

Analysis and design

5.1 Introduction

Eliciting software requirement is done by series of interviews. Interviews were formal as well as informal. Apart from that study of the currently used documents, and laboratory work flow observation was done.

Using the requirements gather, several prototypes were developed. Open interview re used to get feed back for prototypes developed. Following are the functional and non functional requirements gather at the end of requirement gathering phase.

5.1.1 Software Requirements

5.1.1.1 Mandatory Functional Requirements

1. The system shall have facility for user log in and authentication
2. The system shall have the facility to enter request form data in to the system
3. The system shall have the facility to generate receipt for each specimen
4. The system shall have the ability to perform search on duplicate entries for patient name, BHT number or the NIC number
5. The system shall allow consultant microbiologists to perform additional search on bacterial types and antibiotics and review ABST and culture results
6. System shall allow microbiologists to validate the ABST/Culture reports for printing
7. System shall have the facility to print Culture/ABST reports
8. System shall allow the MLT to review the request form information
9. System shall facilitate Lab sheet generation based on the information available in the

request form, antibiotic type, tentative diagnosis and suspected organism

10. System shall have the facility to generate Culture/ABST report based on lab sheet information
11. System shall allow MLT to submit the ABST/Culture reports to the consultant for review
12. The system shall have facility to view the total reports within a given time frame
13. The system shall have a facility to view reports based on turn over time
14. Administrator shall be able to enroll new users to the system

5.1.1.2 Optional Functional Requirements

15. System should allow entering more than one organism per Culture/ABST if those organisms were requested by the physician, MLT or consultant microbiologist
16. Administrator should have the ability to update the laboratory name, consultant, postal address, telephone/fax, email address of the laboratory and laboratory logo
17. Administrator should be able to add new antibiotics and microorganisms to the system
18. Consultant microbiologists should be able to perform historic data analysis based on the type of micro organism or type of anti-microbial agent

5.1.1.3 Mandatory Non functional Requirements

- The System shall not pass data to server without client side validation
- System should be able to restrict access (data entry and edit) of information once data was fed in to the system, based on the user role

User Role	Enter data	Edit data
Clerk	Request form	None
MLT	Lab sheet, Culture/ABST	Request form, Lab sheet
Consultant	Culture/ABST	Request form, Lab sheet, Culture/ABST

Table 6: Data access for user roles

- The system shall not allow self sign-up
- The system shall not allow duplication of system users

5.1.1.4 Optional Non functional Requirements

- System should not have performance incompatibility with Firefox, Internet Explorer or Opera web browsers
- System should not have functional incompatibilities with operating systems, Windows (98, 2000 and XP) and Linux (Debian/Cent OS and Ubuntu)

1.2 Architectural Design

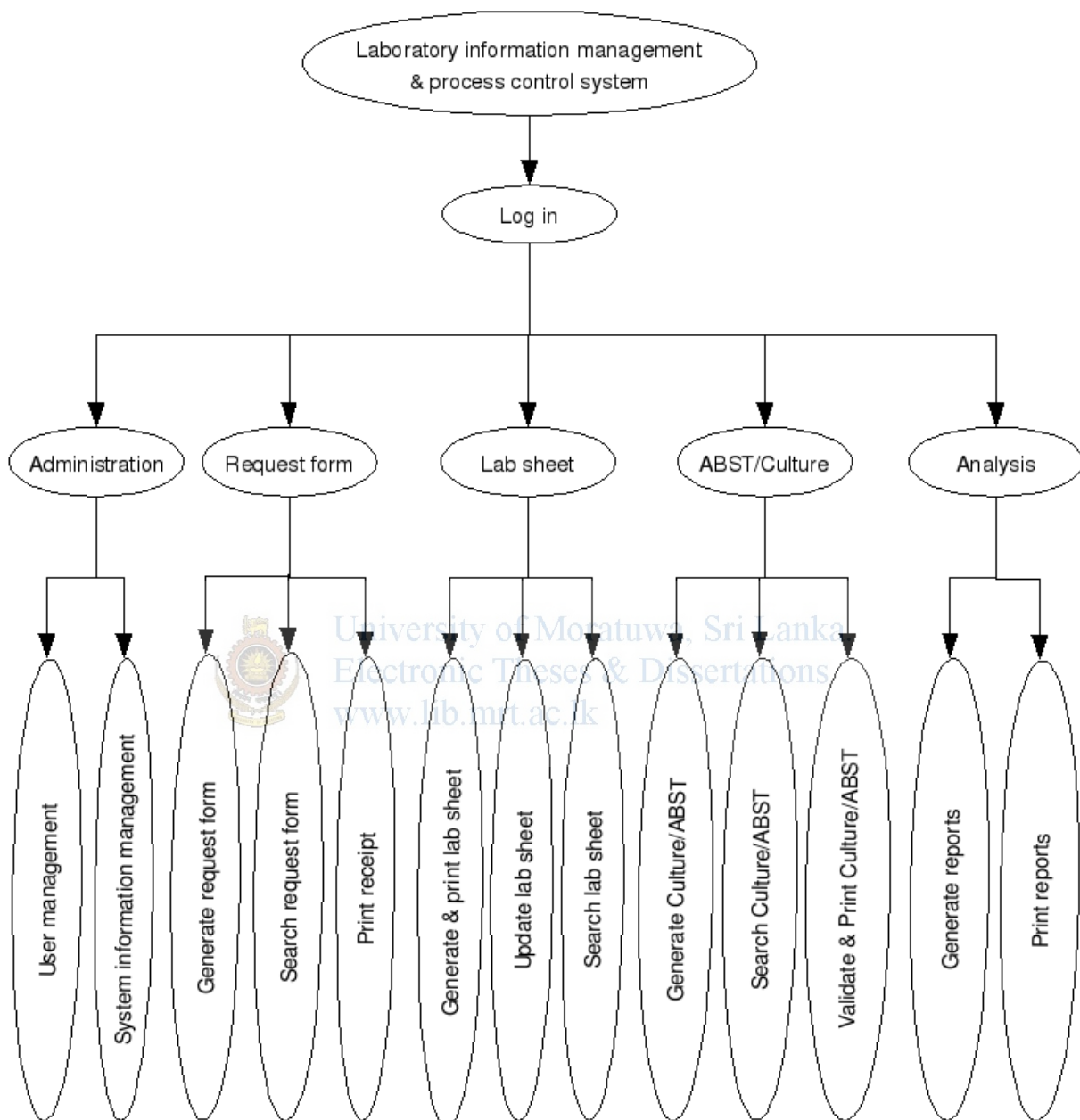


Figure 7: Architectural diagram of the developed system

5.2 Existing system

The overview of the existing manual system is as follows.

