The Design and Implementation of an Information System for Placement Programmes

Steven Kwan Keung Ng, Wai-Shing Ho, Fu Lee Wang,
Kenneth Wong, and Michael Cheung

Caritas Institute of Higher Education,
18 Chui Ling Road, Tseung Kwan O, Hong Kong SAR, China
{sng,wsho,pwang,kfwong,mcheung}@cihe.edu.hk

Abstract. Placement programme is now an integral part of higher education curriculums as it brings invaluable chances to integrate practice and theories. However, traditional course management systems cannot handle all the information inside a placement programme such as the input from stakeholders like employers and placement counselors. We have recently designed and implemented an information system to support the information need of our placement programme. The system provides a centralized platform for employers to post placement information; for students to view possible placement opportunities; and for placement counselor to provide placement guidance to the students. The system also provides a matching service to identify the best placement opportunities for each student and the best students for each placement job. This paper shares our experience in the design and implementation of our placement information system.

Keywords: design, implementation, placement, post-secondary, education, matching algorithm.

1 Introduction

Placement programmes are effective work-based learning opportunities. Students can have practical training at industrial setting which connects classroom theories to workplace applications. Many higher education institutions in Hong Kong have introduced placement programmes to their curriculums. For example, The Hong Kong Polytechnic University (2013b) requires students to complete a placement programme, namely, Work-Integrated Education, as a part of graduation requirements. Similarly, all bachelor degree programmes accredited by Hong Kong Institution of Engineers must include significant, relevant practical training or employment (HKIE, 2013) in their programmes.

Caritas Bianchi College of Careers (CBCC) and its sister college, Caritas Institute of Higher Education (CIHE), aim to provide holistic education to the community. The two colleges consider that placement programme is a crucial component in a holistic education (CBCC, 2011). With the financial support from Education Bureau (EDB) of Government of the Hong Kong Special Administrative Region under the Quality

J. Lam et al. (Eds.): ICT 2013, CCIS 407, pp. 120–134, 2013.

Enhancement Grant Scheme, the two colleges are integrating placement programme into their formal curriculums of different programmes.

The youth unemployment is a common problem in many countries (Li, 2009). As reported by a government study (HKSAR, 2012), most economies showed a very high level of youth unemployment rate with significant worsening over a decade earlier upon their bleaker macroeconomic conditions. A fresh-graduates employment survey (JobsDB.com, 2011) showed that only 27% of companies had hired fresh graduates in the year before the survey. i.e., 73% of companies were not willing to hire fresh graduates. 83% of companies considered that previous work experience was essential. A managing director of a major human resources company also warned that fresh graduates without proper working experiences would have difficulties in finding their first job in the marketplace (Apple Daily, 2011).

As a result, in order to equip students with practical work experiences, it is essential to integrate placement programme into higher education. Through the summer placement experiences, students have an opportunity to integrate theories with practices and to improve their practical and communication skills and their industrial knowledge. Subsequently, students' employability is significantly enhanced.

With the increasing number of placement programmes in the curriculums, a high quality information system is crucial to provide suitable placement information to different stakeholders including students, employers and placement counselors. Career information and guidance services are essential to higher education institutions and most institutions do have career information systems. However, many of them provide only a simple job search function (*JIJIS*, 2012; *NETjobs*, 2013a; *Job Board*, 2013a) or a CV publication service (*NETmatch*, 2013b), and do not provide a tailor-made service for different stakeholders that caters for individual's interests, values, and needs. For example, they may not have the functionality for placement counselors to oversee the placement applications.

In order to cope with the development of placement programme in our Institutes, we have recently designed and implemented a placement information system. This system provides to both CBCC and CIHE the functionality of (i) placement information manipulation such as registration, search, retrieval and updates; (ii) automatic ranking and matching of students and potential placement opportunities; (iii) administrative work support for placement counselors on the whole placement allocation process; and (iv) survey and report generation for reviewing of the placement project. This paper aims to share our experience in the design and implementation of this placement information system. We will describe the system's architecture, highlight the design challenges we faced, and outline our solutions.

2 System Architecture

The placement information system aims to provide a convenience and user friendly interface to different users including students, placement administrators (who are usually the placement counselors) and employers who have agreement with both colleges (CBCC and CIHE) about placement co-operation. The students can use the

system to look for placement and other full-time or part-time working opportunities. The employers can use the system to post job advertisement and look for potential employees. The placement administrators can use the system to oversee the placement application process of every student. Therefore, the system has three main panels – student panel, administrator panel and employer panel. The users interact with the Web-based panels and the user and placement information is stored in a database. The architecture of the system is as shown in Figure 1 and the use case diagram of the system is shown in Figure 2.

