Web Based Timetable Management System for University of Vocational Technology (UNIVOTEC)

A dissertation submitted for the Degree of Master of Information Technology

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DECLARATION

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.
To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this thesis is based on the work of Mr. R.D. P. Indika Priyadarshana under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:
Supervisor Name: Prof. G.K.A. Dias

Signature: Date: 28.11.2021

ABSTRACT

The University of Vocational Technology (UNIVOTEC) was formed by Parliamentary Act No. 31 of 2008 and is overseen by the Ministry of Higher Education, Technology, and Innovation. Skilled technicians ensure that the industrial world's daily technological activities are carried out precisely and efficiently. A hands-on approach to technical education that provides students with the necessary tools to excel in their careers after graduation.

Mostly, in Sri Lanka, the system of managing a university timetable is done manually. This is a cumbersome task, especially with more constraints in concern. Firstly, the generation of the timetable is largely time consuming. Secondly, the management (updates) and management reporting is overwhelming. Thirdly, it is prone to many unexpected “timetable clashes” and inconsistencies.

The scope of this project is to provide a Web Based Timetable Management System for University of Vocational Technology that can automating the complete timetabling process with management Information system reporting.

This timetable management system focuses on User login, course details, programme details, lectures details, staff details, student details, time slot details, lecture room details, labs details, class details, batch details, semester details, course details, department details, time table allocation and generation process, view time table for selected semester, selected date range, selected course selected program.

The system analysis and design followed a fully object-oriented development approach along with some agile/extreme programming best practices. The Implementation architecture falls into the popular three-layered architecture. It adheres to factory pattern identified in the design stage as the core of its implementation. Currently, the system is at the design/development iterations.

This system has been developed in Microsoft® Windows environment using Apache, PHP and MySQL three open source technologies that are often combined to develop web applications.

This time table management system is fully functioned with the functional requirements and the stakeholders are satisfied with the benefits of the system.

ACKNOWLEDGEMENT

First and foremost, I owe my deep admiration to the Director and all the academic staff of University of Colombo School of Computing, for facilitating me to follow the MIT program, which greatly covers the present-day Information Technology. I also thank them for their follow-up giving all the resources of latest technology in the field.

I wish to express my sincere appreciation and deeper thanks to my project supervisor Prof.G.K.A.Dias, without whom this project would simply have never been completed successfully. His expertise on Internet Application Development, Systems and Network Administration and shortly the entire Information Technology industry made the whole task possible without that much of difficulty.

I also offer my gratefulness to the authors of the main and web reference materials which I have referred throughout and all the individuals who answered my questions that were put on the on-line forums and orally. Finally, I am grateful to Microsoft Corporation for Windows® for their very user-friendly Operating System, and the online documentation of Apache, MySQL and PHP the Open Source giants.

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ACID - Atomicity, Consistency, Isolation, Durability

CGI - Common Gateway Interface

GB – Giga Byte

GHz – Giga Hertz

IDE- Integrated Development Environment

ICT – Information and Communication Technology

MVC – Model View Controller

OOSAD – Object Oriented System Analysis and Design

PHP – PHP Hypertext Preprocessor

RAD – Rapid Application Development

RFID - Radio-Frequency Identification

TSU - Technical Services Unit

UNIVOTEC – University of Vocational Technology

UVTTTMS – University of Vocational Technology Timetable Management System

WAMP – Windows, Apache, MySQL, PHP

WWW – World Wide Web

CHAPTER 1 – INTRODUCTION

Improving the quality and efficiency of instruction in the face of tight and often declining budgets is one of the growing concerns for educational institutions. In addition to pushing for more accountability in terms of learning, today's student may anticipate that more technology will be available to them in their classes. Many institutions have acquired and implemented timetable management systems to improve the institute's effective use of resources in the interest of improving technology use in courses.

1.1 Project Overview

Mostly, in Sri Lanka, the system of managing a university timetable is done manually. This is a cumbersome task, especially with more constraints in concern. Firstly, the generation of the timetable is largely time-consuming. Secondly, the management (updates) and management reporting is overwhelming. Thirdly, it is prone to many unexpected "timetable clashes" and inconsistencies.

"Web-Based Timetable Management System developed for the technical services department of University of Vocational Technology. It is a semi-government technical training institute that comes directly under the Ministry of Youth affairs. It consists of five main departments providing various training programs from certificate to undergraduate level. The institution provides training for more than 1000 students per year" (UNIVOTEC, 2017).

Proposed web-based system will be accessed by all level of staff in Technical Services Unit (TSU) and mainly course coordinators lecturers demonstrators and staff directly involve for the resource allocation process of the university. Univotec Timetable Management System (UVTTMS) allows creating timetable considering following constrains.

1. Course MIT offers maximum 20 credits in semester three within 18 weeks of studies, including one-week mid-semester week and two weeks study leave for end semester examinations.
2. Professor ABC can teach maximum 3 credits per delivery

3. Lecture room R015 is not available on Tuesdays during September-December delivery, every year.
4. A laboratory practical session conducted in L003 shall not exceed one hour. However, it will be available 24X7 from October 2020, if the senate approves the proposal.
5. Number of students enroll for particular module that is deliver in lecturer room or lab shall not exceed its capacity.

This system has been developed in Microsoft® Windows 10 environment using Apache, PHP and MySQL three open source technologies that are often combined to develop web applications. Combination of these technologies ensures a development of error free web-based system which will full fill customer requirement on given time-line.

1.2 Motivation

University of Vocational Technology (UNIVOTEC) wants to automate its Timetable operations. There are plenty of commercial timetable management software packages available. However, these timetable management software packages do not fully fit the client requirement, also those software are not flexible for customize configuration. The client is dissatisfied with these packages for these reasons, and they are also highly pricey. Only a small number of businesses can afford such bundles. This was the thought that led the clients to investigate further and determine that it would be better to build small customizable, cost-effective Timetable Management web applications for the use of UNIVOTEC, which would cater to many of the institute's Timetable and Resource allocation related operations.

The desire to work on a challenging project in a fascinating field was the driving force behind this endeavor. The opportunity to learn about a new aspect of timetable management that was not discussed in lectures was appealing, and it allowed me to apply some of the techniques taught during the course, such as programming, software engineering, and project management, into practice. Also, to replace the client's current manual file-based ad hoc method with a automated web system.

Moreover, UNIVOTEC has already planned to extend its timetable and resource management process to a more efficient and productive system. Therefore, a web-based timetable management system that overcomes the above problems and supports the future changes is much needed.

1.3 Objectives of the System

At the end of the project, the System shall be able to.

a) generate the time table based on the constraints entered by the Technical Coordinator
b) generate summary reports for decision making (for example, workload of a specific lecturer, facility utilization, conformity checking against meeting stipulated quality requirements/ standards)

At the end of the project, the Technical Coordinator shall be able to.

c) enter basic (and mandatory) data/ requirements about courses/ programmes, lecturers/ staff, modules, time-slots, lecture rooms (and labs), class/ batch details, semester/ cohort details
d) specify mandatory constraints within the system using a user-friendly interface
e) communicate with other staff members (course coordinators) to receive mandatory details and constraint specifications
f) Assign Substitutions
g) Assign multiple teachers for practical sessions.

At the end of the project, the Management shall be able to.

h) view time table for selected semester, selected date range (day, week, month)
i) view time table by course/ program, by module, by time slot, by staff member, by lecture room, by class/ batch

j) communicate with Course Coordinator to send and receive mandatory details and constraint specifications

k) view/ query summary reports for decision making (for example, workload of a specific lecturer, facility utilization, conformity checking against meeting stipulated quality requirements/ standards)

l) Dashboard for easy view of daily information.

At the end of the project, the Lecturer shall be able to.

m) view time table for selected semester, selected date range (day, week, month)

n) view time table by course/ program (he/ she is assigned), by module (he/ she teaches), by time slot, by lecture room, by class/ batch

o) communicate with Course Coordinator to send and receive mandatory details and constraint specifications

At the end of the project, the Student shall be able to.

p) view time table for selected semester, selected date range (day, week, month)

q) view time table by module, by time slot, by lecturer, by lecture room

1.4 Scope of the Project

The following are the functionalities of the system

a) Provides an effective and efficient constraint management (add, update, delete) Lecturer, resource, module, time slot, class (batch) management (add, update, delete)

b) Provides Management Information System reporting on demand. (by date, time slot, lecturer/ resource person/ resource, module, and etc.)

c) Produces a fully functional timetable generator engine/ algorithm that can automatically cater to each constraint.

1.5 Feasibility Study of Timetable Management System

1.5.1 Feasibility Study

Before starting any project, it is always a good idea to conduct a feasibility study on the intended system. This is done to ensure that the net benefits are justifiable in comparison to overall costs and technical possibilities. As a result, a feasibility study was conducted to determine whether the intended system is feasible.

1.5.2 Technical Feasibility

The proposed Timetable Management System will be completely web-based and will require the use of available web technologies. UNIVOTEC makes a decision to use PHP as the primary development language, with MySQL serving as the system's database management system. PHP and MySQL are both available for free use as open-source software licenses that do not require registration or purchase. The Apache web server is a free and reliable web server technology that will be used as a web server in the proposed system.

All the above web technologies (PHP, MySQL, Apache) are mature enough for enterprise-level software development as all of them are appearing in the software development industry for more than a decade and most of the developers having a good understanding of the technology.

1.5.3 Operational Feasibility

Main stockholders of the system will be academic staff, executive staff, other officer-level staff and undergraduate students. Therefore, no need to provide deep training and every one of the above categories knows how a web-based system to operates.

UNIVOTEC already having dedicated staff to provide technical support as required. They have a very good understanding of web-based software since some other web-based system currently in operation available in the university.

The available modern LAN system has been developed with web-based system operation in mind. Therefore, it is providing all required service such as security, availability, maintainability, robustness and backup for the system, and it will be the advantage of the system.

1.5.4 Economic Feasibility

The system gives added benefits, such as virtual administration and etc. at the successful implementation. Moreover, the system is built using highly reliable and freely available software products (General Public License) such as PHP, MySQL and Apache. The use of available IT infrastructure (hardware, network, etc.) and the ability to virtually work from home would be an added advantage as a means of teleworking in the future. Taking things together, the intended system would contribute to enhancing the quality of the organization in a much cost-effective manner.

1.6 Outline of the Remaining Chapters

The structure of the rest of the report is briefly described below.

Chapter 2, Describes the problem domain and discusses the shortcomings of the current timetable management system as well as some alternative approaches to solving the problem. Furthermore, it will address the advantages and disadvantages of those approaches, as well as describe Technology adapted in UVTTMS Provide, and how these technologies and techniques are used in my research. A review of the literature on other approaches that refer to problems.

Chapter 3, System Design proposes and evaluates alternate solutions and selects Object Oriented System Development (OOSD) in combination with Agile/Extreme programming best practices as the design/development methodology. Further it justifies the use of Model-View-Controller (MVC) architecture and the Factory Design Pattern. Also, its discuses and shows the application of user interface design strategies with important diagrams and sample screenshots.

Chapter 4, the Implementation section, discusses in detail about the implementation environment and the selected architecture, which is, in this literature, the popular three-layered architecture. It adheres to the MVC architecture and Factory Pattern identified in design as the core of its implementation.

Chapter 5 is about testing and evaluation. It demonstrates the test plan along with selected test data and the relevant results. Also, it carries the evidence of user evaluation.

Chapter 6, the last chapter concludes the project. It critically evaluates the final result of the project and leaves some thoughts for further work. Further, it summarizes of what was achieved. A list of references and the appendices (Design, System and User Documentation, Management Reports, Code listings, Client certificate, Glossary and index) end up the report.

CHAPTER 2 – BACKGROUND

2.1 Introduction

The background chapter will provide detailed knowledge to the reader to understand the rest of the document. By giving a brief overview of the client's current situation, the type of system needed, and the concerned areas and technologies used.

2.2 Requirement Analysis

“Requirement analysis is defined as the process of determining user expectations for a new or modified product. This involves frequent communication with system users to determine specific expectations, resolution of ambiguity in requirements and documentation of all aspects of the project development process from start to finish” (TechTarget, 2007).

2.2.1 Gathering Requirements

The success of any system heavily depends on the proper identification of its major requirements and also detailing them as appropriate to avoid the ambiguity of the functionality of the expected system. This could be achieved by using an appropriate set of requirements gathering techniques such as observation of the existing system, interviewing different stakeholders, carefully designed questionnaires, and implementing stage-wise small prototype versions. Therefore, almost all of the mentioned techniques were used to gather the requirements of the system.

As observed, the System has five major departments that are manned by only three employees, including the management. The stakeholders of the proposed system would comprise of;

a) Faculty Dean – who the head of a faculty who is responsible for the management and the academic integrity of the faculty

b) Course Coordinator- who is responsible for liaising with student issues (student enrolment, course maintenance, lecturer allocation and etc.)

c) Technical Services Coordinator - who is responsible for all resources allocation and timetabling with coordinating with staff.

d) Administrator-who is responsible for the overall setting up (such as user accounts, faculties, courses, etc.) and maintenance of the system

e) Lecturer-who is assigned to one or more subjects that are offered in courses

Flow of Current system

Figure 2.1 shows process of UNIVOTEC current system

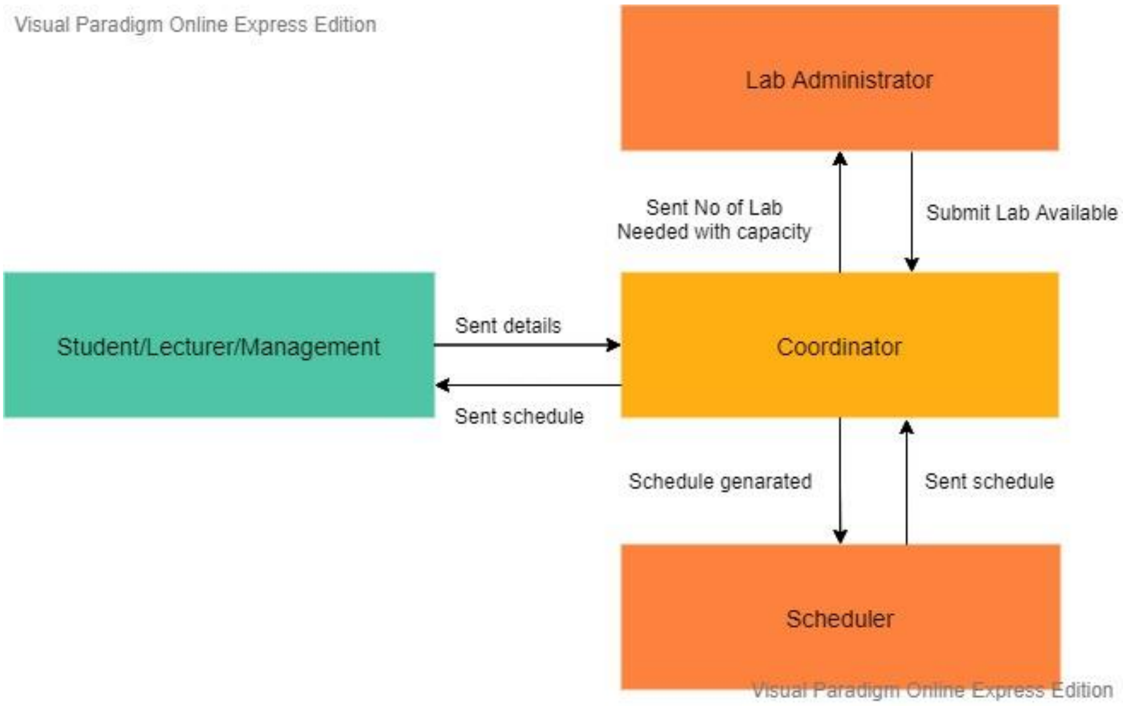

Visual Paradigm Online Express Edition
Lab Administrator
Sent No of Lab Needed with capacity
Submit Lab Available
Student/Lecturer/Management
Sent details
Sent schedule
Coordinator
Schedule genarated
Sent schedule
Scheduler
Visual Paradigm Online Express Edition

Figure 2. 1 Flow of current system

2.2.2 Requirement Analysis - Project Goals

Modules of the System

The module is a different segment of the system that processes a specific task. This facilitates system development and makes it more user-friendly.

As per requirements, the system mainly contains seven modules. Such as Login modules, Registration module, Lecture module, Course module, Subject module, Year plan module, Resources module, timetable generating module and Report module.

Login Module:

This will assist the user in logging into the system with their username and password. Only a user with a valid username and password can access their accounts.

It will facilitate in the authentication of the user who logs into the system. This prevents any anonymous user from entering the system and mishandling the records. It is superior to the manual method because it has no security measures governing who can and cannot access the system.

Timetable generating Module

This is the module generating timetable according to the resources available and with fulfill of institutes constrains. In this module, the user can generate a timetable with few options. University uses maximum resources in weekend, and it is essential to generate timetable with full optimization in weekend courses. Other hand, weekday programms currently have enough resources with a minimum number of weekday degree programms.

Therefore, UVTTMS has a facility to generate the same timetable with a defined set of constraints and export better one as user’s satisfaction.

Subject module:

This module allows the admin to enter a new subject to the system. After submitting the subject each subject is given a “Subject ID Name” which is used to search the subject in the search box.

Lecture module:

This module allowed to add a new lecture to the system. The admin need to fill the details of the lecture. Each lecture is given a “Lecture ID Name” when its stored in the database. This Id name can be used by the admin to search lectures stored by entering the Id name in the search box.

Course module:

The administrator can create a new course, which is saved in the system's database. In order to accomplish this, this admin should enter the course name, the respective department of the course, maximum number of the student in the course and the section. After submitting the course, it is given an auto increment number (course code). This number is used to store the course in the database.

Resource module:

This module which given the details (Classroom Name, Location, Student Capacity and method) of each class room and labs. If a classroom is not added the admin can reenter the “Add resources Page” by clicking the “Add Classroom” button.

Report module:

Report module is used to get the details of time table. This module contains two parts. Such as,

- Semester time table report
- Year plan report

2.2.3 Functional Requirements

These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected. They are basically the requirements stated by the user which one can see directly in the final product, unlike the non-functional requirements (Sandeep Jain, n.d.).

The following major components and their functions were recognized as the main business processes of the intended system.

- System Home page
  - System home page display only User Login form and help option.
  - System identifies correct user group type and direct to appropriate pages with given user privileges.
- User Login
  - System has three user login categories such as Admin, Lecturer and Student.
  - All Students of the UNIVOTEC have a user login.
  - Login user name will be same as student registration number.
  - Default password will be e-mail address and students able to change their password whenever their need.
  - If „Incorrect User name or Password‟ message appears, then user need contact TSU Admin to reset password.
  - There is an accurate validate for user name and password.
  - Successful user login will show a welcome message and direct to employee home page based on their user category.
- Students home page
  - View the entire menu which students accessible for the category, other menu options should be disabled or not view.
  - Students Home page display timetable related to the student with resources allocated with lecturer notifications.

    - Student can change password view and print timetable and make a request through the system.

- Admin home page
    - This menu provides the all administration task.
    - Register all users to the system
    - Adding, editing, deleting entries in the master timetable.
    - Handle bulk printing from the system.
    - Admin can grant privileges to the other users as necessary.

2.2.4 Non-Functional Requirements

"Non-functional requirements may be more critical than the functional requirements. If these are not met, the system is useless" (Sommerville, 2004).

- Shall be platform-independent, i.e. shall run on any platform (Windows, Linux, Mac, etc.)
- Shall maintain high security and highly reliable
- It must be compatible with any other system
- Except for the authorized user/user group, no personal information about external stakeholders (students/affiliated bodies) shall be disclosed to system operators or other users
- The system shall respond quickly (0.2 seconds or below) to user actions
- Searching and sorting larger databases shall be comparatively less time consuming
- Shall provide a Graphical User Interface (GUI) for all end-users of the system
- The system shall be easy to learn (how to work with) and be able to learn by example
- Shall maintain a help facility for "how to use"
- Shall be able to back up the entire system into a different driver/location
- The application server should run on Apache® web server and the backend on MySQL® database server

2.2.5 User Requirements

The only end-user requirement is to have basic literacy of computer use, especially the techniques used in browsing the web.

2.2.6 System Requirements

The system architecture is such that it conforms to 3-Tier Architecture having;

a) a Backend in the bottom layer to store all data used in the system,

b) an Application Server (Web Server) in the middle layer to process requests from and result back to the user

c) a front end (any standard web browser) provides an interface to the end-user to deal with the system.