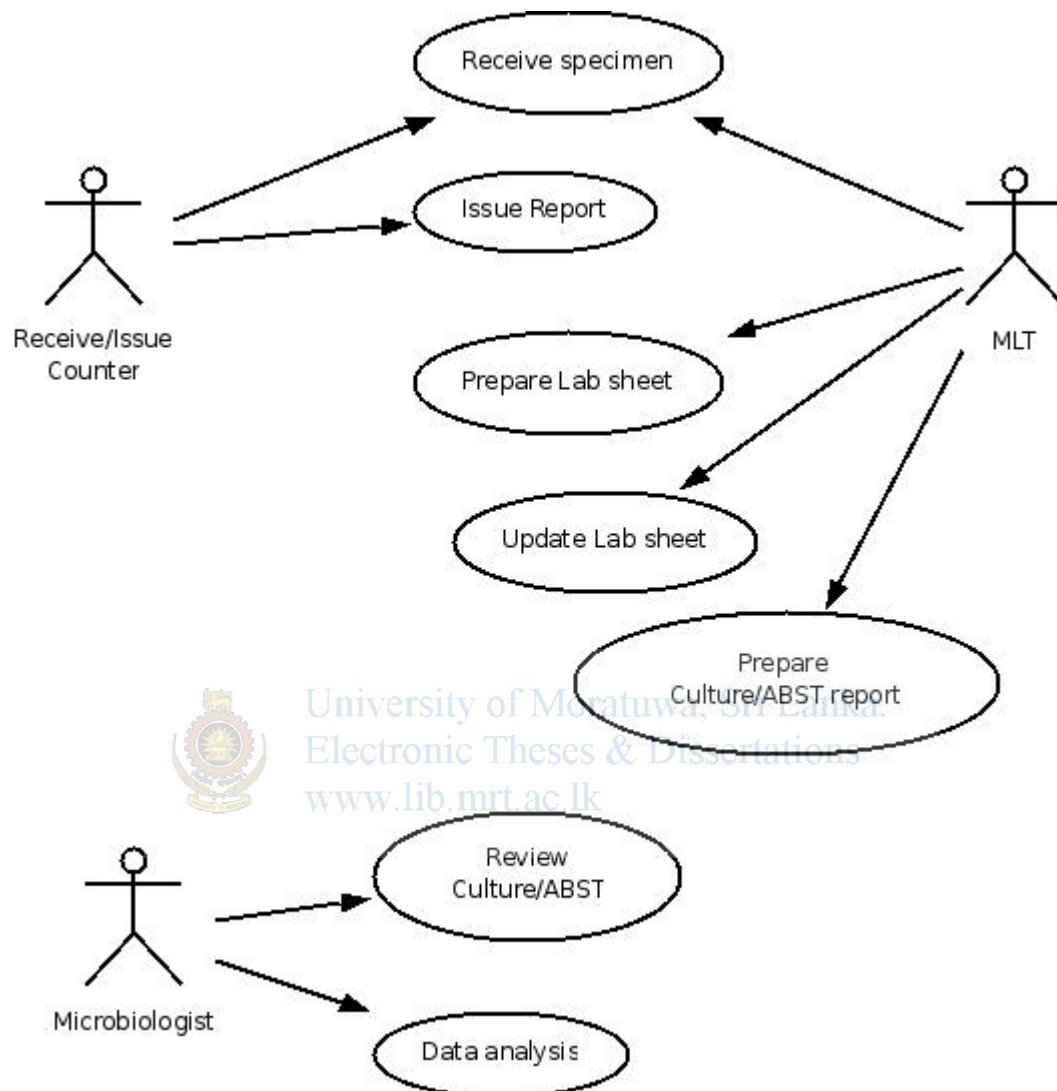


Figure 8: Overview of the manual system.

Clerk, MLT and the consultant are the main actors of the system. They are having, accepting specimens and issuing reports, performing the laboratory work and preparing lab sheet and culture ABST report and review of the culture ABST report respectively.

