Job Board - A Web Based Scheduler

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Abstract

Contractual jobs involve short term work performed one at a time without any long term binding between the workers and employers. For example, a substitute teacher may work for a day or two in a school district. Searching for such contractual jobs by the workers and finding such contractual workers by the employers is a daunting task. It is also preferable to store the information separately by both parties so that the next search will be somewhat easier. This paper describes the design and development of a web-based tool named *Job Board* which assists both contractual workers and potential employers to search for each other and match accurately the qualifications of the workers with those expected for the jobs posted. Job Board has been made as a generic product so that it can be used in any application domain. In addition, the user interface of Job Board is designed in such a way that it is easier to use in a variety of platforms including desktop and mobile devices.

1 Introduction

Dental offices usually hire hygienists on contract basis, mostly on commission to a single job at a time, instead of hiring them as permanent employees. The main reason for this shift is to offer flexibility to hygienists as well as to dental offices. For example, a hygienist may be able to work for several offices and at her preferred time schedule. For the dental offices, it is also helpful to hire people depending on demand such as the number of patients coming to the office at any one time. This arrangement requires some sort of communication tools to keep track of work schedules for both parties - hygienists need to express their preferred work schedules and dental offices need to advertise when they need hygienists. Currently, a third party is taking care of this communication and establishes a working relationship between the two parties. However, most of the work on communication is done through papers, emails and phone conversations. The third party also keeps track of assigned work done by the hygienists in order to process their payments. To make it easier, the third party approached the Computer Science Department at the University of Wisconsin-La Crosse for developing a software tool to assist their communication activities. This paper reports the design and development of the software tool which was originally intended to support the third party facilitating the communication.

The authors of this software tool took the project one step further. After analyzing the requirements of the product which mainly involved keeping track of availability of hygienists and need for dental work, the authors identified that the same process can be applied to any other short-term jobs as well. For example, school boards may need substitute teachers and so advertise for the same. Substitute teachers may express their availabilities, and if a match is found between the two schedules, a substitute teacher may be hired. This idea motivated the authors to develop a generic software tool in which short term contractual workers such hygienists and school teachers can post their availabilities while employers can post their demand for contractual jobs. The tool can facilitate matching the qualifications of contractual employees with those advertised for the jobs by the employers. Thus, the authors came up with the name "Job Board" for this generic product. The design of Job Board includes a configuration mechanism by which the product can be instantiated with specific terms used in the chosen application domain. For example, if this product is going to be used by the dental offices and hygienists, the terms such as 'degree', 'licensure', 'certificate' may be used in defining qualifications.

With the advent of mobile technology, it is assumed that many users of Job Board, especially the potential employees, may use smart phones and mobile devices to access Job Board functionalities. Therefore, the authors of this paper have designed the user interface for Job Board to be sufficiently simple and suits both desktop and mobile applications. This design efforts by the authors relied heavily on using well-styled web pages that are compact and will look the same in all devices. Nevertheless to say that considerable design efforts were required in deciding each user interface component of Job Board.

The rest of the paper is organized as follows: Section 2 explains the functional requirements performed by all the three types of users in the system. The corresponding func-

tionalities are also shown in use case diagrams for easy identification. Section 3 describes the architectural design of Job Board using UML class diagram. Some screen shots of the product are also included in this section showing how some important user interface design decisions were taken care of. The technology used in implementing Job Board is briefly discussed in section 4 which also includes some discussions on testing. The paper concludes in section 5.

2 Functional requirements

The Job Board is mainly used by two groups of people - potential employees, called "freelancers" in this product, and potential employees, called "businesses". There is also a third group called "administrators" who will be taking care of system initiation and configuration of the system and maintenance of user accounts. The functionalities of Job Board are thus described in various subsections addressing the tasks that can be performed by each group.

2.1 Functional requirements - registration by new users

Each freelancer and business user of Job Board is required to register with the system before using it. There is a pre-built administrator account and hence administrators do not register. Creation of additional administrator accounts is beyond the scope of the current system and hence will not be discussed in this paper. Hence, hereafter, the term 'user' will refer to a freelancer or a business contact person.

During the registration process, a user will provide their preferred username, password and answers to three security questions. The user is given the freedom to write any three questions of their choice. This gives a flexibility to the users so that they could easily remember the questions and answers they entered. The three security questions created by the new user will be used every time the user logs in. In addition to the account information (username, password and security questions), a new user can optionally provide an email address and/or a phone number as contact information. If provided, the contact information will be used to disseminate messages to the user from Job Board. Currently, a message will be sent to both email and phone number. Since users of Job Board are expected to use mobile devices, sending messages to their email address and/or phone number will be the easiest way to quickly communicate with the user. Even if a user does not provide additional contact information, by default, a message board will be created for the user internally so that the user, when the user logs in, he/she can view the messages sent to the user. The goal of Job Board is to ensure that a user will not miss any message. It is also possible for a user to change any part of the profile (name, address, email address or phone number) at any time after login.

Once logged in, a user will be able to change his/her password at any time. Passwords are encrypted as a standard security measure. A second level of security is provided by the three security questions initially selected by the user during registration. Every time a user

logs in, one of the three questions will randomly be selected and displayed. This process continues until either the user correctly answers to the currently displayed security question or there is no more question to select from the initial choices. At this time, the account will be locked (a third level of security) and hence the user will not have a choice to log in again until an administrator unlocks the account.

Figure 1 shows the use case diagram[1] for login and registration activities by all types of users.