2.2.7 The Backend (Database Server)

The database server is preferably a 2 CPU cores (recommended), 32GB or higher RAM, 1TB or higher storage space depending on the institution’s data storage requirements. The backend is implemented with MySQL® 5.0 database management system.

2.2.8 The Application Server (Web Server)

It is observed that the performance of the webserver is one of the most vital factors pertaining to the speed of the system. Therefore, 2 CPU cores (recommended), 32GB or higher RAM, 1TB or higher storage or more free Hard disk capacity, and access to Information Superhighway at a rate of 1 Mbps is recommended. It may run on Microsoft® Windows platform and Apache® 2.4 as the webserver software. PHP Hypertext Preprocessor (PHP) 7.1 is used as the scripting language.

2.2.9 Client

All that is needed by the client side is a computer that can run any standard web browser (preferably Google® Chrome) and access to Information Superhighway at a minimum rate of 1Mbps. Nevertheless, the more the performances of the computer and the network bandwidth, the faster the system processes as it would be.

2.3 Existing Similar Systems

A significant amount of effort and time was expended in finding other similar systems and approaches in order to study their benefits and drawbacks in order to implement the system in an effective and efficient manner.

TMS (Timetable Management System) provides a centralized, accurate view of all timetable and resource allocation activities. Technical Services department, as well as increasing department efficiency through standardization of timetable and resource allocation processes. The Technical Services department is critical to the smooth running of the organization because it tracks and analyzes the time keeping and work patterns of academic activities. There are numerous applications available to assist the Timetable and Resource Allocation Department with their tasks, allowing for the automation of certain tasks and assisting in the organization of many other tasks.

2.3.1 BULLET Education Suit-Automatic Timetabling Software

Bullet Education Suite timetable software offers higher education institutions a suite of software solutions designed to simplify the timetabling process. It comes with seven modules, as indicated below.

- BULLET Timetable Education

  An automatic timetabling software capable of generating highly optimized timetables based on the interests of educational institutions. It enables you to make the most of your resources while also ensuring the satisfaction of your students and academic staff.
- BULLET Calendar

  A powerful space management solution with a decision support system designed to assist your Institution's daily operations, ensuring that you will not make any more management mistakes.
- BULLET Info board

  A one-of-a-kind university digital signage solution that will allow you to easily communicate with your academic community.
- BULLET Business Intelligence

  Get real-time data on your institution's current overall performance. It enables massive resource optimization and significant cost savings.
- BULLET Interactive

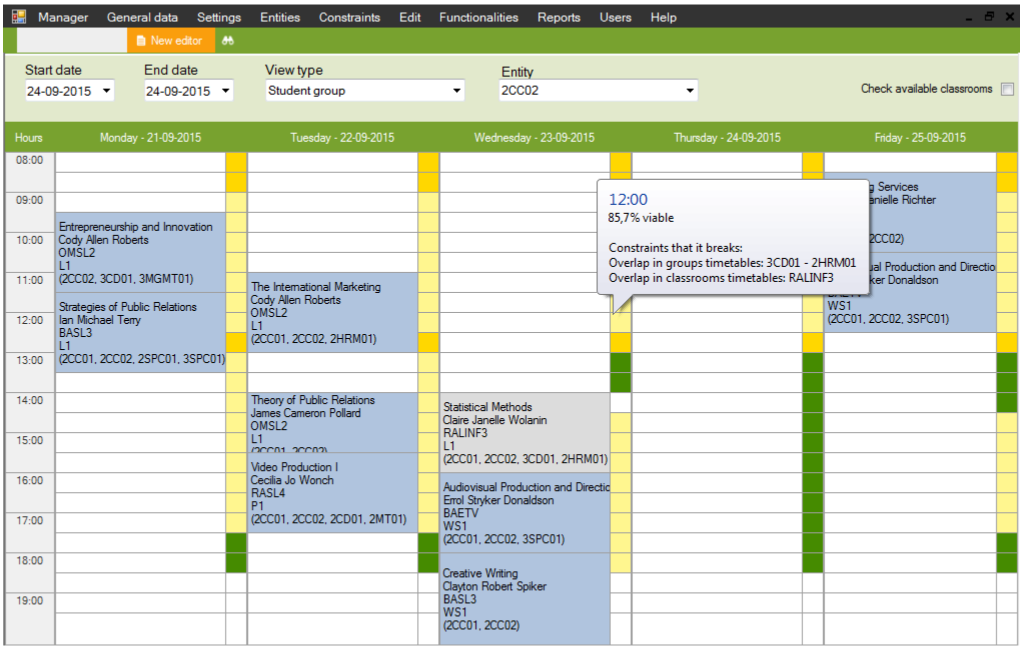
  An interactive web academic portal designed to provide academic staff and students with access to all of the information and materials they require for their daily activities.
- BULLET Exam Planer

  With an automatic exam scheduling tool, you can easily accommodate all academic staff and students to their related activities, ensuring a perfect balance between students, supervisors, and classroom distribution.

- Classroom Allocator

  An automatic classroom management solution designed to assist your institution in making the most of available classrooms in a cost-effective manner, ensuring maximum classroom utilization (Bullet Education , n.d.).

Figure 2.2 shows timetable created by BULLET Education Suit-Automatic Timetabling Software.



Start date 24-09-2015

End date 24-09-2015

View type Student group

Entity 2CC02

Check available classrooms □

Hours	Monday - 21-09-2015	Tuesday - 22-09-2015	Wednesday - 23-09-2015	Thursday - 24-09-2015	Friday - 25-09-2015
08:00					
09:00					g Services anielle Richter 2CC02)
10:00	Entrepreneurship and Innovation Cody Allen Roberts OMSL2 L1 (2CC02, 3CD01, 3MGMT01)				
11:00	Strategies of Public Relations Ian Michael Terry BASL3 L1 (2CC01, 2CC02, 2SPC01, 3SPC01)	The International Marketing Cody Allen Roberts OMSL2 L1 (2CC01, 2CC02, 2HRM01)			ual Production and Directio ker Donaldson WS1 (2CC01, 2CC02, 3SPC01)
12:00					
13:00					
14:00		Theory of Public Relations James Cameron Pollard OMSL2 L1 (2CC01, 2CC02)	Statistical Methods Claire Janelle Wolanin RALINF3 L1 (2CC01, 2CC02, 3CD01, 2HRM01)		
15:00		Video Production I Cecilia Jo Wonch RASL4 P1 (2CC01, 2CC02, 2CD01, 2MT01)	Audiovisual Production and Directic Errol Stryker Donaldson BAETV WS1 (2CC01, 2CC02, 3SPC01)		
16:00					
17:00					
18:00			Creative Writing Clayton Robert Spiker BASL3 WS1 (2CC01, 2CC02)		
19:00					

12:00
85,7% viable

Constraints that it breaks:
Overlap in groups timetables: 3CD01 - 2HRM01
Overlap in classrooms timetables: RALINF3

Figure 2. 2 Timetable Created with BULLET Education Suit

Furthermore, the Bullet timetable solution includes numerous useful features such as fully automatic timetable generation, assisted manual adjustments, error-free timetabling, comprehensive incoherency reports, multiple optimization methods, simple online timetable publication, and full data import and export.

2.3.2 UNITIME- Timetable System

“UniTime is a comprehensive educational scheduling system that allows for the creation of course and exam timetables, the management of changes to these timetables, the sharing of rooms with other events, and the task of students to individual classes. It is a distributed system that enables multiple universities and departmental schedule managers to collaborate on developing and modifying a schedule that meets their diverse organizational needs while minimizing student course conflicts. It can be used on its own to create and maintain a school's class and/or exam schedule, or it can be integrated with an existing student information system” (UniTime, n.d.).

The UniTime timetabling system comes with four main modules. It is

- Course Scheduling and Management
- Scheduling of Examinations
- Event Management
- Scheduling for Students

Course Scheduling

The primary goal of course scheduling is to place each course at a time (or set of times) that does not conflict with the time(s) assigned to any other required course by the students enrolled in it. This is relatively simple if only a few courses are taken in tandem with the course of interest. It becomes significantly more difficult as the number of courses requiring different time placements grows. The availability of faculty, rooms, and a variety of other constraints complicates matters even further.

Actual student course demands, an established set of curricula, historical patterns, or a combination of these data can be used to minimize student course conflicts. To arrive to a solution, student conflicts are weighed against faculty time and room preferences, as well as other desired interactions between classes.

UniTime incorporates the most recent research on solution algorithms designed to solve complex timetabling problems efficiently. It also has a fairly detailed course structure model that makes it simple to specify the links between course components with various styles of instruction (e.g., lecture, discussion, laboratory) and varying meeting time needs. Furthermore, UniTime offers centralized, distributed, and hybrid approaches to creating a class schedule based on your needs. The course scheduling module can also be used to test different scenarios, such as the impact of fewer classrooms or changes in course requirements.

Course Management

"Even the best timetable may necessitate changes due to changing needs or resource availability. A change in a room or time assignment will be necessitated by an increase in demand for a course, the departure of a faculty member, or the loss of a classroom. UniTime enables users to easily search for alternatives that have the least impact on the overall timetable, change the class schedule, and communicate these changes to affected students and other systems.

After the timetable is published, class adjustments are made using an interactive solver that generates a small selection of alternative time and/or room assignments for classes that will allow the proposed change to happen. Initially, the solver looks for alternative assignment adjustments that best meet all of the class requirements and preferences while not altering the assignment of more than two extra classes. The user can then choose the set of changes that best suits his or her needs from the options presented. Each choice includes details on any more student disagreements that may have arisen, as well as any other preferences that may have been violated. If a solution that affects only two other classes isn't possible, the search can be tweaked to accommodate more changes. Changes can be limited to allowing only room swaps, only time swaps, or both room and time swaps" (UniTime, n.d.).

Scheduling of Examinations

Each term, UniTime creates a comprehensive exam schedule that minimizes the amount of conflicting exam placements for all students. It can also reduce the amount of back-to-back tests or students who have more than a certain number of exams in a day. This is especially beneficial for schools and institutions with often changing class offerings or a large number of multi-section courses that do not fit well into mapped exam timetables.

UniTime can be used to generate schedules for both midterm and final exams.

Scheduling for Students

“The student scheduling procedure is matching each student's set of needed classes to available class seats in order to meet all (or as many as possible) of the student's educational requirements. Individual student class time preferences may also exacerbate the situation. The most direct way to ensure that every student is able to attend all of their required courses is to create a class schedule after collecting all student course requirements. UniTime can be used to create a demand-based schedule and maximize the number of students who take the required courses. However, because this is not always possible, it is preferable to accommodate as many students' demands as possible with an existing schedule.

The major challenge of scheduling individual students to a pre-existing timetable in real time is ensuring that the decisions made by the initial students in the process do not unduly prevent later students from attending all of their necessary courses. When numerous portions of a course are given at various times, this becomes a problem. If all courses are offered at the same time and students are unable to attend the courses they require, a more flexible course schedule is required” (UniTime, n.d.).

Figure 2.3 shows timetable created by UniTime Timetable Management System.

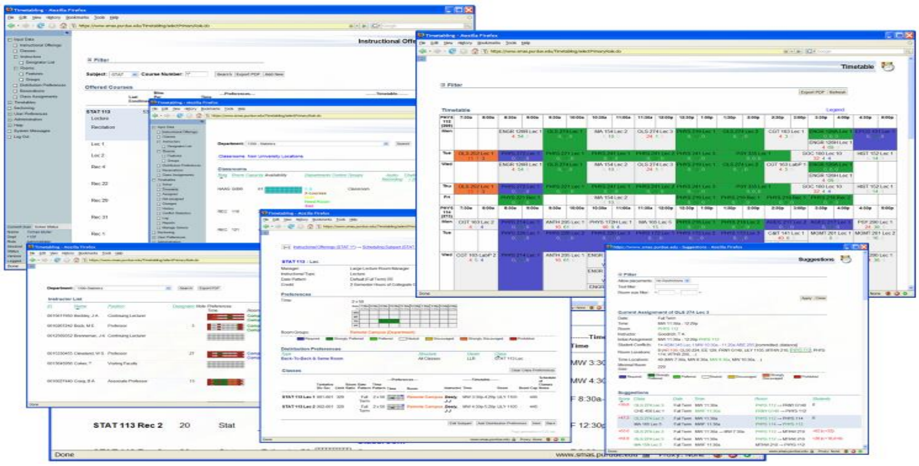


Figure 2. 3 Timetable created with UniTime Timetable Management System

2.3.3 EduSys Auto Timetable System

“The EduSys Web & Cloud-based System offers powerful Classroom Timetable Scheduling Software with full class, course, and exam scheduling capabilities for school, college, and university administrators and instructors to design, administer, and alter classroom timetables and curricula. The online timetabler software eliminates paper dependency by providing secure, automated, and digitized solutions for coordinating examination schedules, managing exam rooms/centers/venue, archiving important events and dates, allocating students to courses, planning class timings for teachers and students, and much more” (Anon., 2017).

Edusys system contains the following main modules with a set of valuable features.

Auto Timetable Schedule

The Auto timetable schedule function automates the scheduling of classes, exams, and courses for students, teachers, and various classrooms by considering all potential "What-if" scenarios and results. Furthermore, the timetabler software includes user-centric and easy-to-use tools that allow educators to view, organize, and generate timetables for each teacher/class/grade, tailor timetables, create and pin to-do lists, schedule substitute replacements for absent staff, manage and organize events on the calendar, and much more on a smartphone, tablet, and computer.

Advance Allocation Tool

The Timetable Software includes sophisticated digital allocation methods for assigning students to courses and classes, assigning instructors to classrooms, and distributing replacement professors online. Furthermore, the system allows administrators to assign and change timetables for specific teachers and pupils, alleviating the burden of manually preparing class schedules and distributing them to each person.

Attendance Management

The Timetable Software works in tandem with all RFID and biometric attendance control systems. The software allows educational institutions such as schools, colleges, and universities to track and record student and instructor attendance, send SMS/Email messages to parents/guardians alerting them of their children's attendance, monitor staff and faculty activities and whereabouts, and much more.

Print & Share

With a single click, you can print and share, personalized, and individual timetable schedules in bulk with colleagues, students, and parents. By utilizing a mobile app on any smart device or the Web version on any computer, you may review and export the reports and schedules to PDF, Word, and many other formats online.

Summary of Similar Systems

In order to execute the system in an effective and efficient manner, a significant amount of work and time was spent in finding other comparable systems and methods and studying their positive and negative elements, as mentioned above. The following are the features of the available system. Some aspects of the existing systems have been enhanced, while others are important to the proposed system.

Summary of existing similar system sown below in Table 2.1.

No	Bullet Education Suite	Comprehensive University Timetabling System	EduSys Auto Timetable Scheduling System	Proposed System
01	**Automatic Generation** Computer do the work for you	**Faculty Time-table** A faculty member can access their own classroom timetable once a timetable has been allocated to a specific class.	**Create timetable for each class and section**	**Automatic Generation** Produces time-table with full-featured algorithm
02	**Manual adjustments** After you've created a schedule, you may make any manual changes you want.	**Student Time - Table** A student can access their particular class timetable on their mobile application, which is produced by an institute on the system.	**Administrator to assign the staff and subject to a particular time slot.**	**No Manual adjustments** Manual adjustments do not facilitate as a requirement of UNIVOTEC
03	**Verifying the Schedule** The algorithm rapidly analyzes the timetable for any inconsistencies.	**Classroom View Time-Table** You may receive an overview of all the class periods for that particular day by using the Classroom view Time-Table.	**Administer the lunch break and other breaks as per your school rules.**	**Provides constraint management** **Lecturer, resource, module, time slot, class (batch) management**
04	**Simple data entry**	**Re-arrangement is possible from time to time.**	**Examinable time tables for many sorts of examinations may be managed in EduSys software.**	**Simple data entry**
05	**Buildings** BulleTimetables may optimize mobility between buildings and supports courses in numerous buildings.	**The ability to choose school working days.**	**Automatic Timetable Maker**	**Provides Management Information System reporting on demand**
06	**Fully customizable** You can use the program as is or modify its individual features to your desire.	**Avoid conflicts in timings for teachers.**		**No customizable**

Table 2. 1 Outline of Similar System

Furthermore, several of the preceding systems were referred to in order to create the web-based system. System UniTime was provided with much relevant information with almost all requirements for the university. Also, the system of the BULLET Education Suit-Automatic Timetabling Software and EduSys was offered some important information. These systems were analyzed and studied well to get better ideas to implement the online system. In addition, some standard application software (such as Microsoft Office Word, Microsoft Office Excel, etc.) was studied to get some ideas about the user interface designing.

2.4 Related Technologies

UVTTMS should be accessing all users, and therefore web application is much suitable for that. Users access system via a uniform environment. It is critical to select the appropriate hardware, software, and technology while developing a better web-based system. The technology chosen as the development tools for the UVTTMS is explained in more detail below.

Web Application

This is a web application. To create an application, a combination of server-side script and client-side script (PHP, HTML, JavaScript, CSS, and so on) is commonly used.

Database Access

This is a real database that can store, update, delete and retrieve data.
"UVTTMS store all the venues, lectures, subjects, students, and preferred timeslots details. UVTTMS always stores more than five years back data to analyze data. MySQL is used as my database. MySQL is the database of choice for the most demanding Web, E-commerce, SaaS, and Online Transaction Processing (OLTP) applications. It is a transaction-safe, ACID-compliant database that supports full commit, rollback, crash recovery, and row-level locking. MySQL provides the usability, scalability, and performance required by Facebook, Google, Twitter, Uber, and Booking.com" (MySQL, n.d.).

2.5 Related Design Strategies

“Given any project requirement, there are many alternative strategies that could be used in achieving the desired objectives/outcomes. However, the selection of a design strategy mainly depends on factors such as the complexity of the project/system, the budget of the system and the time constraints” (Bentley, 2007).

At the design phase of Timetable Management System, it was considered to evaluate the feasibility of alternate design strategies such as Stand-alone system, Mobile application, Commercial Application Package strategy and Web based system.

2.5.1 Standalone system

A stand-alone system is a software application that runs without the need for any other software beyond the operating system. The majority of standalone systems are platform dependent. As a result, establishing the specific operational environment may be prohibitively costly. Because each terminal must be maintained separately, the deployment, upgrading, and maintenance operations take time. Because isolated systems are limited to a single physical place, their applicability is limited. There will be no exchange of information.

2.5.2 Mobile Application

“As of 2019, 3.2 billion individuals globally possessed a smartphone, which means that one out of every three mobile users can run applications on their devices. Combine this with the ongoing astounding surge in app use — downloads climbed from just over 20 billion in 2016 to well over 30 billion in the first quarter of 2020 – and it's obvious that they're a popular way for people to connect with their mobile devices” (Mews, n.d.).

Frequently increasing usage of smart phones, efficiency, performance and capability of run application as well as speed of mobile networks increase day by day. Development of infrastructures of mobile device has create nice opportunity to develop mobile applications for the business.
The mobile App development having following advantages as well as disadvantages.

The Advantage

- Always visible on the user's screen. As a result, your mobile app has a high probability of being displayed at all times.
- More personalization and loyalty. The designers of an app can customize their customer's user experience.
- A great tool of analytics. The app analytics provide the most popular content as well as other useful information.
- Easy to interact with users. You can do so thru two types of messages existing in mobile apps - push and in-app notifications.
- The content is available offline. With an app, It is now possible to download material and subsequently enjoy it when flying or climbing in the mountains without access to Wi-Fi.
- More optimized that website. An app is designed to work with a range of phone models, screen resolutions, and software.
- Apps are more responsive than webpages. Apps may keep all data on the device, but mobile sites must connect to web servers.
- Using device features. For example, you can easily use a camera or a GPS .
- Providing extra revenue channels. For example, the freemium model provides basic software functions for free while charging for additional services. It also enables for the creation of several plans to meet the demands of different users.

The Disadvantage

- The high cost of app development
- The process of developing an app is complicated.
- Long-term investment is required to guarantee compliance.
- Technologies not mature enough
- Knowledge of technology not easily available
- Lack of clarity

2.5.3 The Commercial Application Package Implementation Strategy

These packages could be bought or obtained free (if it is Open Source) and customized according to the business requirements of the organization. These are also known as Commercial Off-the-Shelf Systems. Some advantages of these systems are.