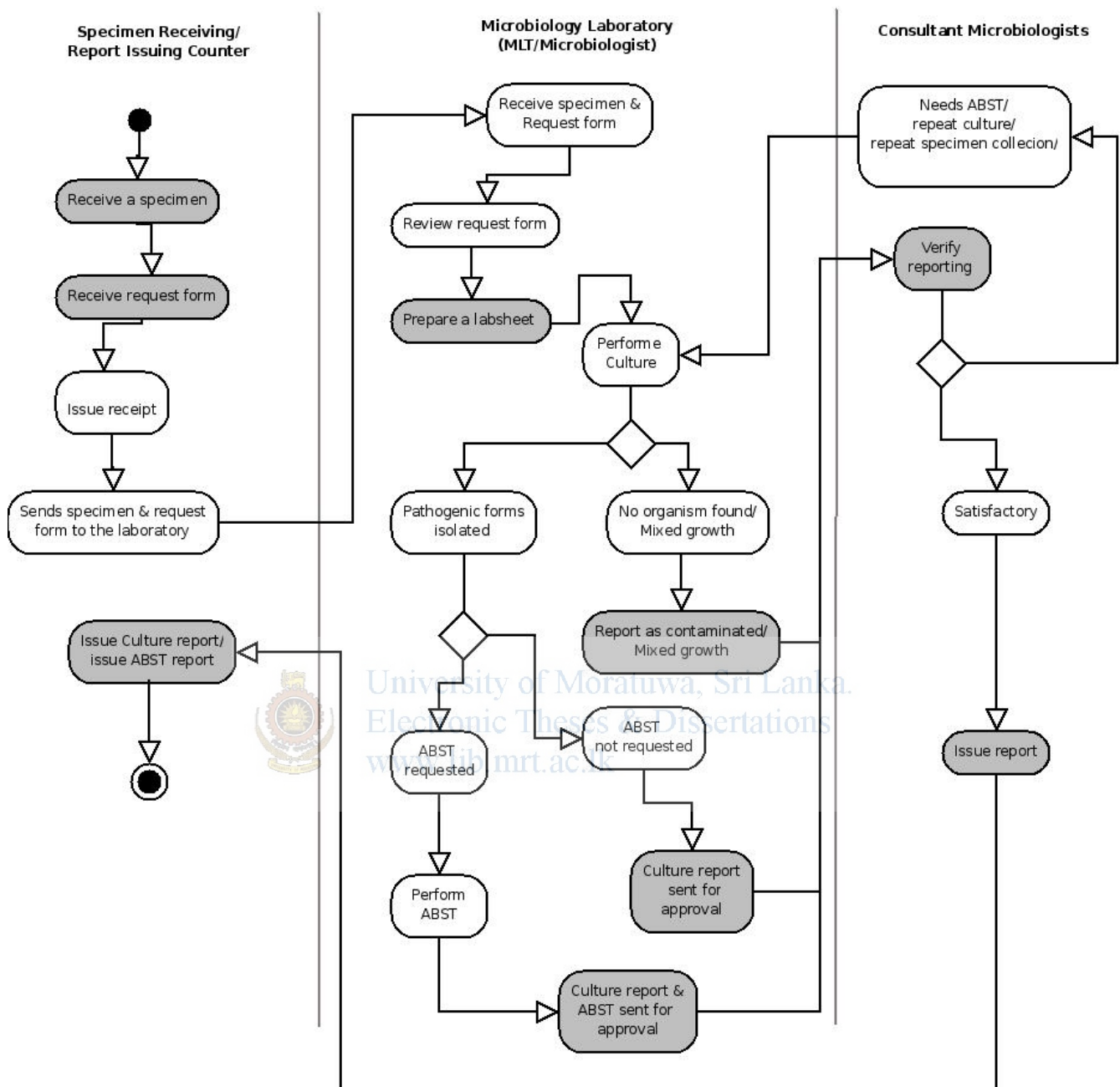


Figure 9: Information flow of the manual system.

5.3. Developed system

Overview of the proposed system is as follows.

It has a system user level Login function and then based on the user authentication, they will have different roles.

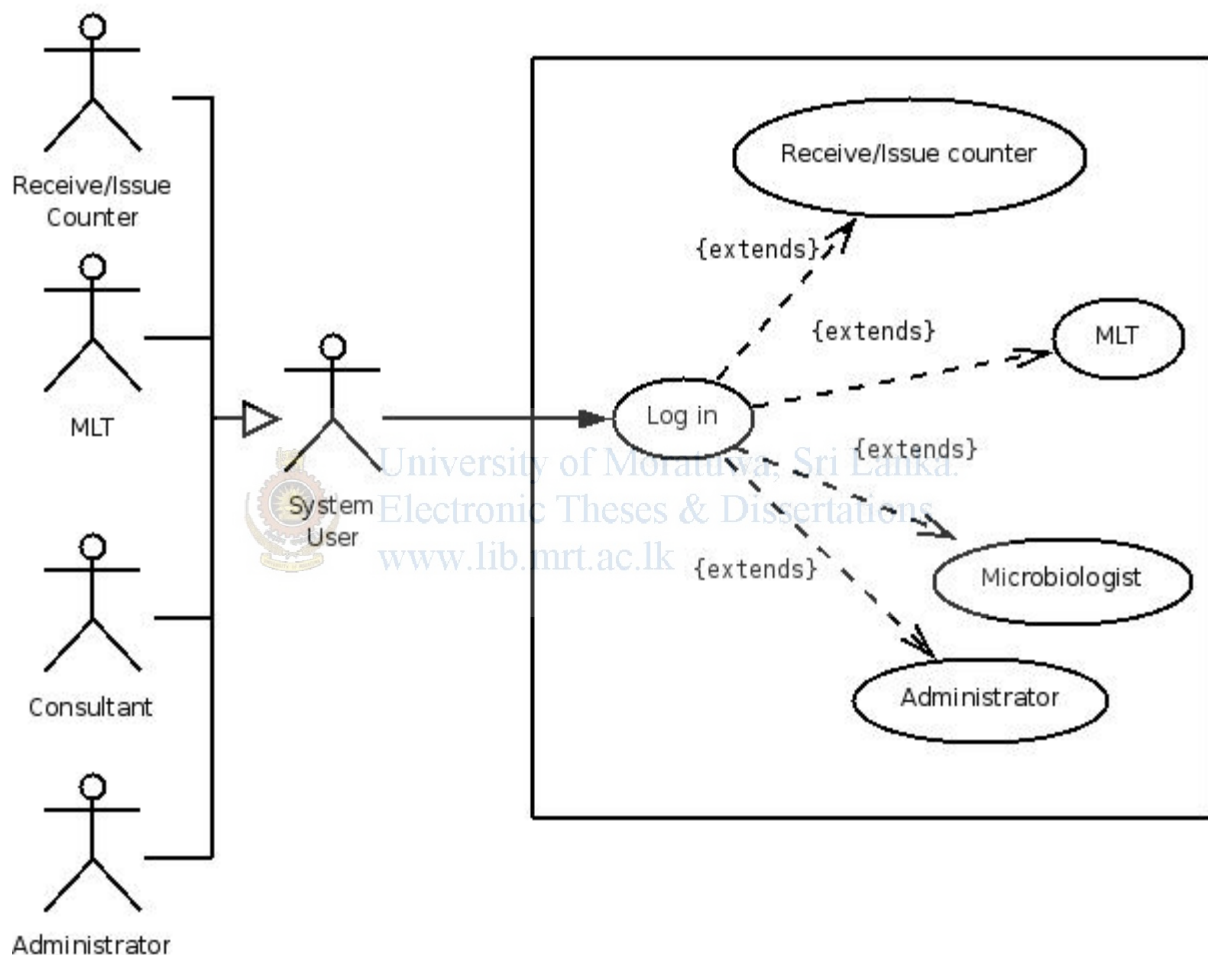


Figure 10: Overview of the proposed system

Detailed design of the proposed systems use case models are as follows. Once Logged in, Clerk, MLT, consultant or system administrator user roles will be assigned to the users. Functionalities of these users within the system will be determined by the user roles.