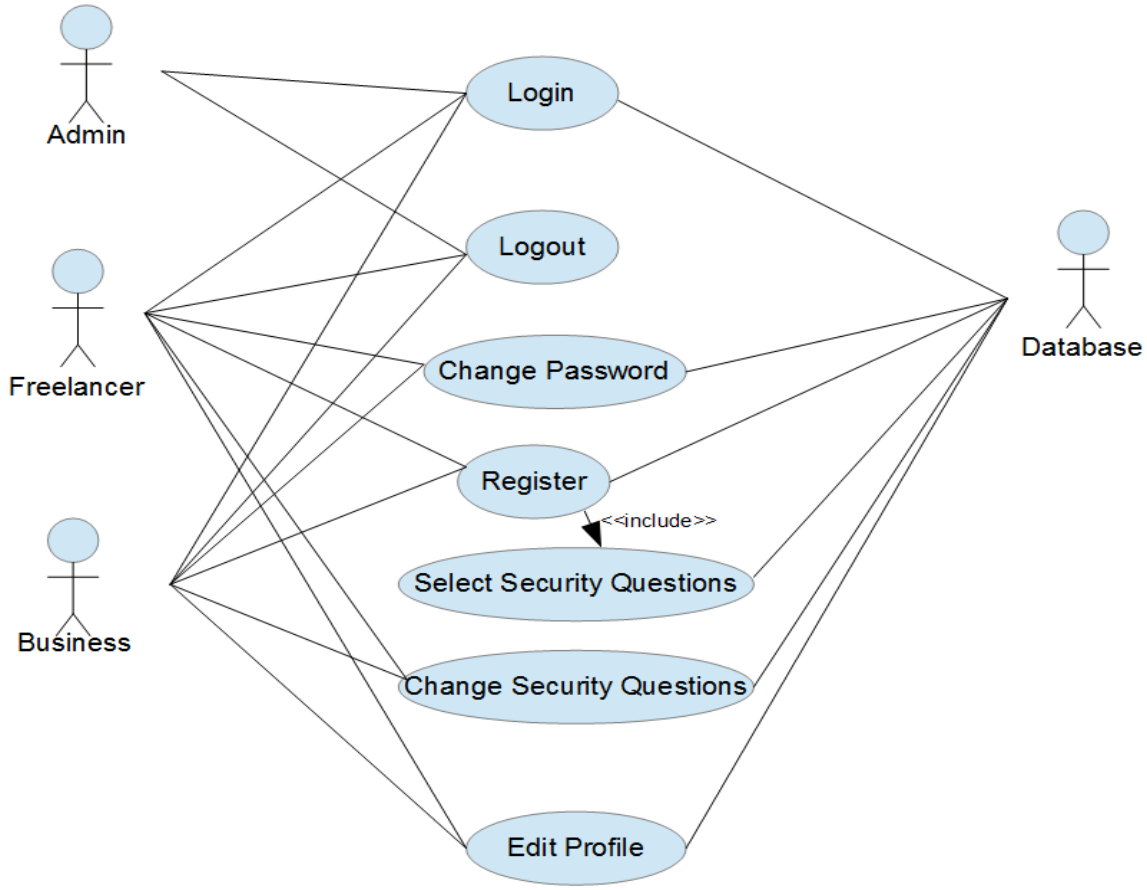

Figure 1: Use Case Diagram for all users

2.2 Functional requirements for freelancers

The following tasks can be performed by a freelancer:

- Create a set of qualifications. Format of qualifications are set by the administrator; this is discussed in detail in section 2.4.

[1] Used the notation for UML Case Diagram as given in [3]

- Modify or update qualifications.
- Create work schedule. Currently, the work schedule is designed to include the times of availability for a week. However, if a user's schedule changes often (for example every week), the user may need to update the schedule regularly.
- Modify work schedule.
- Browse through available job descriptions.
- Apply for jobs.
- Withdraw from applied jobs.

2.3 Functional requirements for businesses

A business represents a company or an organization. Current implementation of Job Board includes only one account for a company. This means that any authorized person in the company knowing the login credentials of the account can log in and use the services of Job Board. Later versions of Job Board may include additional accounts for the same company.

The following functionalities can be invoked from a business account:

- Create a job posting. A job posting includes the title of the job, a short description of the job, the location, the date and time at which the job is expected to be performed, and finally the required and preferred qualifications for the job. The format of qualification for job descriptions will be the same as the qualifications entered by a freelancer so that it would be easier for Job Board to match two sets of qualifications.
- Modify a job posting. Some restrictions are applied while modifying a job posting. For example, the date and time slots for a job posting should not be allowed to be modified if someone has already been matched for this job.
- Delete a job posting. This functionality will be normally used when a freelancer is found for the job and he/she agreed to perform the job. Occasionally, this functionality will also be invoked when no freelancer could be found within a reasonable time period.
- Browse candidates. Similar to freelancers who can browse available job postings, a business user can look through the candidates who have applied for the job posted by the business.
- Accept a candidate. This happens when a freelancer, whose qualifications and schedule match with those included in a job posting, applies for the job and becoming a candidate. Job Board does not automatically select the candidates; instead, it would let both parties (freelancers and businesses) know about the matching results so that both parties agree on the contract.

2.4 Functionalities for administrator

Current implementation of Job Board includes only one administrator. The main functionalities of an administrator include account maintenance and supporting activities, which are summarized below:

- Unlock a locked account. As stated earlier, when a user fails to log in after incorrectly answering to all security questions, the account will be locked automatically. An administrator then unlock an account and a message will be sent to the email address and/or phone number of the user, if one or both of these are provided by the user at the time of registration. Otherwise, communicating this message is outside the scope of Job Board.

- Create new qualification. Generally, every job description includes a set of qualifications expected from the applicants. However, the format of a qualification description varies with respect to the nature of the job. For example, a simple qualification may be asking for number of years of work experience. This can be modeled as a textual question and a numeric answer. However, if the qualification is concerned about how well an applicant knows about a particular software tool, a question may be stated "Describe your experience in using Microsoft Excel or an equivalent spreadsheet software". The answer for this question is not as simple as the previous one. Even if the answer is given in textual form, finding whether or not the applicant has the correct set of qualifications is not easy to deduce.

  In order to make it simpler and usable for a variety of applications, the authors have designed the format of qualification in a tabular format so that every qualification is modeled as a $\langle$ textual question, short answer $\rangle$ format. If the answer is a long sentence or a paragraph, it should be broken down into several simple questions such that the answer to each one of these simple questions can be modeled as a numeric value, a boolean value or a text with one or two words. To illustrate, the question "Describe your experience in using Microsoft Excel or an equivalent spreadsheet software" can be broken down into several simple questions such as "How many years of experience you have in using Microsoft Excel", "Do you have experience in using other spreadsheet software similar to Microsoft Excel", "Will you be able to use complex functions such as Macros in Microsoft Excel or the spreadsheet software you are familiar with", "On a scale of 1 to 5, rate your familiarity with Microsoft Excel" and so on. The design of the table structure for qualification is described in a later section in this paper.

- Prepare initial configuration of Job Board. This functionality will be used only once at the time of installing Job Board so that it may use some of the customized functionalities pertinent to installation. This may correspond to substituting appropriate terminology for freelancers (e.g., hygienists) and for businesses (e.g., dental offices).

Currently, qualifications once created cannot be modified. They can be deleted and added with new contents. The reason for this decision is as follows: For a given qualification

Q, if a freelancer or a business has already used Q, their entries will be inconsistent with the modified Q. So, the authors decided not to allow modifications of any qualification. Instead, when a qualification structure is deleted, it automatically sends a message to those users who use them. It is the user's responsibility then to re-enter the new qualification.

The separate functionalities of each type of user are described in the use case diagram in Figure 2.

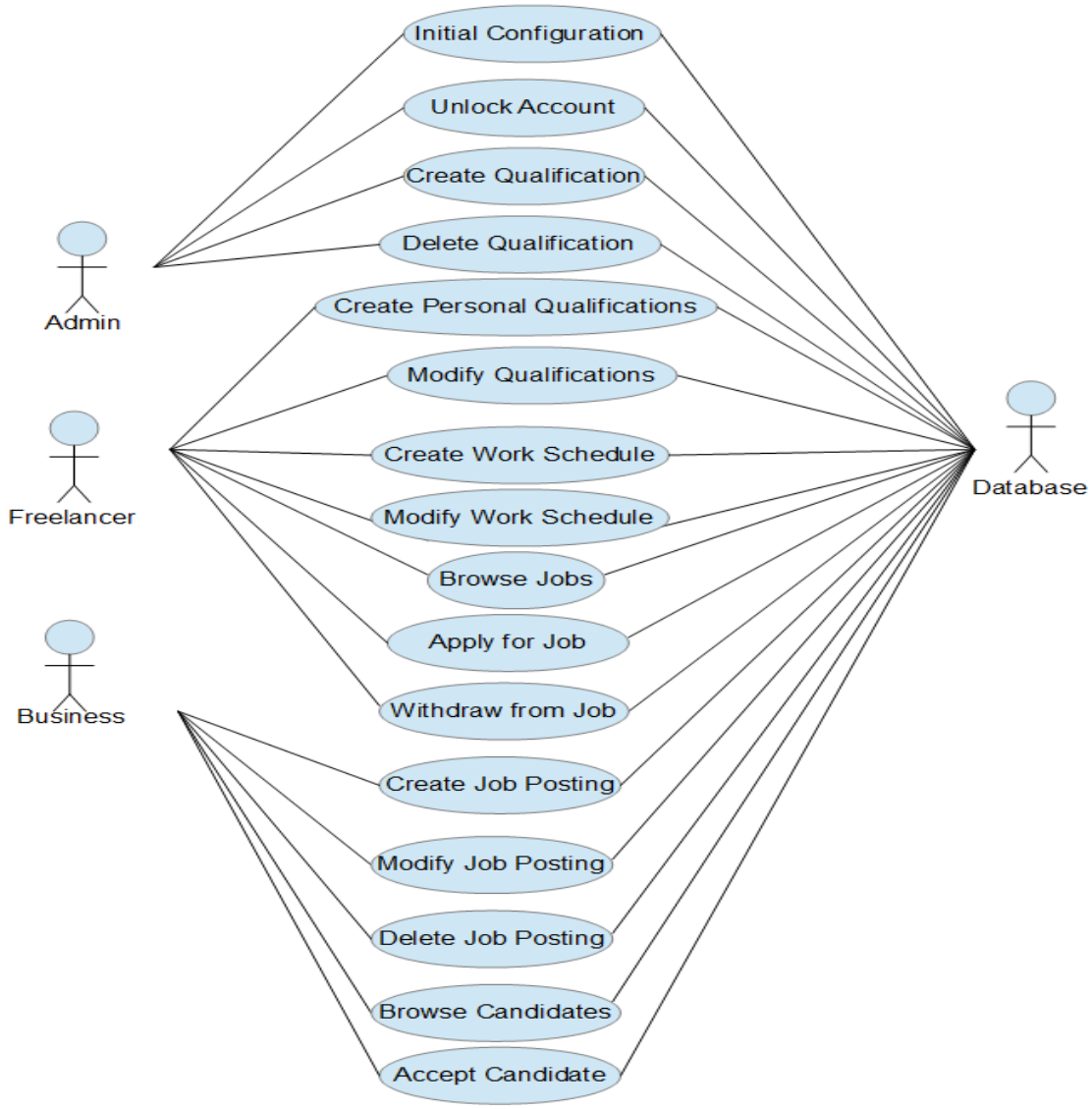

Figure 2: Use Case Diagram for functionalities performed by all three types of users

3 Design of Job Board

This section includes two components - a UML class diagram[2] showing the design of Job Board and a brief description of the configuration file for initial set up.

Figure 3 shows the UML class diagram for Job Board. For brevity, we do not describe all

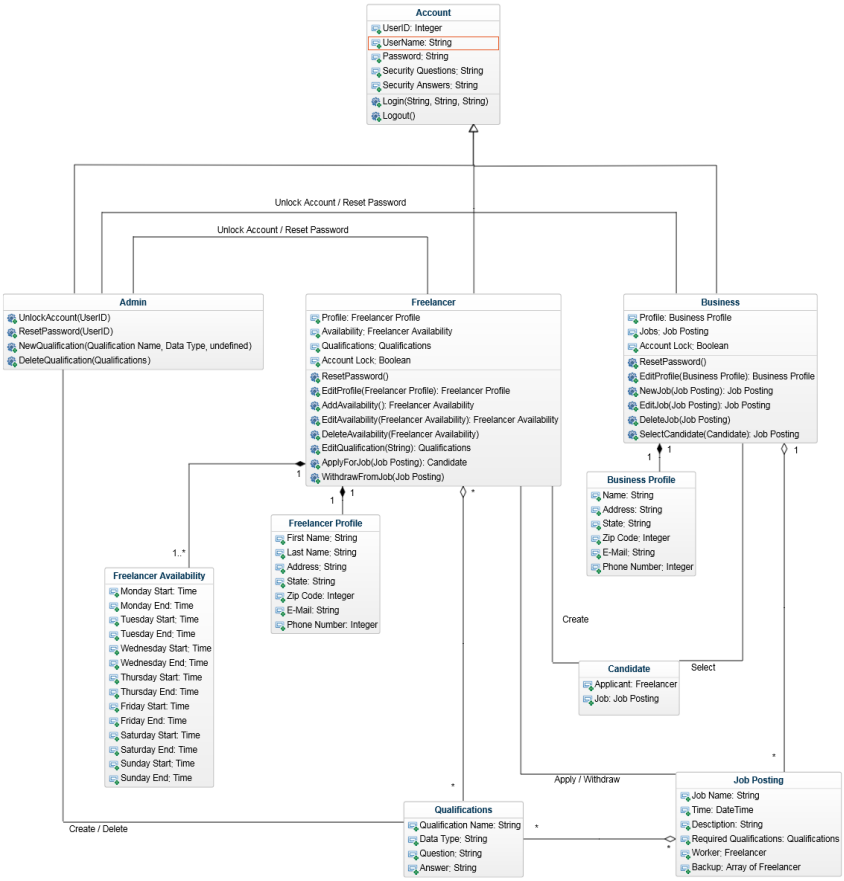

Figure 3: UML Class Diagram for Job Board

details of this diagram. Instead, we highlight some of the design details that deserve special attention in the diagram.

- The “Account” class is specialized into three other classes corresponding to the three types of users in the system.
- The aggregation relationship between “Freelancer” and “Freelancer Profile” and the aggregation relationship between “Business” and “Business Profile” are both set as

[2]Used the notation for class diagram as given in [3]

composite aggregation indicating the corresponding component (e.g. Business Profile) is part of only this aggregate (e.g., Business). However, the class "Qualifications" is connected with shared aggregation relationship with "Job Posting" and "Freelancer". This shared relationship makes it easier to ensure that a freelancer has the subset of qualifications expected from the job posting.

- A "Candidate" is an independent object which is used by both "Business" and "Freelancer" classes and so it has an association with them.

The database has been designed to mimic the same structure as shown in the class diagram so that there is an easy way to store into and retrieve objects from the database.

The second part of design addresses how the product is made generic. As the class diagram shows, Job Board has been designed to make it as a generic product. The class "Qualification" includes four parameters describing the structure of a qualification suitable or any job. Further, the classes "Freelancer" and "Business' heavily rely on "Qualification". Additional information pertinent to a particular domain such as School Board or Dental Services can be included in the profile classes represented by 11Freelancer Profile" and "Business Profile". Even though currently these classes only include basic contact information, they can be easily extended to add application specific details. Such additional details will not affect the matching of qualifications, an important part of any job hunting process (by a potential employee)or job selecting process (by a potential business).

In order to facilitate such customization for particular application domains, the authors have included a configuration file maintained by the administrator. This file, once created and initiated at the time of installation, will provide domain specific details as and when needed.

3.1 User Interface Design

Since Job Board is expected to be used through a variety of platforms including mobile devices such as smart phones, the user interface design was a critical component of the design phase. Due to space limitations, we do not include all different screen shots of the application, but include those that warrant special attention.

Figure 4 shows how an administrator is able to add a new qualification. As mentioned earlier, the goal of Job Board is to make it simpler for entering and matching qualifications and hence the format of a qualification is designed to be simple to fit into a table structure. The types of answers for a qualification are restricted to *numeric*, *Boolean* and *simple string* (meaning one or two words). The textual format of the answer will be expanded in later versions when matching algorithms are fine-tuned. For example, if the textual form includes several words, then keywords (most important words in the application domain) need to be identified first and the ordering of these words in the textual format may also be considered. This makes matching algorithms more accurate in precisely finding a suitable candidate for a job posting.

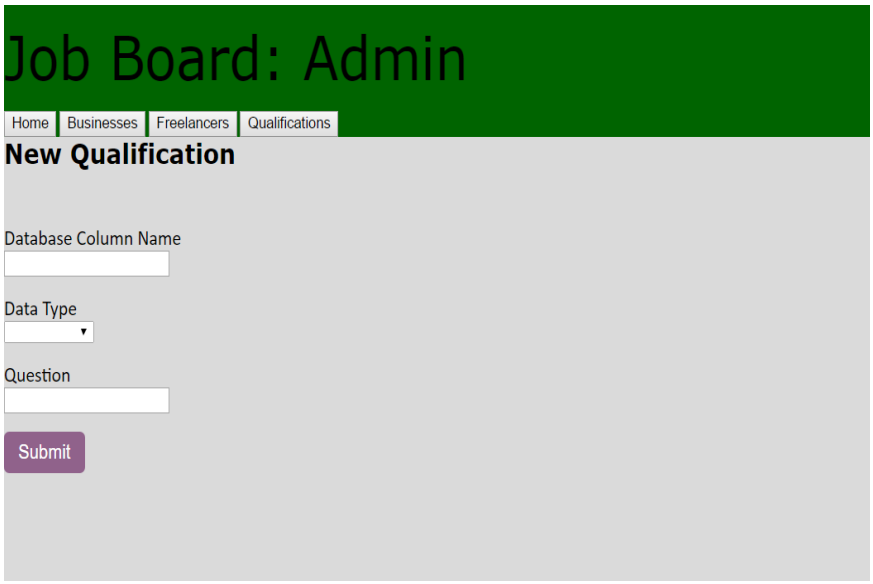

Figure 4: Administrator adding a new qualification

The use of qualifications by a freelancer is shown in Figure 5. The table structure enables anyone to easily understand the set of qualifications of a freelancer. A similar tabular structure is used by the businesses when a new job posting is created.

Entering work schedule by a freelancer is another important task in the matching process. Current implementation of Job Board allows a freelancer to include a preferred work schedule for a week. This means that the freelancer is responsible to update the work schedule every week so that it is up to date. Figure 6 shows the calendar structure using which a freelancer enters his/her preferred work hours. As seen in this figure, a freelancer can include any number of intervals in a given day. For example, the freelancer may want to say that he/she is available from 9:00 A.M. to 11:00 A.M. and then from 2:00 P.M. to 5:00 P.M. on Monday. This poses a challenge for the matching process to accurately match a candidate for a job posting because even if the candidate has the right set of qualifications, the required time schedule of the job posting must be included in the set of time slots posted by the freelancer. The authors have implemented the matching algorithm with this precision in mind.

3.2 The Matching Process

In the current implementation of Job Board, the matching process is automatically invoked (1) when a freelancer enters his/her qualifications and preferred time schedule; and (2) when a business posts a new job. In either case, the addition of a new entry triggers the matching process so that all possible matches between the new entry (freelancer's profile or job posting) and existing entries (job postings or freelancers' profiles) and a listing of matches is compiled. Job Board them individually sends messages to all parties involved. The messages will be sent through emails and/or as text messages to the phone numbers,

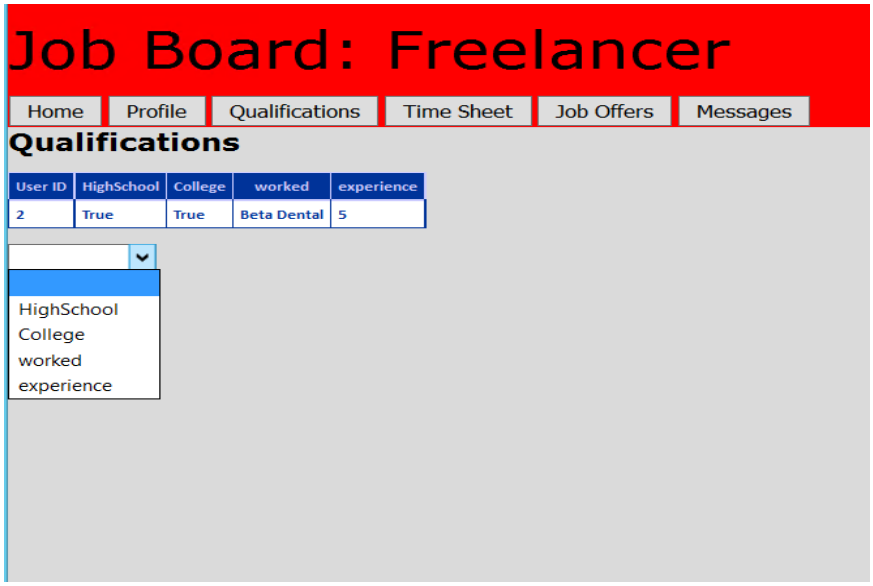

Figure 5: Freelancer entering a qualification

if either email or phone or both of them are included in the profile. In any case, a message is added to the concerned parties' accounts as well so that when they login, they should be able to see the message.

4 Implementation and Testing

Job Board has been implemented as a .NET product using the Microsoft Technology [4]. The authors used C# as the main programming language [1], as well as few functionalities developed in Javascript and JQuery to complete the logic and functionalities. To facilitate this, Job Board was created as a Web Form in Microsoft Visual Studio. This allows developers to create front-end pages with ASP.NET and HTML while each page has a back-end C# page that can dynamically add to the user's web page details specific to them. All data in Job Board is saved in Microsoft SQL Server [2]. All web pages communicate directly to the database and so there is seamless data flow between the database and front-end web pages. CSS style sheets [2] are used to make the front-end pages attractive but at the same time, easy to use.

Unit testing has been performed to test every single functionality. So far there was no problem reported in integration testing as well. However, some additional functionalities are underway to enhance the services provided by Job Board. These will require additional efforts in integration testing. To ensure the generic nature of Job Board, the authors are working on getting test cases from at least three different application domains. This effort will also trigger testing of the configuration file.

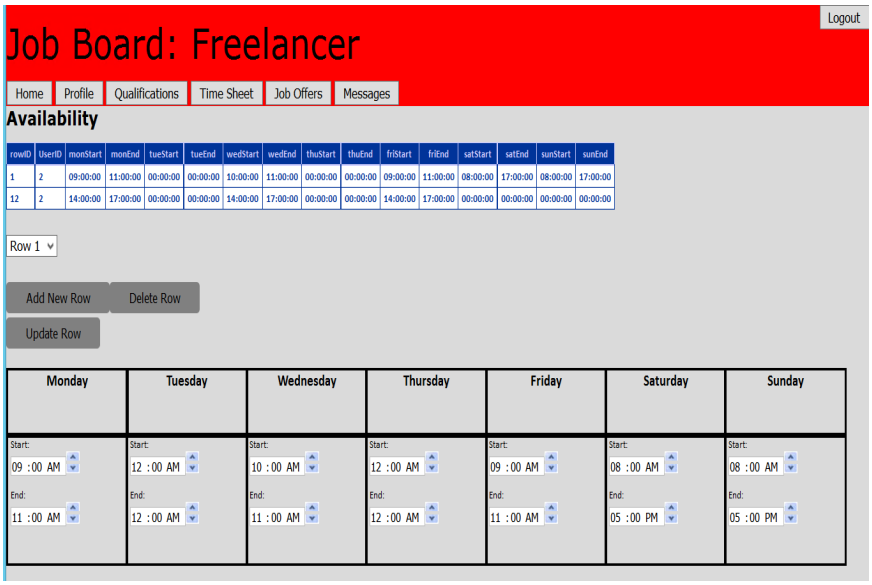

Figure 6: Work schedule of a freelancer

5 Conclusion

This paper describes the design and development of Job Board, a web-based software tool that assists freelances (or job hunters) to find matching jobs and businesses (employers) to find matching candidates for a given job. The purpose is to find short-term contractual jobs rather than permanent jobs. Initiated by a request to maintain work schedule by hygienists in dental offices, the authors found that the request can be made into a generic product and thus Job Board was developed. The current implementation of Job Board serves the most important purpose - matching potential candidates for short-term contractual jobs. The authors continue to work on enhancements of the product to include additional facilities such as tracking work hours, reporting payments and so on.

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