Advantages	Disadvantages	Author	Year
The Ideal Laboratory Information System [1]	- Suggests the use of data mining to improve the quality of the services provided. - Suggests different levels of result certification in the system before the results are released.	- No machine management function is available. - An expert system might become too complex.	1. Jorge L. Sepulveda 2. Donald S. Young	2013
Laboratory Information Management Systems [2]	- Suggests a pre-login sample type for samples expected to be received for testing.	- To implement the suggestion all samples dealt with for the day should be known prior. - The client does not deal with samples from outside the lab.	1.Christine Paszko 2. Elizabeth Turner	2018
Laboratory Information Management Systems (lims) [3]	- Suggests a function to record the possession of samples from the point of collection until it is received at the lab. - Suggests data archiving and warehousing to keep a record history of 5 or more years.	-A function to record possession of samples from the time of collection might result in too much time spent to enter data and might be unnecessary.	1. Kyle Boyar 2. Andrew Pham 3. Shannon Swantek 4. Gary Ward 5. Gary Herman	1970
Matrix Gemini LIMS [4]	- The system has lot of functionalities that cover the requirements of a laboratory information system. - Provides documentation for staff training.	- The system is complex because it has lot of functionalities. - Does not have a function to manage machines.	-	2021
Thermo Fisher LIMS [5]	- Provides workflow capabilities that can map to the laboratory process.	- The business cost can be high when using this system.	-	2021

	- Provides the option to deploy the system on the cloud.	- Not specifically designed for clinical laboratories.		

1.3.1. **Literature Review Summary**

Although the literature about Laboratory Information Management Systems (LIMS) provides some very insightful functions and existing systems already implement innovative functions there are reasons why these systems cannot be implemented as it is without implementing a new system. The reasons are highlighted below,

1. The Ideal Laboratory Information System:
    - Since a computerized system is implemented for the first time for the client the system cannot be complex thus making an expert system is not the best choice.
2. Laboratory Information Management Systems:
    - In addition to not knowing the samples handled in a particular day prior to that day, the client also does not interact with samples originated outside the lab.
3. Laboratory Information Management Systems (lims):
    - Since the client is a small lab operating on 5-6 employees the function to record the possession of samples from the point of collection until is received at the lab will be too time-consuming for an added layer of security. The fact that the lab collects their own blood samples and do not interact with outside samples solidifies the inefficiency of the function.
4. Matrix Gemini LIMS:
    - As mentioned above, since the client is a company that is computerizing their system for the very first-time usability is of the utmost importance.
    - The system does not have a function to manage machine records, which was specifically requested by the customer.
5. Thermo Fisher LIMS:
    - The LIMS is not specifically created for the client and in addition to that, the system is not created only for clinical laboratories, thus making the system provide a very general LIMS.

Due to the above reasons the existing systems cannot be implemented directly since that will not meet the user's requirements completely. Hence a new system should be developed that covers user requirements while maintaining the usability of the system as much as possible to ensure the client can adapt quickly.

1.4. Aims and Objectives

1.4.1. Aims

- By registering the patient on their first visit to the laboratory, LIMS creates a unique identifier for that patient, which is used to track all test results associated with that patient. It tracks samples from the time they are collected to the time they are analysed.

- We are using standardized sample collection to reduce errors and simplify sample tracking. This includes consistent labelling.

- Barcoding is used to label and track samples, making it easier to identify and track them in LIMS. It can reduce errors and improve accuracy.

- In order to overcome the archiving problem, LIMS categorizes data according to different criteria, such as patient name, date of the test, test type, and test results. This helps organize the data and makes it easier to search for specific records. Also set up access control for archived data, so that authorized users can access it. This ensures that patient data is protected. Also authorized users can conduct maintenance on the archived data, including data backup. This makes it easier to search and retrieve previous test records from the LIMS. also reduce the time and effort required to access historical data, ensuring that patients receive the information they need in a timely manner.

- Automate many processes including sample registration, data entry, test result reporting, etc. By going automatic, the laboratory can reduce manual errors, eliminate paper-based systems, and accelerate testing.

- Dashboards are used to provide a visual representation of laboratory operation and performance. This helps to identify the areas that need more attention.

- Inventory management is used to monitor the stock levels of supplies. This can include the quantity on hand, the quantity used, and the quantity ordered. The manager can ensure that supplies are ordered before stock levels fall below 10 or 20. This can help to prevent stockouts and ensure that testing can be done uninterruptedly. By using an inventory LIMS can track supplier information including contact details, and pricing information. This can help to ensure that the laboratory is getting the best value for its purchases. Managing inventory efficiently, reducing the risk of stockouts and overstocking, while also ensuring that testing can be completed on time and at the right cost.

- Reports can provide insights and recommendations based on the data that has been collected and analysed. These insights can help decision-makers better understand the problem and develop appropriate solutions. The recommendations can also help guide future data collection efforts to address any gaps in statistical data.

1.4.2. Objectives

Mediline's information system is manual. We are creating a solution to replace paper-based and outdated systems, as well as spreadsheets, which are usually time-consuming, incorrect, insecure, inconsistent, and lack an audit trail. The main objective is to reduce their manual work. Automate and make tasks easy by managing laboratory data, streamlining workflows, and enhancing data quality. A LIMS may help improve laboratory operations' quality and efficiency, support doctors in better decisions, and improve patient care and safety.

1.5. Solution Overview

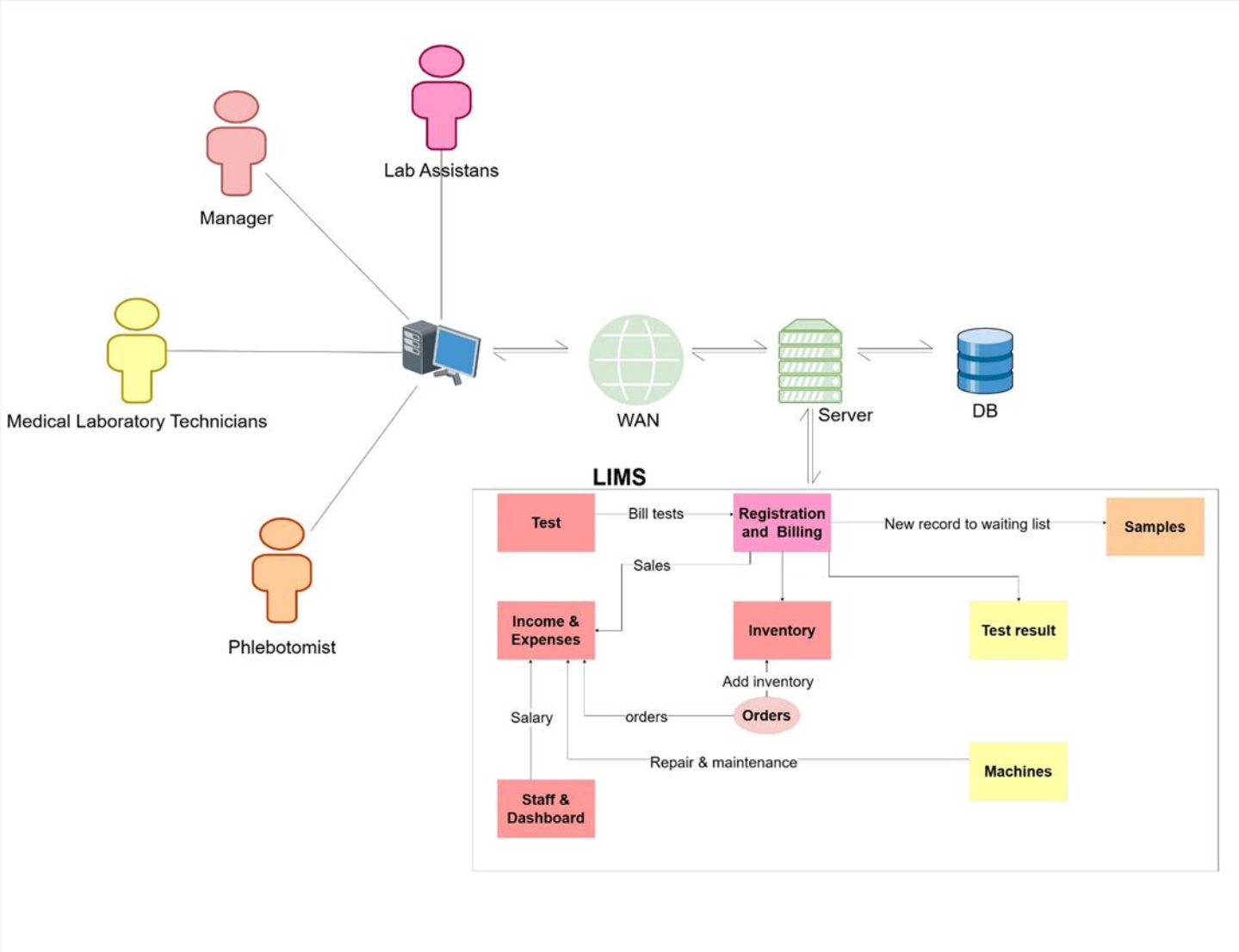

Figure 1-1-1 System overview

- Actors and their functions are colour matched in the above diagram.
- LIMS includes 7 functions:

    1. Sample and Test Results
    2. Registration and Billing
    3. Income and Expenses
    4. Login and Staff
    5. Inventory
    6. Machines
    7. Test Data

1.5.1. Sample and Test results

Effective management of samples and tests is critical for accurate and timely diagnoses and can significantly improve patient outcomes. In a laboratory setting, the process typically comprises three distinct phases, each of which is crucial to ensuring high-quality results: pre-analytical, analytical, and post-analytical. [6]

During the pre-analytical phase, the focus is on proper handling and tracking of samples. When a patient is billed, their information is entered into a waiting list that keeps track of which tests need to be performed that day. A sample record is created from the waiting list, and the sample is marked as pending. When a phlebotomist (a trained professional who performs sample collection) collects the sample from the patient, they mark it as collected in the LIMS system, which records the time of collection and moves the sample to the accessed section. The phlebotomist then prints unique barcodes to label the sample for tracking throughout the lab. If the phlebotomist needs to recollect the sample, they can move it back to the pending stage by clicking on "redraw." Additionally, the phlebotomist can dismiss the sample for reasons such as hemolysis, insufficient quantity, or if the test is canceled.

In the analytical phase, the sample is investigated by the medical laboratory technician (MLT). This is the stage where the actual analysis of the sample takes place, and it is crucial that the technician follows the proper procedures to ensure accurate results.

Finally, in the post-analytical phase, the MLT enters the test results and has the option to edit them before submitting. The test record is then removed from the waiting list and moved to the archives. There is also the option to print or save the report as a PDF.

Non-functional requirements:

- Performance – the system should be able to handle many samples, data entry and retrieval faster.
- Data integrity – the system should identify and prevent entry of wrong data.
- Security – the system should have security measures to protect sensitive data.

Technical requirements:

- Database – the system should have a one centralized database that can handle large amounts of data entry and retrieval and real time updates.
- Export files – the system should be able to export files such as test reports in a pdf format.
- The staff will require printers and barcode readers for labeling and tracking samples.
- Sending emails to patients.

1.5.2. Patient registration and billing

Patient registration and transaction management is essential for any laboratory regardless of organizational size, financial backing, or any other factors. Inefficient and manual record-keeping processes can lead to errors, confusion, and delays in delivery services. The lack of a centralized system can also make it difficult to keep track of patient billing, history, and service delivery. Storing an ever-expanding cluster of patient data effectively can be challenging and tedious if not done properly.

To address the above problem, we propose to facilitate the automation of day-to-day laboratory operations. Said system will enable patients to register, view their previous medical reports, calculate their bills , and view their transaction history. Additionally, the system will also provide a platform for lab personnel to approve the service requests made by the patients, add them to a pending list and mark them as "completed" when the task is performed.

First of all the lab assistant who also doubles as the receptionist, will search for the NIC of the patient when they request a service. If the patient is not registered in the system, the receptionist will proceed with the registration process. For this personal information like name, NIC, email address will be asked and entered to the system. If for some reason the patient is unable to provide NIC, then a legal identification number assigned to the patient such as passport number , driving license number etc can be used instead. If the patient is already registered with the system, then the registration process will be skipped, and the lab assistant will be directed to the patient's profile page.

For the billing process, the lab assistant will inquire to the patient on which services that they need from the laboratory. A list of services offered by the laboratory will be displayed and are expected to be chosen according to the patient's requirements. If the patient requests a service that is not offered by the laboratory, the receptionist will add that as an "to be outsourced" test. After this process, the patient's requirements will be added to a bill. Once the bill is calculated, it will be sent to the patient's email, and it can also be printed as a receipt. The transaction details will be also saved in a database that contains the patient's profile information . Meanwhile, the requested services will be added to a list known as "yet to be completed test", and the lab personnel will mark them as "completed" when the service is performed successfully. Any reports generated by said tests will be stored in a database.

Non-functional requirements

The non-functional requirements of the proposed system include scalability, reliability, and security.

- Scalability - The system should be scalable to accommodate future growth since the patient's datasets are always expanding with every transaction.
- Reliability - This ensures that the system is always available and accessible when needed.
- Security - the system should be secure since it contains sensitive data such as patients' personal information and transaction details.
- User friendliness - The system should also be user-friendly, with an intuitive interface that is easy to use and navigate.
- Low response time - Since the data is stored in servers, the data retrieval and upload time should be decreased.

Technical requirements

- Database – The system should have a centralized database that can handle large amounts of data entry and retrieval and real time updates.
- Printers - The system should have printing capability since the bills and reports should be printed.
- Email API - To send a softcopy of the reports and bills to the patient, an automated emailing system should be implemented.

1.5.3. Income and Expenses

Income and expenses management are very important for any laboratory. Because most of the decisions regarding the future of the laboratory depend on the financial report. This function provides the net revenue of the laboratory and user can get the idea about whether laboratory is working well. The income is the money the laboratory takes in. The laboratory get it from the patients who get the service from the laboratory. To enter income system has billing function and from the income function user can get the total income according to given date or year. In this option system validate the value and date with entered data type and Date.
The expenses are the money the laboratory spends on. In this system expenses are divided into two parts. The first one is daily expenses. It describes the day-to-day expenses laboratory has. Such as water bill, electricity bill etc. The user must manually enter these expenses for the system. For that user must select the add expenses option. Then the system displays the added expenses form. So that user must enter expenses name with amount and the date expenses done. In this option the system validate date and amount with entered data type and Date.
The second one is orders. It describes the money spent by the laboratory on orders. Inventory orders is one of the examples of that. These expenses are in inventory management function and user can get total expenses according to the date or year. In this option also system validate the value and date with entered data type and Date.
Generating the financial report is one of the options of income and expense's function. For this user must choose the generate report option and the time duration. Time duration validate the system with the date and finally generate a financial report with income and expenses details. Whether the user wants to get previous report, system provides search option and user can get it by entering the month or year required. System validates the date in here also. If the user wants to print the report system has print option and user can get the pdf type report.