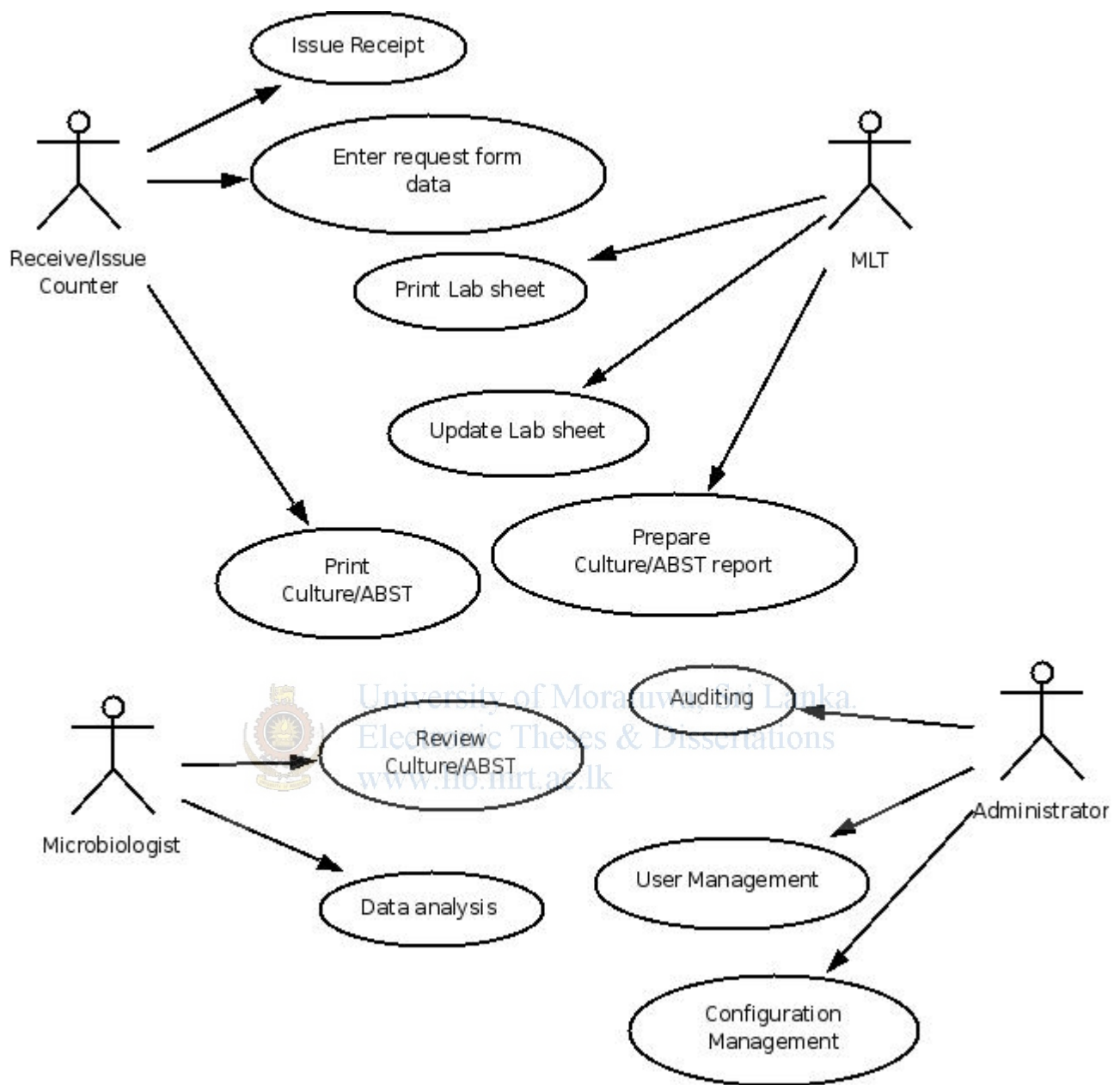


Figure 11: Proposed system model

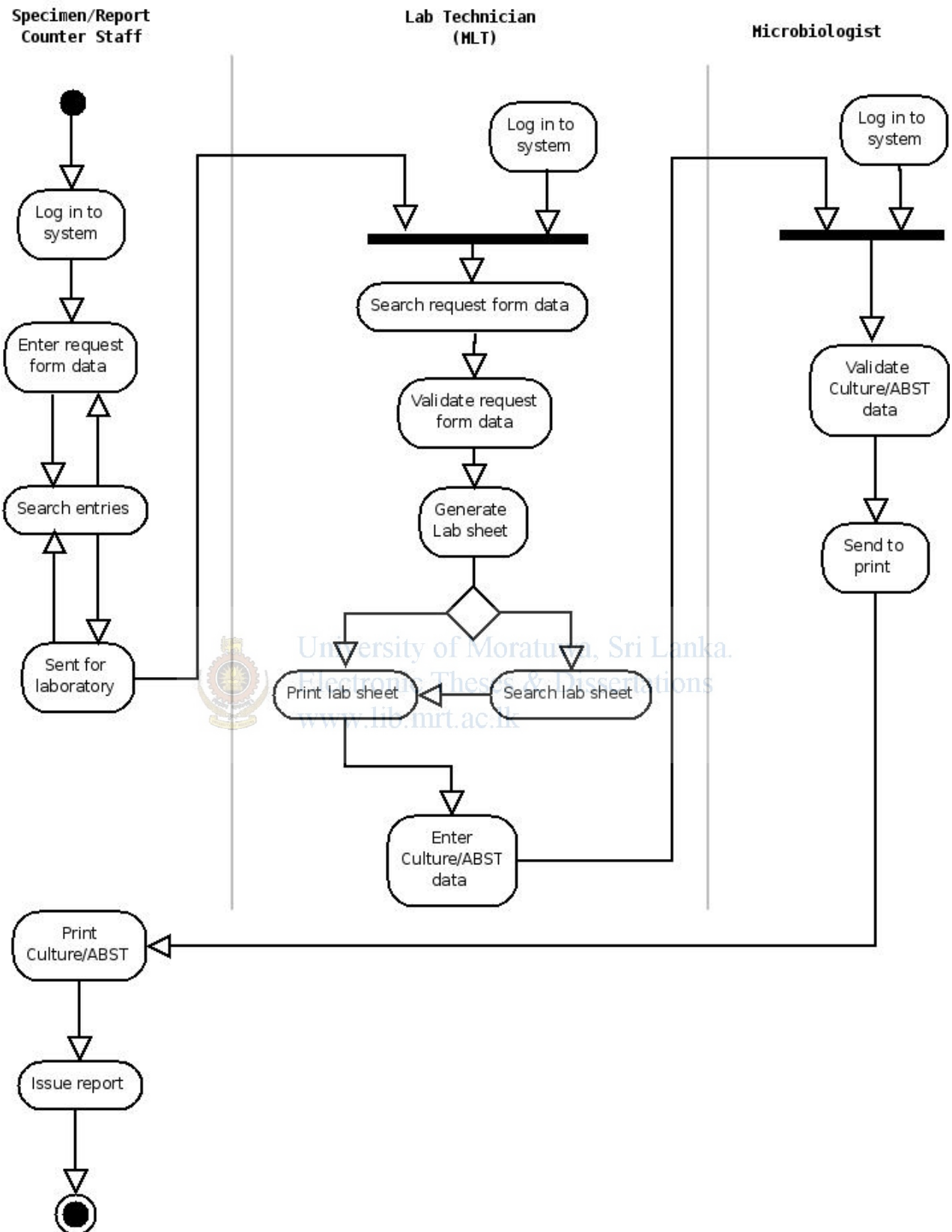


Figure 12: Activity diagram of the Proposed system

More detailed Use case diagrams, Use case descriptions and activity diagrams are available in the Appendix D and Appendix E respectively.

Based on the requirements gathered in the Software Requirement Specification and the use case models and activity diagrams developed, use case check list can be prepared. This check list will verify all the user requirements were satisfied by the use cases and the activity diagrams developed.

Table 7: Use Case Check list

Use case		Software Requirement	Use case Description	Activity Diagram
1	Receive specimen	2	1	1, 3
