

ST. XAVIER'S COLLEGE

(Affiliated to Tribhuvan University)
Maitighar, Kathmandu



Final Year Internship Project Report
on
“Restful Services for College Review System”
At
“TyroCity Pvt. Ltd”
[CSC-452]

For the partial fulfillment of the requirement for the degree of Bachelor of Science
in Computer Science and Information Technology awarded by Tribhuvan
University

Under the Supervision of
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Submitted To:
ST. XAVIER'S COLLEGE
Department of Computer Science
Maitighar, Kathmandu, Nepal
February 18, 2018

Restful Services for College Review System
[CSC - 452]

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CERTIFICATE OF APPROVAL

The undersigned certify that they have read and recommended to the Department of Computer Science for acceptance, an internship proposal entitled “**Restful Services for College Review System**” submitted by **Arun Sanjel (TU Roll No. 2677/070)** and for the partial fulfillment of the requirement for the degree of Bachelor of Science in Computer Science and Information Technology awarded by Tribhuvan University.

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ABSTRACT

In the life of student, college plays a vital role for his/her development. The college or university plays a major role for their career. Currently, students are not only seeking for college with best academic results but are searching for colleges with best learning and teaching practices. Developed countries have their own system to review and rate colleges and university which gives a brief overview of the college.

In context of Nepal, the college review and rating systems are not present. Only way to get information about the college and all facilities are through their websites or magazines. The project “**Restful Services for College Review System**” tackles the problem of college review in Nepal. The review system here used is an algorithm created by the organization which evaluates the college/university by their academic results, physical infrastructure, faculties, teachers and students. Not only these information, the system also takes student feedback and after college life of the students into consideration producing an unbiased review. The review systems grade colleges in scale of 0% to 100%, where 100% referring to best college.

The project is not only a review system but also provides complete profile of the college or university. It involves ICT in education for giving out information about colleges along with review which will help the students making correct choices in their career.

Keywords: *Restful Services, College Review, ICT in education, Algorithms, Information System.*

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LIST OF ABBREVIATIONS

API	Application Program Interface
IT	Information Technology
ICT	Information Communication Technology
CRS	College Review System
CEO	Chief Executive Officer
ARWU	Academic Ranking of World Universities
HTTP	Hypertext Transfer Protocol
SOAP	Simple Object Access Protocol
REST	Representational State Transfer
JSON	JavaScript Object Notation
URL	Uniform resource Locator
XML	Extensible Markup Language
SOA	Service Oriented Architecture
CRUD	Create, Read, Update, Delete
IDE	Integrated Development Environment

CHAPTER 1: INTRODUCTION

1.1 Introduction to Internship

The internship program is designed to provide students engaged in a field experience with an opportunity to share their insights, to explore the links between students' academic preparation and their field work, and to assist participants in developing and carrying out the major research project which will serve to culminate their internship experience. Internships are individualized and tailored to the needs and interests of each student in the program. As part of the internship experience, students are expected to take an active role in finding an appropriate internship for themselves [1][2].

Internship is considered as the practical implementation of the theory education that provides a chance to use the skills learned in the classroom in a real-world setting. It provides opportunities to gain work experience that cannot be achieved just with the theory knowledge which aids in shaping the professional career for beginners like university students. Also, internship is a wonderful and effective way to connect academic knowledge with the professional work and experience. Allowing students to gain valuable exposure to the workplace arena [3].

The modern concept of internships essentially springs from the medieval apprenticeship, in which skilled laborers (often craftsmen) would teach a young person their trade and, in exchange, that person would agree to work for the teacher for a certain length of time [4].

The internship is done as a partial fulfilment of requirements of the Bachelor's degree in Computer Science and Information Technology under Tribhuvan University. The internship is assigned six credit hours (minimum of ten weeks or 180 hours long) as a part of the course requirement.

1.2 Background

With advancement of technology, variety of fields are incorporating technology in them. Being an under developed nation, technology growth is lacking in our country. The information system in our country is also lacking. Here, the information system regarding the education is way less as compared to developed nation. Education being a backbone to a nation, involving ICT in it will enhance the quality of education. The College Review System is such a project which provides the complete profile of any college or university with reviews and rating computed with certain algorithms. The idea of review system was considered after taking the user feedback. The CRS is an extensive college information system which analyzed the college data and produce the statistical review. The review is done with algorithm that was created by the organization. With academic result, physical infrastructure, and faculties being its major parameters in this review system. The information and review of college from this system will help student in picking right college for brighter and better career.

1.3 Project Objectives

1.3.1 Internship Objectives

- To gain knowledge and experience on how a real-world company works.
- To develop the skills required to work in a real work environment.
- To enhance understanding of organizational and group processes.
- To develop the skills required to work in a team.
- To learn to work under industry standard software development strategies and processes like Agile
- To get acquainted with industry standard tools like Git, Scrum
- To gain work experience

1.3.2 Project Objectives

- To produce an API for College Review System.
- To make API cross platform compatible.
- To implement the review system in existing education portal of tyrocity.

1.4 Brief Introduction of the Industry

The Software Industry consists of that part of computer programming activity that is traded between software-producing organizations and corporate or individual software consumers. Traded software represents only a fraction of domestic software activity, whose extent cannot be reliably estimated, since much computer programming takes place within firms and its value is not captured by the industrial census or software industry analysts. The traded software industry consists of three main sectors: programming services, enterprise software products, and shrink-wrapped software products. These three sectors became established in the mid-1950s, the mid-1960s, and the late 1970s, respectively, in response to the technological opportunities and the business environment of the time [6].

Software development is the process of computer programming, documenting, testing, and bug fixing involved in creating and maintaining applications and frameworks resulting in a software product. Software development is a process of writing and maintaining the source code, but in a broader sense, it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process [7].

The software industry expanded in the early 1960s, almost immediately after computers were first sold in mass-produced quantities. Universities, government, and business customers created a demand for software. Many of these programs were written in-house by full-time staff programmers. Some were distributed freely between users of a particular machine for no charge. Others were done on a

commercial basis, and other firms such as Computer Sciences Corporation (founded in 1959) started to grow. Other influential or typical software companies begun in the early 1960s included Advanced Computer Techniques, Automatic Data Processing, Applied Data Research, and Informatics General [8] [9].

1.5 Brief Introduction to the Organization

1.5.1 About Organization

TyroCity Private Limited is a focused team of technology experts and development practitioners who provide integrated and innovative solutions and services to its clientele. The organization emphasizes on facilitating the organizations, streamlining the work culture with the aid of the modern technology and integrating different work procedures. The organization's core capabilities include solutions and services in the field of software development, business/knowledge process outsourcing as well as consultancy and advisory services on information and communication technologies (ICT).

SERVICES [10]:

- Web Development
- Ecommerce
- Application Development
- Content Marketing
- Brand Identity

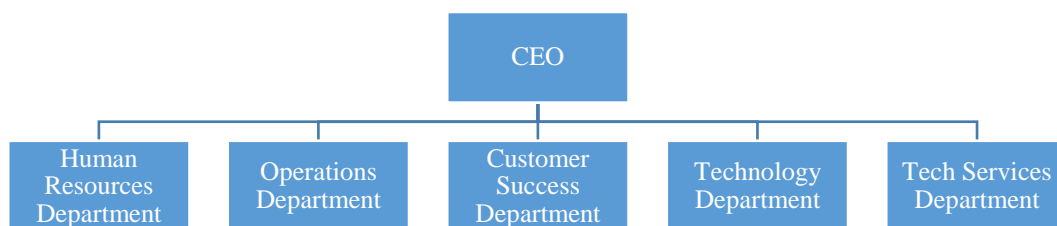
1.5.2 Organization Rationale

TyroCity Private Limited is rooted in the philosophy of serving the clients in a shared value. Flexible business models encourage relationships that can grow and last. Excellence through quality is the foundation on which TyroCity is built. Established corporate traditions of excellence and outstanding customer service are

the trademarks of TyroCity. TyroCity Private Limited bring all the benefits of IT expert

1.5.3 Organization Hierarchy

The team at TyroCity is led by Mr. Angel Poudel, CEO. He constantly motivates his employees and encourages them to come up with new and interesting ideas and does his best to drive the company forward.



1.5.4 Contact Details

Name of Organization	TyroCity Pvt. Ltd.
Location	Kalanki, Kathmandu
Contact	+977-9849865288
Website	http://tyrocity.com
Email Address	info@tyrocity.com

Table 1Contact Details of TyroCity

CHAPTER 2: ANALYSIS OF ACTIVITIES DONE

2.1 Internship Placement Details

The internship is done as a partial fulfilment of requirements of the Bachelor's degree in Computer Science and Information Technology under Tribhuvan University. The internship is assigned six credit hours (minimum of ten weeks or 180 hours long) as a part of the course requirement. The Organization followed a systematic process for selection. First of all, the organization carried out an interview which was followed with a programming task to test the candidate's adaptability to new problems.

2.1.1 Organization Selection

The author being interested in Android mobile application development performed a researched-on software houses that were actively working in field of ICT in education. The author considered their portfolio and used some of the applications developed by the various organizations. The author after completion of research applied for internship at a couple of organization and was called for interview. Out of the options available, the author decided to join TyroCity Pvt. Ltd. for internship. The major reason for selecting TyroCity was its friendly learning environment and a strong portfolio which includes four years continuous working in the field of education.

2.1.2 Placement

During the internship, the author was provided with a working environment alongside the other employees of the organization. The author was provided with information on how the organization operates and the proper guidelines on how the different processes in the organization are carried out.

