

# Analysis & Design

### 5.1 Introduction

Using selected Technologies and methodologies, the IPS-IRD system was planned in the previous chapter. Analyzing existing system, required functions were identified and the system design was planned on them will be described in this chapter.

### 5.2 Analysis of existing system

The existing manual system for tax-information process in IRD was studied by interviewing users, and studying information recording registers, other pre formatted documents used such as information calling letters, interview calling letters, information verification form (1 V), form 70 used for tax-information distribution (these formats are annexure in *Appendix A*), duty allocation lists for all users which involved to this process and other related documents and all procedures using in manual system.

According to the results of feasibility study of the system (*Appendix B*), two main processes were identified in the existing traditional tax-information processing system (See figure 1). And two categories of branches were identified as,

1. Information
2. Tax branches

Information Branch was identified as the main location which handles a wide range of tax-information collector which not identified relation to a registered tax payer. The officer-in charge called Deputy Commissioner (Information) was the responsible person for the head of the department. All tax branches such as corporate tax branches and personal tax branches were involved with this tax-information processing manual system. After studying the manual process of connection between tax branches and the Information Branch, user requirements were identified through interviewing users & stakeholders. Identified requirements were analyzed using my working experience with the domain knowledge of the problem. Collected requirements were classified

and resolved the conflicts. Identified user requirements were specified as user classification as in *Table 5.1*.

### 5.2.1 Basic Flow of the Existing System

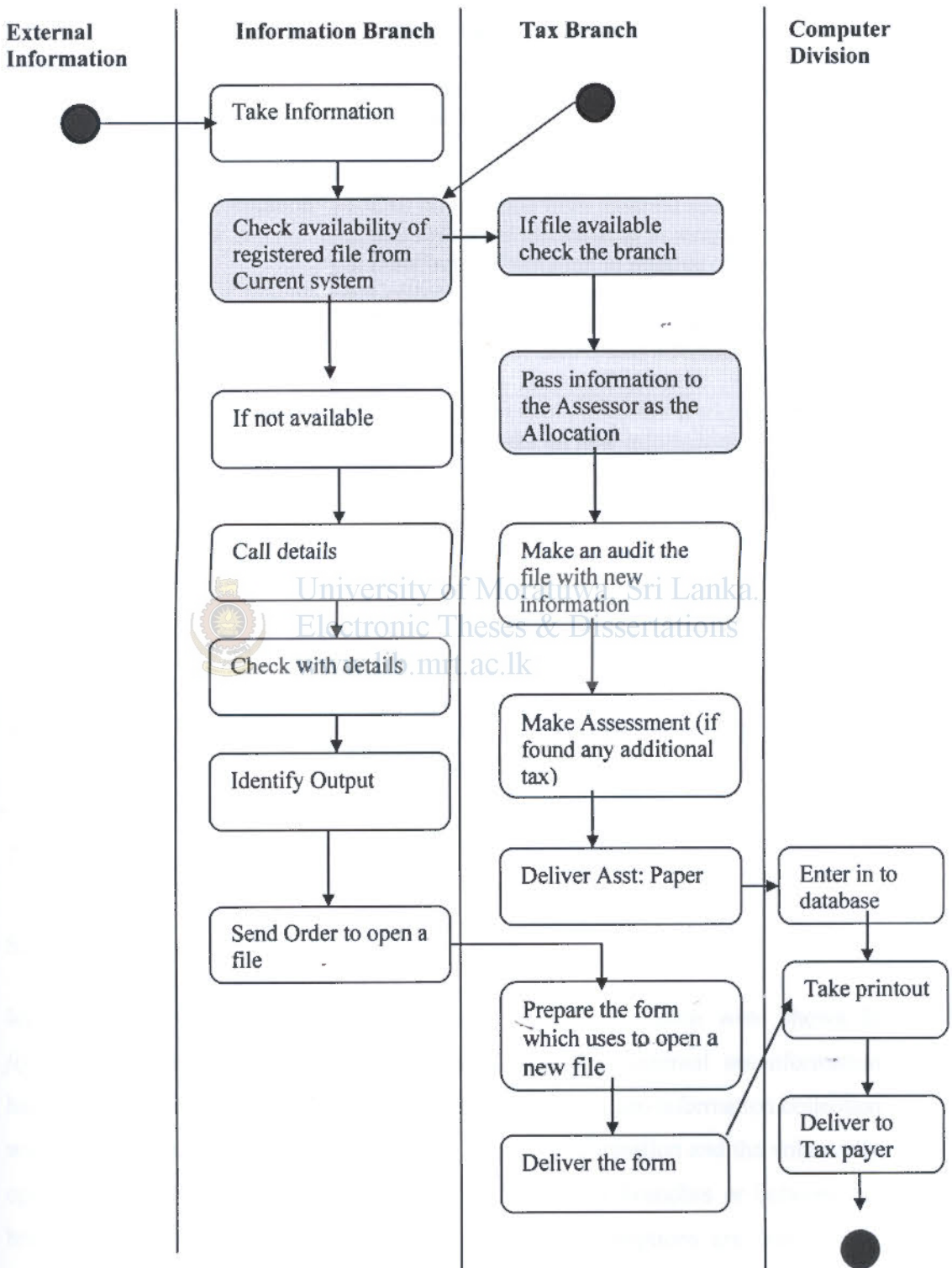


Figure 5.1: Flow of existing system.

### 5.2.2 User Requirements as existing system

User	Allocated Branch	Requirements
Commissioner General of Inland Revenue	Department	<ol style="list-style-type: none"> <li>1. Minimize any corruption can be done on manual process.</li> <li>2. Open more tax files on received correct information.</li> </ol>
Deputy Commissioner	Information	<ol style="list-style-type: none"> <li>1. Call information from external sources.</li> <li>2. Store received information in secure place.</li> <li>3. Distribute information to relative officer.</li> <li>4. Collect information about unregistered tax payable Persons/institutes from internal process.</li> <li>5. Get feedback of distributed information.</li> <li>6. Make reports.</li> </ol>
Deputy Commissioner	Corporate tax	<ol style="list-style-type: none"> <li>1. See the progress of Assessors works on approach of dictions make on new information.</li> <li>2. Collect additional tax from new tax payers.</li> </ol>
Assessors	Information	<ol style="list-style-type: none"> <li>1. Attend on new external information received immediately.</li> <li>2. Distribute details of temporarily opened files.</li> <li>3. Maintain records in a proper way.</li> </ol>
Assessors	Corporate Tax	<ol style="list-style-type: none"> <li>1. Distribute internal information to the end users and get feedback in a short period.</li> <li>2. Reduce time on preparing manual records &amp; manual information process.</li> </ol>
Tax Officers	Both	<ol style="list-style-type: none"> <li>1. They maintain records &amp; write manual documents under the order by Assessors or DC.</li> </ol>

Table 5.1: Identified user requirements

### 5.2.3 Activities of user groups in existing system

Identified use-cases for two main processes in existing system were shown in figure 5.2 and figure 5.3. According to the use-cases in external tax-information handling process, it was clearly identified that the external tax-information collection was handled by the Information Branch only. Internal information and the voluntarily opened tax files were distributed and handled within tax branches or between tax branches and the Information Branch. All use case descriptions are annexure in Appendix C.