2	Accept request form	2, 8	2	1, 3
3	Issue receipt	3	3	1, 3
4	Search duplicates by BHT/name/NIC	4	4	7
5	Review report	4, 5	5	1, 5, 6, 8
6	Validate Culture & ABST	6	6	1, 4, 5
7	Print reports	7	7	1, 5, 6
8	Search information by name/BHT/NIC/Bacteria/Antibiotic	4, 5	8	9
9	Search reports by Name/BHT/NIC	21	9	7
10	Review request form	8	10	1, 3, 4
11	Prepare lab sheet	9, 15	11	1, 4

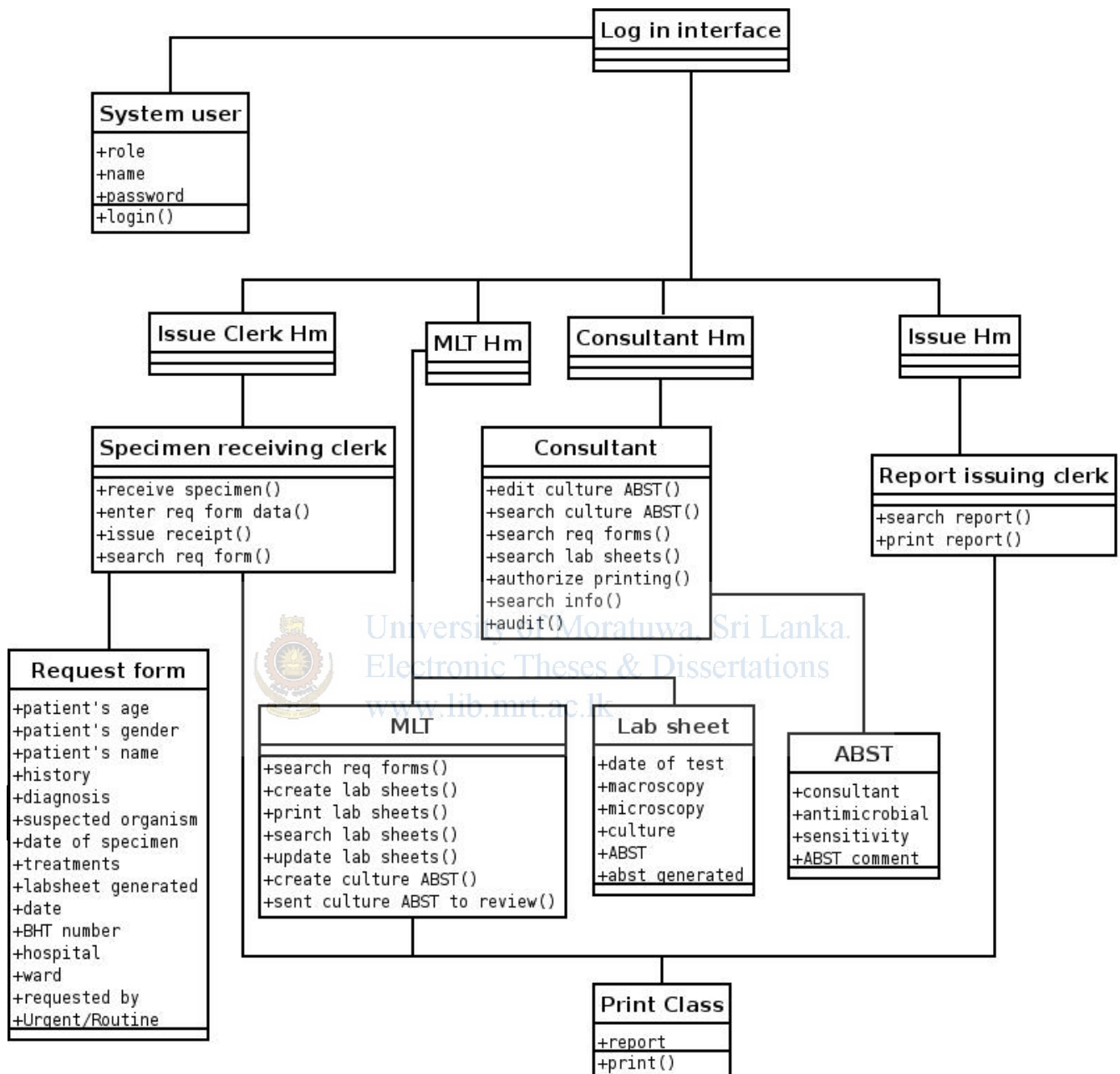
12	Complete lab sheet	9	12	1, 4
13	Prepare culture and ABST	10	13	1, 4
14	Send culture/ABST to be reviewed by microbiologist	11	14	1, 4, 5
15	Search information by BHT/age/ward/type of investigation	12, 13	15	11
16	Customize system information	16, 17, 18	16	10
17	Add user	14	17	10
18	Auditing	12, 13	18	11
19	Log in	1	19	2