2.1.3 Duration

The internship lasted for 3 months and the author was expected to be at the office on every business day for nine hours.

Start Date	1 st September, 2017
End Date	30 th December, 2017
Total Duration	4 Months
Office Hours	9.30 AM - 6.30 PM
Working Hours	9 Hours
Working Days	5 Days a Week
Holidays	Saturday, Sunday

2.1.4 Roles and Responsibilities

During the internship period at TyroCity Pvt. Ltd., the author was assigned various roles and responsibilities. The responsibilities included all parts of API development process from initial analysis to deployment.

- Research on new technologies for Rest API
- Complete the daily task assigned by the authority
- Research on database technology, and Restful services
- Research on review and rating algorithm

2.2 Literature Review

The overall goal of this project is help student in making right choice for betterment of their career. In this ICT world, the computer can perform many analysis and produces various of report. These analysis and report can be vital in our decision-making process. This project is a kind of analysis and reporting system which will give students reports and review about colleges helping them to make the vital and important decision for their life.

2.2.1 Education and ICT

Education is the existence of human societies as it evolves the conveyance of all knowledge that is considered beneficial. It improves the ability of a person to contribute to the development of his society. Information and Communication Technology (ICT) has been adopted in education due to its perceived advantages. Different nations have tried adopting different strategies to choose the right ICT infrastructure with varying degree of success due to the absence of a standard procedure that can be used for the said purpose [11].

Nobody can ignore the national and international contributions of higher educational institutions in terms of manpower development and knowledge creation that is why government and private organizations have established links and provided support to universities. Also, many systems have been designed and developed to facilitate their operations, and improve their strategic planning capacity [12]. However, very little attention is given to individual colleges within universities, as evidenced by the lack of efficient facilities for private and government entities to directly interface with the college coordinators and administrators, the lack of physical resources available for own use of the college, and the lack of information systems that assist the individual colleges in its operations and decisions. College administrators face huge challenges in complying with policies and standards of their respective academic institution, in providing quality instructions to students, in developing their faculty members, in upgrading their program and curriculums, and in managing the colleges own operations. These challenges warrant an effective and efficient system that assists college administrators in management and decision-making, such as a College Management Information System (CMIS) [13].

2.2.2 Information Systems and Decision Making

The relationship between information system and decision making is a central concern in the field of information system (IS). The main objective of information systems is helping decision makers by providing accurate and time-based

information helping them in making the right decisions in turbulent environment. A successful organization nowadays relies heavily on information systems to improve its work in one hand, and on the other hand achieving its goals and benefits. Management Information Systems helps in solving both structured and unstructured problem environments. Information is considered as a most important ingredient for success decision making in now a days companies, Due to the importance of information in decision making a developed system has emerged to serve the appropriate information's to managers for good decision making process; called information system [14].

Management Information Systems is of paramount importance to reach effective decisions in an organization. The literatures presented in this study explained the significant role of MIS in the decision-making process enhancing in an organization. MIS is deemed to be an integrated user-machine system that provides information to support operations, management and decision-making functions at various levels of an organization. Organizations are aware that MIS is a special-purpose system useful for management objectives. The study has highlighted that MIS should be accessible in supplying appropriate and high quality of information from its generation to its users. To MIS, to be vital and effective, a carefully conceived, designed and executed database should exist to communicate the adaptive decisions [15].

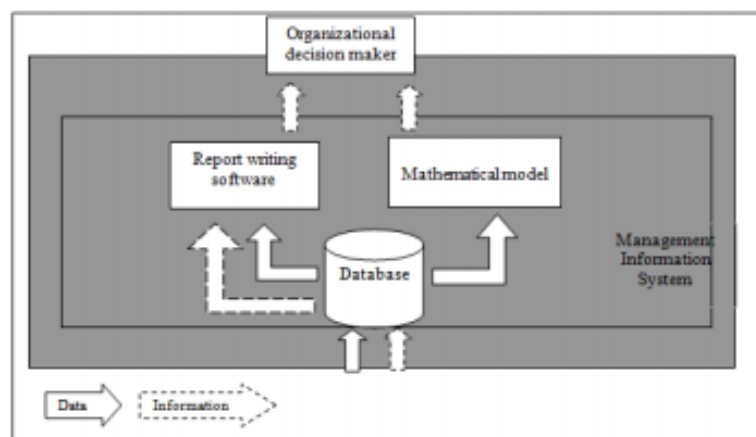


Figure 1 MIS Model for Decision Making [16]

2.2.3 College Review, Rating and Ranking

We, people love ranking systems. Whether we are ranking the hottest celebrities, the top ten singles, the top chef, or the next design star, ranking seems to be built into as a symptom of our competitive, aspirational nature, and our desire to quickly understand the value of things. This desire has fueled a veritable ranking industry with respect to institutions of higher education. There is great diversity in what ranking systems purport to rank. Beyond the well-known U.S. News and World Report (USNWR) “Best Colleges” lists are those that rank specific institutional types, such as flagship, land-grant, and international universities. Others aim to provide information to consumers about how a particular college or university rates on anything from “value,” broadly defined, to institutional commitment to sustainability, gender balance within the student population, and salaries of recent graduates, to the perceived quality of its athletic facilities, the popularity of its website, or its status as a party school [17].

History of College Review

When U.S. News & World Report began its ranking of American colleges in 1983, publishers in other countries quickly followed with their own hierarchical measures, providing consumer information (and opportunities for institutional marketing) while attempting to impact the quality of higher education. In the course of the last two decades, higher education ranking systems and “league tables” (as they are referred to in the United Kingdom and elsewhere) have emerged in dozens of countries [18].

The general disinterest in university rankings began to change in 1983 with the publication of ‘America’s Best Colleges’ by the US News and World Report. For the first-time information about undergraduate programs in America’s higher education institutions was made widely and publicly available to the country’s high school population and their parents via a widely read popular medium [19].

What are university ranking system?

University rankings, or league tables as they are often referred to internationally, are mechanisms that use available information to rank order institutions of higher education based on criteria defined by the ranking organization. The purpose of ranking systems is to quantify—down to a single number—the relative quality of institutions. The process of reducing institutions to one number makes most of researchers and academics cringe, because we fully understand that the complexities of institutions of higher education cannot be boiled down to a single 2- or 3-digit number [20].

2.2.4 Review Methodology

University are ranked and reviewed in several factors producing different league tables. Some majors ranking and review system in the world are:

- Academic ranking producing league table
 - Academic ranking of World Universities (Shanghai)
 - Time Higher Education World University Ranking
 - US News and World Report with Quacquarelli Symonds
- Ranking concentrating only in research only
 - Leiden Ranking (Leiden University)
 - Taiwan Ranking of Research Papers
- Multi Ranking without League Tables
 - CHE/die Zeit University Ranking (CHE, Germany)
 - U-Map Classification [21]

The Time Higher Education World University Ranking has grouped its criteria in five areas:

- Teaching (Learning Environment)
- Research (Volume, Income and Reputation)
- Citations (Research Influence)
- International Outlook (Staff, Students and Research)
- Industry Transfer (Knowledge Transfer) [22]

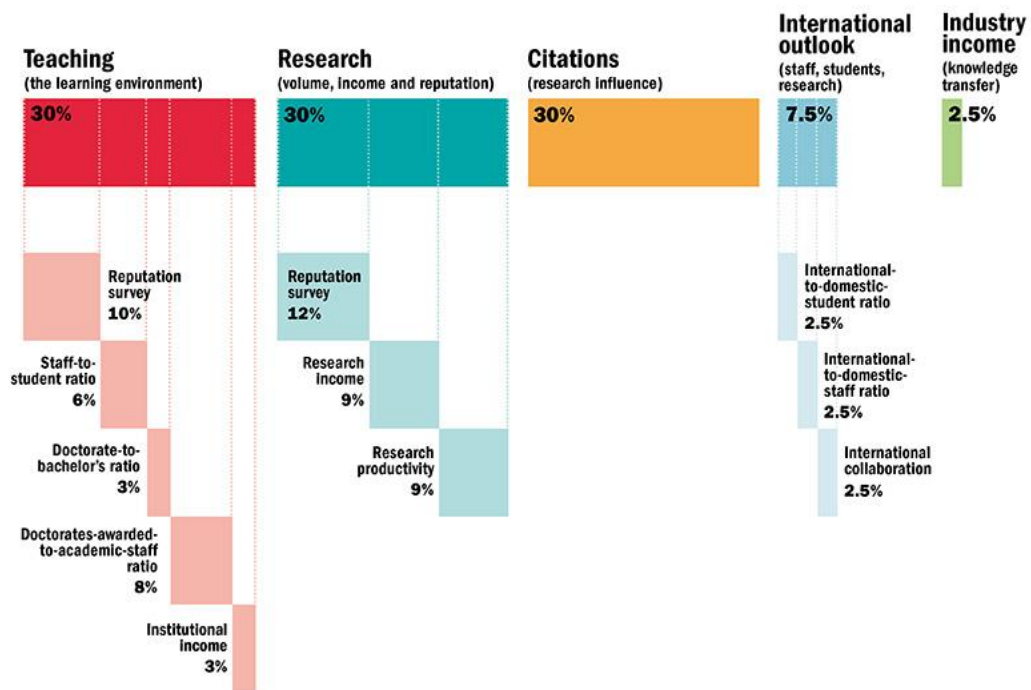


Figure 2 Times Higher Education Ranking Areas with Weightage [22]

ARWU (Shanghai) considers every university that has any Nobel Laureates, Fields Medalists, Highly Cited Researchers, or papers published in Nature or Science. In addition, universities with significant amount of papers indexed by Science Citation Index-Expanded (SCIE) and Social Science Citation Index (SSCI) are also included. In total, more than 1300 universities are actually ranked and the best 500 are published [23].

