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Job matcher: A web application job placement using collaborative filtering recommender system

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Abstract

In today's electronic era, customized collaborative recommender systems developed for hiring and job matching process generally used to helped users identify and select qualified applicants that meet the requirements needed by any organization. Since finding an appropriate job that best fits the interest and skillsets is quite challenging for the applicants, the researcher developed a web application named "Job Matching" that provides an easy and convenient recommender application. This App is intended CICT department and its industry-partners. The researcher used the V-Model Development Model (V Model) for the system development, the researcher made it conveniently in the development by utilizing the target respondents; demonstrate the application and repetitive testing of the system to the users. The CICT Practicum Coordinator, Human Resource Representative, and CICT OJT students who are the participants and beneficiaries of the study were carefully chosen using purposive sampling. The eight criteria of the International Standard for testing and evaluation for software quality product version 25010 were used to validate the system output of the researcher. As a result, of the post-evaluation survey, the web application found to be efficient and useful as strongly agreed by the respondents.

Keywords: recommender; collaborative; V-Model development; web application

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1. Introduction

Employability has a vital role in a person's life. In simple terms, employability is about being capable of getting and keeping fulfilling work. It requires a set off skills knowledge and understanding that makes a student look for a good job (SkillsYouNeed, 2018). Stevens (2018, p. 4) stressed that "meaningful employment can improve life for the whole communities". The critical role of employment is in improving the life for communities, in addressing poverty, in ensuring wellness, and in creating new opportunities. Furthermore, one of the most satisfying achievements in one's life is to have a stable job that will sustain the everyday needs of every person. Being employed boosts self-esteem by giving one a day-to-day purpose and being engaged improves the mental and physical health of a person as it not just rewards a person financially but also contributes to his or her happiness and helps build confidence.

Baumol (as cited in Capozzi, 2017), asserted employment rate and economic growth are linked. It is because being employed contributes to economic growth; thus, workers can buy the right products. Having high employment means a more significant number of goods can also be produced. The employment rate in January 2018 in the Philippines was estimated to 70.9 million wherein Filipinos 15 years old and above are the number of persons who were in the labor force was reported at 44.1 million. Therefore, six out of ten of the population aged 15 years and over were either employed or unemployed (Bersales, 2018).

Meanwhile, online recruiting web applications such as Monster, Indeed.com, and Jobstreet.com and other web platforms have become one of the main channels for people to find jobs. For more than ten years in their services, these web platforms have saved a lot of money and time for both job seekers and organizations wanting to hire people (Guo, 2015). Thus, the growth of online recruitment can be plotted from 1994, when Monster.com first appeared as an online tool for organizations to connect with potentials applicants. Nowadays, there are several online job boards and all-inclusive e-recruitment portals on different company web applications (Chignell, 2013).

In the current advancement of technology and the growth of internet usage, the e-recruitment has revolutionized the way organizations hire, and job seekers search for jobs. With the online job search portals, the recruitment process speeds up at every stage from job posting, to receiving an application from candidates, and to interviewing process. The cost of searching/posting jobs will be much less compared to the traditional method of advertising (Mathukumalli, 2016).

Convenience is one of the reasons innovations and advancements in technology have continuously been evolving. This scenario is the same for both job seekers and companies. Job seekers opt to look for job positions and opportunities in different companies over the internet before going to the location of the company to save time and effort. Likewise, companies posted a job vacancy to reach possible and qualified applicants as much as they can or through these job hosting and publishing sites, companies may also pre -select applicants before the interview and job placement process.

Indeed, online recruitment is an esteemed tool to be used nowadays, mainly searching for a new hire. However, even online recruitment has a downside. First, hard to target the exact applicant because online recruiting can be challenging to focus on a specific group of candidates when viewing them online. Second, the expense because depending on the online platform, the company will use, and some have to pay for a subscription fee or other costs to post their job vacancies. Lastly, it is done informal, and this can be a disadvantage especially if the company is trying to reinforce or promote a professional company culture to the

employees or job seekers (personal communication, 2019).

Nowadays, job seekers are going online to look for jobs and searching background information on companies before the actual interviews, which means companies need to have the right social media infrastructure in place to satisfy the needs of the job seekers or vice versa. The word recommendation generally refers to a statement that someone or something would be good or suitable for a particular job or purpose, or is the act of making such a statement, the definition from the Cambridge Business English Dictionary.

Deepali, Nagpure, Patil, and Rukhar (2016) pointed out that a recommender system is widely used in any way possible, for example, clothes recommendation, book recommendation, movie recommendation, and so on. However, the type of recommendation provided may be different according to the domain of its use. A bit different in the case of the job recommendation system in here, it will be favorable to provide mostly personalized and profile-based job recommendations. Furthermore, in the study of Narayanana and Cherukuri (2016), a recommender system plays an essential role in the daily lives of the people. A recommender system automatically suggests items to users that they might be interested in and may use. Generally, it is used to predict the preference that a user would give to an item.