- Because substantial programming is not required, new systems may be installed more rapidly.
- More suited for organization with less human resources for in-house system development
- Subject to continuous improvement as the vendor distributes the system for use of anyone interested (as in the case of Open source software)

Disadvantages

- The successes of these systems depend on the vendor reputation and stability in the industry.
- A purchased system may not cater the organizations requirement adequately. It may sometimes be more or less featured.

2.5.4 Alternate Solutions Evaluation

There are several alternative solutions available in software industry but required to select the correct tool for system based on the requirement gathered, functional and non-functional requirement. After successful completion of Feasibility study, Requirement Analysis and designing task will continue, and then need to find a solution to perform coding, Testing and Implementation tasks.

Before start coding need to decide whether to build windows based standalone application or web-based application using client server architecture. Since this a Timetable Management System all students of the university need access to the system. Based on the feasibility study done web-based application using client server architecture is selected because,

- High Availability - If all employees need access to the system there should be a high availability, web-based system provide high availability then windows application.

- Easy to maintain - During the software development life cycle maintain is the task which takes more time, in client server architecture maintains is very easy because configurations and implementations need to be done only in the server, not to do each and every client computer.
- Low cost - In client server only server need to be a high powerful computer, due to this it can be implemented with low cost.
- Portability - Web based system is very easy to access from anywhere via network.
- Centralization entails controlling access, resources, and data security through a server.
- Scalability entails the capacity to update any part as needed.
- Flexibility entails the ease with which new technologies may be implemented into the system.
- Interoperability means that all components (clients, network, and servers) cooperate with one another.

Once the Architecture is selected then need to select the programming language, IDE and database to be used to develop the system. Since this is one-year project with limited time constrain therefore need to think about the language which developer familiar and which support for Rapid development technology with client satisfaction. Based on the detail analysis done selected PHP as web technology with and selected MySQL as backend database.

2.5.5 Selected Solution Description and Justification

The system architecture for the proposed system is based on the popular 3-Tier Architecture used in most web-based systems. The User Interface Layer is used to provide the end-user a platform-independent interface to work with the system. It basically consists of the web browser and a firewall/proxy for enhanced security.

The business Layer is where the entire business logic is defined and implemented. System processes are done in this layer. User requests are captured and handled in a way that the requests are sent to the database server (sometimes via Web Services when different databases are used) and queried for the desired output. PHP Hypertext Preprocessor is used to manipulate this layer. This layer consists of a web/application server.

The backend or the Data Layer stores administrates and manages the data used in the entire system. Query requests from the business layer are processed here. The popular MySQL® database management system is used here. The following diagram helps identify the idea of the architecture of this system.

The concept is shown below in Figure 2.4.

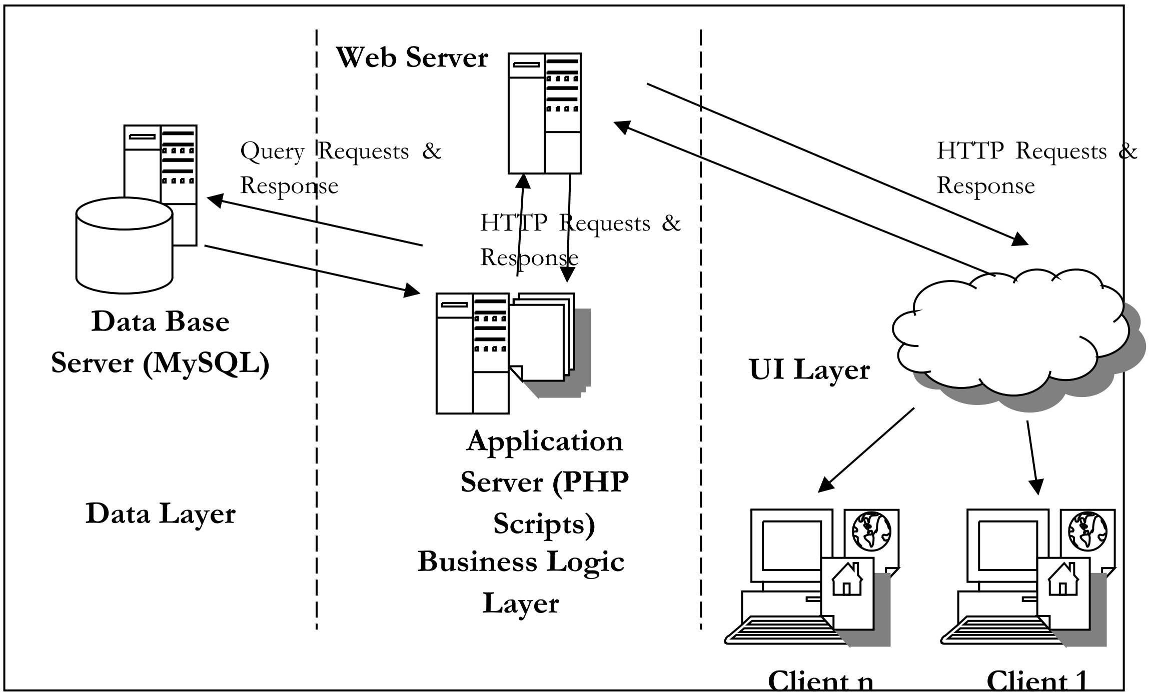


Figure 2. 4 The Three-Layered Architecture

CHAPTER 3 – DESIGN

3.1 Introduction

System design is "the process or art of defining the hardware and software architecture, components, modules, interfaces, and data for a computer system to satisfy specified requirements" (AllWords.com, 2018).System design is concerned with converting user needs into a form that can be implemented using a computer language.

The most essential and time-consuming aspect of a project is system design. In this phase, the information gathered before is used to complete the logical design of the information system. This includes designing user interfaces, databases, and outputs in collaboration with users to satisfy their information needs. The technical or implementation component of the system development project was the emphasis of information system design. The system analysis phase of a system development project is carried out independently. The requirements from the requirement analysis phase are transformed into technological solutions by the system designer. Software architecture, database design, and interface design are all factors in system design.

3.2 Alternate Solution Evaluation

"Given any project requirement, there are many alternative strategies that could be used in achieving the desired objectives/outcomes. However, the selection of a design strategy mainly depends on factors such as the complexity of the project/system, the budget of the system and the time constraints" (Bentley, 2007).

At the design phase of Timetable Management System, It was investigated to see if other solution techniques like Model-Driven Development, Rapid Application Development, and Commercial Application Packages were feasible.

3.2.1 The Model-Driven Development Strategy

This system development strategy stresses the creation of system models to aid in the visualization and analysis of problems, the definition of business requirements, and the design of information systems. The advantages of this strategy are;

- It is a more formal and structured design strategy.
- The requirements specification is more detailed and well-documented.
- Because diagrams are used to convey concepts, it is easier to validate business needs and system architectures.
- Alternative technological solutions are easier to discover, comprehend, and assess.
- System construction becomes easier and logical due to thorough (complete) analyze and design.

Disadvantages

- It takes time to collect information, create models, and evaluate them.
- Models could only be as good as the understanding of the users about the system

The full completion of one phase allows the developer to step into the other phase. Users must specify all requirements before design and the design must fully document technical specification before construction.

3.2.2 The Rapid Application Development (RAD) Strategy

This strategy supports fast development of the system thus saving time and money for the system developers.

- It is beneficial for projects with ambiguous and imprecise needs.
- It involves active user and management participation to increase the end-user enthusiasm for the project
- Errors and omissions are more likely to be identified in prototypes than in system models.
- It is iterative and incremental and supports fast development of the project

Disadvantages

- It is claimed that RAD promotes "a code implements and repair mentality" This raises the system's lifetime operating and maintenance expenses.
- RAD prototypes may dissuade system analysts from investigating more appropriate options.
- The emphasis on speed might have a negative influence on system quality.

3.2.3 The Commercial Application Package Implementation Strategy

These packages could be bought or obtained free (if it is Open Source) and customized according to the business requirements of the organization. These are also known as Commercial Off-the-Shelf Systems. Some advantages of these systems are;

- Because substantial programming is not required, new systems may be implemented more rapidly.
- More suited for organization with less human resources for in-house system development
- Subject to continuous improvement as the vendor distributes the system for use of anyone interested (as in the case of Open source software)

Disadvantages

- The successes of these systems depend on the vendor reputation and stability in the industry.
- A purchased system may not cater the organizations requirement adequately. It may sometimes be more or less featured.

3.3 Design Strategy Selection

As it was observed in the previous sections, every design strategy has its own advantages and disadvantages based on the use. Therefore, a selection of a mixed (hybrid) strategy has been used throughout the system. It uses the formality and structured nature of Model-Driven Design and the rapidness and simplicity of the RAD strategy.

The reasons are being that the system is undertaken as an undergraduate project and hence must be developed in a more formal manner allowing any future developments to be made if required. However, it still needs to involve the end user actively throughout the project life cycle. Moreover, the Object-Oriented System Development (OOSD) in combination with Agile/Extreme programming could also be used with RAD strategy. Another fact is that they support iterative and incremental development. As mentioned by (Scott W. Ambler, 2001), they help ease the design overhead by allowing the designer to model Just Barely Good Enough (JBGE) iterative versions of the software system.

“The use of Model-View-Controller (MVC) architecture and the Factory Design Pattern helps reduce code maintenance overheads. It eases up debugging and helps maintain the clarity of the code. Moreover, it enhances the code reusability and the independence between the model, view and the controller layers” (Ed Lecky-Thompson, 2004).

The design starts with Architectural Envisioning that depicts how different layers are collaboratively working together to make the system more secure, updatable and platform neutral. As the phase moves on, it further concentrates on logical and physical design of data and processes and user interface design.

3.4 Use case Diagram

“The Use case diagram is used to identify the primary elements and processes that form the system. The primary elements are termed as "actors" and the processes are called "use cases". The Use case diagram shows which actors interact with each use case. A use case diagram captures the functional aspects of a system. More specifically, it captures the business processes carried out in the system. Also Use case diagrams define the requirements of the system being modeled and hence are used to write test scripts for the modeled system” (Anon., 2003)**.**

3.4.1 Higher/Top level Use case Diagram (Role based)

Figure 3.1 shows high level use case diagram of Timetable Management System.

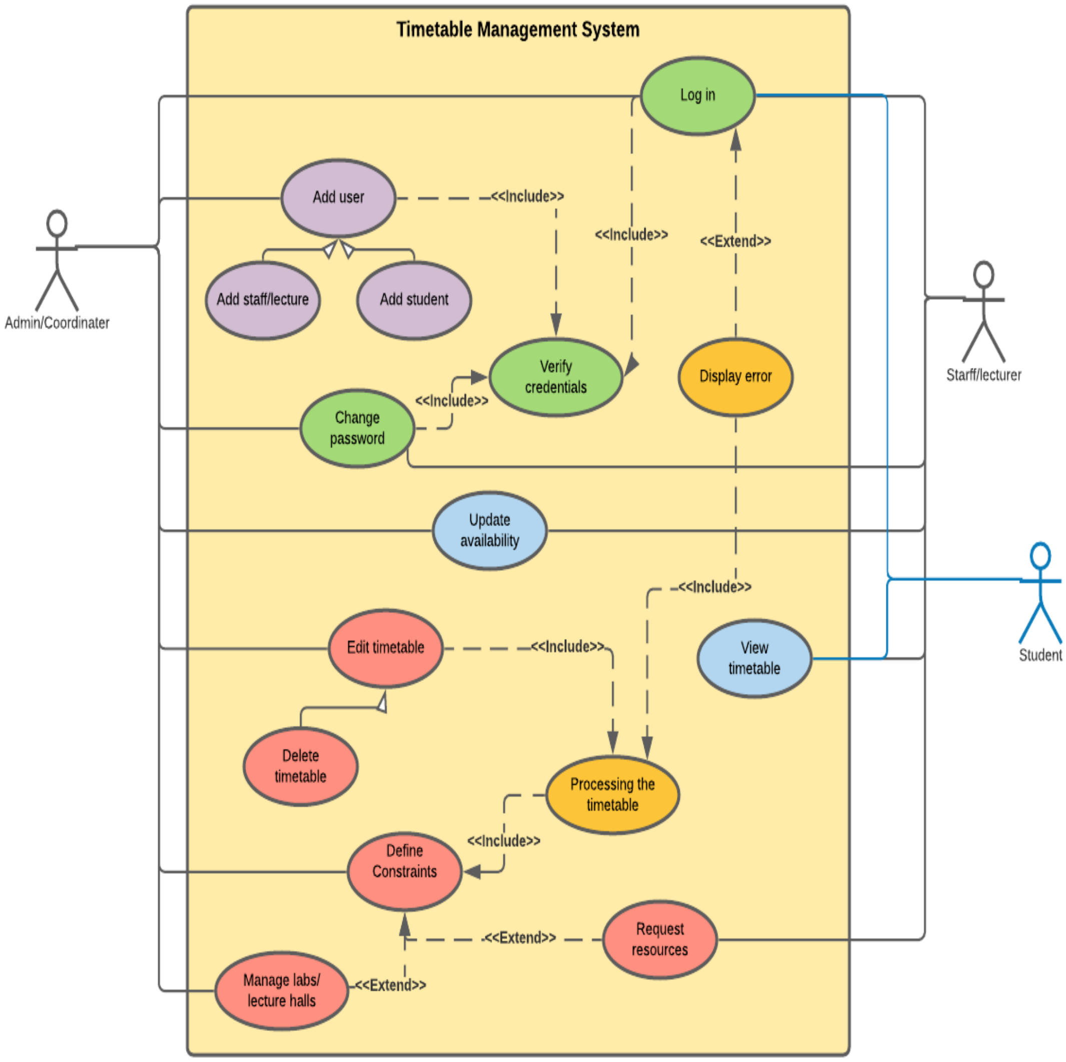


Figure 3. 1 Top level use case Diagram

3.4.2 Detailed Use case Narratives

Following Table 3.1 shows detailed Use case narratives for Login.

Name: Log into the system
Identifier: UC 001
Description: Login in of a registered user into her existing account
Goal: Successful logon to access the services offered to registered user by the system

Preconditions

1. The user is registered with the system.

Assumptions None

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user wants to log into her account to access service available
2. The user enters her "User Name" and "Password" into the system through the "UI002 Security Logon Screen."
3. The system checks to see if the user is already registered with the system.
4. Use case ends when the user is provided with “UI003 User Desktop Screen”

Alternate Course A: The user has provided an incorrect username or a password

Condition: N/A

A.6 The user is provided with a link to “UI002 Security Logon Screen” to try again

A.7 The use case proceeds to Step 2 of the Basic Course of Action.

Alternate Course B: The user has forgotten his password

Condition: N/A

B.1 The user is provided with a link to “UI003 Password Request Screen” to request a new password

B.2 The use case comes to an end.

Alternate Course C: The user does not have a registered account.

Condition: N/A

C.1 The user is provided with a link to “UI003 Register New User Screen” to get registered with the system

C.2 The use case ends

Post conditions

1. The user is successfully logged into his system account
2. The user is able to access the system services pertaining to his authentication level

Table 3. 1 Detailed Use Cases for Login

Following Table 3.2 shows detailed Use case narratives for Add subjects.

Name: Add Subjects

Identifier: UC 002

Description: User hits the site URL on the browser and enters to the home. She navigates specification tab and click on add subject's menu.

Goal: Successful add relevant subjects for create timetable.

Preconditions

The user is registered with the system.

Assumptions: All data must be entered for the academic year.

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user enters into home
2. User navigate specification tab and click on add subjects menu
3. Select subject from dropdown menu if subject already available.
4. If not click new subject and fill information and add new subject to the system.
5. Follow step 3 and 4 to add all subjects.
6. Use case ends when the user is add all subjects related to the process.

Post conditions

1. The user is getting the notification for after adding each subject.

Actors Registered users

Table 3. 2 Detailed Use Cases for Add Subjects

Following Table 3.3 shows detailed Use case narratives for Add class.

Name: Add Class

Identifier: UC 003

Description: User hits the site URL on the browser and enters to the home. She navigate specification tab and click on add Class menu.

Goal: Successful add relevant classes for create timetable.

Preconditions

The user is registered with the system.

Assumptions: All data must be entered for the academic year.

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user enters into home
2. User navigate specification tab and click on add class menu
3. Select class from dropdown menu if class already available.
4. If not click new class and fill information and add new class to the system.
5. Follow step 3 and 4 to add all classes.
6. Create groups if need with create group option.
6. Use case ends when the user is add all classes and made group as needed.

Post conditions

1. The user is getting the notification for after adding each subject.

Actors Registered users

Table 3. 3 Detailed Use Cases for Add Classes

Following Table 3.4 shows detailed Use case narratives for Add Classrooms and Labs.

Name: Add Classroom and Labs

Identifier: UC 004

Description: User hits the site URL on the browser and enters to the home. She navigate specification tab and click on add classroom menu.

Goal: Successful add relevant classes for create timetable.

Preconditions

The user is registered with the system.

Assumptions: All data must be entered for the academic year.

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user enters into home
2. User navigate specification tab and click on add classroom menu
3. Select classroom from dropdown menu if subject already available.
4. If not click new classroom and fill information and add new classroom to the system.
5. Follow step 3 and 4 to add all classroom.
6. Use case ends when the user is add all classrooms related to the process.

Post conditions

1. The user is getting the notification for after adding each classroom.

Actors Registered users

Table 3. 4 Detailed Use Cases for Add Classrooms

Following Table 3.5 shows detailed Use case narratives for Add constraints.

Name: Add constraints.

Identifier: UC 005

Description: User hits the site URL on the browser and enters to the home. She navigates specification tab and click on add constraints menu.

Goal: Successful add relevant constraints for create timetable.

Preconditions

The user is registered with the system.
Assumptions: All data must be entered for the academic year.

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user enters into home
2. User navigate specification tab and click on add constraints menu
3. Select subject from dropdown menu if constraints already available.
4. If not click new subject and fill information and add new constraints to the system.
5. Follow step 3 and 4 to add all constraints.
6. Use case ends when the user is adding all constraints related to the process.

Table 3. 5 Detailed Use Cases for Add constraints

Following Table 3.6 shows detailed Use case narratives for Generate timetable.

Name: Generate timetable.

Identifier: UC 006

Description: User hits the site URL on the browser and enters to the home. She navigates Timetable tab.

Goal: Successful create timetable.

Preconditions

The user is registered with the system.
Assumptions: All data must be entered for the academic year.

Frequency More than 100 time a day

Basic Course

1. Use case begins when the user enters into home
2. User navigate timetable tab and click on Generate timetable.
3. After generate timetable Select test tab and test created timetable according to the constraints.
4. If test not passed use improve tab and optimized created timetable.
6. Use case ends when the user is generated optimized timetable.

Post conditions

1. The user is getting the notification for after generate timetable.

Actors Registered users

Table 3. 6 Detailed Use Cases for Generate Timetable

Following Table 3.7 shows detailed Use case narratives for Register users.

Use case name : Register new user (officers, lecturer, etc.)

Actor/s : All users

Test case ID : T003

Description : Checking if a new user can successfully register with the system

Setup : Create a user account with username saman and the password 123456.

Instructions : 1) Navigate to the home page. And click on “sign up” link. Enter correct information as specified in the page

2) Enter *saman* as the required username together with other details required and submit

Expected Results: 1) The user is provided with the confirmation page. She is asked to wait for the account creation confirmation e mail

The user is notified with a message stating that the username is already existed. She will be provided with the form again to try another user name

Table 3. 7 Detailed Use Cases for Registering New User

3.5 Class Diagram

Class diagrams are an essential component of object-oriented analysis and design. Class diagrams depict the system's classes, their interrelationships (including inheritance, aggregation, and association), and the classes' activities and characteristics. Class diagrams are used for a wide variety of purposes, including both conceptual/domain modeling and detailed design modeling. The class diagram below (Figure 3.2) depicts the idea.