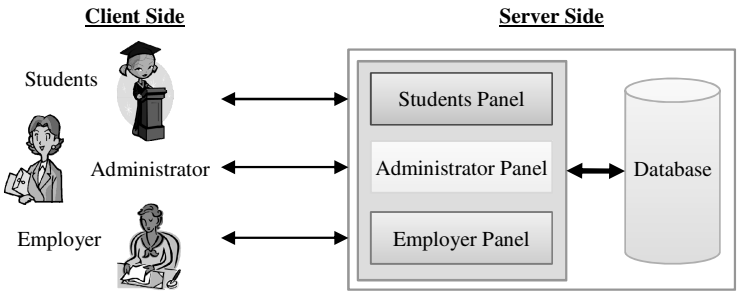

Fig. 1. Architecture of the placement information system

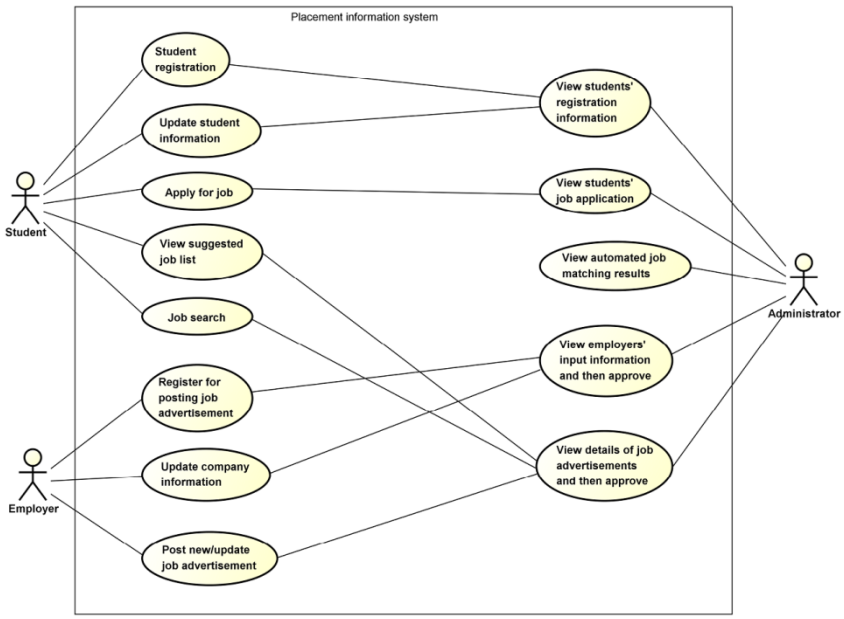

Fig. 2. Use case diagram of the placement information system

2.1 Student Panel

An important goal for the system is to let students find suitable placement or other working opportunities. In order to do so, the students can perform two main tasks on the student panel – personal information manipulation and job searching and application. Before the students can find any job using the system, they should first register to the system by providing suitable information for preparing for job applications. For example, they should provide personal particulars and past working experiences when they perform the registration. Once a student confirms the registration, a personal CV will be automatically generated according to the available information. This CV is sent to the student for his/her reference and can be used by him/her in future job applications inside or outside this system. Afterwards, the students can log in to the system to browse all the available jobs with different criteria through different filters. The students may also use the automatic matching functionality of the system to identify the jobs that the system recommends to them. If a student finds a job that he or she thinks that is suitable for him/her, the student can mark the interest to this job. Placement counselors will provide guidance through this system to this student on whether he/she is really suitable for this marked job according to their expertise.

2.2 Employer Panel

The employer panel is designed for two main purposes – company information manipulation and job advertisement posting. Like the students, before an employer can use a system, the person-in-charge of the company must first register to the system by providing relevant company information. However, in order to protect our students, our placement administrators will verify the company's information before approving the company. Only approved companies can post and edit job advertisements, and the advertisements are subject to approval again. With this approval scheme, students can trust the companies and advertisements posted through this system. On the other side, our system is designed to have a simple interface to employers on the approval so that this approval scheme will not be a hurdle for employers to post job opportunities in our placement information system.

2.3 Administrator Panel

The administrators play a very important role in this system. They have the rights of approving or rejecting employers' registrations and job advertisements. They analyze which placement is the most suitable for which student with the help of our placement information system (the auto-matching module) and refer suitable job placements to each student. They are also responsible for helping students applying for the jobs and following up any issues arising from placement allocation process. The input from the administrators is the most significant difference between our system and other job matching systems.