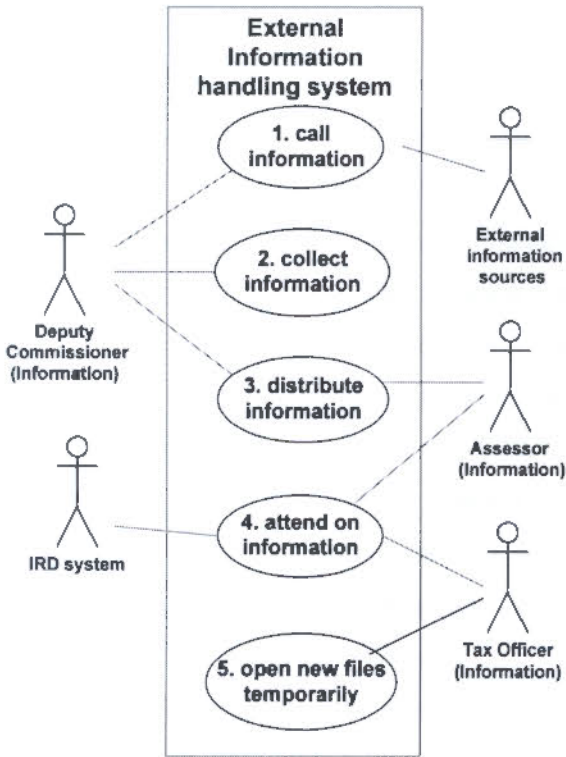


Figure 5.2: The existing flow of handling tax- information

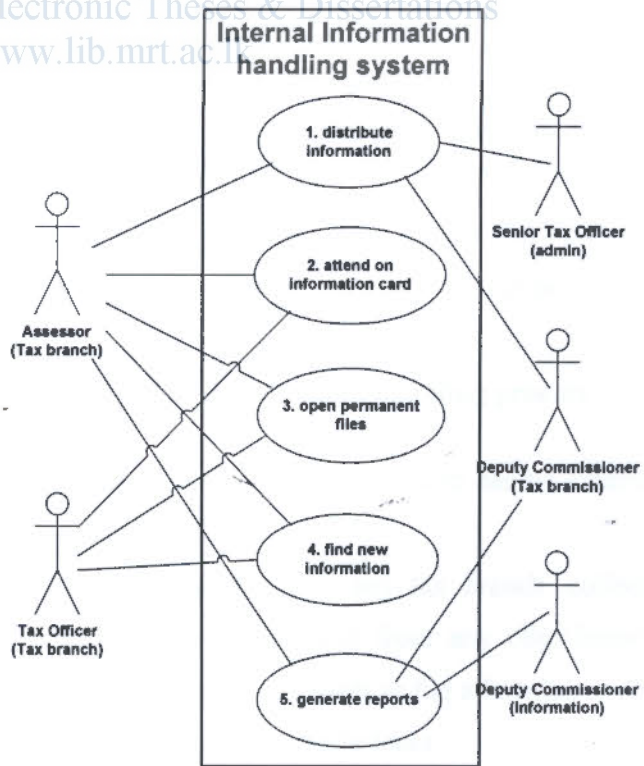


Figure 5.3: Use Case diagram for internal tax- information handling process

#### 5.2.4 Brief description of existing external tax- information handling process

According to figure 5.1, five types of user groups were involved to handle external tax-information process as use case diagram shown above and the brief description as below,

1. Call information - Deputy Commissioner (information) call for taxable information from institutes which provides external information such as department of motor vehicle registration , department of company registrar etc.
2. Attend on information - Deputy Commissioner (information) collects all tax-information received to the Information Branch. Assessors distribute information which identified relativeness of existing tax files to the file allocated branch.
3. Distribute information - Deputy Commissioner (information) distribute many types of tax-information among Assessors in Information Branch selecting them in random manner.
4. Attend on information - Assessors attend on information with the help of the tax officers using existing IRD system whether there is an available registered person or body and if identified new liability, Assessors deliver an order to open tax file voluntarily.
5. Open new files  
Temporarily - Tax officers open new tax files if the Assessor identified any tax liability on new information

#### 5.2.5 Brief description of existing internal tax-information handling process

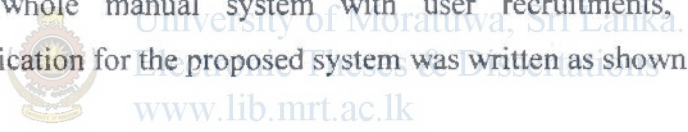
According to figure 5.1, five types of user groups were involved to handle external tax-information process for five use cases as below,

1. Distribute information - Senior tax officer (Admin) in any tax branch collects received tax-information cards from any other branch and distribute them to Assessors as file allocation under supervision of Deputy Commissioner. Assessors (tax) distribute tax-information which found

- on audits of existing tax files to another branch through Senior tax officers (Admin).
2. Attend on information - Assessors (tax) attend on received tax-information with the help of Tax Officers.  
Assessors distribute information related to existing tax files to the file allocated branch.
  3. Open permanent files - Assessors (tax) open new files on received information. Tax Officers help to this process.
  4. Find new information - Assessors (tax) find new tax-information through existing file auditing process. Tax Officers help to this process.
  5. Generate reports - Deputy Commissioners (tax) generate reports on information when asked by the Deputy Commissioner (information) and send reports to him.

All activity flow diagrams designed on use-cases were included in *Appendix D*.

After analyzing whole manual system with user recruitments, the software requirement specification for the proposed system was written as shown in follows.



