

# CARDIAC C-THAL SYSTEM



By

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## **ABSTRACT**

The project aims at developing a System for people with Cardiac issues. Computed Tomography Angiography (also called CT angiography or CTA) is a computed tomography technique used to visualize arterial and venous vessels throughout the body while Thallium Scan is a test that uses a radioactive substance (known as a tracer) to produce images of the heart muscle. When combined with an exercise test, the thallium scan helps determine if areas of the heart do not receive enough blood. Then it is checked manually by comparing the results of Thallium Scan and CTA that which part of heart muscle is affected by which part of artery blockage and vice versa. This type of comparison is time consuming and less accurate.

The Cardiac C-Thal System accesses databases of both the Systems (CTA and Thallium Scan) acting as a server for our system simultaneously and compares their outputs on runtime, producing its own result and aiding the Cardiologist in finding the actual problem in the heart of the patient. This system provides an intuitive and interactive menu structure that allows the cardiologist to navigate and select different features for finding the actual issue in the heart of the patients. It also tests to evaluate the improvement in their abilities. The purpose is to aid the cardiologist in learning actual reason of the heart attack or cardiac arrest in a more efficient manner and in less time.

## **CERTIFICATE FOR CORRECTNESS AND APPROVAL**

Certified that work contained in the thesis – Cardiac C-Thal System carried out by Ahtsham Abbasi, Aneela Zulfiqar and Hammad Ansari in supervision of Asst. Prof Athar Mohsin for partial fulfilment of Degree of Bachelor of Software Engineering is correct and approved.

**Approved by**

**Asst. Prof Athar Mohsin**

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**DATED:**

## **DECLARATION**

No portion of the work presented in this dissertation has been submitted in

Support of another award or qualification either at this institution or elsewhere.

## **DEDICATION**

In the name of Allah, the Most Merciful, the Most Beneficent

To our parents, without whose unflinching support and cooperation,

a work of this magnitude would not have been possible.

## **ACKNOWLEDGEMENTS**

We would like to thank Allah Almighty for His incessant blessings which have been bestowed upon us. Whatever we have achieved, we owe it to Him, in totality. We are also thankful to our families for their continuous moral support which makes us what we are. We are extremely grateful to our project supervisor Asst. Prof Athar Mohsin from MCS who in addition to providing valuable technical help and guidance also provided us moral support and encouraged us throughout the development of the project.

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**CHAPTER:1**  
**INTRODUCTION**

# **1 INTRODUCTION**

## **1.1 Overview**

Computed Tomography Angiography (also called CT angiography or CTA) is a computed tomography technique used to visualize arterial and venous vessels throughout the body while Thallium Scan is a test that uses a radioactive substance (known as a tracer) to produce images of the heart muscle. When combined with an exercise test, the thallium scan helps determine if areas of the heart do not receive enough blood. Then it is checked manually by comparing the results of Thallium Scan and CTA that which part of heart muscle is affected by which part of artery blockage and vice versa. This type of comparison is time consuming and less accurate.

The main purpose of this project is the development of a system that would allow doctors to perform analysis on results of Thallium Scan and CT Angio and compare them to find any blockage in blood vessels through an easy to use interface that incorporates display of both systems used in hospital through network.

## **1.2 Problem Statement**

The purpose is to aid the cardiologist in learning actual reason of the heart attack or cardiac arrest in a more efficient manner and in less time. The Results will be more accurate as they will be the compared and processed form of CT Angiography and Thallium Scan combined.

## **1.3 Approach**

The main focus of the project is to provide a mean to the medical facility through which cardiologists will learn the reason of the Cardiac arrest in a very less time. The Results

will be more accurate as they will be the compared and processed form of CT Angiography and Thallium Scan combined.

#### **1.4 Scope**

The project aims at developing a System for people with Cardiac issues. This system provides an intuitive and interactive menu structure that allows the cardiologist to navigate and select different features for finding the actual issue in the heart of the patients. It also tests to evaluate the improvement in their abilities.

#### **1.5 Aim & Objectives**

The objectives of project include:

Using software engineering techniques for gathering requirements during the development process, designing the software, implementing and testing requirements gathered.

To learn java programming and SDLC

To learn Techniques of Digital image processing

To learn database design and development

To learn data transfer through networking.

#### **1.6 Contributions:**

The project has been qualified for FICS (Finding Innovative and Creative Solutions) where it has cleared the first two stages and is selected for third stage.

This is an industrial project designed and developed for AFIC.



## 1.7 Organization

The first part of thesis is the abstract which describes the main details of Cardiac C-Thal System, followed by the introduction section which specifies the problem statement, approach, scope and objectives. The literature review section state the various resources read online before the commencement of the project. They include learning about CT Angiography and Thallium Scan. The design and development part illustrate the diagrams which describe the detailed design of the Cardiac C-Thal System its components, interfaces and data necessary for the implementation phase. The analysis and evaluation part give details of the black box testing, unit testing and system integration testing; actual results against expected results. The future work gives states the enhancements that can be applied to the application.

## 1.8 Deliverables

*Table 1-1 : Deliverables*

<b>Deliverable Name</b>	<b>Deliverable Summary Description</b>
Software Requirements Specification(SRS) Document	Complete Description of <b>what</b> the system will do, who will use it. Detailed description of functional and non-functional requirements and the system features.
Design Document	Complete description of <b>how</b> the system will be implemented i.e. the detailed design.
Code	Complete code with the API.

Testing Document	The whole system is tested according to the specification described in the SRS document. Black box, unit and System integration testing is done.
Complete System	Complete working system.

**CHAPTER:2**  
**LITERATURE REVIEW**

## **2 LITERATURE REVIEW**

The product uses data from two already installed machines in AFIC that is RDM and CTA System. Firstly we needed to study about these two systems (RDM and CTA System) that how they work. Secondly Data is retrieved from the computers connected to these machines over the LAN (Local Area Network) . Data images retrieved are in the form of DICOM or Bitmap format. Then we have used Digital Image Processing techniques like Image Segmentation, Object Recognition, Image Masking and Pixel Comparison in order to get our final product.

### **2.1 Thallium Scan (RDM):**

A thallium scan is a test that uses a radioactive substance (known as a tracer) to produce images of the heart muscle. When combined with an exercise test, the thallium scan helps determine if areas of the heart do not receive enough blood.

### **2.2 Computed Tomography Angiography (CTA):**

CT angiography is a type of medical exam that combines a CT scan with an injection of a contrast media to produce pictures of blood vessels and tissues in a part of your body. The contrast is injected through an intravenous (IV) line started in your arm or hand.

### **2.3 DICOM/Bitmap (Digital Imaging and Communications in Medicine)**

Both RDM and CTA return data in Bitmap and DICOM format.

DICOM is a standard for handling, storing, printing, and transmitting information in medical imaging. It includes a file format definition and a network communications protocol. Its communication protocol is an application protocol that uses TCP/IP to communicate between systems.

### **2.3.1 TCP/IP (Transmission Control Protocol)**

The stream communication protocol is known as TCP. It is a connection-oriented protocol. In order to do communication over the TCP protocol, a connection must first be established between the pair of sockets. TCP is useful for implementing network services such as remote login (rlogin, telnet) and file transfer (FTP) which require data of indefinite length to be transferred

## **2.4 Digital Image Processing Techniques**

### **2.4.1 Image Segmentation**

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

Our project uses the technique to classify portions of image containing different muscles and arteries of the heart.

### **2.4.2 Object Recognition**

Object recognition describes the task of finding and identifying objects in an image. Humans recognize a multitude of objects in images with little effort, despite the fact that the image of the objects may vary somewhat in different viewpoints, in many different sizes and scales or even when they are translated or rotated. Objects can even be

recognized when they are partially obstructed from view. This task is still a challenge for computer vision systems.

Our project uses the technique to classify different arteries of the heart.

### **2.4.3 Image Masking**

If a given image is intended to be placed over a background, the transparent areas can be specified through a binary mask. This way, for each intended image there are actually two bitmaps: the actual image, in which the unused areas are given a pixel value with all bits set to 0s, and an additional mask, in which the correspondent image areas are given a pixel value of all bits set to 0s and the surrounding areas a value of all bits set to 1s.

Our project uses the technique to cut out relative information about different arteries of the heart.

### **2.4.4 Pixel Comparison**

Pixel Comparison is done when the comparison engine gets the color of pixels that have the same coordinates within the image and compares this color. If the color of each pixel of both images coincides, computer considers the two images to be identical. It can use Pixel Tolerance and Color Tolerance to determine how much of a variance is allowed for it to consider two slightly different images identical.

Our Project uses the technique in conjunction with Image Masking to find out the abnormalities formed in arteries or muscles.

**CHAPTER:3**  
**OVERALL DESCRIPTION**

## **3 OVERALL DESCRIPTION**

This part of the document contains information about the product, its features, perspective, users' characteristics and constraints.

### **3.1 Introduction**

#### **3.1.1 Purpose**

The purpose of the Software Requirements Specification (SRS) is to give the user a clear and precise description of the functionality of the Cardiac C-Thal System, an software system that would be built for AFIC.

This document is aimed to eliminate ambiguities and misunderstandings that may exist. For the user, the SRS will explain all functions that the software should perform. For the developer, it will be a reference point during software design, implementation and maintenance.

This document encompasses the requirements for version-1 of Cardiac C-Thal System. The main purpose of this project is the development of a system that would allow doctors to perform analysis on results of Thallium Scan and CT Angio and compare them to find any blockage in blood vessels through an easy to use interface that incorporates display of both systems used in hospital through network.



### **3.1.2 Intended Audience and Reading Suggestions**

#### **3.1.3 Intended audience**

The intended readers of the SRS are the Hospital authorities (Specialists of Cardiology department of AFIC) who will have the system implemented as well as development team. This document serves as an agreement between both parties (Development team and the AFIC authorities) regarding the product to be developed.

#### **3.1.4 Doctors (Hospital authorities):**

The users of the system shall get a clear idea of the software and hardware requirements that are to be specified.

#### **3.1.5 Developers:**

Project developers have an advantage of quickly understanding the methodology adopted and personalizing the product.

#### **3.1.6 Testers:**

The testers of the system can check user requirements from this SRS and develop test scenarios accordingly.

#### **3.1.7 Documentation writers:**

The document can serve as a future reference for other versions of the SRS.

#### **3.1.8 Project Testers:**

Project testers can use this document as a base for making test cases.

#### **3.1.9 Reading suggestions**

It would be suggested to the clients to go through the requirement section thoroughly.

For the developers it is suggested that they read and understand the product scope, overall description and system features thoroughly.

Testers should go through the operating environment, constraints, and the non-functional requirements before developing the test scenarios for the system.

### 3.1.10 Product Scope

The document only covers the requirements specifications for the Cardiac C-Thal System. All the external interfaces and the dependencies are also identified in this document.

For	Cardiologists and any Trained Hospital Staff
What	Analyzing Artery Blockage and Blood Pressure in heart
The	Cardiac C-Thal System
Is	Software System
That	Provides standardized, easy to understand, rapid and accurate analysis of a patient's heart condition.

The Cardiac C-Thal System shall provide a software system that would run on top of any Windows operating system. It has three modules including file transfer, analysis and record keeping. Two of the modules shall be available for use of hospital staff whereas the last module shall be specific to use for Cardiology Specialists only. It shall be a Windows based solution satisfying objectives such as:

1. Mechanism for Getting Patient Data from External Systems

2. Displaying 3D Models of Results of Thallium Scan and CT Angio Tests
3. Analysis of Results of Thallium Scan and CT Angio Tests
4. Keep a record directory of patients for later use
5. Printing results of a patient
6. A Help Document on how to use the system

## **3.2 Overall Description**

### **3.2.1 Product Perspective**

To build a software system that will enable Doctors to find the blockage of blood vessels in heart by analyzing the results of Thallium scan and CT Angio tests of a patient. It aims to minimize the time constraint and physical transfer of results for analysis. The system will help keep record of each patient and allow doctors to efficiently provide accurate diagnosis.

### **3.2.2 Product Functions**

The main features of the Cardiac C-Thal System are highlighted below:

A main menu - for navigation

Retrieval of patients test results from CT Angio and Thallium scans over the network

View for displaying results side-by-side after comparison

Allow Users to save the records for later use

Allow taking a print of the results.

### **3.2.3 User Classes and Characteristics**

The System will be available for to all trained hospital staff but Records of patients will only be available to authorized Specialists only.

Therefore, users will be divided into two categories:

### **3.2.4 Hospital Staff will prepare the system for Cardiology Specialists**

They would be able to retrieve data from Thallium scan and CT Angio scans over the network

They would have access to start processing of the result

They would be able to take out the prints of the result

### **3.2.5 Authorized Cardiologist**

They would be able to perform above actions as well as view all patient records already stored. A password will have to provide to view the previous records.

### **3.2.6 Operating Environment**

The product will run on all Operating Systems supporting Java version 6 and onwards. The main product can also be installed on personal computers after they have been connected to Hospital Network.

### **3.2.7 Design and Implementation Constraints**

The application will run on devices having a minimum of total 2 GB RAM (500 MB required maximum for the application itself).

Active connection to the hospital network should be available

Java version 6 or higher should be installed

### **3.2.8 User Documentation**

A user manual will be included for the users in which instructions will be given on how to use the system.

### **3.2.9 Assumptions and Dependencies**

Java version 6 or higher is presumed to be installed on system.

## **3.3 External Interface Requirements**

### **3.3.1 User Interfaces**

Main menu for navigation

Tabs will be provided in the main screen.

3D view of Thallium scan and CT Angio results will be shown side by side

Records of older patients will be shown in list view.

### **3.3.2 Hardware Interfaces**

Connectivity to hospital network through Wifi, LAN etc

Printer for printing of results

## **3.4 System Features**

Application will be able to access data from Thallium scan and NT Angio tests through network.

Instructions for using the app shall be provided before the start of each test.

The instructions shall be audio-visual

### **3.4.1 Accessing the Main Menu**

### **3.4.2 Description and Priority**

After starting the system user will first see main menu.

User will be able to access the rest of the system through this main screen. It's priority will be medium.

### **3.4.3 Stimulus/Response Sequences**

Start the System.

Display main menu

### **3.4.4 Functional Requirements**

**REQ-1:** The product must be properly installed on the computer system.

**REQ-2:** The different option available shall be:

Start a new Analysis

View Old Records

Help Menu

Exit

### **3.4.5 New Analysis**

### **3.4.6 Description and Priority**

The acuity tests hold a very high priority since it is a core feature of this product.

### **3.4.7 Stimulus/Response Sequences**

The user selects New Analysis.

The user provides patient code and retrieves the files from remote computers containing Thallium scans and CTA test results.

System then processes the retrieved results and shows user a progress bar.

Takes user to view results screen

### **3.4.8 Functional Requirements**

**REQ-3:** The system will give error if patient code isn't found on remote computers (Thallium scan and CT Angio results)

**REQ-4:** Thallium scan and CT Angio Results will be provided in Bitmap and DICOM respectively.

**REQ-5:** System will prompt if corrupted files are transferred.

**REQ-6:** The system will construct 3D Models of heart from the results obtained from the remote computers.

### **3.4.9 View Results**

#### **3.4.10 Description and Priority**

The View Results will display the results of the analysis.

It also holds a very high priority since it is the feature that helps doctors to diagnose the patient.

#### **3.4.11 Stimulus/Response Sequences**

Analysis completion brings user to this menu.

The user will be able to see 3D images of both CT Angio and Thallium scan of the patient.

Image can viewed from different angles.

Clicking one image will bring the corresponding view of second image

Options to save or print patient results will also be available.

### **3.4.12 Functional Requirements**

**REQ-7:** The product will display patients heart result from CT Angio and Thallium scan on the screen side by side.

**REQ-8:** User will have a 360 degree view of both the images.

**REQ-9:** Clicking one image will bring the corresponding view of the second heart image.

**REQ-10:** User will also be allowed to save the patient's data.

**REQ-11:** User will also be allowed to print the patient's data.

### **3.4.13 View Patient Records**

#### **3.4.14 Description and Priority**

The View Patient Records holds a medium priority. It will allow the doctors to view old patient's record, analyze and print them.

#### **3.4.15 Stimulus/Response Sequences**

The user selects View Old Records from Main Menu.



A list of old patient's details is shown (Name, Patient Code, Test Code, Date)

Selecting a Patient takes user to View Result menu.

### **3.4.16 Functional Requirements**

**REQ-12:** List view of patients will be available for doctors to select.

**REQ-13:** User can sort the records on basis of patient name, code, test code and date.

**REQ-14:** Selecting a patient will take user to View Result Menu.

### **3.4.17 Help Menu**

#### **3.4.18 Description and Priority**

The Help holds a medium priority. It will contain all the instructions needed to use the product.

#### **3.4.19 Stimulus/Response Sequences**

The user selects Help Menu from Main Menu or by pressing F1.

An instruction manual is displayed to guide the user.

#### **3.4.20 Functional Requirements**

**REQ-15:** Pressing F1 or choosing Help option will show Instruction Manual.

## **3.5 Other Nonfunctional Requirements**

### **3.5.1 Performance Requirements**

5.1.1 In case of Cardiac C-Thal System, accurate results and high quality output is required for easy and safe diagnosis by doctor. This may reduce performance and product may work slowly on low end computer systems.

### **3.5.2 Safety Requirements**

The use of the software product has no harms whatsoever; nor does it have any possibility of loss or damage that might be inflicted during the use of the product. However, improper diagnosis and prescription on part of the user may affect patient's health. If the product crashes during any phase, there will be no change in the database.

### **3.5.3 Security Requirements**

Special security measures are added to the product. All patient data can only be accessed by providing a secure password. Password cracking preventing techniques are used. Product also doesn't directly access any other medical equipment directly to safe guard any hacking through the system. Product is not connected to internet to protect from malicious attacks.

### **3.5.4 Software Quality Attributes**

#### **3.5.5 Usability:**

The product will be easy to operate for any user with minimum technical knowledge. However, Analysis and Diagnosis should be done by Cardiology Specialists only.

#### **3.5.6 Accuracy:**

To ensure reliability and correctness, there will be zero tolerance for errors in the algorithm that computes results.

#### **3.5.7 Portability:**

The product will be portable to any device with Java version 6 or higher installed. This includes but not limited to Windows XP, Vista, 7, 8, 8.1, 10, Mac OS X, Linux, Unix based systems.

### **3.5.8 Availability**

The product will be available from boot to shutdown, provided computer is in working state and the product is installed and configured properly.

### **3.5.9 Flexibility**

The design and architecture of the product will be flexible enough for catering any new requirements, if any at some later stage or for the product enhancement.

### **3.5.10 Data Integrity**

If the product crashes during any phase, there will be no change in the database.

### **3.5.11 Scalability**

Only one instance of the application can run at a time. Patients results must be exited before starting a new analysis.

### **3.5.12 Confidentiality**

Patient's records will not be available to any non authorized personal.

## **3.6 Business Rules**

This product is being developed for AFIC.

Developers have right to keep the modules in the product for later use.

## **3.7 Other Requirements**

Newer Versions of the product will support previous database.

Data from CT Angio and Thallium Scan will be made available by the AFIC for development team.

Access to RDM (Thallium scan device) and CTA Systems (CT Angio device) will be granted to development team.

Qualified Medical staff from AFIC will provide required assistance to development team.

**CHAPTER:4**  
**DESIGN AND DEVELOPMENT**

## **4 DESIGN AND DEVELOPMENT**

### **4.1 INTRODUCTION:**

Computed tomography angiography (also called CT angiography or CTA) is a computed tomography technique used to visualize arterial and venous vessels throughout the body. This ranges from arteries serving the brain to those bringing blood to the lungs, kidneys, arms and legs.

A thallium scan is a test that uses a radioactive substance (known as a tracer) to produce images of the heart muscle. When combined with an exercise test, the thallium scan helps determine if areas of the heart do not receive enough blood.

The Cardiac C-Thal System accesses databases of both the Systems (CT Angio and Thallium Scan) simultaneously and compares their outputs on runtime, producing its own result and aiding the Cardiologist in finding the actual problem in the heart of the patient.

#### **4.1.1 Purpose of the document:**

A heart attack happens when the flow of oxygen-rich blood to a section of heart muscle suddenly becomes blocked and the heart can't get oxygen. If blood flow isn't restored quickly, the section of heart muscle begins to die.

The purpose is to aid the cardiologist in learning actual reason of the heart attack or cardiac arrest in a more efficient manner and in less time.

The main focus of the project is to provide a mean to the medical facility through which cardiologists will learn the reason of the Cardiac arrest in a very less time. The Results will be more accurate as they will be the compared and processed form of CT Angiography and Thallium Scan combined.

### **4.1.2 Scope of the Development Project**

The project aims at developing a System for people with Cardiac issues. This system provides an intuitive and interactive menu structure that allows the cardiologist to navigate and select different features for finding the actual issue in the heart of the patients. It also tests to evaluate the improvement in their abilities.

The scope of work is limited to processing raw images from C-Thal and CT Angio results and displaying them for doctors to diagnose.

### **4.1.3 Definitions, acronyms, abbreviations**

Application – C-Thal System

DB – Database

C-Thal – Project name, Cardiac C-Thal System, A Life Saver

Point – a set of x, y and z-coordinates

Target user/population – Cardiac Patients

Two-way bridge – reading and writing data (select, update, delete, insert etc.), application sends a query into the database, and that returns some value (database transaction)

UI – User Interface

UML – Unified Modeling Language

### **4.1.4 Overview of the document**

This document shows the design and working of C-Thal System. It starts from higher level details for a non-technical reader to understand just by seeing the diagrams to the lower level details that aid the developer to code and understand other technical details of the application.

Section 4.2 the System Architecture Description gives a detailed overview of the System.

Section 4.2.1 Overview of Modules/Components shows the main component of the System and their inter-relationships.

Section 4.3 Structure and Relationships shows the higher level details system working by the means of System Block Diagram.

Section 4.4 Architectural Style shows Database Design, Entity Relationship Diagram.

Section 4.5 shows UML Diagram Activity, State Transition, and Use Case diagrams, Sequence diagrams and Structure Chart.

Section 4.6 describes how the application is designed to curb the tendency of User Interface Issues and problems during User Interaction.

Section 4.7 shows the Reuse and Relationship to other Products i.e.; information about work done in the same project before and any reuse of the same work. The section also provides a key to reuse this system for further upgrades.

Section 4.8 Design Decisions and Tradeoffs shows the architecture style and design pattern of the application.

## **4.2 SYSTEM ARCHITECTURE DESCRIPTION**

Detailed description of system architecture and design pattern which this system is going to use is discussed later in the document in section 5 ‘Design Decisions and Tradeoffs’.

This section includes overview of application, its higher and lower levels details and user interfaces.

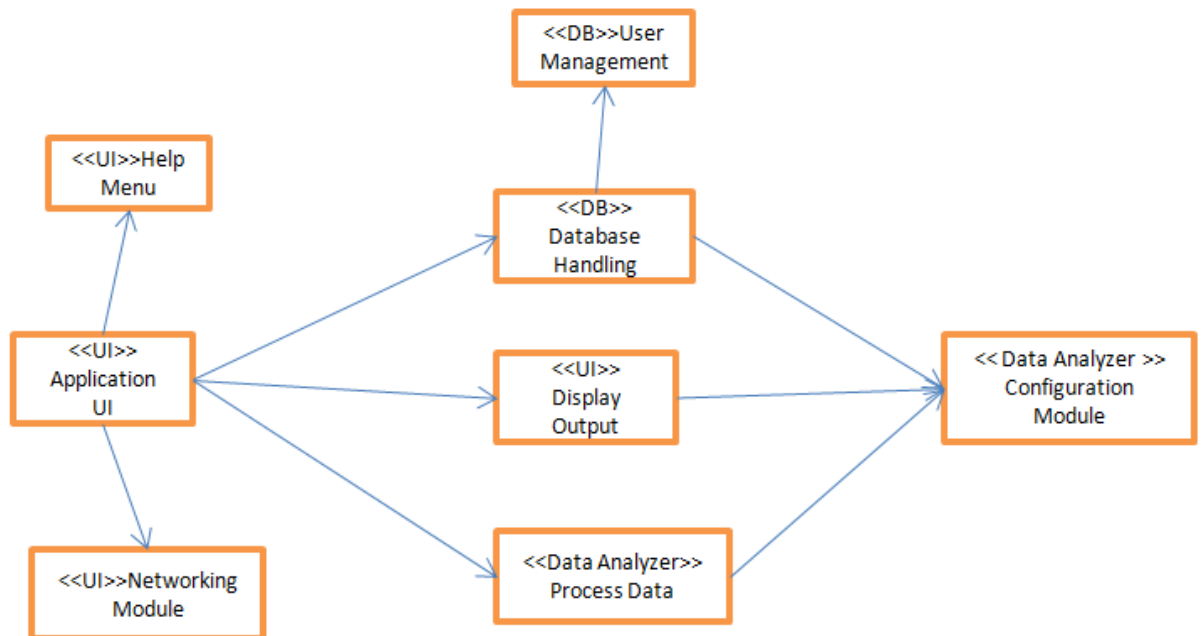
### **4.2.1 OVERVIEW OF MODULES/COMPONENTS**

C-Thal System comprises of following components:

1. Application UI



2. Process Data
3. Display Output
4. Database Handling
5. Help Menu
6. Configuration Module
7. User Management
8. Networking Module



**Figure 4-1 Component Overview for C-Thal**

Application UI, Networking Module and Help Menu are parts of presentation layer in the system architecture.

### **Application UI**

It acquires all its services from the Process Data, Display Output Module and Databases.

The user interacts directly with this component and provides an input to the application

specifying the action required. The component then displays an output according to that user action.

### **Networking Module**

It provides the related network requirement to the Application UI for the user.

### **Process Data**

It controls the flow of data between the databases and the data to be processed. It has two sub-components; CT Angiography results from the database, Thallium Scan Results from its own databases.

### **Help Menu**

It receives data from the Application UI component and give the appropriate sort of result/help to the user if he is having some problem or query regarding the usage of this system.

### **Display Output**

It basically shows the final results to the user after the data has been accessed from the databases by the analyzer and then processed.

### **Database Handling**

It is the module where the internal database and the external databases are handled. The Databases of CT Angio and Thallium Scan are accessed and then after the data has been processed the Internal Database i.e C-Thal's Database is modified.

### **User Management**

It is the module where the user actually accesses the databases of the C-Thal System as well as the External Databases.

### **Configuration Module**

It is where the data from both the databases is analyzed and configured for the display unit to display to the user and for the modification of internal database.

### 4.3 STRUCTURE AND RELATIONSHIPS

This section covers the overall technical description of C-Thal System (refer Section 1.3).

It shows the working of application in perspective of different point-of-views and also shows relationships between different components.

#### 4.3.1 System Block Diagram

This diagram shows generic working of the application and interaction with the user. In this application, User will interact with the UI of the application; UI will interact with the application logic which will then interact with database.

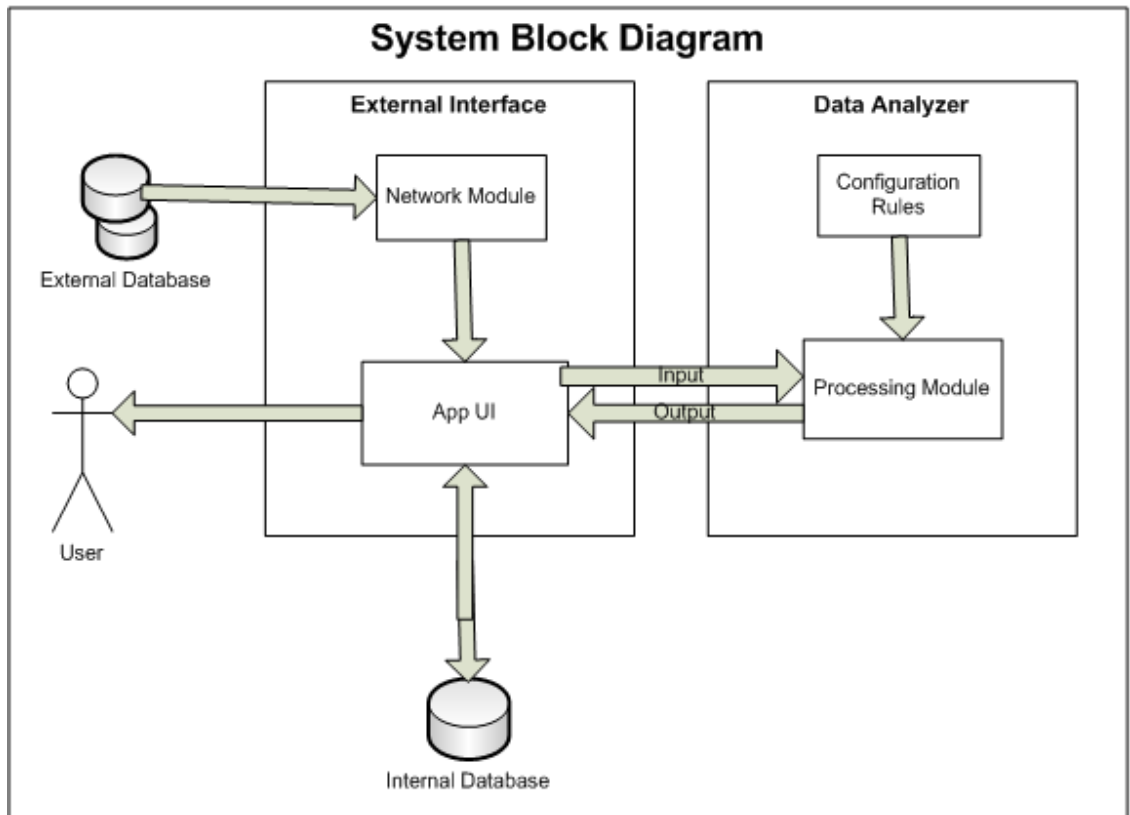


Figure 4-2 Block Diagram for C-Thal

## 4.4 Architectural Style:

### 4.4.1 DATABASE DESIGN:

C-Thal requires the log of all patients and their respective tests to be re-viewed in future. Also it stores the login information of all doctors for security. The database therefore has 3 tables:

1. Patient
2. Test
3. User

### 4.4.2 Entity Relationship Diagram:

Where Patient and Test are connected via 1-Many relationship.

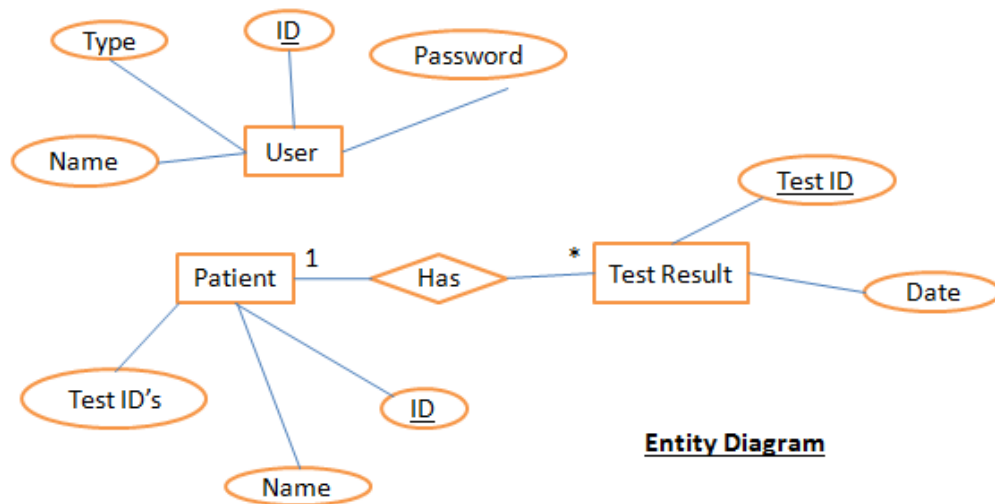


Figure 4-3 Entity Relationship Diagram for C-Thal

The Fig. 4-3 illustrates relationship between all three tables in the database. The boxes are the entities; ovals are attributes while diamonds show type of relationship. The Patient

entity having primary key ID entity has three attributes. It maintains the Names, IDs and Test IDs of the patient. The Test Result entity having primary key TestID has 2 attributes. It maintains the test Data of the patients. The User entity having primary key ID has four attributes. It maintains the login information and type of User Account. It serves the purpose of providing security.

## 4.5 UML Diagrams:

### 4.5.1 User view (use case diagram)

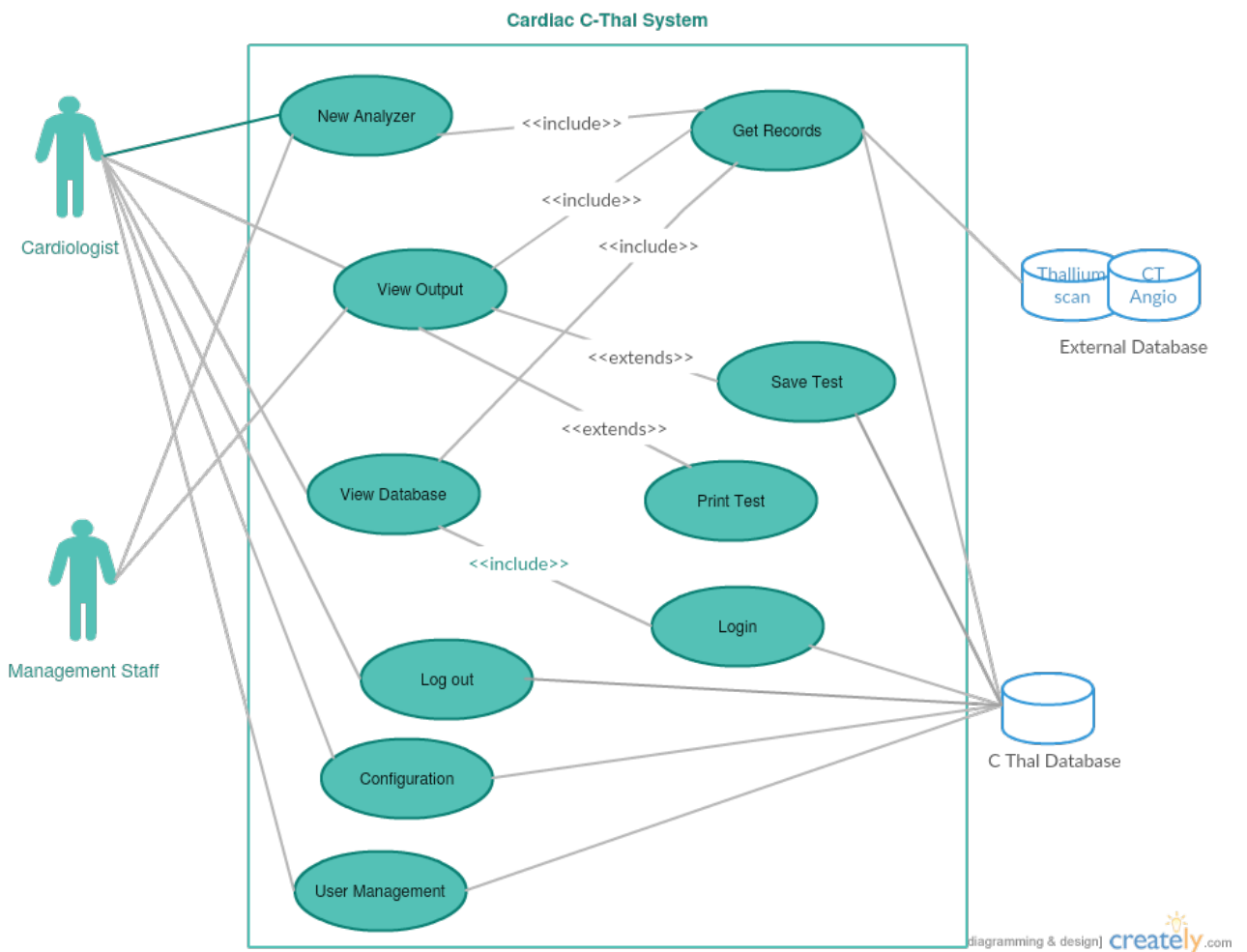


Figure 4-4 Use case Diagram for C-Thal System

## **4.5.2 Use Case Specification:**

### **Actors**

**Primary Actor(s):** Cardiologist, Management Staff

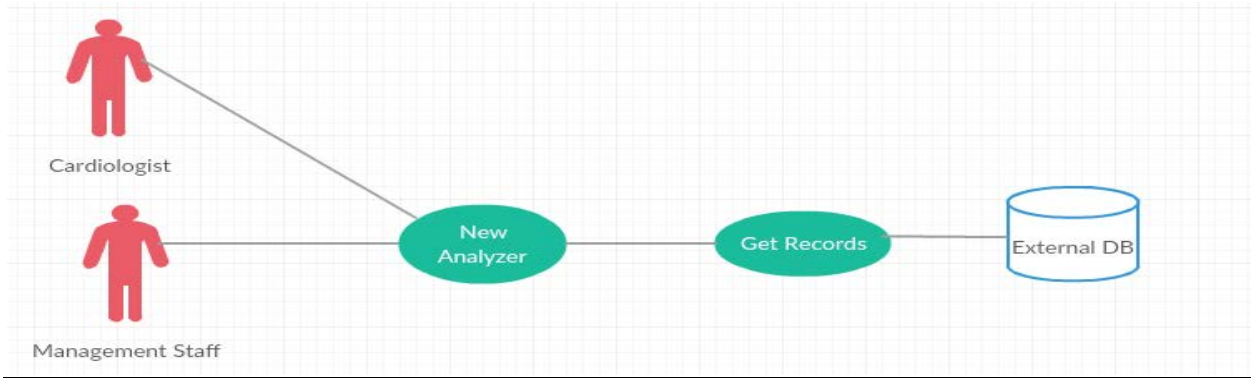
**Secondary Actor(s):** Database

### **Use Cases**

1. New Analyzer
2. Get Records
3. View Output
4. View Database
5. Login
6. Print Test
7. Save Test
8. Logout
9. Configuration
10. User Management

## **4.5.3 Use Case Description**

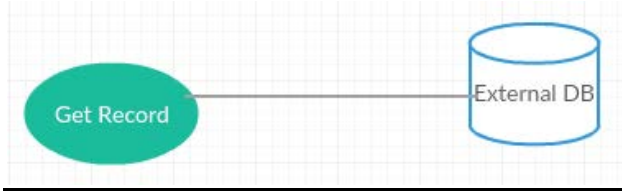
### **Use Case 1**



Use Case Name	New Analyzer
Primary Actor	Cardiologist, Management Staff
Secondary Actor	External Database
Normal Course	Cardiologists and Management Staff both can access a new patient record which is to be analyzed through external Database. Management Staff can access so they can prepare system for Cardiologist.
Alternate Course	If the doctor provides incorrect patient ID which is not available in the external database, it will return a record not found message.
Pre-Condition	The patient record must be present in the external database before the cardiologist or management staff asks the Analyzer for it.

Post Condition	Cardiologist or management staff gets data successfully from Database.
Extends	N/A
Include	Get Records
Assumptions	The cardiologist or management staff enters correct patient ID

**Use Case 2**



Use Case Name	Get Records
Actor	External Database
Normal Course	Doctor gets data of patient form External Database( C-Thal and CT Angio Database)in order to start new Analyzing process.



Alternate Course	If the doctor doesn't get any data from External Database then he/she cannot start new analyzing process.
Pre-Condition	The doctor must be accessing Analyzer.
Post Condition	Patient data is retrieved from the database
Extends	N/A
Include	N/A
Assumptions	Data from the External Database is successfully retrieved by doctor.

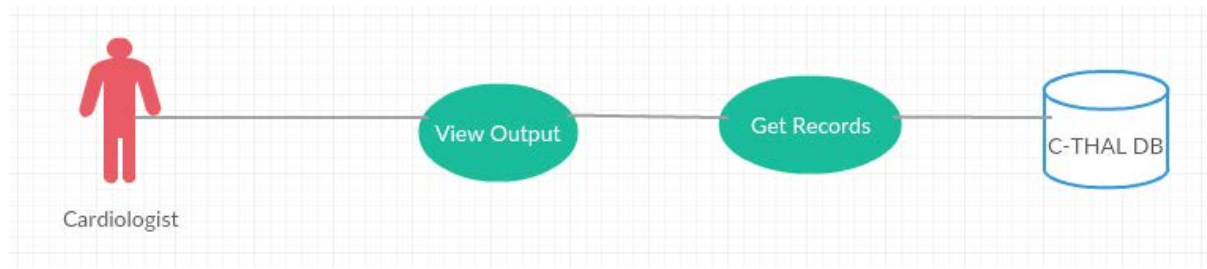
**Use Case:3**



Use Case Name	Get Records
Actor	C-Thal Database
Normal Course	Doctor searches a patient (from the database) by entering his Patient ID in the database, or scrolling through a list of registered patients

Alternate Course	If the doctor has enters a Patient ID or Name that doesn't occur in the database, then application displays an error message "No Record Found"
Pre-Condition	The doctor must be accessing Analyzer, Viewing Database or Viewing Output
Post Condition	Patient data is retrieved from the database
Extends	N/A
Include	N/A
Assumptions	The doctor enters PID or Name of an existing patient

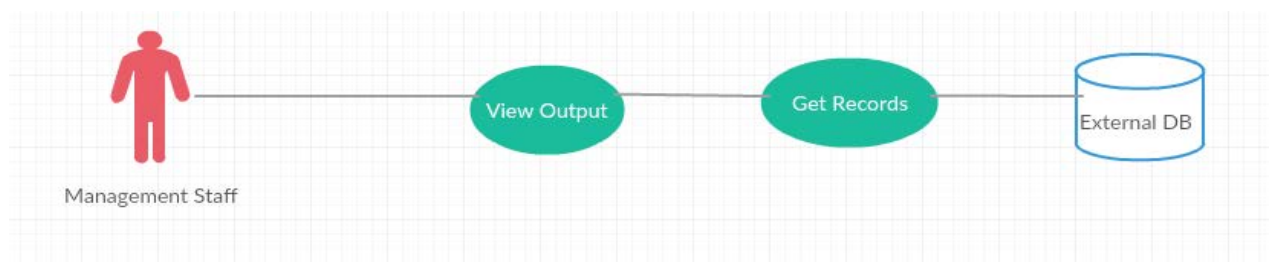
**Use Case 4**



Use Case Name	View Output
Primary Actor	Cardiologist
Secondary Actor	C-Thal Database
Normal Course	Doctor enters Patient ID or Test ID and then clicks "View"

	Record” button
Alternate Course	No Results will be shown if the doctor enters wrong Patient ID or Test ID.
Pre-Condition	Doctor enters Patient ID or Test ID.
Post Condition	Patient Data will be retrieved
Extends	N/A
Include	Get Records
Assumptions	The doctor enters the Patient ID or Test ID correctly

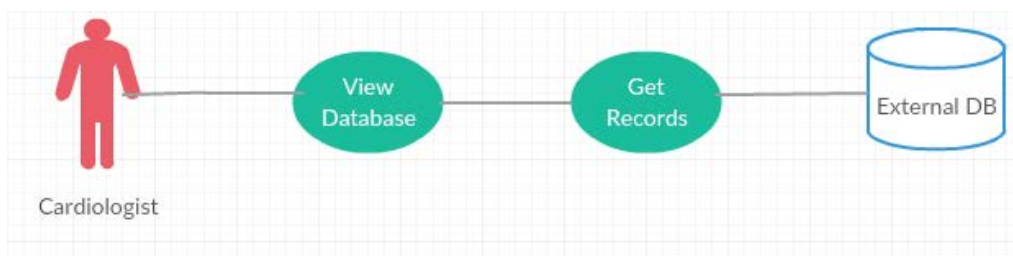
### Use Case 5



Use Case Name	View Output
Primary Actor	Management Staff
Secondary Actor	External Database

Normal Course	Management Staff enters Patient ID or Test ID and then clicks “View Record” button
Alternate Course	No Results will be shown if the Management Staff enters wrong Patient ID or Test ID.
Pre-Condition	Management Staff enters Patient ID or Test ID.
Post Condition	Patient Data will be retrieved
Extends	N/A
Include	Get Records
Assumptions	The Management Staff enters the Patient ID or Test ID correctly

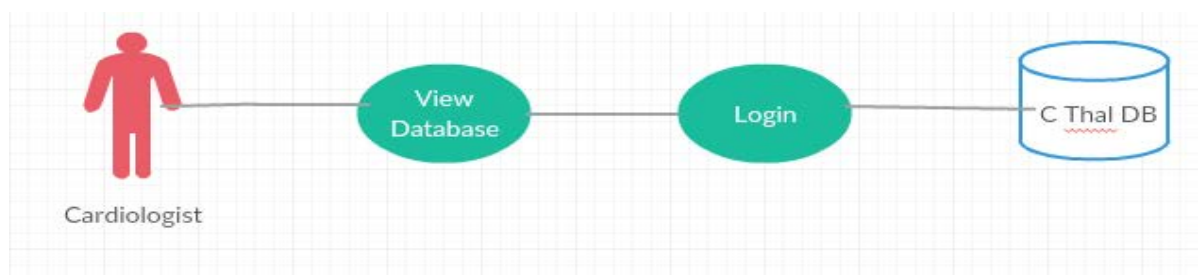
### Use Case 6



Use Case Name	View Database
Primary Actor	Cardiologist
Secondary Actor	External Database

Normal Course	Doctor successfully views the complete database (External) by getting records.
Alternate Course	Doctor tries to view the images received from external database.
Pre-Condition	External database is always accessible
Post Condition	The application displays a “Data successfully Retrieved” message and will navigate doctor back to main screen
Extends	N/A
Include	Get Records
Assumptions	The data of patient is successfully retrieved from the database

**Use Case 7:**



Use Case Name	View Database
Primary Actor	Cardiologist

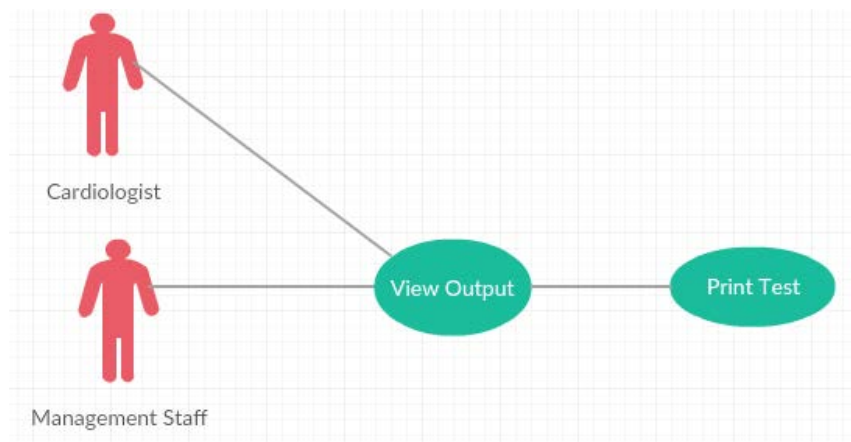
Secondary Actor	C-Thal Database
Normal Course	Doctor successfully views the complete Internal Database if logged in successfully.
Alternate Course	Doctor tries to view the Internal Database without being logged in.
Pre-Condition	The doctor must be logged into the application to view the internal database.
Post Condition	The application displays a “Databases successfully Retrieved” message and will navigate doctor back to main screen
Extends	N/A
Include	Login
Assumptions	The data and records of all patients are successfully retrieved from the database

**Use Case 8**



Use Case Name	Login
Actor	C-Thal Database
Normal Course	<p>Doctor enters his username</p> <p>Doctor enters his password</p> <p>Doctor clicks the login button to enter the application</p>
Alternate Course	If the doctor provides incorrect username or password, the login fails and the application displays an error message
Pre-Condition	The username and password of the doctor must already be registered at the time of coding (default entry in the database)
Post Condition	The doctor successfully logs in to the system
Extends	N/A
Include	N/A
Assumptions	The doctor enters correct username and password

### **Use Case 9**

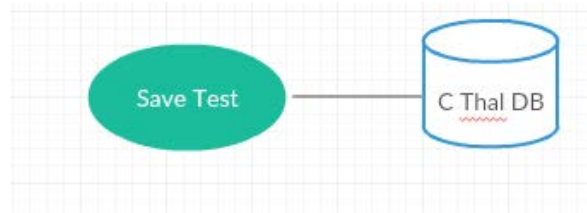


Use Case Name	View Output
Actor	Cardiologist, Management Staff
Normal Course	Cardiologists access a patient's record from the internal database and clicks on "Print Test" button. Management Staff can take printouts of output available at that time.
Alternate Course	Tries to print a Test which is yet not available
Pre-Condition	The doctor must be logged into the application and that patient's record should already exist in the database. Output should be visible to management Staff.
Post Condition	Patient's complete information is shown on the screen and is then printed using printer attached to the system.
Extends	Print Test
Include	N/A



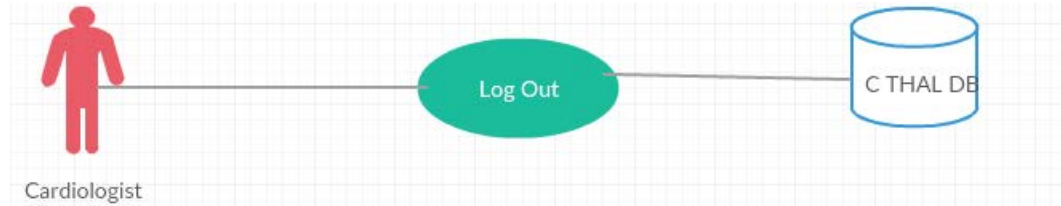
Assumptions	Successfully printing of Patient Records/Tests
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**Use Case 10**



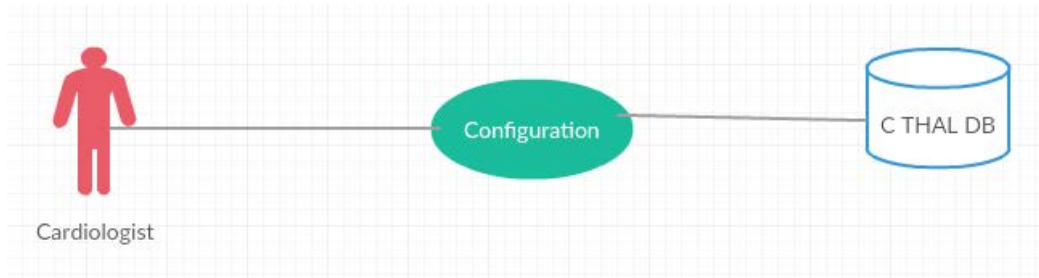
Use Case Name	Save Test
Actor	C-Thal Database
Normal Course	Doctor saves the test in the internal database by clicking the “Save Result” button.
Alternate Course	N/A
Pre-Condition	The doctor must have results of the current patient on the screen after they have been analyzed
Post Condition	The system saves the results in the database of C-Thal
Extends	N/A
Include	N/A
Assumptions	The doctor successfully alters the internal database by saving the results of the patient

## Use Case 11



Use Case Name	Logout
Actor	Cardiologist
Secondary Actor	C-Thal Database
Normal Course	Doctor clicks on the “logout” button to sign out from his account and stop using his special privileges
Alternate Course	N/A
Pre-Condition	The doctor must be logged into the application
Post Condition	A message “You have successfully logged out” will be shown on the screen.
Extends	N/A
Include	N/A
Assumptions	The Doctor will successfully logout from the system

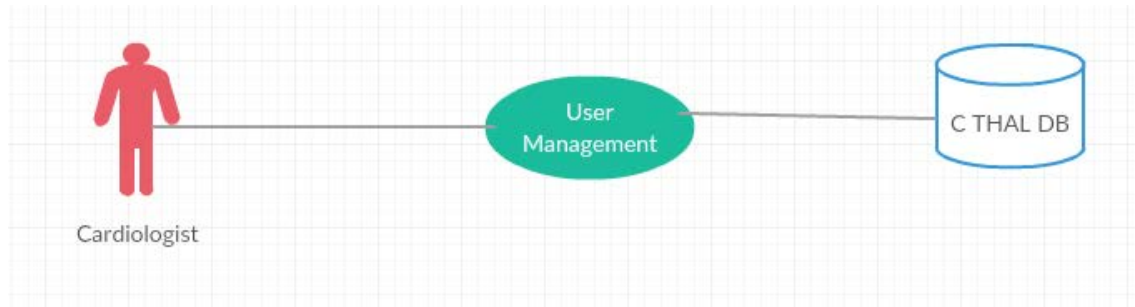
## Use Case 12



Use Case Name	Configuration
Actor	Cardiologist
Secondary Actor	C-Thal Database
Normal Course	Doctor changes the configuration of the system by clicking on the “Configuration” button. By doing this setting the rules to determine the pressure point in veins.
Alternate Course	N/A
Pre-Condition	The doctor must have the analyzed data of the patient present in front of him displayed on the screen
Post Condition	The data is displayed according to the configuration set by the doctor
Extends	N/A
Include	N/A
Assumptions	The doctor will easily configure the analyzed results in the

	desired manner
--	----------------

**Use Case 13**



Use Case Name	User Management
Actor	Cardiologist
Secondary Actor	C Thal Database
Normal Course	Doctors can alter the Username and Password in the internal database by clicking on the “Set Configuration” button
Alternate Course	N/A
Pre-Condition	N/A
Post Condition	The Internal database is altered
Extends	N/A
Include	N/A

Assumptions	The doctor successfully updates/alters the internal database
-------------	--

#### 4.5.4 Sequence diagram

Sequence Diagrams of key use cases are mentioned below:

#### 4.5.5 New Analyze

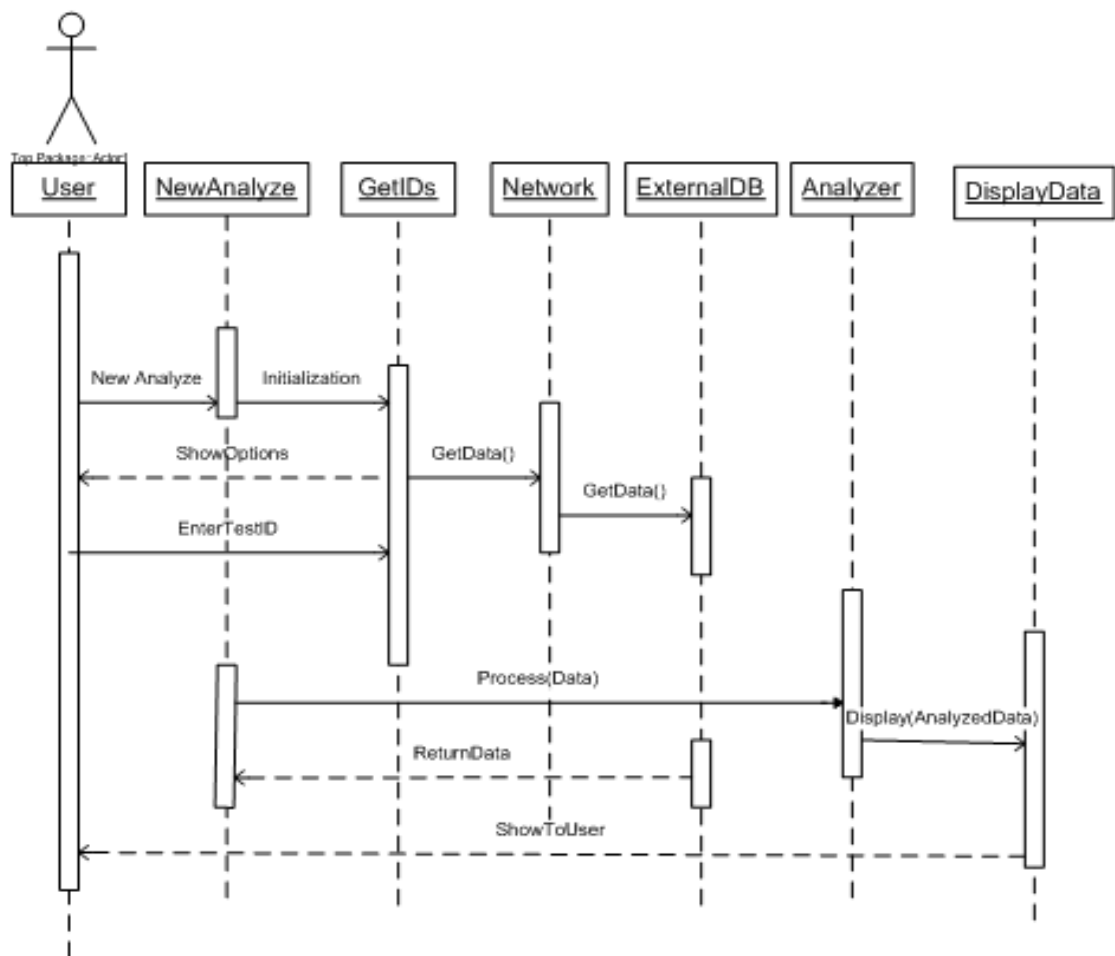


Figure 4-5 Sequence Diagram for View Analyzer

#### 4.5.6 View Database

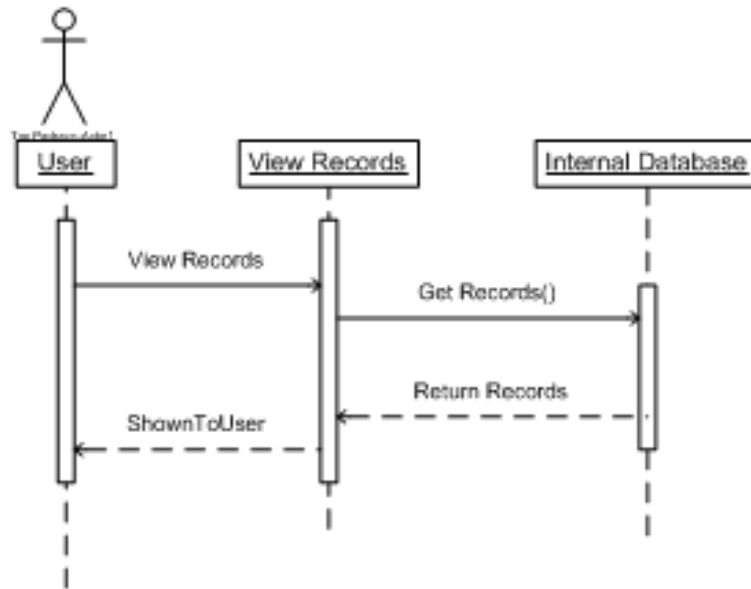


Figure 4-6 Sequence Diagram for View Database

#### 4.5.7 Login

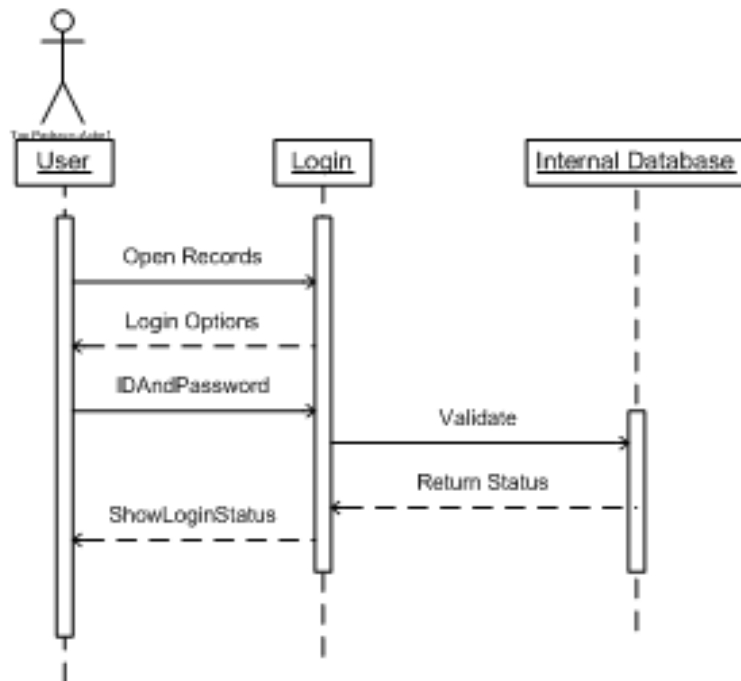


Figure 4-7 Sequence Diagram for Login

#### 4.5.8 Print Data:

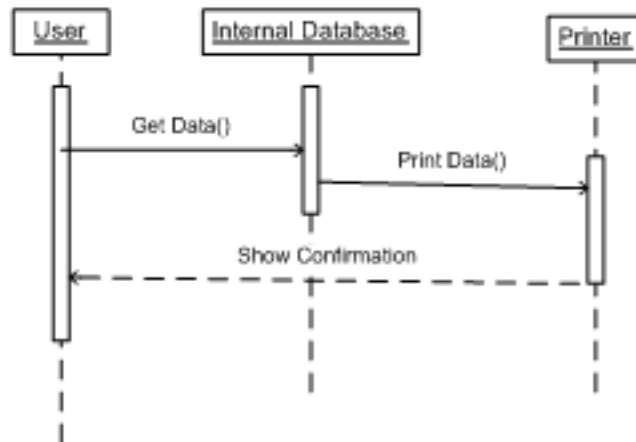


Figure 4-8 Sequence Diagram for Print Data

#### 4.5.9 Change Configuration

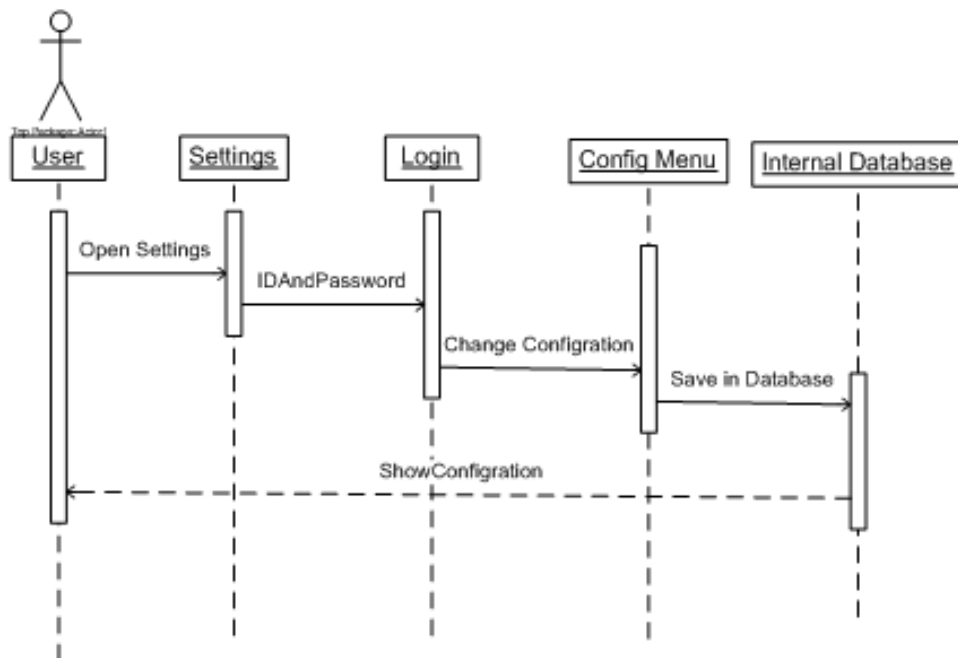


Figure 4-9 Sequence Diagram for Change Configuration

#### 4.5.10 User Management

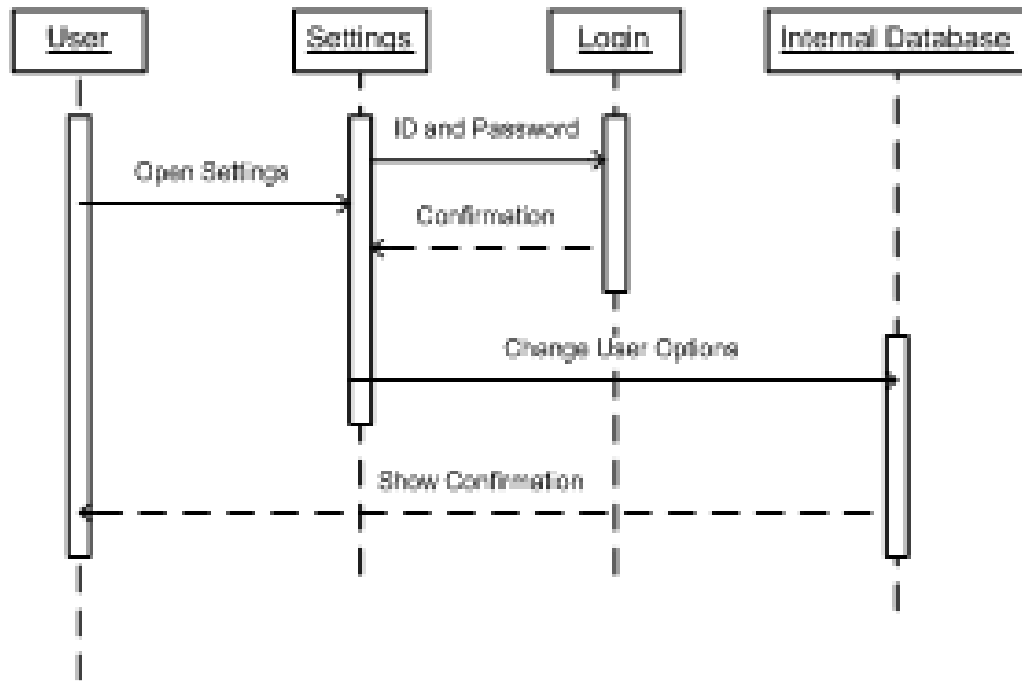


Figure 4-10 Sequence Diagram for user management

#### 4.5.11 Logical View:

#### 4.5.12 State Transition Diagram

The State Transitions occurring in the application are shown in fig. 4-13 below:



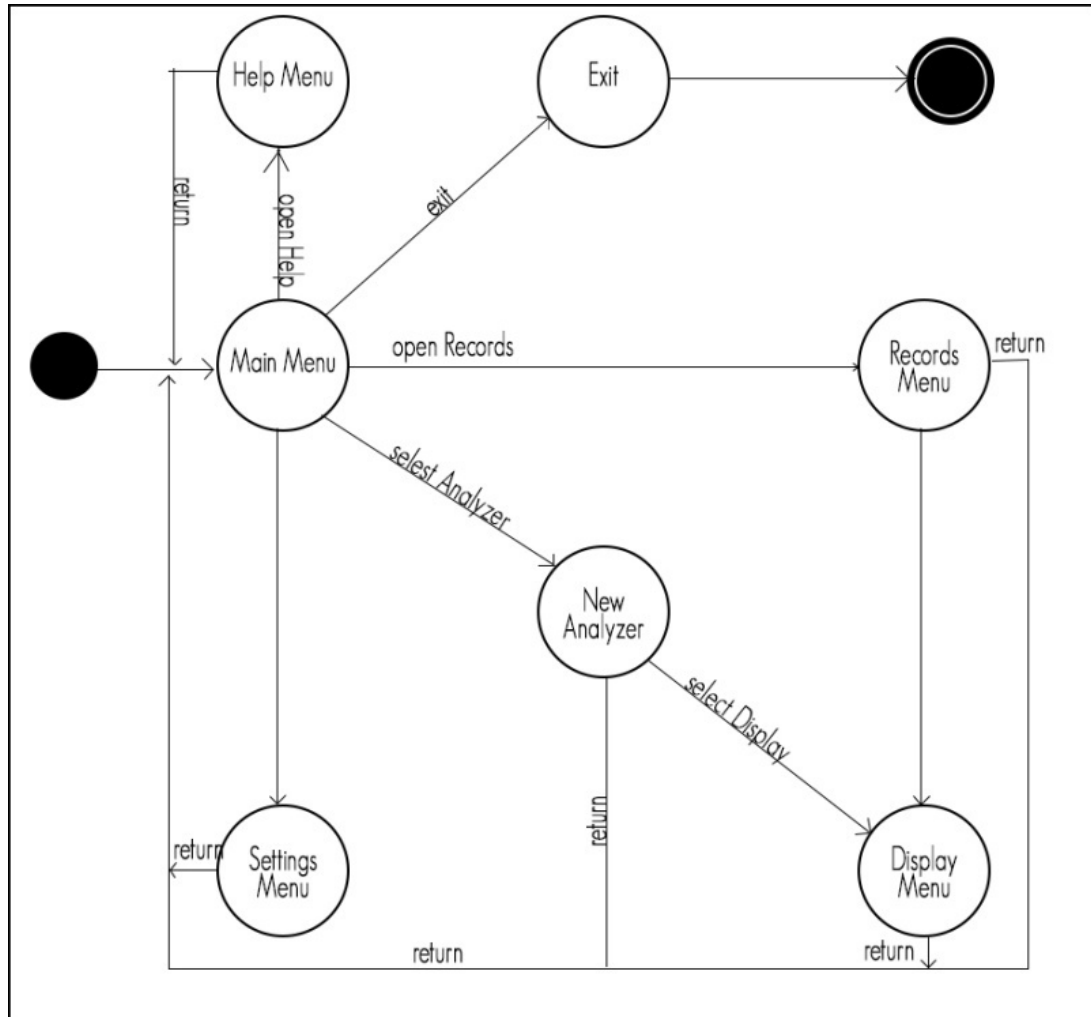


Figure 4-11 State Transition Diagram for C-Thal System

### 4.5.13 Implementation View

### 4.5.14 Class Diagram

To accommodate the class diagram into the document, it has to be divided into parts. Fig. 4-14 (b) is the continuation of Fig. 4-14 (a) with respect to ‘\*’ in the *Database Manager* class.

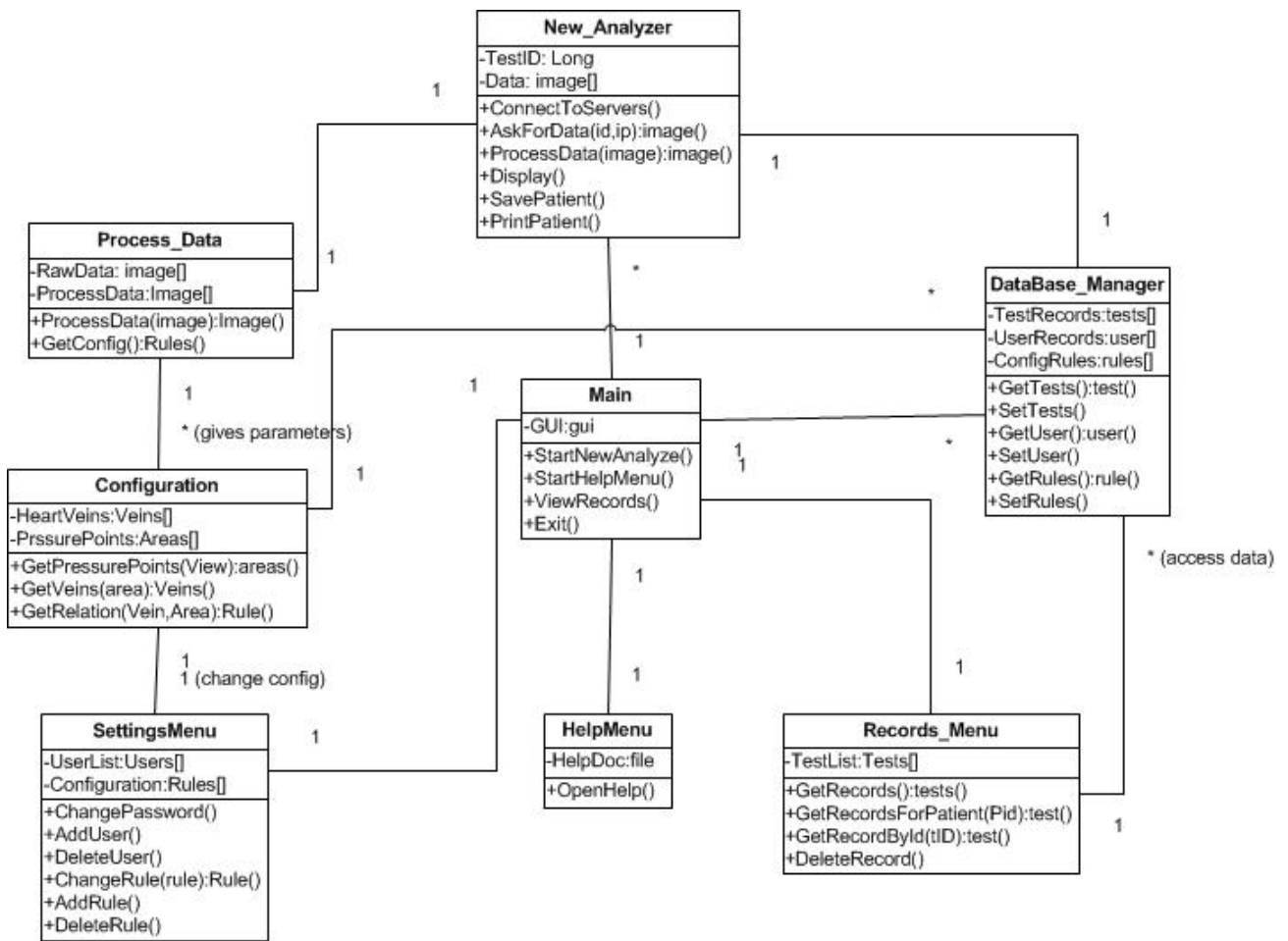


Figure 4-12 (a) Class Diagram for C-Thal System

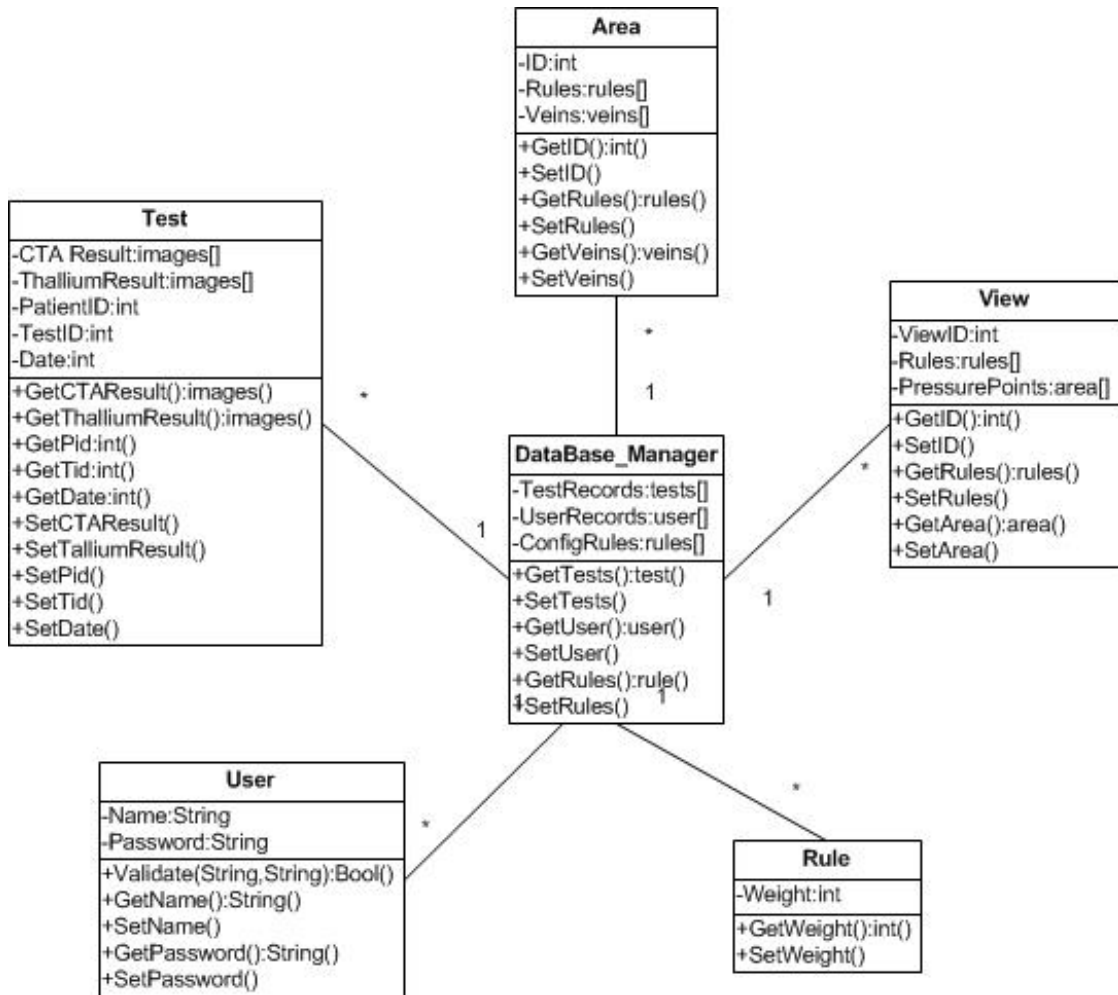


Figure 4-12 (b) Class Diagram for C-Thal System

#### 4.5.15 System Classes Description:

Table 4-1 System Classes Description

Classes	Description
<b>Main</b>	The main class of the application, which will be executed first in when the application is run. It shows different options to use the app.
<b>New Analyzer</b>	The class that starts a new analyze and shows result
<b>Process Data</b>	It processes the data provided to it according to the configuration and returns Analyzed data to Display.

<b>DataBase Manager</b>	It manages all data i.e. Users Lists, Tests Records and Configuration rules.
<b>RecordsMenu</b>	This class contains all the test records and methods to get specific records.
<b>HelpMenu</b>	Contains and opens Help Menu.
<b>SettingsMenu</b>	It contains settings properties and provides methods to change different program settings
<b>Area</b>	This class defines portions of heart ie. pressure points and their relation with veins.
<b>Test</b>	This class defines Test of a patient and provides different methods to access tests
<b>Vein</b>	This class defines veins of hearts and their relation with veins.
<b>User</b>	It saves all user name and passwords, allows to validate them.
<b>Rule</b>	Just contains weight. It associates the relation between veins and Pressure Points.

#### 4.5.16 Structure chart

This chart shows the breakdown of the application to its lowest manageable levels. It shows the modules and their corresponding functions which this application will implement. This chart basically shows the structure breakdown of the application starting from main modules to specific functions.

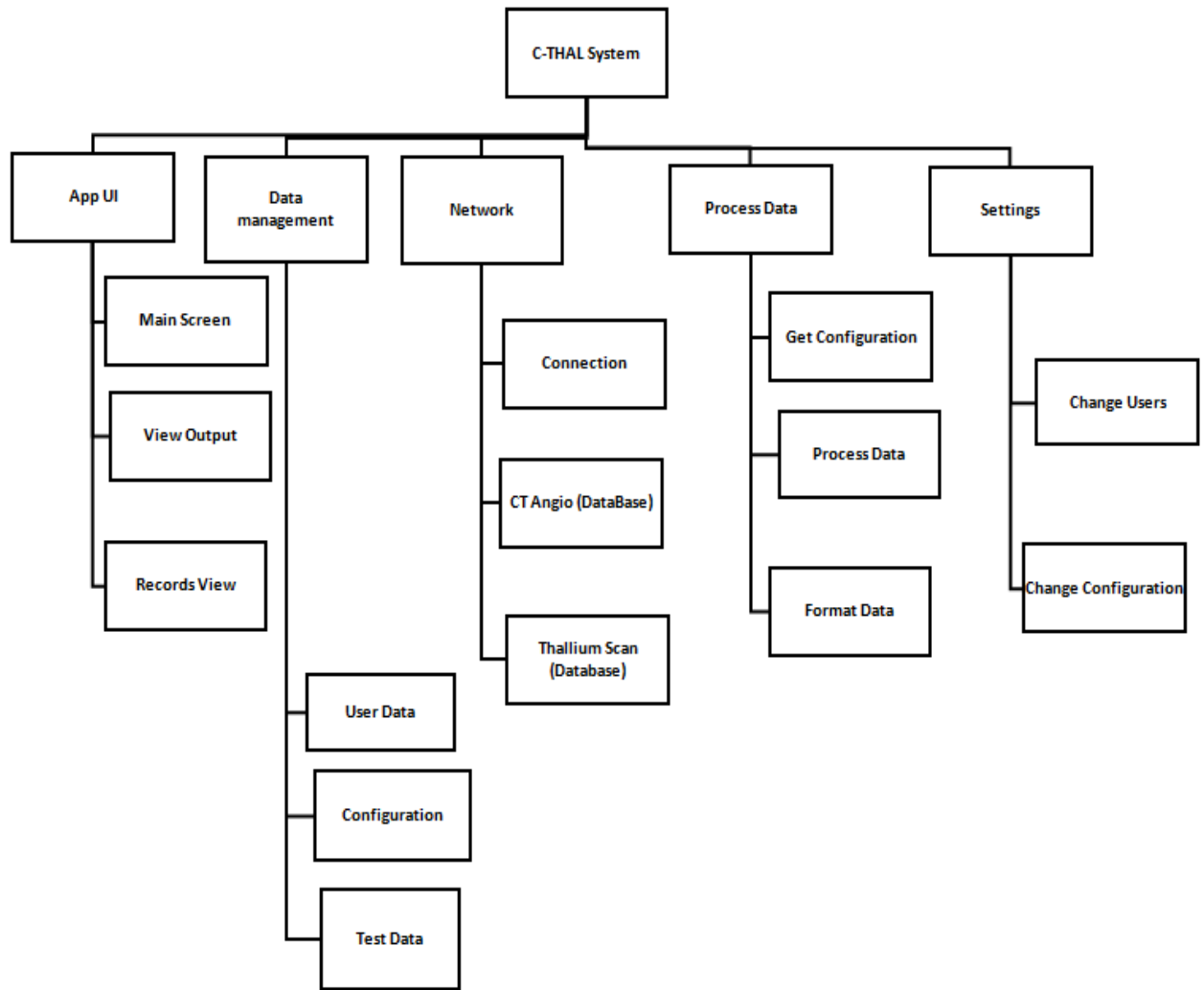


Figure 4-13 Structure Chart for C-Thal System

#### 4.5.17 Dynamic View:

#### 4.5.18 Activity Diagram

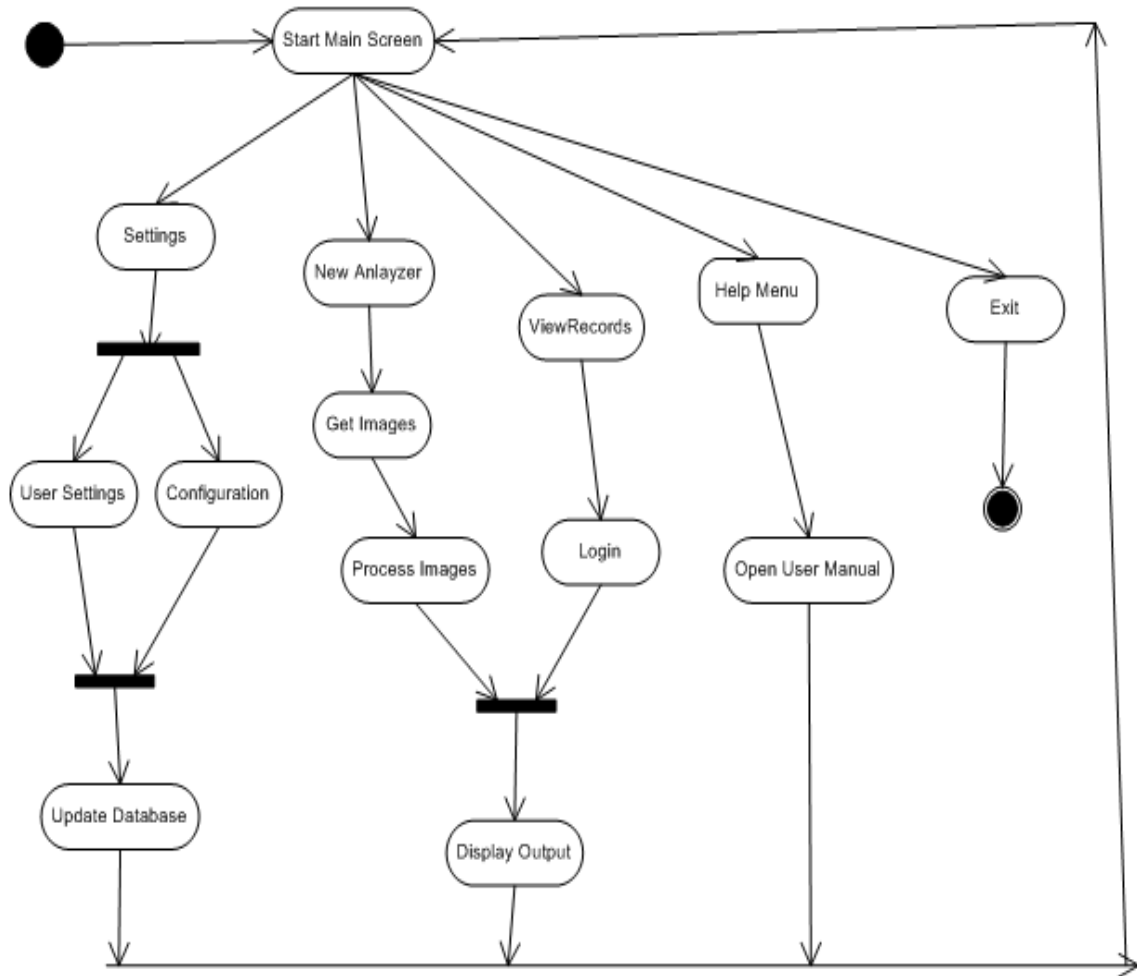


Figure 4-14 Activity Diagram for C-Thal System

#### 4.6 User interface

This is the Main Menu of the GUI. This will start when user opens the app. User can choose different options to move further.

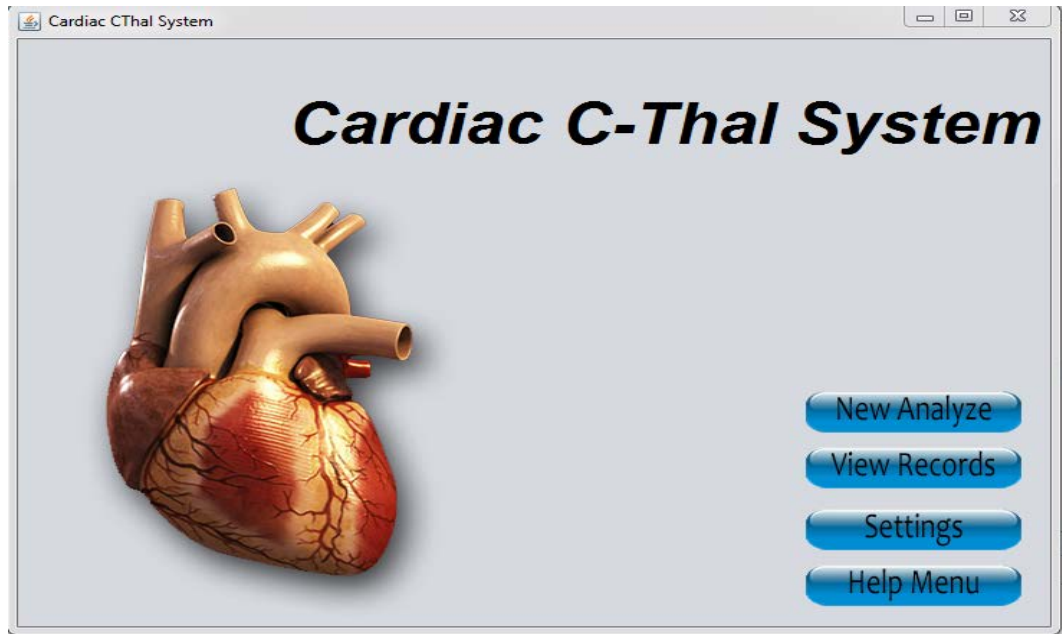
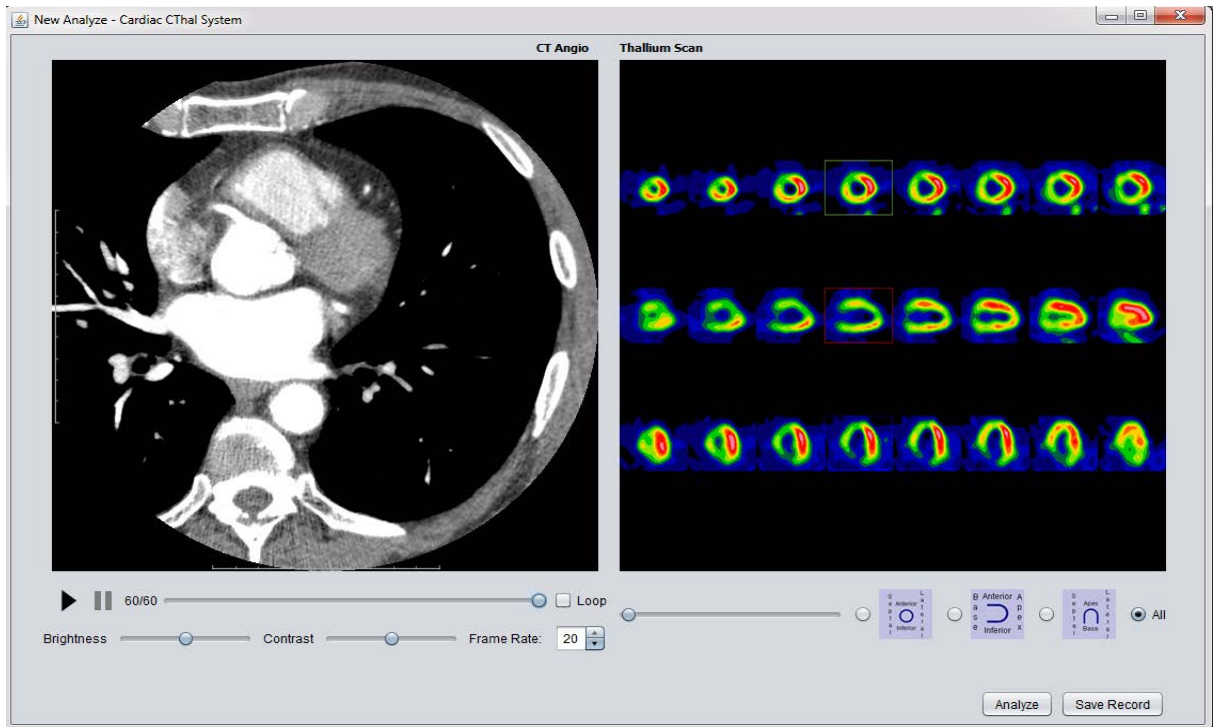
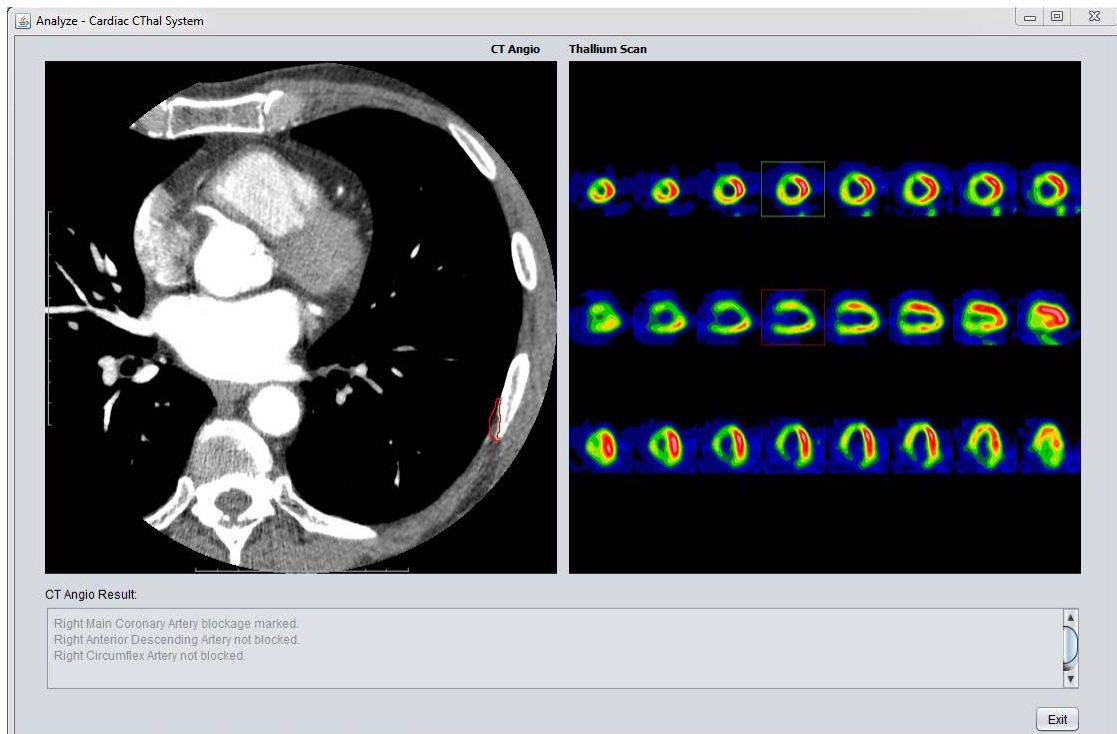


