A CLOUD BASED RECOMMENDATION SYSTEM TO ENHANCE THE EMPLOYABILITY OF FRESH IT GRA-DUATES

[1]SAJU MOHANAN, [2]SUNITHA CHERIYAN

[1,2]Higher College of Technology, Ministry of Manpower, Sultanate of Oman
E-mail: [1]saju.mohanan@hct.edu.om, [2]sunitha.cheriyan@hct.edu.om

Abstract - Employability determination is necessary for a fresh graduate since it is significant to meet a number of variables to accomplish the needs of various needs of the skilled candidates in labor market and for the competency of the students who are graduated from any Higher Educational Institution (HEI). Those variables build relation map between various attributes by the representation of a conceptual model. We emphasize here three key components which are Industries, Academies and Students. Those elements are unified for business needs and it will play a vital role in the development of skillful IT professionals. This paper shows ontologically represented recommender system to enhance the present system and balances the demands of the various stakeholders. This is done through a skill analyzer program; that analyzes and updates the scores of students in their profile. It can also recommend an appropriate candidate to the employer based on the industrial needs. The system also helps the students to examine their own skills, potentials to do a self-analysis and the recommendation engine also recommends the methods for improvement based on the job opportunities. It improves the quality of the query results based on the job notifications currently available. This review of domain provides prompt insight about the system and its stakeholders to identify a sub set of suitable resources from a set of options. Our proposed system acts as a tool to implement an academic skill analyzer mechanism in a cloud computing platform. The use of cloud infrastructure helps all stakeholders to keep track of the assessments and its progress if there is a need arising from time to time.

Index Terms - Skill Analyzer, Employability, Recommender System, Cloud, Ontology, HEI;

I. INTRODUCTION

Today's world demands that the fresh candidate should possess employability skills in order to achieve in their job. Therefore the objective of this study is to identify the level of employability skill and work readiness among IT students. Employability should be at the center of HEIs' strategic planning, both centrally and at the level of individual faculties and departments. Employers expect fresh IT Graduates to demonstrate a range of skills that include Communication (R,W,S), leadership, problem solving and often managerial abilities. Placements, internships and job oriented learning opportunities are an effective way of providing students with technical skills and for the knowledge and awareness of industries culture in all perspective. Partnership between HEIs and employers need to be effective, constant and reliable. According to the graduate survey conducted by the Ministry of Higher Education Sultanate of Oman, graduate survey department in 2016[1] says that the five main sectors that will be employing the graduates the most in 2017 are

(1) Construction
(2) Oil and Gas
(3) Manufacturing
(4) Banking and Insurance
(5) Tourism.

All those sectors need ICT experts for its enhancements and every public and private sector having their own IT training and development sections with its stakeholders. Apart from this, there are many professional IT companies and research centers for software development, networking and other IT enabled services. All those sectors are functioning with all major specializations like Software Engineering, Database, Networking, Internet & E-Security and Information Systems. The IT industries in Oman are fast growing. ITA is a research and development initiated by Government of Oman with a main focus on research, development and training. Students in Oman are getting placed on all major public and private sector fields as per the academic level, specialization and academic CGPA. The private sector employs 54.2% of Diploma (vocational, technical, advanced) holders in which more the 38.6% of Bachelor holders it employs. Employers indicated that the most used methods in recruiting fresh graduates are through government bodies followed by the company's website. The least used methods are career guidance offices and job fairs. The most sought out for graduate skills when hiring is (1) work experience/ training, (2) Soft skills. Graduate GPA came sixth in a scale that included 11 criteria. The skills that the graduates lack are (1) English language skills,(2) communication skills, (3) attitudes and passion towards work. Only 25% of Employers indicated that there was some sort of collaboration between them and HEI. The highest type of collaboration was on (1) Training (2) Employing (3) Research and Development. The proposed model helps the HEI to bridge the gap between the industrial partners by giving the skilled work force that are competent in the labor market. Our research is limited to IT sector jobs and the study conducted among Sultanate of Oman's

Colleges of Technologies IT Department and Industries in the country.

II. LITERATURE REVIEW

Several studies are conducted in this area to frame the employability skills framework [2] [3] [4]. According to Zaharim et al. the framework comprises the technical and nontechnical skills with the requirement of accreditation body and employer's needs. The formulation of skills measured based on criteria is presented in the study conducted by Yuzainee et al. [4]. Studies on employability skills differed with regards to direct or indirect measurement depending on occupational title, qualification and level of education, years of work experience and level of training [10]. Measuring the scores of the employability skills [5] is subjective and depends on the perception of employers. A. Nayak et al. [6] developed an educational domain as enterprise framework using semantic web mining. The system helps in finding the data related to student, faculties and course for the users. According to a recent report [7] the labor markets around the world are currently experiencing a perplexing quandary: high levels of unemployment internationally while job openings are at a record level. Automated skill systems can also be used in job matching and recommendation systems to better match candidates to jobs and reduce unemployment. A skill inference model based on social graph connections is discussed in (Wang et al. 2014). An ontology model is a framework for describing domain knowledge, taking into account pertinent concepts and their relationships (Gruber, 1995).

A. Singh et al. presented the system to short- list candidates for job openings (Singh et al., 2010) [10]. According to Malinowski et al., the search algorithms and the filtering techniques nowadays are insufficient for the purpose of the job matching requirements of candidates [11]. With the tremendous increase in websites and dedicated to job search recommendations are growing area in the research, Wei et al. defined recommender systems for broad categories [12]. The use of Content-based recommender system was to identify the items of interest to the user. This also can be used in various areas like television, news articles, web page recommendation, social media contents etc. is discussed by Brusilovsky et al. [13]. Collaborative filtering is a process of filtering or evaluating items using the opinions of others as suggested by Rafter et al. 2000[14] and Schafer et al. in 2007[15]. Knowledge based recommender system was emerged which suggested products based on the user's preferences and needs [16] [17] [18]. After that hybrid recommender system came into existence. Sanchez et al., in their paper summarized an ontology-based similarity assessment into three types and provided a set of advantages and disadvantages for each approach [19]. Juan Wang et al. combined ontology, network curriculum resource management and linked curriculum knowledge which the system can not only achieve the curriculum learning, but also the enquiry of semantic reasoning and knowledge [20].

III. CURRENT SYSTEM

As shown in the Fig. 1, the model which is currently being followed in the Technical Colleges in Sultanate of Oman



Fig. 1: Sultanate of Oman's Technical Educational Processes under Colleges of Technology.

The students after completing their foundation with the basic skill achieved will go to the Post Foundation. There are three levels of exit in the Post Foundation if the candidate is not having the needed CGPA or IELTS at the end of each level. Students after exit from the post foundation studies will undergo an On-the-Job training with IT companies as part of their curriculum, during this time the student will be placed or trained in a public or private sector. There is no mechanism right now to match the skills of the students with industry needs for the training or placement.

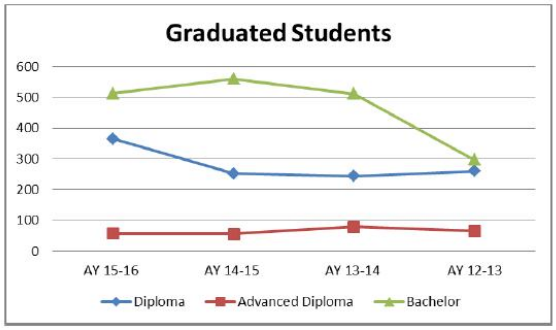


Fig.2: Graduated students in each academic year

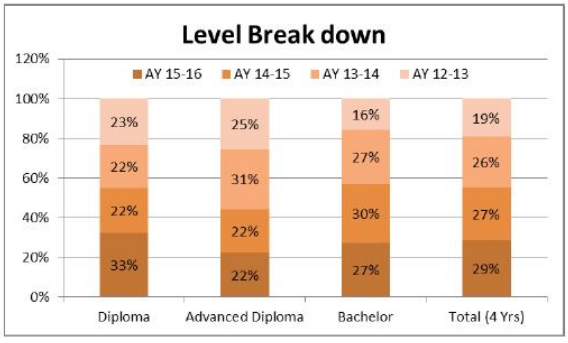


Fig.3: Graduated students based on level

With reference to Fig. 2, the data collected from various colleges under the Ministry of Manpower, indicates the total number of IT Students who have successfully completed their graduation in each academic year for the period from 2012-2016 .The level break down according to each academic year is indicated in Fig. 3. The break down clearly indicates that students exiting at the diploma level are increasing whereas in advanced diploma the trend is decreasing. The pass outs in Bachelor level is having a tremendous growth rate when we analyze the academic year and the total percentage over the past four years.

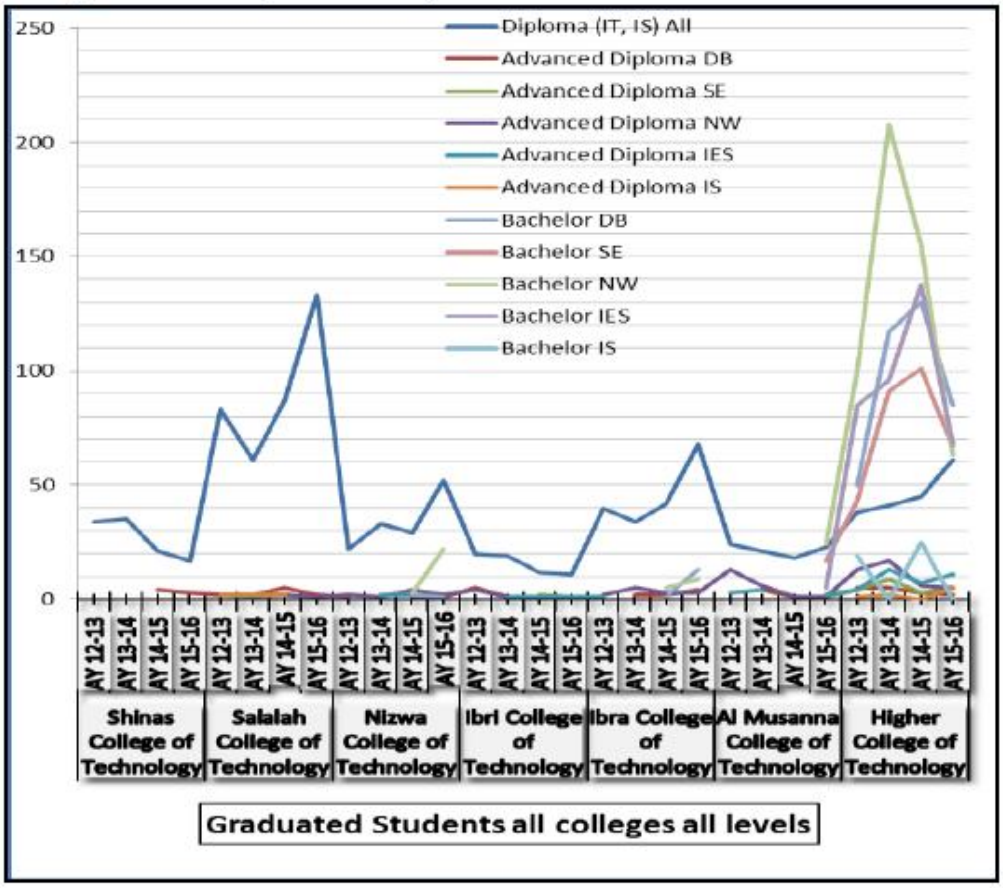


Fig. 4: Various colleges' IT graduates with specialization

The graph in Fig. 4 gives an overview about the number of students who are passed out in each academic year from various specializations and from various colleges for four years. From the plot we can come to the conclusion that numerous amounts are graduated at the diploma level due to several reasons. Some set of students will exit since they got placement in diploma level. Therefore they don't like to continue to the higher level. We found that the majority exits and dropped out due to the lack of a valid CGPA score or IELTS score. It is also evident that the majority of the population is in Higher College of Technology because the student strength is more in the college comparatively.

IV. RECOMMENDED SYSTEM MODEL

A model is defined to trigger the score using skill analyzer program. It is represented as ontology and illustrated for the skills matching with preprocessed steps. Proper mapping is essential to match the job needs and the candidate skills. We used here a graphical ontology 'OWLGrEd' as an OWL to visualize our system. Two perspectives are distinguished in a recruitment process: The job seekers have a skill set defined in the form of a score which covers the skills defined in the database. