Exploring OOAD Concepts Through Course Projects

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Abstract: This paper presents the innovative approach carried out in conducting Object Oriented Analysis and Design (OOAD) lab course for post graduate students. OOAD lab course is designed in such a way that the students will be able to analyze, design and implement the real time problems. The lab course structure involves mainly two parts; in the first part selecting problem, analyzing the requirements and designing the chosen problem. The second part focuses on implementation of the design, completed in previous phase. We discuss the methods of OOAD and applied them for implementing the real world applications. Students have implemented the projects in this lab course through which they have explored the OOAD concepts. Problem selection choice is given to the students. In the first part students have done the design of the chosen problem using OOAD and UML concepts individually. This design is done through Rational ROSE tool. In second part, group of 2 or 3 students have implemented the application using JAVA and My SQL programming language. The outcome of this course, 15 projects like hospital, restaurant, vehicle booking, inventory, hostel and placement management system, etc. have developed by the students. Thus the activity of project development has improved the design,

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implementation and presentation skills of students. The performances of the students are measured in Continuous Internal Evolution (CIE) and Semester End Exam (SEE).

1. Introduction

Object oriented Analysis and Design is an emerging approach for developing software. Object oriented development process is explained through four phases which are; problem definition, requirement analysis, design and implementation shown in Fig.1. Object oriented principles are applied to build the models. Nowadays the software is developed in iterative and incremental manner by following these phases. Main objective of object oriented analysis activity in software development is to model the functional requirements. Model shows the desired specification of the application or the system. The important task of the object oriented analysis is to identify objects, organize objects, define the role of the object, object interaction, and object behavior. Object oriented development differs from

conventional approach. Real world applications are visualized effectively with object oriented analysis models. Object oriented design shows the relationship between objects. The purpose of object oriented analysis is to identify the objects for the chosen problem and providing appropriate relationship between them to produce the efficient design. While developing software, object oriented concepts are used to provide efficient design solutions.
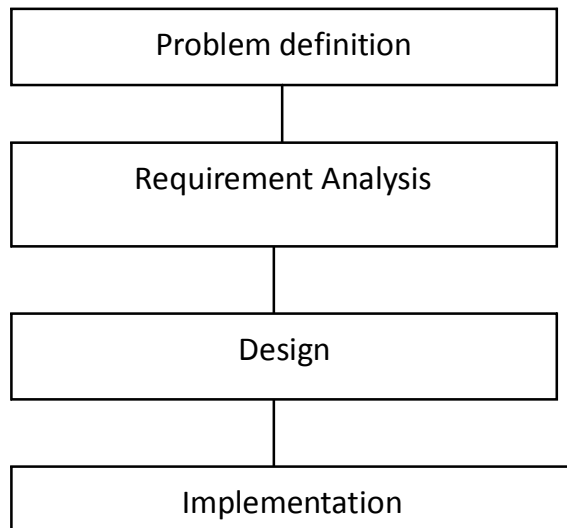

Fig. 1 Object Oriented Analysis

The first phase of Object Oriented (OO) development is selecting problem and second phase concentrates on analyzing the requirements, in this step objects are identified and purpose of the requirements are understood. If the objects are identified properly then the next phases design is easy to complete. Once the objects are identified, these objects are assigned the responsibilities to meet the functionalities. These responsibilities are assigned properly. Objects collaborate with each other to complete the task.

During third phase, objects are provided with appropriate relationships through which the desired function is represented. Unified Modeling Language (UML) is the appropriate choice for building the models. Design is iterated for number of times to obtain the detailed design.

In fourth phase the detail design is implemented using OO concepts and programming languages like C++, Java and C#, etc.

These OO models are classified into two categories: Static and dynamic models. Static model describes the structure of the application. This structure is represented using UML class models. Dynamic model describes the behavior of the application. These models are represented using State, use cases, sequence and activity models.

This OOAD lab course structure is designed by involving two parts; in first part students have to choose the problem statement, analyze the requirements and design the given application. Second part focuses on implementation of the design completed in first part.

During first part, students are having a freedom to choose the problem. Each student has chosen real time application and collected the requirements for the identified problem. Requirements are analyzed using OO concepts [1] and UML; Functionalities are designed using Rational ROSE tool. Various models like Class, State and interaction models like use case; sequence and activity models are designed to understand the requirements of the application. In second part, individual student has developed final design solution using OO programming language like Java. Students have used MySQL query language to design the data base for the chosen application.

The second part is implemented with a group of 2 or 3 students because of the time constraints. Designing is a difficult process, students are motivated to apply the OO concepts [2] to complete the task. This project based activity resulted in development of 15 projects specified in further section.

The organization of the paper is as follows, section 2 discusses about literature survey. Section 3 describes the methodology. Section 4 explains the assessment method used, section 5 summarizes the result of student's activities. In section 6 experiences to conduct the lab course using different pedagogical tools are concluded by the authors.

2. Literature survey

This section discusses about the research carried by different authors on OOAD concepts.

S.R.Balasundaram [3], have discussed about collaborative learning pedagogical approach for

teaching a course on Object Oriented Analysis (OOA). Authors have assigned the problem statements to the students to identify classes and their relationships. Students have used the tools for learning OOA. E-Learning environment is used by the author to practice OOA concepts.

Eugenia Fernandez, et al [4], discusses project based learning approach where, team of students will work on open ended projects. Author used this method for teaching analysis, design and implementation, this pedagogy tool has practiced by the authors to teach courses on system analysis design and implementation.

Sabine Moisan, et al [5] discussed the experience of teaching object oriented modeling and UML for different spectators. Author has studied the characteristics of different spectators. Explored the modeling concepts and identified the common problems, background of spectators. In this paper, author has proposed solutions for the identified problems and suggested the instructions.

Kyung-Soo Joo et al [6], suggests object oriented analysis and design techniques in providing security for web applications. Object oriented analysis and design process uses UML specifications. Requirement analysis and design for security is completed using UML and implementation is done with Java servlets. Authors have chosen banking system application to show the effectiveness of object oriented analysis and design methodology.

Scott Johnson , et al [7] , focuses on building software using software engineering principles. Author study evolves the design and implementation of air traffic control simulation system. System was modeled using UML constructs. Software product was implemented using programming languages. Repeated reviews are carried out to complete the project.

Shruti Pustake, et al [8], discussed about software development process using system development life cycle. Authors have compared traditional approach with object oriented approach and explored the various phases of software development life cycle in object oriented methodology. The comparative study resulted in knowing the importance of both the approaches of software development and also suggested the efficient way of software development

through object oriented methodology.

3. Methodology

OOAD course involves more conceptual and theoretical topics and it is difficult to convince the students without lab exposure. So authors have tried few activities through this lab course to understand the object oriented analysis and design concepts. In view of these challenges, authors have set the following Course learning objectives (CLOs). After completing this lab course students will be able to:

1. Design the OO models like class, state and interaction models for the chosen problem.

2. Design the Advanced OO models like use case relationship, procedural sequence diagrams and special constructs on activity models for the chosen problem.

3. Implement the given object oriented model in an object-oriented programming language they already know.

These CLOs aspire to enhance skills in students; with these objectives students have solved real time applications. Here students have chosen UML to build the design of the selected problem. Using Rational ROSE tool these designs are prepared. The next sub section discusses the approach followed to accomplish these objectives.

A. Course Implementation

The innovative approaches used by the authors are intended to enhance designing proficiency in the students. Object oriented analysis and design lab course is conducted using IBM Rational Rose tool. Authors conducted activities using this tool. This lab course is designed by focusing mainly to enhance the analysis and design skills in students. Entire lab course is divided into two parts; in one part Design solution is considered. Second part concentrates on implementation. At the beginning author has demonstrated the IBM Rational ROSE tool and UML, then individual students are assigned with open ended problems. Problem selection choice is given to the students. In advance lab plan is given to the students. Students are given freedom to use the resources available in the department. These activities are as part of Continuous Internal Evaluation (CIE) and are

executed by the author as follows;

· Continuously instructor monitors and assesses the activities according to the schedule.

· Each student has chosen UML constructs for designing the application. ROSE tool is used by them to build the design solution for the application. Students have used Object oriented analysis and design concepts like class, state and interaction modelling to complete the design of an application in first part of the lab course.

Since Implementation phase is more time consuming, so it is conducted as a group activity. Group includes 2 or 3 students. Students have implemented the application using Java programming and MY SQL as second part of the lab course.

4. Assessment method

In this lab course, students are assessed as a part of CIE. Table 1 summarizes the assessment method to meet the specified CLOs mentioned in section 3. The weightage for this lab course in CIE is 80% and 20% weightage is given to the Semester End Exam (SEE). In CIE out of 80%: 50% weightage is given for analysis &Design phase and 30% for implementation.

Table 1. Assessment of CLOs

Objective No.	Assessment method
1	Students are educated about UML constructs and have applied them during the design of an application using ROSE tool . Their knowledge is assessed in CIE and SEE.
2	In lab diverse applications are modelled using OOAD advanced concepts to understand and analyze the given problem and are assessed in CIE and SEE
3	Students have developed the applications using Java programming, MySQL and demonstrated the solution. Their skill is assessed in CIE.

5. Outcomes and observations

This section depicts the results of the activities conducted in OOAD Lab course. Total of 15 projects are carried out by 21 students. Among these projects some of the projects are specifically developed and deployed for the client workstation. Following Table-2 shows the list of the projects developed by the students.

Table 2. List of Projects

Sl No.	Project Title
1	Hospital Management System
2	Placement System
3	Online Tourism
4	Vehicle booking System
5	Pharmacy management System
6	Hostel Management System
7	Private Financial Management System
8	Time Table Generation System
9	Restaurant Management System
10	Online Shopping Management System
11	Library Management System
12	Inventory Management System
13	Online complaint registration to Police station
14	Quiz management system
15	Mobile Store Automation System

· Author's novel approach made the students to enhance the design skills.

· The designing phase activity helped the students to model the design of the chosen problem.

· Implementation phase activity enhanced programming skills in students.

This section depicts the outcome of the two parts conducted in lab. One of the sample project Inventory Management system, design and implementation results are shown in the further part of this section. Design is prepared using ROSE tool and implementation is carried out using Java programming, Netbeans IDE and MySQL.

Problem Definition

To design and develop software application for Inventory management system

Modules involved in this project are;

· Registration
· Stock
· Sales
· Payment
· Analysis

Following Fig.2 shows the class design of the system. Class diagram designed in Fig.2 shows the

information about the classes, attributes, operations, association end names present in the system and also shows the relationships between classes. This model depicts the classes involved in the entire system.
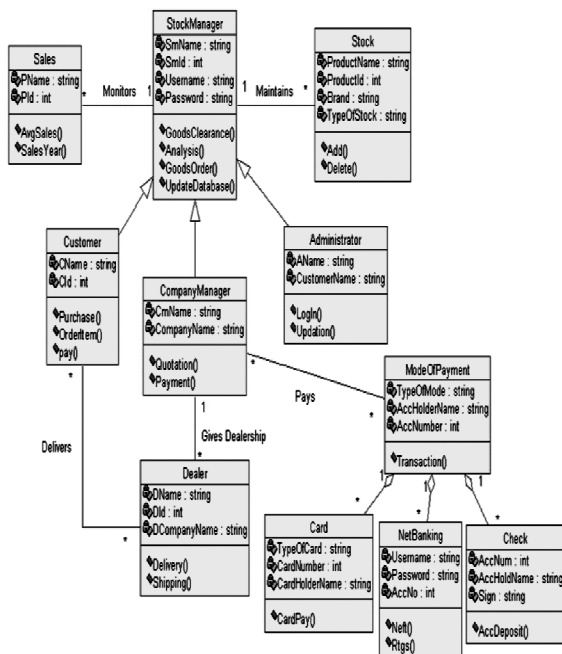

Fig. 2 Class diagram of Inventory management system

Following Fig.3 shows the State diagram of the customer. This model shows the states and events involved in the system. After applying the events objects changes its state from previous state to the next state. State diagram shows the change in the behaviour of the system.
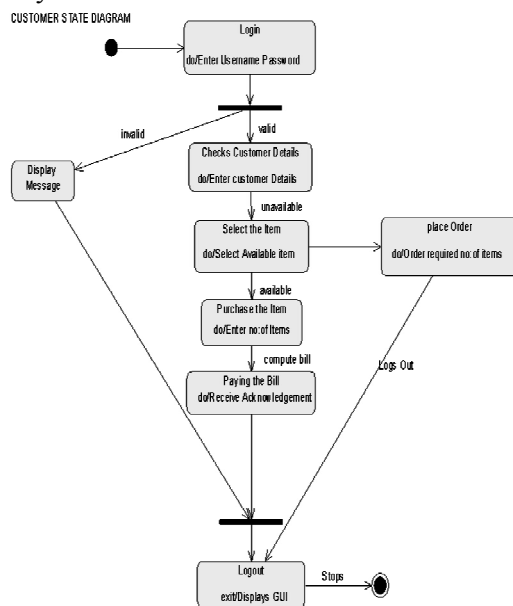
Fig. 3 A Customer state diagram

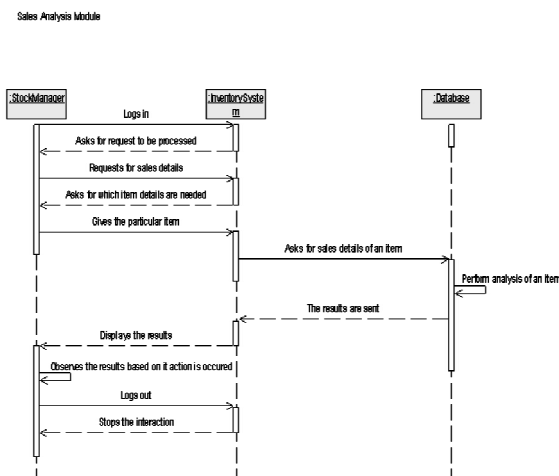Following Fig.4 shows analysis module in the system.

Fig 4. Sales Analysis Sequence Diagram

Sequence diagram shows the objects invoved in the module and shows the interaction between objects.In this module manager consults the inventory system, system asks the request to be processed. Manager inputs the details. System gets the details from the data base and performs the analysis.

Other designs like Use case and data flow diagrams are also designed for the modules as first part of the lab. Through these designs students have improved the design skills. For second part students have implemented these modules using Java programming. Following Fig.5 shows the result of the admin login module. This is one of the module in inventory management system, which shows the login page details.
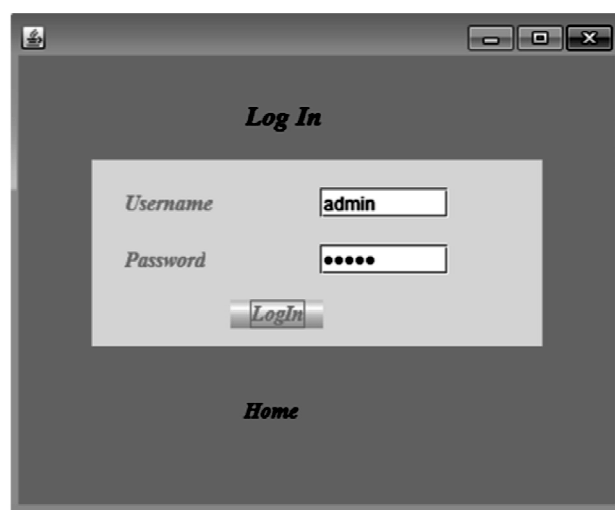

Fig. 5 Snap shot of Login page

Following Fig. 6 shows the adding items in a system

In this module various items are added to the system.