### **5.3 Software requirement specification for proposed IPS-IRD system**

#### **5.3.1 Functional requirements (mandatory)**

1. The system shall have Information table to store all internal & external information, received by the department.
2. Senior Assessor (Information) shall receive replies for information calling letters and any other petitions. (manual work)
3. Senior Assessor (Information) shall put the received date and serial numbers on all received documents. (manual work)
4. Senior Assessor (Information) shall pass all documents to data entry operators to enter details of information to the IPS-IRD system. (manual work)



5. Data entry operator shall have authority to input data into the database.
6. Assessor (Tax) shall input internal information into the database when he identified through the file auditing process.
7. Assessor (Information) shall input information he received as already new external information, when he has found if it was related to an existing tax file.
8. IPS-IRD system shall update the information table, when received new information to the system.
9. IPS IRD system shall have a facility to search if there is an existing tax file related to new information. (This process can run daily)
10. The system shall have a facility to select Assessor in a tax branch and send new information if found an existing tax file.
11. The system shall select an Assessor (information) in a random cycle and send new information, when the system failed to found an existing tax file related to new information.
12. The system shall maintain records of actions taken by the Assessors for distributed information.
13. The Assessors (Tax / information) shall have a facility to upload action taken to the system, for received new information.
14. Assessors (Tax/ Information) shall have facility to mark invaluable information and the reason, if the information is not important.
15. The system shall have facility to distribute details of temporarily opened files to the Assessor (Tax) according to the Allocation lists.
16. The system shall call explanations from the Assessors (Tax) or Assessors (Information), who have not uploaded, action taken for information received.

17. The system shall provide a facility to Deputy Commissioner (Tax) or Deputy Commissioner (Information) to retrieve the action taken by Assessors who have not taken any action for information as given authority.
18. All Deputy Commissioners and Assessors shall have authority to print reports required by him or head of the department.
19. The system shall provide facilities to System Administrator to add users, to delete users and maintain user levels.
20. The system shall provide facilities to the Deputy Commissioners to edit users and to edit their file allocation.
21. All Deputy Commissioners (Tax/ Information), Assessors (Tax/ Information), Data Entry operators shall have system log-in facility.

#### **5.3.2 Functional requirements (desirable)**

1. The system should have facility to issue information calling letters to external information roots.
2. The system should have facility to issue I V forms to identified persons or companies when required by the Assessors.

Top level architectural design was done as identified software requirements. The layered model was selected because it was the most suitable design model for information processes.

#### **5.4 Layered model architectural design**

A layered model architectural design was used to provide the project concept. Since the components are reusable, it was easy to maintain the project because as convenient to separate layers. A layered model architecture highly used for information processing systems that because of data security and user friendly application.



In this type of design, client can make software update easily, because the client side doesn't need to be updated when updating the application. The middle layer (logical layer) needs to be modified when the business rules are changed. And also it is not necessary to modify the interface when the database is modified. According to this model design, users access the information through browsers. The browser displays the interface. User will be provided a personalized entry to all information in consistent and customizable way. The information resources can be received by multiple devices (multiple PCs), because this software will be used by hundreds of users within the department. The business logic layer will be activated by the entry of any user, using interface login. This layer exchanges the data between the data object and the interface. Communication will be fast, because network traffic reduces as this architectural design.

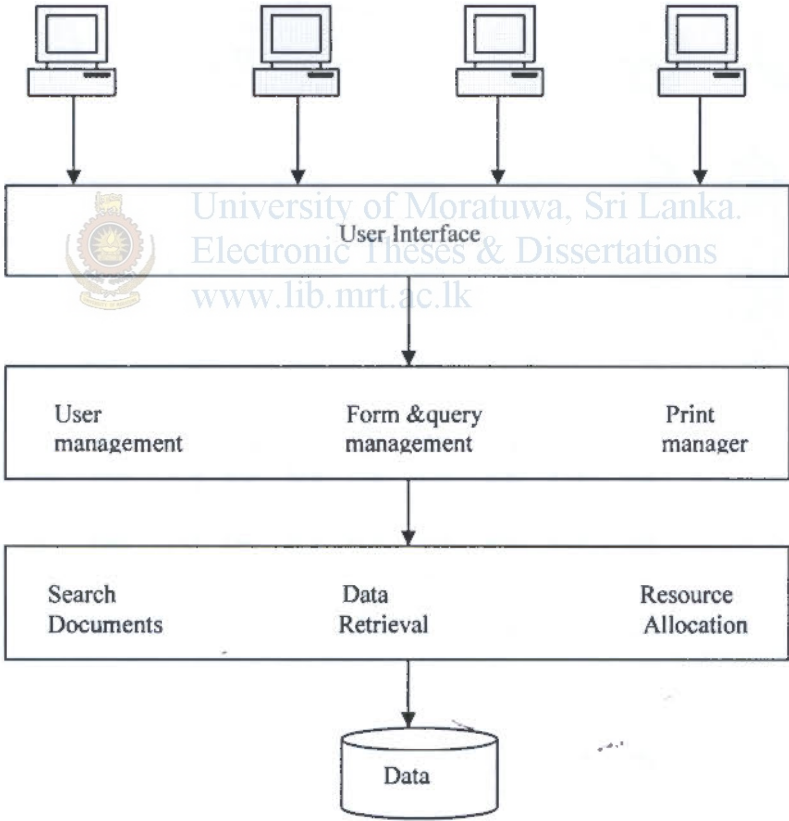


Figure 5.4 : The layered model design.

The model layer design was then converted to a modular decomposition style as in Figure 5.5. An object oriented architectural design was done relating to above figure.



This system can manage system users, manage information, manage Actions taken and generate reports in the system level. The next level shows the sub systems. As an example work floor from a system to sub system is as follows. Information Management system is sub divided into the input process, distribution process of the stored data and the providing facility to view information as per user. The decomposed modular is shown in the lowest layer. As demodulation of the above example, the input information process can be divided as internal information input process and external information process.