2.4 Automated Matching Module

The auto-matching module is another main feature of our placement information system. This module automatically associates the most suitable jobs to every student and the most suitable students to every job. The matching is defined based on the criteria set at the time of registrations. Students may provide their preferred criteria for jobs during the registration. Similarly, each job may have different requirements associated to it. We have defined 7 criteria for matching. While the matching of education level and job category are mandatory (i.e., the job and student that failed to match in these criteria will never be shown as matched), other features of the job may match with the preferences of the students. Table 1 lists the criteria we used in the automated matching module. The matching scores indicate how well a job matches with the student. The more criteria are matched, the higher the rating of matching will be. According to the matching result, the administrators can refer suitable students to employers for interview.

Table 1. The criteria used for automated matching module

Criterion	*Condition to be matched*	*Mandatory or not?*
Education level	The student's current education level is not lower than that the job requirements.	Yes
Job category	The student's studying programme has the same job category as stated in the job.	Yes
Working location	The student's living district is near to the working location of the job	No
Working experience	The student has more working experience than that the job requires	No
Language skills	The student has the spoken level of the language skill that the job requires at "good" or above.	No
Salary Range	The student's expected salary range is the same as that the job offers.	No
Employment type	The student's desired employment type (full-time/part-time/internship) is the same as that the job provides.	No

3 Scenarios of Placement Information System

In this section we will highlight some important scenarios of how different stakeholders use our placement information system. In each scenario we will describe the interaction between the users and different system interfaces by a sequence diagram.

3.1 Student Registration

When a student uses our placement information system to look for jobs or placements for the first time, he or she is required to fill in an online registration form. The sequence

of steps for student registration is shown in Figure 3. During the registration process, the student has to fill personal particulars, education and working experiences, job expectation, etc. in the online form. In addition, the student can upload other supporting materials including photos, résumé, and recommendation letters. Since there are design students in our Institute, our placement information system specially caters for them to upload the information about their design products as this is an important criteria for employers to select suitable candidates.

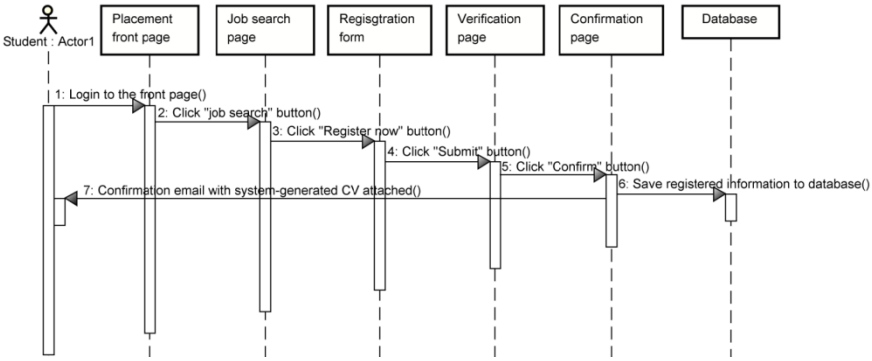

Fig. 3. Student registration process for the system

After filling the registration form and uploading necessary additional information, the student can verify the uploaded information on the verification page. If the student finds that the filled information has error, he/she can roll back to the input page and modify it. If no errors are found in the checking, the student can confirm the registration and the student information will be stored in the database. At the same time, a CV will be generated by the system according to the information filled by the student. This CV will be sent to the student through e-mail for his/her reference and further usage.

3.2 Job Searching and Job Application

After finishing the registration, a student can use the job searching function to find if there are potential jobs or placement opportunities for him/her. From the list of available jobs the student can select and apply for jobs that he/she likes. Figure 4 shows the sequence diagram of the job searching and job application processes.

The student can search the available jobs according to keywords in job titles, company and/or job descriptions, and other chosen criteria such as job categories. The details of a job can be retrieved by clicking the title of the job in the list. After viewing the details of the job, if the student thinks that the job is suitable, he/she can click the “apply now” button to initiate the application process. The placement counselor will be notified by this application request and will analyze if this job is really suitable

for the student, especially on whether this job can fulfil the placement requirement for that particular student if the student is looking for placement opportunities. Moreover, the placement counselor will follow up the application process.