The most common types of recommender systems are collaborative filtering, content-based filtering, and hybrid recommendation systems. A hybrid recommendation system is one of the new methods of a recommender system. It is the combination of collaborative and content-based recommendation that can be more effective. A hybrid recommendation system is based on the predictions done separately and then the combining of the results. While content-based filtering methods are based on the description of an item and a profile of the users' preferred choices.

On the other hand, a collaborative filtering method is usually centered on collecting and analyzing data on user's behaviors, their activities or preferences, and predicting what they will like based on the similarity with other users. A vital advantage of a CF approach is that it does not rely on the machine's analyzable content only. Still, it is also capable of accurately recommending multiple items such as movies without the need to understand the content itself (Techlabs, 2017). Moreover, a recommender system with collaborative filtering is being used nowadays because of the behavior of this technique such as it benefits from large user bases, it is flexible across different domains, and it can capture more nuance around items. However, even if CF is one of the most successful technique s in a recommender system, there are challenges in CF as well such as complexity and expense, data sparsity, and the "cold start" problem (Keenan, 2018).

In the study of Gong (2009), it was revealed that the use of a collaborative filtering technique had been proven to be one of the most successful methods in recommender systems. It was also mentioned in the article of Dakhel and Mahdavi (2012) that CF is the most successful algorithms in the recommender system's field. In addition, collaborative filtering (CF) is a method commonly used to build personalized recommendations on the Web for any organization. Some popular web applications that make use of collaborative filtering technology include Amazon, Netflix, iTunes, and so on (technopedia.com, 2018). It was also discussed in (Cognitive Class, 2017) that collaborative filtering techniques explore the idea that relationships exist between products and people's interests.

Meanwhile, the collaborative method can be classified into two categories: the memory-based and model-based approaches. The model-based methods tend to produce a summary of evaluation patterns offline. On the other hand, the memory-based process requires all ratings, items, and users to be stored in a memory (Mustafa, Ibrahim, Ahmed, & Abdullah, 2017). One of the methods in using collaborative filtering is the memory-based approach and having two main sections which are user-based. It measures the similarity between target users and other users. The item-based method measures the similarity between the items that target users rate/interact with and other things (Grover, 2017). The key idea behind CF is that similar users share the same interest and those users like related items.

According to Ndegwa (2016), recommender systems are essential for a Web application. A web application is a computer program that utilizes web browsers and web technology to perform the task over the internet. Mainly, the web application uses a combination of server-side scripts such as PHP and ASP to handle the storage and retrieval of the information, and client-side scripts use JavaScript and HTML to present information to users. This allows users to interact with the company using online forms, content management systems, shopping carts, and so on.

The private university is located in Sto. Rosario Street, Angeles City, Pampanga is one of the most prominent universities in Region III. It has five (5) schools and two (2) colleges with different course offerings. One of these is the College of Information and Communications Technology (CICT) that offers various courses and specializations such as Bachelor of Science in Information Technology major in Digital Animation, Bachelor of Science in Information Technology major in Network Administration, Bachelor of Science in Information Technology major in Web Development and Bachelor of Science in Computer Science. There were 152 Animation and Web Development graduating students in the first semester and 104 Network Administration and Computer Science graduating students in the second semester of the school year 2018-2019.

The university, through its Career and Placement Office (CPO) which manages the student wellness and services, organizes the actual interview of the students, exposing them to the real job interviews. In addition, each school and college of the university has a corresponding Practicum Coordinator who assists the graduating student on his or her on-the-job training or practicum program.

The researcher had an interview with the Career and Placement Office common issue encountered was students being focused on their specialization are, and they are choosy since they do not have yet work experience. According to CPO head, CICT is one of the most challenging colleges to find for job matching opportunities because some of the students are having a hard time identifying their skills. For example, students who graduated under the specialization of Animation are looking for companies where they can apply their animation-related skills like Pixar, ABS-CBN, and other animation companies. While there do, many companies need a graphics designer, a painter, rigger, and different related positions for Animation graduate. Unfortunately, the employability status of the fresh graduates has become an issue since there are significant mismatches between the acquired graduate skills from universities or their on-the-job training and the required skills employers (Osmani et al., 2015).

The standard-issue or challenges that the CICT Practicum Coordinator encounters is the matching of the applicant's skills with that of the company's needs (CICT Coordinator, personal communication, 2018). However, the traditional process for recruitment for job seekers includes university career employment services, job fairs, employee referrals, wants ads from newspapers and or televisions, networking society, and so on scheme take a lot of time. For instance, to conduct a job fair in the university, it is necessary to submit requirements among the pool of partner companies. In addition, a job fair is held every October, and it is just for one (1) day, and in April graduates have a two (2) day job fair. The Practicum Coordinator relies on the requirements and process by the CPO. Currently, CICT have twenty-five (25) partner companies but only 12 of them have Memorandum of Agreement (MOA).