Figure 4-15 Main Menu Screen

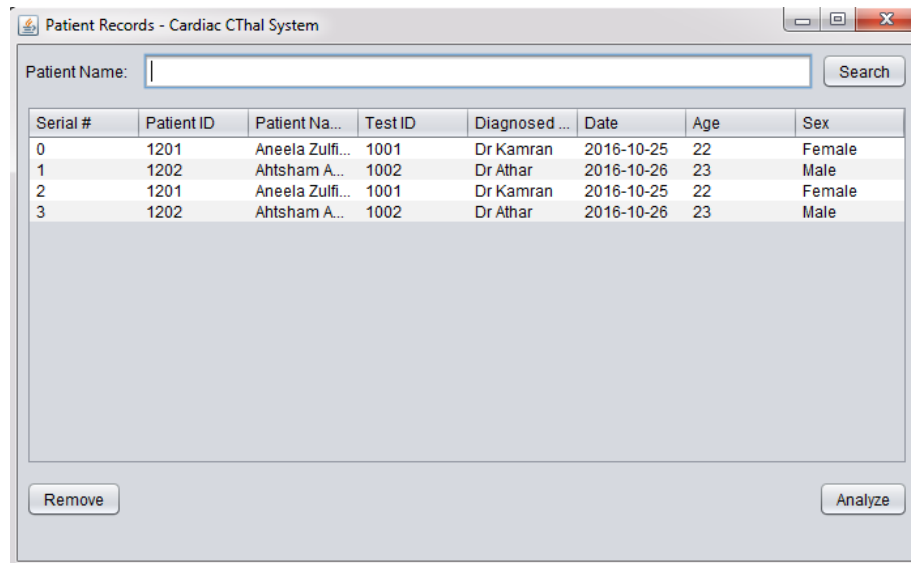
New Analyzer allows user to analyze a new test. It display both side by side and allows doctor to print and save records.





**Figure 4-16 Analyzer Screen**

Records show records from Database and allows user to open test of patient for display. It also has options for searching using different parameters



**Figure 4-17 Records Screen**



Help Menu provides a complete and elaborate user guide on how to operate this application

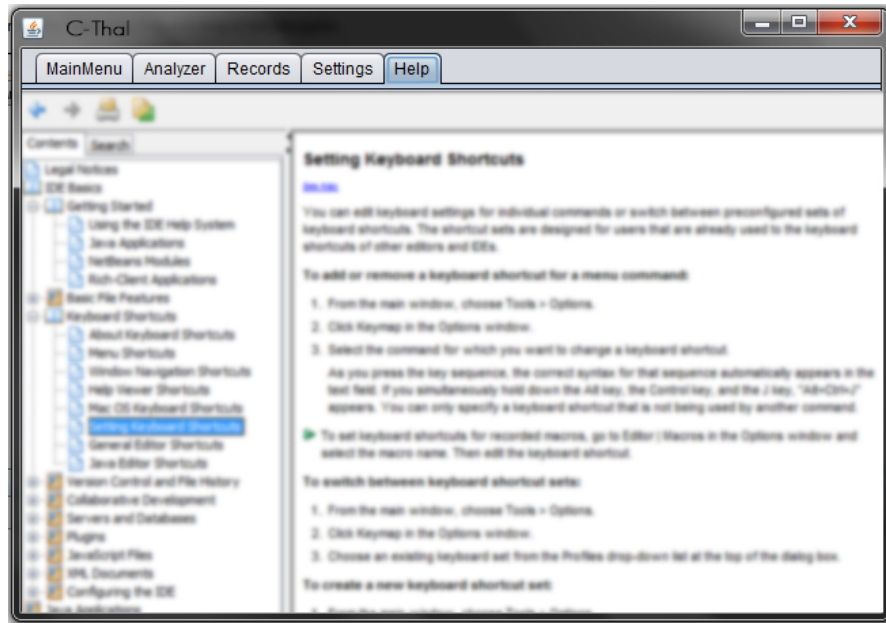


Figure 4-18 Help Menu Screen

#### 4.7 Reuse and Relationship to other products

Cardiac C-Thal System is not based on any previous systems neither it's an extension of any other applications at any level. But it can be evolved into a bigger and more complex system with more features and functionality. Beginner developers can also reuse some of the modules of the system. The practical usage of the system can be increased by monitoring and recording Heart activity of the patient via CT Angio and Thallium Scan actual runtime results, to provide a better and more accurate knowledge about person's Cardiac state, so that further evaluation can be based upon that.

The application can also be enhanced to further include more activities to exercise more areas of the Heart. It has the same procedure of testing for all patients with different Heart Diseases.

## 4.8 Design and tradeoffs

The Cardiac C-Thal System is an interactive application which requires multiple types of user interface. Developing such systems require thorough consideration on the design factors as it might result in complexity problem. A poorly-designed System results in a system consuming more resources with very little efficiency and a slower response time which directly affects the experience of the target user Besides this, poor designs make testing and maintenance activities difficult.

The application is a context-aware pervasive system. Interface of the system is distinct from the application logic. Layered architecture is used to isolate application logic from the user interface. It can be modeled using **Multitier Layered Architecture** consisting of three layers i.e.; presentation, application logic and database. Presentation layer corresponds to elements of the user interface such as text, checkbox item etc., and application logic layer controls the communication of data between the presentation and the database layer, and is the part where the main logic, user actions and working of the system is defined. In general, it controls the complete behavior of the system, while the database layer is responsible for handling and storing of the processed data.

**CHAPTER:5**  
**SYSTEM IMPLEMENTATION**

## 5 SYSTEM IMPLEMENTATION

The application works by accessing database containing pictures on servers that is CTA and Thallium scan and their information. This is then used to display in the application for the user to select the option of analyzing pictures to construct the view the results.

The process of analyzing images consists of the following steps:

Collect the images selected by the user

Analyze them by using the CTA images or Thallium scan images.

### 5.1 Pseudo code for components

#### 5.1.1 For Application UI

```
begin  
  
    Show MainMenu  
  
    Show NewAnalyzer, Help Button  
  
    Show Settings, Exit  
  
End
```

#### 5.1.2 For Process Data

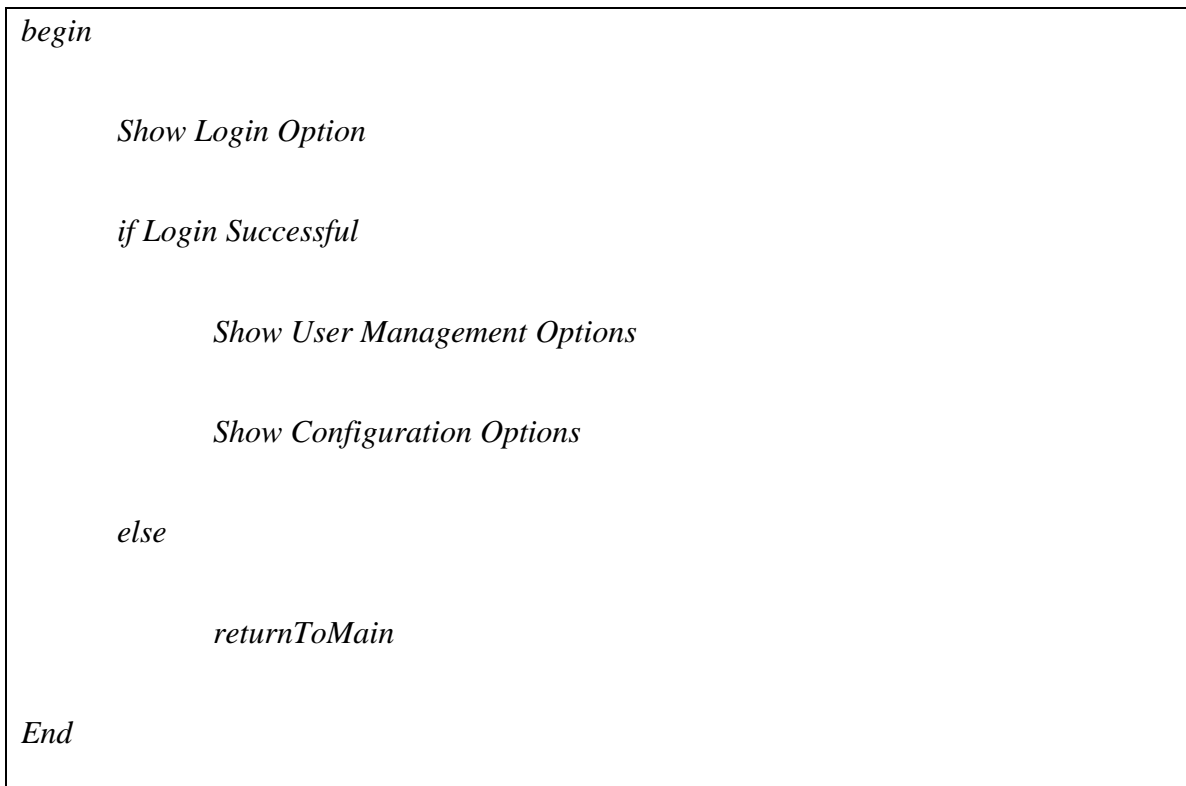
```
begin
```

```
Validate(Images)  
  
if complete  
  
    Get_Configuration  
  
    ProcessImages  
  
    Return ProcessedData  
  
else  
  
    Return Error  
  
End
```

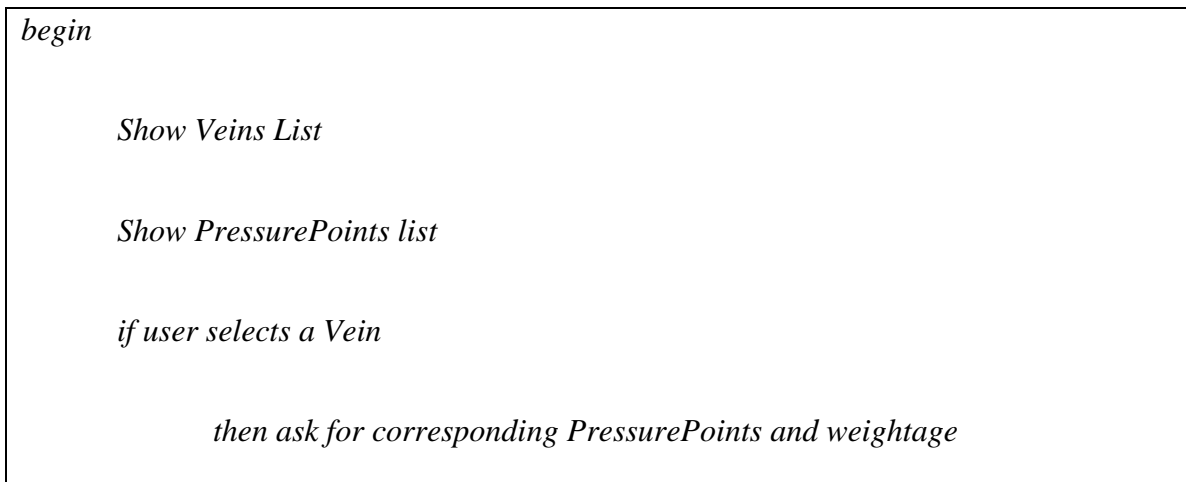
### **5.1.3 For analyzer**

```
begin  
  
    Show Buttons: Movement, Rotation, Zoom  
  
    Get_Images  
  
    Construct 3D Model  
  
    Display Images  
  
End
```

#### 5.1.4 For Settings Menu



#### 5.1.5 For Configuration Module



*if user selects a PressurePoint*

*then ask for corresponding Veins and weightage*

*if User selects Save*

*valideAndSave Settings*

*End*

### **5.1.6 For User Management**

*begin*

*show User ID List*

*if user selects addNewUser*

*take ID & Pass and add new user*

*if user selects deleteUser*

*delete User from DataBase*

*if user selects changePassword*

*take password and save*

*End*

### 5.1.7 For Networking Module

*begin*

*connect to Thallium DataBase*

*if successful*

*get ImageData*

*connect to CTAngio DataBase*

*if successful*

*get ImageData*

*return Data to ProcessModule*

*End*



**CHAPTER:6**  
**ANALYSIS AND EVALUATION**

## **6 Analysis and Evaluation**

### **6.1 Introduction**

This section describes the appropriate strategies, process and methodologies used to plan, execute and manage testing of the Cardiac C-Thal System project. This document will ensure that Cardiac C-Thal meets the customer requirements at an accredited level.

Manual Testing will be followed which includes testing a software manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role of an end-user and tests the software to identify any unexpected behavior or bug. Each Unit will be tested separately and then will be integrated with other units; therefore Unit Testing and Integration testing will be followed. For each unit Black box Testing is done and for combined units Acceptance Testing is done.

The test scope includes the Testing of all functional, application performance and use cases requirements listed in the requirement document

Software testing, depending on the testing method employed, can be implemented at any time in the development process. However, most of the test effort occurs after the requirements have been defined and the coding process has been completed.

This section includes the plan, scope, approach and procedure of Cardiac C-Thal test. The pass/fail criteria of the test items are also defined. The Test Plan document documents and tracks the necessary information required to effectively define the approach to be used in the testing of the product.

## **6.2 Approach**

The overall testing strategy shall be alpha testing. Our project is in modules so we will start the testing phase by testing the modules separately by testing each unit and then step by step integrating modules to test them with each other i.e. integration testing and then the complete application is tested as a whole in system testing.

## **6.3 Features to be tested**

Following Features are tested:

Application will be able to access data from Thallium scan and CT Angio tests through network

Viewing 2D Models of Results of Thallium Scan and CT Angio Tests

Analysis of Results of Thallium Scan and CT Angio Tests

Allow Users to save the records for later use

Allow taking a print of the results.

The application will run on devices having a minimum of total 2 GB RAM (500 MB required maximum for the application itself).

Active connection to the hospital network should be available

Java version 6 or higher should be installed

Instructions for using the app shall be provided before the start of each test that shall be audio-visual.

## **6.4 Item Pass/Fail Criteria**

Details of the test cases are specified in section Test Deliverables. Following the principles outlined below, a test item would be judged as pass or fail.

Preconditions are met

Inputs are carried out as specified

The result works as what specified in output => Pass

The system doesn't work or not the same as output specification => Fail

## **6.5 Testing tasks**

Develop Test Cases.

Execute tests on the basis of the test cases developed

Report defects during tests if any.

Complete the test report.

Manage the changes made after testing.

## **6.6 Test Deliverables**

Test cases

Output from tools

## **6.7 Responsibilities**

All developers of the project are responsible for the completion of all components testing and integration testing tasks.

## **6.8 Staffing and training needs**

Basics knowledge of testing strategies and techniques is needed for the testing of the project.

All the developers will be testing each other's work and will be actively participating in the development and testing of the project simultaneously.

## **6.9 Risks and contingencies**

### **6.9.1 Schedule Risk:**

The project might get behind schedule so in order to complete the project in time we will need to increase the hours/day that the project is being worked on.

### **6.9.2 Budget Risk:**

The budget will be compensated by using less costly alternatives to fit the budget requirements.

### **6.9.3 Operational Risks:**

Operational risks will be eliminated by Scheduling daily meetings and regular deadlines to meet the goals of the project as well as provide proper communication within the group.

### **6.9.4 Technical risks:**

Technical risks will be eliminated by keeping the once defined requirements constant.

### **6.9.5 Programmatic Risks:**

In case of a programmatic risk the scope of the project will be limited in order to stay inside the constraints of the project.

## 6.10 Environmental Needs

### 6.10.1 Hardware

Microsoft Windows PC computers with a broadband connection (LAN)

### 6.10.2 Software

Any device with Java version 6 or higher installed. This includes but not limited to Windows XP, Vista, 7, 8, 8.1, 10, Mac OS X, Linux, and UNIX based systems.

## 6.11 Risks and contingencies

Efforts have been made to remove all and every chance of failure but there are certain unpredictable factors such as network issues, corrupt input data, or system failure that may lead to some issues. Error handling will be applied more deeply to cover all these issues but unforeseen circumstances may happen.

## 6.12 Test Cases:

### Unit Testing and Integration Testing

Test Case Name	Accessing Feature Main Menu
Test Case No	1
Description	Testing Feature Main Menu
Testing Technique Used	Unit Testing
Preconditions	Application must be properly installed on the computer system.
Input Values	Cardiac C-Thal application

Valid Inputs	Open the Cardiac C-Thal application
Steps	Select the Cardiac C-Thal application installed in computer system.
Expected Output	Cardiac C-Thal application opens displaying Feature Main Menu to the user
Actual Output	Cardiac C-Thal application opens displaying Feature Main Menu to the user including :  Start a new Analysis  View Old Patient Records  Help Menu  Exit
Status	Pass

*Table 6-1: Test Cases For Main Menu*

Test Case Name	New Analysis Feature
Test Case No	2
Description	Testing the New Analysis Feature that holds a very high priority since it is a core feature of this product.
Testing Technique Used	Unit Testing and Acceptance Testing
Preconditions	The Application must be opened displaying Feature Main Menu
Input Values	The user provides patient code.
Valid Inputs	The user provides correct patient code.
Steps	First select the Cardiac C-Thal application installed in Computer System, then choose the New Analysis Feature which is displayed on Feature Main Menu
Expected Output	User should provide patient code so that he/she can retrieve the files from

	remote computers containing Thallium scans and CT Angio test results.
Actual Output	User provides patient code and he/she can retrieve the files from remote computers containing Thallium scans and CT Angio test results.
Status	Pass

*Table 6-2: Test Cases For New Analyzer*

Test Case Name	View Results Feature
Test Case No	3
Description	The View Results will display the results of the analysis. It's the feature that helps doctors to diagnose the patient.
Testing Technique Used	Unit Testing and Integration Testing
Preconditions	Analysis completion brings user to this menu.
Input Values	Results from Analysis.
Valid Inputs	Choose Results of Thallium scan and Ct Angio Analysis.
Steps	After Analysis the product will display patient's heart results from CT Angio and Thallium scan on the screen side by side. User will have a 360 degree view of both the images. Clicking one image will bring the corresponding view of the second heart image.
Expected Output	Clicking on one image whether of Thallium scan or Ct Angio should bring the corresponding view of the second heart image.
Actual Output	Clicking on one image whether of Thallium scan or Ct Angio will bring the corresponding view of the second heart image.
Status	Pass

*Table 6-3: Test Cases For View Results*



Test Case Name	View Patient Records Feature
Test Case No	4
Description	It will allow the doctors to view old patient's record, analyze and print them.
Testing Technique Used	Unit Testing and Integration Testing
Preconditions	The user selects View Old Records Feature from Main Menu Feature
Input Values	User enters a password in order to view old patient's records.
Valid Inputs	User enters a correct password in order to view old patients records.
Steps	The user selects View Old Records Feature from Main Menu Feature. User enters a password in order to view old patient's records. List view of patients will be available for doctors to select. User can sort the records on basis of patient name, code, test code and date. Selecting a patient will take user to View Result Menu Feature.
Expected Output	User should be able to sort the records on basis of patient name, code, test code and date. Selecting a patient should take user to View Result Menu Feature
Actual Output	User can sort the records on basis of patient name, code, test code and date. Selecting a patient will take user to View Result Menu Feature
Status	Pass

*Table 6-4: Test Cases For View Patient Records*

Test Case Name	Help Menu Feature
Test Case No	5
Description	It will contain all the instructions needed to use the product.
Testing Technique Used	Unit Testing

Preconditions	Cardiac C-Thal application opens displaying Feature Main Menu to the user
Input Values	The user should select Help Menu Feature from Main Menu Feature or by pressing F1
Valid Inputs	The user selects Help Menu Feature from Main Menu Feature or by pressing F1
Steps	The user selects Help Menu Feature from Main Menu Feature or by pressing F1.  An instruction manual is displayed to guide the user.
Expected Output	Pressing F1 or choosing Help option should show Instruction Manual.
Actual Output	Pressing F1 or choosing Help option will show Instruction Manual.
Status	Pass

*Table 6-5: Test Cases For Help Menu*

Test Case Name	Database Connection
Test Case No	6
Description	It will contain all the saved patient data.
Testing Technique Used	Unit Testing, White Box Testing
Preconditions	Cardiac C-Thal application opens displaying Feature Database.
Input Values	The user should select View Records Feature from Main Menu Feature.
Steps	The user selects View Records Feature from Main Menu Feature.  A Database with all patients' details is shown to the user.
Expected Output	Choosing View Records option should show all patients' record.
Actual Output	Choosing View Records option will show all patients' record.
Status	Pass

*Table 6-6: Test Cases For Database Connection*

**CHAPTER:7**  
**FUTURE WORK**

## **7 FUTURE WORK**

A system of this magnitude always needs more and more work to evolve. There are a lot of possible changes and additions that can be done to the system to improve its performance and functionalities. The system has been made in a modular fashion which enables integrating new features very easy.

Some of the key features which current version doesn't have are: Dynamics of hearts based on factors like age, body type and other possible deforming causes. These functions can be added over the time to increase further usability of the system and provide better results with more proficiency.

Another key development that has been talked about a lot is making the system self intelligent. This will require a lot of work but the end results could be amazing. It will not only remove the issues involving human error but also remove the time doctors have to spend analyzing all the patients. A system intelligent enough to diagnose the patient by itself could be the next big step for the project.

Network module could also be made to connect wirelessly as well. Also going from 2D to 3D could be a new revelation.

**CHAPTER:8**  
**CONCLUSION**

## **8 CONCLUSION**

### **8.1 Overview**

The main purpose of this project is the development of a system that would allow doctors to perform analysis on results of Thallium Scan and CT Angio and compare them to find any blockage in blood vessels through an easy to use interface that incorporates display of both systems used in hospital through network. The system will analyze the data and find the issues by comparing both Thallium Scan and CT Angio results. It will then notify the doctor and generate a report about patient's health results.

The system gets the results from both machines through network established in the Hospital. Doctors can get new records of patients by a single click and let the computer analyze them. The results are stored in a Database. Black box testing has been applied on the application together with unit and integration testing using the incremental technique.

### **8.2 Objectives Achieved**

The Project developed with AFIC as target audience helped to achieve the objectives of learning software development process/cycle, Digital Image Processing, handling network issues and integration of databases. It also helped us understand what are the problems we need to face when developing a project in the industry.

**CHAPTER:9**  
**BIBLIOGRAPHY**

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**APPENDIX A**

**USER MANUAL**

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# **1.0 General Information**

## 10 GENERAL INFORMATION

This section explains in general terms the system **Cardiac C-Thal** and the purpose for which it is intended.

### 10.1 System Overview:

Cardiac C-Thal is a system that allows doctors to perform analysis on results of Thallium Scan and CT Angio and compare them to find any blockage in blood vessels through an easy to use interface that incorporates display of both systems used in hospital through network.

### 10.2 Organization of the manual:

The user's manual consists of five sections: General Information, System Summary, Getting Started, Using The System..

1. **General Information** section explains in general terms the system and the purpose for which it is intended.
2. **System Summary** section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, system's configuration, user access levels and system's behavior in case of any contingencies.
3. **Getting Started** section explains how to setup the system and configure it for the first time. The section presents briefly system's settings.
4. **Using the System** section provides a detailed description of system functions.

## **2.0 System Summary**

## **11 SYSTEM SUMMARY**

System Summary section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, system's configuration, user access levels and system's behavior in case of any contingencies.

### **11.1 System Configuration:**

**Cardiac C-Thal** requires Java to be installed on the operating system. Minimum version required is JDK 1.6. System also needs to be connecting to CT Angio and Thallium Scan systems over the network. First time configuration of database is also needed for the system.

### **11.2 User Access Levels:**

The System will be available for to all trained hospital staff but Records of patients will only be available to authorized Specialists only.

### **11.3 Contingencies:**

In case of any errors or system crashes, the database will not be affected and Patient records will remain safe. The currently running diagnosis will not be saved hence it will have to be started again by getting the CT Angio and Thallium data from the network.

User Settings will also remain same.



## **3.0 Getting Started**

## 12 GETTING STARTED

Getting Started section explains how to configure the system and install it for the first time use. The section also presents briefly the system's menu.

### 12.1 Installation:

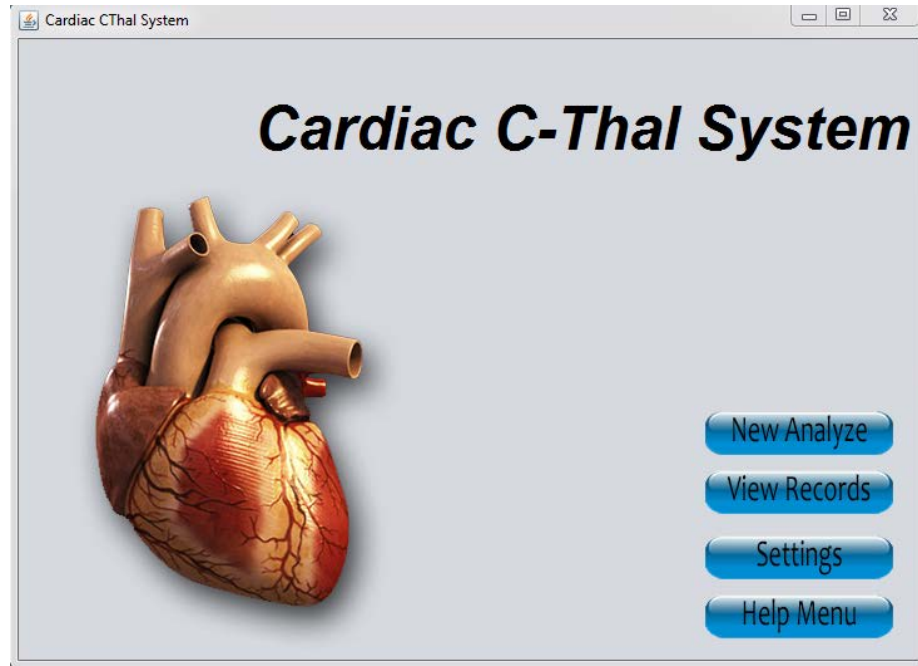
The application can be installed by the exe file provided.

1. After installation, System has to be checked for network availability from Settings.
2. It should be connected to the network
3. CT Angio and Thallium files should be accessible
4. Database has also to be started from Settings Menu

### 12.2 System Menu:

The main menu screen of the application will provide the user four options.

1. It will allow the user to start a new analysis by **New Analyze** button.
2. The **View Records** button shows records saved in DataBase.
3. The **Settings** button will display a new screen which will allow the user to modify the settings according to his choice .
4. The **Exit** button will close the system while saving all current data.



**Figure 3-13 Main Screen**

### **12.3 Starting an Analyze:**

Pressing the new Analyze button will start a new Analyze. User will be able to enter patient Id and get data for that patient displayed on screen side by side.

### **12.4 Settings:**

Pressing the settings button on the main menu will display the settings screen to the user.

1. It will allow user to set up network settings
2. It will allow user to set up database functions
3. User can set up permission levels from here.
4. User can changes veins to muscles dependencies by authorized access.

### **12.5 Exit Application:**

The system will save all settings, Terminate database and network connections and exit the application.

## **4.0 Using the System**

## 13 USING THE SYSTEM:

This section provides a description of system functions and features.

### 13.1 Main Menu:

1. Main Menu gives user options to navigate through the system and use its different functions.
2. It has four options:
  - 2.1. New Analyze.
  - 2.2. View Records
  - 2.3. Settings
  - 2.4. Exit
3. The user will click on a button of his choice. This will display a new tab to the user.
4. To move back to the main screen user will have to press exit button on the screen.
5. Main Menu is the last screen which user has to close to exit the program.

### 13.2 New Analyze:

1. User can initiate a New Analysis by clicking on **New Analyze** button.
2. The user then has to type in a **Patient ID**.
3. If the ID is valid, user will be taken to a display screen with the results of both CT Angio and CThal.
4. User can move forward and backward in CT Angio Results by clicking **navigational function** given on the left side.
5. User can also play the film at a desired **frame rate** with **loop** option.
6. On the right, User has option to select different **views** of Thallium Results.

7. Choosing to click on **Diagnose** button will show the user diagnosis of specific results and a text report.

### **13.3 View Records:**

1. Clicking on View Records will take user to **DataBase Menu**.
2. User can search the database for different patients.
3. Choosing a patient from database and clicking **View Diagnosis** will take the user to Analysis Screen.

### **13.4 Settings:**

1. Selecting **Settings** option from Main Menu will open up Settings tab for the user.
2. User can check **network** feasibility from here.
3. If any of the CT Angio or Thallium Scan systems are not connected, user will get notified.
4. User can also check the **database** info from Settings.
5. User can modify **database** Settings from here.
6. **New Users** and **User Permissions** can be added through here.
7. Upon providing authorization, **System Training** can also be done from here.

### **13.5 Exit**

Clicking exit will terminate the Network connections, close database, save all settings and configurations. It will then exit the system.