Non-functional requirements

- Reliability -This ensures that the system and the data are always available always it is needed.
- Security – system should secure the sensitive data in the system.
- User-friendliness – System should always be user friendly with an interactive interface.

Technical requirements

- Database – The system should have one centralized database to handle the large amount of data.
- Export files – The system should be able to export files when financial reports are needed in pdf type.
- Printers – the system should have printing capabilities to print the financial reports when it is required.

1.5.4. Login and Staff Management

System Login is responsible for holding the accessibility and authentication of users to the system. System login provides two functions as Admin Login and Staff Login. Admin Login is for the administrator of the system and the Staff Login is for the rest of the staff members in the laboratory. System Admin can create accounts in the system for staff members and the function is responsible for adding the account details to the database. Only Admin has the facility to delete profiles. Staff members and Admin may login to the system and update profiles and the function has the capability to retrieve , delete and update data in the database when such actions are performed. Furthermore, sub-functions such as password management, setting user privileges , ability to search for specific system logs and generating reports on system usage are included in the function.

This function is responsible for recording attendance as the user logins to the system. This task will be performed once per day for a single user. At the end of the month the system will calculate the total presented days in the month, and it will calculate the salary of the user. Function can generate reports on the performance of the staff members considering their attendance.

Non-Functional Requirements

- Usability – Login function will be simple so its easy for user to use.
- Performance – System will have quick response time so user can login to the system without a delay.
- Security – password secure policies and procedures will be used to prevent unauthorized access.
- Scalability – As the user base grows the system will be able to keep up with better performance and secure policies.

Technical Requirements

- Database -the system should be able to handle many records and retrieve them faster.
- CAPCHA and two-factor authentication will be used to prevent unauthorized access.
- The attendance will be automatically recorded as the user logins.

1.5.5. Inventory Management

Inventory management System is used for keeping track of chemicals and test-kit in the lab, remove test-kits and track how much has been used. Inventory Management system is very important to the efficiency of laboratory operation. Also, a report is created about all the inventory management processes that takes place in the laboratory over a month.
Here, the quantity of Test-kit and chemical is calculated live and when their quantity is minimum, the manager is notified through notifications. Then the manager is checked if he has current stock. If there is stock, it will be added to the system and if there is no current stock, the manager will order stock in the required quantity.
When a patient registers for a test and selects the test from the drop-down menu, the number of test kits related to that test is displayed, and after the patient registers for the required test, it is subtracted from the inventory of test kits and chemicals related to the test. Always keeping inventory in the lab without inconveniencing the patients. The report created monthly is very helpful to avoid the problems caused by the test kit, because it is created monthly, so we can understand how much inventory we need in the future.

Non-functional requirement

- Accessibility - Only managers can do inventory management.
- Usability – User-friendly, easy to navigate, easy to use and perform tasks efficiently.
- Reliability – No crashes or data loss.
- Integrity – The system does not allow outdated inventory to be entered into the system.

Technical Requirements

- Database – The system should be able to handles and retrieve them efficiently, adding and subtracting inventory according to the test that happens every time.
- Staff need printers to print reports.

1.5.6. Machine Information Management

Machine information management system is designed to collect, store, manage, and analyze machines. Machine information management can help improve laboratory operations' efficiency and accuracy.
This is a system for managing machine information that gathers and stores machine-specific information. The information about the machine includes its model, manufacturer, brand, serial number, date of purchase, and place of manufacture. The database is updated whenever a new device is bought by adding new machine records.
All of the machines that belong to that specific machine type that are available are shown once a staff member searches for a machine type. Assume, for instance, that there are three microscopes in the lab and a staff member is trying to find the oldest one, but all three are on exhibit. The user can then choose a certain microscope and get all of its specifications.
With the scheduling of preventative maintenance and the identification of problems, before they result in downtime or other issues, this machine information management assists in managing the maintenance and servicing of machines. MLT updates the record on that system with all of those details as well. The database also keeps track of when maintenance and quality control were performed. The system creates a report with the technician's name, maintenance information, payments, and the scheduled date for subsequent maintenance. A column in the database keeps track of the upcoming maintenance and quality control days. Hence, staff members should update the database to add new details as soon as machine details are added.
Employees can look up information about machines, including all problems, fixes, replacement parts, and maintenance histories.
The record should be deleted of the machine's details once it is malfunctioning.

Non-functional requirements

- Accessibility – Machine information management is accessible to medical laboratory technicians and the owner of the laboratory.
- Usability – easy to use, user-friendly, easy to navigate, perform tasks efficiently.
- Reliability - downtime, crashes, or data loss are very low.
- User-friendliness - interface is attractive, simple, and easy to use.
- Integrity – system identifies and prevents the entry of wrong data.

Technical Requirements

- Database -the system should be able to handle many records and retrieve them faster.
- Export report - possible to export the reports that the system generates.
- Printers – printers are used to print reports.

1.5.7. Test Data Management

There are different kinds of tests being performed daily in a medical lab. These tests can be divided into two main categories as inhouse tests and outsourced tests. Inhouse tests are tests where the samples are both collected and tested in the lab while outsourced tests are the tests where the samples are collected and transferred to another lab to perform the test. The information recorded on these tests affects the rest of the workflow. Hence it is important that the information about the tests being conducted by the laboratory is managed properly.
This function aims to make the process of creating, retrieving, updating, and deleting different kinds of tests being performed by the lab more efficient and usable. The primary user intended for this is the manager of the laboratory.
The user will be shown a list of all currently available tests when the user first enters the function. In addition to the test name important information such as the test ID, short name for the test and the price will be shown for each test. Also, a special tag will be displayed for the outsourced tests. In addition, a search bar will be available to retrieve a specific test that the user wants.
An option will be given to add new tests using which a user can create a test by providing necessary information such as test ID, test name, short name, price, remarks to be printed in the report related to a new test. Users can also add test subcategories that will be checked in a particular test. A single test can have many subcategories and these subcategories have their own attributes such as unit of measurement (UOM), references range and category heading.
Once a test is selected from currently available tests, if the subcategories of a particular test or the test itself must be updated an option will be provided to accomplish that using this function. The relevant values will be filled upon viewing and user can update the information required and save the changes.
If any of the tests being conducted by the laboratory is discontinued, an option will be provided to delete that test after selecting it from the list of tests.
Additionally, reports can be generated on a specific test that contains all information about the test including the subcategories of that test. Also, the user will be given an option to generate a report on all available tests which will contain only the necessary information such as test ID, test name, short name, and price. An option will be given to manage the courier details of outsourced samples of a particular day.

Non-functional requirements:

- Time to complete user requirement – since the user is entering and managing a lot of data, the time to complete the task should be made low as possible.
- Usability – since this is the first time a computerized system is used for the client; it should be simple and user friendly as possible.
- Access control and Security – since the information on test data can affect the rest of the business flow, who can manage this information should be selected carefully and made sure cannot be accessed by any other.

Technical requirements:

- Database – data entered using this function will be used by other functions thus making a centralized database such as mongo DB a necessity.
- Front-end – a web browser that can run JavaScript is needed since the web app is developed using MERN stack.
- Export reports – the ability to export the reports generated by the system should be present.

1.6. Methodology

Our team plans on using a variety of methods, tools, and technologies to develop an efficient laboratory information management system web application. For this agile system development method will be used, which is well-suited for software development projects with rapidly changing requirements.

Requirements Engineering Methods:

To collect and analyze requirements, we are planning on interviews, surveys, and focus groups. And, through observations and document analysis we can get a better understanding of how the regular business routine is being done currently. We will also use use-case modeling to document the functional requirements of the system. Diagrams.net provides access to all the necessary tools to design the use-case model efficiently. For that reason, Diagrams.net is chosen among alternatives such as Gleek.io and lucid chart. In addition, we will converse with individual stakeholders to ensure that their requirements are addressed and make any necessary changes in a timely manner.

Design Methods:

For designing the system, we will use Figma, a collaborative design tool that allows our team to create interactive and responsive user interfaces. We will create design prototypes and share them with the client to get their feedback. As alternative options, Adobe XD or Axure RP can be used instead. However, since Figma has a very user-friendly nature, all the while providing essential tools for UI designing, we decided to select Figma as the number one option.
Also, for designing essential documents such as project proposals, charters Microsoft Office software package will be used. LibreOffice packages can be used alternatively. However, since Microsoft Office packages offer excellent design tools and all the members are well experienced with the said software package, it was chosen over LibreOffice.

Development Tools and Technologies:

To develop the system, we will use MERN stack, a popular open-source technology stack that includes MongoDB, Express, React, and Node.js. MongoDB will be used for database management, Express for back-end development, React for front-end development, and Node.js for server-side development. The MERN stack is supported by a huge community. And our development team is well versed with MERN stack. So, it was chosen over other alternatives such as MEAN and MEVN. Also GitHub will be used for version control and collaboration since it centralizes the software system in a single development environment that can be accessed by all the members. And GitHub is backed by its popularity and functionality. Alternatively, local Git or Bitbucket can be used.

Testing Methods:

We will use both manual and automated testing methods to ensure that the system is functioning as expected. We will conduct unit tests, integration tests, and system tests to identify and fix any bugs in the system. For this purpose we are planning to use JUnit since it is open source. Testing Whiz or Test Complete tools can be used as alternatives.

Integration Methods:

To ensure that the different parts of the system work together seamlessly, we will conduct integration testing. We will also use continuous integration and continuous deployment (CI/CD) tools to streamline the integration process and quickly deploy new changes.

Project Plan:

To manage the project, we will use Click Up, a project management tool. Click Up offers a variety of tools for project management. And also, it has a user-friendly interface. Therefore, Click Up was selected as the project management tool for our LIMS application. As alternatives, Basecamp or Trello can be used if any unforeseen circumstances were to occur with Click Up. Furthermore, we will create a Gantt chart to track our progress and to ensure that the project is completed on time. We will also create a work breakdown structure (WBS) in a tabular format to break down the project into smaller, manageable tasks.

In conclusion, we believe that our methodology is well-suited for developing an efficient laboratory information management system web application that meets the client's requirements. We will use a combination of methods, tools, and technologies to ensure that the project is completed successfully and on time.
Refer appendices for the Gantt chart.

GitHub Repository

Link : https://github.com/SLIITITP/y2_s2_wd_it_01-itp_wd_b08_g05

Clone it : https://github.com/SLIITITP/y2_s2_wd_it_01-itp_wd_b08_g05.git

2. Requirements

2.1.Stakeholder analysis

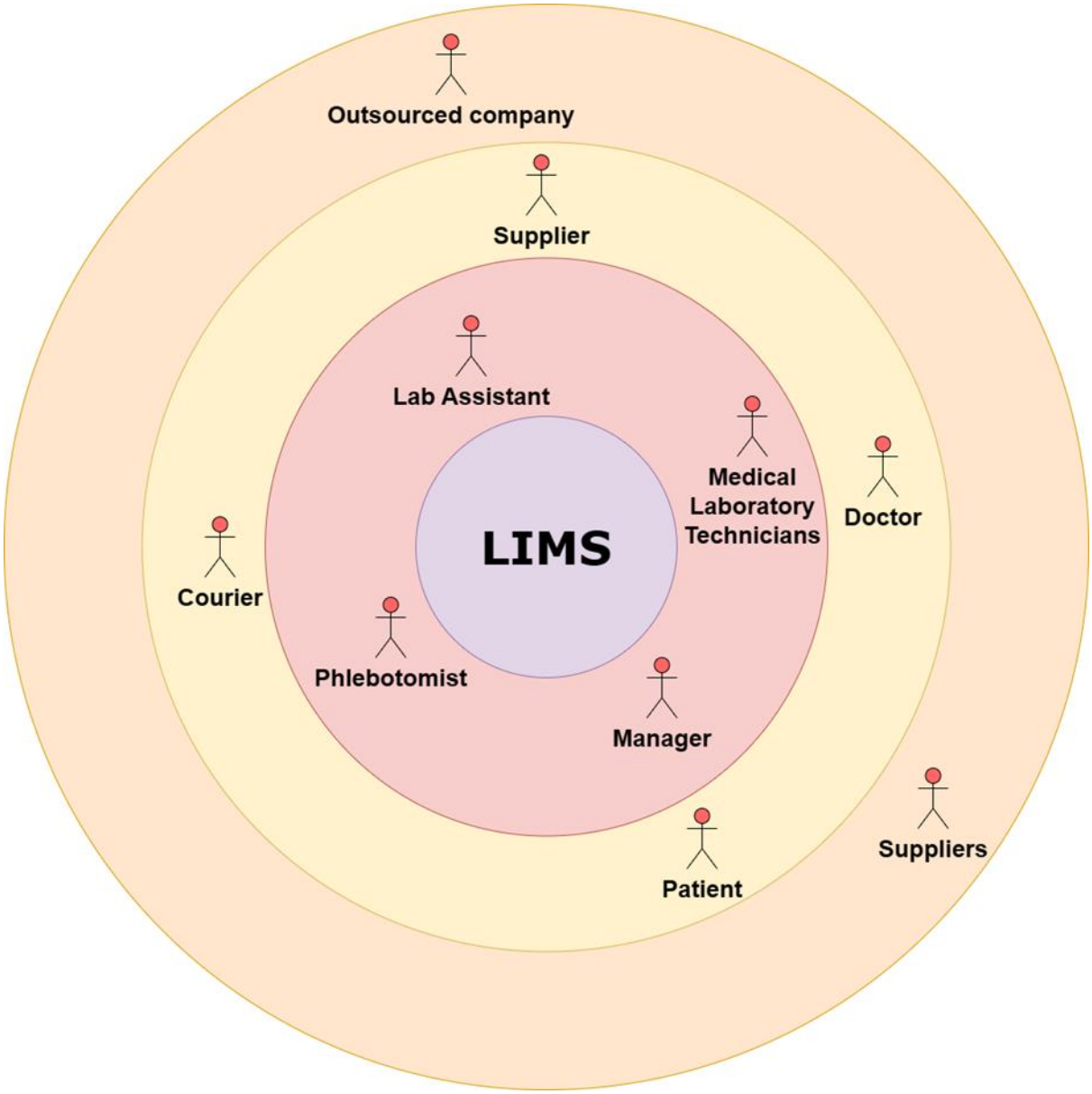

Figure 2-1 Onion Diagram

Based on the provided diagram, we can identify the stakeholders involved in the system. The first circle represents the product, and the second circle represents the stakeholders who interact directly with the product. These stakeholders include lab assistants, MLTs (medical laboratory technicians), managers, and phlebotomists. They are the individuals who directly engage with the product and play a vital role in its development and use.

The next circle represents stakeholders who are not directly involved with the product but are still crucial to the system's success. This group includes suppliers, doctors, couriers, and patients. While

they do not interact with the product directly, they play a crucial role in ensuring that the product is successfully delivered and utilized.

Finally, the outermost circle represents individuals or entities who are outside the business but still play a role in the system. This group includes outsourced companies and other suppliers. These entities are vital to ensuring that the product is developed and delivered efficiently.