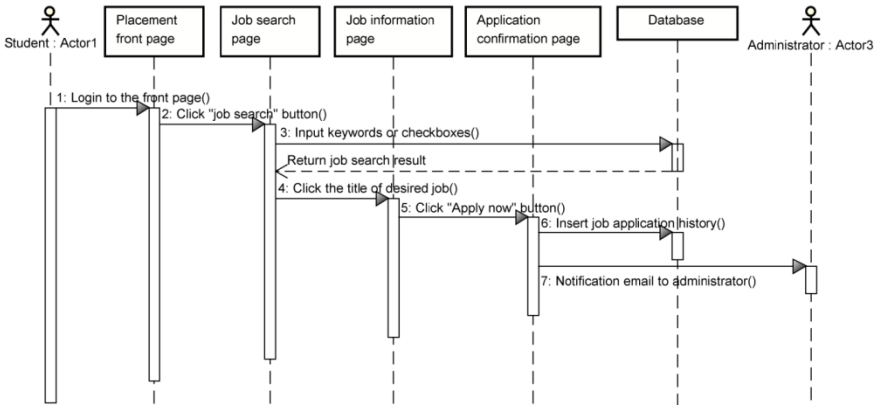

Fig. 4. Process of job searching and job application

3.3 Employer Registration

The registration process for employers is different from that for students. This is because students can authenticate themselves by using the login credentials in our student information system. However, the details of new employers must be verified by the placement administrators in order to protect our students from potential employment frauds. Therefore, after registration, an employer's account is not fully functional until being approved by a placement administrator. Figure 5 shows the steps for an employer to create and register an account in our system.

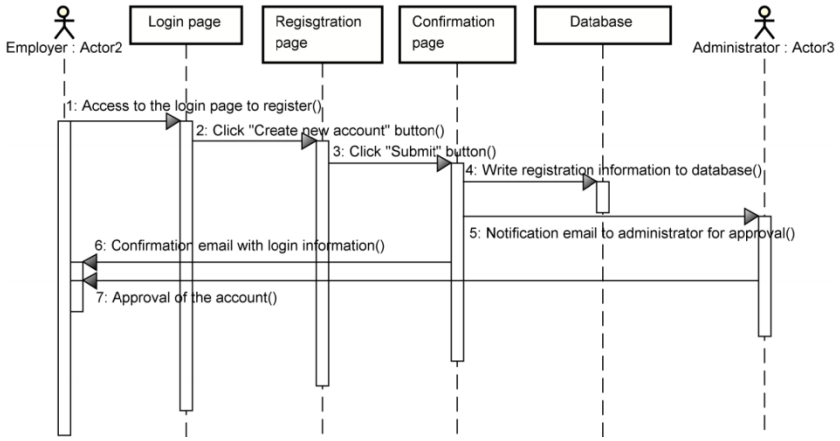

Fig. 5. Process of employer registration

3.4 Posting Job Advertisements

An approved employer can post job advertisements to the system. Figure 6 shows the process of posting a new job advertisement. The employer first logs in to the system and clicks the "new job" button on the employer panel. Then, a job vacancy registration form is shown and the employer needs to fill in the job information such as position name, number of vacancies, requirements, salary and benefits, and recruitment deadline. After the employer filling in the form and submitting it to the system, the job is still not visible to the students yet. Again, to protect our students, any advertisement posted or updated must be verified and approved by a placement administrator. The system will generate a notification to the placement administrators once a new job is posted or any crucial job information is updated. Only approved jobs are visible to the students. Our system will notify the employer about the placement administrators' decision on the job advertisements.

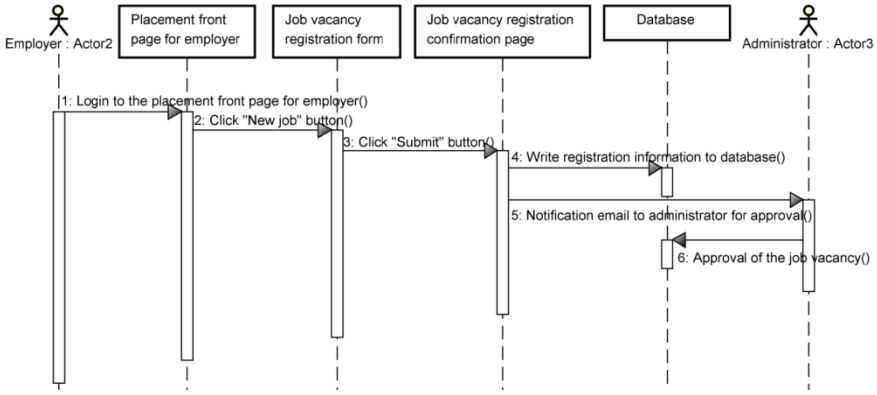

Fig. 6. Process of posting a new job advertisement

3.5 Job Matching

An important task of placement administrators is to refer suitable placement opportunities to every student who needs placement in our institute. As there are a large number of students in our institute, our placement information system aims to help the placement administrators by automating the job matching and ranking process. Figure 7 shows how a placement administrator can use our system to perform job matching and ranking.