### 5.5 Architectural design in decomposition modulation

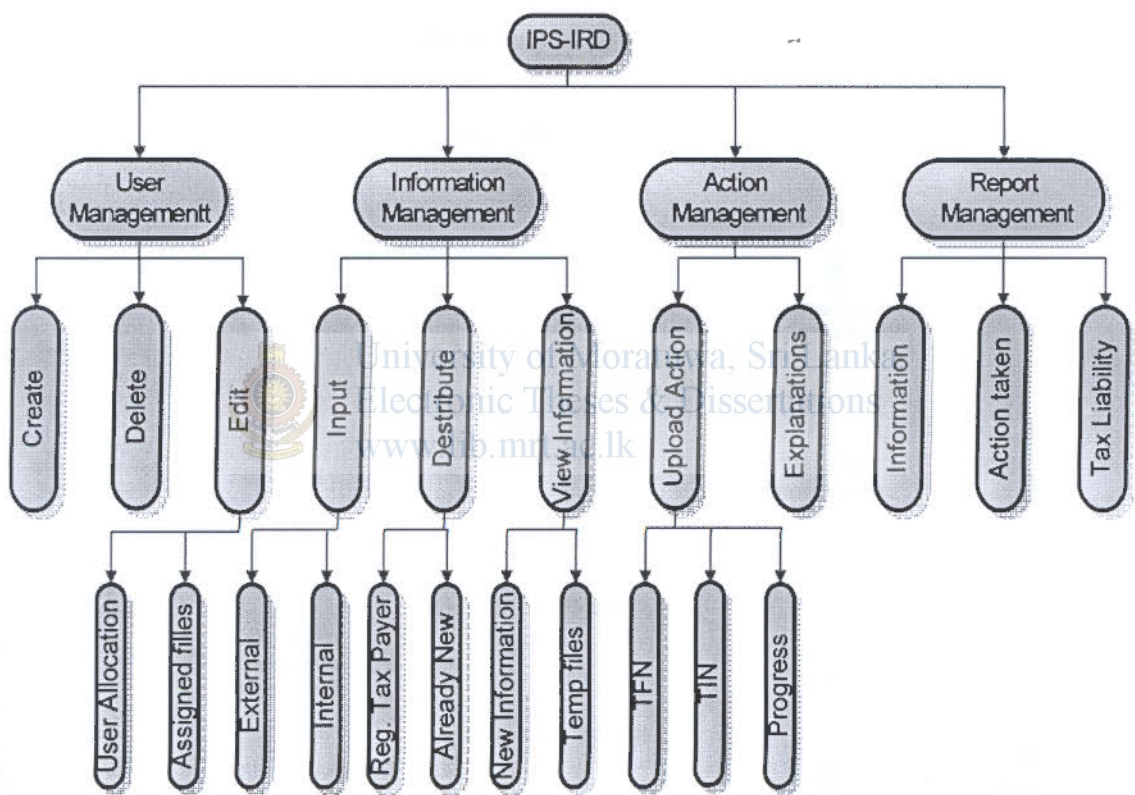


Figure 5.5: Architectural design in modular decomposition system

After doing the architectural design, use-cases were introduced while removing some existing use-cases very carefully on expanded software requirements. The interactions that the users will have with the proposed system were described by the proposed use-case diagram. The figure 5.6 shows the interaction between the system and users. According to the initial use-case diagram, the use-cases can be described as follows.

▪ Log in -

All system users can log-in to the IPS-IRD system as pre defined user roles. All Deputy Commissioners in tax branches can log in to see the whole input and output details according to branch allocation. Deputy Commissioner of the Information Branch can log-in to see the input and output details in the whole system. Assessors can log-in to system to view information received for personal accounts and they can upload the actions they got as the output back to the system and input if any information identified as in internal process. Data entry operators can log-in to the system only to input information received as external information.

5.6 Initial Use case Diagram for the proposed System

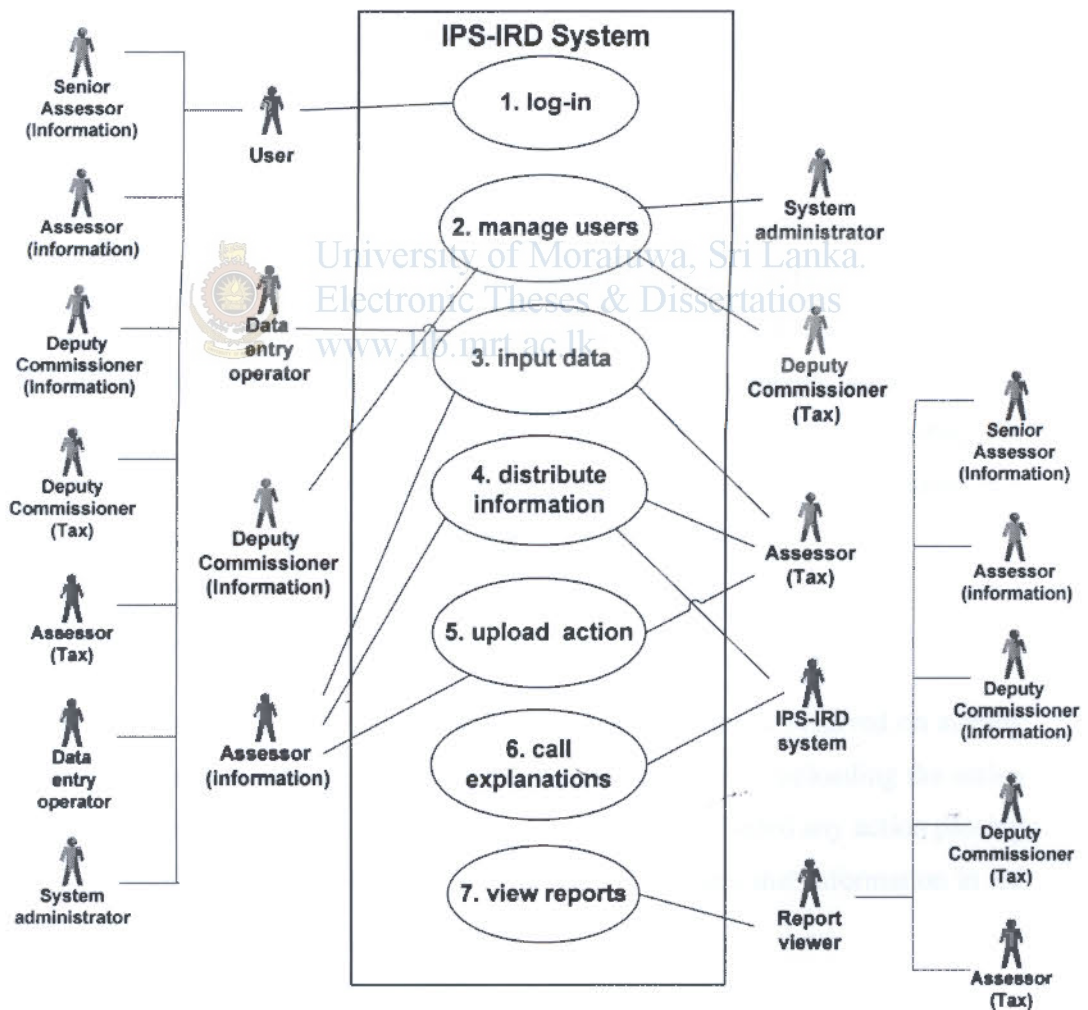


Figure 5.6 : Use-case diagram of the proposed system



- **Manage users –**

The system Administrator is the authorized person who creates or deletes users as system required. A user will be deleted only if the user retired from the department once he created as a user. System Administrator is also restricted to do any other correctible changes to the system without the authority and the supervision of the Head of the Department. The deputy commissioners can edit user allocations and file allocations as per any transaction whenever done by the department administration. The decomposed use-case is shown *figure 5.7*.