In summary, the stakeholders involved in the system can be classified into four circles, with each group playing a crucial role in the success of the product.

2.2.Requirements analysis

Once the stakeholders that were directly involved in the system were identified, the requirements were analyzed by identifying their user stories , functional requirements, nonfunctional requirements, and technical requirements.

Refer Appendix B for use case scenarios.

Table 2-1 User stories of stakeholders

Lab Assistant/Receptionist	As a receptionist, I want to register patients to the system so that I can handle customer requirements. As a receptionist, I want to check previous customer reports, so that I can check the medical history. As a receptionist, I want to calculate bills, so that I can charge patients accordingly.
Phlebotomist	As a phlebotomist, I want to be able to record the date and time of sample collection, so that the laboratory can accurately track the progress of each sample. As a phlebotomist, I want to be able to print labels for blood samples, so that I can label them accurately and efficiently, and ensure that they are processed correctly.
Medical Laboratory Technician (MLT)	As an MLT, I want to add test results so it's available for generating reports. As an MLT, I want to be able to generate test reports so that it will be accessible for health care professionals. As an MLT, I want to check the quality of machines, so that the machines adhere to proper standards and gives accurate results.
Manager	As a manager, I want to record staff attendance, so that I can check staff performance. As a manager, I want to view statistical reports so that I can take data driven management decisions. As a manager, I want to manage inventory, so that I can manage stock levels. As a manager, I want to insert new tests to the system, so that staff can use them to bill patients. As a manager, I want to create user accounts, so that staff can access the system.

Table 2-2 Functional, nonfunctional, and technical requirements

	FRs	NFRs
Lab Assistant	• Patient Registration • View Patient Billing History • View Patient Reports • Calculate Bills • Manage courier details	• User-friendliness • Security • Low server access time • Reliability • Accuracy
Phlebotomist	• Collecting samples • Printing sample labels	• Reliability • Accuracy
Medical Laboratory Technician (MLT)	• Add tests results • Generate Reports • Add new machine records • Quality Control • Maintain machine records • Service maintenance.	• User- friendly • Accuracy • Reliability • Security • High response speed • Low server access time.
Manager	• Manage test data • Enter the expenses. • Calculate the net revenue. • Generate the financial report. • Login • User account management • Back up and restore • Generate test kit and chemical report • Manage Inventory	• Access Control • Usability • Security • Portability • Reliability • Accuracy • Time to generate report

Technical Requirements:

- Computer
- Web Browser
- Internet
- Barcode reader
- Printer

2.3.Requirements Modelling

Requirements modelling were developed by utilizing a use case diagram.

Figure 2-2 Use case diagram

3. Design and Development

The design and development phase of the project involved creating an ER diagram and relational schema as a starting point for our database design. Despite using a NoSQL approach with MongoDB, the ER diagram and relational schema were useful in providing a rough idea of the data model. In addition to this, sequence diagrams were created for each function in order to visualize the process and workflows of the system. Overall, this approach allowed us to establish a solid foundation for the development of the project, ensuring that the database design and system functionality were thoroughly thought out and planned.

In addition to the ER diagram, relational schema, and sequence diagrams, we also created wireframes to help visualize the user interface and interactions. These wireframes were essential in guiding the development of the user interface and ensuring that it was both user-friendly and efficient.

Figma wireframes :
https://www.figma.com/file/mFEnxrEPxJCQ6OZPqM08Ts/LIMS?type=design&node-id=52%3A2&t=gmMTFLo73jrVIAWS-1