A placement administrator can click the "job matching" button on the administrator panel. A list of all jobs, together with a list of students who are suitable for each job is shown to the administrator. For each job, the students are ranked according to the degree of matching to the job requirements. The administrator can retrieve the details of the students, including their CV and supporting information from the system and then refer them to the corresponding companies according to the matching results.

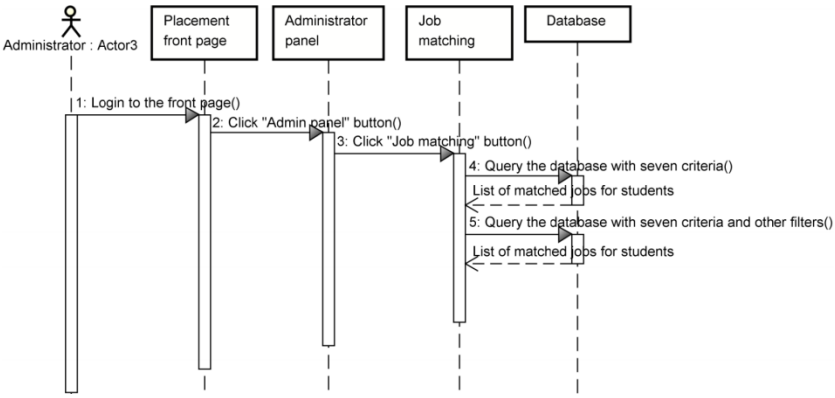

Fig. 7. Process of job matching and ranking

4 System Implementation

The system is mainly a Web-based application and is implemented by PHP on server side and JavaScript on client side. jQuery is also used to enhance the user experience and the page interactivity.

4.1 Server Configuration

Our system is running on a Linux system with Apache, PHP and MySQL installed. Table 2 shows the detailed configuration of our server.

Table 2. The server configuration

Components	*Specifications*
CPU	Intel Pentium E2180 2GHz
Memory	512 MB
OS	CentOS 5.8
Hard disk	160 GB
Web server	Apache 2.2.3, PHP 5.3.3
DBMS	MySQL 5.0.95
JavaScript library	jQuery 1.8.3

4.2 Database Design

The database of the system stores mainly the information from three directions – users, companies, and jobs. Figure 8 shows a simplified E-R diagrams for our system. We have the user table for storing the basic information (user name, encrypted password, privileges, etc.) of different users (administrators, employers and students).

When an employer registers, the company information is recorded and an account is created for this employer. The approval records of the companies are also stored. When a student first logs in to the system, a new profile is created to store the personal information related to job searching, like job preferences, working experiences, etc. Students can use different profiles for applying different jobs. When a student is successfully employed, the details of the employment is recorded so that the placement counselors can follow up the placement progress of the student.

Our system supports multi-languages and is supported by databases. Users can have different language preference settings and the menus can be tailored. To facilitate automatic job matching, we decided to unify the way for students to describe their job preferences and the way for employers to specify job requirements. Most of such entries are implemented using drop-down menus and the menu items are stored inside the database in some constant tables.

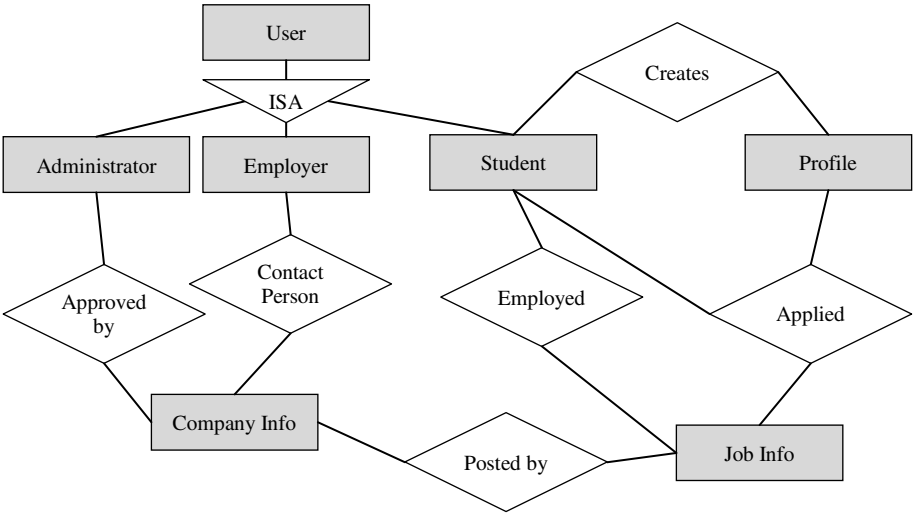

Fig. 8. A simplified E-R diagram showing the relationship sets between key entity sets