- **Input data –**

This use-case decomposed into three sub use cases shown in *figure 5.8*. According to the sub use-cases users can input data into the system as the user role. Here Assessors can input internal information and the data entry operators can input external information.

- **Distribute information –**

According to the sub use-case design it can be described as two processes. The IPS-IRD system automatically searches whether there is referenced existing tax file related to new information and if found existing file record, system display information to the Assessors (tax). If the system failed to found an existing file record for new information, the system will select an Assessor (information) in a random manner automatically and display such information.

- **Upload Action Taken –**

The Assessors (information) must upload the action taken on received on already new information to the department while the Assessors (tax) uploading the action taken for new information. When an Assessor has not uploaded any action passing two weeks period IPS-IRD system automatically highlights that information in red colour background.

### Use-case 2 : Manage users

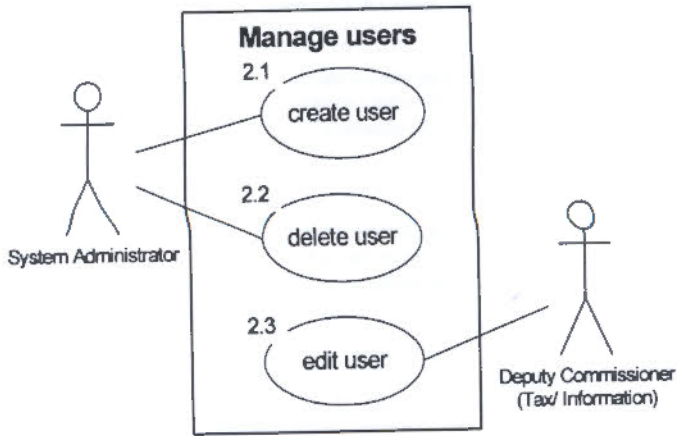


Figure 5.7 : Manage users us- case

### Use case 3 : Input data

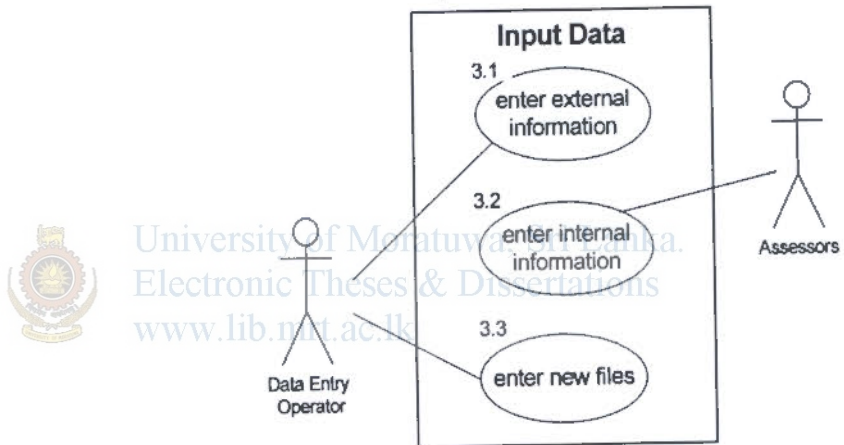


Figure 5.8: Input data use-case

### Use-case 4: distribute information

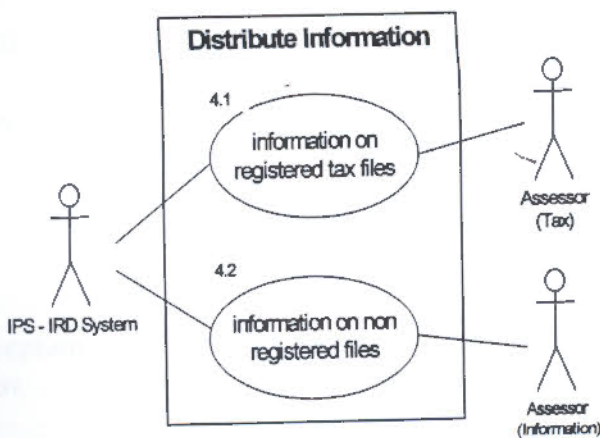


Figure 5.9: Distribute Information usecase

## Use-case 5: Upload action

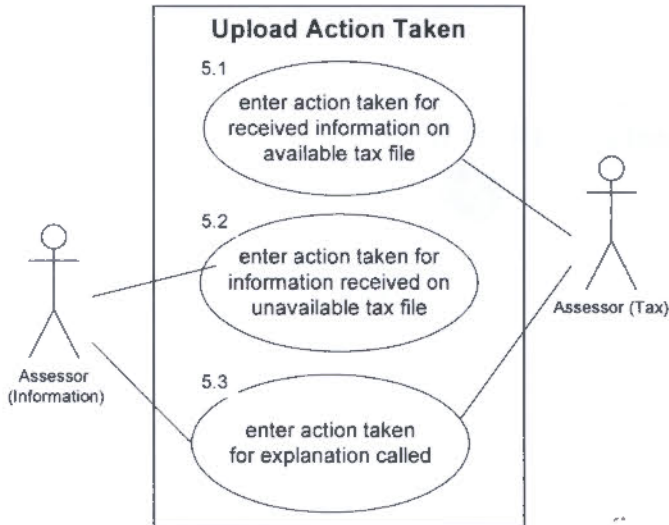


Figure 5.10: Upload Action taken use case

### 5.7 Use case Descriptions and Activity Diagrams

Use case descriptions were written on all above use cases including activity flows. One description and the activity flow diagram designed on the work flow shown in the description were placed on here, as an example. The other use-case descriptions of the proposed system were placed in *Appendix E* and activity diagrams designed for the proposed system were placed in *Appendix F*.

#### 5.7.1 Use case description for “Distribute Information process” as an example

Name	5	Distribute information
Actors	IPS-IRD system	
Pre conditions	New information must have been entered to the database. The list of files allocated to Assessors (branch wise) must be recorded & updated as a table.	
Flow	<ol style="list-style-type: none"> <li>1. IPS-IRD system read new information entered to External information table.</li> <li>2. Search file registry (using TIN)</li> <li>3. If new information related to an existing file, system retrieve Assessor from file as allocation.</li> </ol>	
Exception Flow	If new information not related to any registered file system select an Assessor (information) randomly.	
Post conditions	System display information to Assessor.	

Table 5.2 : “Distribute Information” use-case description



### 5.7.2 Activity diagram to “distribute information”

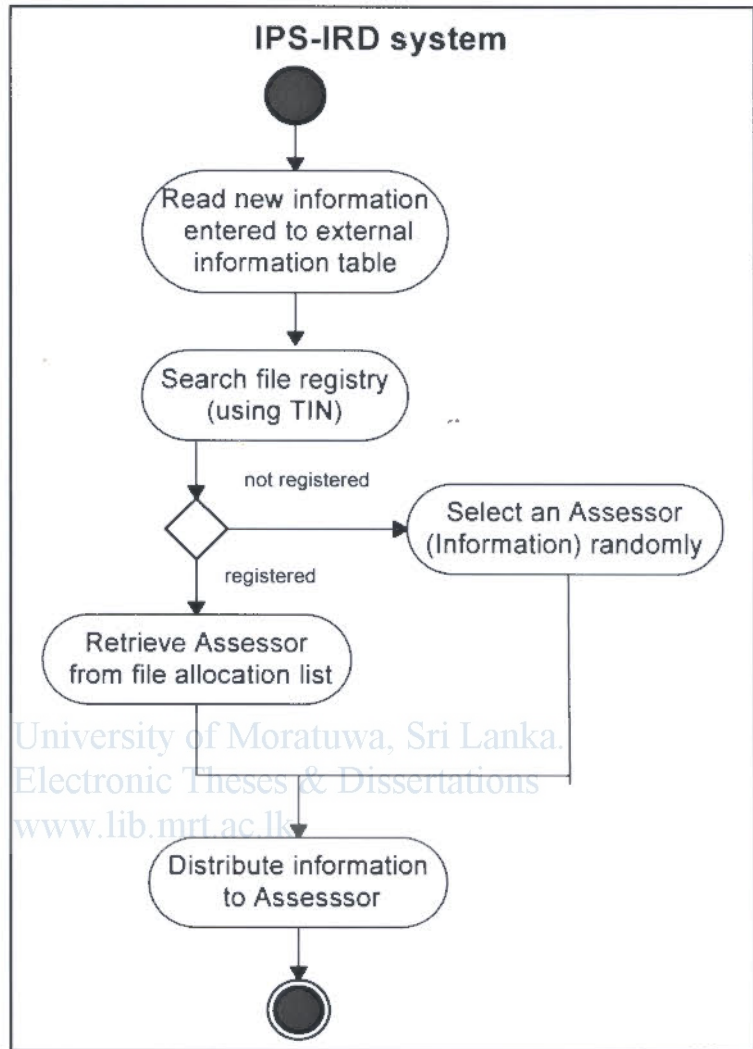


Figure 5.11 : Activity flow on information distribution

### 5.8 Sequence diagrams

Sequence diagrams were designed based on activity flow to describe the interaction between a user and the proposed system to achieve objective of a use case.

As an example the sequence diagram which designed for the above use case shown in figure 5.12. Sequence diagrams designed on other work flows shown in Appendix G.

### 5.8.1 Sequence diagram for information distribution

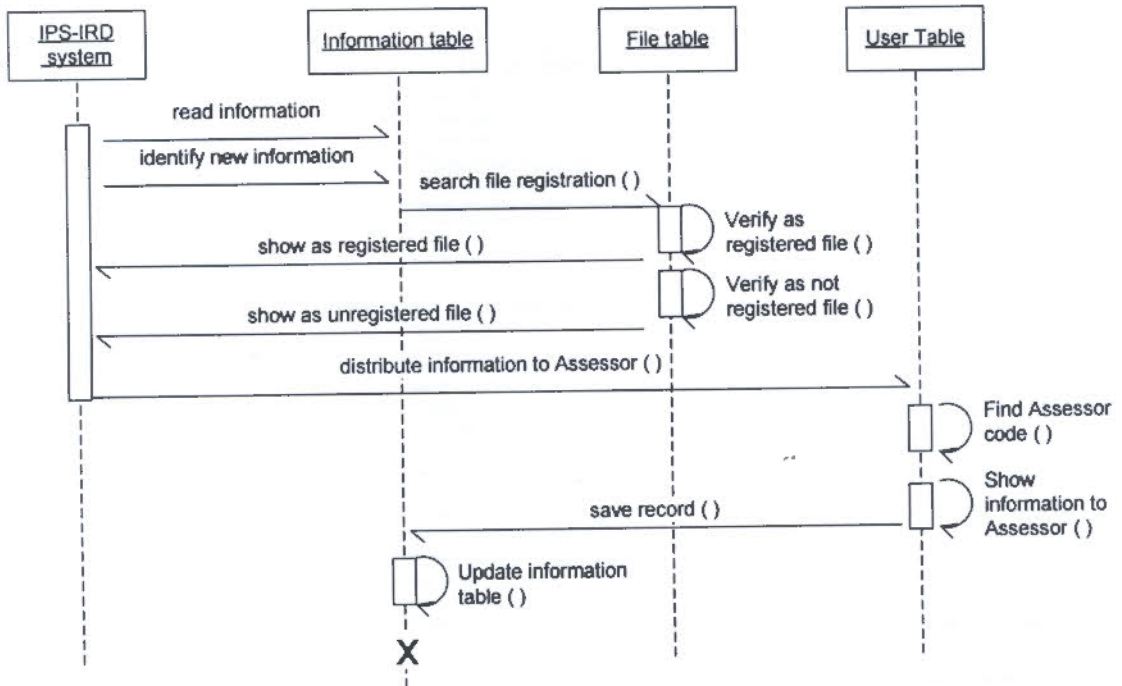


Figure 5.12 : Sequence diagram for information distribution

According to this sequence diagram, the actor of the use-case is the IPS-IRD system. The IPS-IRD system interacted with the information table to read & identify new information received to the table. Information table communicates with file table to search file registration. Then The IPS-IRD distributes information to user table and in here search the Assessor to whom it may be distributed, find the Assessor and show the information to the user. Finally the record must be updated in the information table.