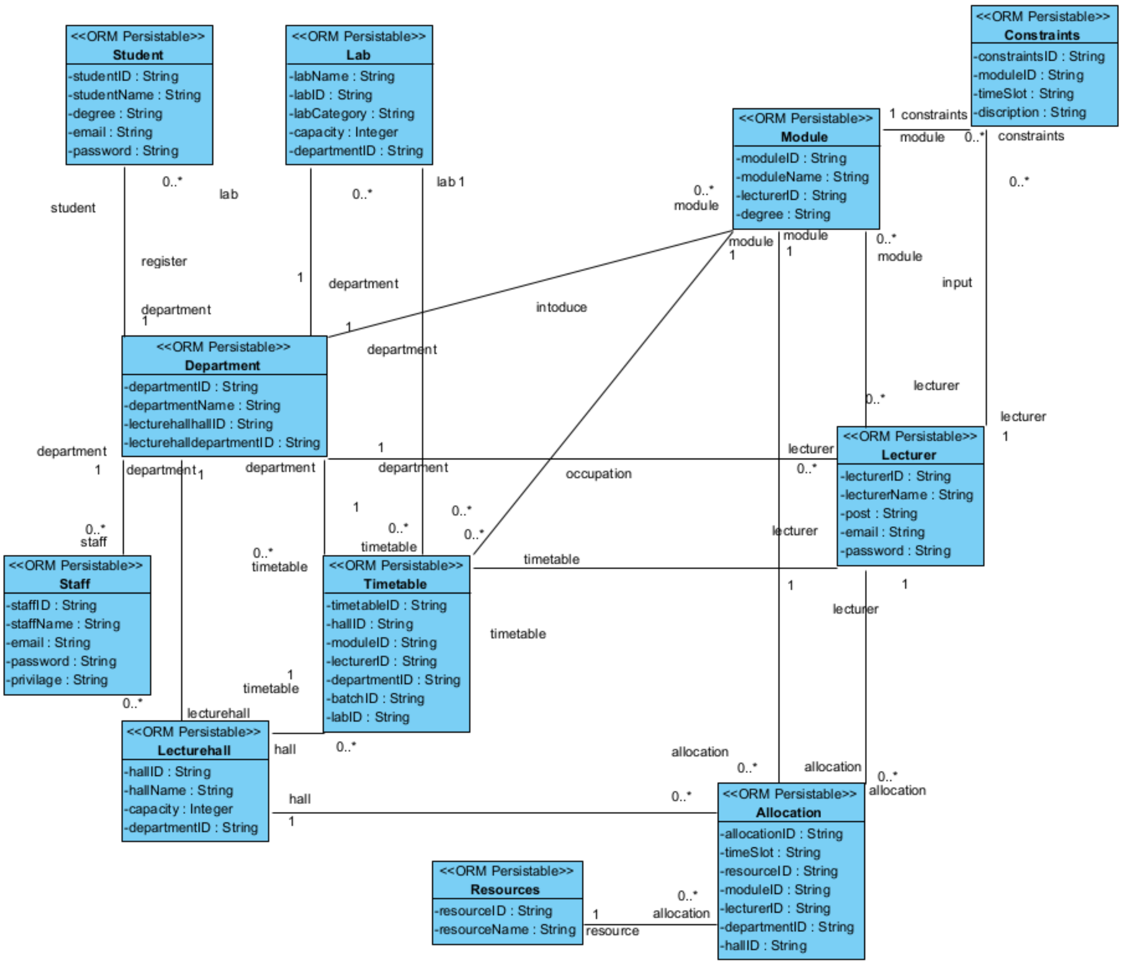


Figure 3. 2 Class diagram of the system

3.6 Activity Diagram

Activity diagrams show how a business process or a use case's activities flow in a logical order. They may also be used to simulate the activities that will be taken when an operation is carried out, as well as the outcomes of those actions. It demonstrates how actions in the system are interdependent in the diagram below in figure 3.3.

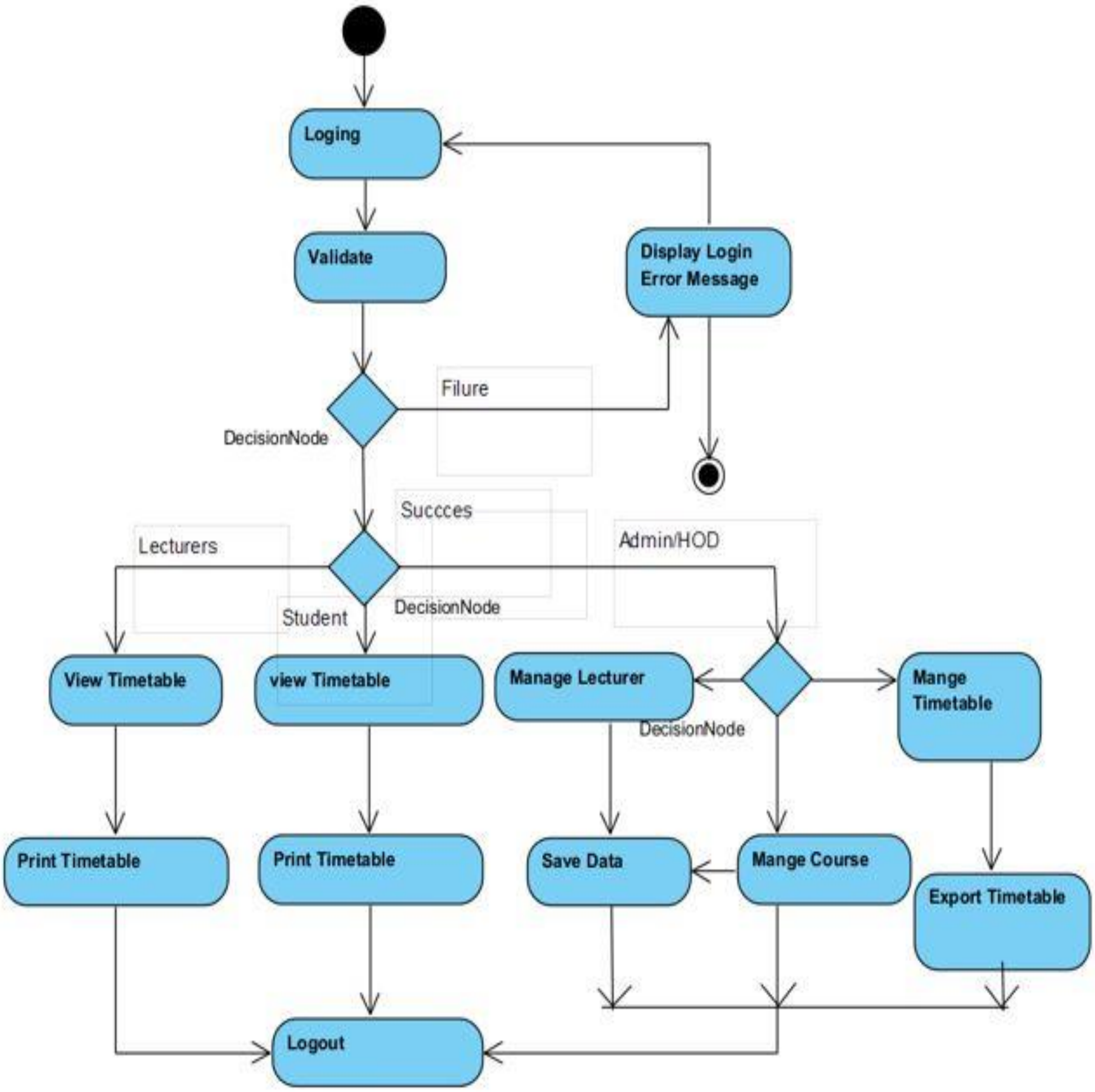


Figure 3. 3 Activity Diagram of the System

3.7 Sequence Diagram

During the execution of a use case or any action, this defines how objects communicate with one another via messages. They show how messages are delivered and received between objects, as well as the order in which messages are sent. It also describes how operations are carried out according to the time of operation. Figure 3.4 depicts the Timetable Management System sequence diagram.

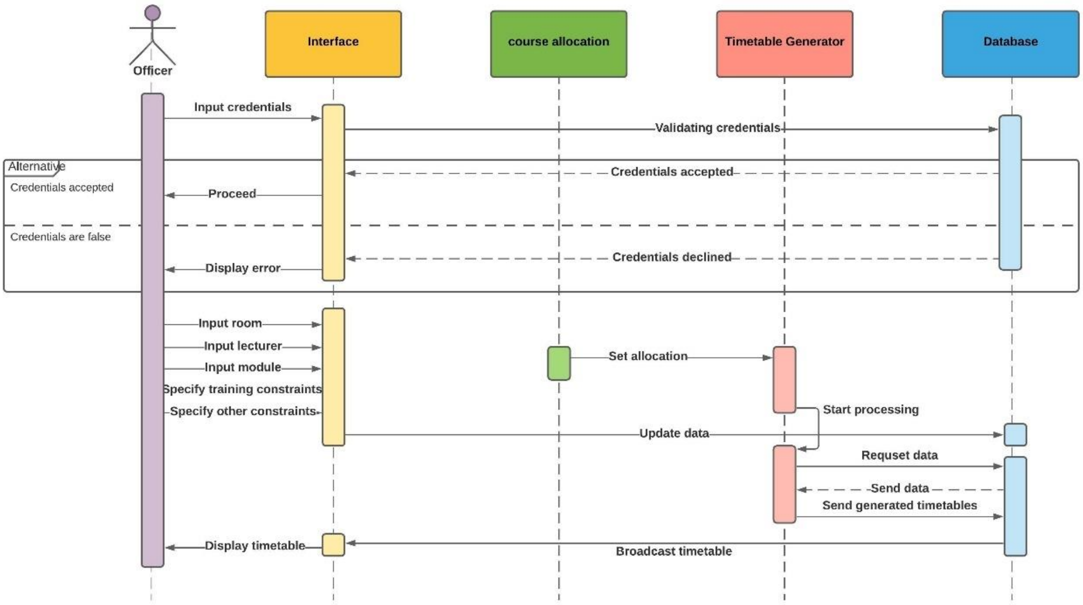


Figure 3. 4 Sequence diagram of the System

3.8 Database Design

The database is an essential component of every software system. Defining the database entails describing the data types, structures, and restrictions for the data that will be stored in it. Entity-Relationship (ER) diagrams, ER Mapping are used to illustrate the design of database.

3.8.1 The Entity Relationship (ER) Model

Figure 3.5 depicts the Entity-Relationship diagram of the timetable management system's major data elements and their relationships.

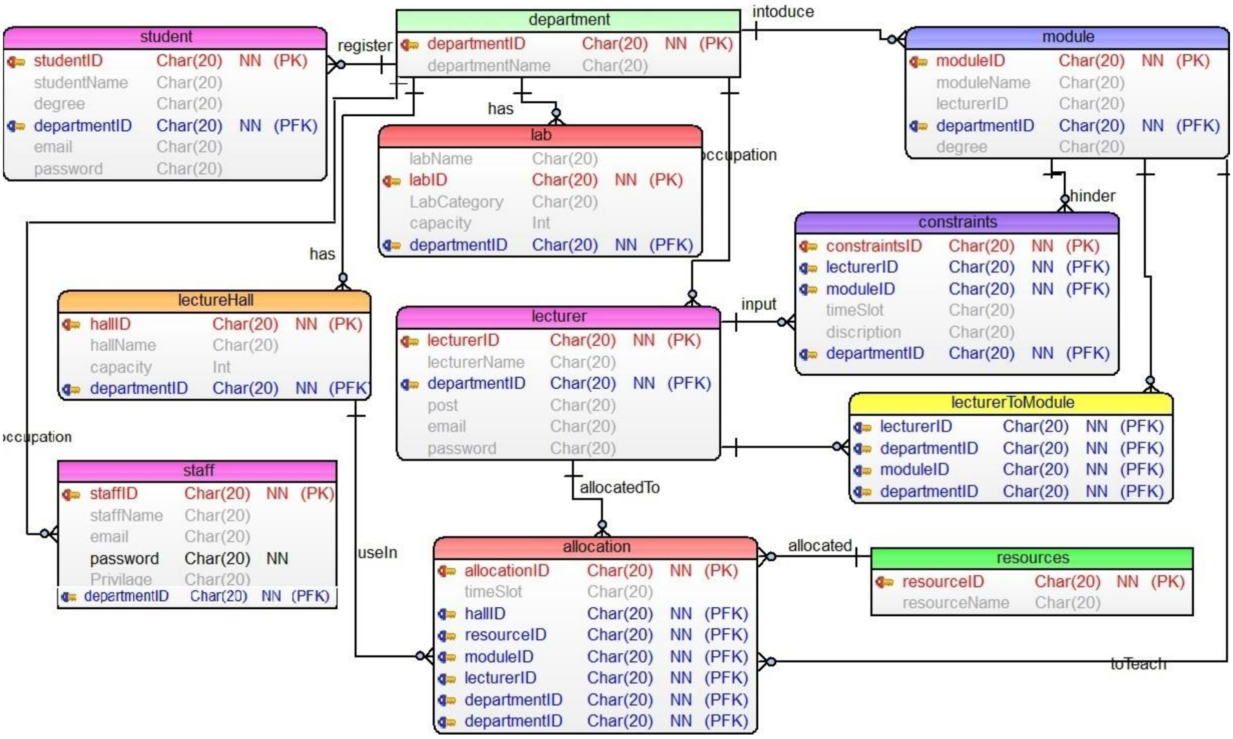

student
studentID Char(20) NN (PK)
studentName Char(20)
degree Char(20)
departmentID Char(20) NN (PFK)
email Char(20)
password Char(20)
register
department
departmentID Char(20) NN (PK)
departmentName Char(20)
intoduce
module
moduleID Char(20) NN (PK)
moduleName Char(20)
lecturerID Char(20)
departmentID Char(20) NN (PFK)
degree Char(20)
has
lab
labName Char(20)
labID Char(20) NN (PK)
LabCategory Char(20)
capacity Int
departmentID Char(20) NN (PFK)
occupation
hinder
constraints
constraintsID Char(20) NN (PK)
lecturerID Char(20) NN (PFK)
moduleID Char(20) NN (PFK)
timeSlot Char(20)
discription Char(20)
departmentID Char(20) NN (PFK)
has
lectureHall
hallID Char(20) NN (PK)
hallName Char(20)
capacity Int
departmentID Char(20) NN (PFK
lecturer
lecturerID Char(20) NN (PK)
lecturerName Char(20)
departmentID Char(20) NN (PFK)
post Char(20)
email Char(20)
password Char(20)
input
lecturerToModule
lecturerID Char(20) NN (PFK)
departmentID Char(20) NN (PFK)
moduleID Char(20) NN (PFK)
departmentID Char(20) NN (PFK)
occupation
staff
staffID Char(20) NN (PK)
staffName Char(20)
email Char(20)
password Char(20) NN
Privilage Char(20)
departmentID Char(20) NN (PFK)
allocatedTo
useIn
allocation
allocationID Char(20) NN (PK)
timeSlot Char(20)
hallID Char(20) NN (PFK)
resourceID Char(20) NN (PFK)
moduleID Char(20) NN (PFK)
lecturerID Char(20) NN (PFK)
departmentID Char(20) NN (PFK)
departmentID Char(20) NN (PFK)
allocated
resources
resourceID Char(20) NN (PK)
resourceName Char(20)
toTeach

Figure 3. 5 The Entity-Relationship diagram

3.9 User Interface Design

The design of the user interface must be done with great attention since it will be critical to the system's success. The user interface was found to be simplistic, yet detailed enough to keep consumers directed around the site. This project's user interface design and development required a long time since it had to accommodate to the many stakeholders' demands, as detailed in the preceding chapters.

Somerville (Sommerville, n.d.) recommends the following key aspects when developing user interfaces.

1. Understand the business functions – The major business functions performed by different stakeholders identified in the Analysis phase have been put into careful consideration to provide the required functionality.
2. Apply general principals of good screen design as depicted by the figure below (Figure 3.6).

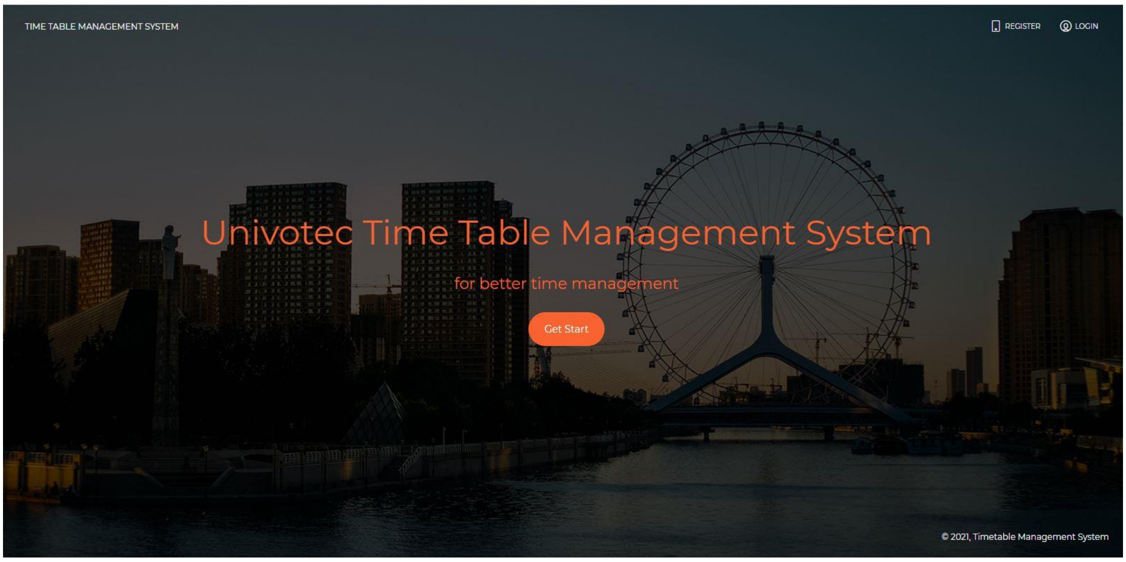

TIME TABLE MANAGEMENT SYSTEM
REGISTER
LOGIN
Univotec Time Table Management System
for better time management
Get Start
© 2021, Timetable Management System

Figure 3. 6 Users logging form

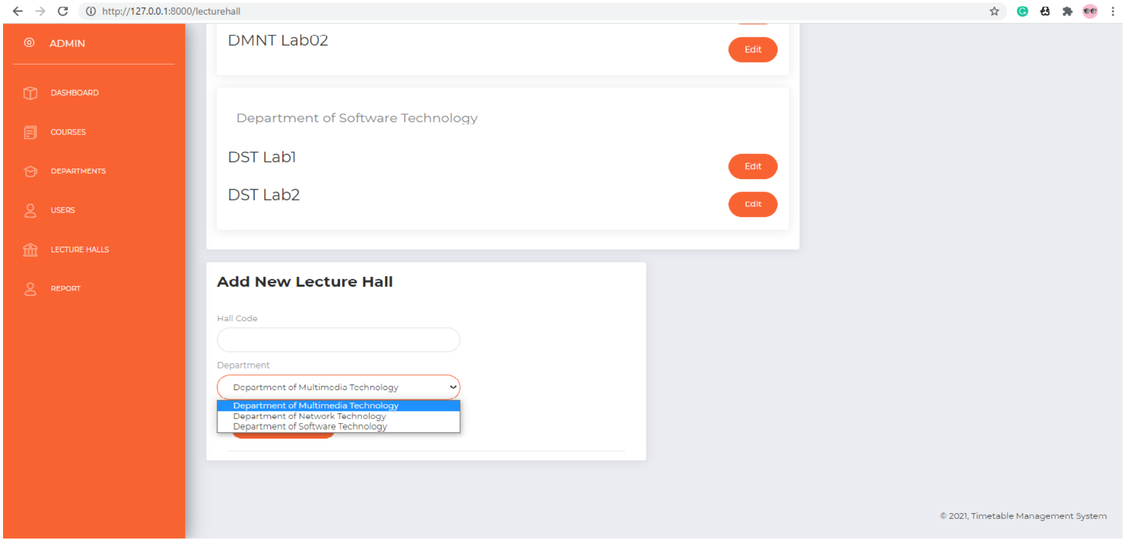
3.9.1 User Friendliness

The user must be able to comprehend warnings and notifications in order to obtain an idea without having to constantly return to the user manual. When feasible, it must always let the user to choose details from a predefined list rather than enabling the user to enter data. Tab order must be placed correctly within GUI fields. Scrolling within the interface must be minimized.

3.9.2 Use of Themes

By providing a GUI template, the look of all interfaces will be consistent, preserving the system's uniqueness.