The explosive growth of the number of users in visiting the internet has created the potential challenge of information overload. In recent years, changes in the job placement practices of many companies have reflected mainly on how business organizations responded to these technological advances. This is particularly true for medium to very large -scale companies that use the web in their search for staff. Thus, the researcher came up with the phrase "job matching" which is a kind of collaborative filtering that is considered as one of the most successful methods in a recommender system that exploits a knowledge-rich representation of the application domain (Lorenzi & Ricci, 2005). Varieties of approaches have been evaluated by different studies in performing recommendations, including content-based, collaborative, and knowledge-based. The researcher decided to name the system "cictjobmatching.online", a placement hub for Holy Angel University with a recommender system.

The labor market is a competitive field for job applicants, especially for a student or a fresh graduate. It is a time-consuming process on the part of a business organization to find the most suitable candidate for a job position; Afanasyeva (2014) opined that having a strong personal branding with a portfolio will have an advantage for a job applicant. The fast rate and constant development of technology have more relevance to focus on a career portfolio. Portfolios are collections of students' artefacts or activities, accomplishments, and achievements to prove their growth. A working portfolio contains works in a process as well as finished works. Displays portfolio showcases students' best practices, and assessment portfolios demonstrate the specific curriculum standards students have taught (Lowe, 2018). Furthermore, portfolios are a living and changing collection of records that mirror one's accomplishments, skills, experiences, and attributes. They highlight the best part of every student's works, along with life experiences, values, and achievements. The personal information that one incorporates into his or her portfolio can significantly reflect on his or her abilities as an individual as well as become oneself tool in marketing yourself to employers, corporations, and universities (The_Importance_of_a_Portfolio21.doc, n.d.).

1.1 Objectives of the study

The main objective of the study is to develop a Job Matcher: A We Application Job Placement using Collaborative Filtering a hub for the partner companies or industry-linkages of the College of Information and Communications Technology of a University and graduating students on their OJT program up to their pre-employment activities after graduation. Specifically, the study sought to develop a system that can match the skills needed by the companies that are seeking applicants among the CICT graduates. A system that recommends a graduate to a potential company and vice versa, house all the partner companies or industry-linkages of the CICT, store and update data of the graduates particularly their profile, skills, academic standing, and work experience.

In view of the preceding, this research aims to:

- to describe the current practices in job searching;
- to assess the need for a recommender system;
- to develop a web application job placement recommender system; and
- to evaluate the recommender system using the ISO 25010

2. Methodology

2.1 Research design

The researcher underwent a Quantitative descriptive research design. Quantitative research explaining phenomena by collecting numerical data through polls, questionnaires, and surveys that are analyzed using mathematically based methods. On the other hand, the qualitative research design is based on a social constructivism perspective, and sample sizes can be as small as one through the data collection of an interview, observation, and data it is an in-depth data gathering.

Both quantitative and qualitative research design was used to gather data from the intended users of the web application with t h e recommender system to identify the requirements needed for the application to be efficient. For the quantitative design, the researcher used the technique of preliminary and post-survey in the form of questionnaire floated via online forms which are the jotform.com both for the students and partner companies. After that, a systematic result was interpreted. Through a thorough observation and unstructured interview with the experts; particularly the OJT Coordinator of the CICT and CPO; including partnered companies used for the qualitative research design.

2.2 Research participants

The researcher identified five (5) groups as the participants of the study. For the pre-surveys, the participants were 1.) Fifty-three (53) OJT students of the CICT, 1st Semester in School Year 2018-2019, 2.) One (1) CICT Practicum Coordinator, 3.) Eleven (11) partner companies that are the HR representatives, 4.) One (1) Head of Career and Placement Office, and lastly 5.) Two (2) IT Experts. The researcher used a non- probability sampling method, particularly purposive and convenience sampling since the respondents were already identified although their availability is unsure. There were twenty-five (25) partner companies of the CICT to date, but not all of them are the participants due to the constraint of schedule.

Post survey handed to selected students and the company's representative, which is the HR supervisors based on their availability, and Practicum Coordinator of the said college in testing and evaluating the web application system.

OJT students were chosen by the researcher to survey because they have hands-on experience in finding jobs. On the preliminary survey, the researcher has done an observation to the students while having their consultation with the practicum coordinator and sent an initial questionnaire using an online form that is the jotform.com to gather more data. On the other hand, post-survey provided on selected OJT students taking up BSIT with an area of specialization in Web Development and Animation and that are enrolled from first Semester in School Year 2018-2019 answered the surveys.

The Practicum Coordinator of the CICT answered in an online questionnaire during the preliminary investigation to gather the needed information to establish the concept and context of the study. Case testing and post-survey served to the Practicum Coordinator for the system testing in the side of the administrator level. Practicum Coordinator was selected because he/she is the university representative for each college and knowledgeable in the process and procedure in deploying the students to the partner companies of the college.

Partner companies, specifically the Human Resources Department and or OJT supervisors have taken from the list of the Practicum Coordinator were chosen for an interview to know more about the specific skills, process, and procedures for the applicants. HR is knowledgeable about the recruitment and placement of employees, and it is. Therefore, their job may range from screening job applicants, and conducting scheduled interviews up to performing background checks, determine the training need for the newly hired and providing orientation to new employees. Out of twenty-five companies, only eleven have answered the pre-survey form due to time constraints and unavailability of the person.