Ranking Criteria and Weights

Criteria	Indicator	Weights
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	40%
Research Output	Highly cited researchers in 21 broad subject categories Papers published in Nature and Science* Papers indexed in Science Citation Index-expanded and Social Science Citation Index	40%
Per Capita Performance	Per capita academic performance of an institution	10%

Table 2 Ranking Criteria and their Weightage for ARWU [23]

Another ranking system is U – Map Classification which uses neutral process indicators not for value judgements or ranking, it is kind of indicators rather than ranking. The basic criteria are:

- Teaching and Learning - levels and orientation of degree, subject range
- Student Profile
- Research Activity
- Knowledge Exchange
- International Orientation
- Regional Engagement [24]



Figure 3 Default Set of 15 indicators [25]

2.2.5 Restful Services

Representational State Transfer (REST) is an architectural style for designing loosely coupled web services. It is mainly used to develop lightweight, fast, scalable, and easy to maintain, web services that often use HTTP as means of communication [26].

Why REST web services?

REST-based Web services are implemented using HTTP. They offer a light-weight alternative to the original SOAP and WSDL-based Web services. REST works with resources that are identified with a Uniform Resource Identifier (URI). REST resources are named with nouns as part of the URI rather than verbs; for example, **/customers** rather than **/getCustomers**. One of the key characteristics of RESTful Web API is that the URI or the request message does not include a verb. To use REST services, a client sends an HTTP request using the GET, POST, PUT, or DELETE verb. The traditional HTTP error messages (for example, 200 - OK and 404 - Not found) can be used to indicate whether a request is successful. If a request is successful, information can be returned in Extensible Markup Language (XML) or JavaScript Object Notation (JSON) format [27].

REST v/s SOAP

SOAP	REST
It is well known old traditional Technology	It is new technology as compared to SOAP
Within the enterprise and in B2B scenarios, SOAP is still very attractive.	This is not to say that REST is not enterprise ready. In fact, there are known successful RESTful implementations in mission critical applications such as banking.
In SOAP, Client-Server interaction is Tightly coupled	In REST, Client-Server interaction is loosely coupled.
In case of implementation, SOAP overtakes REST as there are established development kits in case of SOAP.	But REST developers would argue that it's got interface flexibility.
Changing services in SOAP web provisioning often means a complicated code change on the client side.	Changing services in REST web provisioning not requires any change in client side code.
SOAP has heavy payload as compared to REST.	REST is definitely lightweight as it is meant for lightweight data transfer over a most commonly known interface, - the URI
It requires binary attachment parsing.	It supports all data types directly.
SOAP uses HTTP based APIs refer to APIs that are exposed as one or more HTTP URIs and typical responses are in XML / JSON. Response schemas are custom per object	REST on the other hand adds an element of using standardized URIs, and also giving importance to the HTTP verb used (i.e. GET / POST / PUT etc)

Harder to develop, requires tools.	Much simpler to develop web services than SOAP
Language, platform, and transport agnostic.	Language and platform agnostic

Table 3 Major Differences between REST and SOAP architecture [28]

2.2.6 Performance Evaluation of Restful Services

This communication between the applications is based on SOAP and REST principle. SOAP communications cause network traffic, higher latency and processing delays. To overcome this limitation RESTful architecture is used. REST is a lightweight, easy and better alternative for the SOAP [29].

MULTIMEDIA CONFERENCING API	SOAP-based			REST-based		
	<i>Delay in a distributed environment (ms)</i>	<i>Delay on the same machine (ms)</i>	<i>Network load (bytes)</i>	<i>Delay in a distributed environment (ms)</i>	<i>Delay on the same machine (ms)</i>	<i>Network load (bytes)</i>
Create conference	848.4	381.7	767	171.4	102.7	273
Get conference information	818.6	335.3	546	172.3	98.6	177
Add participant	1325.3	334.2	578	368.8	103.3	200
Remove participant	1322.3	357	588	382.9	107.2	195
Get participants	787.1	342.7	615	197.8	104.8	195
Get participant information	766.2	346.7	619	169.8	105	204
End conference	1508.4	341.4	500	556.6	105.3	204

Table 4 Performance Results Using Soap And Rest Interfaces [30]

2.3 Specific Problem Analysis

The Problem Analysis process helps teams and individuals trying to solve a specific problem to focus on the solutions that will best solve the problem. Analyzing a

problem has help identify sub-problems which can be solved in order to solve the problem as a whole. Also, it helps to create a list of solutions among which the best one can be chosen according to the characteristics of the problem at hand.

There was no any mobile platform application which help the user to view the contents and data and information on the website easily.

2.3.1 Understanding Existing Systems

The first challenge was to understand current existing system which provides college rank and review. Some famous college review systems are available in the internet but none of them work for our country. These systems generally divide review into multiple parameter and measure them. They used history of data and data sets to analyze and compute review for each of the college. These systems were thoroughly studied with detail view of how the system is working. The major challenge was to figure out how the data can be collected for each and every college in the country.

2.3.2 Development of Project Goals

After the analysis of the existing systems, the primary goal of the project was to build an API that is restful and works on JSON data. The user feeds all data to the API using data pump service. The validator that checks all the validation work of the API. At last, an algorithm that compute and provide rating from given data.

2.4 Management Strategy

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements and to execute projects effectively and efficiently [31]. Project management is the discipline of planning, organizing, and controlling resources to achieve specific goals. Project Management deals with various issues like time and cost management. Project management takes a strategic approach to managing resources in the project.

2.4.1 Time Management Strategy

Time management is the process of allocating time for the various activities and tasks involved in completing a project. The first few weeks were used to research on how the required data can be collected and on learning how to build basic mobile application. The following weeks dealt with development of the system along with research on how the collected data can be analyzed and meaningful information can be extracted from it.

2.4.2 Cost Management Strategy

It is very important to control the cost of a project and to complete it within a certain budget. It is necessary to control the quality of the project with respect to the available budget.

2.5 Project Schedule

2.5.1 Time Schedule

Task Name	Start Date	End Date
Planning and Analysis	10/01/17	10/14/17
Idea and Concept Generation	10/01/17	10/01/17
Project Topic Selection and Analysis	10/02/17	10/02/17
Research and Paper Study	10/03/17	10/06/17
Feasibility Study	10/07/17	10/08/17
Background Study	10/09/17	10/09/17
Requirement Study	10/10/17	10/11/17
Preliminary Research on The Project	10/12/17	10/14/17
Project Proposal	10/15/17	10/18/17
Preparing Project Proposal	10/15/17	10/16/17
Proposal Submission	10/17/17	10/17/17
Initial Review	10/18/17	10/18/17
Research	10/20/17	11/05/17
Research on Review and Rating System	10/20/17	10/22/17
Research on Go Programming	10/23/17	10/26/17
Research on Cassandra Database	10/27/17	10/28/17
Research on Restful Services	10/29/17	11/04/17

Meeting the Supervisor	11/05/17	11/05/17
Design	11/06/17	11/10/17
Data Flow Diagram	11/06/17	11/07/17
Other Design Diagrams	11/08/17	11/09/17
Review of Project	11/10/17	11/10/17
Development and Testing	11/11/17	12/10/17
Review with Supervisor	12/10/17	12/10/17
Report Writing	12/11/17	12/20/17
Draft Report Writing	12/11/17	12/14/17
Proof Reading	12/15/17	12/15/17
Draft Submission to Supervisor	12/16/17	12/16/17
Corrections for Final Draft	12/17/17	12/18/17
Final Documentation Printing and Binding	12/19/17	12/21/17
Final Report Submission to College	12/20/17	12/20/17