The concept is depicted in the below figure (Figure 3.7).



http://127.0.0.1:8000/lecturehall

DMNT Lab02

Department of Software Technology

DST Lab1

DST Lab2

Add New Lecture Hall

Hall Code

Department: Department of Multimedia Technology

Department of Multimedia Technology
Department of Network Technology
Department of Software Technology

© 2021, Timetable Management System

Figure 3. 7 Insert Hall web form

3. The availability of suitable widgets, such as date pickers, search boxes, and so on, has been selected and used in areas where they are required.

4. Creation of basic page layouts – Sketch of basic layouts (as in Figure 3.8) in a piece of paper according to the requirements captured was done initially. A sample sketch is depicted below.

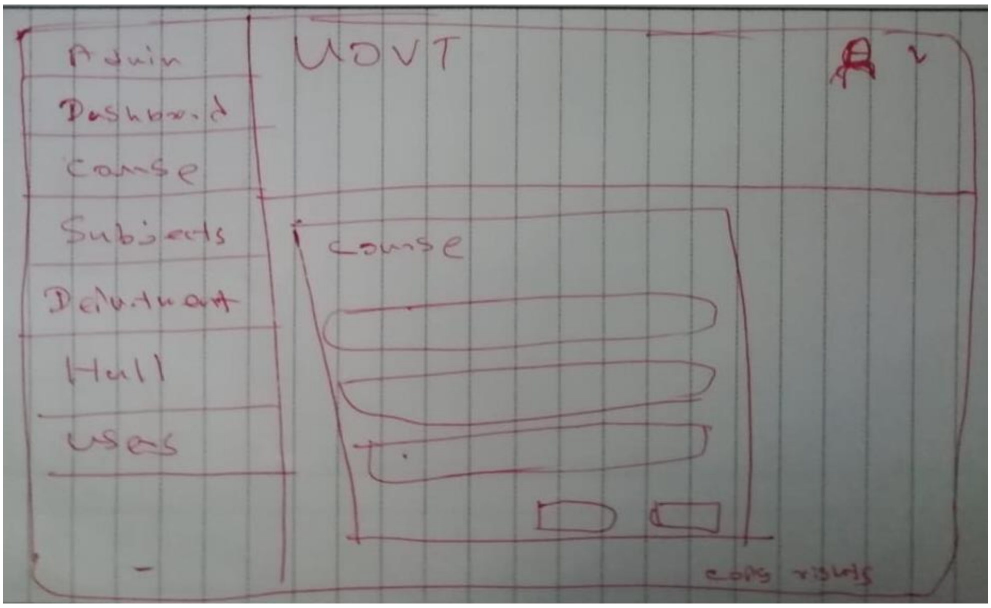
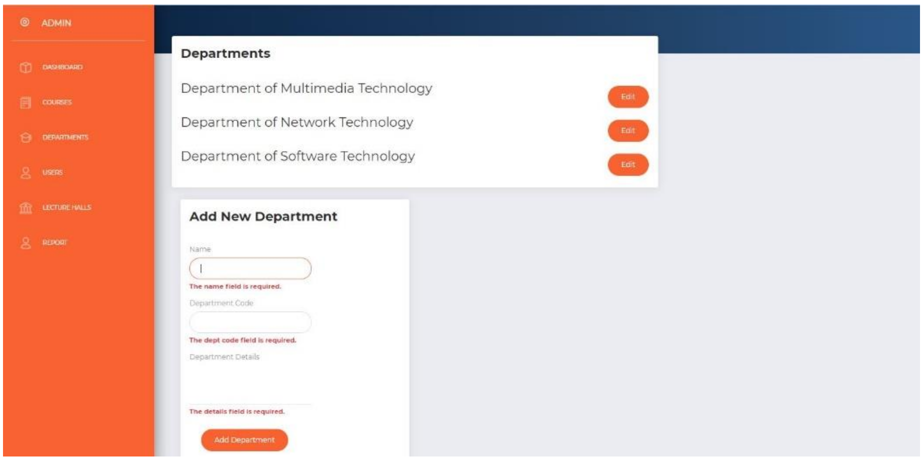


Figure 3. 8 UI Design for Screen Sketches

5. Create menus and navigational elements – UI design is sometimes considered as a complex and iterative process as far as the developers' point of view is concerned. Menus, Headers, Footers and the main panel of links have been put into separate files to be included in all pages. This reduces the overhead of redesigning interfaces.

6. GUI Messages (Refer Figure 3.9) – The support of user-friendly messages to guide the user with the system interaction is provided. A sample message are available below.



Departments

Department of Multimedia Technology

Department of Network Technology

Department of Software Technology

Add New Department

Name

The name field is required.

Department Code

The dept code field is required.

Department Details

The details field is required.

Figure 3. 9 UI Design for User Messages

CHAPTER 4 - IMPLEMENTATION

As mentioned in the Design phase, the system was built on a Three Tier Architecture. One of the big advantages of the layered architecture is the use of business logic as the middle layer. Business components that are self-contained exhibit strong cohesion and loose coupling. Moreover, those components, once created and handled in the middle layer, can be converted into any architecture or platform (Personal Digital Assistant, etc.) and become more portable. In addition, this greatly improves the ability to change any layer without affecting the functionality of the other layers.

The User Interface Layer is used to provide the end user a platform independent interface to work with the system. It basically runs on any standard web browser and a firewall/proxy that can be used for enhanced security. eclipse® was used as the Integrated Development Environment (IDE) as the main editor. PHP Hypertext Preprocessor was used to implement user inputs and business logic. Use of JavaScript® for client-side user input validation and Adobe Photoshop® for image preparation were too used.

The business Layer is where the entire business logic is defined and implemented. Main classes identified and designed in analysis and design phases were implemented. An Object Oriented approach was too considered according to the analysis and design choices. Overall implementation was more Agile as it was found to be the most practical methodology for a considerably fast and more accurate implementation. One of the highlighted aspects of Agile Process is the Test Driven Design and Implementation (TDD). This process is more stakeholder-centric and allows for light traveling through the iterations. Moreover, it needs Just Barely Good Enough (JBGE) approach for implementation.

Also, the user requests are captured and handled in this tier, so that the requests are sent to the database server and queried for the desired output. This layer consists of a web/application server that runs Apache® software.

The backend or the Data Layer stores, administrates and manages the data used in the entire system. Query requests from the business layer are processed here. The popular MySQL® database management system was used.

4.1 Implementation Environment

Implementation is based on Windows, Apache, MySQL and PHP (WAMP) environment. One major reason for the use of WAMP environment is its Open Source and free availability (except Windows).

4.1.1 Hardware and Software Requirements

The Backend (Database Server)

The database server is preferably an Intel Dual Core® computer with the processor speed of 2.0 GHz (recommended), 8GB or higher RAM, 500GB or higher storage space depending on the company's data storage requirements. The backend is implemented with MySQL® 5.0 database management system.

The Application Server (Web Server)

It is observed that the performance of the web server is one of the most vital factors pertaining to the speed of the system. Therefore, an Intel Dual Core® processor (3.0 Ghz), 2GB or higher RAM, 1TB or more free Hard disk capacity, and access to Information Superhighway at a rate of 512 kbps is recommended. It may run on Microsoft® Windows platform and Apache® 2.4.41 as the web server software. PHP Hypertext Preprocessor (PHP) 7.4.4 was used as the scripting language.

Client

All that is needed by the client side is a computer that can run any standard JavaScript enabled web browser (preferably Google® Chrome) and access to Information Superhighway at a minimum rate of 1Mbps. Nevertheless, the more the performances of the computer and the network bandwidth, the faster the system processes as it would be.

4.1.2 Development Tools

PHP® Hypertext Preprocessor (PHP) Scripting Language (The PHP Group, 2001)

The most difficult aspect of this project was creating dynamic web pages. CGI (Common Gateway Interface) programming is not restricted to scripting languages. CGI scripts may be written in almost any programming language, including compiler languages like as C. However, the PHP language is highly popular as a CGI scripting language since it is simple to learn, incredibly powerful, and backed by a wide range of functions. It too supports fully Object Oriented characteristics. PHP offers a number of advantages that make it one of the finest programming languages for web development. The desired system necessitates data processing based on records. PHP's record manipulation capabilities are quite strong.

a) A database will be used in this system. PHP readily interfaces with external applications (such as databases) and has its own file system capabilities.
b) PHP is used in various platforms
c) PHP fully supports Object Oriented Programming
d) CGI scripts are used in this system. As a reason, PHP is a well-known and strong language in the CGI context.
e) Because PHP is an interpreted language, it enables for quick development.

MySQL® Database Server (Oracle Corporation, n.d.)

The UVTTMS Data Base Management Technology was built using the MySQL® database management system (DBMS). It is powerful and open source.

Apache® 2.2 Web Server (The Apache Software Foundation, 1997)

A loosely-knit group of programmers created this public-domain Web server. In 1995, the initial version of Apache was released, based on the NCSA httpd Web server. Because it was built using existing NCSA code and many patches, it was dubbed a patchy server, thus the name Apache Server. Apache has become the world's most used Web server as a consequence of its complex features and great performance.

4.2 Major Code and Module Structures

4.2.1 Algorithm Design

Following are some important algorithms that can be performs general tasks pertaining to the intended system.

1. Connecting to the server and the Database.
2. Login to the System.
3. Creating Timetable According to the constrains.
4. Adding Data to the Database
5. Update Data to the Database.
6. Delete Data in the Database

4.2.2 Module Structure

The module diagram showing the hierarchy of code modules used and the way they are incorporated with each other is depicted below in Figure 4.1 below.

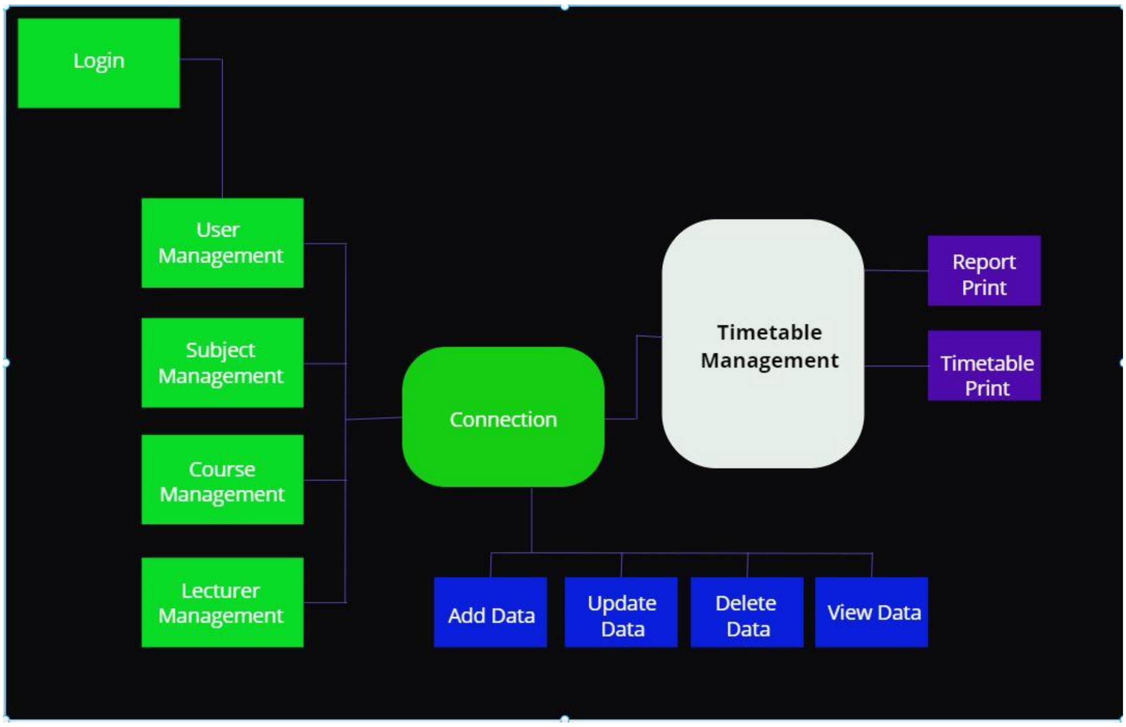


Figure 4. 1 Module Structure Diagram

CHAPTER 5 – Testing and Evaluation

“Testing is done to verify the results by testing each build, including both internal and intermediate builds as well as final versions of the system to be released to external parties” (Booch, Jacobson and Rumbaugh, 2003).

The steps involved are;

A. Build the test plans required in each iteration
B. Perform integration and system tests
C. Create test cases to design and implement tests. Test cases define what to test, how to test and create executable test components
D. Systematically handle and record test results of each test so that the significant defects and be fixed

5.1 Test Plan

A software project test plan is a written document that outlines the goals, scope, strategy, and emphasis of a software testing activity. Preparing a test plan is a good approach to think through the steps required to confirm the acceptance of a software product. The finished test plan will assist consumers outside of the test group in comprehending the "why" and "how" of product validation.

- Requirements Analysis: collecting and assessing customer requirements.
- Software Test Plan: defining the scope and goals, developing acceptable testing techniques, developing a software testing strategy, assigning roles and duties, defining resource needs, and establishing start and completion criteria.
- Test Environment: establishing the test infrastructure, determining the testing environment and tools, and installing and configuring the product.
- Test Metrics: a description of the areas to be measured, as well as the creation and collection of metrics.
- Test design and implementation include the creation of test scenarios, test cases, test checklists, test processes, and test scripts, as well as the creation of test applications.

- Test execution is the static and dynamic performance of testing that is given for the use of human and automatic test cases as needed by STP and STS.
- Defect Management (Bug Tracking), documenting testing results, defect description (Problem Reports, Change Requests); defect review and testing results analysis, faults repair, and defect resolution verification
- Status reports, weekly reports, milestone reports, and a closing report are all examples of reporting.

Interface, unit, system, integration, security and acceptance testing were planned to be carried out at different stages and times as in Table 5.1

STAGE	START DATE	END DATE	DURATION	DATES SPENT
Unit	7/04/21	7/05/21	30 days	32 days
Sub System	10/05/21	18/05/21	08 days	08 days
Integration	20/05/21	25/05/21	05 days	05 days
Acceptance	26/05/21	05/06/21	10 days	15 days

Table 5. 1-Test Planning

5.2 Test Cases and Results

A test case is a series of actions used to verify the correct behavior of an application's functionality or feature. A test case is a document that defines Input, Action, Event, and Expected Response in order to assess whether or not a feature of an application is operating properly.

Here for each module from system need look at Test case, detail Test case for each form attached in Appendices.

The following tables include observations and summaries of carefully selected test cases and outcomes (Table 5.2, Table 5.3, Table 5.4, Table 5.5 Table 5.6 Table 5.7 Table 5.8 and Table).

Name User Login	**Interface Name** Main Login	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing Connection to the Server	Server name, user name, password and database name	Display connection confirmation page	OK
Login – Registered User	Username and password	Login confirmation page (Interface Logged User Home)	OK
	Wrong username or password	Login Error page. Prompt the user for another attempt	OK
Request Password (When forgotten)	Enter username, date of birth and e mail in the Request Password page	Display confirmation on request	OK
	Enter username and data that does not match with the user name	Display error page. Prompt for another attempt.	OK
Password Receipt		New email from the TTMS Administrator with the new password	OK

Table 5. 2-Test Case for Main Login

Name Test Authentication	**Interface Name** Main Login	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing Authentication	User name, password in the main login for a user with administrator authentication	Logged administrator's Home Page	OK
Testing the appropriate services available to the user	Click on each functionality to check the functionality	Availability of appropriate pages for each functional component	OK

Table 5. 3-Test Case for Authentication Check

Name New User Registration	**Interface Name** Register New User	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Request a New User Account	Account details with expected username and contact details	Display request confirmation page	OK
Account Creation Confirmation Notification		An email is sent to the appropriate user notifying the confirmation of account creation	OK

Table 5. 4 Test Case for User Registration

Name Generate Timetables	**Interface Name** Timetable Generator	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing generate timetable according to the free define constrains	Constraints, Subjects, resources	Display newly created timetable for students ,lecturer and lab/classroom.	OK

Table 5. 5 Test case for Generate Timetables

Name New Lab Insertion	**Interface Name** Labs	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing Create New Lab with all inputs	Lab name, lab type, category, capacity, department name	Display newly created lab in Labs interface	OK
Testing Create New Lab with Some blank details	With few input missing	Form validation displays errors in relevant fields. System rejects input.	OK
User tries to respond positive to the alert related to the deletion of lab (if user clicks “Yes”)	Clicks Delete	Particular lab will be deleted from the database.	OK
User tries to respond negative to the alert related to the deletion of lab.(If user clicks “Cancel”)	Clicks Delete	Particular lab will not be deleted from the system.	OK
User tries to search for specific lab by using the Particular lab’s Name.	Enter lab name in search field	Particular Lab’s details will Be shown in the display page.	OK

Table 5. 6 Test case for Create New Lab

Name New Lecturers Insertion	**Interface Name** Lecturers	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing Insert New lecturer with all inputs	Lecturer name, Department, Designation.	Display newly inserted lecturer in Lecturer interface	OK
Testing Insert New lecturer with Some blank details	With few input missing	Errors in relevant fields are displayed during form validation. The system rejects the input.	OK
User tries to respond positive to the alert related to the deletion of lecturer (if user clicks "Yes")	Clicks Delete	Particular lecturer will be deleted from the database.	OK
User tries to respond negative to the alert related to the deletion of lecturer.(If user clicks "Cancel")	Clicks Delete	Particular lecturer will not be deleted from the system.	OK
User tries to search for specific lecturer by using the Particular lecturer's Name.	Enter lecturer name in search field	Particular Lecturer's details will Be shown in the display page.	OK

Table 5. 7 Test case for Insert New lecturer

Name New programmes Insertion	**Interface Name** Programmes	**Tested Date** 12/05/2021	
Test Case	**Input**	**Expected Result**	**Status**
Testing Insert New programmes with all inputs	Programme name, Department, Active/inactive.	Display newly inserted programmes in programmes interface	OK
Testing Insert New programmes with Some blank details	With few input missing	Form validation displays errors in relevant fields. System rejects input.	OK
User tries to respond positive to the alert related to the deletion of programme (if user clicks “Yes”)	Clicks Delete	Particular programme will be deleted from the database.	OK
User tries to respond negative to the alert related to the deletion of programme. (If user clicks “Cancel”)	Clicks Delete	Particular lecturer will not be deleted from the system.	OK
User tries to search for specific programmes by using the Particular programme’s Name.	Enter programme name in search field	Particular programme’s details will Be shown in the display page.	OK

Table 5. 8 Test case for Insert New programmes

Test No	Test Case	Purpose	Expected Result	Actual Result
01	Click Insert button in form	To add the details in database and view details	It should be add the details in database and view details	As expected
02	Click Edit button in form	To send the selected data to the editable form.	It should be send the selected data to the editable form.	As expected
03	Click Update button in form	To update the details in database and view the details.	It should be update the details in database and view the details.	As expected
04	Click Delete button in form	To delete the details in database and display confirmation message.	It should be delete the details in database and display confirmation message.	As expected
05	Enter the parameter and click Search button in form	To send the selected parameter with data to the editable form.	It should be send the selected parameter with data to the editable form.	As expected
06	Not filling all required fields	To check whether the form does not allow empty field to be submitted to the database.	It should display an error message.	As expected
07	All required fields are filled	To check whether allows to be submitted to the database and display success confirmation message.	It should be display success confirmation message.	As expected
08	When entered data already exists	To display error message	It should be display an error message.	As expected
09	Test browser	To access & load system in different browsers (Internet explorer, Firefox, Chrome).	The system should act and display interfaces in similar way in all browsers.	As expected

Table 5. 9 Test case for General functions

5.3 Testing process

“Unit testing and module testing is carried out at the development stage when the programs are developed. In the testing phase of the project schedule, system testing and acceptance testing are done. System testing is done in order to find out errors which result from unanticipated interactions between sub-systems and system components. It is also concerned with validating that the system meets its functional and non-functional requirements. Structural or white-box testing is used for defects testing. Code is analyzed and the knowledge about the structure of the component is used to find out the number of test cases and test data (Sommerville, 2001)”.

Before the system is accepted for operational usage, acceptance testing is performed. Rather than generated test data, this testing is performed with data given by the intended system user.

5.3.1 Testing schedule

In the primary project development timeline, testing is allotted a specific amount of time. According to that, the testing procedure takes little over seven weeks. Despite the fact that unit testing and module testing (i.e. component testing) are done during the development phase, these components are tested separately during the testing phase.

5.3.2 Test Recording Procedure

“Test cases and test results are systematically recorded as the standards defined by Perry (Perry, 2006)”. The purpose of a test case work paper is to document a collection of test inputs, execution circumstances, and expected outcomes produced for a specific test aim.

Hardware and Software Requirements

The system is tested without the use of any specific testing software. However, the system requirements determined during the analysis step are required in order to test the system.

5.4 System Testing Process

To guarantee that all parts of the system have been evaluated, test cases are created using a wide range of test data. The inputs designed to test the system are referred to as test data. These test cases are created using the system requirements created during the project's design phase (i.e., knowledge of the program's structure and implementation).

5.5 Testing Data

The current manual System collected the system's test data, which was saved in Excel and Word formats.

5.6 User Evaluation

The user evaluation is done by using a questioner. The questioner compost of 10 questions to obtain user feedback.

Regarding requirement fulfillness, user friendliness, report generation, supporting to decision making functionality, authentication, interface and response time.

The response is obtained as satisfactory levels.

The questioner is shown below.

1.Requiement full illness of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

2. User friendliness of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

3. Helpfulness of reports for your decision-making process

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

4. Availability of required functionality of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

5.The system is authorized to do what your user level is required to do?

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

6. The system is authorized to do what your user level is not required to do?

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

7. Interface designing of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

8. Navigation process of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

9. The average response time for a link selection is

a) <1s b) >1s and <3s c) >3s and <5s d) > 5s

10. Overall satisfaction of the system

1) Not at all 2) Average 3) Satisfactory

4) Good 5) Excellent

A sample of 20 users selected representing different user levels (EX: CEO,TO,DG, Director)

The system was underwent one month time period of Users testing and after that feedback is obtained (Figure 5.1 summary of users feedback shown below).

Answers	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total
Not at all	0	0	0	0	0	0	0	0	0	0	0
Average	1	0	1	3	0	1	0	1	0	0	7
Satisfactory	2	1	1	3	3	3	5	4	1	0	23
Good	5	5	2	4	6	4	5	6	3	0	40
Excellent	12	14	16	10	11	12	10	9	16	20	130

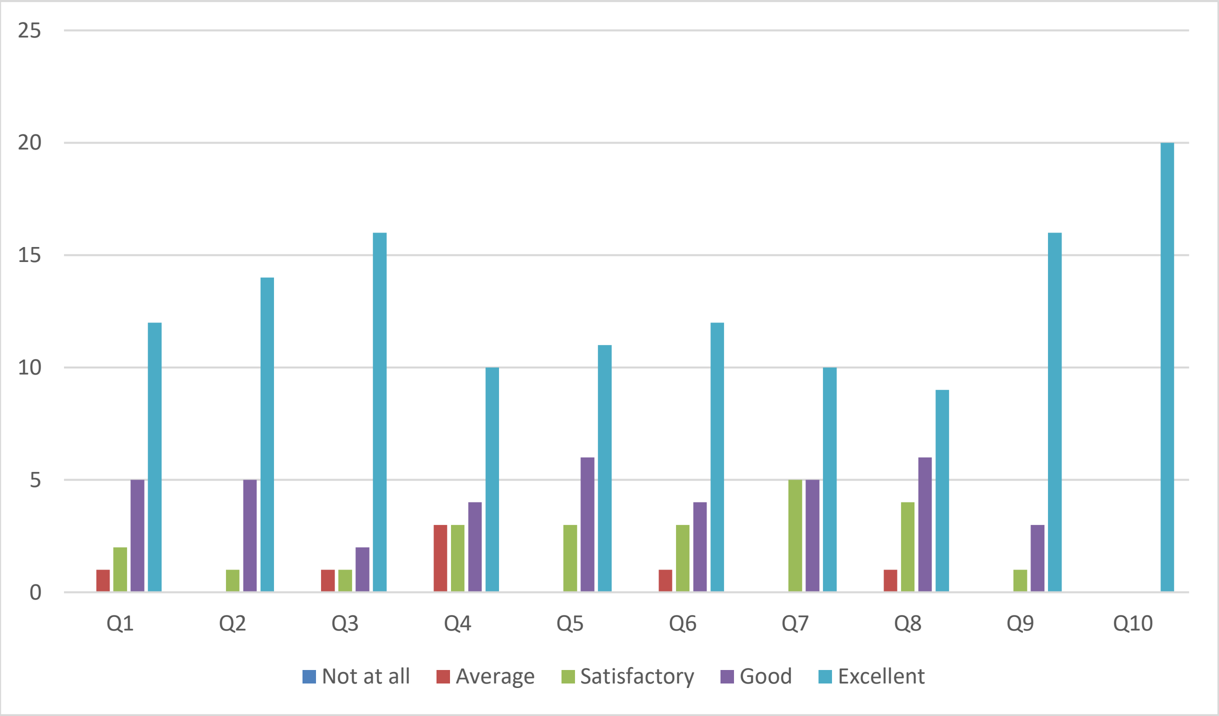
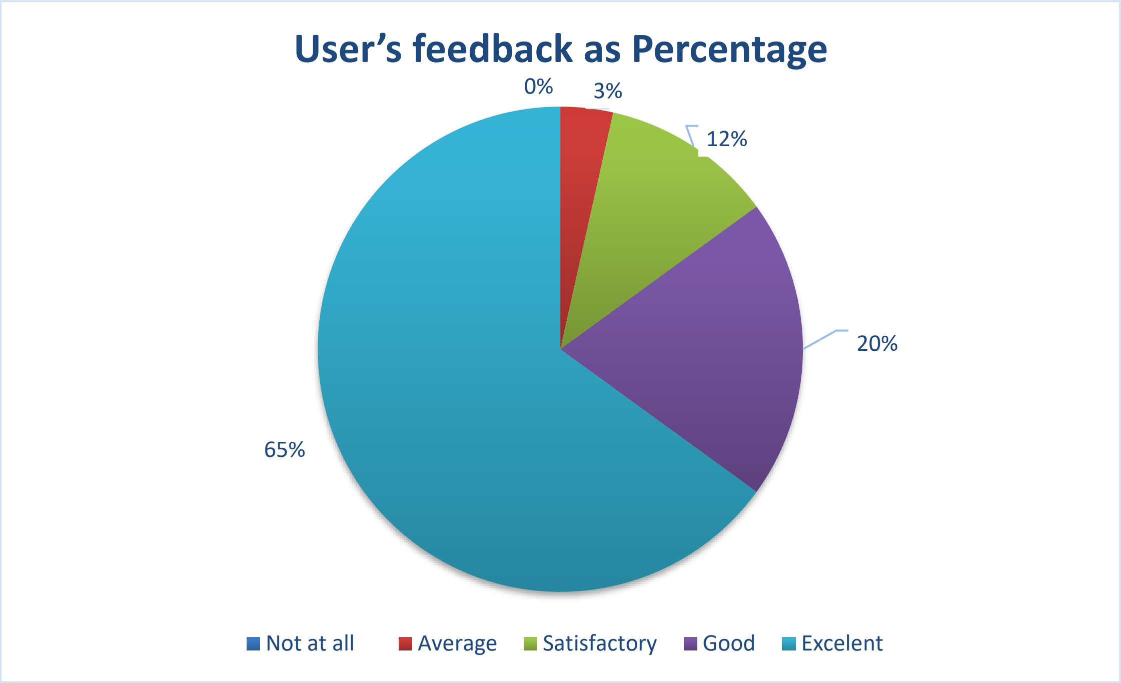


Figure 5 1 Summery of user's feedback

Assuming of feedback received from twenty users different level for ten questions are shown bellows.

Response

Not at all	0
Average	7
Satisfactory	23
Good	40
Excellent	130



A

Figure 5 2 User's feedback as Percentage

CHAPTER 6 – CONCLUSION

This chapter wraps up the dissertation with a critical assessment of the system, lessons gained, and recommendations for future research.

6.1 Critical Assessment of Timetable Management System

By the end of the project, almost all of the primary objectives had been accomplished to a large extent. The main objective was to provide a web-based facility for staff, dean, lectures, and the technical coordinator. As it was observed in the analysis phase, the main areas included students timetable, lecturer timetable, lab and classroom timetable and management reports. Separate User Management module is provided for the admin apart from system backup facility. They all were proved to be at the acceptable standards during the acceptance testing.

More effort is spent on system analysis and design throughout the project life cycle. Various methods of data collection were utilized for system analysis. They were interviewing, past reports observation and prototyping. As each requirement was found, it was recorded in the Requirements Catalogue and due care was made to maintain the catalogue correctly as it serves as the main reference for the other stages of the project. IEEE standards were used to document the requirements catalogue. Regular requirement reviews were carried out to ensure the accuracy of the requirements gathered.

In design phase, the use of OOSD with Agile/Extreme programming helped the design to be more accurate, fast, reliable, and practical. OOSD improved the module reuse and independence and the introduction of strong cohesive modules that are loosely coupled enhanced maintainability to a much greater extent. The use of case tools at all stages cannot be forgotten as they made the entire process automated and thus easier.
Implementation, the whole phase was generally based on Agile Process, which made the implementation much faster and accurate. Stakeholder participation and implementing Just Barely Good Enough (JBGE) amount of work cut off extra overhead. The use of simple, open source, yet powerful case (implementation and testing) tools for modeling,

implementing and testing were outstanding. User interfaces were proved to be friendly and easy to use and consists with a good color combination that mix together.

The system was tested using the test cases and test data developed in the design stage of the project. The outcomes of the tests were documented and compared to the expected findings in the original test cases. All test findings were checked and validated against the predicted outcomes.

Documentation, the most important artifact as far as it is concerned in general, was done in a much-organized manner with the help of the sample reference material given by the Institute.

The total project completion time was extended than projected time in the original project schedule, because of the excessive development time. Most of the concepts and technologies were new and comprehensive initial knowledge was required to develop appropriate applications. Therefore, development time extended than the projected time.

6.2 Lessons Learnt

During the course of this project considerable number of new concepts and lessons were learnt and they are listed below.

Thorough understanding of Software Engineering was obtained. It was understood that Software Engineering is all about engineering the artifact from the inception to the release and for this modeling plays an important role.

Software Project Management - From project proposal through final system implementation, all aspects of a typical software project were thoroughly covered.

A great opportunity was made through this project as its paved way to lot of research and background literature review. Moreover, this was an opportunity to fully practice what have been studied in theory.

An insight to proper documentation was well covered. The importance of documentation at all stages of the Software Life Cycle was clearly understood.

The application of Object Oriented concepts in analysis, design and implementation stages to create more practical, robust, maintainable and platform independent components were well appreciated.

Writing working web applications and use of PHP and MySQL.

Another main concept learnt was how to practically handle the business logic in the middle tier of the 3-tier architecture. Since this application spans over different platforms and hardware over different tiers the variations were learnt well.

6.3 Future Work

Identified some further work to be done on implemented system. Since in the development process followed incremental model for software development which allows developing system incrementally module by module.

- Integrate Mobile Application

  Presently university students and staff having smart phone it is better to integrate mobile application to the system will improve efficiency of the system functionality.

- Improve Performance

  User has identified there is a performance issue on timetable generation when number of constrains is high. As a solution in future planning to generate reports Crystal report as HTML report.

- Knowledge sharing

  Since most of the modules are developed with the requirement gathered from selected employees, others do not aware the exact functionality of other system, therefore planning to do a hands-on practical session of all employees.

- Add reports with more filtered options

  Presently for the reports only date range filter options is provided, but in future is planned to build with more filtering options.

- Include new feature to indicate distance between one hall to another to get easily to indicated location.

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APPENDIX A-SYSTEM MANUAL

UVTTTM is a web-based application developed on three-tier architecture. It has three major components such as Client, Middle-tier and Server with different hardware configuration.

Server Hardware Requirement

- Server – Intel Dual Core® computer with the processor speed of 3.0 GHz (recommended)
- 8 GB RAM
- 1 TB SCSI on RAID 5
- Backup
- Ethernet Connection 1000 Base T

Client Hardware Requirement

- Client – 3 GHz with 2Gb RAM, 200 GB Hard disk
- 15’’ Monitor with 1024 x 768 screen resolution.
- Printer (Optional)

Client-Server Architecture

User can access the web application, which is installed in Application server via web browser. First web application will connect to LAN using company Intranet, and then it will connect to security layer. Security layer will perform the user validation; if the user validation is successful then the user will be allow to connecting to Application server, Email server, Printer server and MySQL database server.

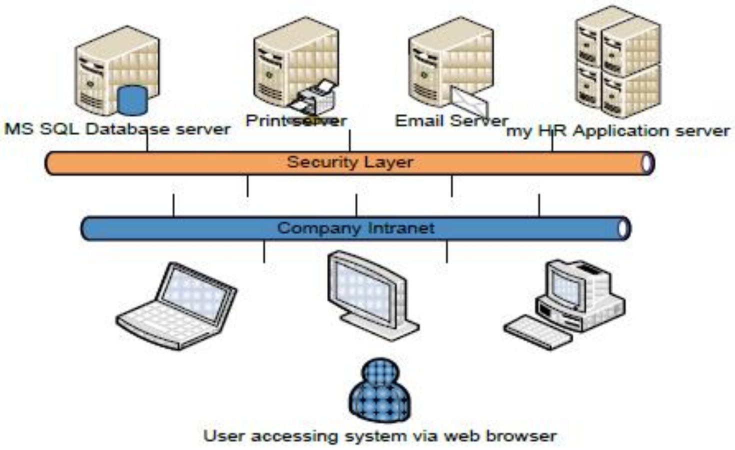


Figure A. 1: System Architecture

3-Tire Architecture

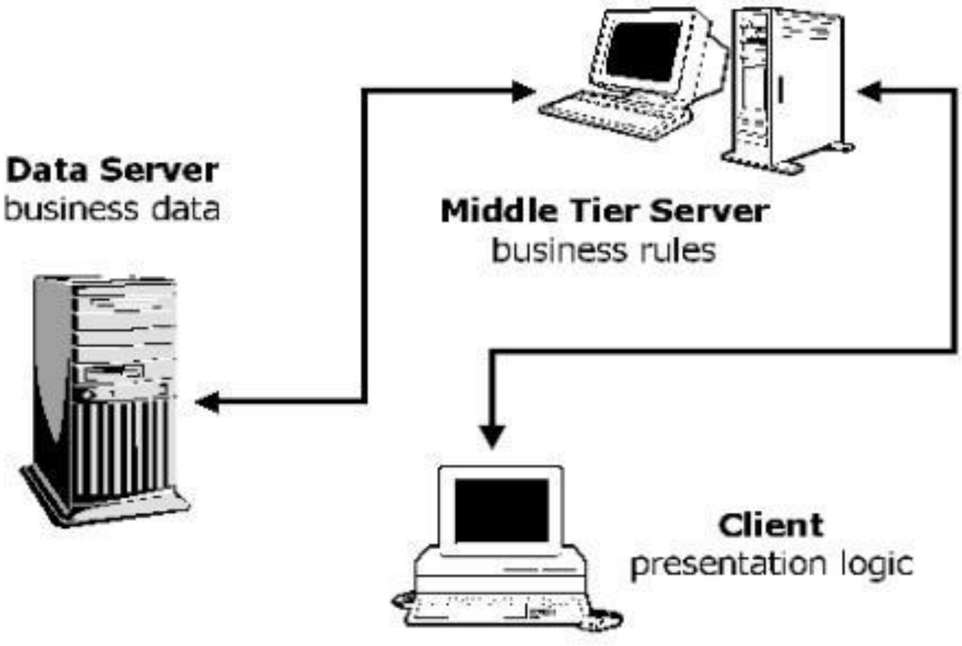


Figure A. 2: 3-Tire System Architecture

3-Tier architecture generally contains UI/ Presentation Layer, Business Layer (BA)/Business Access Layer (BAL) or and Master Layer (MA)/ Data Access Layer (DAL).

Presentation Layer (UI)

The presentation layer includes pages such as Windows form, which show data to the user or accept input from the user.

Business Layer (BS)/Business Access Layer (BAL)

BAL comprises data-related business logic, validations, and computations.

Master Layer (MA)/ Data Access Layer (DAL)

DAL includes methods that assist the business layer in connecting data and performing needed actions, such as returning data or modifying data (insert, update, delete etc.)

Software Requirements

Server Software Requirement

- MS Windows XP, Windows 7 or Windows 10
- Apache® 2.2 Web Server
- MySQL® Database Server

Client Software Requirement

- Web browser

XAMPP Installation (Windows 10)

1. Go to http://www.apachefriends.org/en/xampp-windows.html in your web browser to download XAMPP.
2. Once your download is complete, run the application by clicking the "Run" button.
3. Accept the default configuration.
4. When the installation is finished, close the command window by entering x on the command line.
5. Begin by launching the XAMPP Control Panel.
6. Start the Apache and MySQL servers.
7. Verify the Apache installation by going to the Control Panel and clicking on the Apache administrator link.

8. Verify the MySQL installation, by clicking on the MySQL administrative link in the XAMPP Control Panel.

Installing Firefox or Google chrome web browsers

Download and install the most recent versions of Mozilla Firefox and Google Chrome from www.mozilla.com and www.google.com, respectively.

System Installation

Composer packages install

Run in command prompt: **composer install**

- Node modules install

Run in command prompt**: npm install**

- Creating a .env file

Go to project folder and then rename. env. example file to .env

Then in terminal run following command to create Laravel key

php artisan key:generate

- Config the env file

Go to .env file and then first change the value of **DB_DATABASE** to your database name *(you can create database using phpMyAdmin)*

Then u need to change the value of **BROADCAST_DRIVER** to **pusher**

- Then u need to change values of following keys

PUSHER_APP_ID

PUSHER_APP_KEY

PUSHER_APP_SECRET

You can put any values in theses keys this part it required for the WebSocket initialization.

PUSHER_APP_ID=local_ttm

PUSHER_APP_KEY=ttm_key

PUSHER_APP_SECRET=local_key

- Database Migration

php artisan migrate

- Sample data initialize

php artisan db:seed

- Optional: To compile npm modules with webpack – (You only need this step if u change anything in vuejs part)

npm run dev (Anon., n.d.)

Run the System

- To start webscoket server

php artisan websocket:serve

Optional: Websocket stats can be monitor using following command but make sure you run webserver

http://127.0.0.1:8000/laravel-websockets

- To start Laravel project with inbuild web server

php artisan serve

After above command you can visit

http://127.0.0.1:8000/

APPENDIX B-USER MANUAL

Introduction

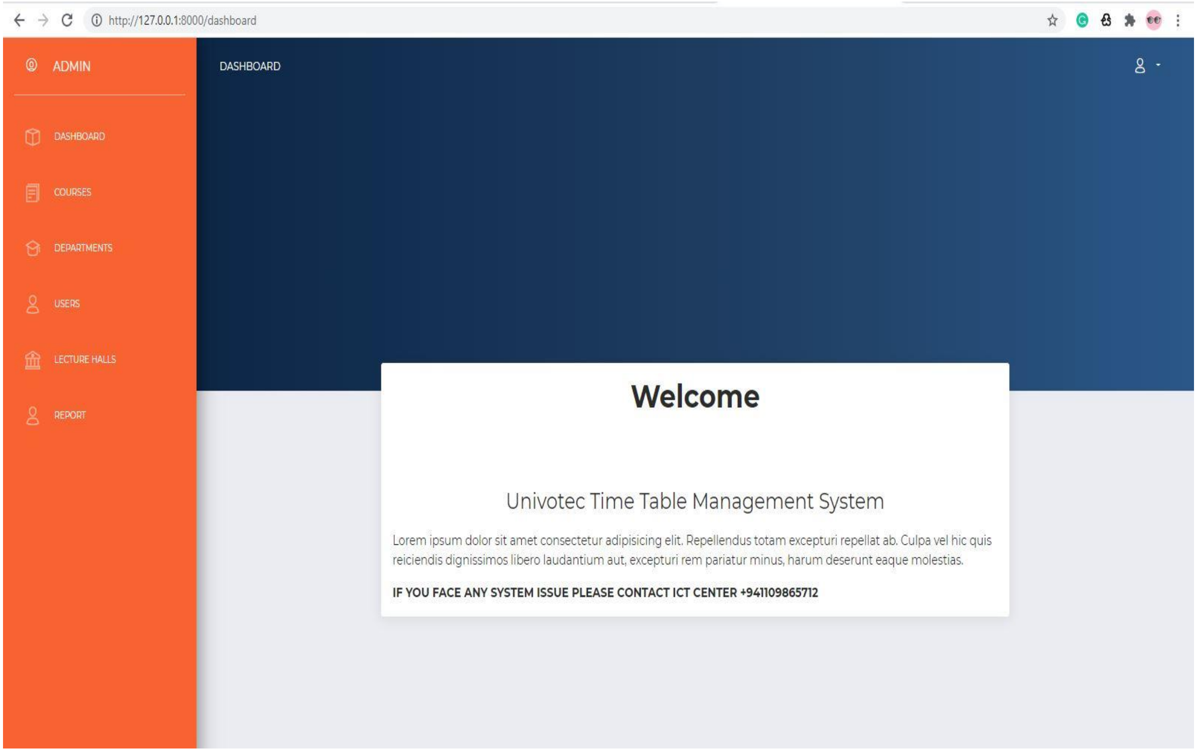
The user documentation is a major supplementary provided with the system. This user documentation has been provided in order to develop an idea and the familiarity of the effective use of the system. The prerequisite is the basic computer literacy; especially web browsing skills.

