INTELLIGENT SYSTEM FOR THE MATCHING OF JOB REQUIREMENTS WITH RESUMES FOR JOB SEARCH AND CAREER BUILDING (Career Resource)

By

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CERTIFICATE

DEDICATION

This is dedicated to my parents, without their help, support and prayers, I wouldn't have been successful

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ABSTRACT

Career Resource is a web portal that is aimed at aiding users in job searching and employee searching. The system works with an intelligent system developed using the concept of Decision Trees. The intelligent system is used for intelligent matching of the job requirements posted by companies and the resumes posted by the individuals. The portal will also contain general information that would help individuals in their careers.

There are 4 sections of the portal, the job seeker's area, employer's area, general area and the administrator's area. Users can sign up with the service to post their CVs (job seekers) and job ads (employers) after signing up. A decision tree has been designed for the matching of the resumes with the job ads based on some marked fields used for matching. The system compares the job ads and the resumes and when a match is made, the users are informed.

The general area is basically designed for the resource portion of the portal. This area provides users with useful information about different academic and professional resources in Pakistan. This section is aimed at being populated by the users themselves and thus will evolve with time as the information posted by the users will be searchable by other users.

The administrator's area is restricted only to the site's administrators. The administrators are responsible for the management and the maintenance of the user accounts and the different site areas. The administrator is also responsible for the invocation of the recruitment process.

The report begins with the introduction of the system. The introduction is followed by an overview of the system for better understanding of the technical

terminologies used in this document and the system. A complete description of the design, working and features of each module is also given along with the results of testing.

Chapter 1

INTRODUCTION

The idea leading to *Career Resource* was to develop a system strong enough and intelligent enough that it can actually help individuals and companies alike, in finding jobs/employees for themselves. *Career Resource* is also an online resource for individuals in their educational as well as professional life. So basically *Career Resource* is a social services web portal that provides services to individuals, helping them in their educational and professional life.

Individuals generally face the problem of misunderstanding the job requirements that appear in ads etc. Some have a language problem while some misunderstand the meaning of the ad. Different companies use different jargons for the description of their jobs, which are very hard to understand unless you ask the company itself about it.

Similarly, companies hiring individuals face the problem of filtering resumes of individuals applying for the jobs. The information provided on the resumes is too large to be read and also the number of resumes coming in for the jobs is so large that it is impossible for a person to read all the data provided in the resume and for that matter filter the resumes correctly. The possibility of an error is high.

A common problem that both the parties face is the conveyance of the message that a job opening is present and to get that message to the individuals. Openings emerge and they are missed by people. Companies as well as job seekers both suffer from this absence of a decent communication channel that can take the information to all the individuals.

Career Resource provides the solutions to the above mentioned problems. The users just have to post their resumes (job seekers) and job requirements (companies) and the system automatically matches them. If a match is found, then both the parties will be informed of it. The system does so, on the basis of some selected fields, values of which will be provided by the users themselves. This system allows the users to search for jobs/employees on the go, at all times. The system does all the work for them. In this way opportunities aren't missed and also the requirements are not misunderstood.

Moreover, the information that resumes contain is not always sufficient to project the actual skills or experience of an individual. Similarly for job requirement specifications, the information provided is either too ambiguous or too less to understand. *Career Resource* provides users with their own space to post files searchable by others. These files can contain the details of information provided in their resumes or projects etc. that they are undertaking. It gives the contenders a better idea of the requirements and the offerings thus making the decision of the users easier.

Students these days face the problem selecting universities for their future studies. Individuals fail to apply for certain universities due to lack of information, some even don't know if a certain university exists or a certain discipline of their interest is taught by which university. *Career Resource* holds a complete database of the universities chartered by the Higher Education Commission of Pakistan. More over, for individuals looking for studies abroad or a foreign degree staying in Pakistan, the information about that is also provided on the web portal. Students can search the information from here. They can also search for scholarships offered by the government, private companies,

firms and organizations. This information will be posted on the website by the concerned firms.

There are basically 4 types of users who will interact with the system;

- Job Seekers (registered)
- Employers (registered)
- General Users (unregistered)
- Administrators

Career Resource provides certain features and privileges to each of the users mentioned above. Users must register in order to gain access to the websites main features. General users just have the privilege of viewing and searching for jobs/resumes manually. They won't be able to enjoy the main features of the site i.e. the intelligent searching and matching of values posted by the users.

Related to the users, there are 4 basic areas for the website which comprise the 4 main modules of the project. There are a number of underlying tasks that combine to form the whole working system. Some of the modules overlap internally which was necessary for the working of the system. The system comprises of the following modules;

- Module 1: User Sign Up
- Module 2: Job/Resume Posting
- Module 3: Job/Resume Search
- Module 4: Intelligent matching of jobs with resumes (Decision Trees)

- Module 5: File upload and search mechanism
- Module 6: Information Resource
- Module 7: Placement of Advertisements on the site
- Module 8: Site Administration and Management Section
- Module 9: Google Search API implementation

Career Resource is developed using Microsoft Visual Studio.NET with Microsoft SQL Server 2000 as the database management system and MatLab 5.3 for deploying and running the Neural Networks. The implementation of the Decision Trees module was done in Microsoft C#. The application is designed for the Windows Operating System.

This report is divided into different chapters. The following chapters contain the Overview of the project giving adequate information about the technical terminologies that are used in this document. The project review is followed by the technical details of the project in the system detailed design and the system implementation. The report ends with the recommendations and conclusion.

Chapter 2

PROJECT REVIEW

This chapter discusses the terminologies, tools and techniques that I have used in this project. It provides an insight on the working and details of the project for better understanding. There are two major portions of this tutorial, one describes the front end of the system, i.e. is the web portal and the second describes the decision tree algorithm used at the back end for the intelligent searching and matching of values.

2.1 THE PORTAL

2.1.1 Sign Up

The sign up process is used get the user registered with the service. The user will have to fill in a form, choosing a user name and password and giving out some basic information that will then be saved in the database. The user name of the person will be unique across the system and no other user can obtain the same user name. Sign up is also used alternately with “register” in this report.

2.1.2 Post

Post is the term used for the process of saving values on the server. The user is required to save values of his resume/job requirements in the database. An alias for this phrase is “upload”.

2.1.3 Edit

Edit is the process used to change the values previously saved by the user, on the server.

2.1.4 Sign In

After signing up for the service, each user gets an allocated space on the server and certain privileges. In order to access the allocated space and use the privileges, the user needs to authenticate his ID. The authentication process is called the Sign In process. Another name for this process is “Login”

2.1.5 Manage

Manage is the process of making changes/modifications to the data stored previously. The user can delete, edit, update or add new data to the previous one.

2.1.6 Search

The process of going through the records and finding the required data/file is called the search process. “Explore” is used alternately with search in the project. Both have the same meaning.

2.1.7 Delete

Delete is the process by which the user removes previously stored values from the database/server.

2.1.8 Sign Out

Sign Out is the process through which the users ends the session with the server and closes his account. Sign Out is also referred to as “Logout” in the project.

2.1.9 Upload

Upload is the process used to save files in the allocated space on the server. Users can upload their files on the server for others to view and download. Upload is used in the context of files, while in the context of information posted in text form (not in file format), “post” is used.

2.1.10 Resume Builder

A tool designed to be used for building and uploading the resumes of the person looking for a job. This tool will be available for the users once they sign up as job seekers with the service.

2.1.11 Job Advertisements

Job advertisements are the job openings that users will post on the website, for others to view and respond to. This service will be available once the users sign up as employers with the service.

2.1.12 Resume Explorer

Resume Explorer is the tool used by companies to search for resumes posted by job seekers.

2.1.13 Employment Explorer

Employment Explorer is the tool used by the job seekers to search for job advertisements posted by the employers.

2.1.14 Message

A short piece of information posted in the user's account to inform him of any news of job matching.

2.1.15 Industry Type

Industry type is defined as the main field of work of the person. It may also be called the primary field of expertise of the person e.g. IT, Management, Finance etc. In resumes, it is the field of work of the users, while in job ads, it is the required field of work of the person required for the job. The list of industry types can be found in Appendix G of this report.

2.1.16 Functional Area

Functional Area is the sub field of work of the person with in the industry type that the person chose. This field is used to specify the field narrowing down the ambiguity e.g. IT-Databases, IT-Embedded Systems, Human Resource Management, Chartered Accountancy etc. The list of functional areas can be found in Appendix H of this report.

2.2 INTELLIGENT SYSTEM

In this scope of this project, there was a need for an intelligent system that would match the job requirements with the resumes posted by users. The 2 models studied for this reason were the neural networks model and the decision tree model. Both the models were studied thoroughly and then it was concluded that the Decision Tree Model is the better choice. Both the models are explained in the following text.

2.2.1 Neural Networks

Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements.

Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. The network is adjusted, based on a comparison of the output and the target, until the network output matches the target. Typically many such input/target pairs are used, in this *supervised learning*, to train a network.

The leading characteristic of neural and adaptive systems is their adaptivity, which brings a totally new system design style. Instead of being built a priori from specification, neural and adaptive systems use external data to automatically set their parameters. This means that neural systems are parametric. It also means that they are made "aware" of their output through a performance feedback loop that includes a cost function. The performance feedback is utilized directly to change the parameters through

systematic procedures called learning or training rules, so that the system output improves with respect to the desired goal (i.e., the error decreases through training).

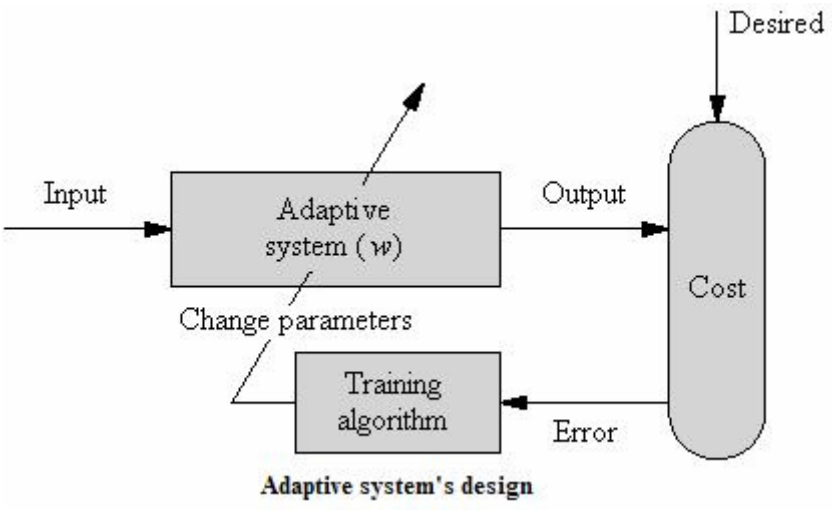


Figure 1: Adaptive System's Design

Neural and adaptive systems are used in many important engineering applications, such as;

- Signal Enhancement
- Noise Cancellation
- Classification of Input Patterns
- System Identification
- Prediction
- Control

They are also used in many commercial products such as;

- Modems
- Image-Processing & Recognition Systems
- Speech Recognition
- Front-End Signal Processors
- Biomedical Instrumentation.

It is expected that the list will grow exponentially in the future.

2.2.2 Decision Trees

Decision trees are powerful and popular tools for classification and prediction. The attractiveness of decision trees is due to the fact that, in contrast to neural networks, decision trees represent *rules*. Rules can readily be expressed so that humans can understand them or even directly used in a database access language like SQL so that records falling into a particular category may be retrieved.

In some applications, the accuracy of a classification or prediction is the only thing that matters. In such situations we do not necessarily care how or why the model works. In other situations, the ability to explain the reason for a decision is crucial. In marketing one has describe the customer segments to marketing professionals, so that they can utilize this knowledge in launching a successful marketing campaign. These domain experts must recognize and approve this discovered knowledge, and for this we need good descriptions. There are a variety of algorithms for building decision trees that

share the desirable quality of interpretability. Two well known and frequently used over the years are the ID3 and the C4.5 Algorithm

2.2.2.1 Definition

Decision tree is a classifier in the form of a tree structure (see Figure 1), where each node is either:

- a *leaf node* - indicates the value of the target attribute (class) of examples, or
- a *decision node* - specifies some test to be carried out on a single attribute-value, with one branch and sub-tree for each possible outcome of the test.

A decision tree can be used to classify an example by starting at the root of the tree and moving through it until a leaf node, which provides the classification of the instance.

Decision tree induction is a typical inductive approach to learn knowledge on classification. The key requirements to do mining with decision trees are:

- *Attribute-value description*: object or case must be expressible in terms of a fixed collection of properties or attributes. This means that we need to discretize continuous attributes, or this must have been provided in the algorithm.

- *Predefined classes (target attribute values)*: The categories to which examples are to be assigned must have been established beforehand (supervised data).
- *Discrete classes*: A case does or does not belong to a particular class, and there must be more cases than classes.
- *Sufficient data*: Usually hundreds or even thousands of training cases.

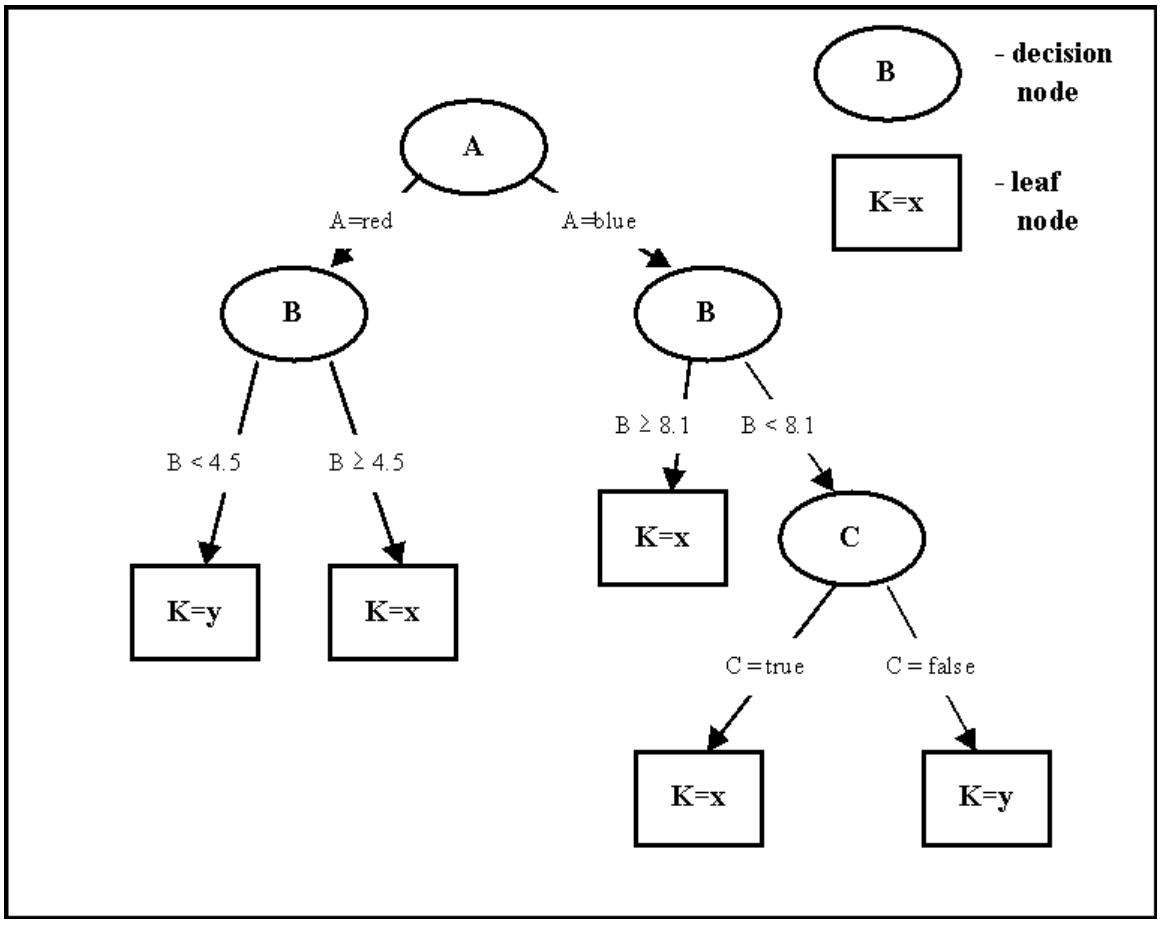


Figure 2: An example of a simple decision tree

2.2.2.2 Constructing Decision Trees

Most algorithms that have been developed for learning decision trees are variations on a core algorithm that employs a top-down, greedy search through the space of possible decision trees. Decision tree programs construct a decision tree *T* from a set of training cases.

J. Ross Quinlan originally developed ID3 at the University of Sydney. He first presented ID3 in 1975 in a book, *Machine Learning*, vol. 1, no. 1. ID3 is based on the Concept Learning System (CLS) algorithm.

2.2.2.3 The ID3 algorithm

The ID3 Algorithm is as follows;

Given a set of examples, S, categorized in categories c_i, then:

1. Choose the root node to be the attribute, A, which scores the highest for information gain relative to S.
2. For each value v that A can possibly take, draw a branch from the node.
3. For each branch from A corresponding to value v, calculate S_v. Then:

    - If S_v is empty, choose the category $c_{default}$ which contains the most examples from S, and put this as the leaf node category which ends that branch.
    - If S_v contains only examples from a category c, then put c as the leaf node category which ends that branch.