4.3 User Interface

Administrator Panel. Placement administrators have to work with the system closely to oversee the placement information. For example, he/she has to verify the employer's information during their registration and also after they post the jobs. Figure 9 shows a list of pending employers and the administrator can approve the employers he/she knows in a batch. As another example, administrators have to follow up the applications referred by them. Figure 10 shows a list of application history so that they can follow up (e.g., input the actual employment details if the student is employed).

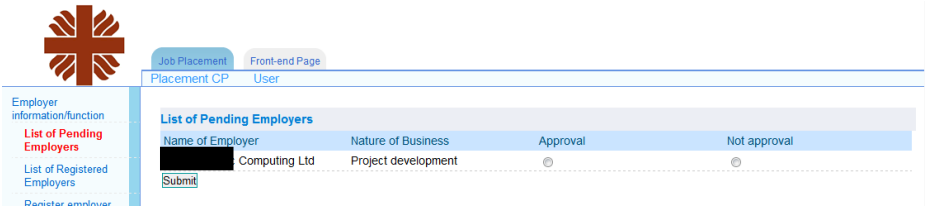

Fig. 9. List of pending employers in administrator panel

Another important task of administrator is to refer suitable placement to students. The administrators can select the placements through a filter and then the system will list out the students who are suitable for the jobs according to the matching criteria discussed in Section 2.4. Administrators can associate the placements to students by clicking the "Refer" button as shown in Figure 11.

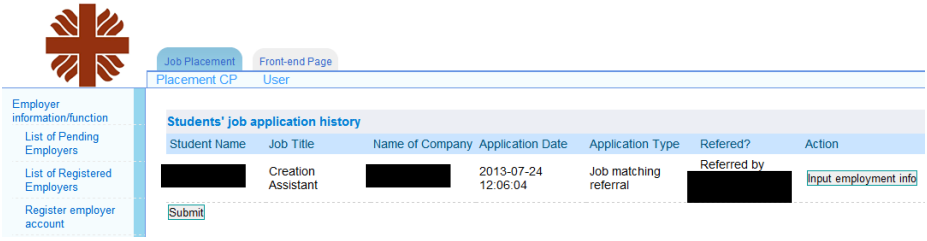

Fig. 10. The application history of the students to the jobs

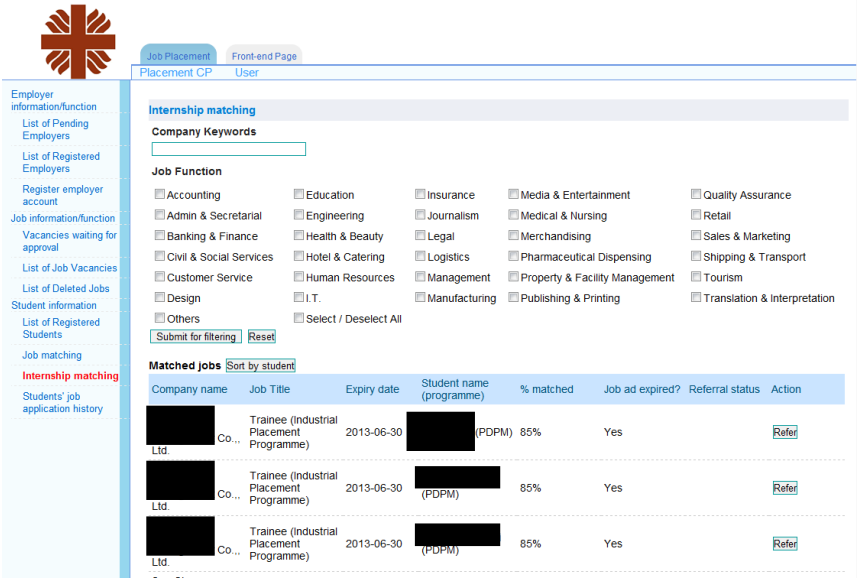

Fig. 11. List of matched students for placements

Student Panel. When a student logs in to our system, he/she sees our homepage as shown in Figure 12. This page shows a summary of the suggested jobs to the students according to his/her preferences set previously. If the student cannot find suitable jobs from this list, he/she can click the "Job search" button and goes to the job searching page as shown in Figure 13. On that page the student can browse the list of all available jobs and set filters on the jobs using keywords and/or other job attributes.