The system mainly provides its functionality to the following users/stakeholders. They are.

a) The Admin
b) The Lecturer
c) Hall keeper

UVTTTM Home (The Index Page)

The system's home page may be accessed at http://127.0.0.1:800. On the left side of the website, there is a menu (category/subcategory links) and a search box. Customers may easily browse system in this area. The center area, often known as the main part, offers room for putting out the contents of the webpage being browsed.



Welcome

Univotec Time Table Management System

Lorem ipsum dolor sit amet consectetur adipisicing elit. Repellendus totam excepturi repellat ab. Culpa vel hic quis reiciendis dignissimos libero laudantium aut, excepturi rem pariatur minus, harum deserunt eaque molestias.

IF YOU FACE ANY SYSTEM ISSUE PLEASE CONTACT ICT CENTER +941109865712

Figure B. 1 UVTTM Home Screen of the System

Login to the System (The Login Page)

When a user clicks on the login link found at the right-most (quick links) section, she is provided with the following page.

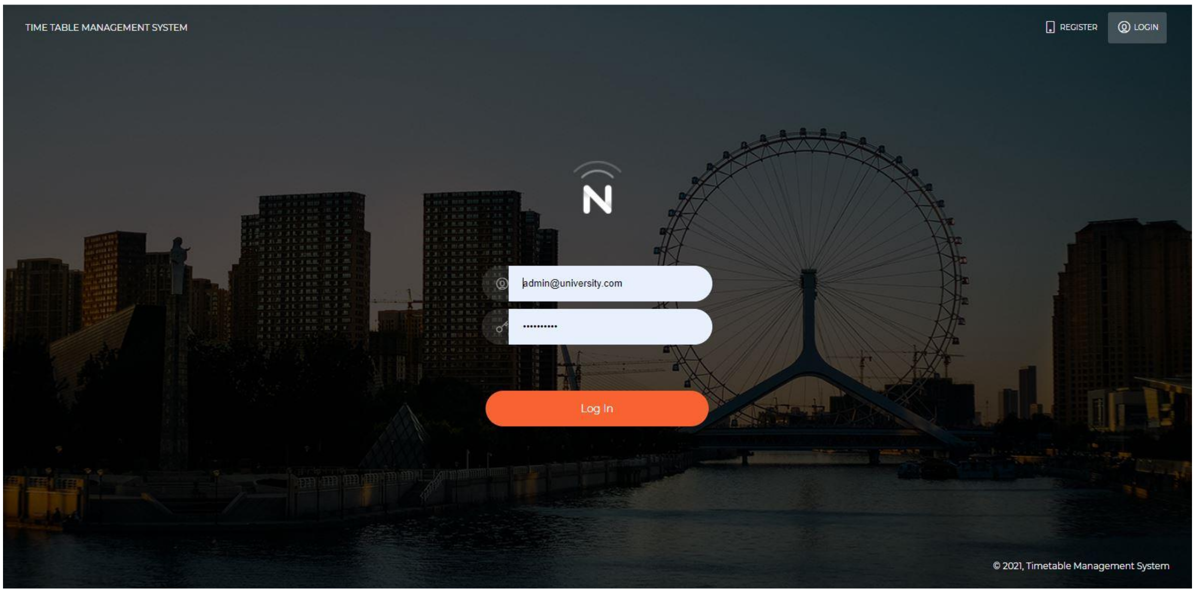

TIME TABLE MANAGEMENT SYSTEM
REGISTER
LOGIN
N
admin@university.com
....
Log In
© 2021, Timetable Management System

Figure B. 2 Systems Login Screen

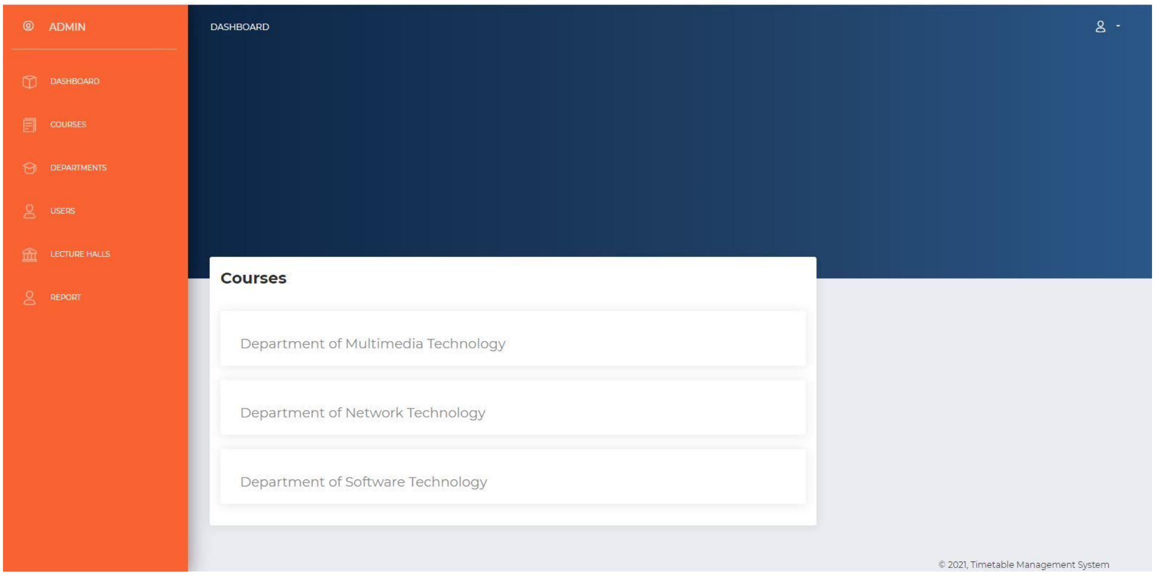
All registered employees can access to the system by using the use name and password, Successful login will direct user to system home page and Unsuccessful page will trigger "Login Failed!" error message.

If user forgot the password by clicking „Forgot your password link‟, he can get his/her password by email by typing correct Security Question and Answer. Or User get an approval from Manger reset password and TTM-Admin can reset password for default password.

Admin Home

As identified under introduction section of this document, the UVTTTM admin is a main stakeholder of this system. The following topics will look in detail at main functions performed by UVTTM Admin.

The following figure shows the home page of the logged Admin user.



Courses

Department of Multimedia Technology

Department of Network Technology

Department of Software Technology

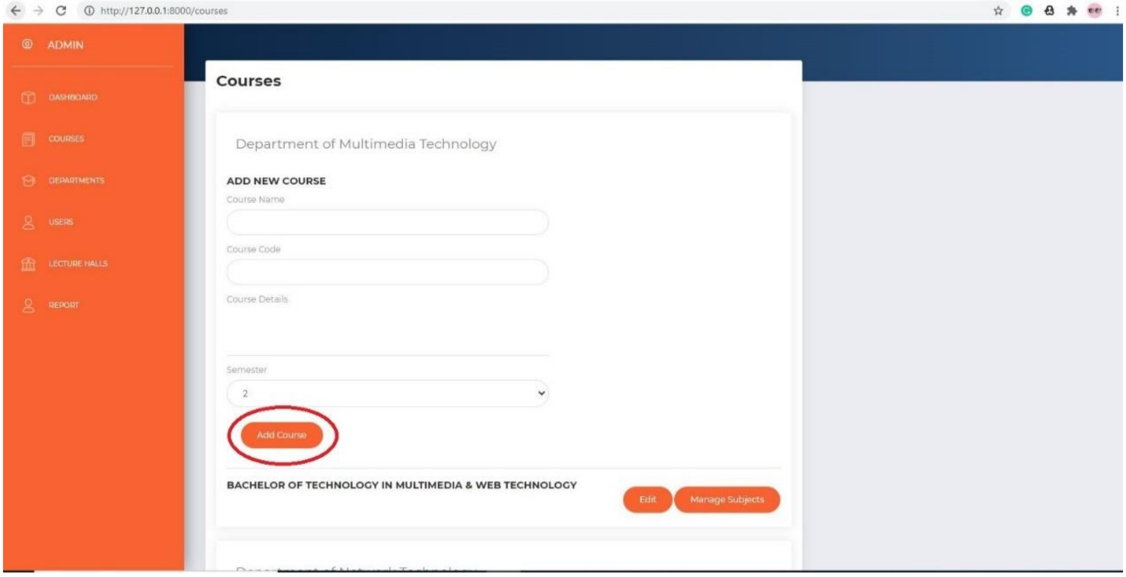
© 2021, Timetable Management System

Figure B. 3 Admin user home page

Courses Management

Courses Management includes the add, update, delete functions of course. A course can be add and update in to the respective departments.

The following figure shows details of course with links for adding, updating and deleting course to the respective departments.



Courses

Department of Multimedia Technology

ADD NEW COURSE

Course Name

Course Code

Course Details

Semester

2

BACHELOR OF TECHNOLOGY IN MULTIMEDIA & WEB TECHNOLOGY

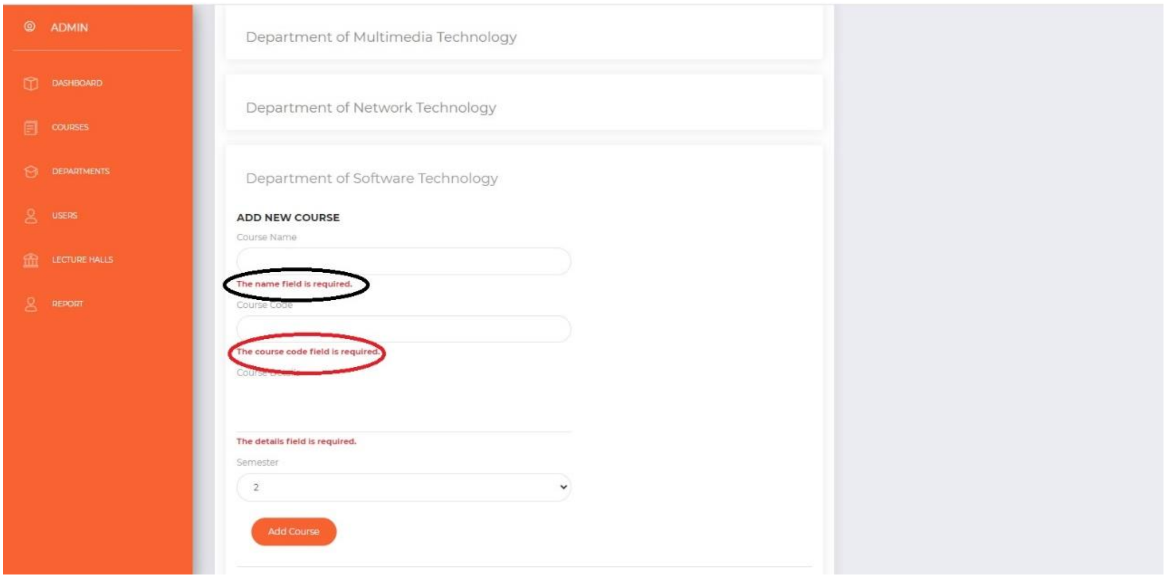
Department of Network Technology

Figure B. 4 Adding course to the system

Add Course Page

Adding Course to the system is done through a web form (Figure B.4) generated upon a user's click on Add Course button highlighted above.

The data fields and user information messages/screens used throughout the web forms are self-descriptive.



Department of Multimedia Technology

Department of Network Technology

Department of Software Technology

ADD NEW COURSE

Course Name

The name field is required.

Course Code

The course code field is required.

Course Details

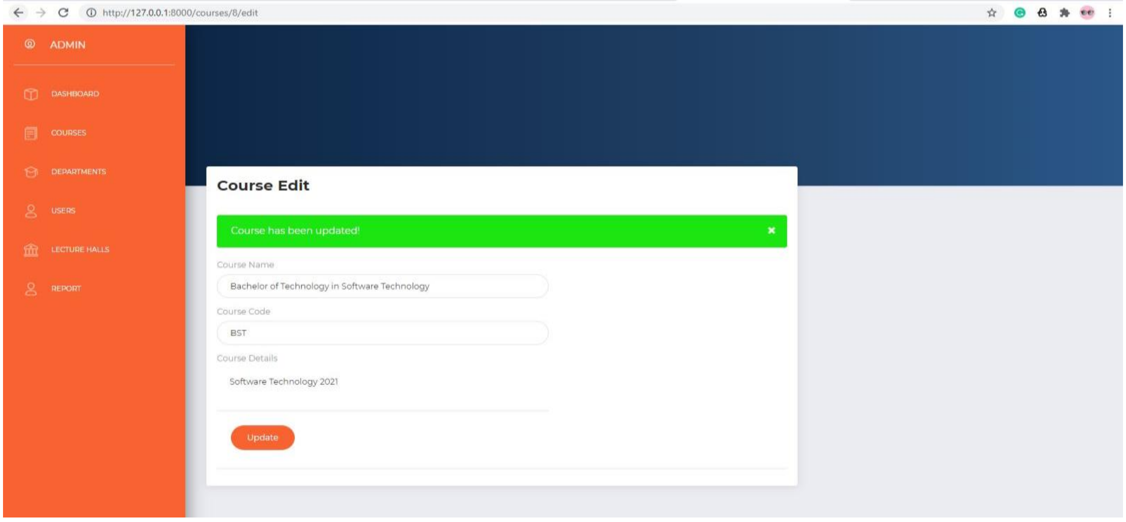
The details field is required.

Semester: 2

Figure B. 5 Error message

Update Course

Updating items to the system is done through the web forms generated upon a user's clicks on View/Edit links as highlighted in Figure B.6 bellow.



http://127.0.0.1:8000/courses/8/edit

Course Edit

Course has been updated!

Course Name: Bachelor of Technology in Software Technology

Course Code: BST

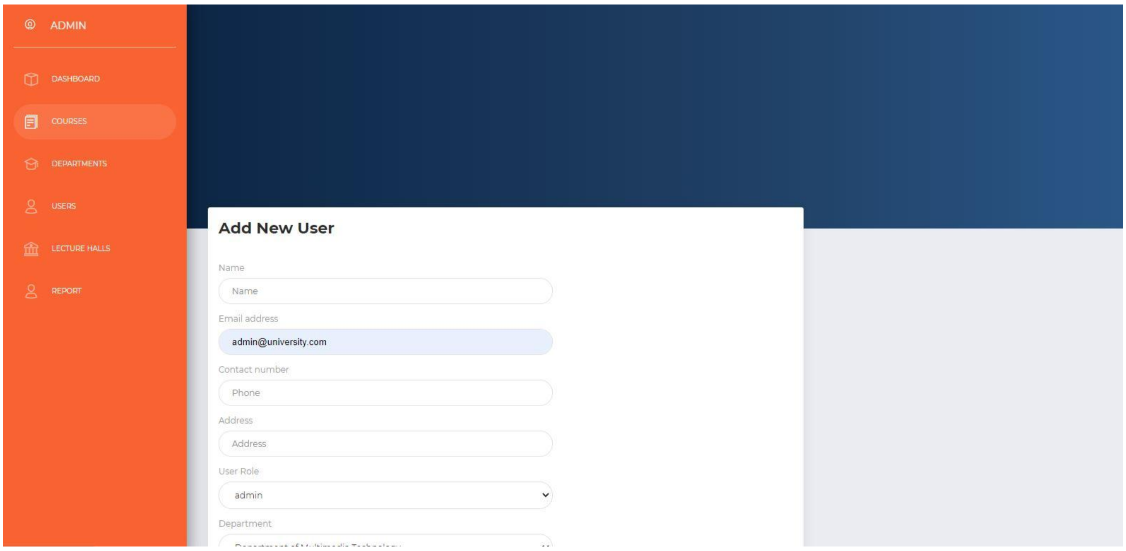
Course Details: Software Technology 2021

Figure B. 6 Update courts screen

Manage Users

User Management allows the UVTTM admin to view registered users' while maintaining the details of them. Every user of the system must fall into some authentication category in order to use the system. The Admin, however, may change the authentication category of a user at any time through the provided interface/s.

Upon the click of the Users link from admin home will result the following screen (Figure B.7) to the admin. Add and Update users are too started through this page by the clicks of necessary links.



Add New User

Name: Name

Email address: admin@university.com

Contact number: Phone

Address: Address

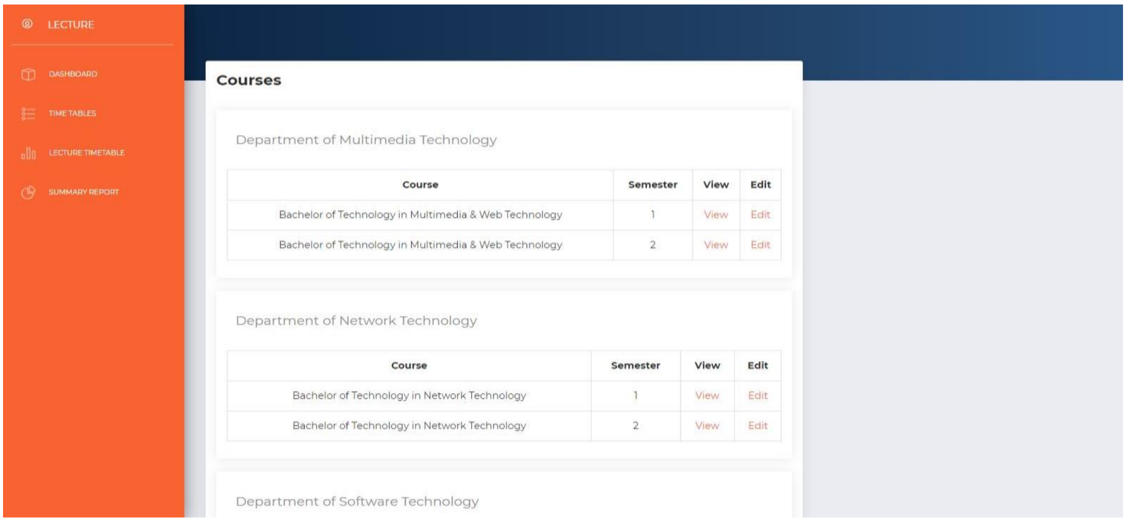
User Role: admin

Department: Department of Multimedia Technology

Figure B. 7Add users to the system

Manage Timetables

When you log on to the system with Lecturer only you can manage time tables on this system. Upon the click of the Lecturer link from screen will result the following screen (Figure B.8 and B.9) to the lecturer. Add and Update timetable and it will update and visible all logged users simultaneously.



Courses

Department of Multimedia Technology

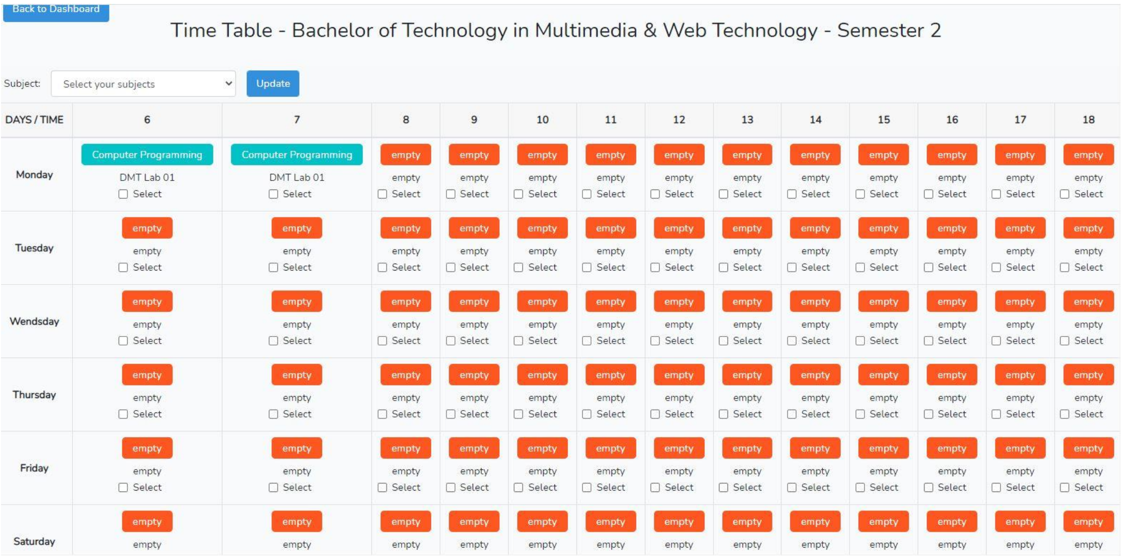
Course	Semester	View	Edit
Bachelor of Technology in Multimedia & Web Technology	1	View	Edit
Bachelor of Technology in Multimedia & Web Technology	2	View	Edit

Department of Network Technology

Course	Semester	View	Edit
Bachelor of Technology in Network Technology	1	View	Edit
Bachelor of Technology in Network Technology	2	View	Edit

Department of Software Technology

Figure B. 8 Manage timetable screen



Time Table - Bachelor of Technology in Multimedia & Web Technology - Semester 2

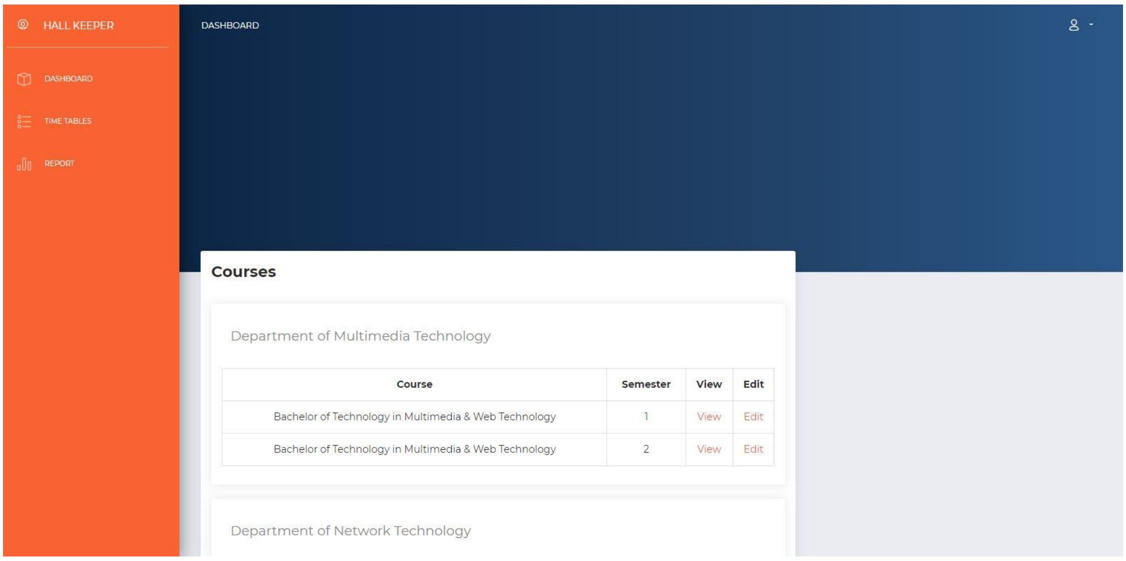
Subject: Select your subjects

DAYS / TIME	6	7	8	9	10	11	12	13	14	15	16	17	18
Monday	Computer Programming DMT Lab 01 ☐ Select	Computer Programming DMT Lab 01 ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Tuesday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Wendsday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Thursday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Friday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Saturday	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty

Figure B. 9 Create timetable

Manage Hall

When you log on to the system with Hall keeper only you can manage hall and labs of the institute on this system. Upon the click of the Hall keeper link from screen will result the following screen (Figure B.10 and B.11) to the hall keeper. Add and Update hall and allocate according to the timetable is possible on this system.



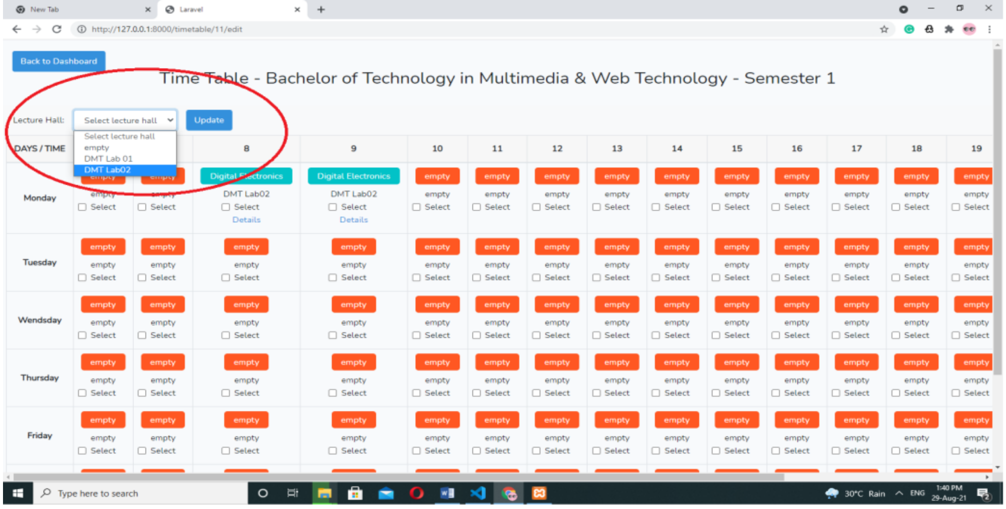
Courses

Department of Multimedia Technology

Course	Semester	View	Edit
Bachelor of Technology in Multimedia & Web Technology	1	View	Edit
Bachelor of Technology in Multimedia & Web Technology	2	View	Edit

Department of Network Technology

Figure B. 10 Manage hall screen



http://127.0.0.1:8000/timetable/11/edit

Time Table - Bachelor of Technology in Multimedia & Web Technology - Semester 1

Lecture Hall: Select lecture hall

- Select lecture hall
- empty
- DMT Lab 01
- DMT Lab02

DAYS / TIME			8	9	10	11	12	13	14	15	16	17	18	19
Monday	empty empty ☐ Select	empty empty ☐ Select	Digital Electronics DMT Lab02 ☐ Select Details	Digital Electronics DMT Lab02 ☐ Select Details	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Tuesday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Wendsday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Thursday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select
Friday	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select	empty empty ☐ Select

Figure B. 11 Assign hall to the subjects

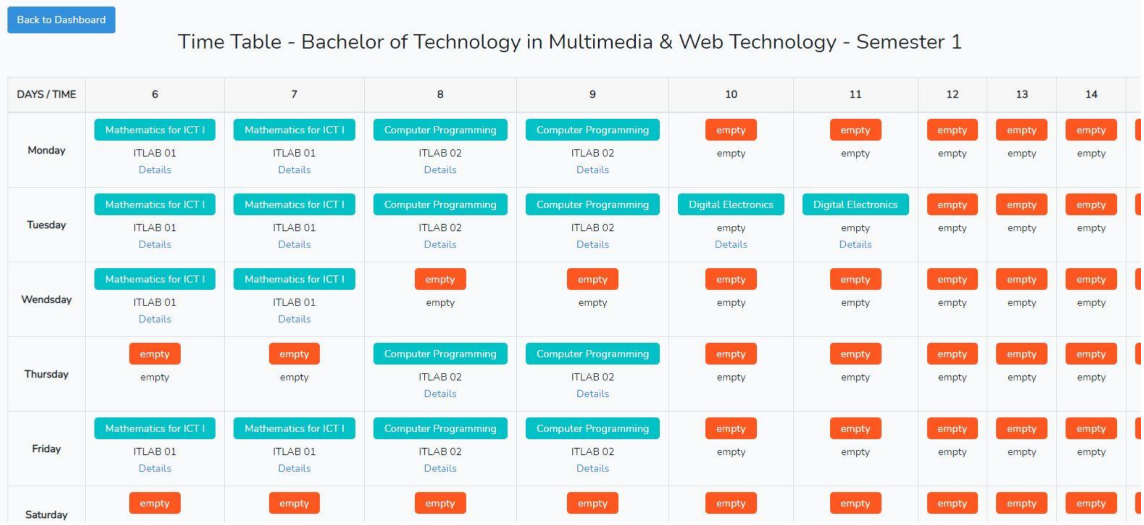
APPENDIX C-MANAGEMENT REPORTS

Introduction

As per the objectives set out at the inception phase of this system, management reports provide useful information to the management to assist in their decision-making process. Some mandatory data analysis reports will be illustrated and discussed in detail in the following topics.

Semester Timetable

The Semester Timetable shows the all subjects allocated to the semester within the week, with relevant lecturer details and hall arrange for the semester on this report. The following figure (Figure C 1) shows the semester report for the week.



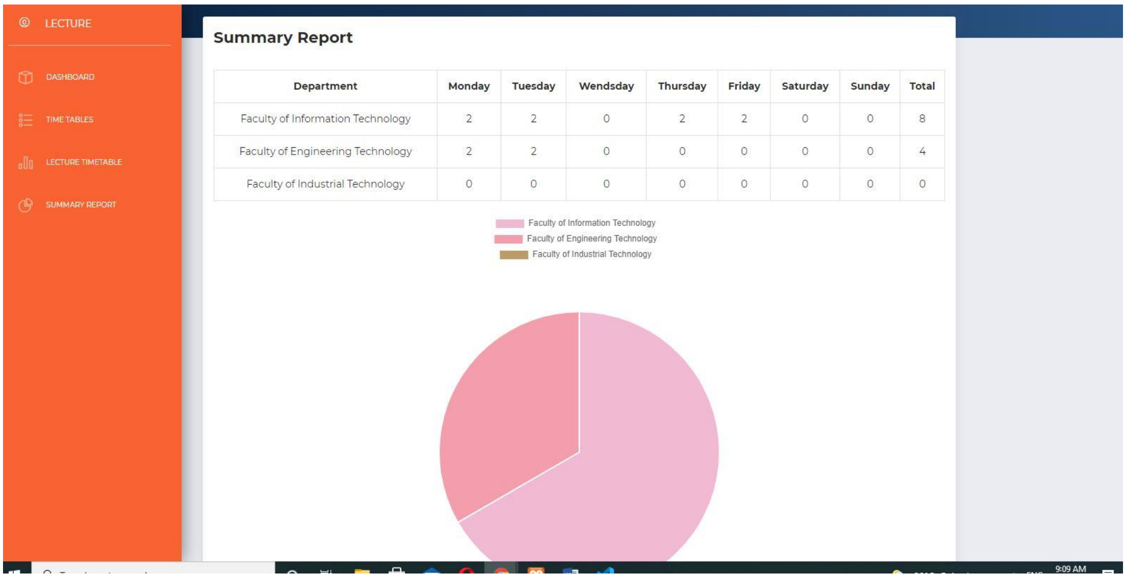
Time Table - Bachelor of Technology in Multimedia & Web Technology - Semester 1

DAYS / TIME	6	7	8	9	10	11	12	13	14
Monday	Mathematics for ICT I ITLAB 01 Details	Mathematics for ICT I ITLAB 01 Details	Computer Programming ITLAB 02 Details	Computer Programming ITLAB 02 Details	empty empty	empty empty	empty empty	empty empty	empty empty
Tuesday	Mathematics for ICT I ITLAB 01 Details	Mathematics for ICT I ITLAB 01 Details	Computer Programming ITLAB 02 Details	Computer Programming ITLAB 02 Details	Digital Electronics empty Details	Digital Electronics empty Details	empty empty	empty empty	empty empty
Wendsday	Mathematics for ICT I ITLAB 01 Details	Mathematics for ICT I ITLAB 01 Details	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty	empty empty
Thursday	empty empty	empty empty	Computer Programming ITLAB 02 Details	Computer Programming ITLAB 02 Details	empty empty	empty empty	empty empty	empty empty	empty empty
Friday	Mathematics for ICT I ITLAB 01 Details	Mathematics for ICT I ITLAB 01 Details	Computer Programming ITLAB 02 Details	Computer Programming ITLAB 02 Details	empty empty	empty empty	empty empty	empty empty	empty empty
Saturday	empty	empty	empty	empty	empty	empty	empty	empty	empty

Figure C. 1 : Semester Timetable

Lecturer Progress Report

The summery of lecturers total lecturing hours for each faculty for the week shows in the following figure (Figure C 2).


LECTURE
DASHBOARD
TIME TABLES
LECTURE TIMETABLE
SUMMARY REPORT
Faculty of Information Technology
Faculty of Engineering Technology
Faculty of Industrial Technology
9:09 AM

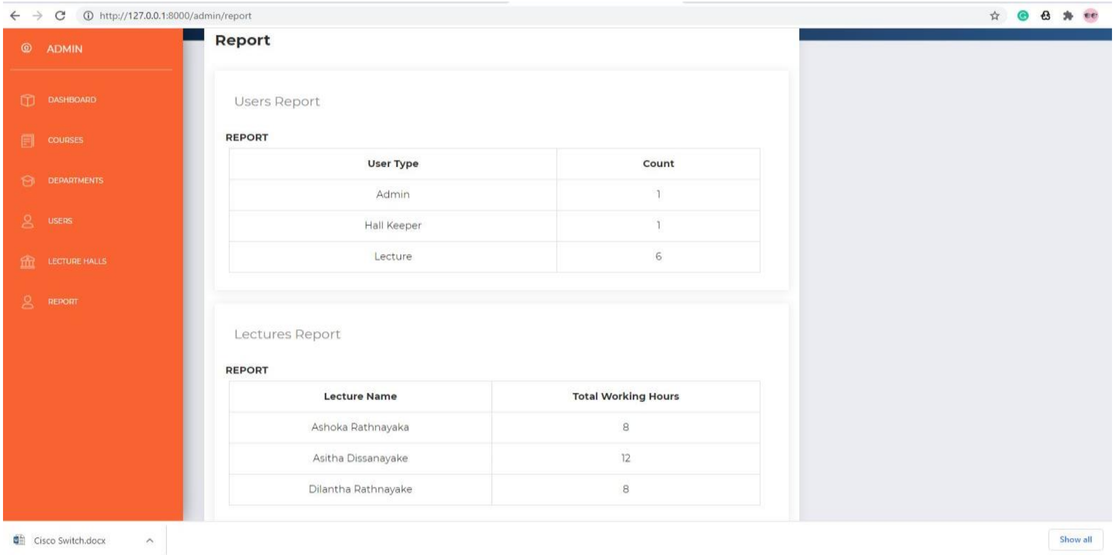
Summary Report

Department	Monday	Tuesday	Wendsday	Thursday	Friday	Saturday	Sunday	Total
Faculty of Information Technology	2	2	0	2	2	0	0	8
Faculty of Engineering Technology	2	2	0	0	0	0	0	4
Faculty of Industrial Technology	0	0	0	0	0	0	0	0

Figure C. 2 : Programme Modules Report

List of Lecturer Hours Report

The count of registered users of the system and all lecturers working hour count report is shown below in Figure C 3.



Report

Users Report

REPORT

User Type	Count
Admin	1
Hall Keeper	1
Lecture	6

Lectures Report

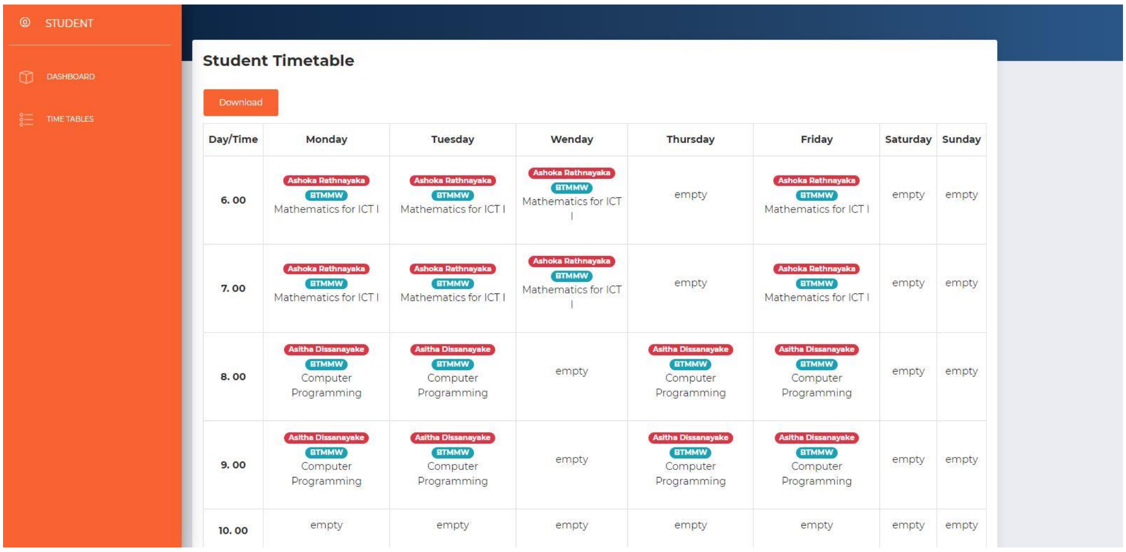
REPORT

Lecture Name	Total Working Hours
Ashoka Rathnayaka	8
Asitha Dissanayake	12
Dilantha Rathnayake	8

Figure C. 3 Lecture hour report

Lecture Hall/Lab Allocation Report

The following report (Figure C4) shows labs/hall allocation list for the week.



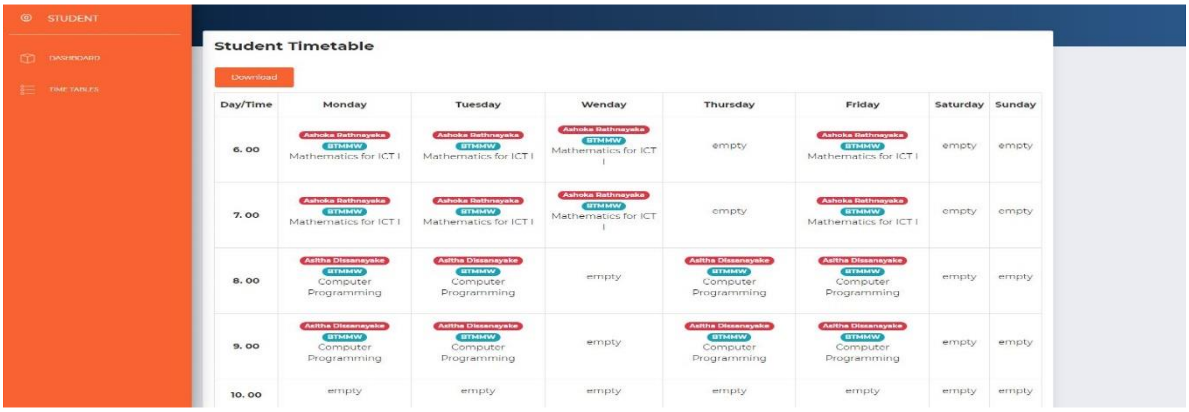
Student Timetable

Day/Time	Monday	Tuesday	Wenday	Thursday	Friday	Saturday	Sunday
6. 00	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	empty
7. 00	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	empty
8. 00	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	empty
9. 00	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	empty
10. 00	empty	empty	empty	empty	empty	empty	empty

Figure C. 4 Lab/Hall Allocation Report

Students Timetable

The following report (Figure C5) shows students timetable for the week with lecturer subject and relevant venue.



Student Timetable

Day/Time	Monday	Tuesday	Wenday	Thursday	Friday	Saturday	Sunday
6. 00	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	empty
7. 00	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	Ashoka Rathnayaka BTMMW Mathematics for ICT I	empty	empty
8. 00	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	empty
9. 00	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	Asitha Dissanayake BTMMW Computer Programming	Asitha Dissanayake BTMMW Computer Programming	empty	empty
10. 00	empty	empty	empty	empty	empty	empty	empty

Figure C. 5 Students timetable