Career and Placement Office Head (CPO) was chosen to gather appropriate information for the process and procedure of the placement of the students after their graduation. CPO handles all students, precisely the graduating level in all areas for each school and college.

2.3 Research instrument

Gathering and collecting data and information a r e crucial in the completion of a study; thus, research instruments or tools are necessary to be designed and utilized. Without these tools, data would be impossible to put in hand. Preliminary survey in the form of a questionnaire the researcher constructed a separate questionnaire for the company and students. The researcher used an online form, which is jotform.com for an easy-to-use online form builder; the respondents will just use their email address and respond to each question provided and collect data. A type of open and closed-ended questionnaire served to them, and this is the most common instrument for research in obtaining the data beyond the physical reach of the researcher. Also, an unstructured interview was done to the OJT coordinator and CPO, and through online, the OJT coordinator answers the questionnaire. A pre-development survey in the form of test case scenarios the researcher also constructed a separate module scenario for students, company, and OJT coordinator modules.

Post-evaluation phase, the researcher checked the list schedules of the target students and visited t h e m in their classes. The researcher provides the link of the web application while demonstrating to students the navigation of the system. The respondents were given enough time to answer the questions to avoid errors and inaccuracies with their answers. The company scheduled evaluation is done, and a set of questionnaire was provided to them, including the expert's assessment. The researcher administered a post-evaluation survey in the form of a Likert scale questionnaire to evaluate the proposed system according to functionality suitability, usability, security, compatibility, performance efficiency, reliability, maintainability, and portability. These eight characteristics were based on ISO 25010, an international standard for testing and evaluating software product quality features.

Figure 1. ISO 25010 model (Source: https://www.tutorialspoint.com/)

The questionnaire was checked and validated by a research expert/statistician by profession. The purpose of validation is to ensure that the survey is suitable for the target respondents and proper construction of the questionnaire.

2.4 Sources of data

The researcher used two sources of data collection techniques: primary and secondary data, for primary data collection, surveys, interviews and direct observations which the researcher used mostly to the participants. A discussion was done for the Practicum Coordinator since he has first-hand information with the process of OJT and CPO that is knowledgeable in deployment. Furthermore, secondary data collection conducted by collecting information from various sources of a document or electronically stored information such as articles, journals, related studies, and literature over the internet to further the knowledge of the research.

2.5 Research procedure

The researcher gathered data through an unstructured interview; t h e smartphone was used to record the conversation and take some notes. The respondents are aware of the voice recording, and they are free to convey their views and opinions if some of the discussions are not convenient to respondents.

Preliminary Investigation and Conceptualization **-** On July 4, 2018, the head for Career and Placement from the University visited for interviewed and trace the student's requirements for employment up to their deployment in different companies. Expertise through the various experiences students she recommends some features for the study of the researchers such as having a portfolio for each student, updating resumes' and evaluation for the students. Furthermore, it was mentioned in spite of the fact that HR specialist depend more on employee referrals and the web application to search for possibly employment.

CICT Practicum Coordinator from University set a date for an interview with the research last July 12, 2018. The coordinator formally explains the process and procedures on how students will be deployed to different companies. The practicum coordinator also stated the difficulties in implementing students, especially in which related skills students have. Currently, he has ninety (90) students from web development specialization and

forty-nine (49) from digital animation who are taking up OJT.

For the System Analysis, Design and Development, the researcher used -Model as the software engineer paradigm; it is an enhanced version of the classic waterfall model whereby each level of the development life cycle is verified before moving on to the next level. With V-Model, where process executes sequentially in V -shape it also provides means of testing of a module at each phase. V model contains Verification and Validation, for the verification phase, the researcher has the requirements analysis, system design, architectural design, and module design in this phase developmental is being done. While the validation phase has a unit, integration, system, and user acceptance, this side is the testing phases each of these phases corresponds to the other side.

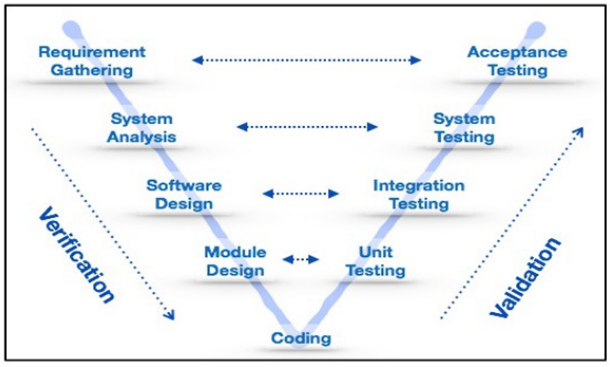

Figure 2. V model system development life cycle (Source: https://www.tutorialspoint.com/)

For the verification side, which is identifying requirement and designing this are the following phases:

- In the requirement stage, the researcher set a schedule for the initial interview with the corresponding personnel to gather information. This step helped to accomplished in identifying and understanding the need for the proposed system. Also, it added information for the researcher to analyze the functionality needed by the users.