2.5.2 GANTT Chart

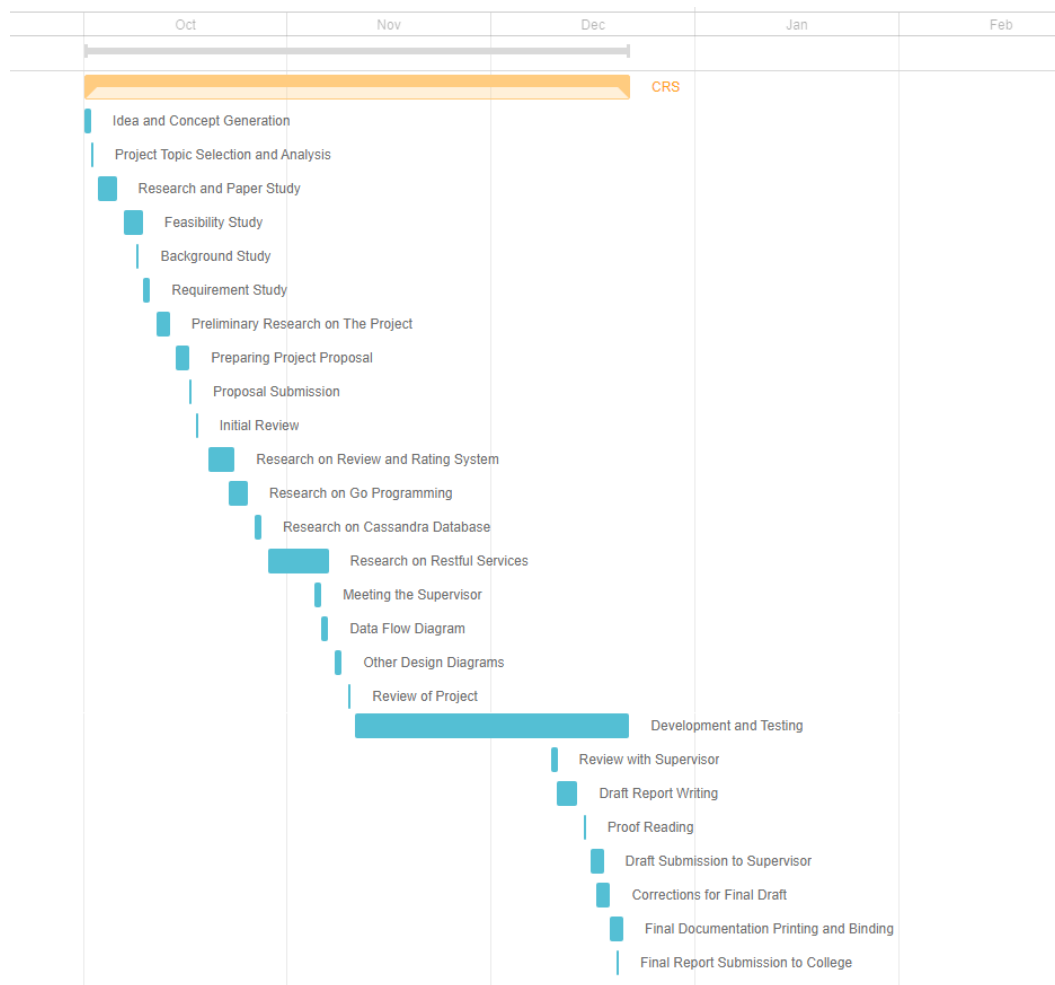


Figure 4 Gannt Chart

CHAPTER 3: SOLUTION DESIGN

3.1 Project Management Plan

A project is a group of activities designed to produce a unique product, service or result. Project management is the application of knowledge, skills and techniques to execute projects effectively and efficiently. Project management is the discipline of planning, organizing, and controlling resources to achieve specific goals. Project management has been necessary and important in this project. The constraints for this project, as for most projects, have been time, cost and quality. Project management is necessary to complete the project under these constraints and utilize the resources properly [32]. The project management process can be categorized into five groups – initiating, planning, executing, monitoring and controlling and closing [33].

3.1.1 System Analysis

System analysis is the study of the system under consideration which includes defining the goals and purposes of the system and to study and figure out the procedures which can be followed to carry them out most efficiently. System analysis is a very important process for developing any kind of systems or to carry out some activity in a system in a systematic manner.

3.1.1.1 Feasibility Study

A feasibility study is done to determine whether the project is technically, economically and operationally feasible. This study helps us know if the project is viable and will also help govern different situations where problems may arise during implementation. The feasibility analysis carried out in this project are elaborated below.

3.1.1.1.1 Technical Feasibility

The technical feasibility study assesses the details of how the project delivers a product or service. This study defines if a project can be feasible in terms of technical requirements or not. The following conclusions were obtained after a thorough technical feasibility study:

- Since the API is REST API, they are based on HTTP protocol and provide simple way to connect. Any HTTP supporting device or unit can communicate with the API.
- The API uses JSON which is light weight and act as standard communication channel.
- The API is based SOA architecture which makes update and maintenance flexible and easy.

3.1.1.1.2 Economic Feasibility

As part of feasibility, the costs and benefits associated with the proposed system are economically feasible as its benefits outweigh costs. The API does not require any additional hardware or software. All the development tools are also available free of cost.

3.1.1.1.3 Legal Feasibility

Implementation of this project does not violate any rules or standards defined by the government of Nepal or any principles internationally. The concepts and techniques taken from other sources are properly cited. The concept also does not violate any copyright act.

3.1.1.1.4 Operational Feasibility

Any project that can be implemented in real world remains beneficial. If it cannot be implemented, it exists only in theoretical approach. This project is feasible operationally. It requires running a single server for storage and analysis of collected data. This is not such a challenging requirement.

3.1.1.1.5 Schedule Feasibility

For this analysis, a time schedule was created prior to the initiation of project and a deadline on which it must be completed. The project has a minimal schedule for completion and can be completed within the defined period.

3.1.2 System Design

Systems design is the process of defining the architecture, components, modules, interfaces, and data for a system such that they conform to the specified requirements. Systems design can be seen as the application of systems theory to product development [34] [35]. It implies a systematic and rigorous approach to design—an approach demanded by the scale and complexity of many systems problems.

The system designs used for building this project include Basic System Architecture, Flowchart, Context diagram, Data flow diagram, ER Diagram and Use Case diagram.

The design of the application addresses the requirements set in the initial stage of the application development. The graphical representation of the project makes us able to have the overview of the system and its various structural and functional aspects. The development phase is hugely assisted by the design of various components. The design part however excludes any association with the code that builds the application.

3.1.2.1 Architecture Diagram

Basic System Architecture



Figure 5 Basic System Architecture

The basic system architecture of the College review system is show above in the figure. The system consists of four major sub system which are described below:

Data Pump: This sub system simply enables users to upload their college data and also receive data from review and rating scores. This system enables user to perform CRUD operation in the database.

Verification Module: The verification module allows admin to review all the uploaded data and verify each of them. Admin verified data are only allowed for reviews.

Parameter Analysis: This module takes verified data from previous system and perform three basic analysis: Result analysis, Infrastructure Analysis, and Research Analysis. These three analyses are bases of the review and rating processor.

Review and Rating Processor: This sub system calculates the rating by using the inputs of verification module and parameter analysis.

3.1.2.2 Flow Chart

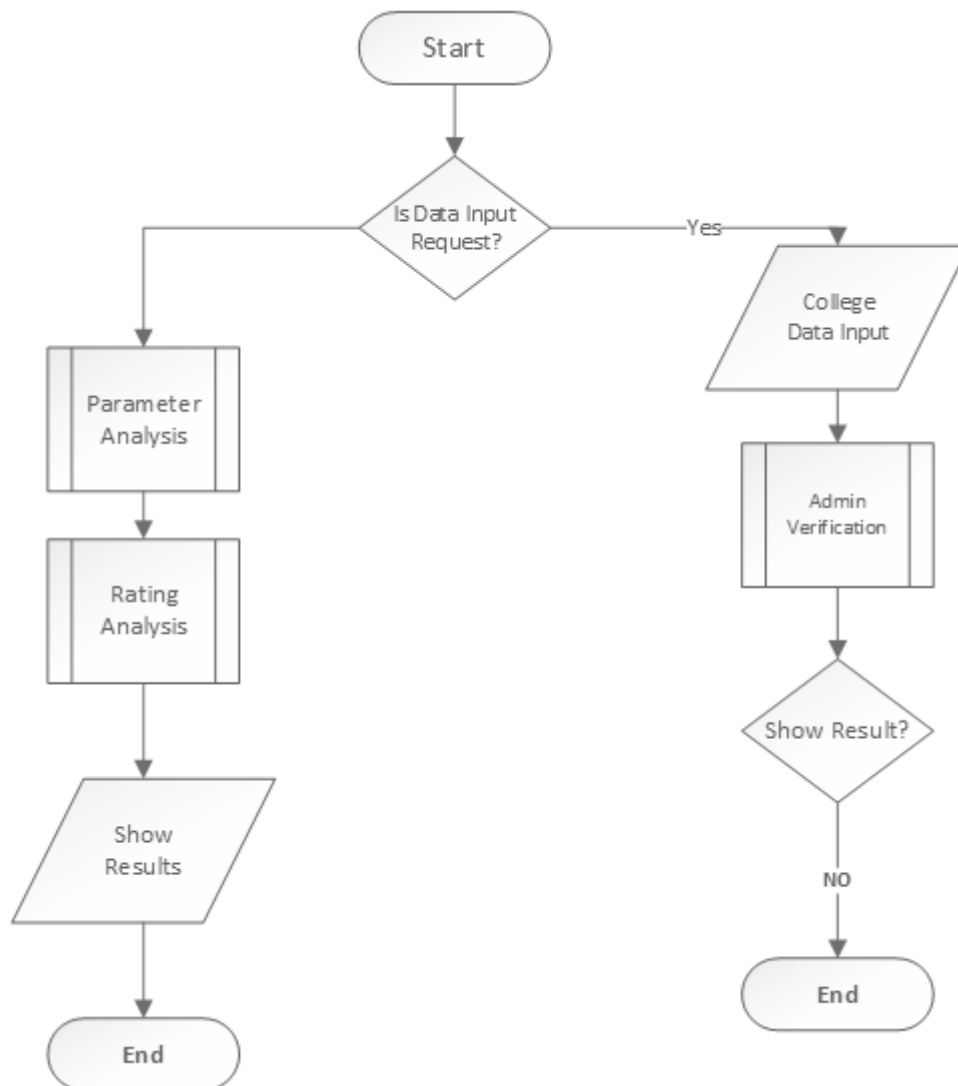


Figure 6 Flowchart of College Review System

The figure 6 shows flowchart of college review system where basic flow of the API is shown.