### 5.9 Initial Class Diagram

Initial class diagram was designed based on grammatical analysis done on activity and sequence diagrams achieving object requirements. Figure 5.13 shows the initial class diagram



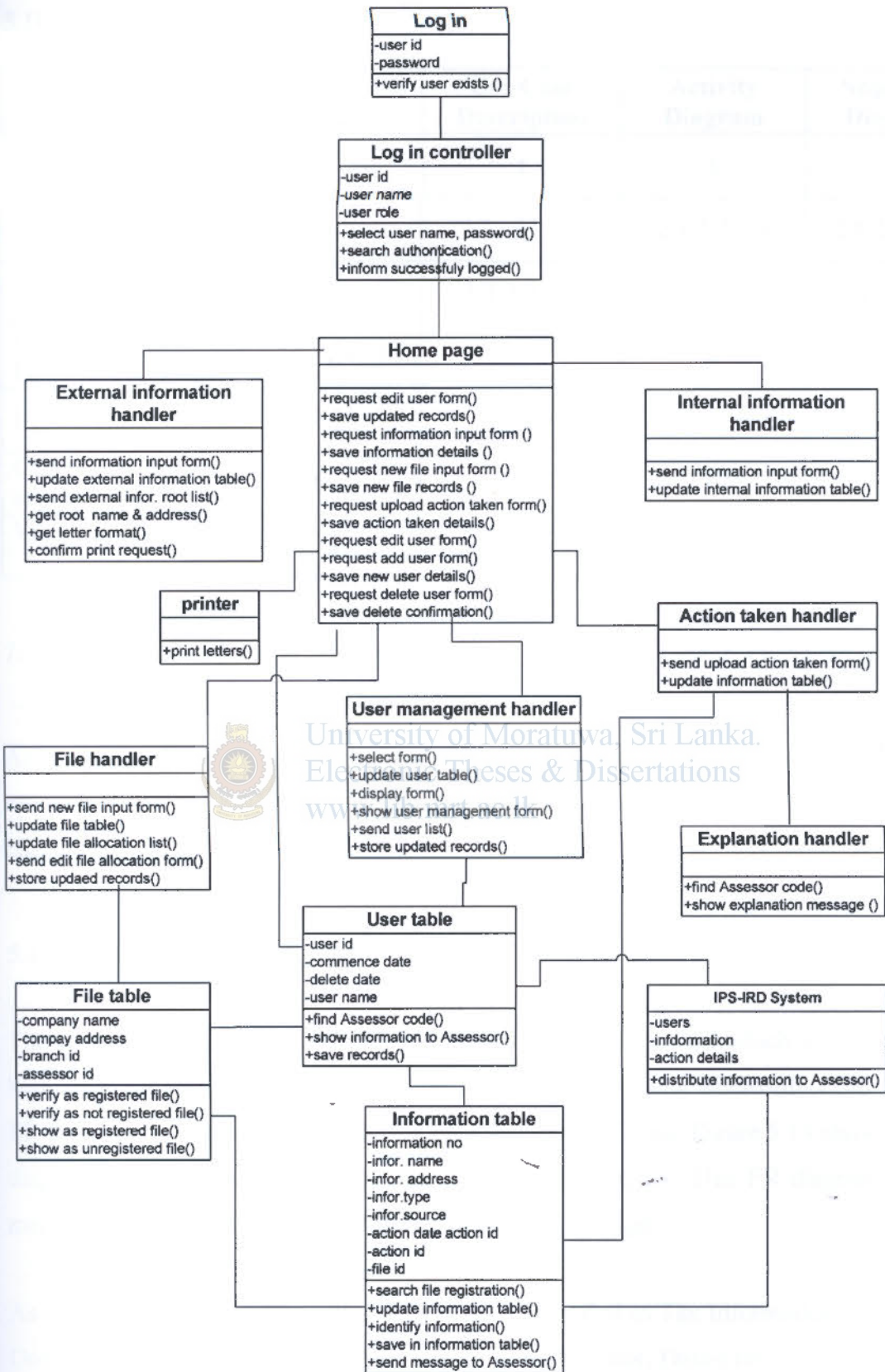


Figure 5.13: class diagram



## 5.10 Check List

Use Case	Software Requirement	Use-Case Description	Activity Diagram	Sequence Diagram
Log in	21	1	1	1
Manage Users	19,20	2	2.1,2.2,2.3	2.1,2.2, 2.3
Input Data	5,6,7	3.1,3.2,3.3	3.1, 3.2, 3.3	3.1,3.2,3.3
Distribute Information	1,8,9,10,11,12,15	4	4	4
Upload Action	13,14	5	5	5
Call explanations	16	6	6	6
View Reports	17,18	7	7	7

Table 5.3 : Check list for design stages

According to the software requirement specification, requirements on number 2,3,4 can only be done manually. So these requirements have not been included to the check list.

## 5.11 Database Design

The database was designed using Entity Relationship (ER) model which is a popular high level conceptual model in data base designing [8]. Using Microsoft-Visio tool, ER diagram of “ird” data base was designed with ER notations. Figure 5.14 shows ER diagram of the proposed database, which consist five entities. This ER diagram was mapped to a relational model diagram under database design.

As on the ER diagram, 05 entities were mainly identified as Tax Information, System Users, Tax Files, Branch and Action-Taken. Then Assessor, Data-Entry-Operator and Deputy Commissioner defined under System Users, because their relationships must not be in a similar manner.