- For the System and Software, the design is the process of defining elements such as the architecture, components, modules, different interfaces, and data for a system to satisfy requirements. System design is modelled using Unified Modelling Language (UML) a standardized modelling language enabling developers to specify, visualize, construct, and document artefacts of a software system. It uses a graphic symbol to create visual models of software systems.

In the development stage, which is in V-model it is the coding, the researcher used PHP and MySQL server for the database. Web service PHP is an open-source web framework for building modern web apps and services with .NET. ASP.NET creates web applications based on HTML5, CSS, and JavaScript that are simple, fast, and can scale to millions of users. MySQL Server is a relational database management system (RDBMS); it supports a wide variety of transaction processing and business intelligence. RDBMS a built on top of SQL, a standardized programming language to manage databases and query the data they contain. A data dictionary that contains the metadata of web applications, such as data about the database. The data dictionary is essential; it contains information for databases like who can access it, where is the database physically stored, and so on. An entity-relations hip diagram or ERD model used to describes the interrelated entity- relationship of each module is a graphical representation of an information system that depicts the relationship of each module of the web application. Web service of PHP connecting to registration to mobile and Firebase cloud messaging for Android push notification. Bootstrap for designing, JavaScript for front-end, Android Native for android application, Android studio for mobile app notification.

On the other hand, hardware specifications: Processor (CPU) with 2 gigahertz (GHz) frequency or above, a minimum of 4GB RAM, Windows 7, 8 and Windows 10 including Ubuntu and a minimum of 120 GB of available space on the hard disk for the development of the web application up to deployment. For internet

connection broadband with a minimum, speed of one (1) Mbps or higher. Browsers: Google Chrome, Microsoft Edge, Firefox, and Opera.

For the validation side, which is testing this, are the following phases:

- Unit testing should correspond to module design. The researcher checked each module if the required output is the expected output of the user. Next is the integration testing that coordinates to software design the researcher checked each module how they are being interacted, cooperate among other modules. The third phase is system testing the researcher done test cases for the students, partner companies, and administrators to check and validate if each module should correspond accordingly to the level of the requirement by the users. Lastly, acceptance testing this final phase will, therefore, correspond to the first phase of verification, which is the requirements gathering, at this phase, the researcher meet s all the changes and recommendation by all the users that they affirmed with the quality of the system. That is to consider an implementation plan. The researcher needs to seek help from the Dean of the College of Information and Technology or Administrator of the University that handles their Information System to allow this web application to be administered by them.

The researcher used the Collaborative Recommender System, particularly the memory-based method focusing on the User Base technique. There are two main approaches to collaborative filtering: Model-Based and Memory Based. This study discusses Memory Based collaborative filtering, as user-based and item-based filtering falls under this category. These two are mainly different in what they take into account when calculating the recommendations. Item-based collaborative filtering finds similarity patterns between items and recommends them to users based on the computed information. User-based finds similar users and gives them recommendations based on what other customers with identical intake patterns valued (Bostrom, 2017).

2.6 Statistical treatment of data

The researcher utilized the following descriptive statistical tools to analyze the data:

Frequency and percentage distribution - A frequency distribution is an arrangement of data that shows the number of observations per category or number of occurrence of the value falling within arbitrarily defined ranges of variables. Meanwhile, per cent distribution is a descriptive statistic that is used to determine the magnitude of a frequency count relative to the total number of respondents.

Mean - The mean is the average of a group of numbers and is applicable for interval and ratio level data. It is computed by summing all values in the data set and dividing the sum by the number of benefits in the data set. The mean uses every value in the data and hence is a good representative of the data.

All statistical computations were performed using Microsoft Excel. SPSS is an acronym for the Social Sciences Statistical Package, a widely used application by researchers from health surveys, survey firms, data miners, government, and even research into education. Simply import an Excel file into SPSS, the researcher then opens the SPSS database wizard after some setup, which will enable you to identify windows variables.

Table 1

Likert scale presentation

Range	Weight	Verbal interpretation
5	4.21 – 5.00	Very Great Extent (VGE)
4	3.41 – 4.20	Great Extent (GE)
3	2.61 – 3.40	Moderate Extent (ME)
2	1.81 – 2.60	Less Extent (LE)
1	1.00 – 1.80	Small Extent (SE)
0	0	Not at all

3. Results

This chapter presents the collected data from the selected respondents. The respondents were composed of representative each specialization, representative for each company, and the practicum coordinator of the CICT who will use the system.

3.1 Current practices in job searching

Tables 2 to 3 present the results of the survey conducted among CICT students on OJT status concerning current practices in job searching. Among the current methods used in job searching, job fairs are deemed by the student-respondents as most effective (mean = 3.71) followed by employee referrals and job search web application (mean = 3.67, respectively). However, a survey of human resource practitioners showed that employee referrals and job search web applications are more commonly utilized in placing or searching for an applicant as compared to job fairs. Radio Alert found to be the least source in seeking a job with a total mean of 2.02.