3.1.2.3 System Context Diagram

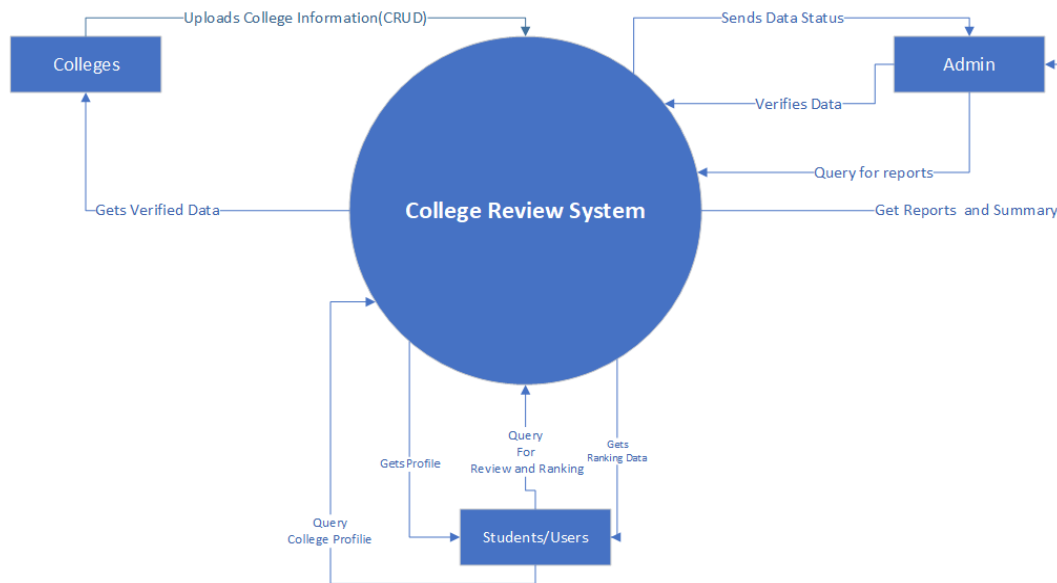


Figure 7 Context diagram

In figure 6, context diagram of College Review System is shown where there are three external agents: Colleges, Admin and Student/Users. The Colleges entity uploads their data in the system which is then verified by the system admin and student/users gets the review and rated scores of the colleges.

3.1.2.3 Data flow diagram

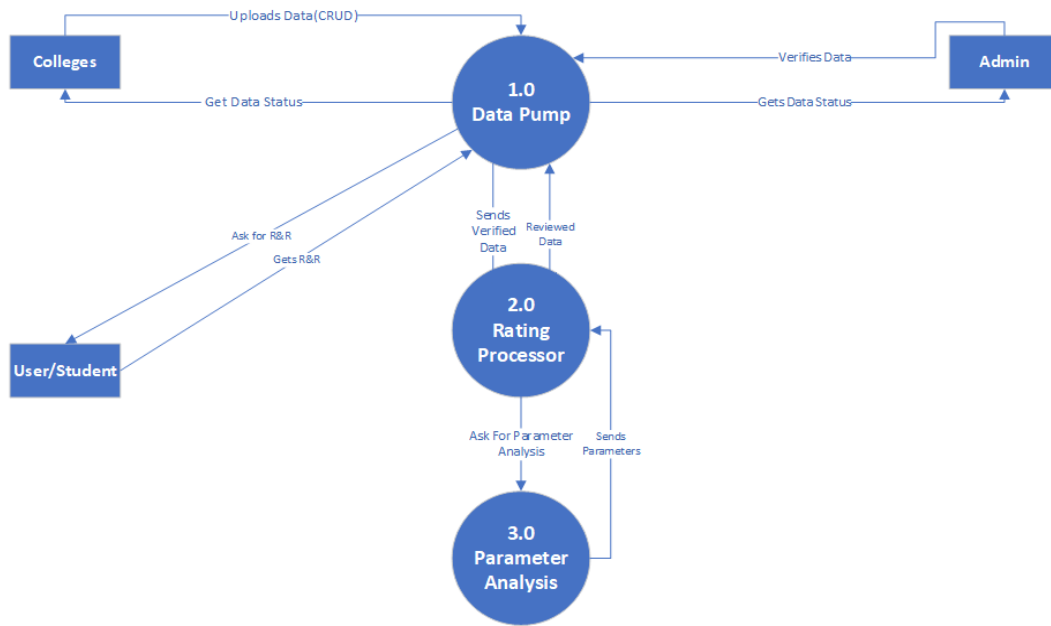


Figure 8 DFD Level 1

Figure 7 shows Data Flow Diagram Level 1 of College Review System where there are 3 sub processes: Data Pump, Rating Processor and Parameter Analysis.

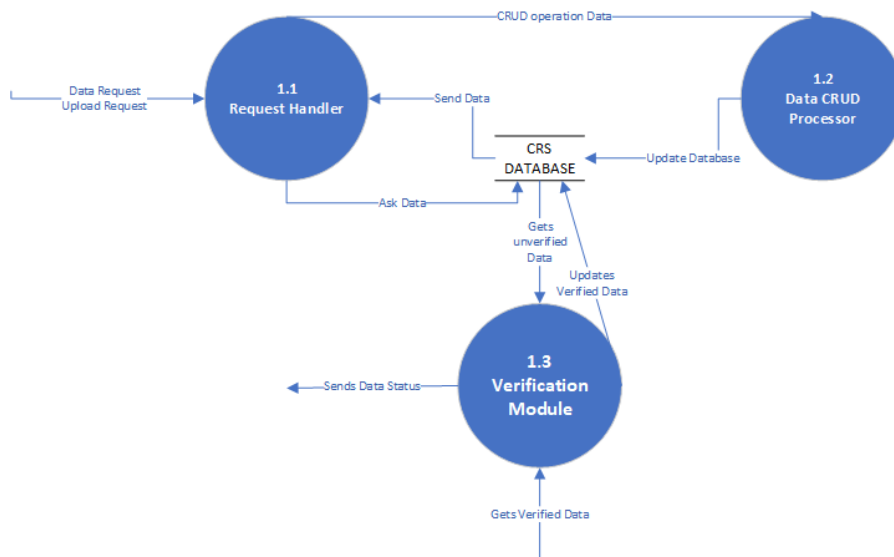


Figure 9 DFD Level 2 of 1.0 Data Pump

The figure 8 shows DFD level 2 expanding sub process 1.0 Data Pump, this sub processor consists of 3 sub modules called: **Request handler, Data CRUD**

processor and **Verification module**. Request Handler acknowledge all the request from client and response each of them. Data CRUD processor performs all the Data operations i.e. Create, Read, Update, and Delete. Verification module checks the integrity constraints of the data.

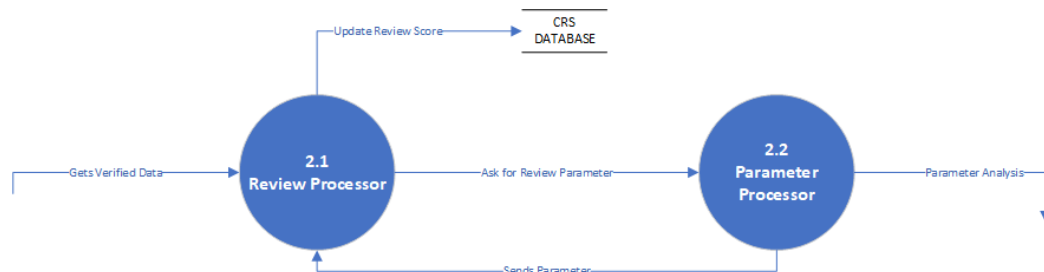


Figure 10 DFD Level 2 Expanding 2.0 Rating processor

In Figure 9, the DFD level 2 shows the sub processes of Rating processor. The rating processor consists of Review and Parameter Processor. The review processor gets all the verified data and produce a rating from that college. The Parameter processor sends data to multiple analyzer and sends data to review.

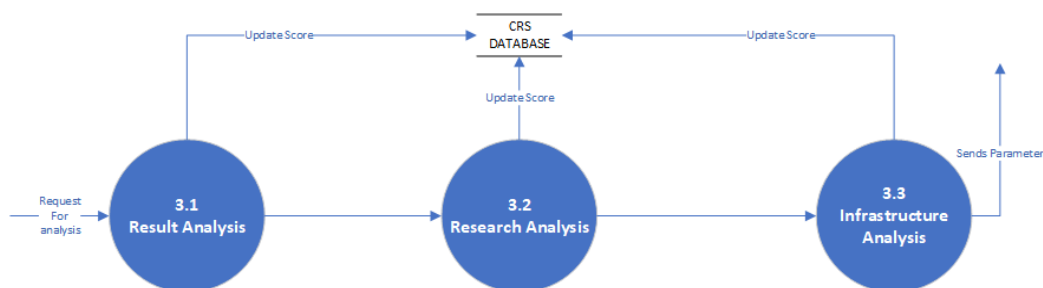


Figure 11 DFD Level 2 of Parameter Analysis

In Figure 10, three sub processes of parent process Parameter Analysis are described. These three sub processes produce individual score that will determine the overall review and rating score. The Result Analysis calculate the history of results, and research analysis calculate the research of the college. The infrastructure analysis works on the physical aspect of the college and provide a numeric data.