### 5.11.1 ER Diagram

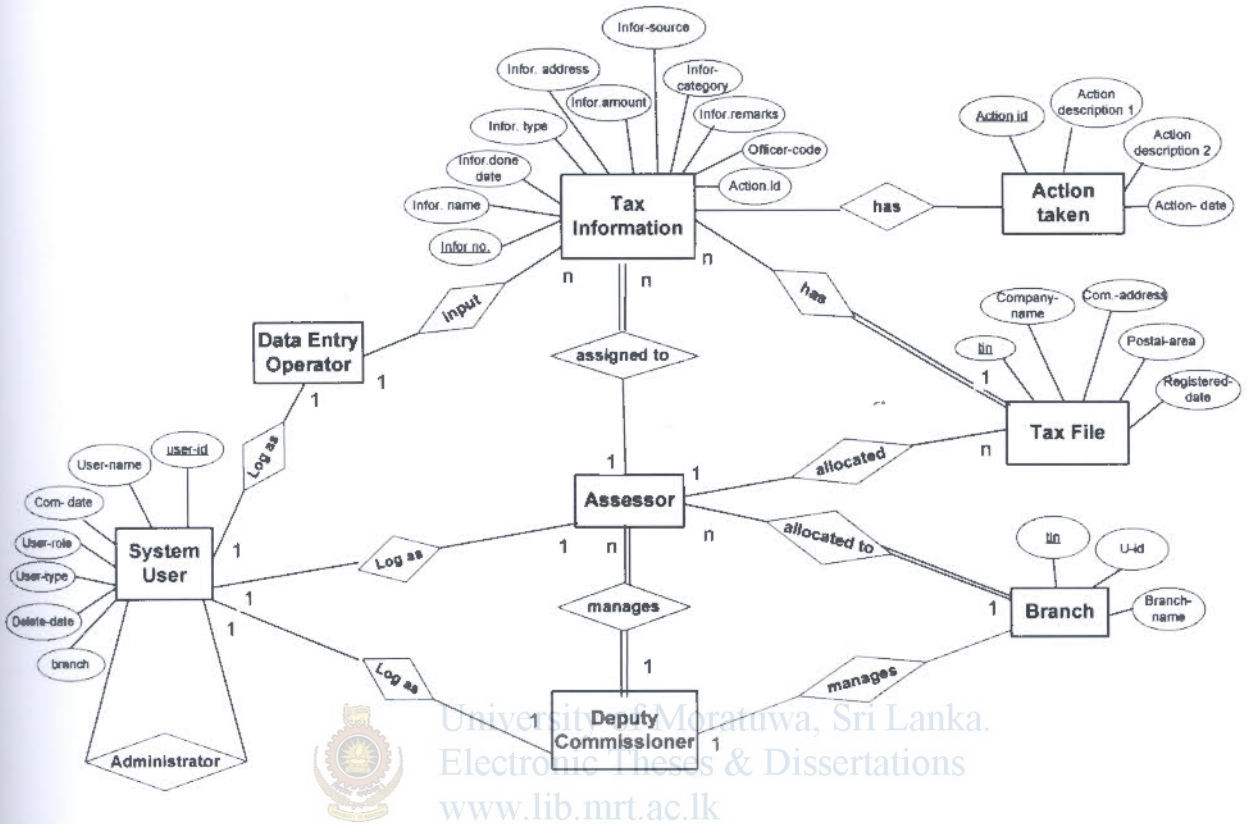


Figure 5.14 : ER diagram

### 5.11.2 Relational database design

The database layer which described in figure 5.4 in chapter 5 is the back end layer which is used to store application data permanently. These permanent data can be used to provide data to the users in application layer. According to the SRS in chapter 5, an E-R model diagram (figure 5.14) shown in chapter 5 of the project was designed first and then it was converted to a relational model diagram shown in figure 5.15. In this process first identified the database in first normal form and then it was normalized into third normal form.

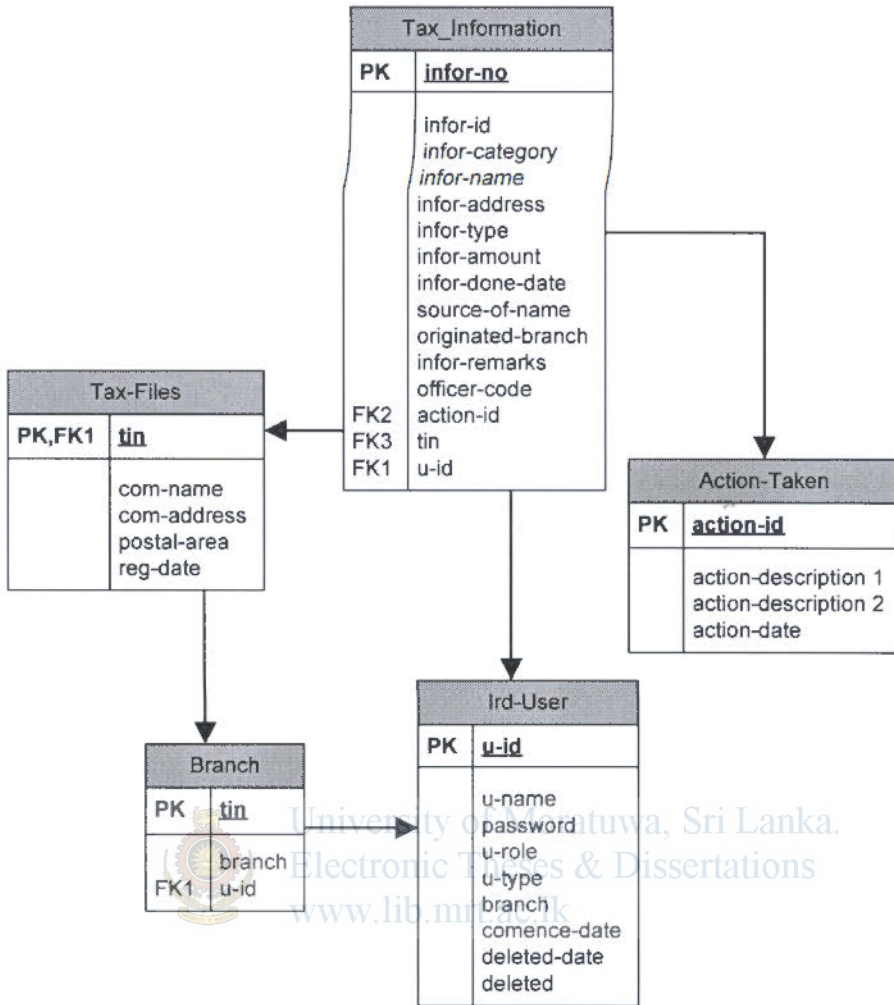


Figure 5.15: Relational data model diagram

The database is named as “ird” and it contains 05 tables as follows.

- Tax-Information - used to store all received information
- Ird-User - designed to store user details
- Tax-Files - used to store registered file details
- Branch - used to store the branch related to a registered tax file details
- Action-Taken - used to store taken action records

Field definitions were shown in *Appendix H*.



### 5.11.3 Data Channels

There are different types of users in the proposed system and different user roles were provided by them. The deputy commissioners, assessors, data entry operators and system administrator are the different user groups who have different authority to access the database. So the channels were identified according to the user roles. The *figure5.16* shows how to planned channels to be provided to different user groups as user roles.

- Create user channel saves user data to the database table Ird\_User.
- Delete user channel removes user data from the database table Ird\_User.
- Edit user channel update user data to the database tabs Ird\_User and Tax\_Files.
- Change password channel updates secret user data to the database table Ird\_User.
- Input information channel saves new information data to the database table Tax\_Information.
- Input files channel saves newly registered file records to the database tables Tax\_Files and Branch.
- Upload action taken channel updates actions taken for information to the database table Action\_Taken.
- View information channel displays assigned new information to the Assessors from the database table Tax\_Information.
- Report channel displays records on information or uploaded actions individually or branchwise from tables Tax\_Information or Action\_Taken.
- Exit channel logout any user logged to the database “ird”.

### 5.12 Summery

After analyzing existing system, proposed system was design sequentially in order to UML model designing with discussions in this chapter as the background to implementation of the system which describes in next chapter.