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Based on the above artifacts, grammatical analysis can be performed to identify the major domain classes involved in the system functionality.

Figure 13 : Class diagram of the proposed system



When the domain classes were identified, sequence diagrams were developed. Through the sequence diagrams, Interface classes and control classes can be identified.

Following is a sample sequence diagram which represents the Login process.

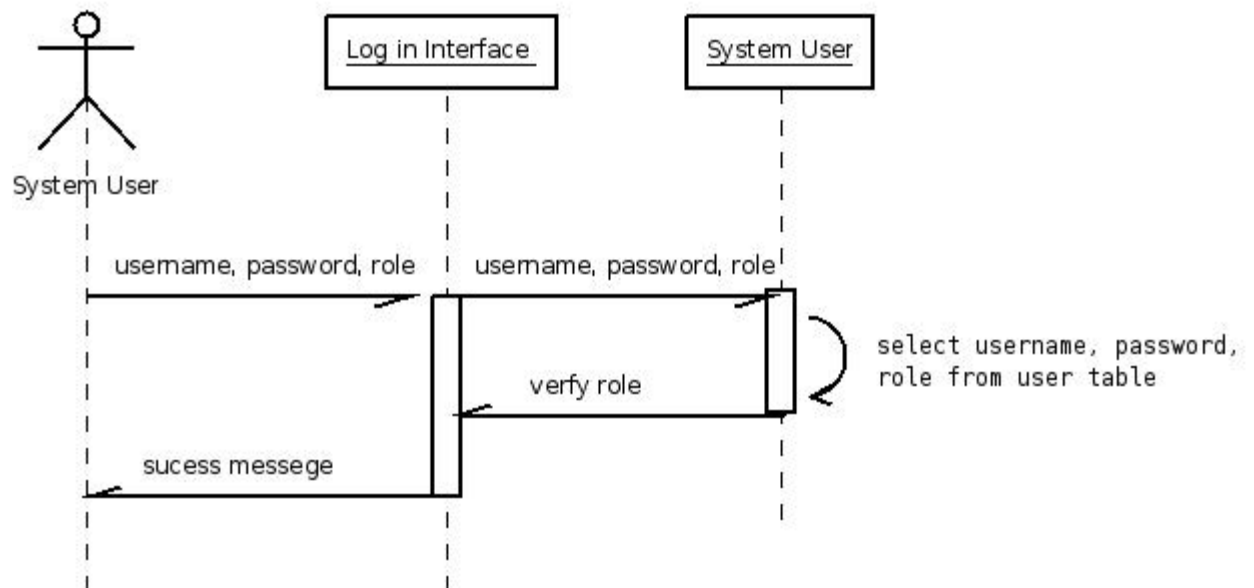


Figure 14: Login process sequence diagram



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Complete set of sequence diagrams are available in the Appendix F.

5.4. Database design.

Database design was started with the 'Mini World'. Mini world for the proposed system was as follows.

1. Single laboratory may have a single or multiple centers for specimen receiving, laboratory work and issuing of Culture/ABST reports
2. Single system may be used by many laboratories
3. Users may log in to the system one at a time or concurrently
4. Once logged in system users have the role of system administrator, consultant, MLT,

- specimen receiving clerk or report issuing clerk
5. Single system user will not have multiple user roles
 6. Specimen receiving clerk should issue receipts upon receiving a specimen
 7. System should store information on each specimen, lab sheet and culture/ABST report
 8. Specimen receiving and issuing occurs at different settings at different times
 9. Specimen is accepted by the specimen receiving clerk
 10. One specimen receiving clerk will accept many specimens
 11. One specimen only have one receipt and one request form
 12. One patient may have several specimens
 13. One patient may have different BHT numbers depending on the admission
 14. System users have unique national identification numbers
 15. One request form creates one lab sheet
 16. MLT will generate and update the lab sheet
 17. One MLT will generate many lab sheets
 18. The testing/laboratory procedure is done by MLT and the results have to be approved by the consultant Microbiologists for ABST to be printed
 19. One lab sheet will generate one Culture/ABST report
 20. One MLT will generate many ABSTs
 21. Consultant will review ABSTs
 22. One consultant will review many ABSTs
 23. Consultant will approve every ABST before it is being printed
 24. Report issuing clerk will print and issue the Culture/ABST report
 25. One report issuing clerk will issue many report
 26. lab sheet contains information of Macroscopy, Microscopy, Culture and ABST
 27. Culture will be done on many bacteria
 28. ABST will done on many Antibiotics
 29. System administrator will update the consultant name, laboratory name, laboratory address and contact details and laboratory logo
 30. System administrator will add users to the system

Based on the above mini world, Entity – Relationship (ER) modeling was done. Based on the ER diagram, relational tables were built. Once the tables and primary and foreign keys were

identified, tables can be converted to the third normal form.