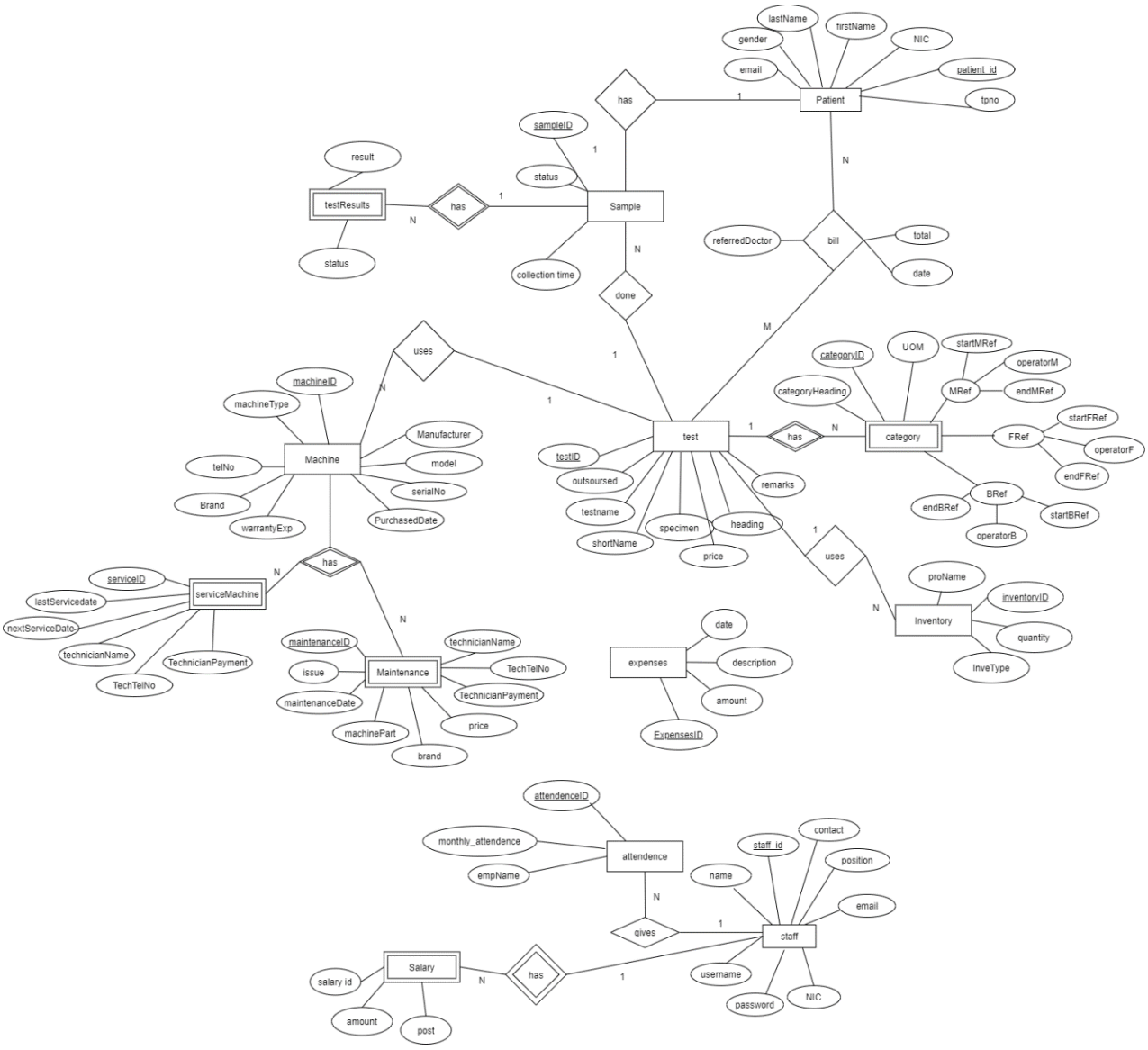

Figure 3-1 ER diagram

Figure 3-2 Realshional Schema

Class diagram

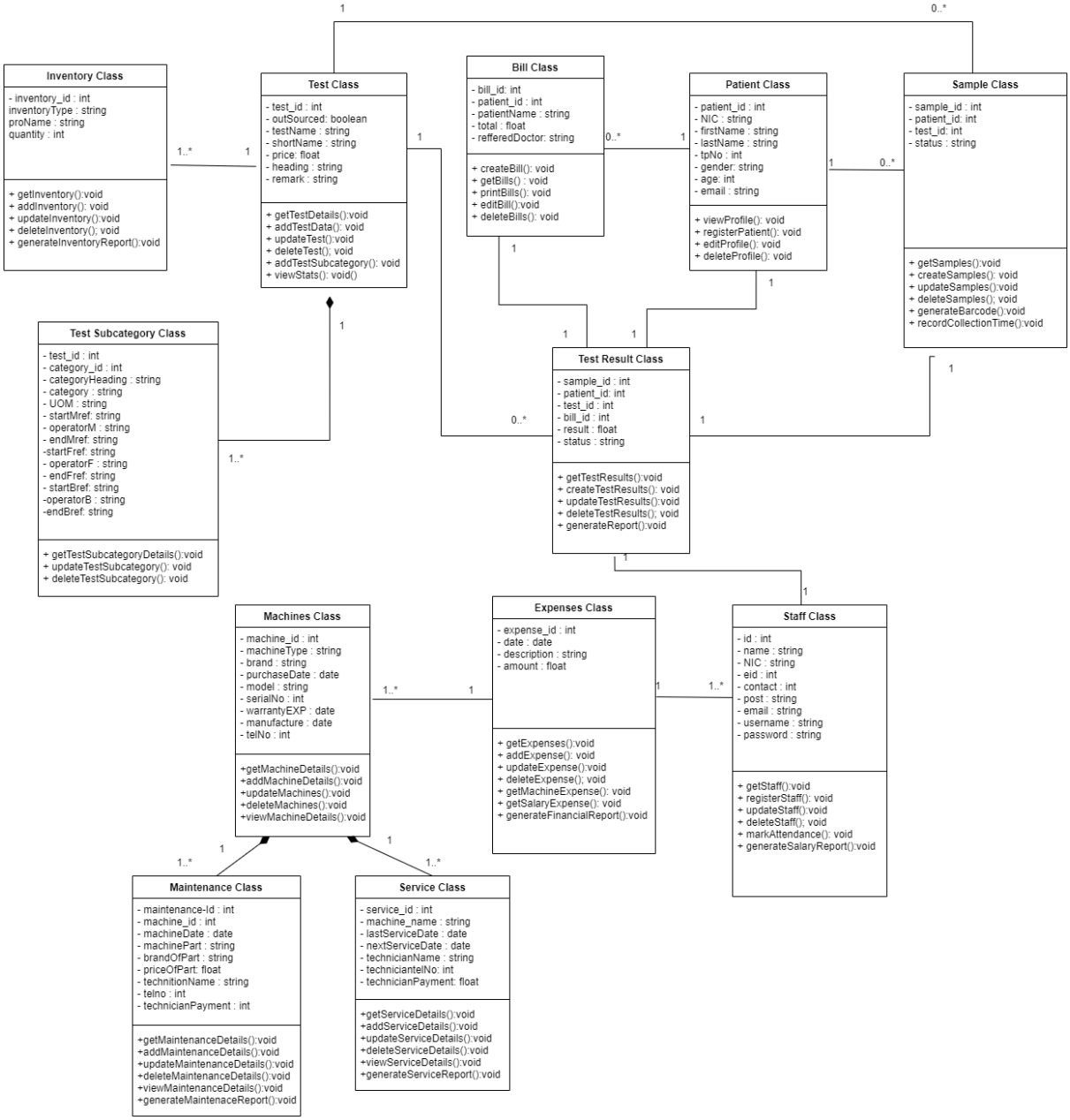

Figure 3-3 Class diagram

Sequence diagrams

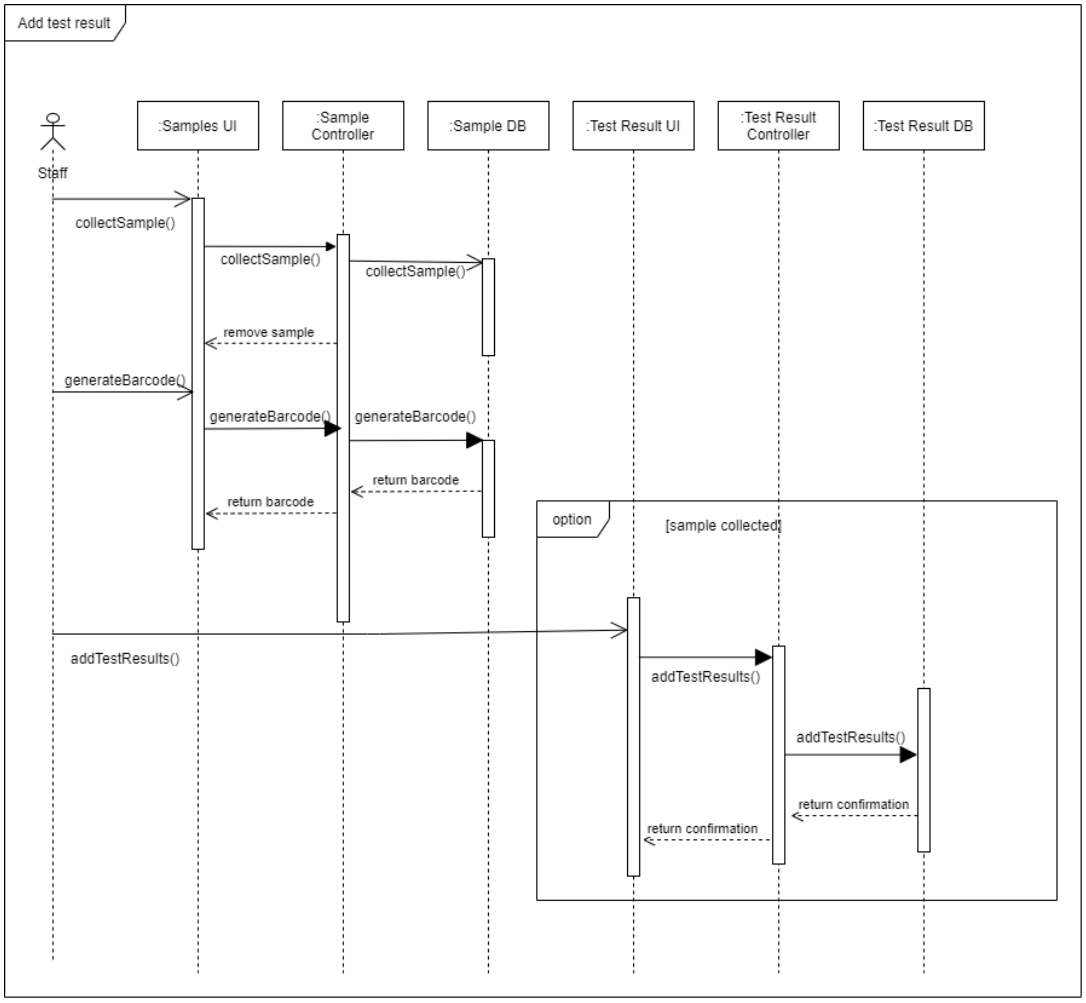

Figure 3-4 Sd Add test result

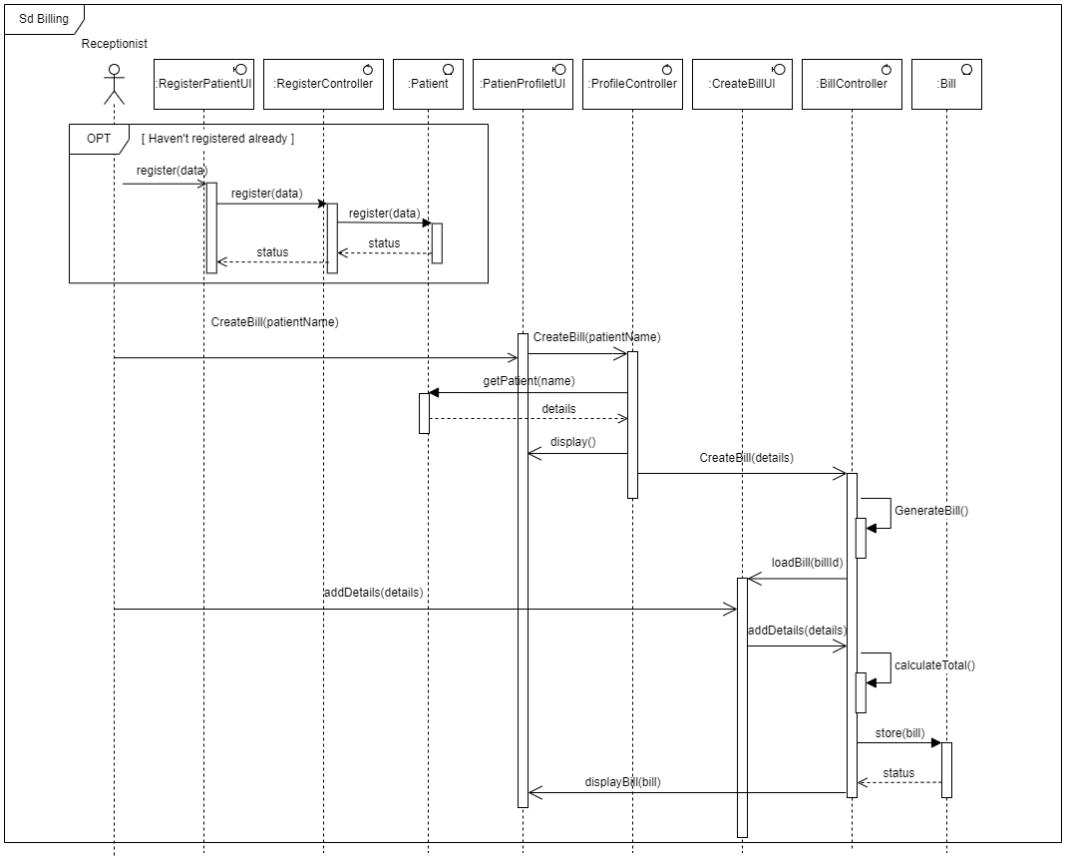

Figure 3-5 Sd Billing

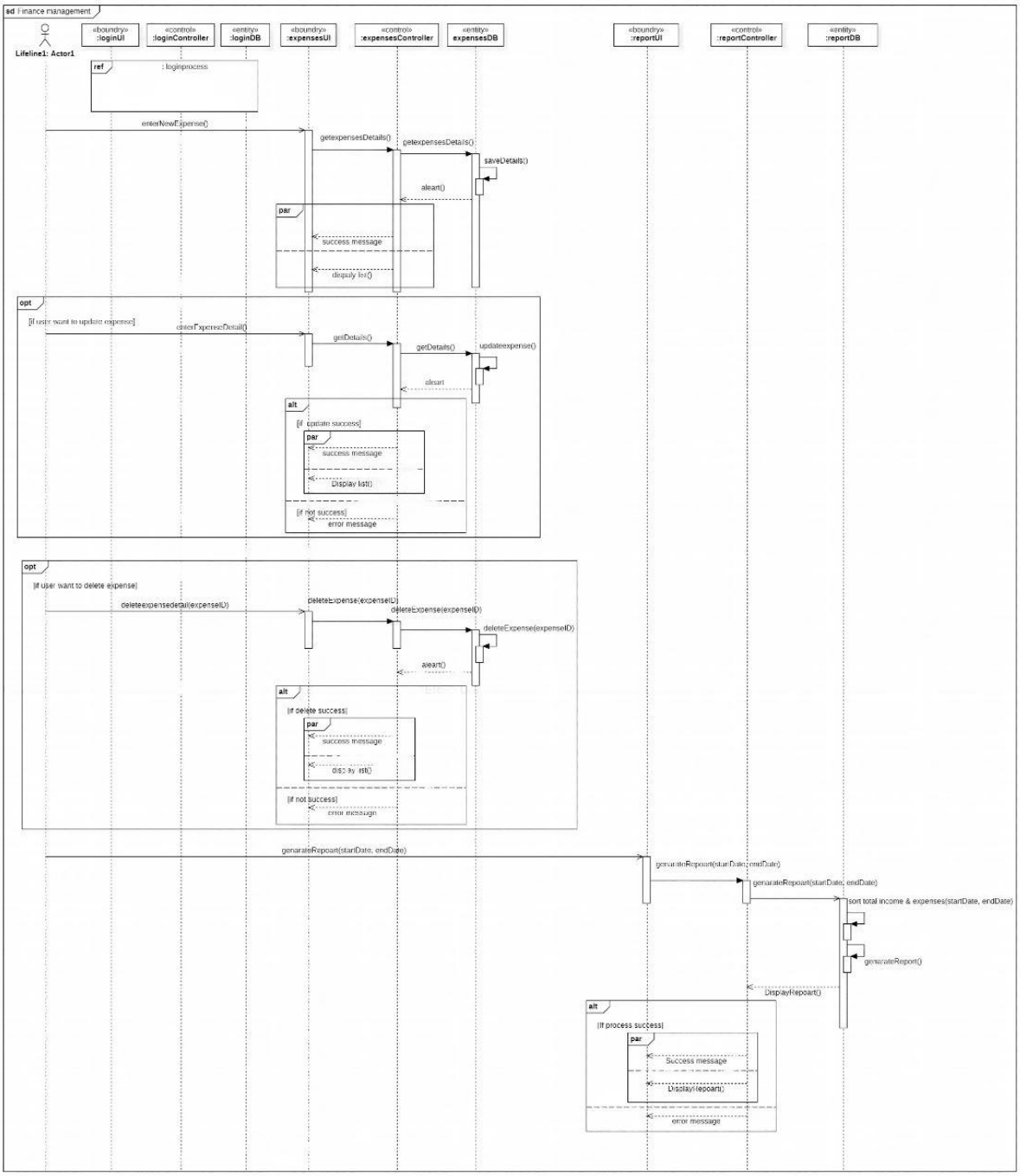

Figure 3-6 Sd Finance management

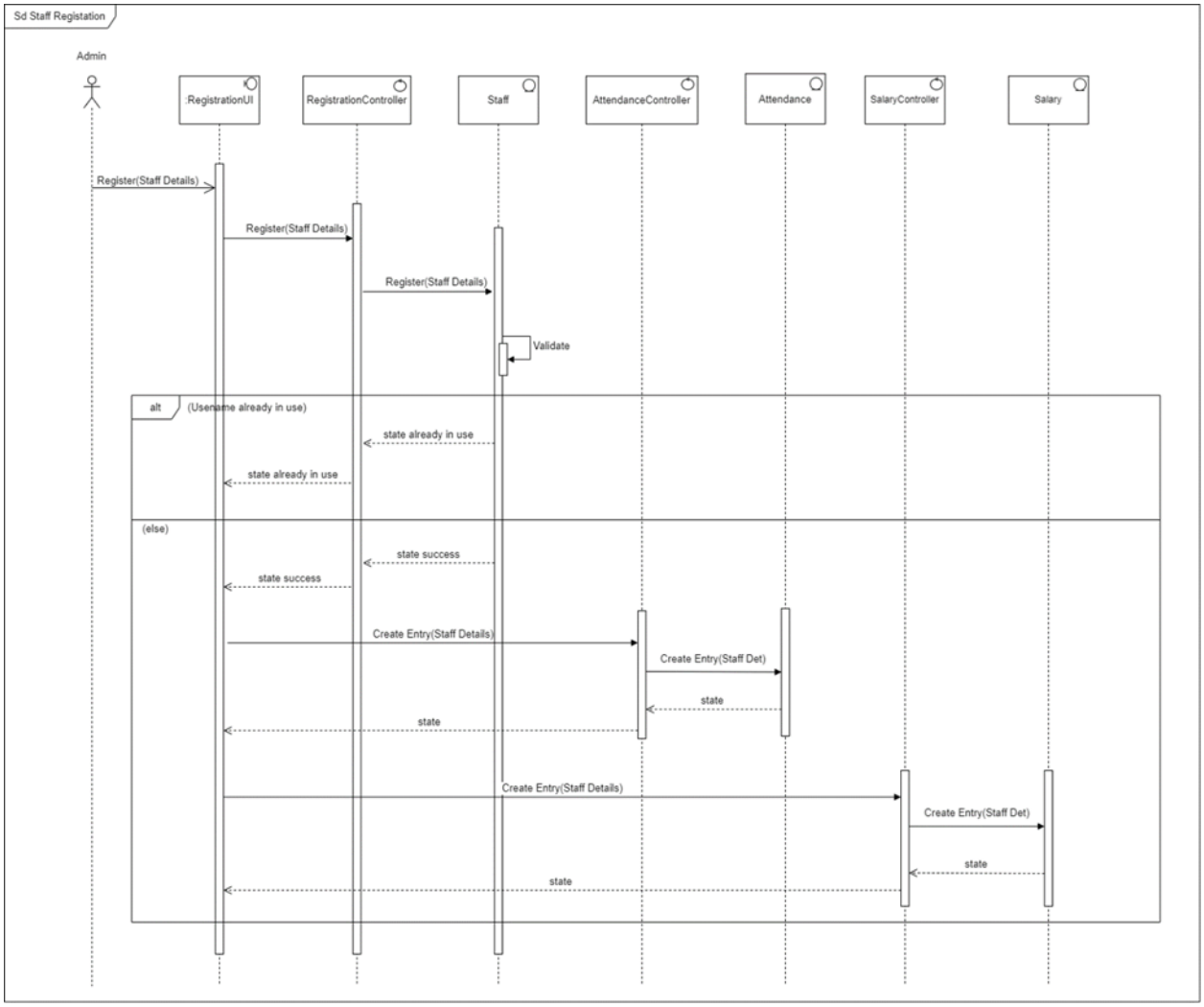

Figure 3-7 Sd Staff registration

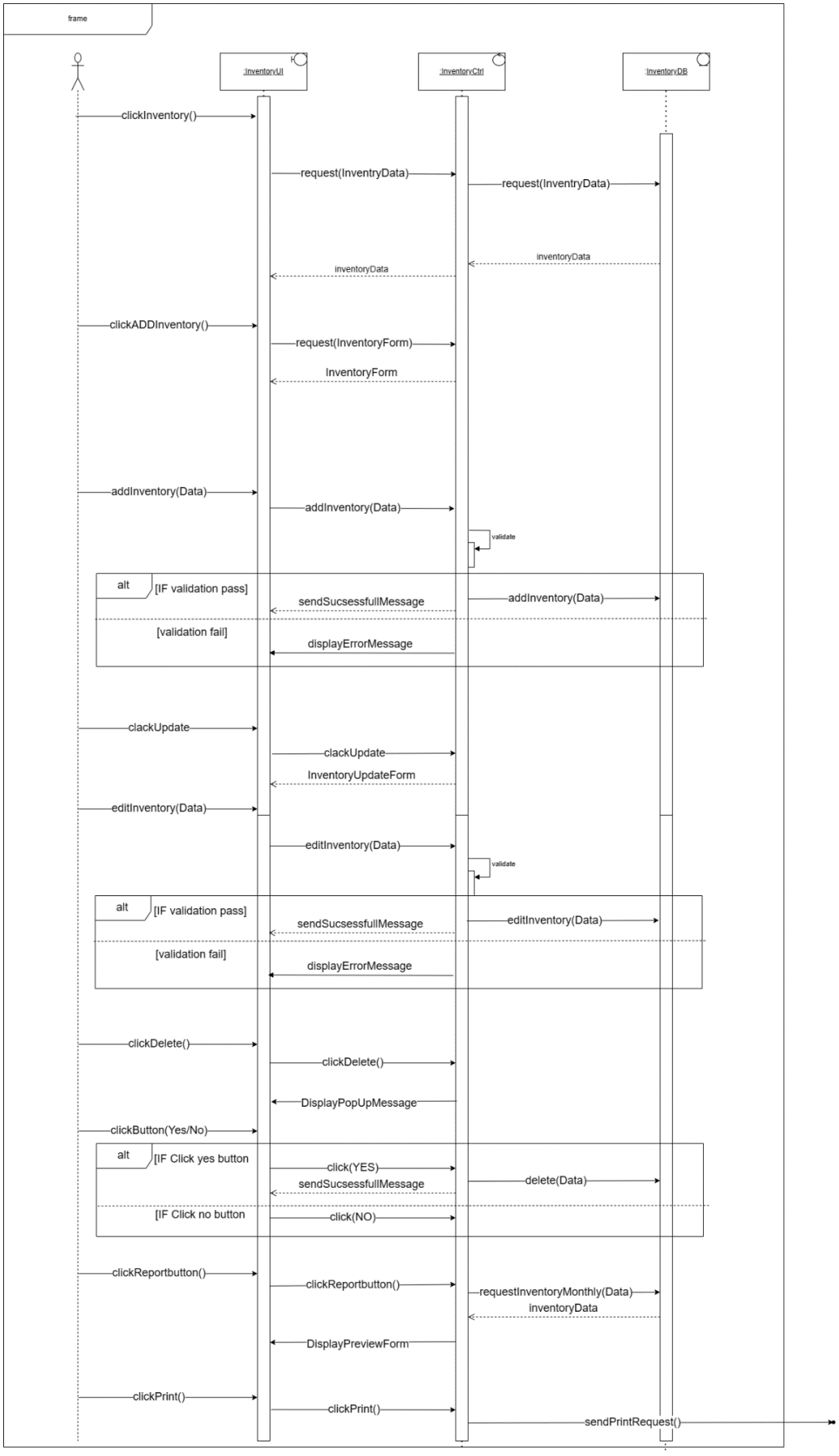

Figure 3-8 Sd Inventory

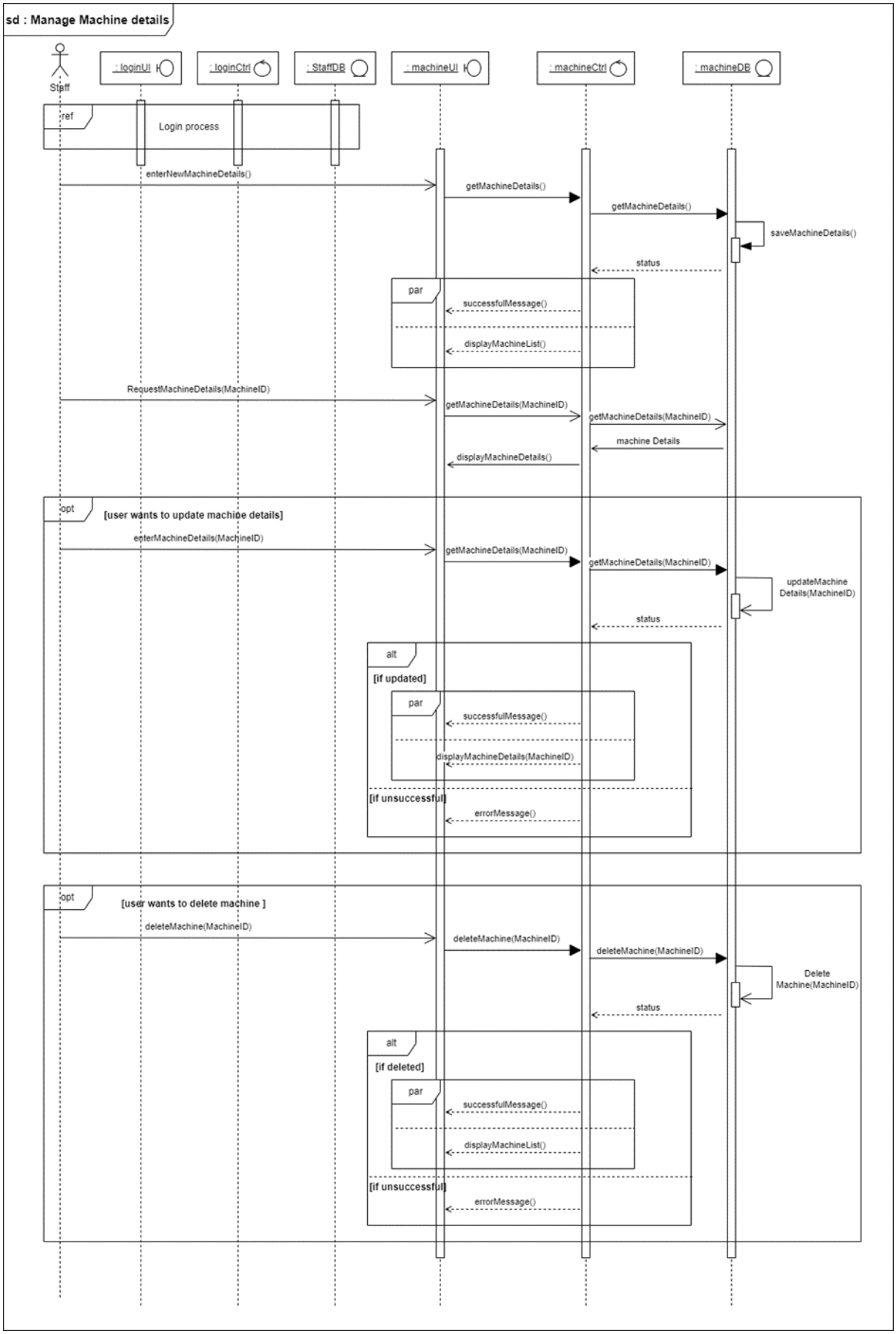

Figure 3-9 Sd Manage machine details

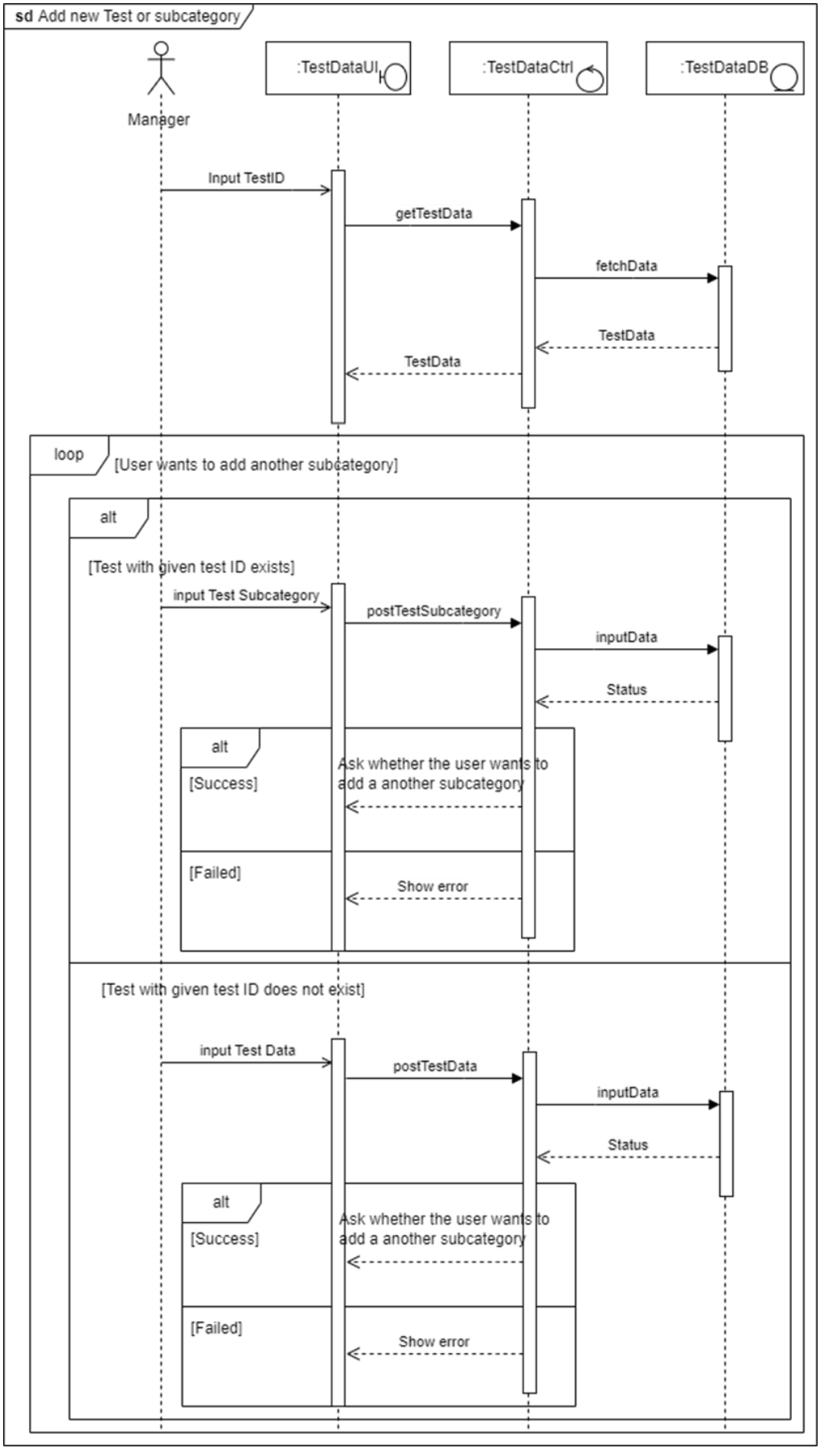

Figure 3-10 Sd Add new test or subcategory

4. Testing

In order to ensure the reliability and functionality of the system, testing was conducted using a manual approach. The first step was to develop test cases for each of the seven functions of the system. These test cases were designed to cover all possible scenarios and ensure that the functions performed as intended. Once the test cases were developed, individual tests were carried out to determine how each function worked. After testing each function individually, integration testing was conducted to ensure that the different functions worked together seamlessly. The results of these tests were documented and analyzed to identify any issues or bugs that needed to be addressed before the system could be deemed fully functional and ready for use.

Below are the test cases and results for the create/add and retrieval operation. Refer appendix B section for further test cases and results related to update and delete.

4.1. Sample and Test Results Testing

Test case ID: T01	Test designed by: Gunawardana U.G.C.D
Test title: Creation of sample and test records	Test designed day: 08/05/2023
Test priority: High	Test executed by: Gunawardana U.G.C.D
Module name: Sample and Test results	Test executed day: 08/05/2023
Description: Once a patient is billed new sample and test records should be created	
Preconditions: Patients should exist	
Dependencies: Patient, Bill	
Test steps: Navigate to patients list, Add a bill to the patient Select services and add bill Navigate back to pending tests, Naviagate to pending test results	

Test case ID: T03	Test designed by: Gunawardana U.G.C.D
Test title: Add test results	Test designed day: 08/05/2023
Test priority: High	Test executed by: Gunawardana U.G.C.D
Module name: Test results	Test executed day: 08/05/2023
Description: Add test results to the pending tests that needed to be done	
Preconditions: Patients should be billed	
Dependencies:	
Test steps: Navigate to pending test results page, Click on add button, Add test results, Click on submit button	

Test ID	Test inputs	Expected Output	Actual Output	Result
T01	Add bill	Display relevant records in the data table	Display relevant records in the data table	Pass
T03	values in numeric values	Success alert. Update status to completed	Success alert Update status to completed	Pass
T03	Values in letters	Does not let enter characters other than numbers	Does not let enter characters other than numbers	Pass

4.2.Patient Registration and Billing Testing

Test case ID: T04	Test designed by: Gunathilaka L.P.N
Test title: Register patients to the system	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Patient management	Test executed day: 08/05/2023
Description: verify that the patient registration process , registers a patient to the system	
Preconditions: The receptionist is logged into the system	
Dependencies:	
Test steps: Navigate to Patient Registration page Fill the given form with correct values Click the submit button	

Test case ID: T07	Test designed by: Gunathilaka L.P.N
Test title: Create Bill	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Billing	Test executed day: 08/05/2023
Description: verify that the bill is created successfully	
Preconditions: The receptionist is logged into the system	
Dependencies:	
Test steps: Navigate to Patient Registration page Click the Add Bill button Add services requested by the patient and fill the referred doctor field Click the confirm button	

Test ID	Test inputs	Expected Output	Actual Output	Result
T04	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Success Message	Success Message	Pass
T04	NIC: Invalid NIC First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot Enter Invalid Characters	Cannot Enter Invalid Characters	pass
T04	NIC: First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot submit Empty values	Cannot submit Empty values	pass

T04	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: Invalid Id Age: 10 Email:example@example.com Gender: Male	Cannot Enter Invalid Characters	Cannot Enter Invalid Characters	pass
T04	NIC: 200021701855 First Name: Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot submit Empty values	Cannot submit Empty values	pass