Inside the list of jobs, the student can click the title of the job and then go to the job details page as shown in Figure 14. If the student thinks that the job is good, he/she can click "Apply Now" and choose a CV profile for this application. The student may choose to use his/her current CV or update the CV with information suitable for this application. Then, the placement administrators will receive the notification and provide suitable guidance to the students on the applications.

Fig. 12. System homepage for students

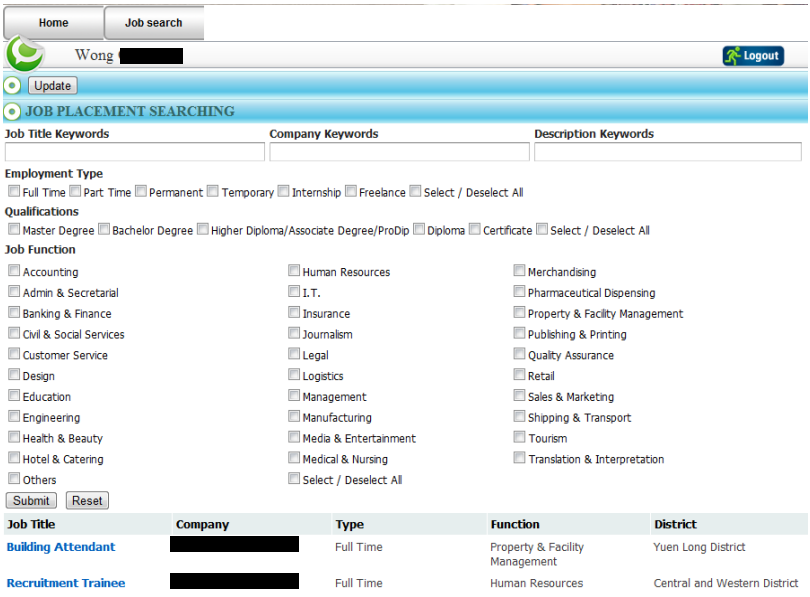

Fig. 13. Job searching page under student panel

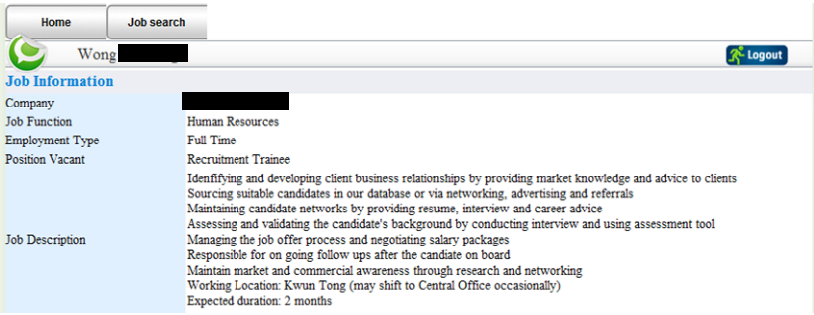

Fig. 14. Job details page under student panel

Fig. 15. Registration screen for employers

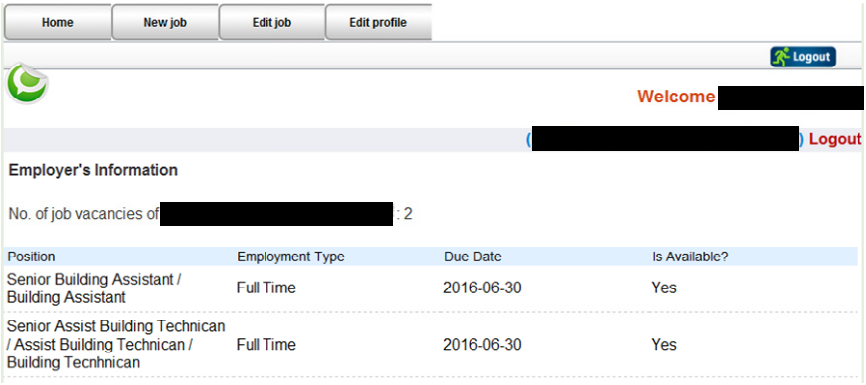

Fig. 16. Employers' home page with job status

Employer Panel. Employers can use the panel to edit their company profiles and to post jobs. Before that, they must first register to the system via the form as shown in

Figure 15. The administrator will then verify the information and activate the account. Employers can use the activated accounts to post jobs. However, the jobs must be verified by the administrator before being accessible by the students. Employers can see the status of the job in their home screen as in Figure 16.

5 Discussions

Over the implementation of the system, we faced problems in (i) designing the data format (including programme information, placement location district, etc.) for automated job matching, and (ii) generating students' CVs and convert them into PDF format. In order to facilitate automated matching between jobs and students, we decided to unify the descriptions of the matching criteria in job descriptions and students' preferences. Moreover, as different people may use different notation on the same information (e.g., district of the company and the working area preferences in student profile), we decided to make the fields non-free-text in most cases. For example, users must select the districts, study programmes, education level requirements, etc., by drop-down menus. This reduces the chances of input error, and also makes the matching easier.

CV is a very important document in job application. A clear and concise CV gives a good image to employers and is beneficial to the students. Therefore, we help the students create a CV in PDF format for job applications through the system or through other means. After entering the information, the students will receive the generated CVs in PDF through e-mails. During the generation, our system first converts the students' information into Excel format using PHPExcel for clear and organized structures. Then, the tcPDF library is used to convert the Excel object into a PDF file. As the CVs contain Chinese characters and optionally students' image, special handling was required for such conversion.

6 Conclusion

The implementation of the placement information system in our Institutes provides a platform for students to find desired placement opportunities under the guidance of placement counselors. The verification and approval mechanism in this system makes sure that the information provided by both students and employers are valid so as to prevent the job mismatches and job frauds. In order to reduce the workload of the placement counselors, automated job matching is provided to them for identifying good matches between students and placements. Placement counselors can also review students' job application history and follow up any problems the students faced in job applications. This placement information system plays an important role in the matching of students and placement opportunities and is helpful to the integration placement into programmes' requirements for providing a holistic education. Furthermore, students in the Institutes may also use the system with the guidance of placement counselors to find suitable part-time and full-time jobs so as to build up their career path.

Acknowledgement. This project *Placement Programme to Support Holistic Education* is funded by the Education Bureau (EDB) of the Government of the Hong Kong Special Administrative Region of the People's Republic of China under the Quality Enhancement Grant Scheme (QEGS).

References

1. Apple Daily. Graduated for 3 years; Applied CSSA for 1.5 years. Apple Daily (February 14, 2011), Retrieved from http://hk.apple.nextmedia.com/
2. Caritas Bianchi College of Careers, Placement program to support holistic education (2011), Retrieved from Quality Enhancement Grant Scheme: http://www.ipass.gov.hk/eng/64A2011.pdf
3. Government of the Hong Kong Special Administrative Region, Youth unemployment in Hong Kong. In Third Quarter Economic Report, p. 81. Author, Hong Kong (2012)
4. JIJIS, Joint Institutions Job Information System (2012), Retrieved from http://www.jijis.org.hk/
5. JobsDB.com. JobsDB Q2 2011, Hiring Index (August 7, 2011), Retrieved from JobsDB.com: http://hk.jobsdb.com/HK/en/StaticContent/promo/survey2011/q2/em/index.htm
6. Li, J.: Huge supply of graduates the cause of youth unemployment. China Daily, p. 4 (June 26, 2009), Retrieved from http://www.chinadaily.com.cn/hkedition/2009-06/26/content_8324429.htm
7. The Hong Kong Institution of Engineers, Professional Accreditation Handbook (Engineering Degrees). Author, Hong Kong (2013), Retrieved from http://www.hkie.org.hk/docs/accreditation/Accr_Handbook_EngDeg.pdf
8. The Hong Kong Polytechnic University (2013a), PolyU Job Board. Retrieved from The Hong Kong Polytechnic University: http://www.polyu.edu.hk/caps/jobboard
9. The Hong Kong Polytechnic University. Work Integrated Education (2013b), Retrieved from The Hong Kong Polytechnic Univserity: http://www.polyu.edu.hk/cpa/polyu/index.php?option=com_content&view=article&id=46&Itemid=62&lang=en
10. The University of Hong Kong. NETjobs (2013a), Retrieved from CEDARS, HKU: http://cedars.hku.hk/sections/careersplacement/NETjobs/
11. The University of Hong Kong. NETmatch (2013b), Retrieved from CEDARS, HKU: https://extranet.hku.hk/netmatch/