3.1.2.4 Database Schema

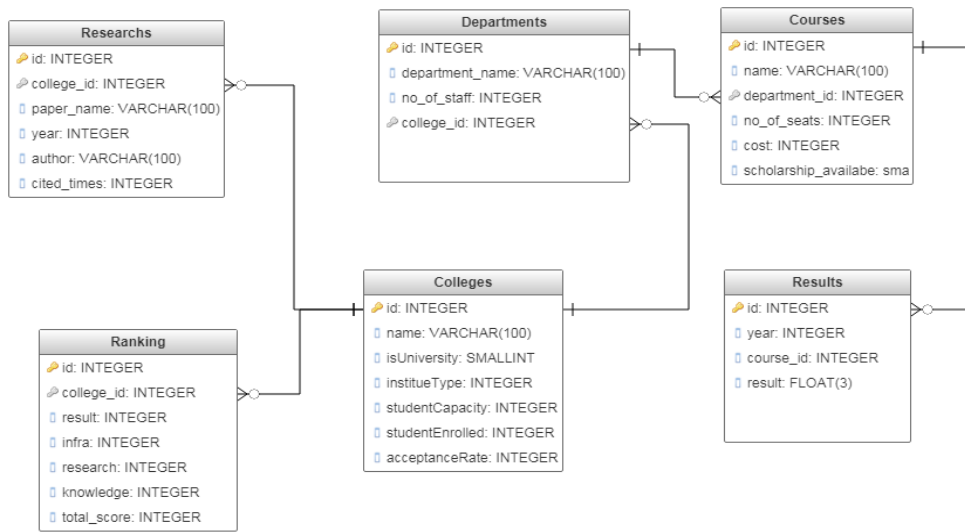


Figure 12 Database Schema

The figure 11 above shows database schema of CRS system where 6 tables with their attributes and data types are shown.

3.1.2.5 ER Diagram

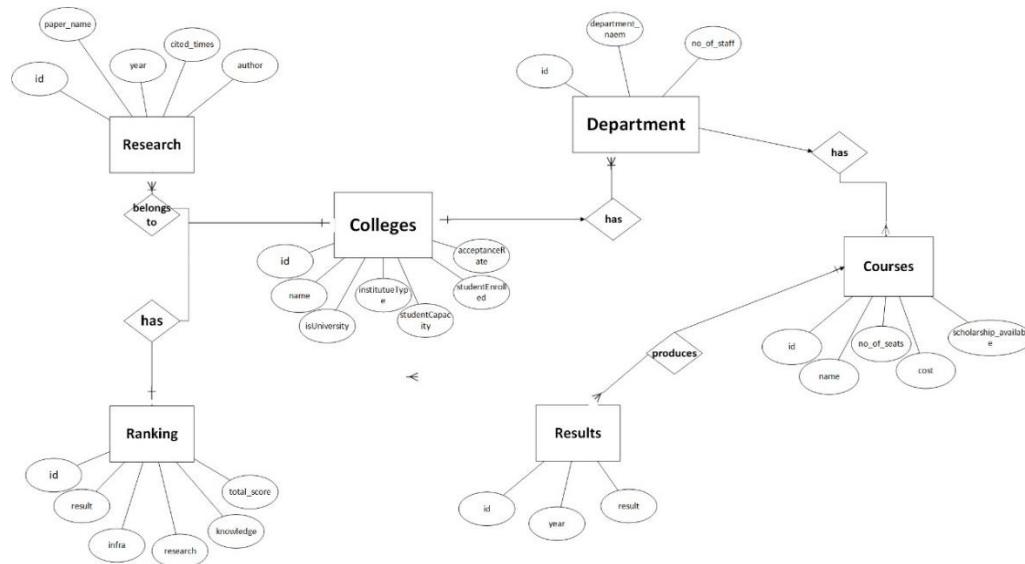


Figure 13 ER Diagram of CRS

The figure 13 shows the Entity Relationship diagram of CRS where all entities along with their relationship is shown.

3.1.2.6 Use Case Diagram

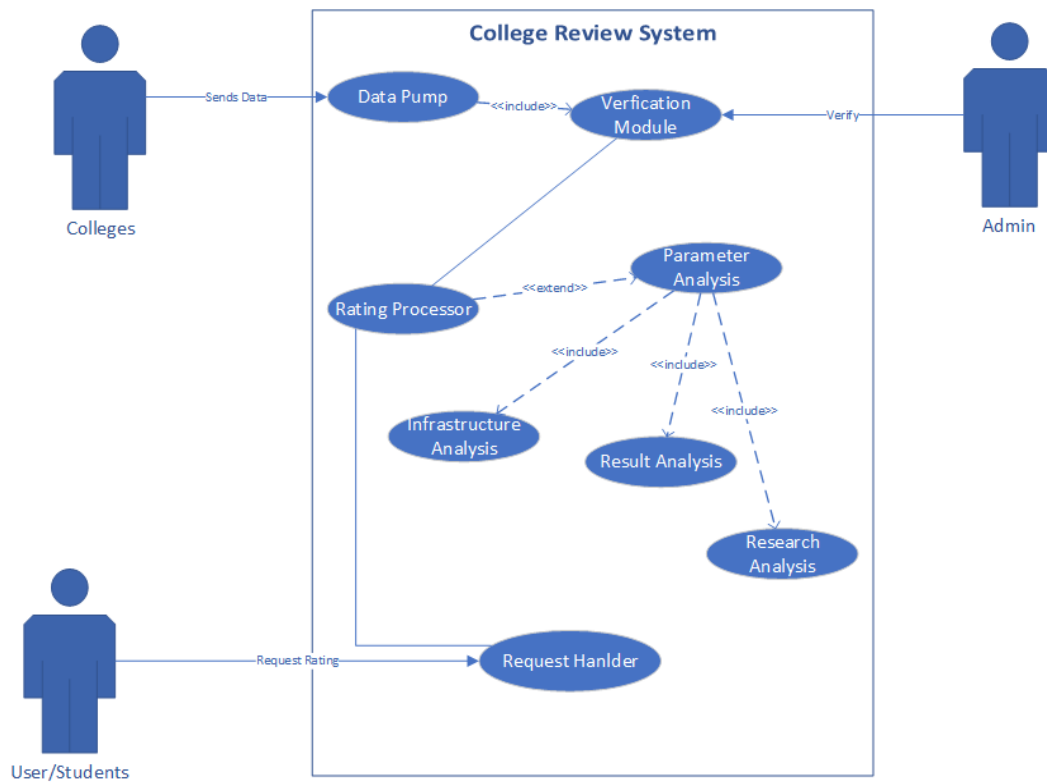


Figure 14 Use Case of CRS

The figure 13, the use case of CRS is shown where three actors and their usage of API is shown.

3.1.3 Alternative Solution

There are often multiple options for solving a specific problem. The degree of success of a system is often dependent on the choice of the proper solution among the various alternatives available. In the case of this project, there were various alternatives available for implementing the project. For instance, Java or python can be used for development. But Go was chosen as it was fast and efficient than any other tool. And the author was more familiar with Go than mentioned previous tools.

3.2 Technical Requirements

3.2.1 Hardware Requirements

The minimum hardware requirements, which are:

- Any device that supports HTTP.

3.2.2 Software Requirements

The minimum software requirements are also the same as for Google Chrome, which are:

- Windows 7, Windows 8, Windows 8.1, Windows 10 or later / OS X Mavericks 10.9 or later / 64-bit Ubuntu 14.04+, Debian 8+, openSUSE 13.3+, or Fedora Linux 24+
- Any software that can send and receive http message

CHAPTER 4: IMPLEMENTATION STRATEGIES

4.1 Testing Strategies

Implementation of a project remains fruitful if no error befalls during operation. Ensuring the lack of error is only possible if the system is properly tested and does not fail in different test approaches. Unlike other development platforms, it is not an easy task to perform automated tests on browser extensions as this requires making use of multiple testing tools. Thus, unit tests were determined as the best way to test browser extensions. In contrast, the backend was easy to test with the various tools available. Various testing approaches were implemented throughout the project and specific tests were carried out at the completion phase. The tests carried out in this project are described below.

4.1.1 Unit Test

Unit testing is a software development process in which the smallest testable parts of an application, called units, are individually and independently scrutinized for proper operation [36].

Test Cases:

1) Test Connection of Backend to Cassandra DB

Context	Expected Output	Obtained Output
When Cassandra is running	“Connected to Cassandra Session” on console	“Connected to Cassandra Session” on console
When Cassandra not running	“No Connection” on console	“No connection” on console

Table 5 Cassandra Session Unit Test

2) Testing Endpoints of Each Service

Context	Expected Output	Obtained Output
---------	-----------------	-----------------

Checking Service	College	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman
Checking Service	Department	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman
Checking Service	Courses	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman
Checking Service	Result	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman
Checking Service	Research	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman
Checking Service	Ranking	200, OK, “Service is alive” in Postman	200, OK, “Service is alive” in Postman

Table 6 End Points Unit Test

4.1.2 Integration Testing

The integration test is a specialized testing carried out by merging various component tests as one. In this phase, the various services of APIs implemented in the backend were tested.