Table 2

Perceived effectiveness of job search methods

Job search method	*Mean*	Verbal interpretation
Job Search Websites	3.67	Great Extent (GE)
LinkedIn	3.58	Great Extent (GE)
Poster/Fliers	2.83	Moderate Extent (ME)
Radio Alert	2.02	Less Extent (LE)
Blogs	2.64	Less Extent (LE)
Job Fairs	3.71	Great Extent (GE)
Employee referrals	3.67	Great Extent (GE)
Employee agencies	3.19	Moderate Extent (ME)
Walk-in	3.47	Great Extent (GE)
Recruitment from School	3.40	Great Extent (GE)

The most common practice of the student-respondents when finding a job is online job searching (83.6%) followed by checking company web application (67.3%).

Table 3

Practices of the student-respondents when finding a job

Practices	Frequency	Percent (out of n = 55)
Checking company websites	37	67.3%
Online job searching	46	83.6%
Contact recruiters	14	25.5%
Redoing resume	22	40.0%
Resume posting	22	40.0%

3.2 Assessment of the need for a recommender system

When asked to give suggestions to improve job search methods further, the student-respondents expressed the desire for a system that will match the skills they possess with the skills needed by employers to facilitate the more natural and faster job application process. Some of the verbatim suggestions of the student- respondents are as follows:

- Advance filter if there's a vacant job based on my skill set I think for the online job posting web application that we currently have. In this module, it would match the applicant's skills based on his/her profile which would then automatically suggest job vacancies since every company requires different skills even though they are in the same industry.

- Job filtering with what skills or strength they are looking for
- Matching the skills of the applicant to the job description
- More filters to quickly search what job they want.

When asked if they would prefer to have a web-based skill matching with the recommender system, 53 out of the 55 student-respondents (96.4%) answered "yes". Moreover, five out of the 6 HR practitioners said they would prefer a web application skill matching system that recommends applicants. According to them, such a system would make the screening process faster and easier, entail a lesser cost, and centralize the pool of applicants. Furthermore, when asked if they would suggest having a Web Application Employment Hub for HAU with Recommender System, the student-respondents generally agreed (mean = 4.22). In contrast, HR-practitioner respondents generally strongly agreed (mean = 4.50).

Table 4

Recommendation on having a web application employment hub for HAU with recommender system

Response	Student respondents		HR respondents	
	Frequency	Percentage	Frequency	Percentage
Very Great Extent	32	58.2%	4	66.7%
Great Extent	19	34.5%	1	16.7%
Moderate Extent	4	7.3%	1	16.7%
Less Extent	0	0.0%	0	0.0%
Not at all	0	0.0%	0	0.0%
Mean	4.22		4.50	
Verbal Interpretation	Agree		Strongly Agree	

3.3 Validation of the developed recommender system

Based on the identified need for a recommender system, the Job Matching Web Application Employment Hub Recommender System was developed. This system subjected to evaluation through test case scenarios and post-evaluation surveys.

3.4 Test case results

Test Module for Students - Four OJT students were asked to evaluate the recommender system as job seekers. All four students indicated that the following modules met the expected results as passed in all scenarios tested.

Test Module for Company - Human Resources Department - Two evaluators from the HR Department/OJT coordinator students were also asked to evaluate the recommender system. Both evaluators indicated that the following modules met the expected results as passed in all scenarios tested.

Test Module for Administrator - One evaluator was also asked to evaluate the recommender system as an administrator. The said evaluator indicated that the following modules meet the expected results as passed in all scenarios tested.

To obtain more feedback on the developed recommender system, a post-evaluation survey was administered to the student, Human Resource Department, and Expert respondents. Results of the said post-evaluation showed that students, Human Resource Department, and expert-evaluators generally rated the quality characteristics of the recommender system as “very good extent” except for:

- compatibility characteristics (co-existence and inter-operability),
- selected usability characteristics (appropriateness recognizability and user error protection),
- fault tolerance (which is under reliability), and
- integrity (which is under security).

The other characteristics were rated as "very satisfactory". Comments and suggestions obtained during the test case web application as well as during the post-evaluation survey were all considered in the improvement system.

3.5 Web application evaluation by the Student/HR

Table 5 shows the response of the students and the human resource department as the primary users of the web application. Based on the result of the respondents rated the web application with a weighted mean of 4.77 for students and 4.88 for HR with Verbal Interpretation of Very Great Extent in terms of Functional Suitability. This means that the web application functionality is suitable for each intended user.

Table 5

Functional suitability of the web application

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching has all the functions required.	4.64	4.5	4.57	VGE
Job Matching is precise in executing its functions.	4.86	5	4.93	VGE
Job Matching is precise in delivering its results.	4.79	5	4.90	VGE
Job Matching can store artifacts into students' profile that serves as their portfolio.	4.77	5	4.89	VGE
Mean for Suitability	4.77	4.88	4.8	VGE

The students and HR department rated the web application with an overall weighted mean of 4.9 with a verbal interpretation of Very Great Extent, as shown in table 6. This means that the degree to which characteristics such as time behavior and capacity represents the performance to the number of resources used on the given scope.

Table 6

Performance efficiency of the web application

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching loading time is appropriate.	4.92	4.50	4.71	VGE
Job Matching resources used are appropriate such as uploading artifacts	4.77	5.00	4.88	VGE
Job Matching updates real-time when there is a change or actions made such as push notification.	4.86	5.00	4.93	VGE
Mean for Performance	4.85	4.88	4.90	VGE

The respondents show that the compatibility of the web application works correctly and in multi-users processing, as shown in table 7. For the student's response, the weighted mean is 4.85 while the HR is 4.88 that conclude the co-existence and interoperability is a Very Great Extent.

Table 7

Web application compatibility

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching works properly while using other applications.	4.92	4.50	4.71	VGE
Job Matching has the capacity for multi-users processing.	4.77	5.00	4.88	VGE
Mean for Usability	4.85	4.88	4.90	VGE

The usability of the web application as shown in Table 8 that has an overall weighted mean of 4.58 which is a Very Great Extent in Verbal Interpretation that means the user satisfaction with the usability characteristics of

the web application was achieved. Meanwhile, for the menu user guides an overall mean of 4.18 for both students and HR with the verbal interpretation Great Extent.

Table 8

Web application usability and user interface

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching has menus for user's guides and tips.	4.36	4.00	4.18	GE
Job Matching simplifies the user's data entry.	4.69	4.50	4.62	VGE
Job Matching attributes are easy to operate.	4.86	5.00	4.68	VGE
Job Matching alerts the users when an error occurs.	4.86	4.50	4.68	VGE
Job Matching is easy to navigate and is user-friendly.	4.86	4.50	4.68	VGE
Job Matching is accessible on different platforms using the internet.	4.86	4.50	4.68	VGE
Mean for Usability	4.75	4.50	4.58	VGE

In terms of Reliability, Table 9 shows that the users rated the web application with an overall weighted mean of 4.6 and with the verbal interpretation of Very Great Extent. This means that the applications perform specified functions under specified conditions for a specific period.

Table 9

Reliability of the web application

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching has no downtime.	4.71	4.5	4.6	VGE
Job Matching is readily available and running in the server.	4.71	4.5	4.6	VGE
Job Matching alert users concerning invalid data entry.	4.71	4.5	4.6	VGE
Job Matching stores data upon an interruption.	4.71	4.5	4.6	VGE
Mean for Reliability	4.71	4.5	4.6	VGE

Both for students and HR evaluation on the Security of the Web Application as shown in Table 10 the user rated the web application in an overall weighted mean of 4.57 with the verbal interpretation of Very Great Extent. It shows that the web application through the security certificate that makes sure that there is a secure connection between the server and browser. The web application protects the credential information of the users and has the level of data access appropriate to their types and levels of authorizations.

Table 10

Web application security

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching has users' login credentials.	4.57	4.50	4.50	VGE
Job Matching has unauthorized protection.	4.57	4.00	4.20	VGE
Job Matching shows users' information once the action has been made.	4.79	4.00	4.30	VGE
Job Matching uses unique usernames and passwords.	4.71	4.50	4.60	VGE
Job Matching uses a different level of access to its users.	4.79	5.00	4.89	VGE
Job Matching is easy to create, update, and delete data.	4.86	5.00	4.93	VGE
Mean for Security	4.71	4.50	4.57	VGE

Users' portability ratings as revealed in Table 11 of the web application show that both students' and HR's overall weighted mean is 4.77 which has a verbal interpretation of Very Great Extent. Thus, it shows that web application users can adapt to the standards of portability.

Table 11

Portability of the web application

Criteria	Students *Mean*	HR *Mean*	Overall *Mean*	Verbal interpretation
Job Matching is responsive and adapts to different screen sizes.	4.79	4.50	4.64	VGE
Job Matching is compatible with the following browsers: Google Chrome, Mozilla Firefox, IE, and Safari.	4.79	4.50	4.64	VGE
Mean for Portability	4.81	4.75	4.77	VGE

3.6 Web application evaluation by the IT experts

Table 12 to 18 shows the evaluation of the Web Application by two (2) IT Experts Personnel who validated the use and security of the system. Table 12 shows the response of the IT experts who rated the web application with a weighted mean of 4.83 with the Verbal Interpretation of Excellent in terms of Functional Suitability. This means that the web application functionality is suitable for each intended user.

Table 12

Functional suitability of the web application

Criteria	IT expert *Mean*	Verbal interpretation
The web application able users to locate key features (use page control) and functionality that the system provides.	5.00	VGE
The web application functions cover all the specified tasks and users' requirements.	4.50	VGE
The web application can store the correct data from the main input fields.	5.00	VGE
Mean for Suitability	4.83	VGE

The IT experts rated the web application with an overall weighted mean of 4.5 with a verbal interpretation of Excellent, as shown in table 13. This means that the degree to which characteristics such as time behavior and capacity represents the performance to the number of resources used on the given scope.