- Otherwise, remove A from the set of attributes which can be put into nodes. Then put a new node in the decision tree, where the new attribute being tested in the node is the one which scores highest for information gain relative to S_v (note: not relative to S). This new node starts the cycle again (from 2), with S replaced by S_v in the calculations and the tree gets built iteratively like this.

The algorithm terminates either when all the attributes have been exhausted, or the decision tree perfectly classifies the examples.

Explanation

The decision tree is generated by a set of questions which are answered in order to move forward and solve the problem. Each node of the tree acts as a question. The answer of the question under consideration then results in taking the route to the next node. The order of the questions on the nodes is determined by calculating the entropy and the information gain for each question at hand. The question that has the highest information gain value is placed at the top of the tree and then moving down in descending order, the next questions are placed on the tree based upon the information gain value of each question. When the tree is invoked, the values are fed into the first node. Based upon the answer of the question, the route is chosen to the next node. Similarly, based on the answer of the subsequent nodes, the routes are chosen and the tree moves on until all the nodes have been traversed or when the information is enough to take the required decision from the tree.

The following diagram should explain the ID3 algorithm further:

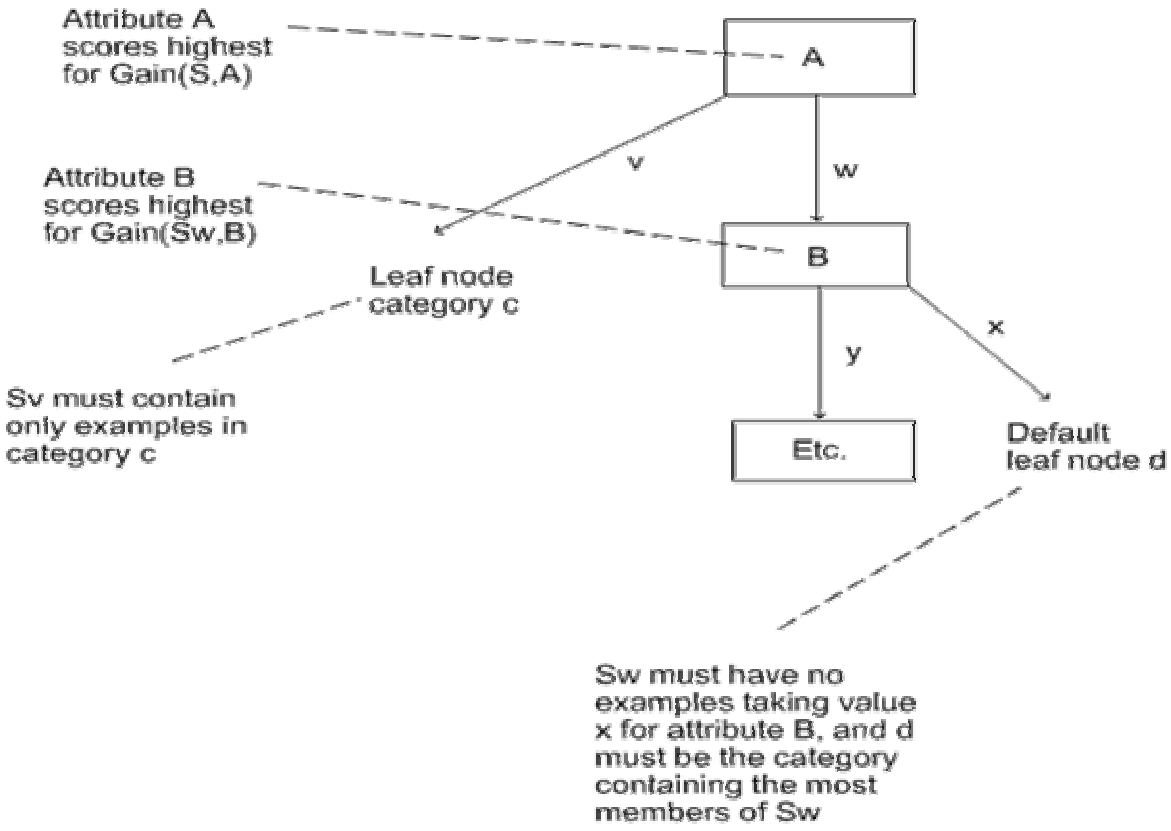


Figure 3: Decision Tree Creation

ID3 searches through the attributes of the training instances and extracts the attribute that best separates the given examples. If the attribute perfectly classifies the training sets then ID3 stops; otherwise it recursively operates on the m (where m = number of possible values of an attribute) partitioned subsets to get their "best" attribute. The algorithm uses a greedy search, that is, it picks the best attribute and never looks back to reconsider earlier choices. Note that ID3 may misclassify data.

The central focus of the decision tree growing algorithm is selecting which attribute to test at each node in the tree. For the selection of the attribute with the most

inhomogeneous class distribution the algorithm uses the concept of entropy, which is explained next

2.2.2.4 Classification

The estimation criterion in the decision tree algorithm is the selection of an attribute to test at each decision node in the tree. The goal is to select the attribute that is most useful for classifying examples. A good quantitative measure of the worth of an attribute is a statistical property called *information gain* that measures how well a given attribute separates the training examples according to their target classification. This measure is used to select among the candidate attributes at each step while growing the tree.

2.2.2.5 Entropy - a measure of homogeneity of the set of examples

In order to define information gain precisely, we need to define a measure commonly used in information theory, called entropy, that characterizes the (im)purity of an arbitrary collection of examples. Given a set S, containing only positive and negative examples of some target concept (a 2 class problem), the entropy of set S relative to this simple, binary classification is defined as:

$$\text{Entropy}(S) = - p_p \log_2 p_p - p_n \log_2 p_n$$

Where p_p is the proportion of positive examples in S and p_n is the proportion of negative examples in S. In all calculations involving entropy we define 0log0 to be 0.

To illustrate, suppose S is a collection of 25 examples, including 15 positive and 10 negative examples [15+, 10-]. Then the entropy of S relative to this classification is;

$$\text{Entropy}(S) = - (15/25) \log_2 (15/25) - (10/25) \log_2 (10/25) = 0.970$$

Notice that the entropy is 0 if all members of S belong to the same class. For example, if all members are positive (p_p= 1), then p_n is 0, and Entropy(S) = -1´ $\log_2(1)$ - 0´ $\log_2 0$ = -1´ 0 - 0´ $\log_2 0$ = 0. Note the entropy is 1 (at its maximum!) when the collection contains an equal number of positive and negative examples. If the collection contains unequal numbers of positive and negative examples, the entropy is between 0 and 1. Figure 3 shows the form of the entropy function relative to a binary classification, as p_+ varies between 0 and 1.

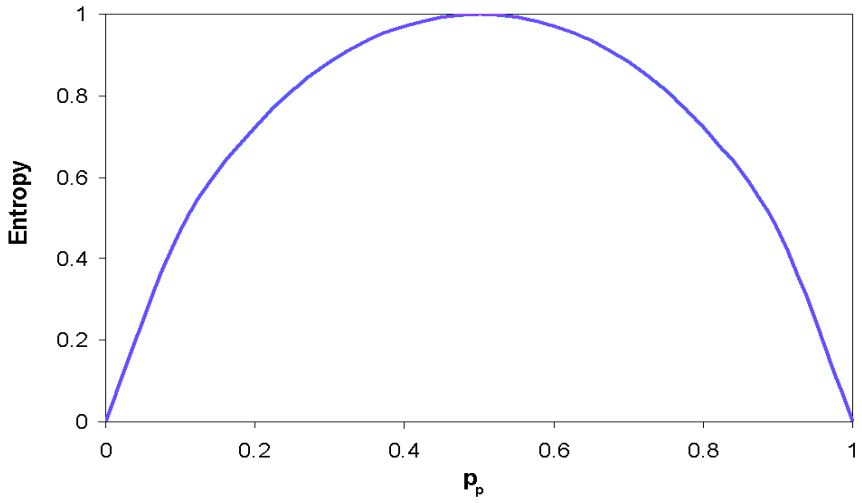


Figure 4: The entropy function relative to a binary classification, as the proportion of positive examples p_p varies between 0 and 1.

One interpretation of entropy from information theory is that it specifies the minimum number of bits of information needed to encode the classification of an arbitrary member of S (i.e., a member of S drawn at random with uniform probability). For example, if p_p is 1, the receiver knows the drawn example will be positive, so no message need be sent, and the entropy is 0. On the other hand, if p_p is 0.5, one bit is required to indicate whether the drawn example is positive or negative. If p_p is 0.8, then a collection of messages can be encoded using on average less than 1 bit per message by assigning shorter codes to collections of positive examples and longer codes to less likely negative examples.

Thus far we have discussed entropy in the special case where the target classification is binary. If the target attribute takes on *c* different values, then the entropy of S relative to this *c*-wise classification is defined as;

$$Entropy(S) = \sum_{i=1}^{c} - p_i \log_2 p_i$$

Where p_i is the proportion of S belonging to class *i*. Note the logarithm is still base 2 because entropy is a measure of the expected encoding length measured in bits. Note also that if the target attribute can take on c possible values, the maximum possible entropy is $\log_2 c$.

2.2.2.6 Information gain measures the expected reduction in entropy

Given entropy as a measure of the impurity in a collection of training examples, we can now define a measure of the effectiveness of an attribute in classifying the

training data. The measure we will use, called *information gain*, is simply the expected reduction in entropy caused by partitioning the examples according to this attribute. More precisely, the information gain, *Gain (S, A)* of an attribute *A*, relative to a collection of examples S, is defined as;

$$Gain(S,A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

Where *Values(A)* is the set of all possible values for attribute *A*, and S_v is the subset of *S* for which attribute *A* has value *v* (i.e., $S_v = \{s \in S \mid A(s) = v\}$). Note the first term in the equation for *Gain* is just the entropy of the original collection *S* and the second term is the expected value of the entropy after S is partitioned using attribute *A*. The expected entropy described by this second term is simply the sum of the entropies of each subset S_v, weighted by the fraction of examples $|S_v|/|S|$ that belong to S_v. *Gain (S,A)* is therefore the expected reduction in entropy caused by knowing the value of attribute *A*. Put another way, *Gain(S,A)* is the information provided about the target attribute value, given the value of some other attribute A. The value of *Gain(S,A)* is the number of bits saved when encoding the target value of an arbitrary member of *S*, by knowing the value of attribute *A*.

The process of selecting a new attribute and partitioning the training examples is now repeated for each non-terminal descendant node, this time using only the training examples associated with that node. Attributes that have been incorporated higher in the tree are excluded, so that any given attribute can appear at most once along any path

through the tree. This process continues for each new leaf node until either of two conditions is met:

- Every attribute has already been included along this path through the tree.
- The training examples associated with this leaf node all have the same target attribute value (i.e., their entropy is zero).

2.2.2.7 The strengths of the Decision Tree algorithm

The strengths of decision tree methods are:

- Decision trees are able to generate understandable rules.
- Decision trees perform classification without requiring much computation.
- Decision trees are able to handle both continuous and categorical variables.
- Decision trees provide a clear indication of which fields are most important for prediction or classification.

Chapter 3

SYSTEM REQUIREMENTS SPECIFICATIONS

This chapter covers the details of the requirements of *Career Resource*. The detailed requirements are as follows;

3.1 GENERAL FEATURES

3.1.1 Application Interface

The main page of the web site will have navigation buttons to all the general pages of the website. Links will be provided on all the general pages and the user can navigate back and forth between pages easily.

One the user logs in to his account, the general area features will not be accessible anymore for security reasons. But the user can open a new window in order to access those features.

The user account pages will have navigation links to the different modules/pages within the user account area.

3.1.2 Information Resource

The information Resource portion of the portal will carry the information about;

- HEC accredited Universities in Pakistan
- HEC accredited Foreign University Programs in Pakistan

Users can easily view and search the universities using the comprehensive search facility provided on each of the mentioned pages. Apart from the above mentioned resource facilities provided by the web site, users will also be provided by resources posted by other users. Companies/Users will have to free of charge to submit resource offerings. The resources that can be posted by users for others to avail are as follows;

- Scholarship postings by companies who wish to provide scholarships to students
- Offers by Venture Capitalists who wish to invest in a new venture
- Internship Offers by companies
- Sponsorship offer postings by companies willing to sponsor events

Users will be able to post these offerings which will be searchable by other users.

3.1.3 Registration Process

Users will be required to register with the service if they wish to post their Resumes or Job Requirements for others to search and for the system to find a match for them. Job Seekers will not be charged anything for the service, but companies posting jobs for other users will be charged a certain amount for the service. Each user will be allocated 1 MB of space on the server for uploading and saving files.

3.1.4 Job/Resume Search

The Job/Resume Search module will be free for all to use. Users will be required to fill in certain criteria (Industry Type, Functional Area, Experience, Qualification), and then the search will be performed according to that criterion.

3.1.5 Job/Resume Posting

The Job/Resume posting module will be accessible to users once they have signed up for the service. Users will be required to sign in to their account in order to be able to post their Resumes and Job Requirements.

Job Seekers will post their Resumes with the service. Each job seeker will be allowed to post exactly "one" resume with the service which will be editable. Multiple CVs will not be allowed.

Employers (Companies looking for employees), will post jobs requirements with the service. Companies will be allowed to post multiple job openings at a time which will be editable.

3.1.6 File Upload/Search

Users, once signed up will also be allowed to upload files in their allotted web space. These files will be completely public and will be searchable and downloadable by other users. File Information will be saved in the Database for easier searching and archiving.

3.1.7 Account Management

Users will be allowed to manage their accounts. Change Password and Edit Information privileges will be provided to them to manage their accounts.

3.1.8 Advertisements

Ads have been placed on different pages of the web portal. Administrator will be able to change the ads that are to be shown on the site. XML files will be uploaded with the Ads that are being uploaded to set the probability of the ads to be shown.

3.1.9 Analysis/Reports

Reports will be generated that will then be shown to the administrator.

3.1.10 System Preferences

The Administrator will be able to change or edit the different support data being used in the site. The administrator will also be able to create, activate or de-activate user accounts and even terminate/discontinue the service to any of the users. The administrators will also have the privilege to access user accounts for screening and management purposes.

3.1.11 Database

The information will be stored in a database for later retrieval and use.

3.1.12 Job Searching/Matching

Once the users have posted their CVs and Job Requirements, it will then be up to the system to match them and inform the concerned parties of the match. Users will not be able to invoke or view the process, the site administrator will invoke the process manually. The users whose resume/job requirements match the required criterion, they will be informed through internal site messaging and through email as well.

3.2 PROJECT TIME LINE

The Project Time Line contains the names of the modules and the time taken in the completion of each module. The Gantt chart of the Project Time Line is in Appendix F of this report.

Chapter 4

SYSTEM DETAILED DESIGN

4.1 SYSTEM ARCHITECTURE

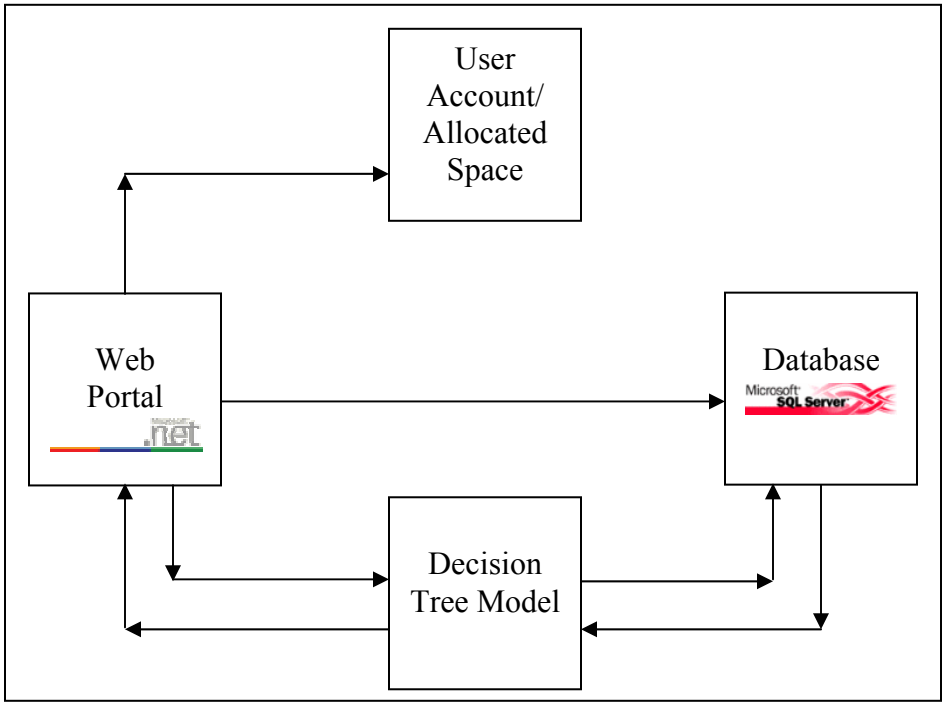


Figure 5: System Architecture

The system basically has 3 portions. The web portal, the database and the decision trees module. The web portal is the front end of the system which is designed in Macromedia Dreamweaver MX and developed in Microsoft Visual Studio.NET 2003. The programming language used for the web portal is Microsoft C#.NET. Microsoft ASP.NET is used for the development of the site i.e. for publishing it over the web. As a requirement for using ASP.NET, Internet Information Systems (IIS) is used as the web server for the web portal. Microsoft SQL Server 2000 is used for the Database

Management. The database integrity and the constraints like relationships are being managed on the application level. The Decision Tree module is applied using Microsoft C#.NET. All of the above mentioned modules combine to form the complete system.

The web portal, the database and the decision tree module are all maintained on the same machine for faster data retrieval. However they can be moved to other machines without changing much of the structure of the site as these 3 modules are completely separate from each other, integrated in a way that changing their locations would not affect the working of the site. The need for moving the database and the decision tree module may arise if the information load on the site increases as more users may sign up and also when the number of jobs and the resumes to be matched increases.

Users have the privilege of uploading files to their accounts. Each user is allotted 1 MB space on the server. As space on the server may go short as more and more users sign up, the system has the facility of maintaining the user web space on other machines as well. The locations for user allocated spaces are set by the administrators. The user account can also be relocated by the administrators.

When the user logs on to the system, he interacts with the web portal only. The data that is passed on to the portal is saved in the SQL Database. The files that the users upload to the server are saved on the users' allocated space on the server. The description of the files is saved in the database. When the Administrator invokes the process, the specified data from the database is fed into the Decision Tree Module which then matches the resumes with the job requirements informing when ever a match is found.

The signup process for the job seekers is free, but the employers have to pay a certain amount through credit card to get registered with the service. The credit card entered by the user is validated using the LUHN formula for credit card validation.

4.2 DATA FLOW DIAGRAMS (DFDS)

The Data Flow Diagrams (DFDs) are given in Appendix A, the details of which are given below.

4.2.1 Seeker Sign Up (1.0)

The seeker sign up process registers job seekers with the service. The data required for a job seeker to sign up are;

- User Name
- Login Name
- Password
- Email Address

The data is saved in the seekers table.

4.2.2 Employer Sign up (2.0)

The employer sign up process registers employers with the service. The process is similar to the job seekers sign up process but it is not exactly the same as the former. The data required for the employer sign up process are;

- Company Name
- User Login
- Password
- Phone Number
- Email Address
- Address
- Postal Code
- City

The sign up process had 2 steps. The next step is the credit card validation page. The data required for this page are;

- Card Holder's Name
- Credit Card Number
- Expiration Date
- Card Type

4.2.3 Post Resume (3.0)

The post resume process posts resumes of the job seekers in the database. The resume information is saved in 4 different tables. The required data for this process are;

General Information

- Name
- Date of Birth
- Gender
- Country

Job Requirement Information

- Objective
- Desired Job Type
- Desired Employment Type
- Experience
- Industry Type
- Functional Area
- Status
- Key Skills

Educational Information

- Degree Name
- Specialization Field
- University Name
- Graduation Year
- Course Type

Job Experience Information

- Name of Employer
- Designation
- Duration of Employment
- Role in the Organization

4.2.4 Post Jobs (4.0)

The post jobs process stores the job requirements information entered by the employers. The major data required are;

- Job Title
- Job Description

4.2.5 Search Files (5.0)

The search files process searches for files from the database, based upon the search criteria entered by the user. The data used for search criteria are;

- File Title
- File Description
- File Name

OR

- User Name

4.2.7 Search Resumes (6.0)

The search resume process searches for resumes based upon the search criteria input by the user. The data required for performing the search are;

- Industry Type
- Functional Area
- Experience
- Qualification

4.2.7 Search Jobs (7.0)

The search jobs process searches for jobs for the users based upon the input criteria. The data required for the search is the same as for that for the resume search;

- Industry Type
- Functional Area
- Experience
- Qualification

4.2.8 Post Files (8.0)

The post files process saves files on the web server and saves the file information in the database. The file information saved in the database is;

- File Title

- File Description
- File Name

4.2.9 Seeker Login (9.0)

The Seeker Login process requires the following data

- User Login
- User Password
- Current Date Time

The User's login and password fields are used for the user's validation and the date time field is used to check if the user's account has expired or is active.

4.2.10 Employer Login (10.0)

The Employer Login process required the same information as mentioned above in the seeker login process.

4.2.11 Search Universities (11.0)

The Search Universities process searches for university information for the user. User can query all results or search giving a search criteria

4.2.12 Post Scholarship Offers (12.0)

The post scholarship process saves the data provided by the user in the database. The required fields for this process are;

- Company Name
- Email Address
- Scholarship Description

4.2.13 Search Scholarships (13.0)

The search scholarships process searches for scholarships for the user based upon the user's search criteria.

4.2.14 Search Internship Offers (14.0)

The search internship offers process searches for scholarships for the user based upon the user's search criteria.

4.2.15 Post Internship Offers (15.0)

The post internship offers process saves the internship offer data provided by the user, in the database. The required fields for this process are;

- Company Name
- Email Address

4.2.16 Search Internship Resumes (16.0)

The search internship resume process searches for internship resumes posted by other users. The search is performed according to the search criteria provided by the user.

4.2.17 Post Internship Resumes (17.0)

The post internship resume process saves the data provided by the user to the database. The required fields for this process are;

- User Name
- Email Address

4.2.18 Search Free Jobs (18.0)

The search free jobs process searches for jobs information from the database. The search is performed according to the criteria provided by the user.

4.2.19 Post Free Jobs (19.0)

The post free jobs process saves the data provided by the user into the database. The required fields for this process are;

- Company Name
- Email Address
- Job Description

4.2.20 Search Sponsorship Offers (20.0)

The search sponsorship offers process searches for sponsorship offers information from the database. The search is performed according to the criteria provided by the user.

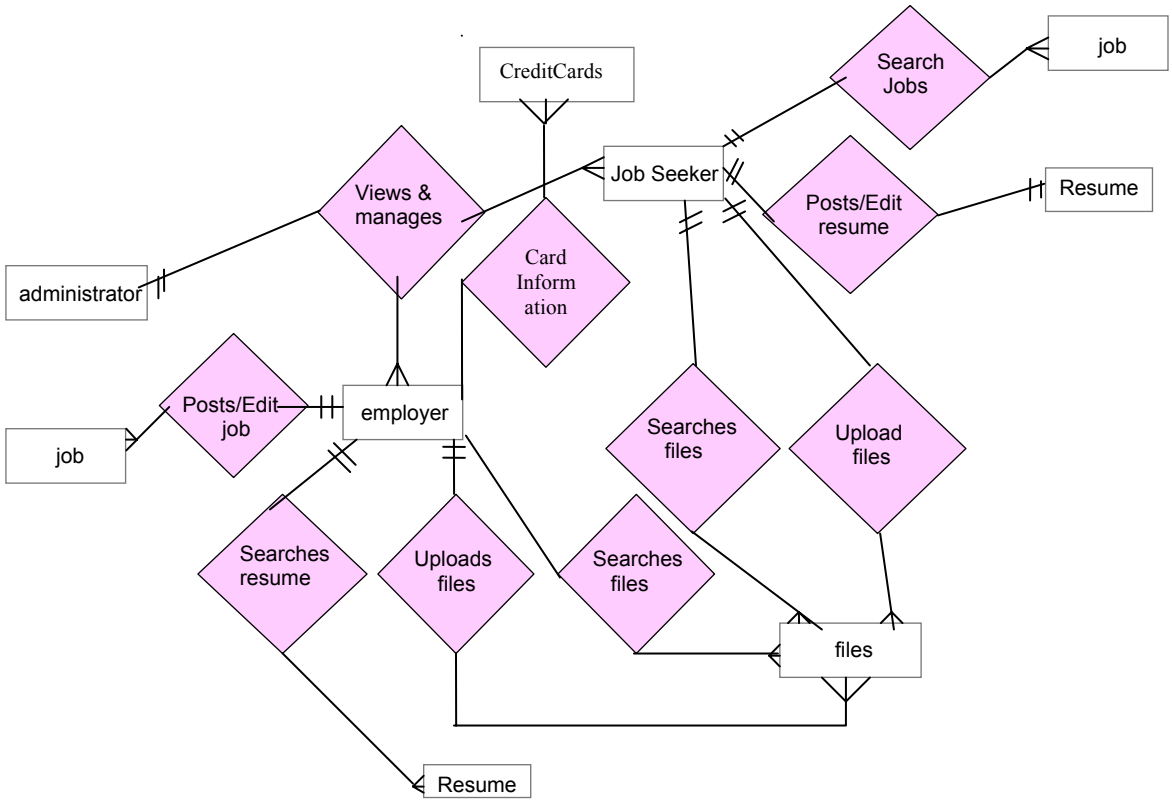
4.2.21 Post Sponsorship Offers (21.0)

The post sponsorship offers process saves the sponsorship offer data provided by the user, in the database. The required fields for this process are;

- Company Name
- Email Address

4.3 ENTITY RELATIONSHIP DIAGRAM (ERD)

The Entity Relationship Diagram is given as follows



4.4 DATABASE DESCRIPTION

The Details of the tables are given in the Appendix D of this report.

Chapter 5

SYSTEM IMPLEMENTATION

This chapter covers the complete implementation of *Career Resource* with details about each module. The programming language used for this project is Microsoft C#.NET. C# is a new language from Microsoft which has ample support for web applications. It is a server based programming language where all the processing takes place on the server. C# coupled with ASP.NET creates web pages. C# uses the advanced version of ASP (Active Server Pages) i.e. "ASP.NET". ASP.NET generates "aspx" pages which are actually html pages with their code resident on the server. The server only sends the html page to the client machine keeping all the code and processing with itself. When the client machine sends a request to the server, the server responds by sending the aspx page to the client machine. When ever the user clicks on a button or fills in a form, the request is sent back to the server where the requested processing takes place. In this way the code is more secure and less prone to attacks.

Session handling is also made easier in ASP.NET as the server maintains the sessions itself. When ever a user sends a request to the server, a session is created for that particular user. The session may or may not expire for the user depending upon the code written for the page. If the code for handling the session exists for the page, then the server handles the session and it is expired depending upon the conditions mentioned in the code. If there is no mention of session handling in the code, then the server handles the sessions itself.

In ASP.NET, an html page is called a web form. All the controls on the page are enclosed in an html “form” tag. There can be only one html form tag per page as when ever a change is made on the page, the page is posted back, or in other words the “form” is posted back to the server. More than one form cannot be posted back at the same time, so the restriction of having one form per page applies here.

When ever a web form is created in ASP.NET, it imports the name space of the project that is being created. All the pages must be inherited from the name of the project for session handling and for importing objects from other classes into the current class. We cannot import the object of another class into the current class if the namespace is different. So, all the pages of a particular project must belong to the same namespace. More over, each page has its own class, i.e. upon creation of a new page, the Microsoft .Net framework creates a new class for that page. In this way, the concept of object oriented programming is maintained.

Microsoft Visual Studio.NET also has good support for database access. The database system used in the course of this project is Microsoft SQL Server 2000. VS.NET has good support for SQL Server data access. The embedded controls provided in VS.NET allow users to create and maintain database connections without going into much detail of handling the connections. The VS.NET handles the connections itself. The connections can also be made secure using the functionality provided in VS.NET. Data can also be retrieved in the form of sets from the database, using the controls provided in VS.NET. This allows faster access and maintenance of the data on the server so that the request need not be sent to the database over and over again. VS.NET and SQL Server,

both being Microsoft products, integrate well and make a good combination for web based applications.

The final module of this project is the implementation of the intelligent system using decision trees. The intelligent system is used for the matching of job requirements with resumes posted by the users. There are fields marked for the matching (the details of these fields are provided in the data dictionary and in the details of the modules in the following sections of this chapter). The decision tree algorithm is used for the matching of these fields. A criteria for this matching has been devised and if that criteria is fulfilled, i.e. if a match is made, the users are informed. This module is also developed in C#.

As support for the functionality of this project, LUHN formula for credit card validation is used for validation of the card numbers that the users enter, for payment of their dues (the details of the LUHN formula are in the Appendix B of this report). Email generation is done through the "System.Web.Mail" class provided in C# while the file upload and download mechanism is applied using the html file upload field and the download feature respectively. Crystal Decisions Crystal Report Viewer is used for the generation and viewing of reports. Reports may be used for analysis of financials and decision making.

The system currently resides on a single machine, but if the need arises, the different portions of the system can be moved to other machines as well for faster processing.

The design and complete details of each module are given below;

Figure 6: Portal Main Page

5.1 MODULE: USER SIGN UP

In order to enjoy the major facilities that *Career Resource* provides for its users, they need to sign up. The sign up process is different for both types of users. The sign up forms for job seekers and the employers are different as the service is free for job seekers, but for the employers, a certain amount of money is charged for acquiring the service.

- Job Seekers Sign Up
- Employers Sign Up

5.1.1 Job Seekers Sign Up

The sign up process is very simple and the users only need to give out their contact information in order to sign up. The login names are unique across the service, and there can be no duplicate login names in job seekers and employers combined.

Once the requirements of the login form are fulfilled, the user is signed up. The user information is saved in a table. The user name, password and contact information is all saved in the same table. As offered by the service, the user gets a 1MB space on the server to store files. The table saving all the paths being used is separate from the table saving the user information. Each path is assigned a unique path number. This path number is then saved against the user's information in the user information table. In this way, if the user's folder is moved to a new location, only the location in the user path table is changed and the changes take place automatically for all the users. We do not have to change the user path value for each of the users separately.

A field in the user information table is used to save the logon time of the user. When ever the user logs in to his account, this field is updated and the current time is saved in the database. If the user doesn't login to his account for a considerably long time, his/her account can be expired or terminated by the administrator. However, the account is reactivated when the user logs in the next time. If the account has been terminated by the administrator, then the account cannot be reactivated unless the administrator does so.

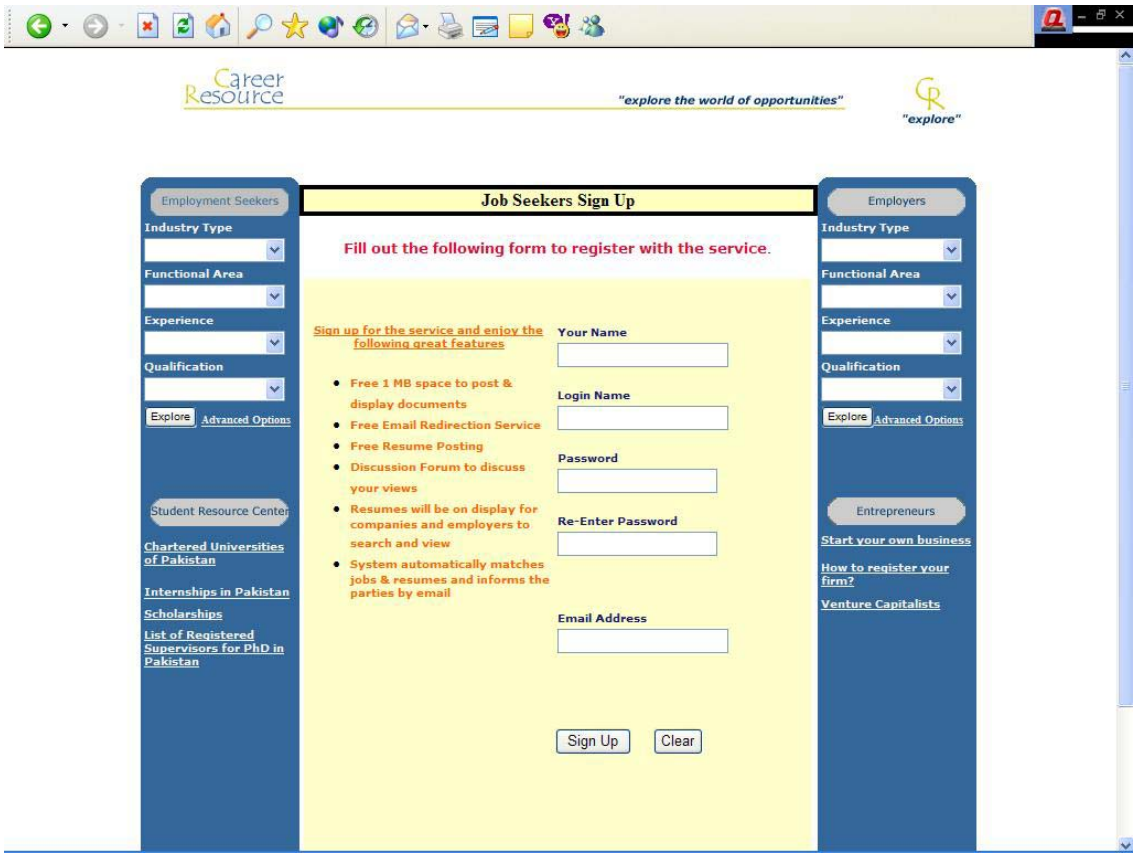


Figure 7: Job Seeker's Sign Up

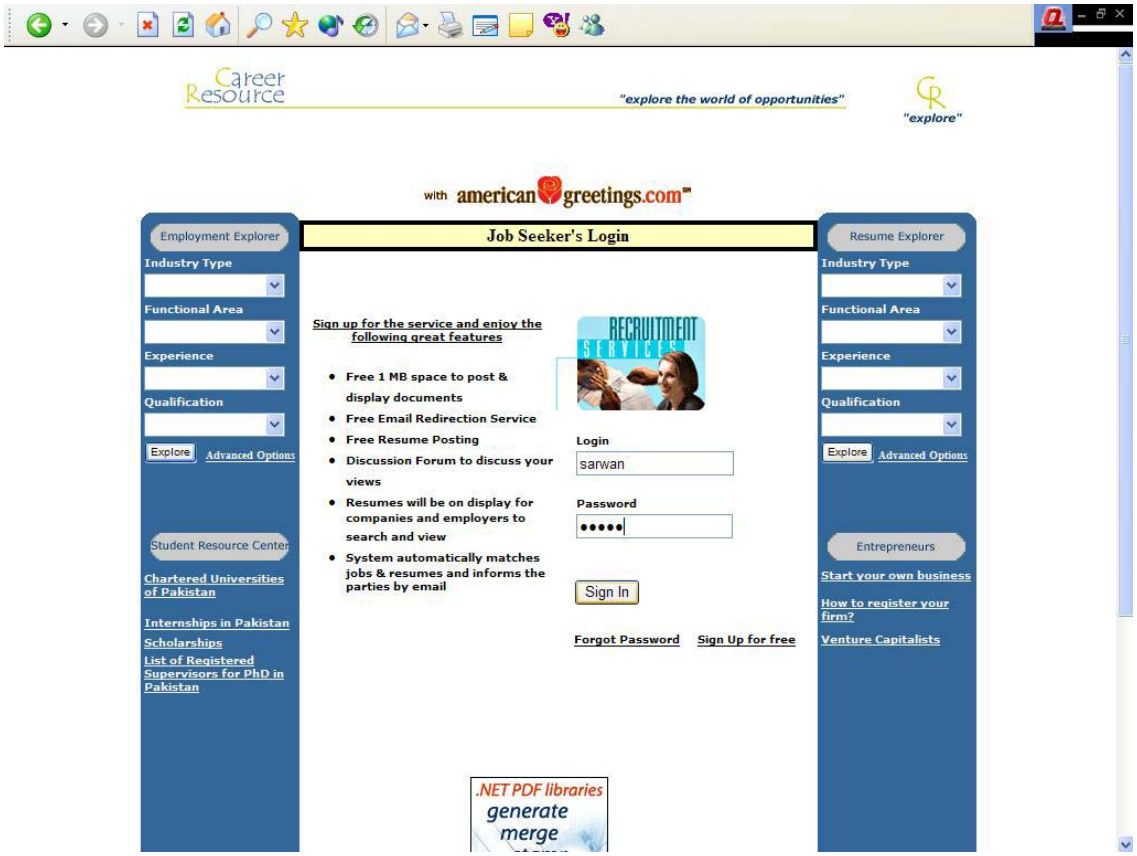


Figure 8: Job Seeker's Login

5.1.2 Employers Sign Up

The employers sign up module works differently than the seekers sign up module. Employers can sign up for the service after paying a certain amount of money through credit card. Unless the payment is made, the user is not signed up, he is considered to be in waiting for the activation of the service.

Employers need to provide their detailed contact information in order to sign up. Their email address, address and phone number is required. Once they fill in their information, they are directed to a credit card information page where they need to fill in their credit card information. They also need to specify their duration of use of the service

and they will be billed accordingly. The service duration is also set according to the duration that the user selects from the list.

The folder creation mechanism and the saving of the folder paths is the same as that of the job seekers.

The user account expiration is handled by the system in this case. As the employers are paid users, their account is not expired due to lack of use, it can only be expired if their duration of service expires or if the administrator wishes to do so manually. System checks for the deactivation of account do not run with periods of time, but the activation and deactivation of an account is checked when the user tries to log in. the dates are checked and if the account is expired, the user is not allowed to login. An expired account can be reactivated by the user by paying the specified amount of money. Unless the payment is made, the user account will remain locked.

The LUHN formula for credit card validation is used for the validation of the credit card number that the user enters to activate the account. Users have to enter the name of their card, the credit card number and the expiry date. The LUHN formula then validates the card number returning true or false. The user can only move forward if the LUHN formula validates the card number. The details of the working of the LUHN formula are given in Appendix C of this report.

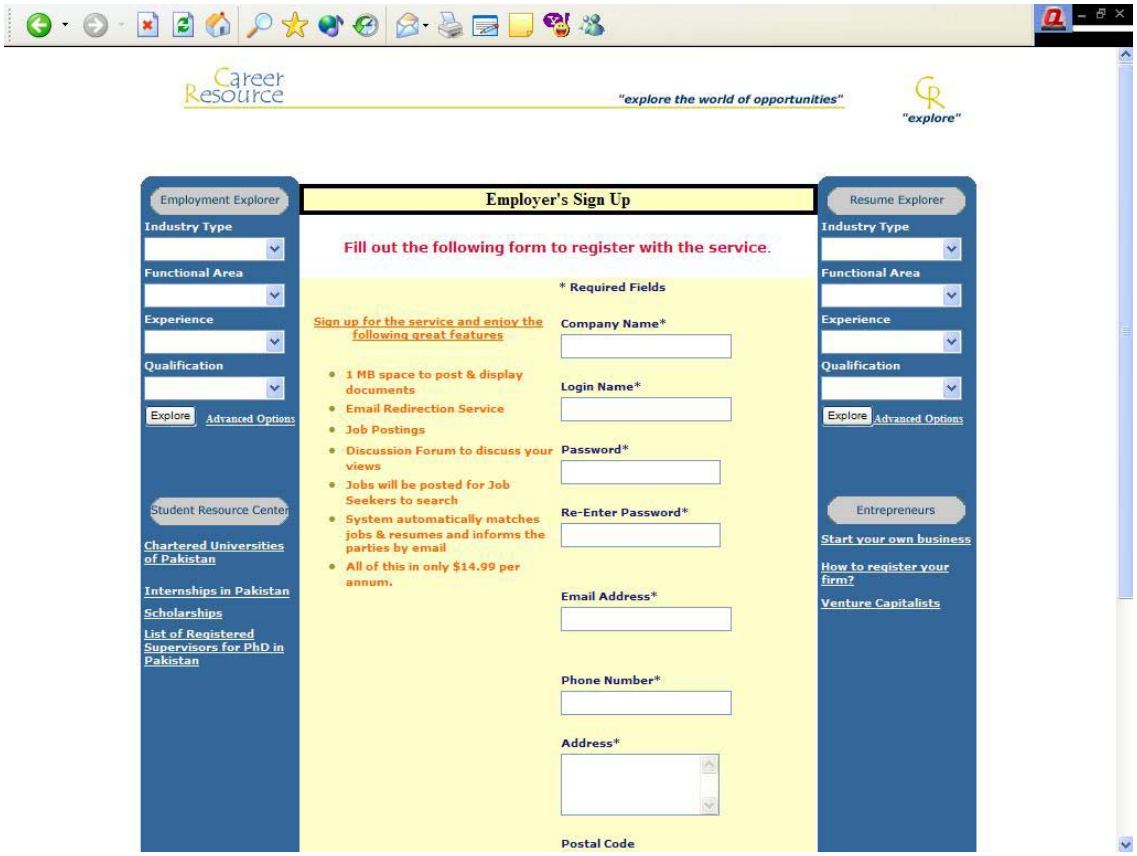


Figure 9: Employer's Sign Up

5.2 MODULE: JOB/RESUME POSTING

This module is the most important module in terms of the scope of the project. Users are required to post their resumes (Job Seekers) and job requirements (Employers). The information is then fed into the decision tree module to decide if a particular job resume matches the job requirements posted.

- Resume Builder
- Job Advertisements

5.2.1 Resume Builder

Users will have the facility to use the online resume builder to post their resumes on the website. For ease of use and better categorization of users, most of the values are placed in drop down lists for users to choose from.

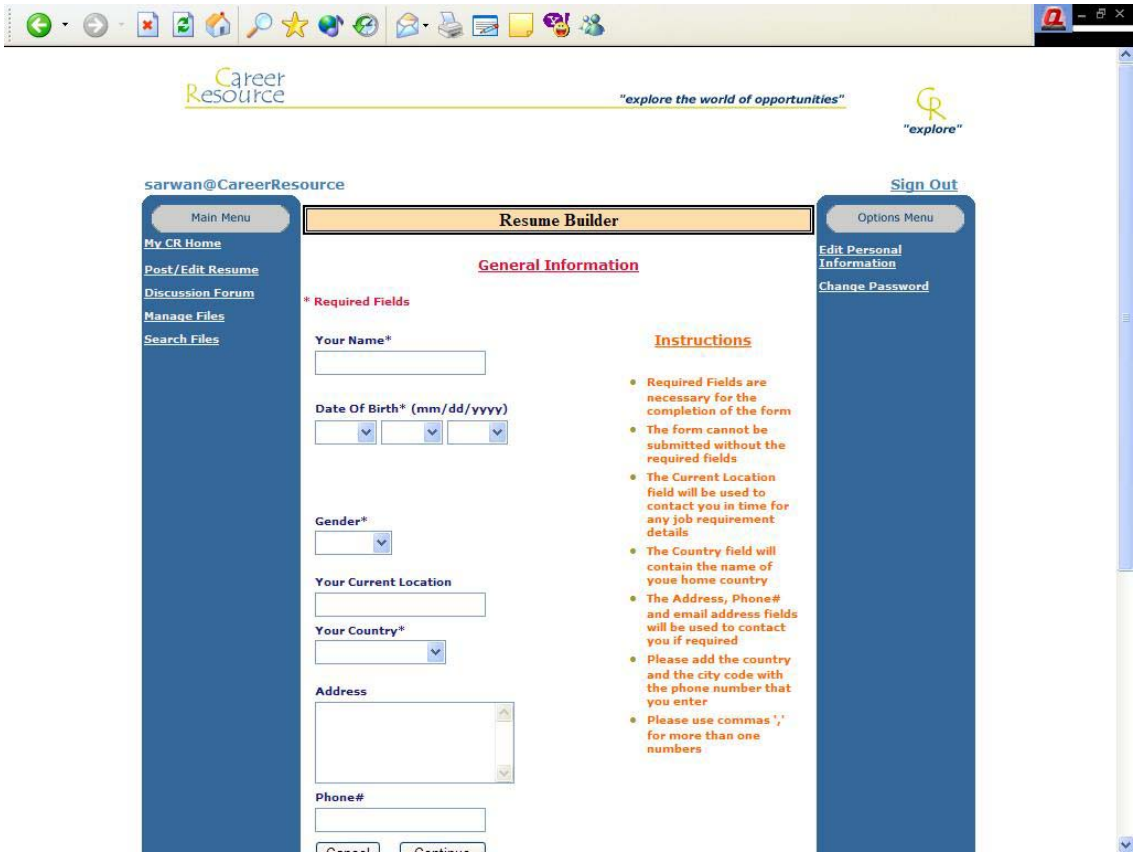


Figure 10: Resume Builder-General Information

Once the user signs up for the service as a job seeker, he/she will get the facility to post his/her resume. The user will be required to fill out the forms specially designed for this purpose. There are 5 sections of the resume form all covering different sections of a resume. The user will fill out each section posting it on his way to the next sections. The first section contains the user's personal data and contact information. Some of the

fields are required fields and the form will not submit unless these fields are fulfilled by the user.

The next section contains the information about the user's objective and the user's field of work. On this form the user will also be able to fill out his/her preferences, skills etc. This information is not critical but still is important in order to give the companies a better idea about the applicant's abilities. The next sections of the resume builder contain the user's educational and professional job experience information. The user can insert as many entries on this form as he wishes to do so, depending upon his qualifications and job experiences.

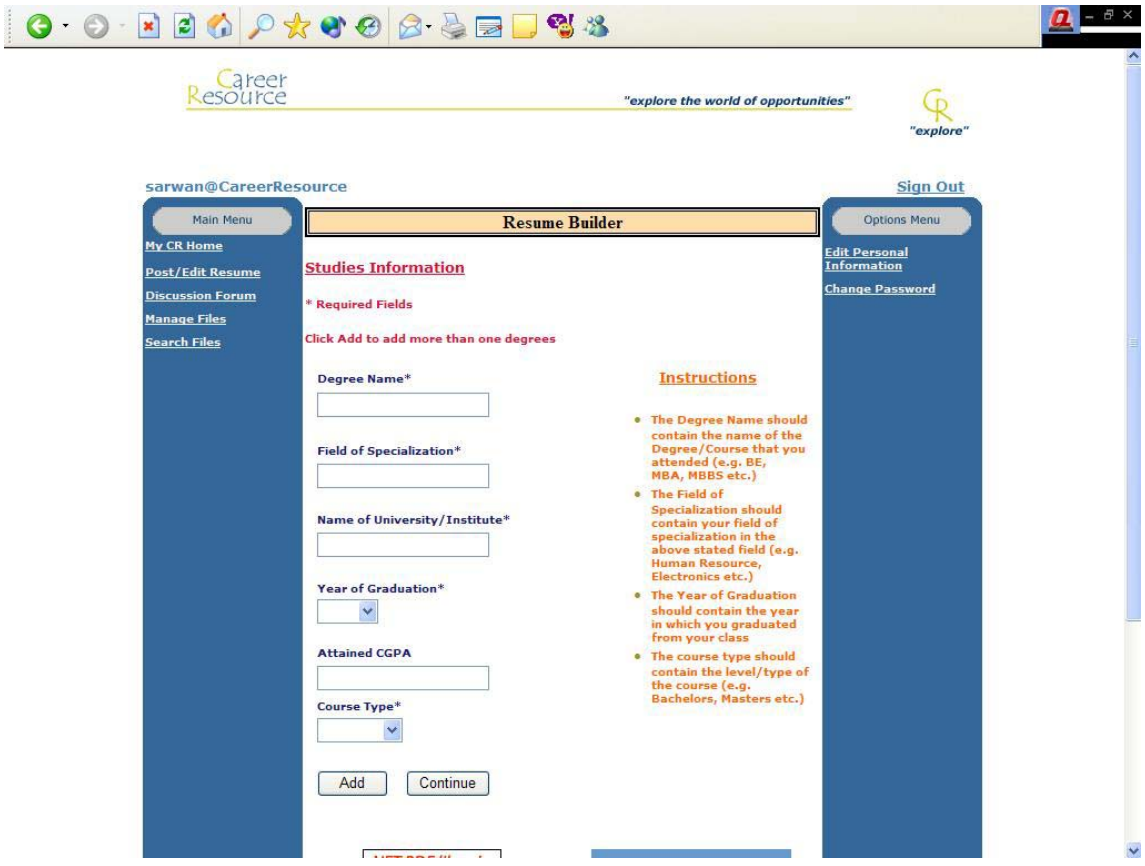


Figure 11: Resume Builder-Studies Information

The data from these sections goes into 3 separate tables in the database. The educational qualification information has been divided into 2 portions further in order to make it easier for the user to understand and use the forms. The first section contains the professional education information (Bachelors, Masters, PhD etc.), while the second section is used to insert the information about any additional qualifications that the user has acquired.

Figure 12: Resume Builder-Job Experience Information

The user has the privilege to post part of the resume, completing the rest at a later time. Once the user posts full/part of the resume with the service, the post resume option is no longer visible. The Edit Resume option is then visible to the user, and the user can

use it to make any changes to the resume that he/she had posted earlier. The resumes posted here will be searchable by the users of the website.

There are four important fields in the resume builder which are used for the matching of job requirements with the resumes. These fields are;

- Industry Type
- Functional Area
- Educational Qualification
- Experience

The industry type is defined as the basic field of expertise of the user. The functional area is defined as the sub field of work of the user within the industry type of the user. The educational qualification and the experience fields, as the name suggests, hold the educational information and the experience of the user. The educational information field does not have the details of the applicant's qualifications, but only the level of education that the applicant has. There are other fields present which are not as critical as the ones mentioned above but are important in their own sense. These fields hold additional information of the users. This information will be provided to the Employers which they can then use to select the best option in case 2 more than one resume matches their job requirement.

5.2.2 Job Advertisements

The job advertisements feature is available to users registered as Employers with the service. This feature works similarly as the post resume feature. It has only one section which the user has to fill out in order to post the job advertisement with the service. The fields are similar to the ones used in the resume builder for matching purposes. The job advertisements is designed keeping in view the job ads appearing in news papers etc. the fields are the same with the user requiring to select values more than typing in the information for better categorization and management.

The user needs to fill in the title and description of the job opening and also the requirements of the person required for the job. The user has the privilege of posting as many job advertisements as he wishes. There is no separate section for the editing of posted jobs. The same form can be used to delete and or edit the postings at a later time if the user wishes to do so. The jobs posted here will be searchable by the users of the website.

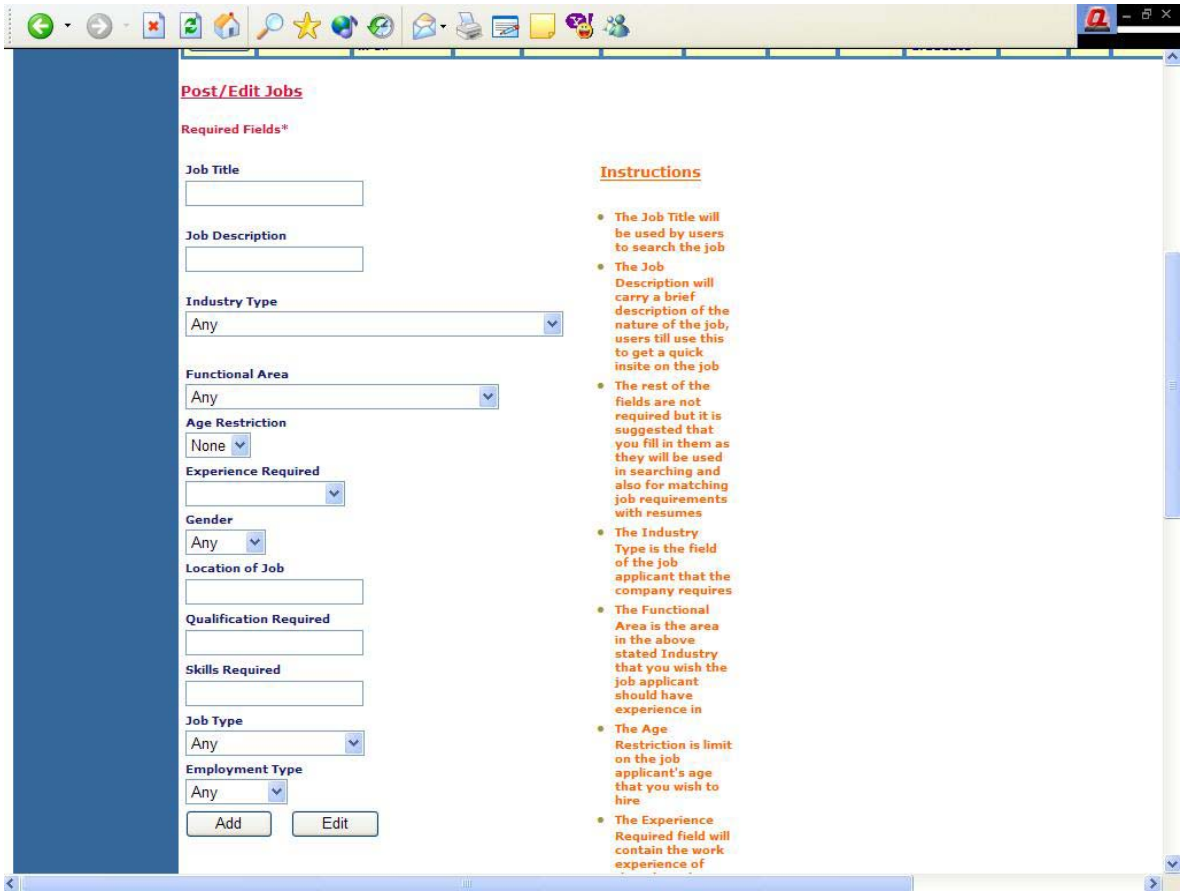


Figure 13: Post Job Advertisements

The four fields mentioned before will be used here as well to match the job requirements with the resumes. The additional information fields will be used for the detailed description of the job advertisement.

5.3 MODULE: JOB/RESUME SEARCH

The module for job and resume search is accessible to all users. Users do not need to register with the service in order to search for jobs. There are 4 selected fields and the search is based on these 4 options. The same fields are used for both the purposes, job search and resume search. The 2 sections designed for this reason are as follows;

- Employment Explorer
- Resume Explorer

5.3.1 Employment Explorer

The employment explorer is used to search for jobs by the users visiting the website. The four fields used as the basis of the search are the same as mentioned before;

- Industry Type
- Functional Area
- Educational Qualification
- Experience

These four fields are required in order for the search to be performed. The search then matches the requirements with the job advertisements posted by the companies and where ever a match is made, the result is shown on the screen to the user. The user can then get the contact information of the company and/or post a message in the company's message box on the site, filling in his own contact information.

The users can search for the jobs required filling in all or part of the options. The query for the search is built on run time depending upon the search criteria filled in by the user. The fields which are left empty by the user are left out of the query as well and the query is built upon the filled fields only. The results are displayed only if all the search

criteria filled in by the user, are fulfilled. In this case only text matching is done that if the search criterion matches the data saved in the database.

5.3.2 Resume Explorer

The resume explorer works similar to the employment explorer but its algorithm is more complex than that of the employment explorer. In this case the search fields are the same but the data that is to be searched is placed in different tables. So in order to get the required resume, the data has to be hauled in from these different tables. Once a match is made, the result is displayed on the screen to the user, where the user can either get the contact information of the search result user and/or post a message in the user's message box on the site, filling in his own contact information.

5.4 MODULE: INTELLIGENT MATCHING OF JOBS WITH RESUMES

This module is the whole focus of this project. The resume/job post module is important for the facilitation of this module as the resumes/jobs posted will be used in this module for the intelligent matching of the values. The execution/invocation of this module is in the hands of the administrators. The invocation of this module could be made automatic but it was not feasible once the number of resumes and job ads became large.

In order to match the job requirements with the resumes posted by the users, there was a need for an intelligent system. The adaptive/intelligent systems that were studied for this reason are;

- Neural Networks
- Decision Trees

Both the models were thoroughly studied for this module and based upon the study, the decision trees model was found to be better than the neural networks model in this particular case. The advantages of decision trees are in Chapter 2 of this report.

The four critical values identified before will be used for the matching. The Decision Tree Algorithm used for the matching of values is the ID3 Algorithm. The algorithm requires the calculation of *entropy* and *information gain* in order find out which node must come first and which ones should follow. In the course of this project, a modified form of the ID3 algorithm is being used.

The information required for the process to take place is already at hand and is stored in the data base. The sequence of the nodes has been predefined as the critical information from the resume has been selected and from that information, the fields have been categorized in descending order according to their importance in a real life resume. So the calculation of the entropy and the information gain is not required here. The structure of the tree has also been defined while the processes if the values are matched have been developed. So, the tree already developed and we only need to feed the information in the tree for it to decide if the resume and job requirement is a match or not. The tree takes the form of a Boolean categorization model that if the conditions are true then the result will be true and if the conditions are false, then the value returned will be false. As there are 4 values that are being fed into the system, 3 are being used to actually perform the required operation. Thirty (30) conditional statements check if the values match or not or are close enough to being called a match. A threshold has been set

and the values have been assigned certain numbers. If that threshold is crossed, only then it is called a match, otherwise not.

The Algorithm in C# is given in Appendix C of this report.

The Graphical Representation of the algorithm is given below;

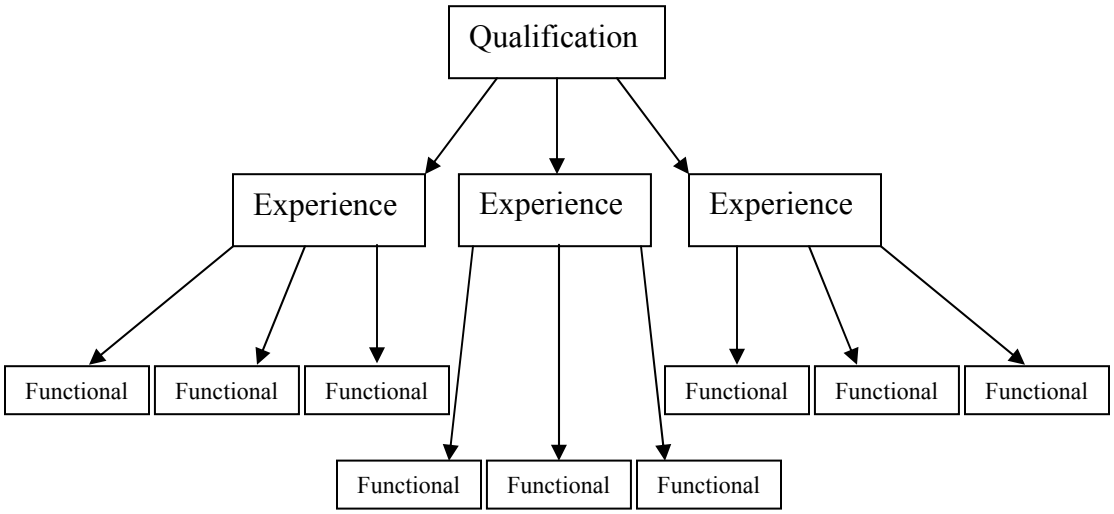


Figure 14: Graphical Representation of the Decision Tree

The Description of the Algorithm is as follows;

The algorithm has 30 conditional statements. Each statement either returns true or false. Depending upon the input values (resumes and jobs). The algorithm first checks if the qualification of the person is *greater than, equal to* or *less than* the required qualification of the job advertisement. The next level of conditional statements checks if the experience of the person is *greater than, equal to* or *less than* that required experience

of the job advertisement. Finally the third level of conditional statements checks if the functional area of the person matches that of the job requirement.

The matching of the experience and the educational qualification is easier as compared to the matching of the functional areas as there can be some functional areas that are similar to each other. The matching of industry types has been excluded from the decision tree as making the decision on this base became more ambiguous rather than precise. In order to cater for the problem of similar functional areas, they have been classified into different groups called classes (the details of the classes are in Appendix E of this report. If the user's and the job advertisement's functional area do not match, the system then checks if the 2 functional areas lie in the same class. If they do lie in the same class, then the tree returns true. When the tree returns true, the system posts a message in the user's message box on the website and also emails them on the email address provided by them.

5.5 MODULE: FILE UPLOAD AND SEARCH MECHANISM

Users get 1 MB of storage space on the server once they sign up. In order to use that web space, users can upload files using the file upload mechanism. The files are uploaded and saved to the user's allocated folder. The file information along with the user's name is saved in a database for later file search and retrieval and also for archiving of the data. The file information that is stored in the database is;

- File Title
- File Description

- File Name
- User Login Name
- File Location

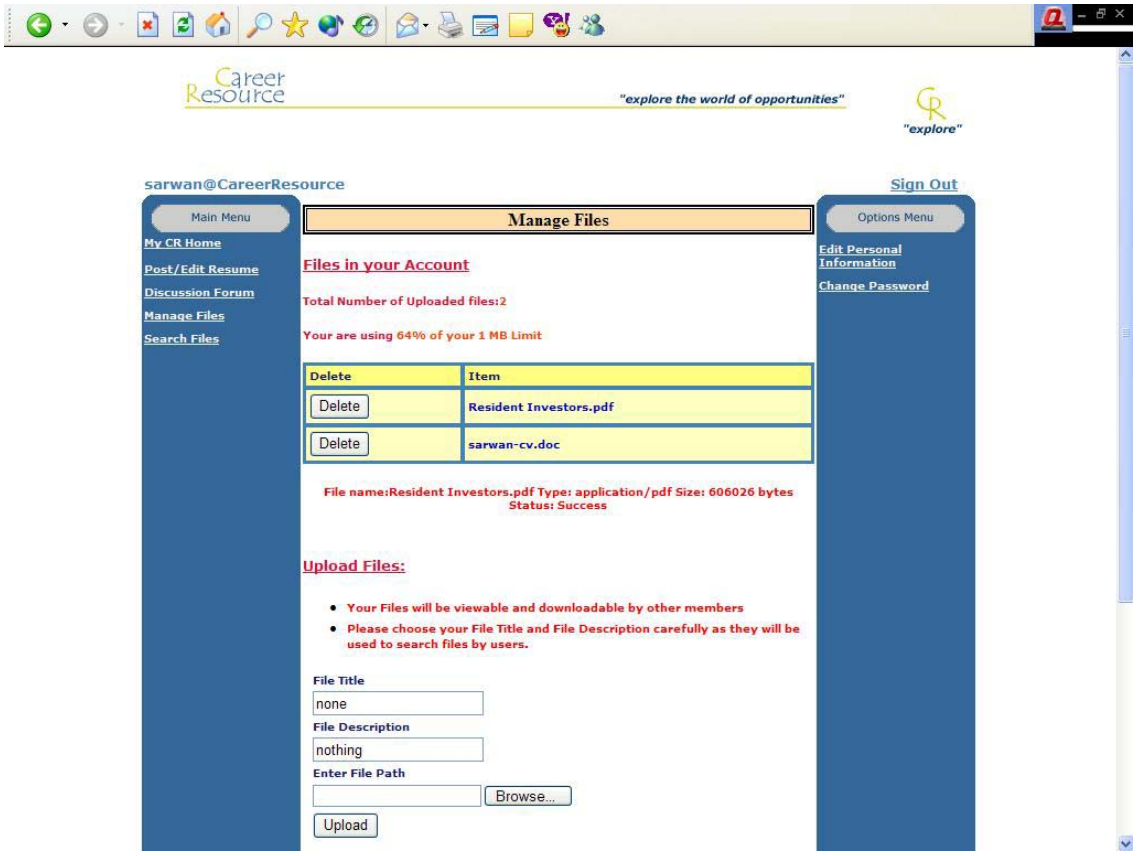


Figure 15: Manage Files

The above information of the file is used for searching and retrieving of files. Users can search for files by either providing the File Title, Description or File Name. Wild cards are also allowed. The query is generated on run time leaving the blank fields out of the query. The database is queried for the file search based upon the search criteria. In order to download the file, the user can click the download button on the search results displayed on the screen. The file is downloaded by first checking the folder path information from the user information table. Once the folder path number is known, the

folder path is attained from the folder path table. The selected file name is then appended with the folder path selected and this forms the complete path of the file required. This file is then acquired from the folder of the user and downloaded to the specified location provided by the user downloading the file.

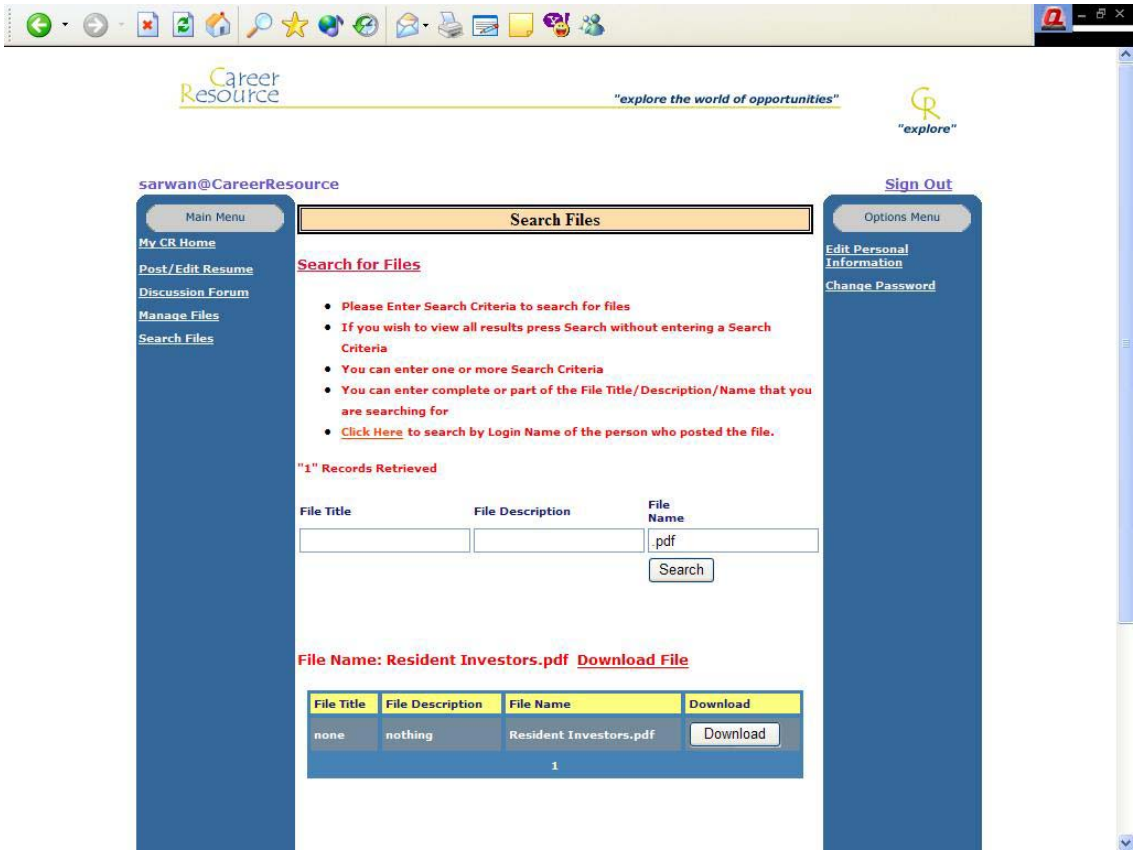


Figure 16: Search Files by file information

Users also have the facility to search for files by entering the login name of the user who posted the file. By this feature, users can easily skim through the files of the user that they are looking for, narrowing the search by a great margin. As the login names are unique, this feature will only return the files of one person, duplication is not possible.

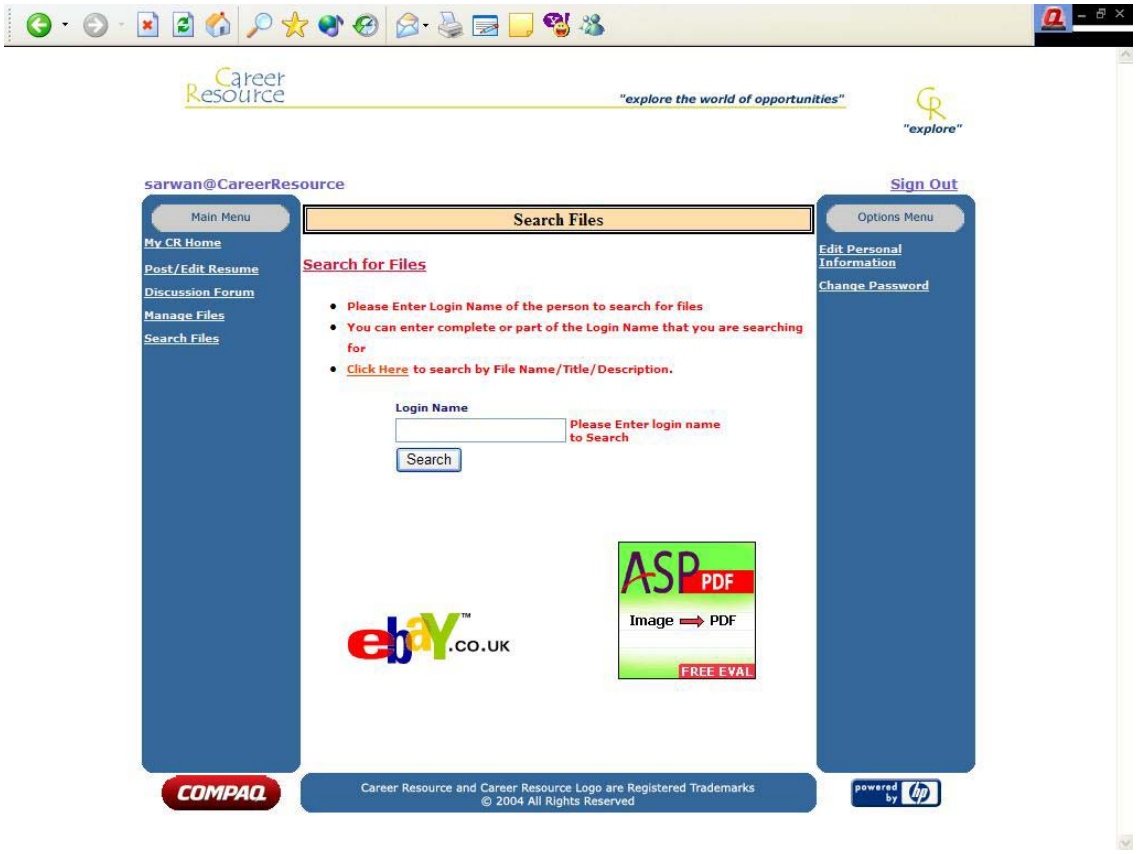


Figure 17: Search Files by user information

The file search and retrieval mechanism is similar for both the job seekers and the employers. The files posted by one user can be easily searched and retrieved by any other user of the site (either job seeker or employer).

5.6 MODULE: INFORMATION RESOURCE

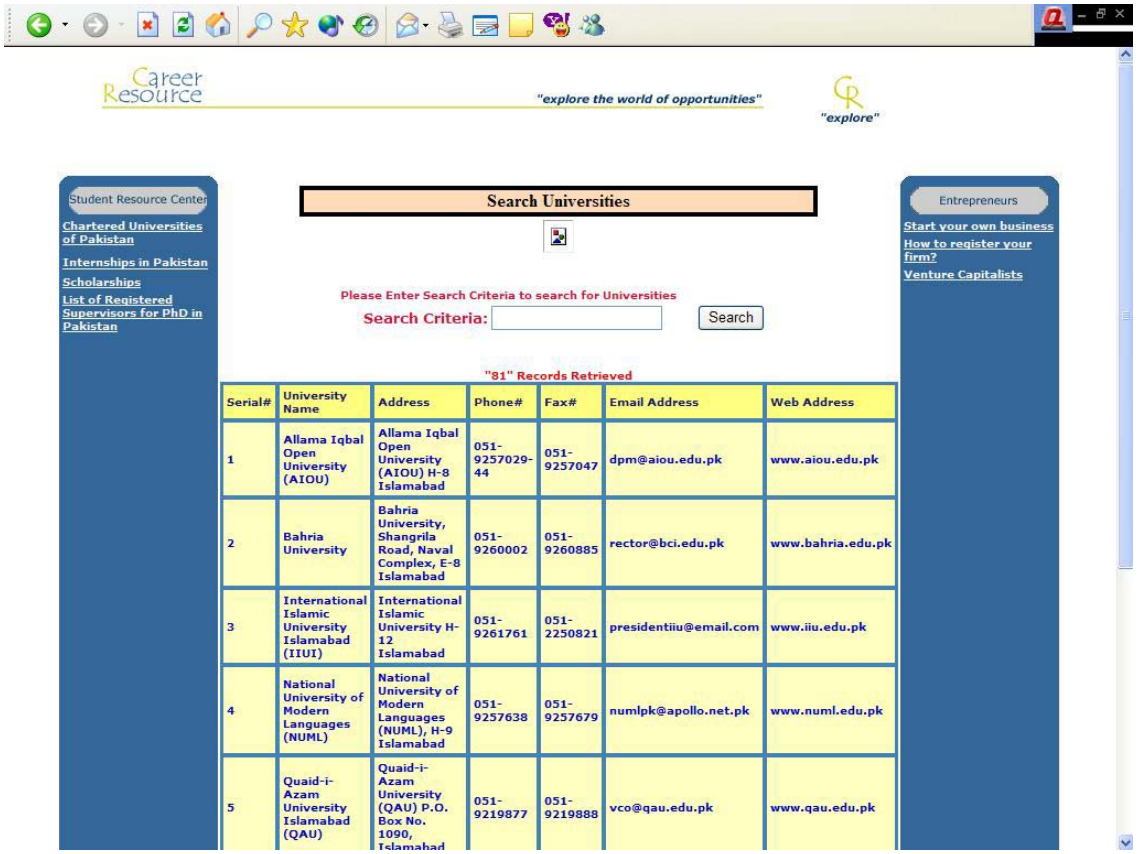
The information resource section is aimed at providing the student class of Pakistan with the required information for their future educational and professional careers. The focus of this section is the students but the scope is not limited to them. It also provides information for new ventures, sponsorships etc. The information resource module has 2 sections;

- Information Resource provided by the website
- Information Resource provided by other users

5.6.1 Information Resource Provided by the Website

The information resource sections of the website are a compilation of information for the students starting or are already in their educational career. The information of resources available for the students are compiled and structured at one place for the students. Students can search through the information using the search facility provided on the site.

The information resource includes information about the all the universities in Pakistan that are accredited by the Higher Education Commission (HEC). The contact information (Address, Email Address, Phone#, Fax#, Web Address etc.) of these universities is provided along with their names and location. Also, for students pursuing doctorial level education in Pakistan, a list of advisors has been provided for them. The task of this section is to provide the information to the students who then have to further pursue the resource them selves. The site acts as a medium between the student and the resource only till the point that the information is transported to the students. The rest of the work needs to be done by the students.



Serial#	University Name	Address	Phone#	Fax#	Email Address	Web Address
1	Allama Iqbal Open University (AIOU)	Allama Iqbal Open University (AIOU) H-8 Islamabad	051-9257029-44	051-9257047	dpm@aiou.edu.pk	www.aiou.edu.pk
2	Bahria University	Bahria University, Shangrila Road, Naval Complex, E-8 Islamabad	051-9260002	051-9260885	rector@bci.edu.pk	www.bahria.edu.pk
3	International Islamic University Islamabad (IIUI)	International Islamic University H-12 Islamabad	051-9261761	051-2250821	presidentiiu@email.com	www.iiu.edu.pk
4	National University of Modern Languages (NUML)	National University of Modern Languages (NUML), H-9 Islamabad	051-9257638	051-9257679	numlpk@apollo.net.pk	www.numl.edu.pk
5	Quaid-i-Azam University Islamabad (QAU)	Quaid-i-Azam University (QAU) P.O. Box No. 1090, Islamabad	051-9219877	051-9219888	vco@qau.edu.pk	www.qau.edu.pk

Figure 18: Search Universities

This section is designed to evolve with time. As new information comes in, it can be added to the current information by the site administrator.

5.6.2 Information Resource Provided by Other Users

The information resource on the web is too large to be compiled into one website. Moreover, the collection of all the information is also impossible as it keeps growing with time. In order to get as much information as possible, the site provides the facility to users to post the information on the site by filling it in on a form. This information includes any scholarship offers, venture capitalist offers, sponsorship offers and internship offers. It also provides the facility for users to post their resumes for free if

they are looking for an internship. For posting these resumes, they don't need to sign up for the service, they just need to fill out a form placed on the website.

For the management of this section, the date of posting of the information is also saved in the database. the site administrator can delete the posted information when required depending upon the time the information needs to be displayed on the site. The time period will be decided by the site administrator.

5.7 MODULE: PLACEMENT OF ADVERTISEMENTS

Generating financial resources and revenues is the key for the survival of a website. May it be an e-commerce website or a general services website, without these resources, the site will seize to exist in a very short span of time. Generating revenues and finances is a mammoth task for the site administration. The down fall of the e-commerce boom of the late 90s was the fact that the web developers and the web community forgot about the money. In order to make *Career Resource* a big success, ways of generating revenues for the service have been devised.

The revenues of the site will be generated from paid users (employers) and the advertisements that are placed on the website. The user's who sign up for the service, will only pay once in at least 6 months. The revenues generated by this will not be sufficient for keeping the website online. In order to generate more revenues, advertisements have been placed strategically on the website. Displaying more ads than required is also irritating for a serious user as they can be distractive and can cause loss of concentration for the user. Misuse of advertisements and use of too much advertising on the site may even drive the users away. To counter this problem and also to place ads in a way that

they don't hinder the working of a user, the advertisements will be placed on the sides and on the bottom of each page so that they don't interfere with the user's work space. On the main page the ads appear on the top, the bottom and the sides of the pages leaving the main work place unhindered for the users.

The Ads placed on the site are actually ASP Ad Rotators. These ad rotators can display multiple advertisements, displaying them one at a time depending upon the probability of display set by the site administrators in the XML file of these advertisements. A separate XML file has been formed for the different sections of the site and for the different types of ads displayed on the site. The site administrator can change the XML file when ever he/she wishes to do so changing the ad probability and the ads to be displayed. The administrative section of the site does not have any ads as they don't need to be displayed in this section.

5.8 MODULE: SITE ADMINISTRATION AND MANAGEMENT SECTION

A strong site administration and management section is an important feature for the management and proper running of any website. *Career Resource* is also equipped with a strong site management section.

There are 2 types of site administrators for *Career Resource* depending upon their privileges. The administrative section has been divided into these 2 sections for security and better management.

- Site Administrator
- Super User

5.8.1 Site Administrator

The site administrator will have the privileges to view, change and manipulate all the sections of the site. The privileges of the site administrator are as follows

- Search and View users
- Change status of any user
- Change the folder paths of users
- Upload and change advertisements for each section
- Change the password for any user
- Access/View the account of any user
- Change any values, files etc. of the user to ensure ethical values and for site management.
- Add/Change the information in the resource portion of the site
- Manage the support tables of the website
- Generate Reports

The site administrators can view any of the users registered and they can change their status or deny them access to their accounts. They can also relocate the folders of the users if the need arises to do so. The administrators can also visit any user account. This is done by creating a session in the selected user's name and the administrator then gains access to all the sections, files, information that the user has posted.

As it appears, the site administrators are allowed to change and manipulate any values, files etc. that the user posts. This can be allowed as the information that is being posted on the site is not sensitive information. The information is on display for all the users who visit the website. In order to ensure that the ethical norms of the society are maintained and also to manage the users properly, the site administrators have been given the privilege of manipulating any value, file that they deem fit. Site administrators can also generate reports relating to users. However they don't have the privilege of generating financial reports.

As the administrators have an unlimited number of privileges, they need to be administered as well. For this reason, the 2nd type of administrator has been created.

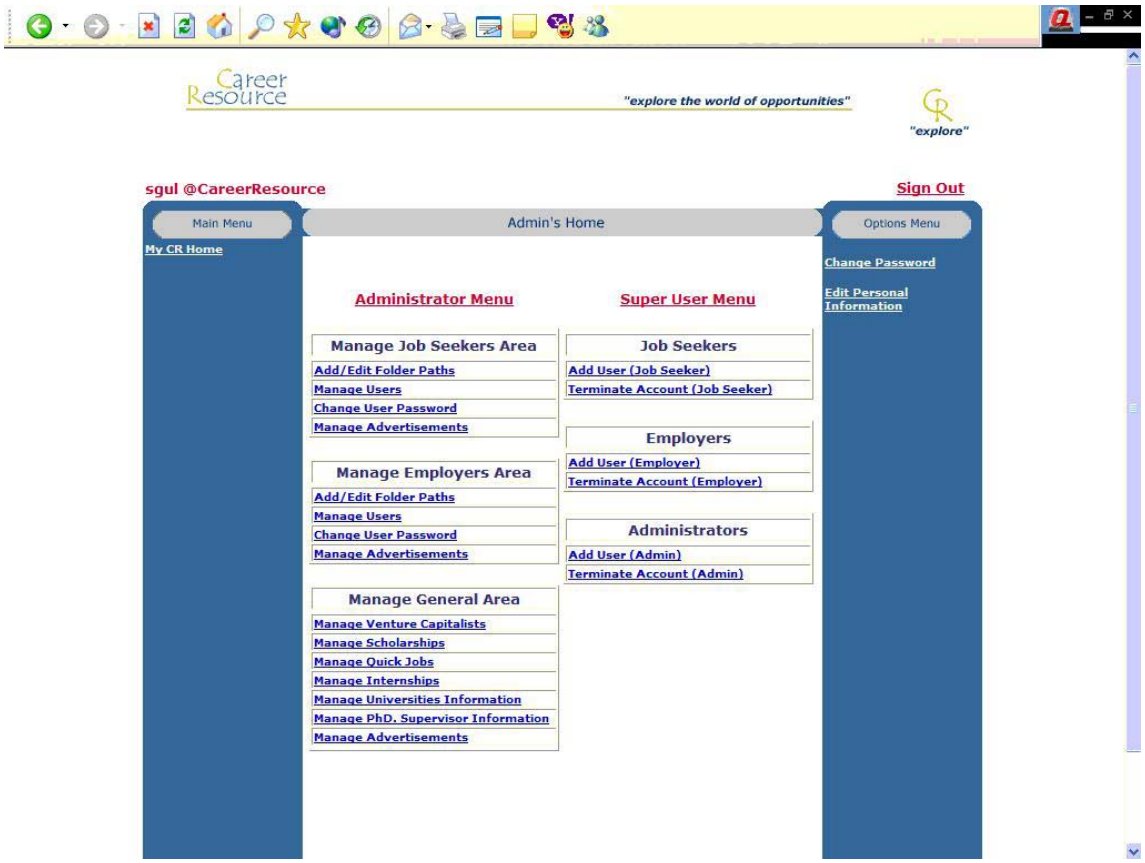


Figure 19: Administrator's Page

5.8.2 Super User

The reason for having a super user for the site is to administer and manage the site administrators. The super user has all the privileges that the normal administrators have along with some additional privileges.

- Add Users
- Delete Users
- Add Administrators
- Delete Administrators
- View Financials and Generate Reports

The "add and delete users" privilege has been limited to the super users for limiting the complete control of the site to a select few administrators. Similarly the super user has the privilege of adding administrators for the management of the site.

The financials of the site hold sensitive information which cannot be left in the open for all the administrators. This information has also been withheld for the super users to view.

5.9 MODULE: GOOGLE SEARCH API IMPLEMENTATION

All website users have the facility to use the search engine powered by Google. The search engine has been implemented using the Google search API available at Google.com.

Chapter 6

SYSTEM TESTING

After the completion of each of the modules, unit testing was done on each of them. The most important part of the project was the intelligent matching mechanism of job ads with resumes. Decision trees were applied for this module and rigorous testing was done to check the working of this module.

For the testing of the decision trees module, dummy values were inserted into the database for the job ads as well as the resumes. As there are about 60 different values for the field *functional area,* one resume and job ad for each value was inserted into the database. When the recruitment process was run, it returned 284 matches on 62 resumes and 60 job advertisements. The matches made through the recruitment process were valid when checked manually. Upon running the process again, it returned the same number of matches but identified them as old matches which showed the proper working of the process.

The system was further checked by removing some of the required values for the recruitment process. The system returned errors showing that these values were required for the process.

The other modules of the system were also checked. The sign up process was tested and the folder creation functionality was also tested changing the folder paths which worked fine.

Chapter 7

CONCLUSION

Through *Career Resource*, job seekers and companies can find jobs and employees respectively for themselves with minimum effort. Users just need to post their requirements with the service, and the system does the rest. It is the same for job seekers and the employers. The fields being used for matching of the jobs are the most commonly used fields in resumes and job advertisements. The decision tree algorithm used for the matching of jobs with requirements has been altered to fit the requirements of this module and to make the results as close to reality as possible.

The file upload and search mechanism enables users to get an insight on the detailed information about either the users abilities in case of a job seekers or the detailed job requirements in case of an employer.

As a resource website, *Career Resource* has almost all the information that a person might need when starting his/her educational or professional career. May it be in terms of finding a job, an employee, a university or even starting a new business for your self, all the information is collected and structured for easy searching and understanding. *Career Resource* is designed to be an evolving/growing system. As time passes, the information resource automatically grows as users themselves will provide information to fill the repository.

Another feature of *Career Resource*, that makes it stand out amongst systems of its kind, is that it has been designed in such way that it does not need to be administered in terms of job matching. The implementation of this module for this project has been

done in way that the administrator has to invoke the process of matching jobs. This was done as the processing power of the machine being used was not enough to handle the work load of matching a large number of jobs with a large number of resumes. If a high end machine is used to host this site, or if the module matching the jobs with requirements is placed on a separate machine specially devised for this purpose, the system can be left alone and it will perform its job un-administered. The only administration needed will be for the scanning and management of accounts.