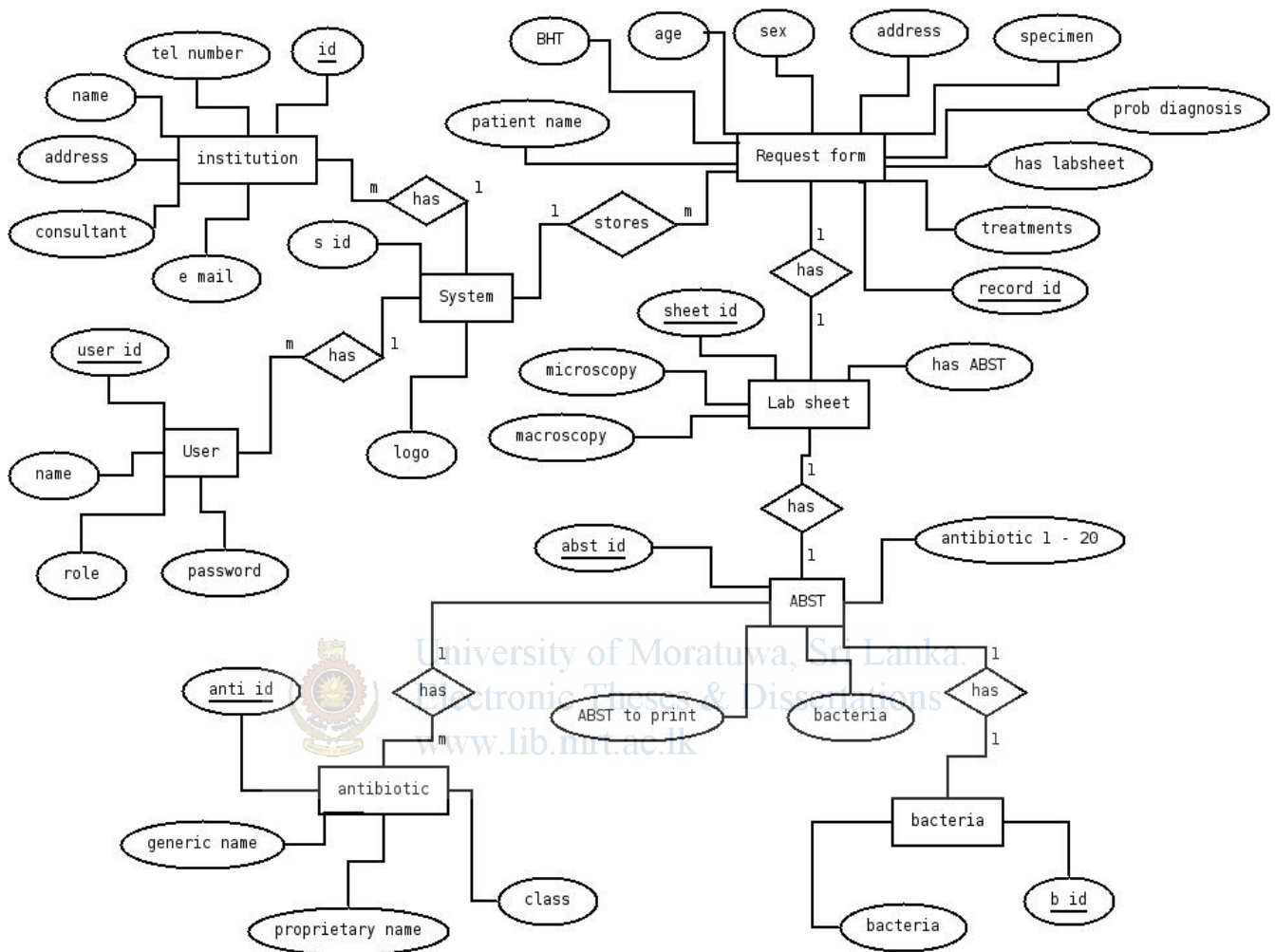
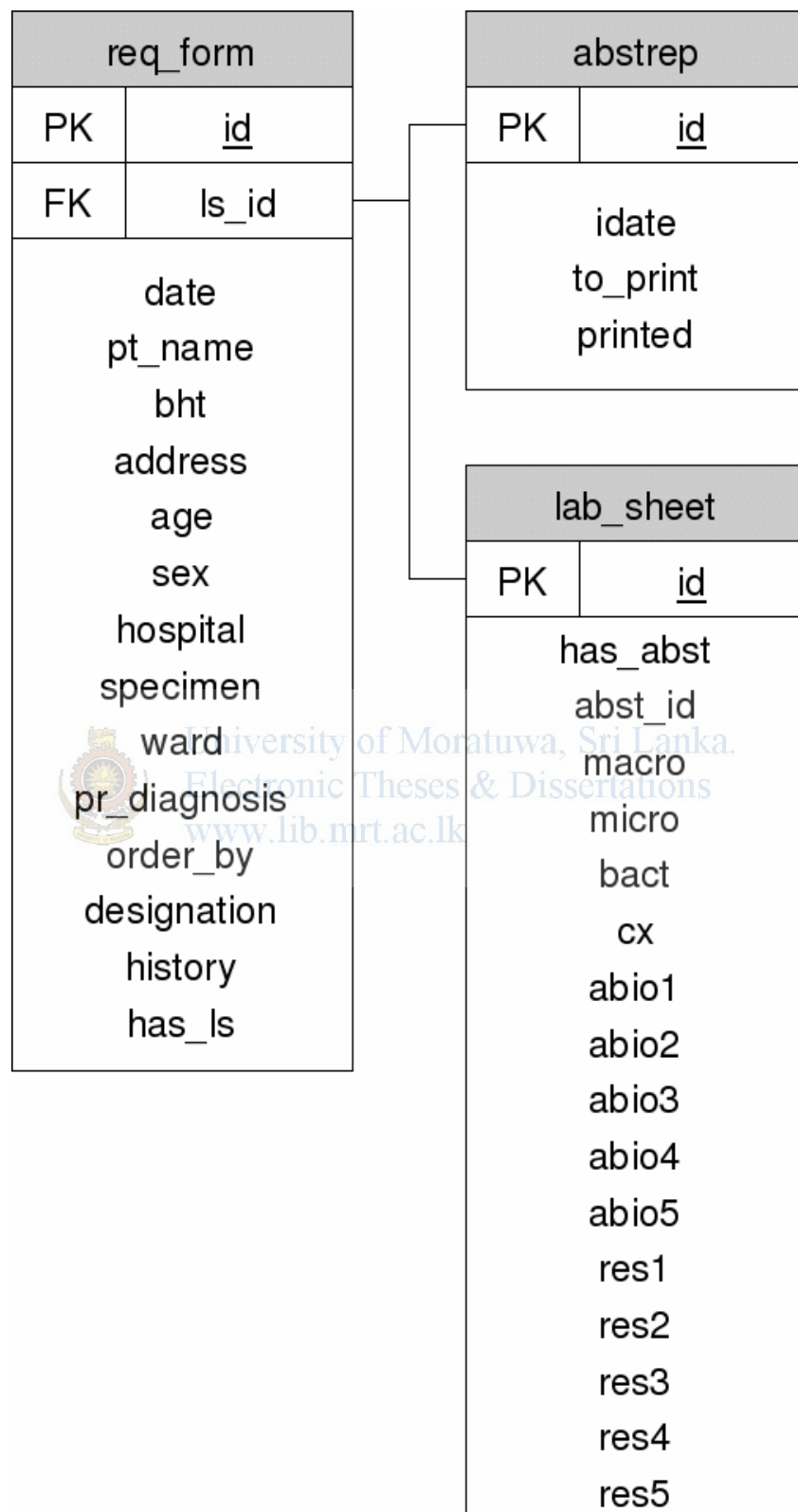


Figure 15: Entity Relationship (ER) Diagram

Figure 16: Database Diagram



5.5 Graphical user interface design

Then the designing process can be directed towards the Graphical User Interface (GUI) design. GUIs can be represented by schematic diagrams and common features of the GUIs can be identified, which will convert to Cascading Style Sheets (CSS) in the coding phase.

Following are some of the common features identified in the GUI design.

All forms

size	500x600 pixel
bgcolor	#d5d0d0
alignment	left
left margin	50 pixels

Heading

font	14 pixel bold
font color	#000000

Standard

font	12 pixel regular
font color	#000000

Link

font	12 pixel bold
font color	#a03d57

Error message

size	400x40 pixel
align	centre
font	12 pixel bold
font color	#000000
margin	1 pixel
border color	#a03d57
padding	5 pixel
bgcolor	#bab6b6
symbol	

Sample GUI design is shown here.

Figure 17: Login form GUI design

Ref:Log1.0		GUI reference ID
Login		title
Name:		text box, 30pixel
Role:		drop down box
Password:	*****	password box, 20, *
Login Reset		
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Each GUI will have a GUI references ID. Following is a tabular representation of each graphical user interface and corresponding GUI ID number.

Table 8: GUI ID for Graphical User Interfaces

GUI Title	GUI Reference ID
Login Page	Ref:log1.0
Receive clerk home page	Ref:Rcv2.0
Search Request Form	Ref:Rcv2.1
Add new request form	Ref:Rcv2.2.0
Receipt	Ref:Rcv2.2.1

MLT Home page	Ref:Mlt3.0
Search Request Form	Ref:Mlt3.1
Select request form to generate Lab sheet	Ref:Mlt3.2.1
Worksheet for processing microbiological specimen	Ref:Mlt3.2.2
Lab sheet	Ref:Mlt3.2.3
Search Lab sheet	Ref:Mlt3.3
Select lab sheet to update	Ref:Mlt3.4.0
Update worksheet	Ref:Mlt3.4.1
Select lab sheet to generate ABST	Ref:Mlt3.5.0
Antibiotic sensitivity test result	Ref:Mlt3.5.1
Search ABST	Ref:Mlt3.6
Consultant Home page	Ref:Con4.0
Search request form	Ref:Con4.1
Search lab sheet	Ref:Con4.2
Review ABST	Ref:Con4.3.1
Antibiotic sensitivity test result	Ref:Con4.3.2
Analysis	Ref:Con4.4.0
GIS Mapping	Ref:Con4.5
Auditing	Ref:Con4.6
Issue clerk home page	Ref:Iss5.0
Search issued ABST	Ref:Iss5.1
Select ABST to print	Ref:Iss5.2.1
Antibiotic sensitivity test result	Ref:Iss5.2.2
Administrator Home page	Ref:Adm6.0
Update system information	Ref:Adm6.1
Enroll user	Ref:Adm6.2
Add antibiotic	Ref:Adm6.3
Add bacteria	Ref:Adm6.4

5.5.1 Form Validation

Each form will be validated before it is submitted to the web server. This client side form validation is done using java Scripts.

Following is an example form validation.

Form : Login form (Ref:log1.0)

```
if name == " " -> "Enter valid user name. If you are not a registered user, please
                contact system administrator"
```

```
if role == " " ->"Select valid user role"
```

```
if password == " " -> "Enter valid password. Password is case sensitive."
```

This set of rules will not submit the form data to the PHP script if any of the fields contains a null value.

Summary

The design phase was discussed in this chapter. Use Case, Activity, Sequence are some of standard UML diagrams to be used in this process. Data base ER modeling and the Graphical User Interface design are two other important design issues.

As shown above all the graphical user interfaces are designed with Cascading Style Sheets, uniform form outlines and controls and client side form validation rules.

Next chapter will concentrate on some of the implementation issues.