Table 13

Performance efficiency of the web application

Criteria	IT expert *Mean*	Verbal interpretation
The web application responds immediately to the users when it needs certain data at a certain time.	4.50	VGE
The web application handles incoming data including huge loads of data at a single time.	4.50	VGE
Mean for Performance Efficiency	4.50	VGE

The respondents show that the compatibility of the web application adapts system environment as shown in table 14, rated its performance with a weighted mean of 4.83 with a verbal interpretation of Very Great Extent.

Table 14

Web application compatibility

Criteria	IT expert *Mean*	Verbal interpretation
The web application works well in the users of each computer.	5.00	VGE
The web application adapts to the system environment.	5.00	VGE
The web application works well even other applications are open	4.50	VGE
Mean for Compatibility	4.83	VGE

The usability of the web application as shown in table 15 has an overall weighted mean of 4.25 that is a Very Great Extent in Verbal Interpretation that means the user satisfaction with the usability characteristics of the web application was achieved.

Table 15

Web application usability and user interface

Criteria	IT expert *Mean*	Verbal interpretation
The web application has an understandable interface and useful notifications features.	4.00	GE
The web application is easy to navigate and user-friendly.	4.50	E
Mean for Compatibility	4.25	VGE

In terms of Reliability, table 16 presents that the validators rated the web application with an overall weighted mean of 4.5 and with the verbal interpretation of Very Great Extent. This means that the applications perform specified functions under specified conditions for a specific period.

Table 16

Reliability of the web application

Criteria	IT expert *Mean*	Verbal interpretation
The web application has no downtime.	4.50	VGE
The web application implements specific functionalities under specified conditions for a specified period.	4.50	VGE
The web application accommodates the needs for reliability under regular operation.	4.50	VGE
Mean for Reliability	4.50	VGE

Table 17 shows that the IT experts evaluated the Security degree of the web application with a total weighted mean of 4.83 with the verbal interpretation of Very Great Extent. This means that the web application is secured that just the credentials data but also thru from web servers.

Table 17

Web application security

Criteria	IT expert *Mean*	Verbal interpretation
The web application allows the data that is only accessible to those authorized user's access.	5.00	VGE
The web application helps to protect sensitive information such as logins, passwords, and account details.	5.00	VGE
The web application provides trusted indicators, which can help visitors to make sure that web application is reliably protected.	4.50	VGE
Mean for Security	4.83	VGE

Users' portability ratings as revealed in Table 18 of the web application show that the IT experts' overall weighted mean is 4.58 which has a verbal interpretation of Very Great Extent. Thus, it shows that web application users can adapt to the standards of portability.

Table 18

Portability of the web application

Criteria	IT expert Mean	Verbal interpretation
The web application supports most used web browsers without adjusting any of its features.	5	VGE
The system is responsive to different platforms.	4	GE
The web application is easy to get running on any compatible server(s).	4.75	VGE
Mean for portability	4.58	VGE

4. Discussion and conclusion

This part explains the results presented in the preceding section of this paper. In terms of current practices in job searching, this study's findings showed that job fairs are deemed by the student-respondents as most effective followed by employee referrals and job search web application while human resource practitioners rely more on employee referrals and job search web application. Overall, the use of job search web application is in the top three (3) most frequently used/effective job search practices. Green, de Hoyos, Li, and Owen (2011) stated that the role of the Internet in a job search is multi-faceted and Internet use has permeated much of the job-search process over recent years. Use of the Internet can facilitate the exchange of information between employers and job seekers, while at the same time reducing the cost of finding out information about job opportunities and applying for jobs.

In view of this, the need for an online system that will match the skills possessed by applicants with the skills needed by employers to facilitate easier and faster job application process cannot be overemphasized. Thus, the Job Matcher Web Application Job Placement Recommender System using Collaborative Filtering was developed. After a series of tests and evaluations, the modules for job seekers, HR, and administrator were all evaluated to be meeting expectations. Results from post-evaluation with the students, HR and IT experts-evaluators mostly rated the quality characteristics of the web application as "Very Good Extent" specifically with the functional suitability, performance efficiency, compatibility and reliability of the web application after evaluating it. The respondents particularly the students and partner companies will benefit from this study by having appropriate job placement of the students to partner companies.

As a conclusion, this study established the need for web application that matches skills possessed by applicants with the skills needed by employers to facilitate a better job fit. Anchored on the said need, the Job Matcher Web Application Job Placement Recommender System using Collaborative Filtering was developed. Describe the current practices in job searching and assessed the need for the recommender's system by testing and evaluation of the said system showed an excellent system that can already be used by its intended users. For the betterment of the system, the following aspects may be improved: compatibility characteristics (co-existence and inter-operability), selected usability characteristics (appropriateness recognizability and user error protection), fault tolerance (which is under reliability), and integrity (which is under security).

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