Chapter 8

RECOMMENDATIONS

In order to improve the system in the future, we can expand the decision tree algorithm to work with more values. Currently there are only 3 values each from the job advertisements and the resumes that are fed into the decision tree for matching. We can improve it to take more than 3 inputs each and then match the resumes and the job ads. In this way it will produce a much more accurate result covering more fields of the resume, further reducing the work of the companies looking for employees as well as the individuals searching for jobs.

Another improvement that can be made to the system is that, the system applied for users to find jobs, can also be applied for users searching for internships. Currently there is no automated matching mechanism for matching of resumes and ads for internships. If this mechanism is also applied, it will help the students who are still in their educational phases of life, to find internships more easily.

The system can also improve by carrying guidance tips for the users, on which field to choose for their future, based upon previous analytical results. This can be done by applying data warehousing techniques on the information and then analyzing it to find out the market trends and popular fields that a person can choose.

The above mentioned improvements can enable the system to become more powerful. The necessary work, to set up the stage for future improvements has been done. We just need to build upon the existing system to improve it.

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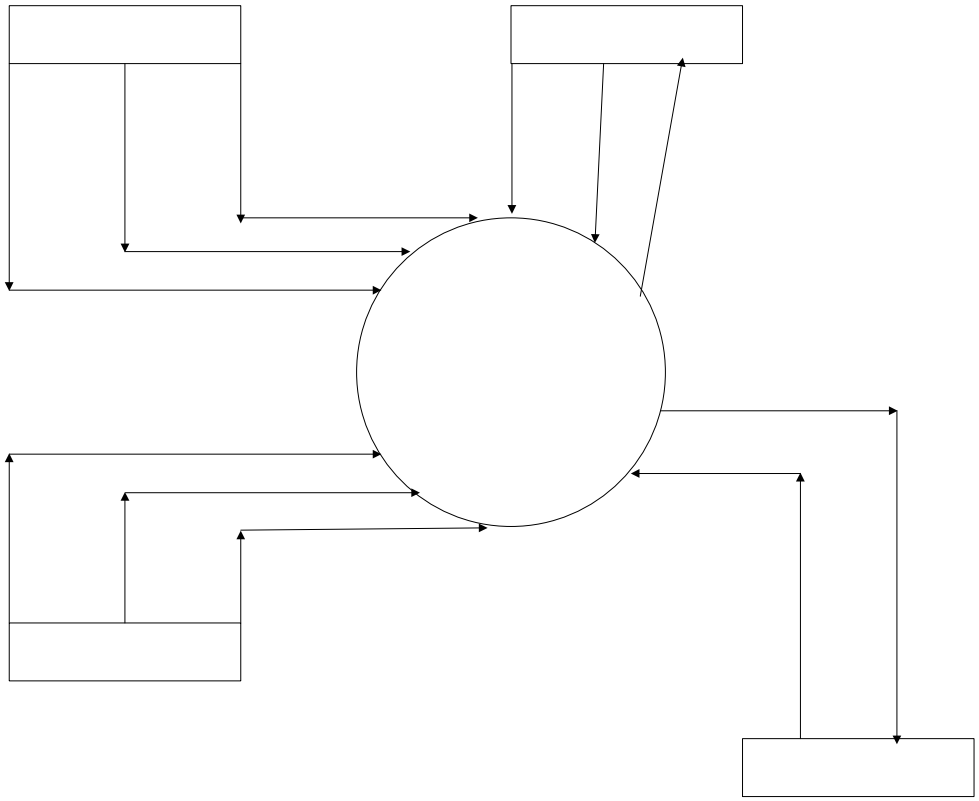
Appendix A – Data Flow Diagrams

Context DFD



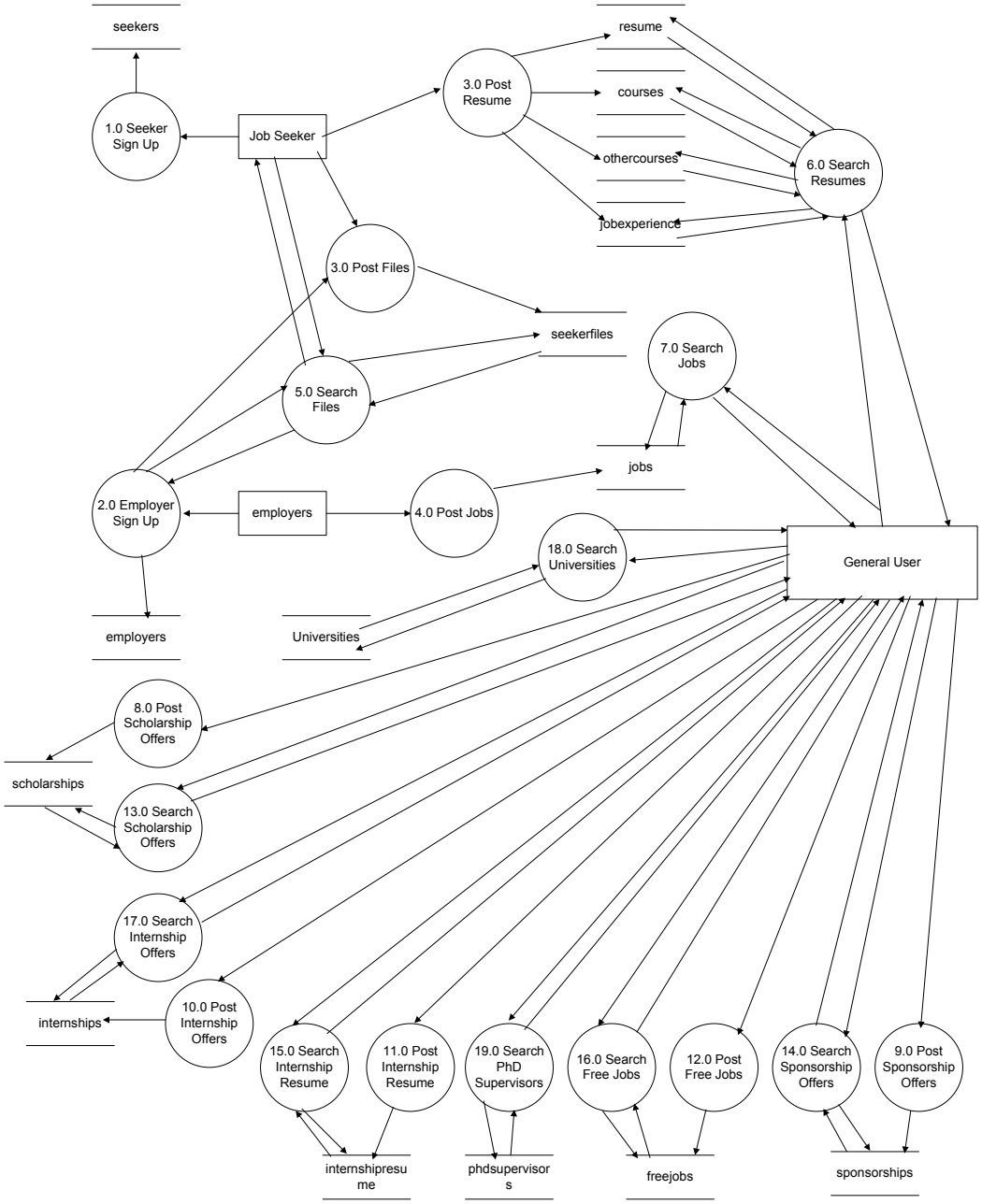
Job Seeker

Regis

Post Resume

Post Files

DFD Level 0


seekers
1.0 Seeker Sign Up
Job Seeker
3.0 Post Resume
resume
courses
othercourses
jobexperience
6.0 Search Resumes
3.0 Post Files
seekerfiles
7.0 Search Jobs
5.0 Search Files
jobs
2.0 Employer Sign Up
employers
4.0 Post Jobs
18.0 Search Universities
General User
employers
Universities
8.0 Post Scholarship Offers
scholarships
13.0 Search Scholarship Offers
17.0 Search Internship Offers
internships
10.0 Post Internship Offers
15.0 Search Internship Resume
11.0 Post Internship Resume
19.0 Search PhD Supervisors
16.0 Search Free Jobs
12.0 Post Free Jobs
14.0 Search Sponsorship Offers
9.0 Post Sponsorship Offers
internshipresume
phdsupervisors
freejobs
sponsorships

Appendix B – LUHN Formula for Credit Card Validation

The following steps are required to validate the primary account number:

Step 1: Double the value of alternate digits of the primary account number beginning with the second digit from the right (the first right-hand digit is the check digit.)

Step 2: Add the individual digits comprising the products obtained in Step 1 to each of the unaffected digits in the original number.

Step 3: The total obtained in Step 2 must be a number ending in zero (30, 40, 50, etc.) for the account number to be validated.

For example, to validate the primary account number 49927398716

Step 1:

4 9 9 2 7 3 9 8 7 1 6

x2 x2 x2 x2 x2

---

18 4 6 16 2

Step 2: 4 + (1 + 8) + 9 + (4) + 7 + (6) + 9 + (1 + 6) + 7 + (2) + 6

Step 3: Sum = 70: Card Number is validated

Note: Card is valid because 70/10 yields no remainder

Appendix C – Sample Source Code for the Decision Tree Algorithm

```
public bool Decide(Values v1, Values v2)
{
	bool result=false;


	if(Convert.ToInt32(v1.Qualification)>Convert.ToInt32(v2.Qualifica
tion))
	{

		if(Convert.ToInt32(v1.Experience)>Convert.ToInt32(v2.Experi
	ence))
		{
			if(v1.FunctionalArea==v2.FunctionalArea)
			{
				result = true;
			}
			else if(v1.FunctionalArea!=v2.FunctionalArea)
			{
				result = Check(v1.Functional,v2.Functional);
			}
		}
		else if(Convert.ToInt32(v1.Experience)==
	Convert.ToInt32(v2.Experience))
		{
			if(v1.FunctionalArea==v2.FunctionalArea)
			{
				result = true;
			}
			else if(v1.FunctionalArea!=v2.FunctionalArea)
			{
				result = Check(v1.Functional,v2.Functional);
			}
		}
		else if(Convert.ToInt32(v1.Experience)<
	Convert.ToInt32(v2.Experience))
		{
			if(v1.FunctionalArea==v2.FunctionalArea)
			{
				result = true;
			}
			else if(v1.FunctionalArea!=v2.FunctionalArea)
			{
				result = Check(v1.Functional,v2.Functional);
			}
		}
	}

	else if(Convert.ToInt32(v1.Qualification)==
Convert.ToInt32(v2.Qualification))
	{
```

```
            if(Convert.ToInt32(v1.Experience)>Convert.ToInt32(v2.Experi
      ence))
            {
                  if(v1.FunctionalArea==v2.FunctionalArea)
                  {
                        result = true;
                  }
                  else if(v1.FunctionalArea!=v2.FunctionalArea)
                  {
                        result = Check(v1.Functional,v2.Functional);
                  }
            }
            else if(Convert.ToInt32(v1.Experience)==
      Convert.ToInt32(v2.Experience))
            {
                  if(v1.FunctionalArea==v2.FunctionalArea)
                  {
                        result = true;
                  }
                  else if(v1.FunctionalArea!=v2.FunctionalArea)
                  {
                        result = Check(v1.Functional,v2.Functional);
                  }
            }
            else if(Convert.ToInt32(v1.Experience)<
      Convert.ToInt32(v2.Experience))
            {
                  if(v1.FunctionalArea==v2.FunctionalArea)
                  {
                        result = false;
                  }
                  else if(v1.FunctionalArea!=v2.FunctionalArea)
                  {
                        result = false;
                  }
            }
      }

      else if(Convert.ToInt32(v1.Qualification)<C
onvert.ToInt32(v2.Qualification))
      {
            if(Convert.ToInt32(v1.Experience)>Convert.ToInt32(v2.Experi
      ence))
            {
                  if(v1.FunctionalArea==v2.FunctionalArea)
                  {
                        result = true;
                  }
                  else if(v1.FunctionalArea!=v2.FunctionalArea)
                  {
                        result = Check(v1.Functional,v2.Functional);
                  }
            }
            else if(Convert.ToInt32(v1.Experience)==
      Convert.ToInt32(v2.Experience))
            {
                  if(v1.FunctionalArea==v2.FunctionalArea)
```

```
                {
                        result = false;
                }
                else if(v1.FunctionalArea!=v2.FunctionalArea)
                {
                        result = false;
                }
        }
        else if(Convert.ToInt32(v1.Experience)<
    Convert.ToInt32(v2.Experience))
        {
                if(v1.FunctionalArea==v2.FunctionalArea)
                {
                        result = false;
                }
                else if(v1.FunctionalArea!=v2.FunctionalArea)
                {
                        result = false;
                }
        }
    }
    else
    {
        result = false;
    }


    return result;
}
```

Appendix D – Database Tables Description

Seekers		
Field Name	Data Type	Constraint
UserName	Varchar	None
UserLogin	Varchar	Primary Key
UserPass	Varchar	None
Email	Varchar	None
FolderPath	Int	None
LastAccess	Datetime	None
Status	Varchar	None

Employers		
Field Name	Data Type	Constraint
CompanyName	Varchar	None
UserLogin	Varchar	Primary Key
UserPass	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
PostalCode	Varchar	None
City	Varchar	None
FolderPath	Int	None
LastAccess	Datetime	None
RegDate	Datetime	None
ExpDate	Datetime	None
Status	Varchar	None

Admin		
Field Name	Data Type	Constraint
UserLogin	Varchar	Primary Key
UserPass	Varchar	None
UserName	Varchar	None
Email	Varchar	None
Type	Varchar	None

Resume		
Field Name	Data Type	Constraint
UserLogin	Varchar	Primary Key
Name	Varchar	None
DOB	Datetime	None

Gender	Varchar	None
Location	Varchar	None
Country	Varchar	None
Address	Varchar	None
Phone	Varchar	None
Objective	Varchar	None
JobType	Varchar	None
EmpType	Varchar	None
PrefLocation	Varchar	None
Experience	Varchar	None
IndustryType	Varchar	None
FunctionalArea	Varchar	None
CurrentStatus	Varchar	None
KeySkills	Varchar	None
Languages	Varchar	None
InternshipsInfo	Varchar	None
OtherInfo	Varchar	None
ExtraAct	Varchar	None
PersonalAchieve	Varchar	None
PersonalStrengths	Varchar	None

Courses		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UserLogin	Varchar	Foreign Key
DegreeName	Varchar	None
Specialization	Varchar	None
Institute	Varchar	None
YearOfGraduation	Varchar	None
GPA	Float	None
CourseType	Varchar	None

OtherCourses		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UserLogin	Varchar	Foreign Key
DegreeName	Varchar	None
Specialization	Varchar	None
Institute	Varchar	None
YearOfGraduation	Varchar	None

JobExperience		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key

UserLogin	Varchar	Foreign Key
EmployerName	Varchar	None
Designation	Varchar	None
Duration	Varchar	None
Role	Varchar	None

Jobs		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UserLogin	Varchar	Foreign Key
JobTitle	Varchar	None
JobDescription	Varchar	None
IndustryType	Varchar	None
FunctionalArea	Varchar	None
AgeRestriction	Varchar	None
ReqExp	Varchar	None
Gender	Varchar	None
Location	Varchar	None
ReqQualification	Varchar	None
Skills	Varchar	None
JobType	Varchar	None
EmploymentType	Varchar	None

SeekerPath		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
Path	Varchar	None
Flag	Int	None

EmployerPath		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
Path	Varchar	None
Flag	Int	None

SeekerFiles		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UserLogin	Varchar	Foreign Key
FileTitle	Varchar	None
FileDescription	Varchar	None
FileName	Varchar	None
FolderPath	Int	None

Industry		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
IndustryType	Varchar	None

Functional		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
FunctionalArea	Varchar	None

Internships		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
Location	Varchar	None
Gender	Varchar	None
ReqQualification	Varchar	None
SpecializationField	Varchar	None
OtherSkills	Varchar	None
Objective	Varchar	None
PostDate	Datetime	None

InternshipResume		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
Name	Varchar	None
Gender	Varchar	None
Location	Varchar	None
Email	Varchar	None
Address	Varchar	None
Phone	Varchar	None
Qualification	Varchar	None
Specialization	Varchar	None
Skills	Varchar	None
PostDate	Datetime	None

Universities		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UnivName	Varchar	None
Address	Varchar	None
Phone	Varchar	None

Fax	Varchar	None
Email	Varchar	None
Web	Varchar	None

Scholarships		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
ScholarshipDesc	Varchar	None
PostDate	Datetime	None

Ventures		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
InvestmentDesc	Varchar	None
PostDate	Datetime	None

Sponsorships		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
SponsorshipDesc	Varchar	None
PostDate	Datetime	None

FreeJobs		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
Email	Varchar	None
Phone	Varchar	None
Address	Varchar	None
JobDescription	Varchar	None
PostDate	Datetime	None

Cities		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
CityName	Varchar	None

Country		
Field Name	Data Type	Constraint
SrNo	Int	Primary Key
CountryName	Varchar	None

CreditCards		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
UserLogin	Varchar	Forign Key
CardName	Varchar	None
CardNumber	Varchar	None
CardExpiry	Datetime	None
Valid	Varchar	None

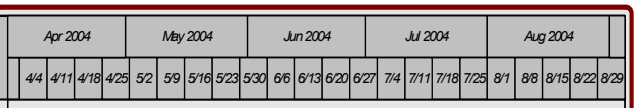
Revenues		
Field Name	Data Type	Constraint
SrNo	Numeric	Primary Key
CompanyName	Varchar	None
CompanyLogin	Varchar	Foreign Key
Amount	Varchar	None
PostDate	Datetime	None

Appendix E – Functional Area Classes

SrNo	Items
1	Fresh Graduate, Call Center/Services/Operations/Telecall, Agents
2	Top Management, Hotel Management, Corporate Planning/Consulting/Strategy, HR/Administration, PR/Corporate Communications, Production/Quality Management, IT-Organisational Management,
3	Accounting/Tax/CS, DSA/Insurance Agent/Banking, Corporate Finance/Banking,
4	Anchoring/Film Making,
5	Architect/Interior Designer, Art Director/Designer,
6	Editor/Journalist,
7	Entrepreneurs,
8	Exports/Imports,
9	Fashion/Models,
10	Front Office/Secreterial/Operator, Purchase/SCM/Logistics, Technical Staff/Support, Security, Call Center/Services/Operations/Telecall, Sales/BD, Agents
11	Legal/Law,
12	Marketing/Media/MR/PR
13	Doctors/Dentists/Nurses, Veterinarian
14	Service/CRM/Ops, Projects/Civil Engineering, Service Engineering, Project Management/Site Engineers
15	Packaging, Production/Quality Management,
16	Airline/Reservation/Ticketing/Travel/Touring, Hotel Management, Production/Quality Management, Sales/BD
17	R&D/Scientists, Teaching Education
18	IT-Middleware, IT-Mainframe, IT-Embedded Systems, IT-Telecomm Technician, IT-Grid Systems, IT-Intelligent Systems, IT-Micro Devices, IT-Hardware, Systems/EDP/MIS
19	IT-Mobile, IT-Application Programmer, IT-Client Server, IT-Embedded Systems, IT-Network Security, IT-System Programming, IT-Network Programming, IT-Micro Devices, Systems/EDP/MIS,
20	IT-Application Programmer, IT-Database Administrator, IT-Client Server, IT-ERP. CRM, IT-Network Security, IT-System Programming, IT-Network Programming, IT-Hardware
21	IT-Quality Assurance/Testing, IT-Organisational Management, Systems/EDP/MIS, Technical Staff/Support
22	IT-E-Commerce, IT-Application Programmer, IT-Client Server, IT-Web Development,

Appendix F – Project Time Line (Gantt Chart)

ID	Task Name	Start	Finish	Duration
1	Data collection and structuring	4/1/2004	4/15/2004	11d
2	Design and Development of the Database	4/15/2004	4/26/2004	8d
3	Design and Development of the front end	4/26/2004	5/10/2004	11d
4	Development of user/jobseeker area including basic features	5/10/2004	5/25/2004	12d
5	Development of employer area including basic features	5/25/2004	6/4/2004	9d
6	Development of seeker and employer area account management	6/4/2004	6/18/2004	11d
7	Development of account management and site management areas	6/21/2004	7/9/2004	15d
8	Development of Site General Area	7/12/2004	7/19/2004	6d
9	Development of Site General Area Administrative Section	7/20/2004	7/26/2004	5d
10	Structuring of information of Universities	7/26/2004	7/30/2004	5d
11	Development of intelligent search mechanism to search and match jobs	8/2/2004	8/16/2004	11d
12	Testing and Debugging of the whole website	8/16/2004	8/23/2004	6d
13	Documentation	4/16/2004	8/16/2004	87d



Appendix G – List of Industry Types

The list of Industry Types is as follows;

Serial#	Industry Type
1	Software Services
2	IT/Hardware/Networking
3	Consumer FMCG/Foods/Beverages
4	Consumer Goods-Durables/Home Appliances
5	Retailing
6	CRM/IT Enabled Services/BPO/Medical Transciption
7	Banking/Financial Services/Stock Broking
8	Accounting/Consulting/Taxation
9	Bio-Tech/Pharma
10	Advertising/Event Mgmt/PR/MR
11	Airlines/Hotels/Hospitality/Travel/Restaurants
12	Entertainment/Media/Publishing/DotCom
13	Insurance
14	Telecom Equipment/Electronics/Semi Conductors
15	Telecom/ISP
16	Accessories/Apparel/Fashion/Textile/Garments
17	Agriculture/Dairy Technology
18	Architectural Services/Interior Designing
19	Auto Ancillary/Auto Parts
20	Auto Sales
21	Life Sciences/Clinical Research
22	Cement/Construction/Engineering
23	Metals/Steel/Iron
24	Chemicals/Petro Chemicals/Plastics/Rubber
25	Courier/Freight/Transportation/Warehousing
26	Defence
27	Education/Training/Teaching
28	Employment Firms/Recruitment Services Firms
29	Export Houses
30	Fertilizers/Pesticides
31	Gems & Jewelry
32	Healthcare/Medicine
33	Law/Legal Firms
34	Machinery/Equipment Manufacturing/Products
35	NGO/Social Services
36	Office Automation/Equipment
37	Paper/Files
38	Petroleum/Oil & Gas/Projects/Infrastructure
39	Power/Non-Conventional Energy

Serial#	Industry Type
40	Printing/Packaging
41	Real Estate
42	Security/Law Enforcement
43	Shipping/Marine
44	Tyres
45	Other

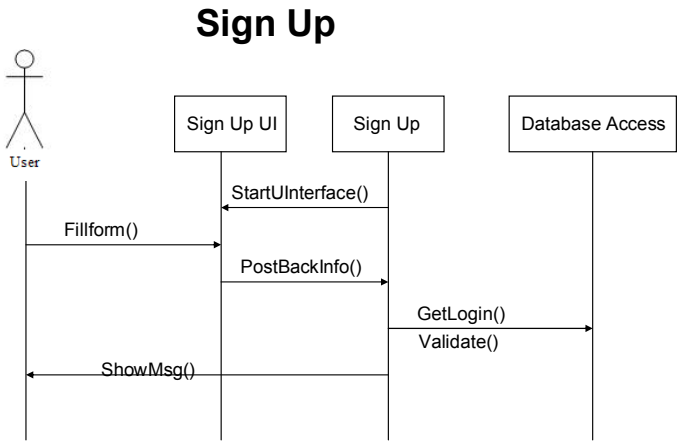
Appendix H – List of Functional Areas

The List of Functional Areas is as follows;

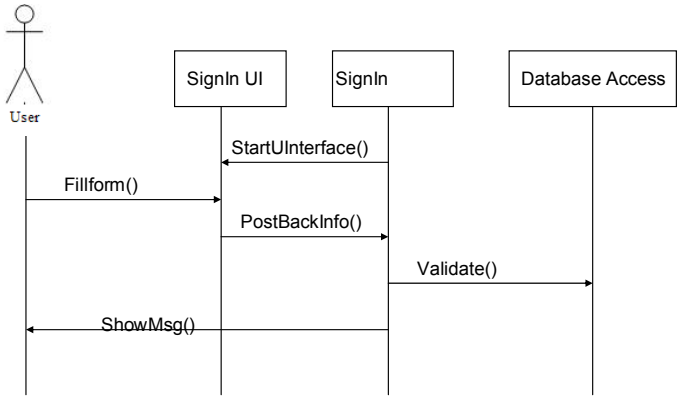
Serial#	Functional Area
1	Fresh Graduate
2	Top Management
3	Accounting/Tax/CS
4	DSA/Insurance Agent/Banking
5	Anchoring/Film Making
6	Architect/Interior Designer
7	Art Director/Designer
8	Hotel Management
9	Editor/Journalist
10	Corporate Finance/Banking
11	Corporate Planning/Consulting/Strategy
12	Entrepreneurs
13	Exports/Imports
14	Fashion/Models
15	Front Office/Secreterial/Operator
16	HR/Administration
17	Legal/Law
18	Marketing/Media/MR/PR
19	Doctors/Dentists/Nurses
20	Service/CRM/Ops
21	Packaging
22	Purchase/SCM/Logistics
23	PR/Corporate Communications
24	Airline/Reservation/Ticketing/Travel/Touring
25	Production/Quality Management
26	Projects/Civil Engineering
27	R&D/Scientists
28	IT-Middleware
29	IT-Mobile
30	IT-Mainframe
31	IT-Application Programmer
32	IT-Client Server
33	IT-Database Administrator
34	IT-ERP. CRM
35	IT-Embedded Systems
36	IT-Network Security
37	IT-Quality Assurance/Testing
38	IT-System Programming
39	IT-Telecomm Technician

Serial#	Functional Area
40	IT-E-Commerce
41	IT-Grid Systems
42	IT-Web Development
43	IT-Network Programming
44	IT-Intelligent Systems
45	IT-Micro Devices
46	IT-Hardware
47	IT-Organisational Management
48	IT-Other
49	Systems/EDP/MIS
50	Technical Staff/Support
51	Teaching Education
52	Security
53	Service Engineering
54	Sales/BD
55	Call Center/Services/Operations/Telecall
56	Project Management/Site Engineers
57	Agents
58	Veterinarian
59	Other

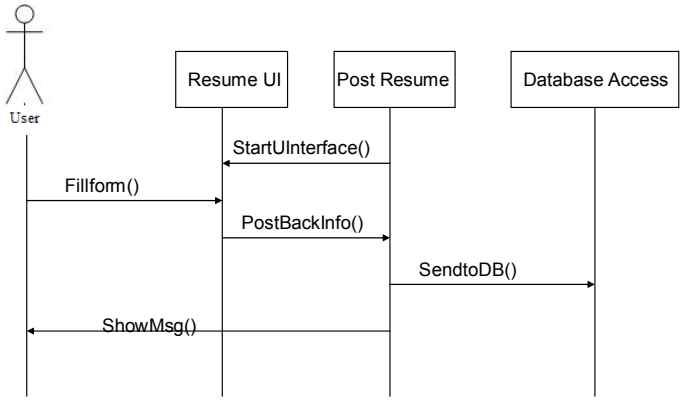
Appendix I – Sequence Diagrams



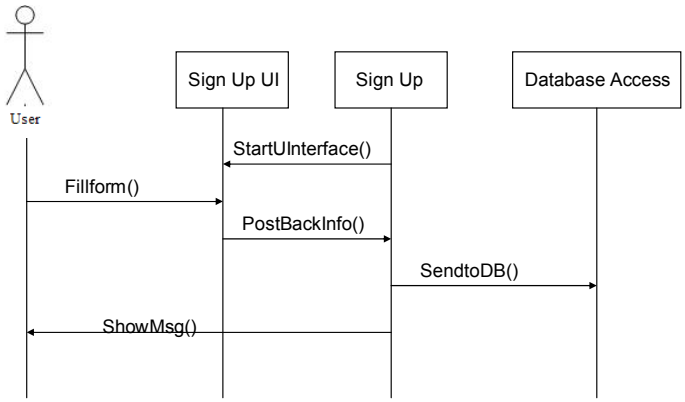
Sign In



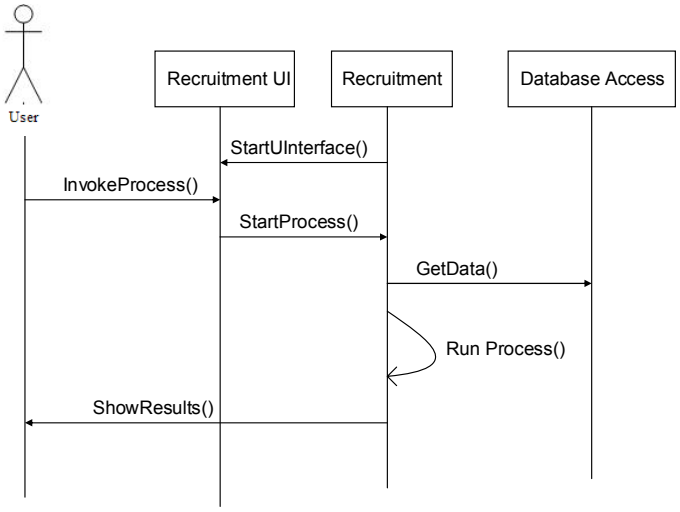
Post Resume



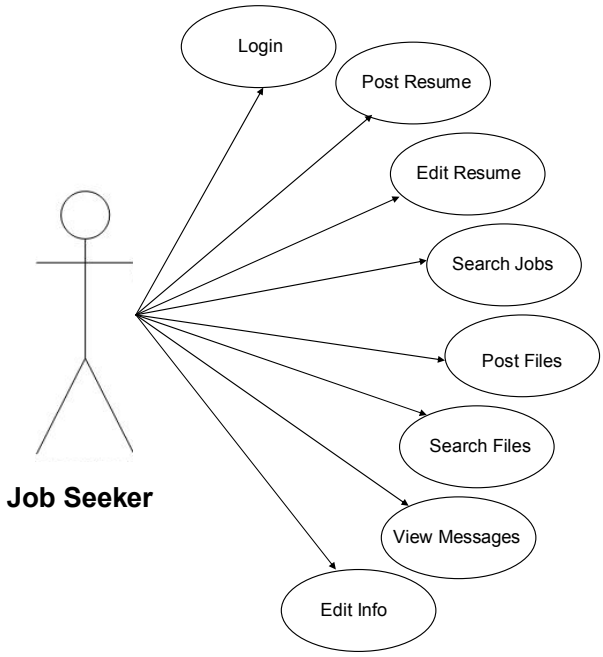
Post Job Advertisements

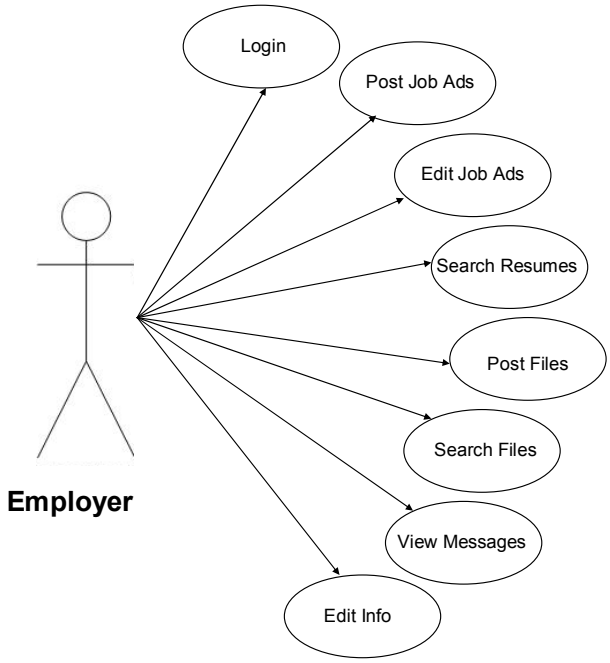


Recruitment Process



Appendix J – Use Case Diagrams

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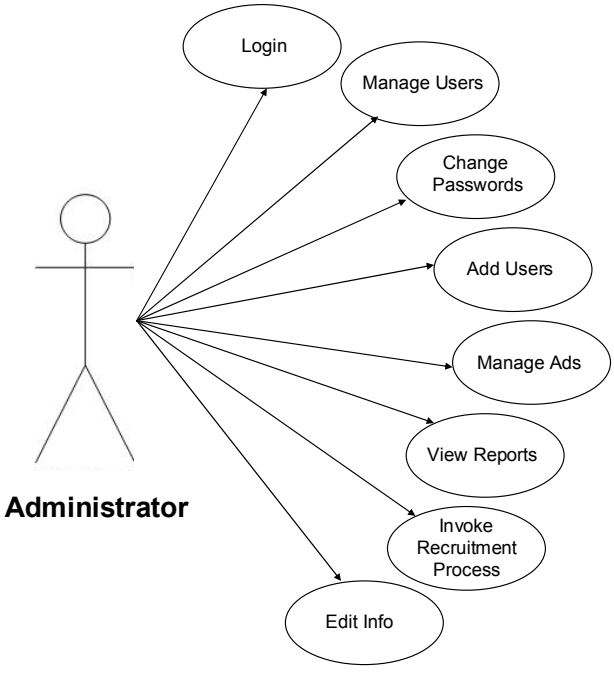
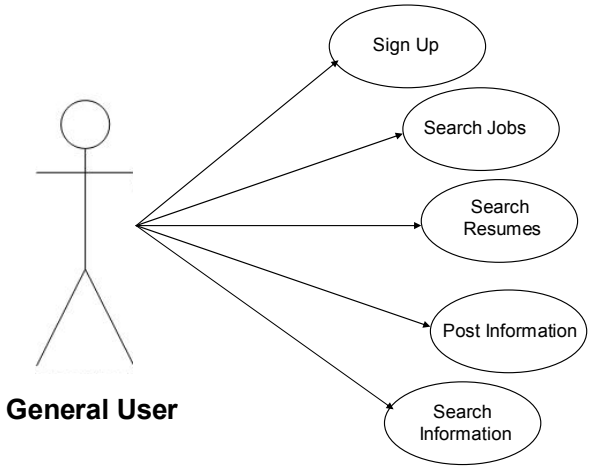
Post Job Ads
Edit Job Ads
Search Resumes
Post Files
Search Files
View Messages
Edit Info
Employer


Login
Manage Users
Change Passwords
Add Users
Manage Ads
View Reports
Invoke Recruitment Process
Edit Info
Administrator


Sign Up
Search Jobs
Search Resumes
Post Information
Search Information
General User