T04	NIC: 200021701855 First Name: Dinal Last Name: Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot submit Empty values	Cannot submit Empty values	pass
T04	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: -1 Email:example@example.com Gender: Male	Cannot submit numbers less than 0	Cannot submit numbers less than 0	pass
T04	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email: Invalid Email Gender: Male	Cannot submit Invalid email format	Cannot submit Invalid email format	pass
T07	Referred Doctor : Dr. example Select requested services	Success Message	Success Message	Pass
T07	Referred Doctor : Select requested services	Cannot submit	Cannot submit	Pass
T07	Referred Doctor : Dr. example Do not select requested services	Show Error message	Show Error message	Pass

4.3.Income and Expenses Testing

Test case ID: T10	Test designed by: Surendra D.M.B.G.D
Test title: Creation of day-to-day expenses and retrieve records.	Test designed day: 08/05/2023
Test priority: High	Test executed by: Surendra D.M.B.G.D
Module name: Expenses insert	Test executed day: 08/05/2023
Description: Once a user inserts a new expense, expenses record should be retrieved	
Preconditions: User should exist	
Dependencies: User, Expenses	
Test steps: Navigate to add expenses, Add a new expenses record, Navigate to the view expenses.	

Test case ID: T13	Test designed by: Surendra D.M.B.G.D
Test title: Generate financial report	Test designed day: 08/05/2023
Test priority: High	Test executed by: Surendra D.M.B.G.D
Module name: Financial report	Test executed day: 08/05/2023
Description: Financial report should be generated.	
Preconditions:	
Dependencies: Expenses, income	
Test steps: Navigate to Financial report page, Select the start date and end date, Try to generate report.	

Test ID	Test inputs	Expected Output	Actual Output	Result
T10	Description: Water bill Amount: 20000.00	Success alert	Success alert	Pass
T10	Description: Amount: 20000.00	Empty fields error	Empty fields error	Pass
T10	Description: Water bill Amount: Rs:20000.00	Error. Does not enter characters other than numbers.	Error. Does not enter characters other than numbers.	Pass
T10	Description: Water bill Amount: 20000.00	Retrieve the entered records.	Retrieve the entered records.	Pass
T12	Delete button	Deletion of expenses record	Deletion of expenses record	Fail
T13	Start and end date should be in date type.	Success alert & generate the report	Success alert & generate the report.	Pass

4.4.Login and Staff Management Testing

Test case ID: T14	Test designed by: Wijerathne B.N.B
Test title: Staff member Create and Retrieve	Test designed day: 08/05/2023
Test priority: High	Test executed by: Wijerathne B.N.B
Module name: Staff	Test executed day: 08/05/2023
Description: Register a new Staff member in the system	
Preconditions: User must be logged in as Admin to register and Login as the created Staff member to view	
Dependencies: Staff, Admin	
Test steps: Login as Admin Click on Register Staff member Fill the form and submit Login as Staff member View profile page	

Test ID	Test inputs	Expected Output	Actual Output	Result
T14	Name: Alex NIC:200035903300 Employee ID: LA1 Contact Number: 0123456789 Post: Lab Assistant Email: Alex@gmail.com Username: AlexG Password: Alex@2000	Record updated alert	Record updated alert	Pass
T14	Name: Alex NIC: Employee ID: Contact Number: 0 Post: Lab Assistant Email: Username: Password:	Empty fields error	Empty fields error	Pass
T14	Name: Alex NIC:200035903300 Employee ID: LA1 Contact Number: qwert Post: Lab Assistant Email: Alex@gmail.com Username: AlexG Password: Alex@2000	Match number	Match number	Pass
T14	Name: Alex NIC:200035903300	Match email pattern	Match email pattern	Pass

	Employee ID: LA1 Contact Number: 0123456789 Post: Lab Assistant Email: Alex@ Username: AlexG Password: Alex@2000			
T14	Name: Alex NIC:200035903300 Employee ID: LA1 Contact Number: 0123456789 Post: Lab Assistant Email: Alex@gmail.com Username: AlexG Password: Alex	Password not strong enough	Password not strong enough	Pass

4.5.Inventory Testing

Test case ID: T18	Test designed by: Gunasekara G.G.K.T.A.V
Test title: Inventory data retrieval test	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunasekara G.G.K.T.A.V
Module name: Inventory	Test executed day: 08/05/2023
Description: Verify that data retrieval and deletion can be done from the list of tests	
Preconditions: User must be logged in and tests already added	
Dependencies:	
Test steps: Navigate to view Inventory page	

Test case ID: T19	Test designed by: Gunasekara G.G.K.T.A.V
Test title: Inventory Add	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunasekara G.G.K.T.A.V
Module name: Inventory	Test executed day: 08/05/2023
Description: Adding new inventory to the system as soon as it arrives	
Preconditions:	
Dependencies:	
Test steps: Navigate to Inventory update page. Enter text into fields. Click Submit button	

Test ID	Test inputs	Expected Output	Actual Output	Result
T17	Inventory Type: Chemical Product Name: Glucose Expire Date: 06/07/2028 Quantity: 15	Updated sweet alert	Updated sweet alert	Pass
T17	Inventory Type: Product Name: Trisodium citrate dihydrate Date: Quantity:	Empty fields error	Empty fields error	Pass
T17	Product Name: SDT Test-kit	Updated sweet alert	Updated sweet alert	Pass
T18	Select a Inventory	The same inventory is displayed on the same page.	The same inventory is displayed on the same page	Pass
T18	Click “Delete” Button	A pop up should come up asking if you want to delete this	A pop up should come up asking if you want to delete this	Pass
T18	Click “Yes” Button	Delete Inventory from the database and update table	Delete Inventory from the database and update table	Pass
T19	Inventory Type: Test-kit Product Name: COVID-19 Date: 06/09/2028	Submit sweet alert	Submit sweet alert	Pass

	Quantity: 15			
T19	Inventory Type: Product Name: Trisodium citrate dihydrate Date: Quantity:	Empty fields error	Empty fields error	Pass

4.6.Machines Testing

Test case ID:T21	Test designed by: Perera M.A.S.S
Test title: Add machine	Test designed day:
Test priority:Medium	Test executed by: Perera M.A.S.S
Module name:MachineForm.js	Test executed day:
Description: Add machines when the owner buy a new machine	
Preconditions: User must logged to the application	
Dependencies:	
Test steps: • Navigate to the add machine form page • Enter text into fields • Click Add Machine button	

Test case ID:T23	Test designed by: Perera M.A.S.S
Test title: Generate bill for machine parts replacement	Test designed day:
Test priority: Medium	Test executed by: Perera M.A.S.S
Module name: machinePartsBill.js	Test executed day:
Description: Generate bill for technician with technicians payment	
Preconditions: Machine parts replacement details are added and displayed on the parts replacement list.	
Dependencies: machineParts	
Test steps: • Click on the Receipt button on particular machine in the machine parts list • Navigate to the report	

Test ID	Test inputs	Expected Output	Actual Output	Result
T21	Machine: Portable Blood Gas Analyzer Brand: YSENMED Model: YSPT-1000 Serial No: 234690007865432 Purchased Date:02/23/2023 Price: 1170051.53 Warranty Expiration:01/08/2026 Manufacturer: YSENMED Tel No: 0114567890	Display success alert – Machine added successfully	Display success alert – Machine added successfully	Pass
T21	Machine: Portable Blood Gas Analyzer Brand: YSENMED Model: YSPT-1000 Serial No: Purchased Date:02/23/2023 Price: 1170051.53	Highlight empty fields and display an error message	Highlight empty fields and display an error message	Pass

	Warranty Expiration:01/08/2026 Manufacturer: YSENMED Tel No: 0114567890			
T21	Machine: Portable Blood Gas Analyzer Brand: YSENMED Model: YSPT-1000 Serial No: 234690007865432 Purchased Date:02/23/2023 Price: 1170051.53 Warranty Expiration:01/08/2026 Manufacturer: YSENMED Tel No: 01145678901	Display a message to add a valid telephone number with 10 numbers	Display a message to add a valid telephone number with 10 numbers	Pass
T21	Machine: Portable Blood Gas Analyzer Brand: YSENMED Model: YSPT-1000 Serial No: 234690007865432 Purchased Date:02/23/2023 Price: Warranty Expiration:01/08/2026 Manufacturer: YSENMED Tel No: 01145678901	only numbers are allowed to be input	Only numbers are allowed to be input	Pass
T23	Click on receipt button	Display report	Display report	Pass

4.7.Test Data Testing

Test case ID: T24	Test designed by: Dinal
Test title: Test data retrieval test	Test designed day:
Test priority: medium	Test executed by: Dinal
Module name: Test Data	Test executed day:
Description: Verify that Test Data retrieval and deletion can be done from the list of tests shown.	
Preconditions: User must be logged in and tests already added	
Dependencies:	
Test steps: Navigate to view tests page	

Test case ID: T25	Test designed by: Dinal
Test title: Test Data creation test	Test designed day:
Test priority: medium	Test executed by: Dinal
Module name: Test Data	Test executed day:
Description: Verify new tests and related categories can be created	
Preconditions: User must be logged in	
Dependencies:	
Test steps: Navigate to add test page. Fill necessary fields. Press Add Test button.	

Test ID	Test inputs	Expected Output	Actual Output	Result
T24	Select a test	Redirected to a page with test data	Redirected to a page with test data	Pass
T24	Click “Delete” Button	Show dialog to get user confirmation	Show dialog to get user confirmation	Pass
T24	Click “Yes” of shown dialog box	Delete Test from the database and update table	Delete Test from the database and update table	Pass
T25	Test ID: 10 Short Name: Open Tube Price Rs: 500 Specimen Blood Heading: Open Tube Outsourced: No Category Heading: WBC UOM: 10^9/l Male Ref Range: 4-11 Female Ref Range: 4-11 Baby Ref Range: 4-11	Ask the user whether the user wants to add more subcategories for that test.	Ask the user whether the user wants to add more subcategories for that test.	Pass
T25	Test ID: 10	Fetch relevant test data and fill required fields	Fetch relevant test data and fill required fields	Pass
T25	Click on fetched category	Navigate to category update form	Navigate to category update form	Pass
T25	Test ID: -1	Display error showing Test	Display error showing	Pass

	Short Name: Open Tube Price Rs: 500 Specimen Blood Heading: Open Tube Outsourced: No Category Heading: WBC UOM: 10^9/l Male Ref Range: 4-11 Female Ref Range: 4-11 Baby Ref Range: 4-11	ID cannot be a negative number	Test ID cannot be a negative number	
T25	Test ID: Short Name: Price Rs: Specimen: Heading: Outsourced: Category Heading: UOM: Male Ref Range: Female Ref Range: Baby Ref Range:	Error highlighting the empty fields	Error highlighting the empty fields	Pass

5. Evaluation and Conclusion

The aim of this project was to develop a solution for MediLine that addresses the identified problems and achieves the stated objectives. Through thorough testing and analysis, it can be concluded that the objectives have been successfully met, and the aims have been achieved with the implementation of the Laboratory Information Management System (LIMS).

One of the aims was to establish a unique identifier for patients upon their first visit to the laboratory, allowing for efficient tracking of all test results associated with each patient. With the implementation of LIMS, patient registration and tracking have been streamlined, ensuring accurate and organized management of patient data throughout the testing process. The manual testing conducted has confirmed that the patient tracking functionality of LIMS is robust and reliable.

Standardized sample collection procedures were another aim of the project. By implementing consistent labeling and barcoding techniques, sample tracking has been significantly improved. The test results from the manual testing indicate that the barcoding system effectively identifies and tracks samples, reducing errors and enhancing accuracy in the laboratory workflow.

To address the archiving problem, LIMS categorizes data based on various criteria, such as patient name, date of the test, test type, and test results. This has facilitated efficient organization and retrieval of archived data. The access control mechanisms implemented ensure data security, allowing authorized users to access and maintain archived records. The manual testing results demonstrate that the archiving and retrieval functions of LIMS are efficient and reliable.

Automation of processes, including sample registration, data entry, and test result reporting, was a significant objective of the project. The manual testing has shown that LIMS successfully automates these processes, reducing manual errors and eliminating paper-based systems. This automation has significantly accelerated testing procedures and improved overall laboratory efficiency.

Finally, the generation of reports and statistical charts from the collected and analyzed data aims to provide valuable insights and recommendations. These insights can aid decision-makers in understanding problems and developing appropriate solutions. The manual testing validates that LIMS generates insightful reports, which can guide future data collection efforts and improve decision-making processes.

In conclusion, the implementation of the Laboratory Information Management System (LIMS) successfully achieved the aims and objectives outlined in this project. Through comprehensive testing, it has been demonstrated that LIMS effectively addresses the identified problems, reduces manual work, streamlines laboratory operations, enhances data quality, and improves patient care and safety. The successful implementation of LIMS has transformed MediLine's information system, replacing outdated and manual processes with an automated and efficient solution, ultimately leading to improved efficiency and quality in laboratory operations.

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Appendix A

		Contribution
IT21237904	Gunawardana U.G.C.D	Sample and Test Results: This function allows users to manage tests that have been ordered. Sample and test result records will be auto created based on the information during the patient billing process. This function also includes collecting and labeling samples, recording results, and the ability to update, delete, and search for specific samples or test records. Furthermore, it should generate reports on test results.
IT21286414	Gunathilaka L.P.N	Registration and Billing: This function allows users to manage patient registration and billing information. Patient demographics and contact information are stored and managed. Then patients could be billed accordingly by adding requested services to the bill It also includes updating, deleting, and searching for specific patient records and bills. Additionally, it generates reports on bills.
IT21273230	Surendra D.M.B.G.D	Income and Expenses: This function allows users to manage the financial aspect of the system. It provides the ability to perform crud operations on expense records, fetch other income and expenses from the database, calculate income from sales and search records based on date. Additionally, the function provides the ability to generate report based on the time interval.
IT21216046	Wijerathne B.N.B	Staff and Login: This function allows user access and authentication (login). This includes creating and managing user accounts. Additionally, this function allows users to manage the laboratory staff and their roles. It should include the ability to perform crud operations on staff records, search for specific staff members, record staff attendance, calculate their pay, and generate reports on staff salary.

IT21268694	Gunasekara G.G.K.T.A.V	Inventory: This function allows users to manage inventory items. This includes managing lab equipment and chemicals, reordering supplies, and tracking inventory levels. Users can also search for specific items. Additionally, it should have the ability to generate reports on inventory levels and usage.
IT21214752	Perera M.A.S.S	Machines: This function allows users to manage machines in the laboratory. It includes maintaining a record of all the machines available in the laboratory. Records are saved based on machine service and maintenance. It also includes the ability to update, delete and search for specific machines. Additionally, it should have the ability to generate reports on machine service and maintenance.
IT21219252	Senadheera S.A.A.D	Test Data: This allows users to manage information on tests in the system. It includes the ability to perform crud operations on tests, test subcategories, and reference ranges. Users can also search for specific tests. Furthermore, it should generate a chart displaying statistical data on the number of tests that have been billed, categorized by the month of the current year.

Appendix B

Gantt Chart

PROJECT **Laboratory Information Management System for Medi Line**

Gantt Chart																														
Week			01							02							03							04						
			M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Requirement analysis	06/2	10/2																												
Planning	13/2	24/2																												
Page UI design	20/2	03/3																												
Database Design	27/2	17/3																												
Coding the structure	06/3	24/3																												
Development	06/3	07/4																												
Testing	10/4	21/4																												
Launching the webapp	24/4	28/4																												

Gantt Chart																														
Week			05							06							07							08						
			M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Requirement analysis	06/2	10/2																												
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Page UI design	20/2	03/3																												
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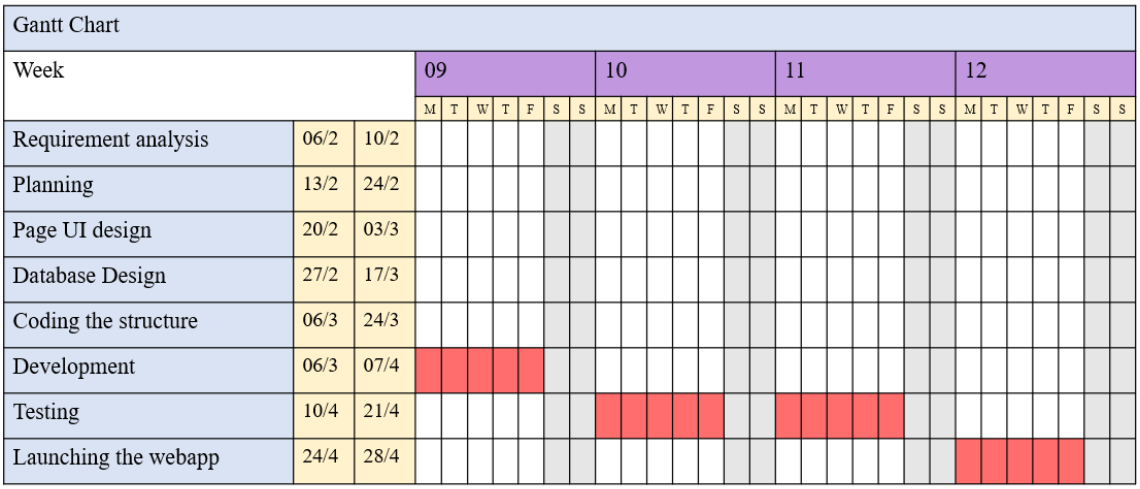
Coding the structure	06/3	24/3																						MID EXAM						
Development	06/3	07/4																												
Testing	10/4	21/4																												
Launching the webapp	24/4	28/4																												



User case scenarios

Lab Assistant

Use Case Name	Patient Registration
Actor(s)	Lab assistant
Summary Description	The lab assistant registers new patients into the system.
Priority	Must have
Pre-Condition	The lab assistant has logged in to the LIMS
Post-Condition(s)	The patient is registered in the system.
Basic Path	The lab assistant selects the "Patient Registration" function. The system prompts the lab assistant to enter the patient's personal information. The lab assistant enters the patient's NIC, name and other and personal information. The system validates the entered data. The system stores the patient details in the server. The system displays the success message.
Alternative Paths	3a. If the patient does not provide the NIC, then the driving license number, passport number or any other similar unique identification number can be used instead. 4a. If the patient has already registered in the system prior to this, then his/her profile can be viewed. 4b. If any of the crucial information was not entered, then an error message will be displayed. 5a. If the system fails to access the server, then an error message will be displayed.

Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Use Case Name	View Patient's Previous Billing History
Actor(s)	Lab assistant
Summary Description	The lab assistant views a patient's previous billing history.
Priority	Must have
Pre-Condition	The lab assistant has logged in to the LIMS
Post-Condition(s)	The lab assistant has viewed patient’s transaction history
Basic Path	The lab assistant selects the "View Patient's Billing History" function. The system prompts the lab assistant to enter the patient's NIC. The lab assistant enters the patient's NIC. The system validates the NIC. The system searches the database and displays a list of transactions that patient has made previously. The lab assistant views individual transactions in detail.
Alternative Paths	2a. If the patient has not registered previously, then the lab assistant will choose to register the patient instead. 3a. If the patient does not provide the NIC, then the driving license number, passport number or any other similar unique identification number can be used instead. 4a. If the entered value is not a valid identification number, then the system will display an error message. 5a. If the system fails to access the server, then an error message will be displayed. 5b. If the system does not find the entered value in its databases, an error message will be displayed.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Use Case Name	View Patient's Reports
Actor(s)	Lab assistant
Summary Description	The lab assistant views a patient's reports.
Priority	Must have
Pre-Condition	The lab assistant has logged in to the LIMS
Post-Condition(s)	The lab assistant has viewed the reports of the patient
Basic Path	The lab assistant selects the "View Patient's Reports" function. The system prompts the lab assistant to enter the patient's NIC. The lab assistant enters the patient's NIC. The system validates the NIC. The system searches the database and displays a list of reports. The lab assistant views individual report in detail.
Alternative Paths	2a. If the patient has not registered previously, then the lab assistant will choose to register the patient instead. 3a. If the patient does not provide the NIC, then the driving license number, passport number or any other similar unique identification number can be used instead. 4a. If the entered value is not a valid identification number, then the system will display an error message. 5a. If the system fails to access the server, then an error message will be displayed. 5b. If the system does not find the entered value in its databases, an error message will be displayed.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Use Case Name	Calculate Bills
Actor(s)	Lab assistant
Summary Description	The lab assistant adds and calculates the bill
Priority	Must have
Pre-Condition	The lab assistant has logged in to the LIMS
Post-Condition(s)	The lab assistant has calculated the bill
Basic Path	The lab assistant selects the "Add transactions" function. The system prompts the lab assistant to enter the patient's NIC. The lab assistant enters the patient's NIC. The system validates the NIC. The system displays the layout of a newly created(empty) bill. The system displays a button to “Add Service” which is provided to the patient by the laboratory. The lab assistant selects the “Add Service” function. The system displays a list of services that can be provided by the laboratory along with their prices. The lab assistant selects the services that the patient requests. The lab assistant confirms the services. The system calculates the total fee. The system displays the bill with added services. The system prompts to finalize the bill. The lab assistant finalizes the bill. The system sends a copy of the bill to the patient’s email The system uploads the requested services to the “Yet to be completed work” list.
Alternative Paths	2a. If the patient has not registered previously, then the lab assistant will choose to register the patient instead. 3a. If the patient does not provide the NIC, then the driving license number, passport number or any other similar unique identification number can be used instead. 4a. If the entered value is not a valid identification number, then the system will display an error message. 8a. If the system fails to access the server, then an error message will be displayed. 9a. If the requested service is not available in the list, a choice will be given to outsource the service. 9b. If an incorrect service is selected by mistake, it can be removed. 10a. If the bill contains any mistakes, then the lab assistant will not confirm. Instead, it should be corrected. 14a. If the bill contains any mistakes, then the lab assistant will not confirm. Instead, it should be corrected. 15a. If the patient’s email address is not in the system, then skips the sending email function 15b. If the system fails to access the server, then an error message will be displayed and lab assistant will be given the choice to skip the sending email function

	16a. If the service is to be outsourced, then it will be added to "Yet to be outsourced services" list instead.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Phlebotomist

Use Case Name	Collect Samples
Actor(s)	Phlebotomist
Summary Description	Collection of samples after a patient is billed
Priority	Must have
Pre-Condition	Phlebotomist must be logged into the system first. Patients should be billed for tests.
Post-Condition(s)	Collection of sample data
Basic Path	phlebotomist navigates to the samples section. system shows a list of pending samples which are not collected. phlebotomist clicks on collect sample. system will record the time of collection. system will move the sample to collected samples.
Alternative Paths	5a. phlebotomists choose to reject sample. 5b. phlebotomist will choose to re draw sample.
Non-Functional Requirements	Reliability Accuracy

Use Case Name	Print Sample labels
Actor(s)	Phlebotomist
Summary Description	Printing of sample labels
Priority	Must have
Pre-Condition	Phlebotomist must be logged into the system first. Samples must be collected
Post-Condition(s)	Printing sample label
Basic Path	phlebotomist navigates to the samples section. phlebotomist clicks on collected samples. system shows collected samples. phlebotomist chooses to print on an individual sample. system will generate a barcode for printing
Alternative Paths	3a. system shows empty list
Non-Functional Requirements	Reliability Accuracy

Medical Laboratory Technician (MLT)

Use Case Name	Add test results
Actor(s)	MLT
Summary Description	Test results are added for pending tests after investigation
Priority	Must have
Pre-Condition	Must be logged in. Samples must be collected
Post-Condition(s)	Adding test results
Basic Path	MLT navigates to adding test results page System shows a waiting list of tests MLT adds test results
Alternative Paths	3a. Samples are not collected, results cannot be added
Non-Functional Requirements	Speed Real time updates accuracy

Use Case Name	Generate Reports
Actor(s)	MLT
Summary Description	Test reports are generated inserting the test values
Priority	Must have
Pre-Condition	Must be logged in. Test results must be inputted the system
Post-Condition(s)	Generating patient report.
Basic Path	MLT navigates to the test result page MLT chooses to generate the report A report is generated by the system MLT chooses to print it
Alternative Paths	2a. Test results are not added
Non-Functional Requirements	Speed Real time updates accuracy

Use Case Name:	Service Machines
Actor(s):	Medical Laboratory Technician (MLT)
Summary Description:	Service machines, add parts, and repair when machines are malfunctioning or it is time to service.
Priority:	Most have
Pre-Condition:	MLT checks the last service date and next service date
Post-Condition(s):	MLT update the service date and the next service date
Basic Path:	When MLT clicks on the 'Service Machines' function. System directs MLT to search machines. MLT enters the machine name to check the history of the machine. System directs MLT to machine history. MLT checks the next service date. MLT records the current condition(issues). MLT adds parts to the machine and records all the details about the parts. MLT adds the technician payment and technician details to the system. System calculates service cost. System generates a report for service maintenance. MLT updates the last service date and next service date.
Alternative Paths:	7a. if the machine has an issue, then repair it and record it in the database. 7b. if the machine is malfunctioning and can't repair then inform the owner and record it.
Non-Functional Requirements:	NF1. Accuracy NF2.Reliability NF3. User friendly NF4. Security NF5. High response speed NF6. Low server access time.

Use Case Name:	Add new machines
Actor(s):	Medical Laboratory Technician (MLT)
Summary Description:	Add a new machine record to the database.
Priority:	Must Have
Pre-Condition:	The owner purchases a new machine.
Post-Condition(s):	Updating machine records.
Basic Path:	MLT selects the 'Add new machine' function. System directs to new machine form. MLT completes the form. MLT clicks 'Save machine details' option. System adds a new record to a database. System display updated list of machines.
Alternative Paths:	3a. If MLT has not completed all the required details and hasn't entered valid details Then display an alert to fill the complete form and complete it with valid data. 5a. If machine details are not added then retry to add a new machine record. 5b. If system can't reach the server then display an error message.
Non-Functional Requirements:	NF1. User- friendly NF2. Accuracy NF3.Reliability NF4. Security NF5. High response speed NF6. Low server access time.

Use Case Name:	Quality Control
Actor(s):	Medical Laboratory Technician (MLT)
Summary Description:	Check the quality of the machine.
Priority:	Must Have
Pre-Condition:	The owner brings a sample test and sample test result to check.
Post-Condition(s):	Use the machine for a certain time period until the next quality check.
Basic Path:	MLT selects the 'Quality Control' function. System directs to add details of the sample report. MLT completes the form and submits it. System add the record to database. System display successful message to MLT. System directs MLT to add the generated test results MLT add generated test results to the form. System check the similarities between two datasets. System displays the percentage of the similarity. System generate a report certification.
Alternative Paths:	4a. If system can't reach the server then display an error message. 5a. If machine details are not added then retry to add a new machine record. 9a. If both data sets are similar to each other then system do not direct to any quality control option.
Non-Functional Requirements:	NF1. User- friendly NF2. Accuracy NF3.Reliability

	NF4. Security NF5. High response speed NF6. Low server access time.

Use Case Name:	Manage Machine records
Actor(s):	Medical Laboratory Technician (MLT)
Summary Description:	Update, delete a new machine record to the database.
Priority:	Must Have
Pre-Condition:	The machine record is already added to the database
Post-Condition(s):	View all machine details.
Basic Path:	MLT search the machine. System display all the available machines of that particular machine type. MLT select the machine. System display the details of the machine MLT selects the 'Update' function. MLT add updated machine details. System update the record to a database and display. System display the updated machine record and display 'Delete' option.
Alternative Paths:	5a. If MLT wants to delete the record then click 'Delete' function. 5b. System delete the record. 5c. System display successfully deleted message. 7a. If system can't reach the server then error message will be displayed.
Non-Functional Requirements:	NF1. User- friendly NF2. Accuracy NF3.Reliability NF4. Security NF5. High response speed NF6. Low server access time.

Manager

Use Case Name:	Manage Test Data
Actor(s):	Manager
Summary Description:	Allow manager to perform CRUD operations to manage test data
Priority:	Must have
Pre-Condition:	User must be logged into the system
Post-Condition(s):	User can add, delete, update or view test data according to the need.
Basic Path:	User navigates to Test Data tab. System displays all tests. User decides to add a new Test. User clicks on “add new test” option. System navigates user to a form. User enters test details. User selects a test subcategory. User clicks on “save subcategory” option. User clicks on “save new test” option. System displays the updated list of all tests.
Alternative Paths:	2a. System does not have any tests created. 3a. User decides to view available tests. 3b. User decides to update an available test. 3c. User decides to delete a discontinued test. 9a. User decides to add more subcategories. 9b. User cancels the operation
Non-Functional Requirements:	Time to manage tests. Usability of function. Access Security.

Use Case Name:	Manage Courier Details
Actor(s):	Lab assistant
Summary Description:	Allow user to manage courier details when samples are sent out
Priority:	Must have
Pre-Condition:	User must be logged into the system and samples must be already made.
Post-Condition(s):	User can add, delete, update or view courier details according to the need.
Basic Path:	User navigates to courier details tab. System displays courier details according to the date. User decides to add courier details for the current day. System displays a form. User enter the data needed. User decides to save the information. User clicks on “save courier details” option. System displays updated courier details.
Alternative Paths:	2a. System does not have any courier records. 3a. User decides to update a courier record. 3b. User decides to view existing courier records.

	3c. User decides to delete a courier record. 7a. User cancels the operation.
Non-Functional Requirements:	Time to manage courier records. Usability. Access Security.

Use Case Name:	Manage Expenses
Actor(s):	Financial Manager
Summary Description:	The financial manager manages the company expenses.
Priority:	Must have
Pre-Condition:	The financial manager has logged in to the LIMS
Post-Condition:	Enter the expenses details to the system
Basic Path:	The manager selects the “enter expenses” option. The system shows the expenses form. The financial manager enters the expenses details. System validates the details, System stores the entered data. Display success message.
Alternative Path:	4a. when the important details are not entered system display message. 4b. when the entered data not in correct data type system display error message. 5a. When the system cannot find the server display error message.
Non-Functional Requirements:	Security Reliability User friendly Accuracy portability

Use Case Name:	Calculate the net revenue
Actor(s):	Financial Manager
Summary Description:	The financial manager calculates the company revenue.
Priority:	Must have
Pre-Condition:	The financial manager has logged in to the LIMS
Post-Condition:	Calculate the net revenue using entered data.
Basic Path:	The manager enters the “calculate revenue” option. System display revenue calculate form. System displays the entered expenses list. Manager select the require month expenses details from system. Enter the total income amount for require month. System validates the income amount. System calculates the net revenue of the month. System displays the net revenue. System stores the revenue.
Alternative Path:	3a. If the system cannot find the expenses list display the error message. 6a. When the total income amount did not match to the stored amount display the error massage. 6b. If the entered amount not in correct data type system generate error message. 9a. If the system cannot find the server display error massage.
Non-Functional Requirements:	Security Reliability User friendly Accuracy portability

Use Case Name:	Generate financial report
Actor(s):	Financial Manager
Summary Description:	The financial manager crates the financial report.
Priority:	Must have
Pre-Condition:	The financial manager has logged in to the LIMS
Post-Condition:	Generate the financial report
Basic Path:	The finance manager enters to the “create report” option. System displays the entered and calculated details. Finance manager select the require month or year. System generates popup view of the report. Finance manager must conform the report.
Alternative Path:	3a. If the enter date format wrong system generate error. 4a. If manager want to edit the report, he can click edit option. 4b. If manager does not like the report, he can delete it from delete option.
Non-Functional Requirements:	Security Reliability User friendly Accuracy portability

Use Case Name	Admin login to the system
Actor(s)	Admin
Summary Description	Admin login to the system and access functionality
Priority	
Pre-Condition	Admin has access to the system
Post-Condition(s)	Admin has logged into the system
Basic Path	User clicks on 'Login' in homepage. System displays a login page, prompting the user to enter their username and password. User enters username and password. System validates the credentials. System logs user into the system System shows the user profile.
Alternative Paths	4a. If the username or password is incorrect system shows an error message. 4b. System ask user to login again.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Use Case Name	Admin make a backup and restore the database
Actor(s)	Admin
Summary Description	Admin executes the backup function of the system and make a backup in the hard drive
Priority	
Pre-Condition	Admin has logged into the to the system. Hard drive has enough space to backup the database.
Post-Condition(s)	Admin has made a backup and restore the database of the system
Basic Path	Administrator clicks on 'Backup and Restore system' in the admin profile. System shows the last backup and restore details. Administrator selects the data to be backed up. Administrator clicks on 'Backup now'. The backup function initiates the backup process and copies the data to a secure storage device. System confirms that the backup is successful and stores the storage device in a safe location. System notifies the user that the backup is completed. System provides details about the backup process and storage location. System updates the last backup details. Administrator clicks on 'Restore now'. System asks to select a backup file. Administrator selects the backup file from the storage device. System initiates the restore process. Administrator confirms that the restore is successful and tests the system for functionality.