Figure shows the items and quantity details.

Fig. 6 Snap shot of Add items web page

Following Fig. 7 shows the analysis of stock. Total items, total quantity and the stock details of the items are depicted in the result.
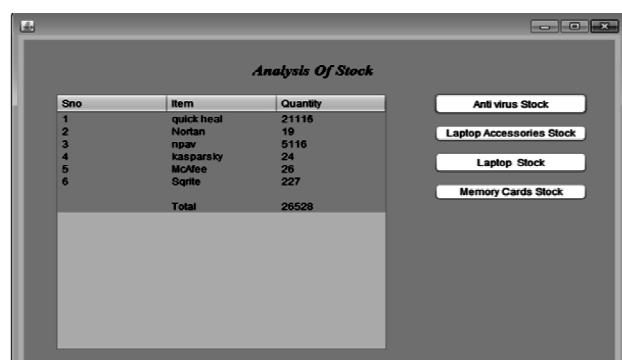

Fig. 7 Analysis of inventory system

The course was conducted through pedagogical activities which are listed in Table 3. These activities helped the students to complete the application development.

Result Analysis

The Semester End Exam results of three years from 2014 to 2016 analysis are shown in Fig. 8. Because of pedagogical activities there is a drastic improvement in the results and 99% of students have scored 'S' and 'A' grades only. Only one student has scored 'B' and 'C'.
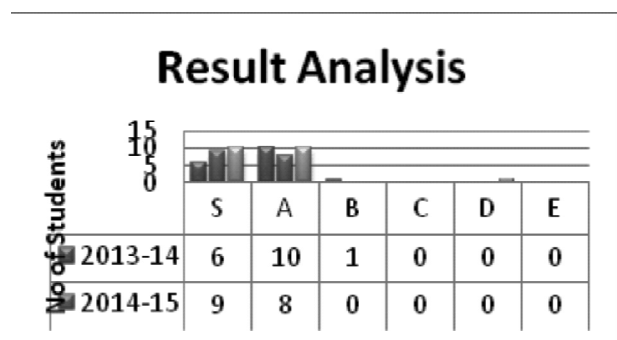

Fig. 8: Result Analysis of OOAD Course

Table 3 Pedagogical Activities

Activity	Outcomes
Design activity	• Designed models using UML constructs. • Designed modules using Rational ROSE tool • Enhanced their design skills
Implementation Activity	• Enhanced programming skills. • Communication and presentation skills improved.

Among 15 projects 3 of the projects are deployed in the customer site, which are Hospital management, Vehicle booking system and Hotel management system.

6. Conclusions

Authors have designed the OOAD lab course for post graduate students to enhance the design and development skills. Pedagogical Activities conducted in this course are focused mainly on utilization of object oriented analysis and design concepts while developing applications. Two activities are planned in this lab course; first activity of the course focused on designing the models for the given application. Second activity concentrated on development of the application. Students have designed the models using UML constructs and ROSE tool. In design phase OOAD concepts are used by the students. Class model, state model and interaction models are built in first part of lab activity. Development of the application is done in Java and My SQL. Author's innovative approach motivated the students to apply the design and modeling concepts of OOAD. These design activities enhanced the design skills in students. Students have developed better quality design solutions. Analytical, logical thinking, programming skills, communication and presentation skills are improved in the students.

The proposed project based activity can be utilized in further cources like mini, minor and capstone projects. This pedagogical activity can be enhaced to other disciplinary students.

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