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We would highly appreciate and heartily welcome suggestion for further improvement if any.

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ABSTRACT

Recommending any task to other looking their expertise is always a tough job. Recommendation System can be very useful for any organization and individuals to carry day to day task. This is the report that explains how a system recommends the task to the user or organization. The ***Job Recommendation System*** deals with the use of information technology that helps an employee to search for a suitable job and an employer to search for a best employee. ***Job Recommendation System*** is a web-based portal supporting these facilities. The application is developed with simple user interfaces but giving high priority to the application logic. The application logic uses the Content Based Filtering (CBF) to search for perfect employee-employer pair.

This project also aims to contribute on social welfare so that the employee who are willing to get engaged can utilize their time and skill by searching a suitable job easily as well as the employer who are willing to give job and also search for a best employee in real time. This approach of searching by usage of machine learning stood as a successful experiment which concludes that machine learning algorithms can optimize the search where different entities have different nature of attributes. At the same time the results generated by the CBF algorithm can be prioritize to support recommendation.

Keywords: *content-based, recommendation, job, online job, cosine similarity*

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LIST OF ABBREVIATIONS

CBF	Content Based Filtering
JRS	Job Recommendation System
GUI	Graphical User Interface
UML	Unified Modeling Language
ER	Entity Relationship
HTML	Hypertext Markup Language
CSS	Cascading Style Sheet
JS	Java Script

CHAPTER 1: INTRODUCTION

1.1 Introduction

There has been always a big overhead for the employee to find a quality job at the time they require. In our country, it's a difficult task for the employee themselves to find a job in related field. The main problem behind this is due to lack of advertisement. Whenever an employer needs to hire employee they announce the vacancy in many newspapers, make lot of phone calls to the people they know and ask them if they know some good. In some cases, this procedure is effective but not scientific and reliable when we have technology to use. Since technology has grown vast we are used to application of technologies for faster and reliable result.

The project is based on the reliability and flexibility of technology that is used to facilitate the employer and employee to find each other. The employee can be a well-qualified person or an employer at present that is willing to fill the vacancy. The employee is simply an employee at present. Both the entities must sign up in the system to profile useful information related to their profile that is used by the system in order to make an optimal searching and recommendation. The optimal searching and recommendation is done simultaneously by Content Based Filtering (CBF). The CBF algorithm is a supervised learning algorithm that has been trained to optimize the searching result and displaying them with ranking, highest rank recommended first. The system also supports tracking of the details related to user information.

1.2 Problem Statement

The manual work of communicating with many people asking them for a vacant post is time consuming work. Although there are few successful implementations of such projects there are lot of problems in finding an appropriate job. The application supports a two-way searching which includes both the entities (employee and employer) to search for each other. This application is for all job seekers, skilled as well as intern (people who are willing to do job to enhance their skill). Thus, this topic is chosen to use technology for searching the desired entity, minimizing the manual work and social development.

1.3 Objectives

The primary objectives of the project are as follows:

- To make the machine able to match perfect pair of employee-employer.
- To facilitate the employee to search a job of their need.
- To facilitate the employee to utilize their time and knowledge.
- To notify the entities about the viewing of their details by other entities.

The secondary objectives of the project are as follows:

- Optimal search
- Easy navigation and user interface.

1.4 Scope of Project

This is a web-based application intended to use by every job seekers and job providers. Due to web based it is easily available to the users. It will have comfortable interface and navigation. With the usage of CBF algorithm, optimal searching is made possible. It solves the problem of many phone calls, personal visits, and time table of the Employer. Also, it is most beneficial for the employee who are willing to do a job corresponding to their location. The information like phone number, address etc. are not made public like many other websites does. The system also has less operational and maintenance cost from organizations perspective. Besides these scopes, there are some limitations of the system. The vacancy announcement is not done by the system.

1.5 Report Organization

Chapter 1 contains Introduction to this project which explains why this project is undertaken and the concepts associated with it.

Chapter 2 consists of reviews of the system both functional and non-functional requirements and also explains how the project is feasible in various fields and structure of the system requirement.

Chapter 3 describes the design of system. This includes design of database, interface and input output.

Chapter 4 includes implementing and testing of the system. Implementation includes various tools used in the system. Testing includes various types of testing performed to verify the system.

Chapter 5 concludes the document with summary. Rest of the report deals with conclusion and future scope.

CHAPTER 2: REQUIREMENT ANALYSIS AND FEASIBILITY STUDY

2.1 Literature Review

Content-based filtering recommender systems [1] recommend items based upon a description of the item to a user based upon a description of the item and a profile of user's interests. Content-based recommendation systems may be used in variety of domains ranging from recommending webpages, movies, articles (jobs,here).Content-based recommendation systems share in common a means for describing the items that may be recommended, a means for creating a profile of user that describes the types of items the user likes, and a means of comparing items to the user profile to determine what to recommend[1]. However, there requires having a solid user profile database that stores the preferences and activity related data about the users. If the users of the digital library are not actively participating by making reviews or providing some feedback about the articles, or if they do not have full specified profiles (research area, interests), this database would lack of important data for the recommendation process. However, if these data exist, there is a high probability that the recommendation process produces good results [2].

SongJie Gong and Zhejiang [4] proposed that 'personalized recommendation systems' are widely utilized in e-commerce websites to provide recommendations to its users. The paper states that the recommendation systems use Collaborative Filtering technique which has been successful in providing recommendations. A technique to solve the common problems that are encountered in recommender systems namely, sparsity and scalability is suggested in this paper. This paper suggests the recommender system which combines both user clustering and item clustering can be used to provide recommendations. This approach is employed to provide recommendations in this project which makes the prediction smoother. In this approach, item clustering is done using the two techniques Pearson correlation technique and Adjusted cosine similarity technique to find the similarity between the items. Then, users are clustered depending on a likeness between the user targeted and cluster center.

Micheal Pazzani [5] discusses about recommending data sources for news articles or web sites after learning the taste of the user by learning his profile. This paper mentions various types of information that can be considered to learn the profile of a user. Based on ratings given by a user to different sites, ratings that other users have given to those sites and demographic information about users the recommendations can be made. This paper describes how the above information can be combined to provide recommendations to the users.

Merojob.com is extra than just a job website. From the web, to mobile, to social media tools and apps, they provider corporations of all sizes to discover the proper in shape the use of most superior generation in Nepal. Supplying recruitment solutions to employers finding, fostering and preparing the proper applicants in every possible ways with an powerful tracking machine and a dedicated group of customer support to each; the employers and the job seekers, has always been our primary intention. The business enterprise dashboard at mero job allows employers such as you register your esteemed enterprise, put up jobs and use the simplified short listing manner to rent the exceptional in few clicks with technology-guided equipment. Customized platform supplied to process seekers, on the other hand, let them sign in, seek, follow and get jobs totally free. Blogs associated with task education and career improvement with survey reviews from exceptional college and outside events have help to many get the right possibilities in the process market of Nepal [6].

RamroJob.com is one of the leading and growing job portals in Nepal. It is a product of Creative Job Pvt. Ltd. It is covering almost every job in Nepalese job market with free job posting service to job provider. It aims at providing detailed information to job seeker at free of cost. Currently, they are in beta testing phase and our skilled human resource at they are continuously working on website improvement and making website more user-friendly [7].

Gulf talent is the leading online recruitment portal within the center east, utilized by over 7 million experienced professionals from all sectors and task classes. It serves because the number one supply of both neighborhood and expatriate skills to over 8000 of the most important employers and recruitment groups across the place. Founded in 2005, the organization has converted the place's on-line recruitment panorama via its modern

techniques in addition to its relentless obsession with first-rate and excellence. Gulf talent is run by means of a pro team of young experts with various backgrounds throughout exclusive industries, which includes era, finance, income and recruitment. The team also brings collectively a wealth of worldwide experience throughout 4 continents [8].

Among these algorithms content-based filtering with cosine similarity will be used because the results with this algorithm tends to be highly relevant and avoids the problem of coldstart.

Content-based filtering methods are based on description of the item(job in this case) and the profile of the user's preferences. In a content based recommender system, keywords are used to describe the items and the user profile is built to indicate the type of item this user likes. In other words, these algorithm tries to recommend items that are similar to those that a user has liked in the past.

Cosine similarity: A popular measure metric similarity between two vectors of n dimensions in the cosine similarity metric[3].

For two vectors x and i

$$\text{Cos}(\theta) = (x \cdot i) / (|x||i|)$$

Where x is user_profile built with user's attributes and i is another user_profile of job_profile based upon our requirement.

The mathematical distance measuring profile calculates distance between two vector x and i and gives a n information on how close are x and i.

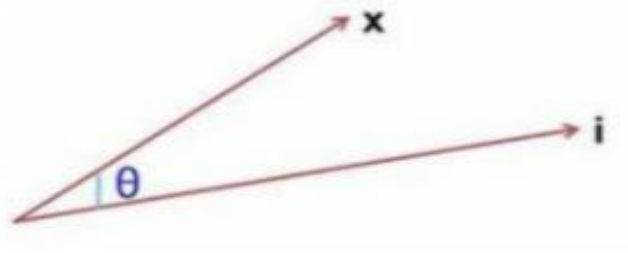


Figure2. 1 : Cosine similarity Measure

2.2 Requirements Analysis

The requirements are the major part in the system development. Once the requirements are collected they determine the structure, functionalities and operational constraints of the system. The requirements are hard to determine due to their dynamic and dependent nature. During system development, the requirements may change by the system user. One requirement may depend on another requirement thus making changes to lower requirement leads another requirement thus making changes to lower requirement leads to change of upper requirements and vice-versa.

The requirements of the proposed system 'Job Recommendation System' has been determined by ourselves. It does not deal with taking interview with the users since it is a generic software product.

2.2.1 Functional Requirements

The functional requirements specify the services that the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. In some cases, the functional requirements may also explicitly state what the system should not do. The functional requirements of 'Job Recommendation System' are as follows:

- Use Content Based Algorithm on the basis of cosine similarity value for matching the pair
- Provide a search interface
- Prioritizing the search result to display the outcome with highest priority first
- Verify the user as employee or employer

- Update and delete user information

The following use case diagram depicts the major functions of the Job Recommendation System. There are two major actors- Employee (Job Seeker) and Employer(Company). The Employee can perform functions like sign up, sign in, search employer, apply job, update profile and check notification. The Employer also perform the same functions except it searches for a Employee.

The system requirements specify that the entity cannot search for the same entity group.

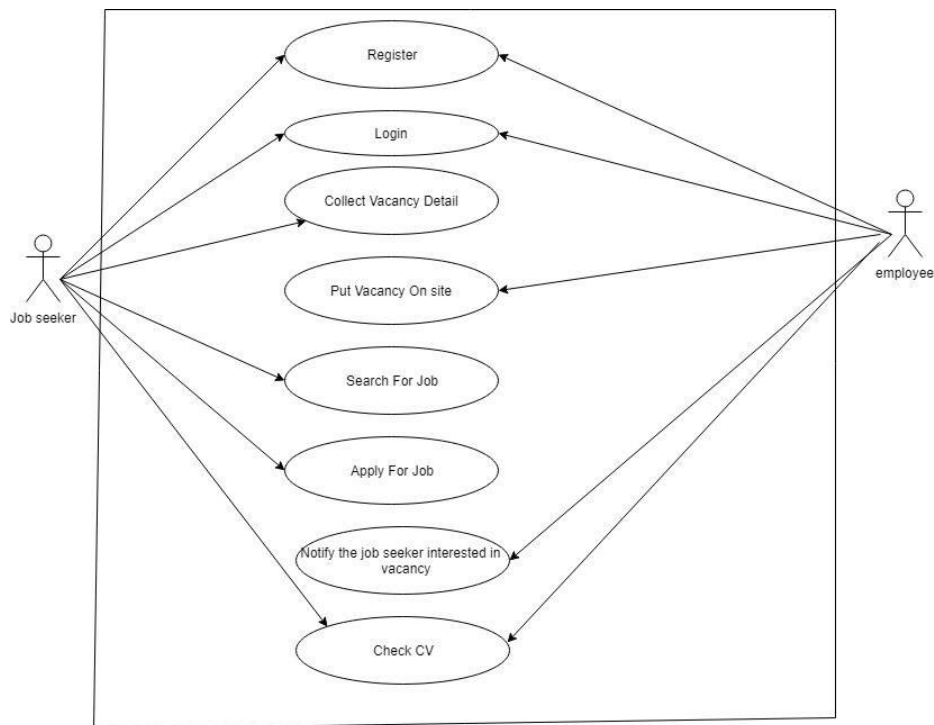


Figure2. 2: Use Case Diagram of Job Recommendation System

2.2.2 Non-Functional Requirements

These are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process and standards. Non-functional requirements often apply to the system as a whole. The non-functional requirements of 'Job Recommendation System' are as follows:

- **Performance:**
The application should provide the search result in less time.
- **Maintenance:**
The system should be maintained so that cost incurred is minimum.
- **Reliability:**
The searching should be accurate and optimal.

2.3 Feasibility Analysis

The feasibility study helps to determine the benefits of the proposed system in the society and organization. It also determines if the system can be built successfully with cost, time and effort. The study is conducted by analyzing the collected requirements.

2.3.1 Economic Feasibility

The Job Recommendation System is cheap to build. The application requires web programmer, designer, and database designer. All the tasks are performed by the team. The major benefit of this application is that it will help the employee and employer for searching each other. There are no such drawbacks of this application based on costs. It is also cheap to operate and maintain. Job Recommendation System do not require manual administration and monitoring.

2.3.2 Technical Feasibility

All the tools and software products required to construct JRS is easily available in the web. It doesn't require special environment to execute. It needs a web server and a DBMS to operate. The operation makes use of internet. All these aspects are affordable. The application requires simple user interfaces but result calculations are complex. It can be done with some assistance from our supervisor.

2.3.3 Operational Feasibility

All the functions of the system are possible to create. The system processes the data of employee and employer only. The calculations and database queries are possible execute without any errors and extra requirements. The software configurations used by the system

are possible to establish. The system will operate over internet thus making the user available with the latest job.

2.4 Structuring System Requirements

2.4.1 Class diagram

A class diagram shows the static structure of an object-oriented model: the object classes, their internal structure and the relationship in which they participate. In UML, a class is represented by a rectangle with three compartments separated by horizontal lines. The class name in the top compartment, list of attributes in the middle and list of operations in the bottom compartment.

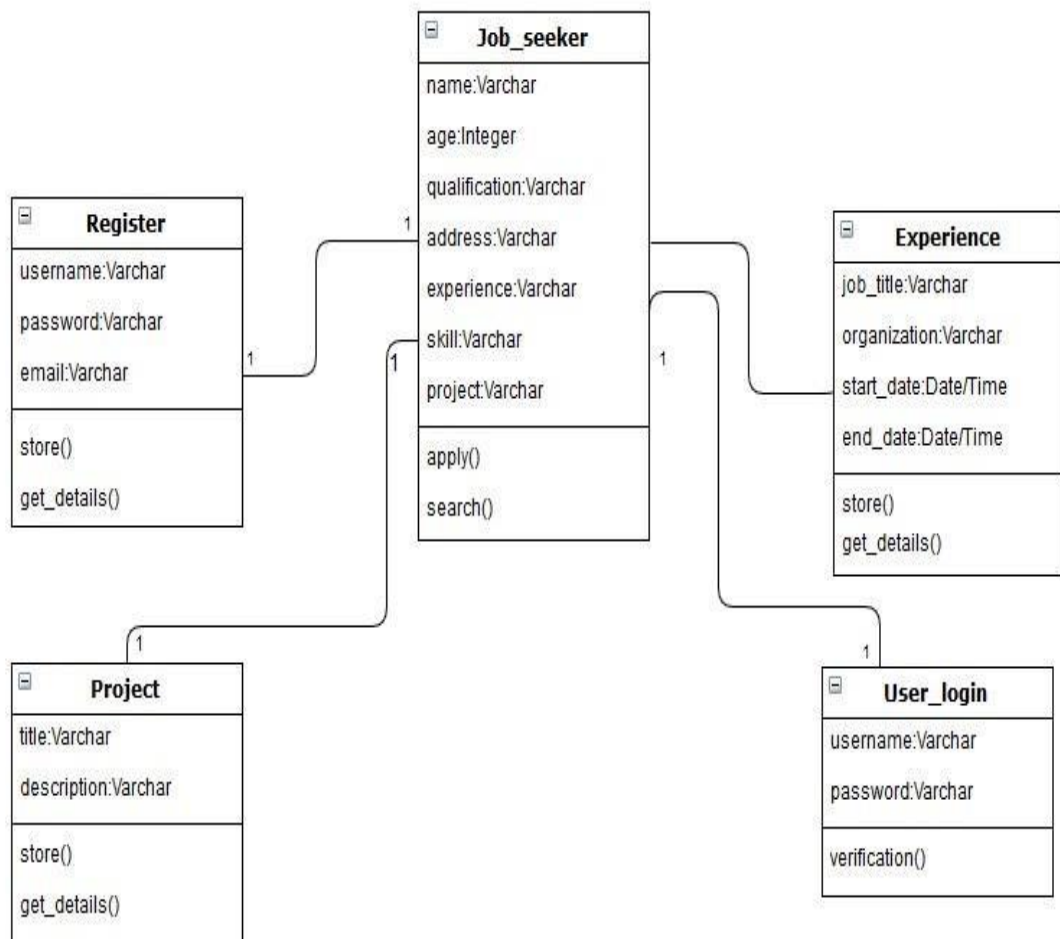


Figure2. 3:Class diagram of Employee

The above figure represents the objects that are related to perform all the activities of the Job Seeker entity. There are 6 major classes that work in coordination to complete the requirements related to the Job Seeker entity.

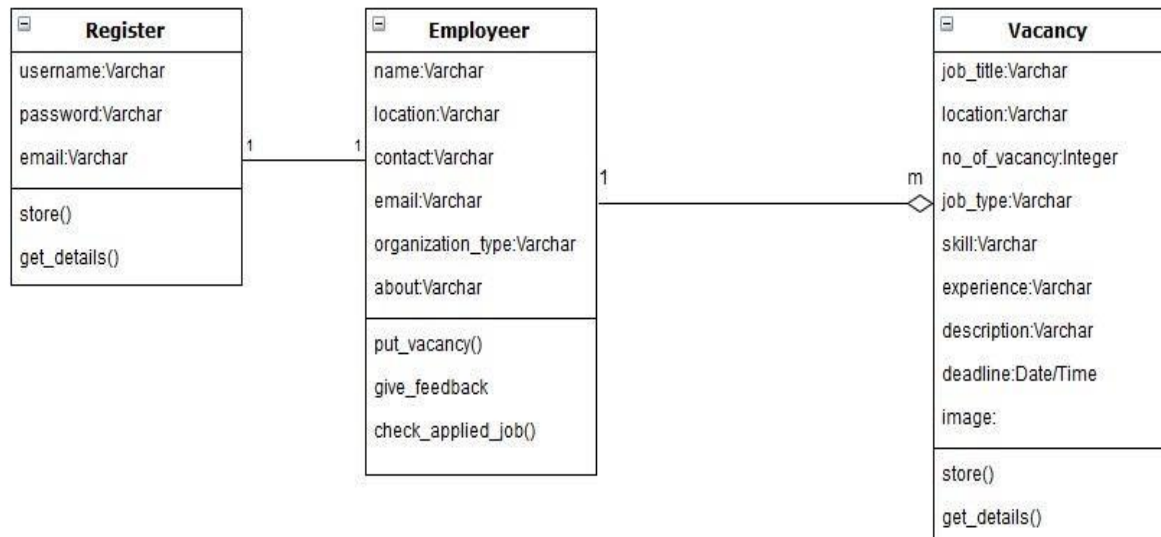


Figure2. 4:Class diagram of Employer

The class diagram of Employer is also similar to that of the Job Seeker instead it performs the Employer related operations. It contains 2 major classes for the implementation of the Employer activities.

2.4.2 ER Diagram

The ER-diagram represents the real-world objects called entities and association among those entities. The ER-diagram is the best tool to design the database. It helps the designer to determine the useful entities of the database, the relationship they hold and the degree of relationship.

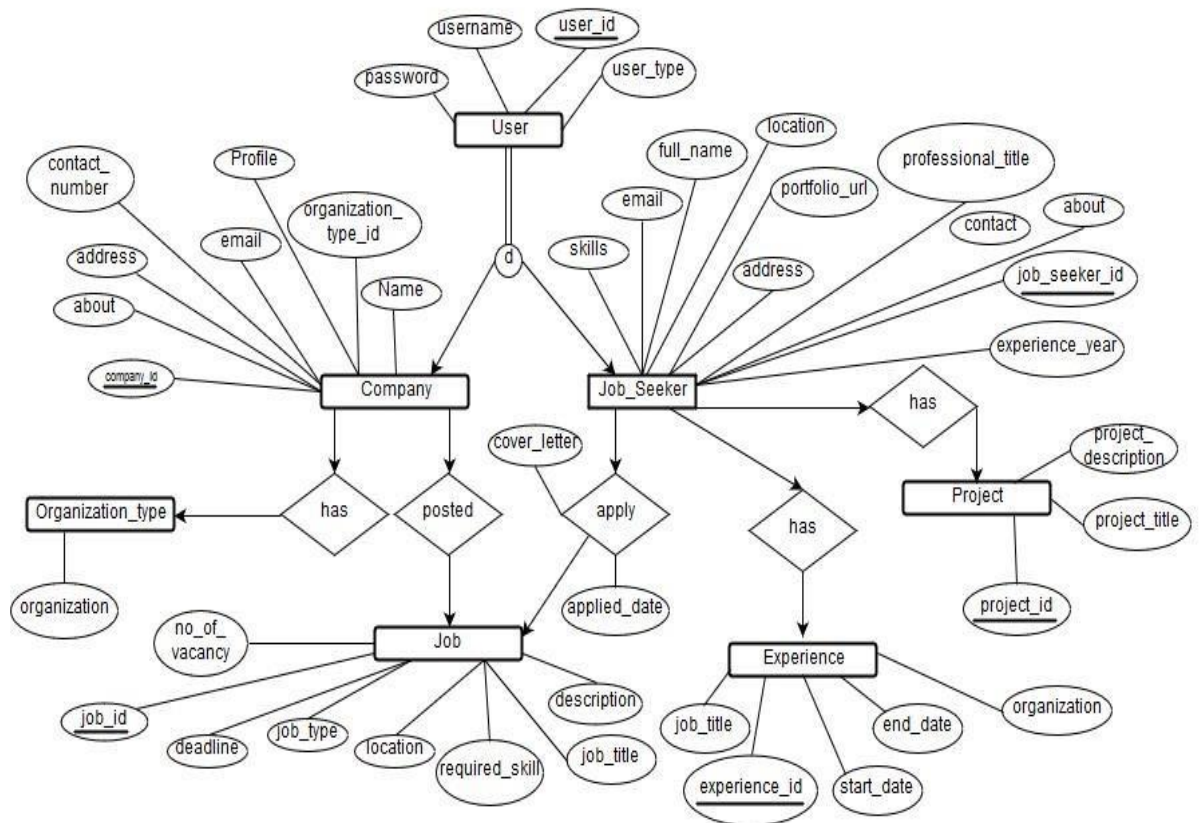


Figure2. 5: ER diagram of Job Recommendation System

CHAPTER 3: SYSTEM DESIGN

The essence of system design is making decisions about the logical organization of the software. Sometimes, we represent this logical organization as a model in a defined modeling language such as the UML.

3.1 System Architecture

The system architecture for 'Job Recommendation System' is client-server architecture. The client server architecture has different forms among which the 'Job Recommendation System' is built in 1 tier architecture environment. The implementation in real world will be in 3 tier architectures. The built-in process was carried out in single desktop having GUI browsers, Apache server and DBMS in a single machine. But in real implementation we have separated the presentation logic, application logic and data management at different tiers to form 3 tier architectures as shown in figure below:

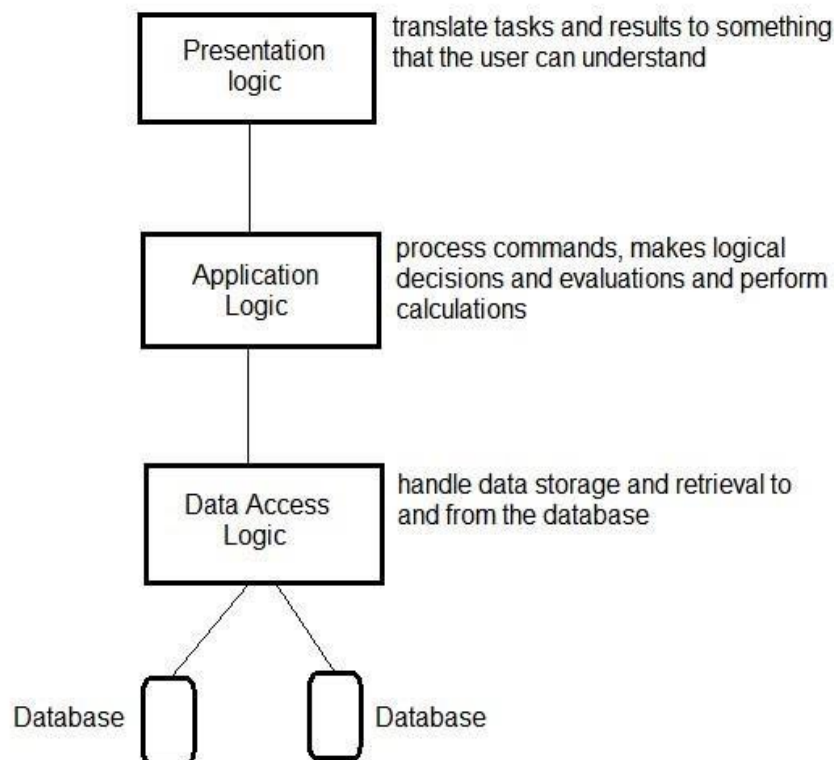


Figure3. 1: 3-tier client-server architecture

3.2 Sequence diagram

A sequence diagram depicts the interactions among objects during a certain period of time. Because the pattern of interactions varies from one use case to another, each sequence diagram shows only the interactions pertinent to a specific use case.

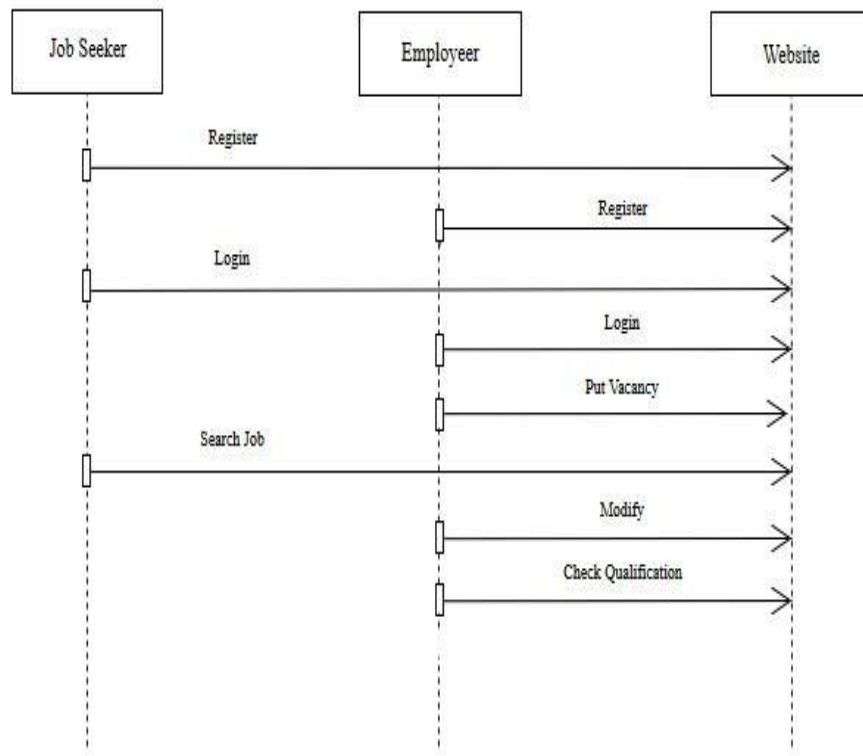


Figure3. 2: Sequence diagram of Employee and Employer

The above figure represents the sequence diagram of Employee and Employer. The Job Seeker activity is initiated when the job Seeker invokes the Registration. The objects interact with each other by passing appropriate messages. The connection is activated till the time where Employer ends its session.

All the activities of Employer are performed by communicating appropriate messages between the objects.

3.3 Database Schema design

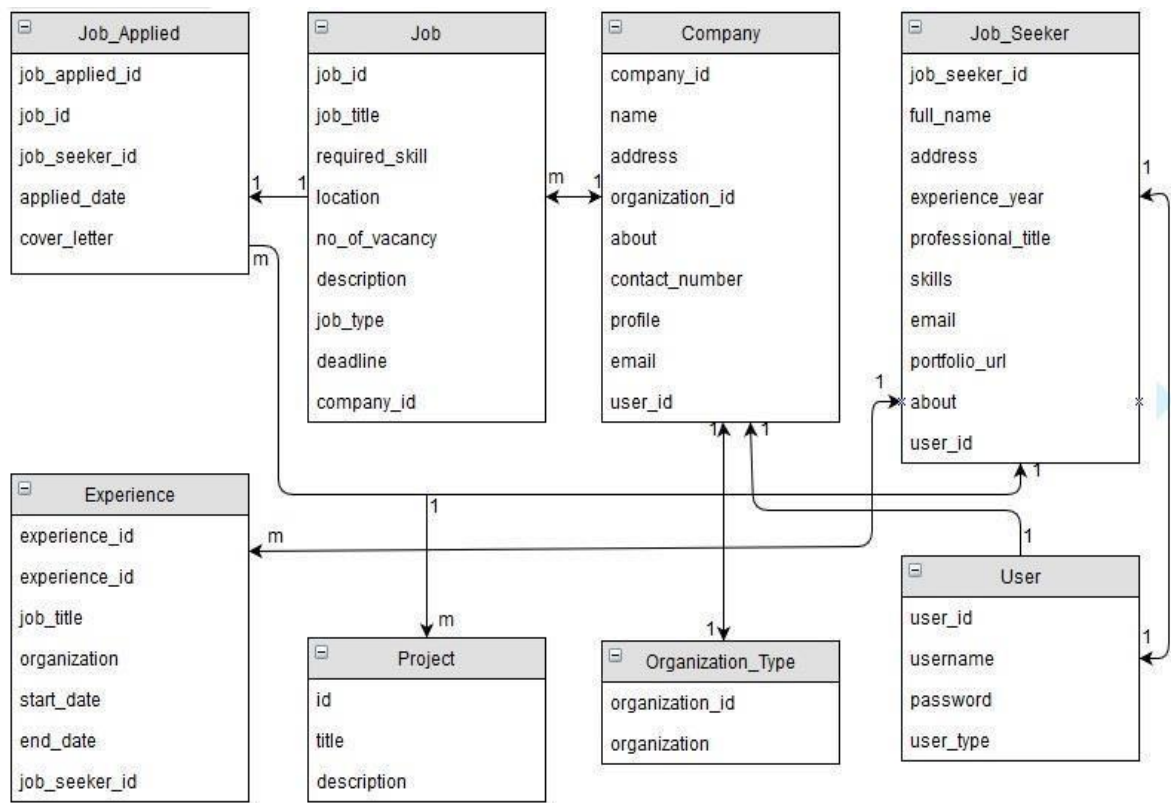


Figure3. 3: Schema diagram of Job Recommendation System

The ER-diagram is mapped to schema diagram for creating relations in the database. Each rectangle in the schema diagram corresponds to an actual relational table. In the above figure, the attributes in the top compartment represents the primary key for that relation. The relation name is specified at the top of each rectangle. The remaining bottom compartment of the rectangle represents the component attributes of the relation. The arrow from A to B represents A is a foreign key referencing B.

3.4 Process Design:

The overall process of job seeking process can be summarized as the following flowchart:

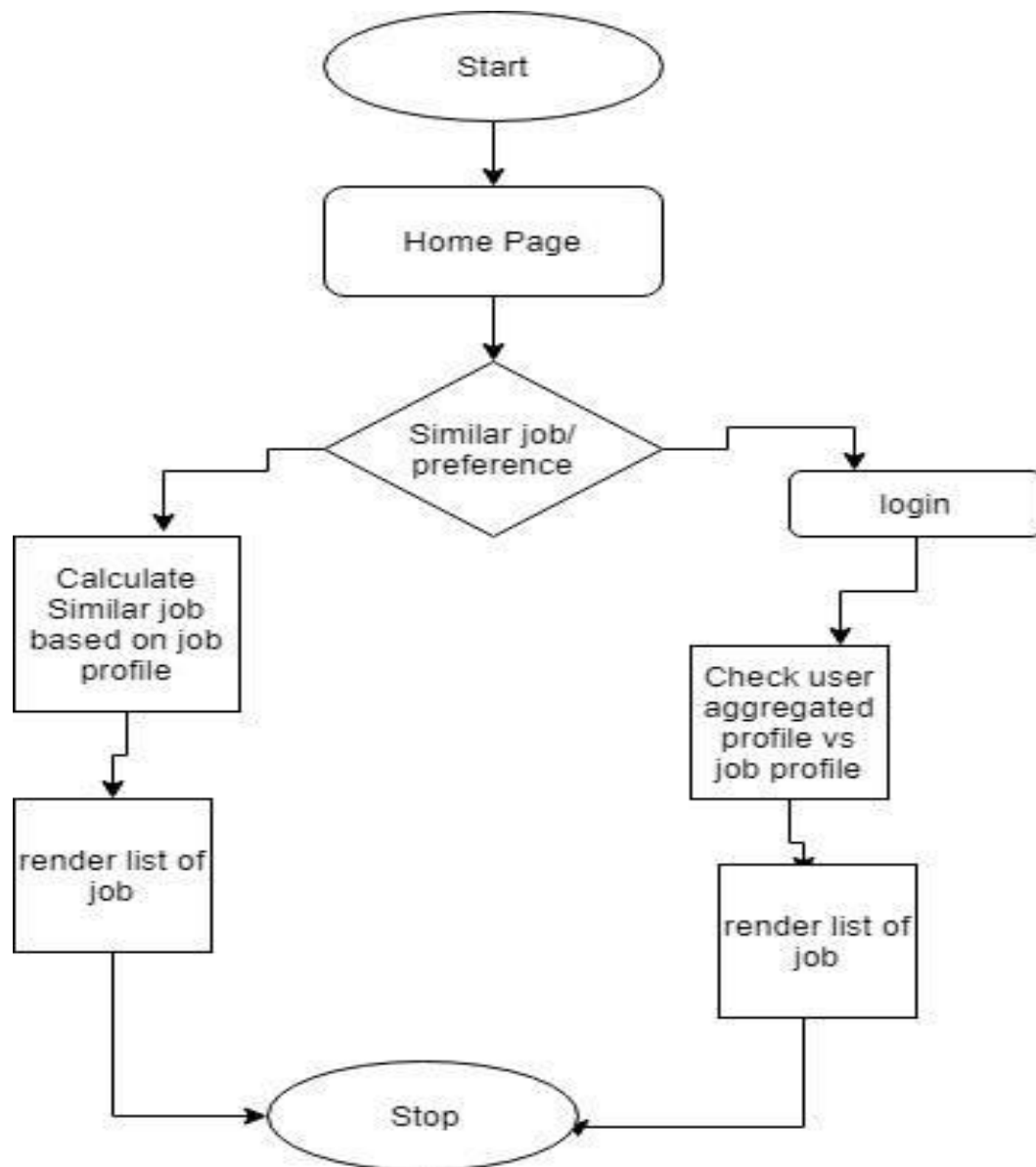


Figure3. 4:Process Design

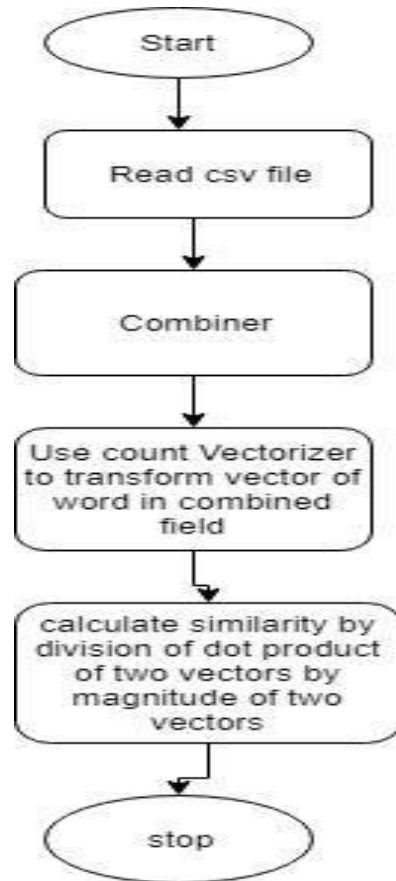


Figure3. 5:Algorithm Design

3.5 Interface Design

There will be admin panel or backend for staffs and admin and they are restricted to access the all privileges according to their roles. Admin gets access to all whereas staffs won't get access to user management. The admin can also view the list of customers. User interface in the server part is designed using Django framework. The customer panel or front end displays a site. User can sign up and login the site and users can register themselves by providing signup details to database through website. User interface in the client part is designed using HTML, CSS and JavaScript.

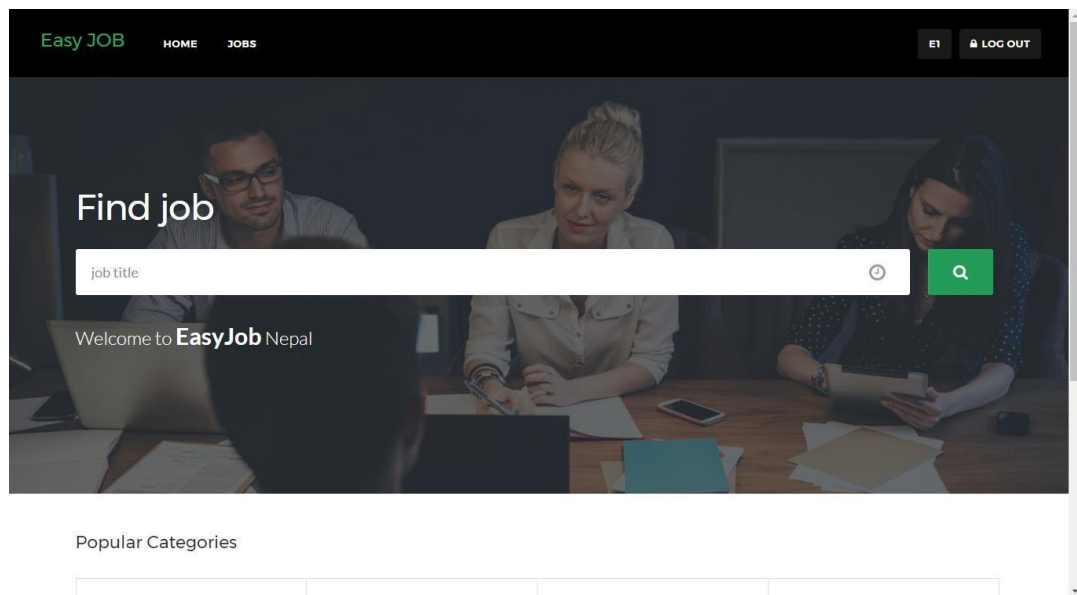


Figure3. 6: Homepage of Job Recommendation System

Home page of Job Recommendation System allows to search job based on the location. The user must be logged in to perform this request. The homepage of Job Recommendation System provides sign in option, sign up option for teacher and student, and several navigation options. The simplicity in the UI is useful for the new users to use the system easily without any confusion.

Figure3. 7: Register as Employee/Employer

User must register themselves as Employee or Employer.

CHAPTER 4: IMPLEMENTATION AND TESTING

4.1 Implementation of CBF Algorithm

Content-based filtering, also referred to as cognitive filtering, recommends items based on a comparison between the content of the items and a user profile. The content of each item is represented as a set of descriptors or terms, typically the words that occur in a document. The user profile is represented with the same terms and built up by analyzing the content of items which have been seen by the user.

Several issues have to be considered when implementing a content-based filtering system. First, terms can either be assigned automatically or manually. When terms are assigned automatically a method has to be chosen that can extract these terms from items. Second, the terms have to be represented such that both the user profile and the items can be compared in a meaningful way. Third, a learning algorithm has to be chosen that is able to learn the user profile based on seen items and can make recommendations based on this user profile. During the implementation of the system, we have assigned the terms manually during the profile creation.

4.1.1 Tools Used

Major applications tools used for developing the application is categorized into two groups. This can be explained as:

Front End Tools:

The front end will be designed using HTML, CSS and JavaScript.

- HTML: It is used in order to layout the project.
- CSS: It is used in order to design the layout of project.
- JavaScript: It is server side scripting language.

Back End Tools:

Back end will be mainly used to store the data and also retrieve the data using Python along with Django framework.

4.1.2 Listing and Description of Major Classes

Various major classes used can be given as:

- **Signup Class:**

This class is used by user in order to create new account or for signing up purpose.

- **Login Class:**

This class is used for login purpose. User can login using this class.

- **Main Activity:**

This class consists main page of the application. Main user interface is described here.

- **User Class:**

This class contains method for describing user's profile. All the data related to the users are shown here.

- **Skill Class:**

This class is used in order to define the skill of the user for the related job.

- **Experience Class:**

This class is used in order to define the experience of the user required in the related job.

- **Employee Class:**

This class is used to store all the entities of the user.

- **ResetPassword Activity:**

In this class, if the user has forgotten their password, then one can reset their password easily.

4.2. Testing

The testing phase is done to verify and validate the Job Recommendation System. The Job Recommendation System is tested to check if the developed system is free from programming and logical errors, and the developed application is what we were expecting. It also checks whether all the system and user requirements are met or not. We have conducted following tests.

4.2.1 Functional Testing

The system is treated as a black box whose behaviour can only be determined by studying its inputs and the related outputs. We are only concerned with the functionality and not the

implementation of the software. In this method, we performed the testing of test cases by simply providing questions as inputs to the system then analyse the tags recommended by the system. The outputs determine whether the test cases are met or not. Job Recommendation System has successfully passed the functional testing.

4.2.2 Module Testing

This application is built in python language. Python language is object oriented language. Thus, we have defined classes for performing the application logic. In module testing the objects for each class are created and then the methods of the classes are tested with the test data. The testing is done to detect errors in the class specifications and operations. This application has successfully passed the module testing.

4.2.3 System Testing

System testing is focused on assessing the system's reliability. It helps to determine the optimality of the internal structure and the outputs generated by the system meets the system requirements. Faults that are discovered during system testing are passed back to the development phase for repair. Then the faults are recovered and then the system is tested again as a whole. This process helps in validating the system by testing the system as a whole that covers each module of the application, database specifications and underlying configurations. This application passes the system testing and is ready for real world implementation.

4.2.3.1 Test Case

Table 1: Test cases for user

S.N	Test Cases	Input Data	Expected Outcome
1	Login page	Username: admin password: nepal@123	User must redirect to profile page after successful login.
2	Login page	Username and password empty	Both username and password field required.
3	Login page	Username: admin Password: pass124345	Invalid username or password please try again.
4	Create account	Username: admin Password: hello1234 Password Confirm: hello1234	Account with this username already exist please try another username.
5	Create account	Username: admin1234 Password: pass1234 PasswordConfirm: pass@1234	Password you entered did not matched please try again.
6	Create account	Username: admin_ram Password: P@\$word1234 Password Confirm: P@\$word1234	Your account is created please check your email for activate your account or click here.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main intention of the project is to develop a system such that user doesn't have to face the problems regarding being employed. This project provides the way of finding appropriate jobs for the user's profile. Hence, this project shows the usefulness of the platform related to finding job among several many opportunities over the market.

5.2 Recommendation

This system is very useful for getting the jobs according to the users experience and skills. Though it can be used as the system that recommends the job it has certain limitations. This system needs internet for the performance. The limitations of this system are:

- a. Internet
- b. Ambiguity

This application can be extended to further uses such as for recommendation of jobs with respect to the location. This system recommends keywords as tags for the given location. With further enhancement, this system could be able to recommend the jobs in brief rather than tags only. Similarly, the learning can be done, to improve the reliability of tagging. In the same way, the multilabel recommendations can added so that user can get close reference of tags.

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- [8] <https://www.gulftalent.com/>

Appendix-I

Screenshots:

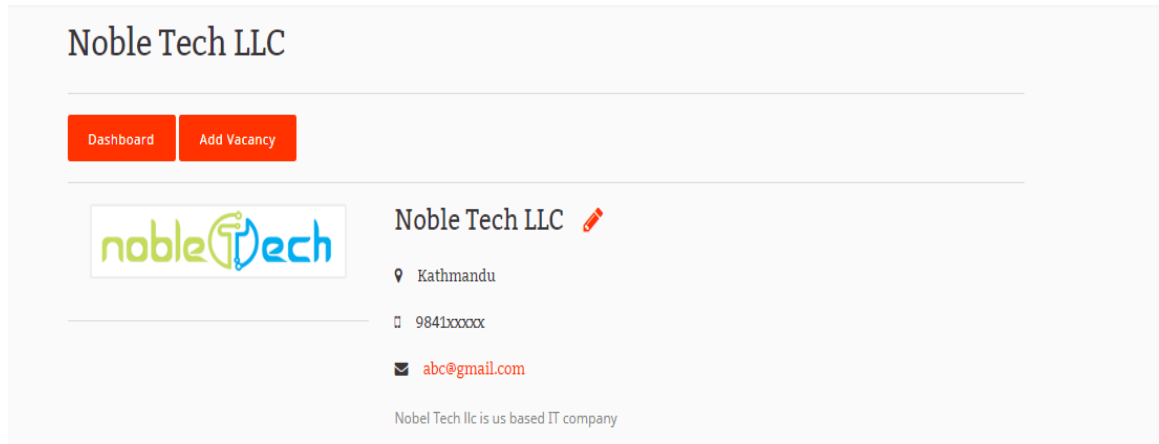


Figure: Extra details

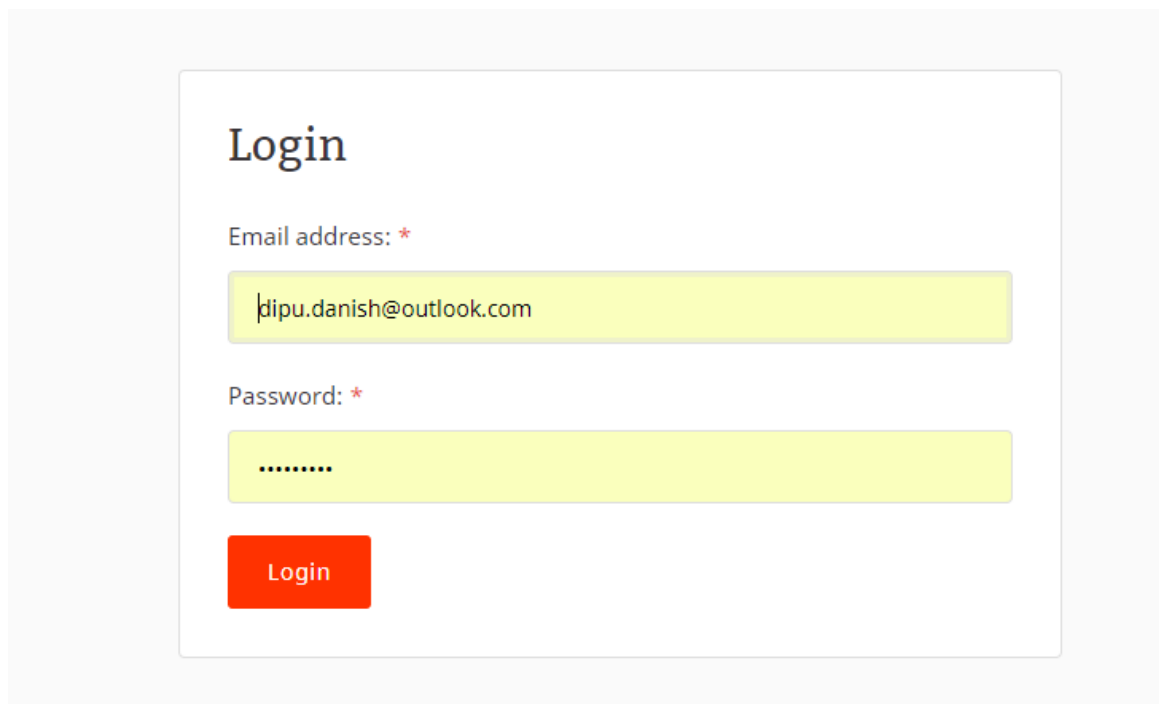


Figure: Login page for Employee/Employeeer

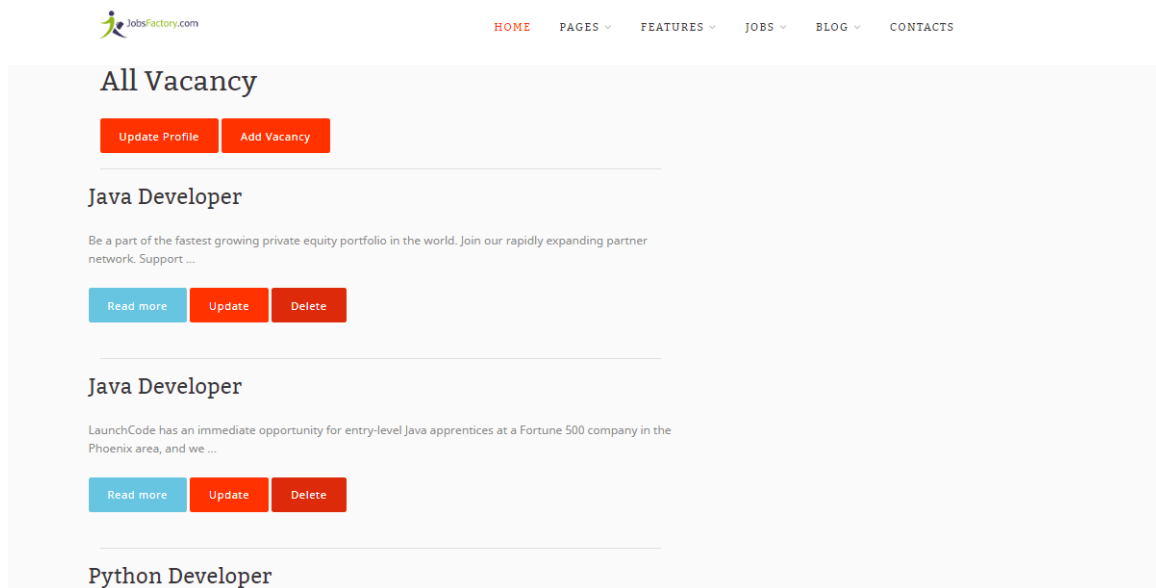


Figure: Recommended jobs for Employee

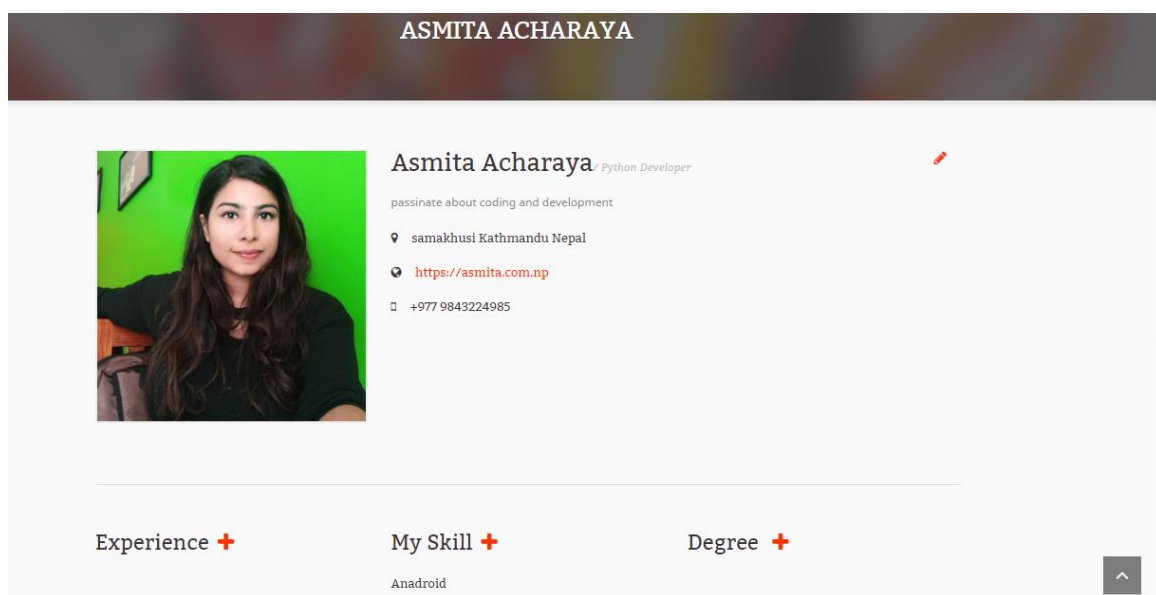


Figure: Recommendation of employee for company

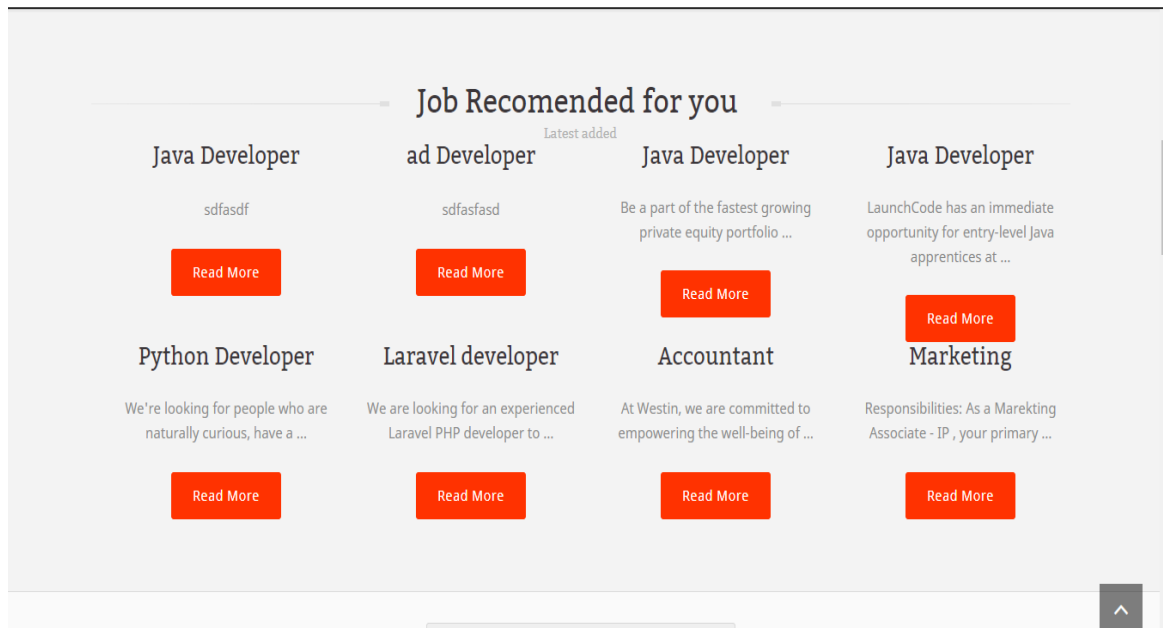


Figure: Search result