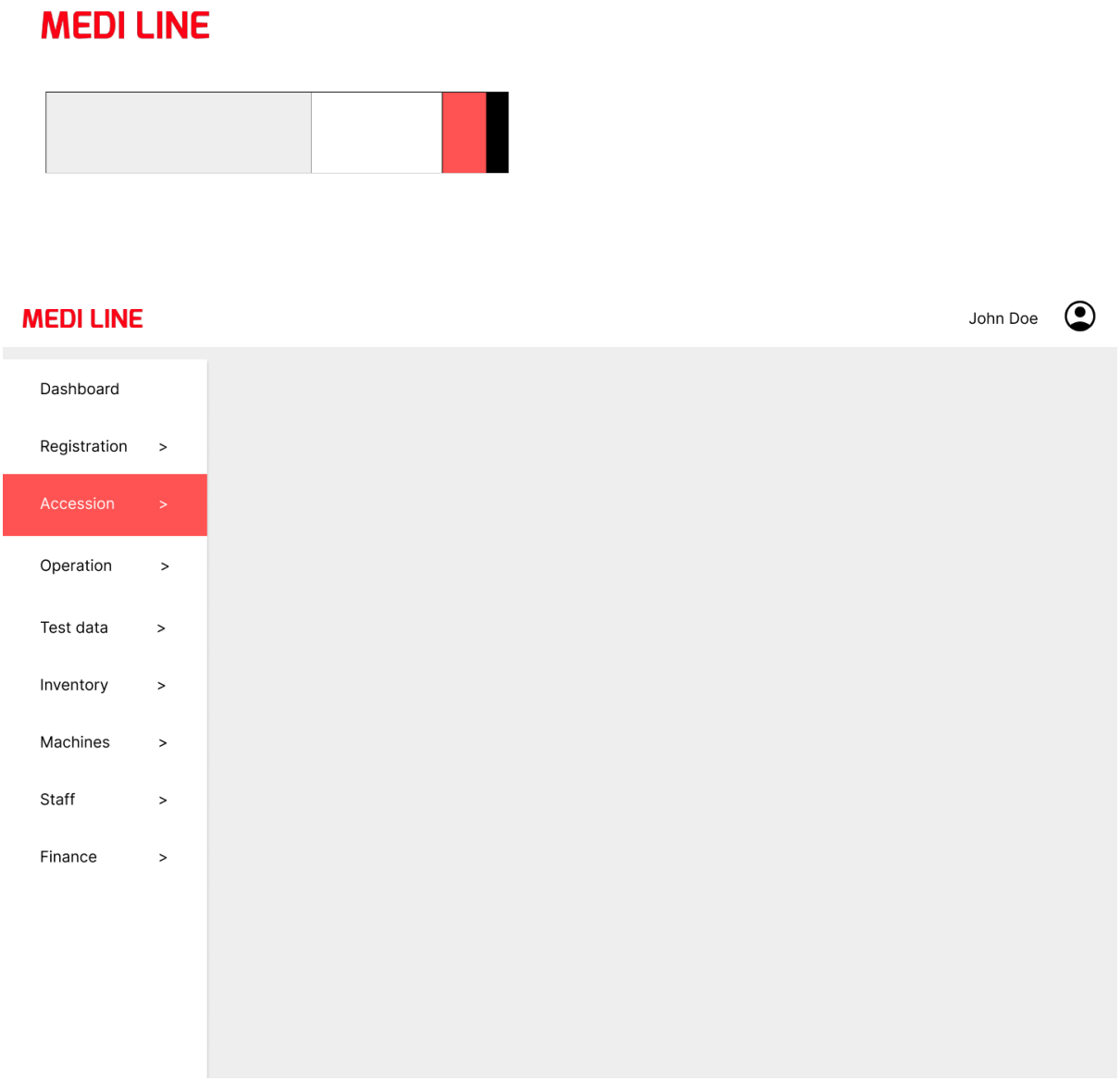
Alternative Paths	5a. If the backup process encounters errors, the backup function alerts the administrator and provides instructions for resolve the errors. 5b. Administrator resolves the errors and restart the process. 13a. If the restore process encounters errors, the backup function alerts the administrator and provides instructions for resolve the errors. 13b. Administrator resolve the errors and restart the restore process.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

Use Case Name	User account management
Actor(s)	Admin
Summary Description	Admin creates, updates and deletes the accounts for staff members
Priority	
Pre-Condition	Admin has access to the system. Admin has access to staff member accounts
Post-Condition(s)	Admin has logged into the system
Basic Path	Administrator clicks on 'Create user account'. System displays the registration form and prompt to fill out the details such as employee name, employee id, username, password, user email Administrator fills the form and submit. System sends an email to the provided email address asking for user verification. User verifies the email. System shows that the account is successfully created. System redirects the Administrator to the user account. Administrator logs in to the user account and do changes. Administrator logs out from the user account
Alternative Paths	9a. If Admin wants to update the profile Admin clicks on 'Edit profile' 9b. System gives the access to edit profile details. 9c. Admin edits the necessary details of the profile and save. 9d. System updates the details in the database. 9e. If Admin wants to delete the profile Admin clicks on 'Delete profile' 9f. System ask for confirmation. 9g. Admin confirms the action. 9h. System deletes the profile. 9i. System updates the database.
Non-Functional Requirements	NF1. User-friendliness NF2. Security NF3. Low server access time NF4. Reliability NF5. Accuracy

User Case Name:	Generate Test kit and Chemicals report
Actor(s):	Manager
Priority:	Must have
Pre-Condition:	Manage must log in to the system
Post-Condition(s):	Manager successfully Generate Test-kit and Chemicals report
Basic Path:	Check the Test-kit & Chemical quantity. User decides to create a weekly report. User click on Create report button. System shows the preview of the report. User confirm preview. System generate report.
Alternative Paths:	4a. If system can't reach the server display error message. 5a.user cancel out of the process.
Non-Functional Requirements:	Accuracy Usability Time to generate report

User Case Name:	Manage inventory.
Actor(s):	Manager
Priority:	Must have
Pre-Condition:	Manage must log in to the system
Post-Condition(s):	User Manage test-kit and chemicals.
Basic Path:	User navigate to the inventory tab. System shows the current inventory. System shows low inventory warning. User decides to add more to inventory. System displays a form. User enter new stock details. User confirms the form. System shows updated inventory.
Alternative Paths:	3a. Inventory is not low. System does not show as warning. 4a. User decides not to add more inventory. 7a. User cancels out of the process.
Non-Functional Requirements:	Accuracy Usability

Wireframes



Test Cases and Results (update and delete)

Test cases

Test case ID:T02	Test designed by: Gunawardana U.G.C.D
Test title: Deletion of Sample and test records	Test designed day: 08/05/2023
Test priority: High	Test executed by: Gunawardana U.G.C.D
Module name: Sample and test records	Test executed day: 08/05/2023
Description: Sample and test records must be deleted	
Preconditions:	
Dependencies:	
Test steps: Navigate to Samples page, Try deleting any of the record	

Test case ID: T05	Test designed by: Gunathilaka L.P.N
Test title: Edit registered patient's details	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Patient Management	Test executed day: 08/05/2023
Description: verify that the patient information can be edited successfully	
Preconditions: The receptionist is logged into the system	
Dependencies:	
Test steps: Navigate to Patient profile page Click edit profile button Fill the form with desired values Click update button	

Test case ID: T06	Test designed by: Gunathilaka L.P.N
Test title: Delete patient	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Patient management	Test executed day: 08/05/2023
Description: verify that the patient profile can be deleted successfully	
Preconditions: The receptionist is logged into the system	
Dependencies:	
Test steps: Navigate to Patient Registration page Click the Delete account button Click the confirm button on the popup alert	

Test case ID: T08	Test designed by: Gunathilaka L.P.N
Test title: Edit Bill	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Billing	Test executed day: 08/05/2023
Description: verify that the bill is edited successfully	
Preconditions: The receptionist is logged into the system	
Dependencies:	
Test steps: Navigate to Patient Registration page Click the Transaction history button Select the bill Click edit button Add services requested by the patient and fill the referred doctor field Click the confirm button	

Test case ID: T09	Test designed by: Gunathilaka L.P.N
Test title: Delete bill	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunathilaka L.P.N
Module name: Billing	Test executed day: 08/05/2023

Description: verify that the bills can be deleted successfully
Preconditions: The receptionist is logged into the system
Dependencies:
Test steps: Navigate to Patient Profile page Click transaction history page Select the bill. Click the Delete bill button Click the confirm button on the popup alert

Test case ID: T11	Test designed by: Surendra D.M.B.G.D
Test title: Update the exist expense record.	Test designed day: 08/05/2023
Test priority: High	Test executed by: Surendra D.M.B.G.D
Module name: Expenses update	Test executed day: 08/05/2023
Description: Once a user updates the exist expense record it should be updated.	
Preconditions: User should exist	
Dependencies: Expenses	
Test steps: Navigate to view expenses, Select the update option, Navigate to the update expenses, Update the expense, Navigate to the view expenses.	

Test case ID: T12	Test designed by: Surendra D.M.B.G.D
Test title: Deletion of expenses records	Test designed day: 08/05/2023
Test priority: High	Test executed by: Surendra D.M.B.G.D
Module name: Expenses	Test executed day: 08/05/2023
Description: expenses records must be deleted	
Preconditions:	
Dependencies: Expenses	
Test steps: Navigate to view expenses page, Select the delete option of any record.	

Test case ID: T15	Test designed by: Wijerathne B.N.B
Test title: Staff member update	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Wijerathne B.N.B
Module name: Staff	Test executed day: 08/05/2023
Description: Update Staff Profile	
Preconditions: User must be logged in as Staff member	
Dependencies: Staff, Admin	
Test steps: Login as Staff member Go to profile page Click on Edit profile button Enter the modifications Click on Update button	

Test case ID: T16	Test designed by: Wijerathne B.N.B
Test title: Delete Staff member	Test designed day: 08/05/2023
Test priority: Medium	Test executed by: Wijerathne B.N.B
Module name: Staff	Test executed day: 08/05/2023

Description: Remove a Staff member from the system
Preconditions: User must be logged in as Staff member
Dependencies:
Test steps: Login as Admin Click on Staff Details button Click on DELETE button

Test case ID: T17	Test designed by: Gunasekara G.G.K.T.A.V
Test title: Inventory Update	Test designed day: 08/05/2023
Test priority: medium	Test executed by: Gunasekara G.G.K.T.A.V
Module name: Inventory	Test executed day: 08/05/2023
Description: verify that the entered details are updated	
Preconditions:	
Dependencies:	
Test steps: Navigate to Inventory update page Enter text into fields Click update button	

Test case ID:T20	Test designed by: Perera M.A.S.S
Test title:Delete Machine	Test designed day:05/09/2023
Test priority:Medium	Test executed by: Perera M.A.S.S
Module name:machineList.js	Test executed day:05/09/2023
Description:Delete all machine details including services and replaced machine parts details.	
Preconditions:Machines should be added and displayed on a machine list	
Dependencies:	
Test steps: • Click on the delete button on particular machine in the machine list • Select yes on alert to delete machine machine	

Test case ID:T22	Test designed by: Perera M.A.S.S
Test title: Update Machine Service	Test designed day:
Test priority:Medium	Test executed by: Perera M.A.S.S
Module name:UpdateMachineService.js	Test executed day:
Description:Update Last service date and next service date with technician's details	
Preconditions:Service should be added to the particular machine	
Dependencies:Machine , Service Bill	
Test steps: • Click the update button on the service of that particular machine • Navigate to the service update form with previously added service details • Enter text to update • Click update Button	

Test case ID: T26	Test designed by: Dinal
Test title: Test Data edit test	Test designed day:
Test priority: medium	Test executed by: Dinal
Module name: Test Data	Test executed day:
Description: Verify update and delete form of test data	
Preconditions: A test must be already created	
Dependencies:	
Test steps:	

Navigate to view tests page. Click on a test. Click on Update/Delete

Test results

Test ID	Test inputs	Expected Output	Actual Output	Result
T02	Delete button	Deletion of sample record and table update	Deletion of sample but table not updated	Fail
T05	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Success Message	Success Message	Pass
T05	NIC: Invalid NIC First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot Enter Invalid Characters	Cannot Enter Invalid Characters	pass
T05	NIC: First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot submit Empty values	Cannot submit Empty values	pass
T05	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: Invalid Id Age: 10 Email:example@example.com Gender: Male	Cannot Enter Invalid Characters	Cannot Enter Invalid Characters	pass
T05	NIC: 200021701855 First Name: Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	Cannot submit Empty values	Cannot submit Empty values	pass
T05	NIC: 200021701855	Cannot submit Empty	Cannot submit	pass

	First Name: Dinal Last Name: Telephone Number: 0712345678 Age: 10 Email:example@example.com Gender: Male	values	Empty values	
T05	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: -1 Email:example@example.com Gender: Male	Cannot submit numbers less than 0	Cannot submit numbers less than 0	pass
T05	NIC: 200021701855 First Name: Dinal Last Name: Senadheera Telephone Number: 0712345678 Age: 10 Email: Invalid Email Gender: Male	Cannot submit Invalid email format	Cannot submit Invalid email format	pass
T06	Click delete button and confirm	Success Message	Success Message	Pass
T08	Referred Doctor : Dr. example Select requested services	Success Message	Success Message	Pass
T08	Referred Doctor : Select requested services	Cannot submit	Cannot submit	Pass
T08	Referred Doctor : Dr. example Do not select requested services	Show Error message	Show Error message	Pass
T09	Click delete button and confirm	Success Message	Success Message	Pass
T11	Amount values in numeric type values.	Success alert & update the field.	Success alert & update the field.	Pass
T11	Amount values in letters	Do not enter characters other than numbers.	Do not enter characters other than numbers.	Pass
T15	Name: Alex NIC:200035903300 Employee ID: LA1 Contact Number: 0123456789 Post: Lab Assistant Email: Alex@gmail.com	Updated alert	Updated alert	Pass
T15	Name: Alex NIC: Employee ID: Contact Number: 0 Post: Lab Assistant Email:	Empty fields error	Empty fields error	Pass
T15	Name: Alex NIC:200035903300 Employee ID: LA1 Contact Number: qwert Post: Lab Assistant Email: Alex@gmail.com	Match number	Match number	Pass
T15	Name: Alex	Match email pattern	Match email	Pass

	NIC:200035903300 Employee ID: LA1 Contact Number: 0123456789 Post: Lab Assistant Email: Alex@		pattern	
T16	Click on 'DELETE' Button	Staff member is deleted	Staff member is deleted	Pass
T20	Click delete button	Display record successfully deleted message - sweetalert	Display record successfully deleted message - sweetalert	Pass
T20	Click delete button	Delete machine details , service details and maintenance details	Delete only machine details	Fail
T22	Last Service Date:05/09/2023 Next Service Date:05/20/2023 Technician's Name: J.B.Corea Techinician's TelNo : 0779865342 Technician's Payment:1500.00	Display success alert – Service Machines updated successfully	Display success alert – Service Machines updated successfull	Pass
T22	Last Service Date:05/09/2023 Next Service Date:05/20/2023 Technician's Name: J.B.Corea Techinician's TelNo : 0779865342 Technician's Payment:	Highlight empty fields and display an error message	Highlight empty fields and display an error message	Pass
T22	Last Service Date:05/09/2023 Next Service Date:05/20/2023 Technician's Name: J.B.Corea Techinician's TelNo : Technician's Payment:1500.00	Display a message to add a valid telephone number with 10 numbers	Display a message to add a valid telephone number with 10 numbers	Pass
T22	Last Service Date:05/09/2023 Next Service Date:05/20/2023 Technician's Name: J.B.Corea Techinician's TelNo : 0779865342 Technician's Payment:	only numbers are allowed to be input	Only numbers are allowed to be input	Pass
T26	Test ID: 10 Short Name: Open Tube Price Rs: 500 Specimen Blood Heading: Open Tube Outsourced: No	Show an alert that the test has been updated	Show an alert that the test has been updated	Pass
T26	Test ID: Short Name: Price Rs: Specimen: Heading:	Highlight empty fields	Highlight empty fields	Pass

	Outsourced:			
T26	Click Delete button	Show a dialog to confirm user's choice	Show a dialog to confirm user's choice	Pass
T26	Click Delete button then click "Yes" of shown dialog box	Delete Test from the database and update table	Delete Test from the database and update table	Pass