1) GET / endpoint

Context	Expected Output	Obtained Output
/colleges/	All Colleges Data	All College Data
/colleges/<collegeID>	Get College Data of single college with sent ID	Get College Data of single college with sent ID
/research	All research data	All research data
/research/<researchId>	Get single research data with research Id	Got single research data of that research Id
/colleges/<collegeID>/ranking	Ranking information of given collegeID	Ranking information of given college

Table 7 Get End points Integration Test

2) Put and Post/ End Points

Context	Expected Output	Obtained Output
/colleges/add (with JSON Data)	Data Successfully Inserted	Data Successfully Inserted
/colleges/<collegeID>/department (with empty JSON Data)	Error in Decoding JSON	Error in Decoding JSON
/colleges/<collegeID>/department (invalid College Id)	Invalid College ID	Invalid College ID
/research/ (with JSON Data)	Data Successfully inserted	Data Successfully Inserted
/research/ (with empty JSON Data)	Error in Decoding JSON	Error in Decoding JSON

Table 8 Put and Post Integration Test

3) Delete / End Point

Context	Expected Outcome	Obtained Outcome
/colleges/	All College Successfully Deleted	All College Successfully Deleted
/colleges/<collegeID> (with valid college Id)	College Deleted	College Deleted
/colleges/<collegeID> (with invalid College Id)	Invalid College Id	Invalid College Id

Table 9 Delete Integration Test

4.1.3 Acceptance Testing

Acceptance testing is done in order to ensure that the created software matches the requirements and fulfills the criteria of the product that is to be delivered. It ensures that the software and its features are ready for delivery.

The acceptance test for this API was tested for the end points ranking for 3 different test cases:

Context	Expected Outcome	Obtained Outcome
Ranking College with no ranking, research and infrastructure	Research:0, Infra:0, Result: 0, Ranking: 0	Research:0, Infra:0, Result: 0 Ranking: 0
Ranking College with best ranking, research and infrastructure	Research:100, Infra:100, Result: 100, Ranking: 100	Research:100, Infra:100, Result: 100, Ranking: 100
Ranking College with random ranking, research and infrastructure	Research:70, Infra:80, Result: 95, Ranking: 86	Research:70, Infra:80, Result: 95, Ranking: 86

Table 10 Acceptance Test of API

4.2 Hardware Implementation

The restful API is not hard to implement. As for this project, the current API is being implemented only in local machine since all the tasks required to make this project fully operational have not been completed yet. Once completed, the API, along with Cassandra will move to cloud-based hosting service like Azure or AWS. The API will be public and accessible by all.

4.3 Software Implementation

The development of the project was done in Gogland IDE. The database service was provided by Cassandra and project was created in Go programming Language.

CHAPTER 5: RESULT ANALYSIS

5.1 Result

The developed API allows user to insert, update or delete college information by accessing multiple API services. It basically divides into five services i.e. college, department, course, result, research and rating services, each of them are loosely coupled and can work independently. The developed API will have following features:

- Perform all data operation tasks i.e. Create, Read, Delete and Update for college information
- Provide Ratings of a college according to data presented.
- Act as a college information system for storing information of colleges

5.2 Screenshots

The screenshot here presented are request sent by Client and response from API all here done in Postman to create real time scenario.

5.2.1 College Services

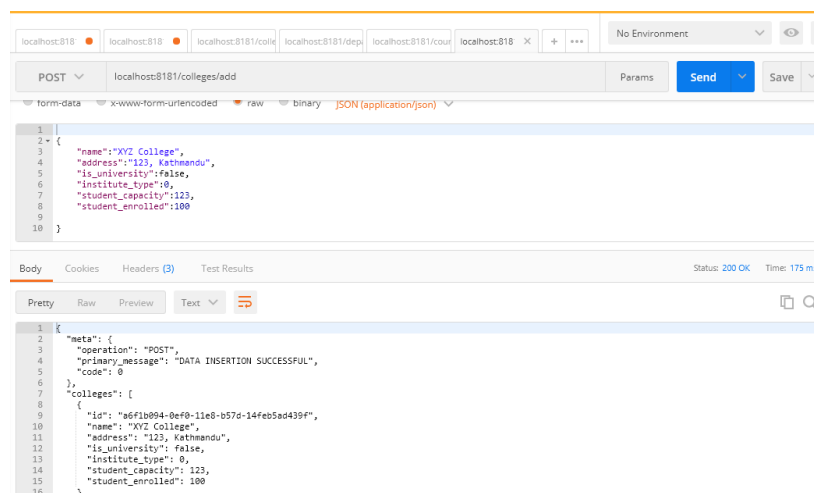


Figure 15 College Services Feeding in data

The college services allow pump data and information of college to the API. It can be accessed using URL (/colleges). Once requested, the API send a JSON response back.

5.2.2 Department Services

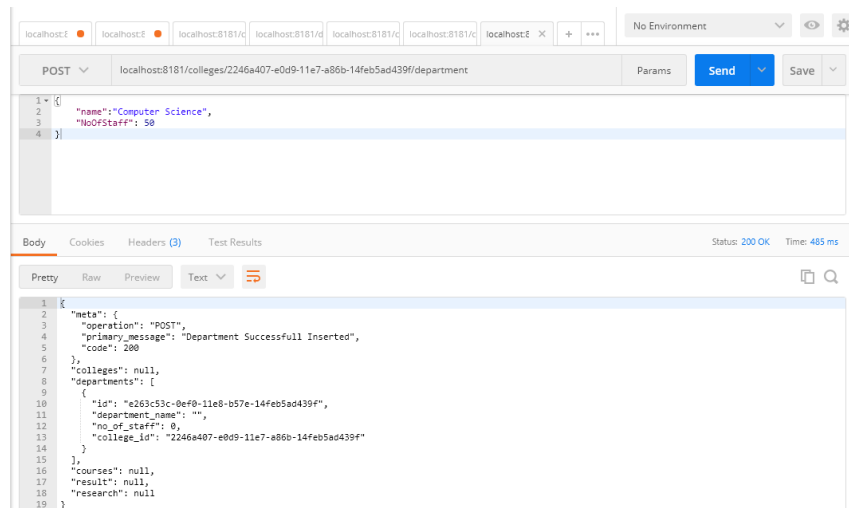


Figure 16 Department Service

In Figure 16, the client here sends the data of department to data pump which then stores data after validation. URL used here to request API is: **colleges/[CollegeID]/department**. With different method types user can easily create, read, delete the data.

5.2.3 Courses Services

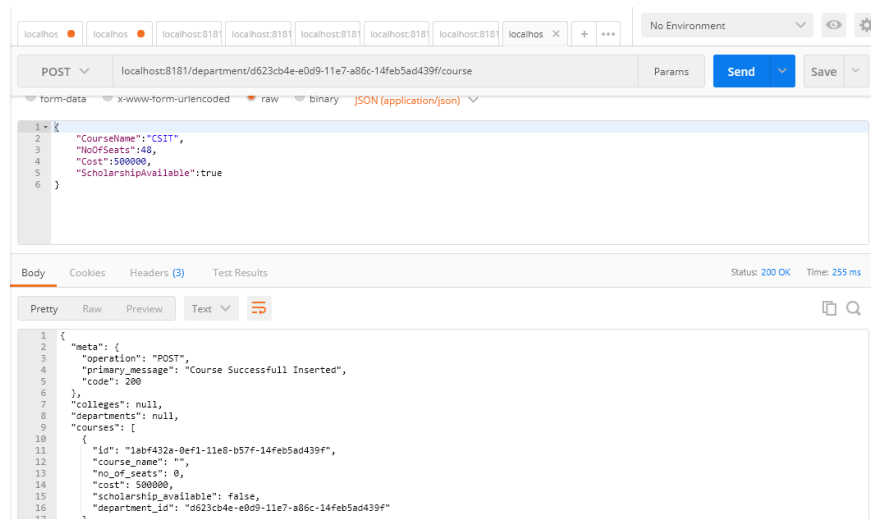


Figure 17 Course Services

The figure 17 shows adding of courses data in a department. The URL here used is: **department/[departmentID]/courses/**. With different method types user can easily create, read, delete the data.

5.2.4 Result Services

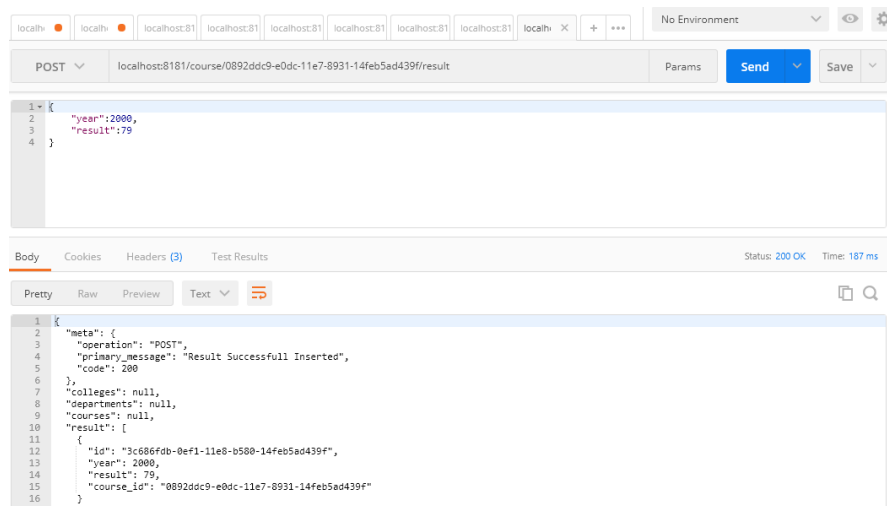


Figure 18 Result Services

The figure 18, Result service where user request API to perform CRUD operation on result data. Here, User send a post method request on URL : **course/[coursed]/result** . Other method can also be applied in this service.

5.2.5 Research Services

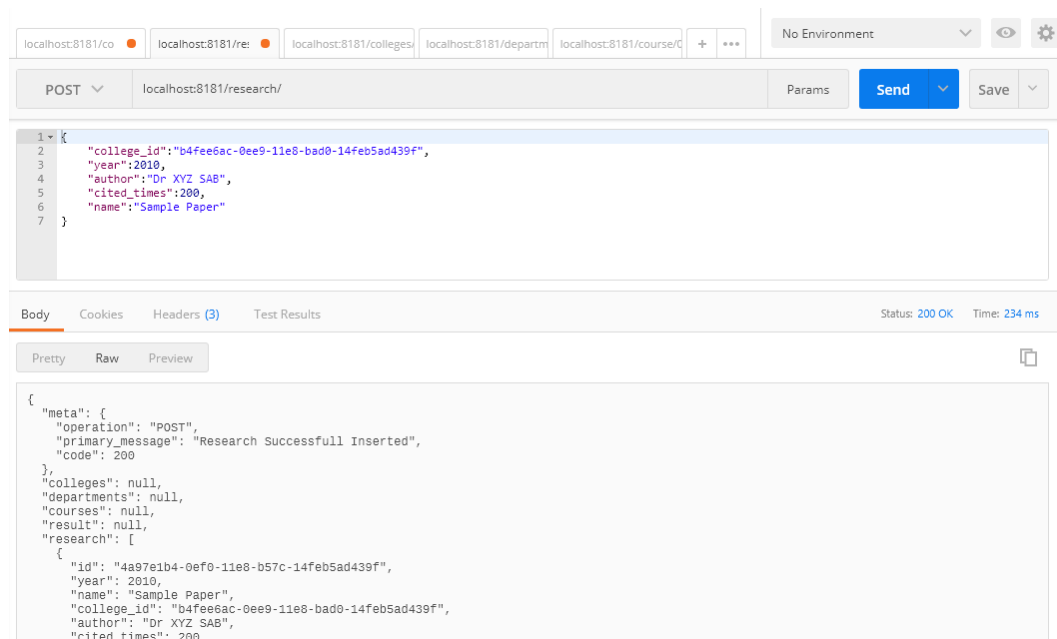


Figure 19 Research Services

The figure 19, Research service where user request API to perform CRUD operation on result data. Here, User send a post method request on URL: **research/**. Other method can also be applied in this service.

5.2.6 Ranking Services

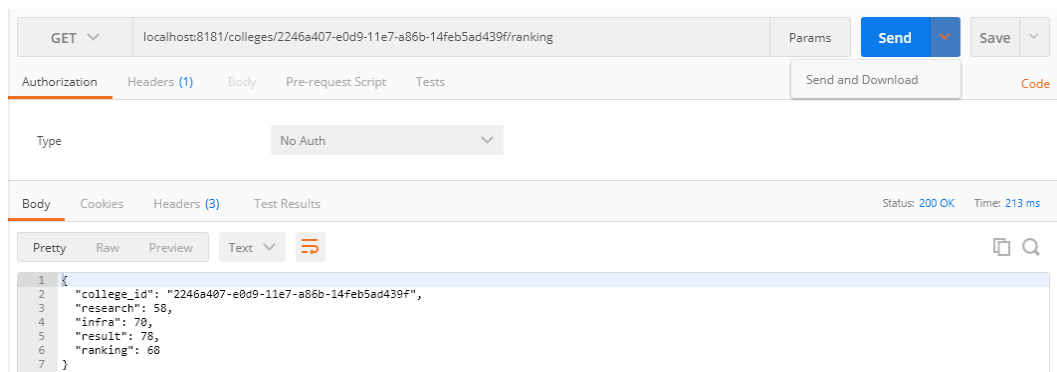


Figure 20 Ranking Services

The figure 20, Ranking service where user request API to get ranking of college. Here, User send a post method request on URL: **college/[CollegeID]/ranking**. Response here is presented in three parameter : Research, Infra, Result.

Function Prototype:

```
getRank(College Id){
if collegeID exists in Database {
    result = resultCalc(CollegeId)
    research = researchCalc(CollegeId)
    infra = infraCalc(CollegeId)
    CollegeRank = 0.5 *resultcalc + 0.3 * infra + 0.2*research
}
```

5.3 Critical Analysis

In order to fulfill the requirements of this project, a lot of research had to be done. First of all, collecting the data required for this project was a challenge in itself. The research on how rating and reviews works required a great search and analysis. Multiple ranking algorithm was searched and their methodology was also viewed. The popular algorithm like World Ranking, US News are college ranking was

checked and studied thoroughly. The rating and review feasibility with current condition of our country was also checked in this process.

After research about different college review and ranking algorithms in the internet, the author along with his supervisor start working on designing their own algorithm which can fit current scenario. The data in author's country was far less from adequate and in fewer number than other developed nation. So, compensating such data loss, the algorithm must be very flexible in terms of data requirements. The algorithm with all detail requirement was presented to the department head. Few suggestions from the department head, enhanced the algorithm.

After designing the algorithm in which the project works on. The author focused on how the project must be developed. With great research and analysis, the author concluded to make a restful service and developing a Public API. One of the key advantages of REST APIs is that they provide a great deal of flexibility. Data is not tied to resources or methods, so REST can handle multiple types of calls, return different data formats and even change structurally with the correct implementation of hypermedia. This flexibility allows developers to build an API that meets your needs while also meeting the needs of very diverse customers.

After the development goal was fixed. The author started researching on various tools and services to develop the project. Many programming tools was analyzed by the author. Finally, with supervisor acceptance, the author selected Go programming language. The choice of GO as programming language is done because:

- Go is fast and simple to work on. It fast to learn, code, compile and deploy.
- Go is modern language i.e. it was created with modern task and hardware in mind.
- Go is cross-platform compatible.
- Go is concurrent. It has built in concurrency which enables to carry out many process at the same time.

The project also required database services, Cassandra DB developed by Facebook was picked as it provided faster read/write support.

The algorithm that had some issues in the beginning of the project, research analysis had no data to evaluated on. Yet, with consolidation with supervisor, the started working with fake data sets. Each parameter required in the algorithm was separately created as service. This was done for flexibility and scalability of the API and also to maintain the SOA of entire project. Another key issue in the project was security of data. For this, another security service by my fellow co-worker was created. As the API was based on SOA, it was easily coupled with author's existing system. The project was all developed based on designed algorithm. After the development, the system was rigorously tested. Multiple test cases, integration test was done to insure the overall calculations are accurate. The testing phase resulted the algorithm to be more effective and efficient.

Yet, there were some performance hindering factor in this project. The developed might not able to work for high request as high calculation is to be done to produce a single rating. When user wants generate a top ten list, the API calculates all the data. This results in slow performance. This can be omitted by creating a separate data table or key space for top ten list. The API automatically creates and stored them to table. Thus, the request can be easily processed with no calculation every single time.

Overall, the project has a lot of room for improvement because it is just in the beginning phase but it functions well in its current state and design. In particular, the data structures could be better optimized in order to allow faster reads of only the information that is required. The algorithm can be made more efficient by increases more parameter to be analysis. The algorithm does not check the exposure of students after college. Some parameter like physical assets and infrastructure are being directly inserted which can be fixed to calculate automatically. Other than that, there are a lot of features that can be added which make the review and rating more accurate.

5.4 Limitation of the System

The developed system has further room for improvement and has the following limitations:

- The system is requiring lot of data to inputted rather than to calculating them.
- The system cannot compute rating in one of parameter is not passed.
- The system can have incorporated Machine Learning and suggest college to user as per user profile.
- Algorithm here generated as per research done by author and author organization. It might not include all parameters that is required for rating. Thus, Algorithm can still be improved by taking clients suggestions

5.5 Recommendation to the Organization

Tyrocity has left no stone unturned in providing guidance and support to the author during his internship period. Tyrocity is one of the best organizations to seek an internship at with a very friendly and motivating environment with everyone ready to provide help and guidance.

5.6 Recommendation to the Internship Program

Tribhuvan University has put great effort to design the course for BSc. CSIT. The internship requirement is a nice touch that not a lot of other courses provide as it provides students with real world experiences. The university could put more courses that align with current industry requirements in order to train the students beforehand and help them do better on their internships.

CHAPTER 6: CONCLUSION

With the help of this internship opportunity, the author has gained real world experience in the software and IT industry of Nepal. The whole period of the internship at Tyrocity was very productive and provided opportunities to learn a wide variety of skill including backend development. The author was placed in an API team that had a major task to developed required API. The author learned a lot of new technologies including and not limited to Java, JavaEE, Spring and Hibernate, Go, CassandraDB, MongoDB, Design Patterns, Git, Travis and Octave. The author also gained familiarity with many industry standard tools and processes like Scrum and Agile Methodologies. The internship also led to the development of the research skills of the author because the work and the project required a lot of research.

The Internship Project done during the internship was one of the many tasks assigned to the author during the internship. The Project delivers an API which gets college data and then calculate the rating of the college. The API provides standard communication channel using JSON data. The developed API which showcases this project required knowledge of structure programming, knowledge of SOA, restful services, JSON data and Cassandra database services.

The delivered project has a lot of room for improvement which resulted to the limited time and resources available to work on this project. However, the project will be a very promising once it reaches its full potential. Working with this project alongside other projects of the organization also provided valuable time management skills. The other projects mainly included working with Java and JavaEE in order to create APIs as per organizational need.

All in all, this internship was a perfect opportunity to learn a variety of real world skills and a chance for the author to grow both personally and professionally.

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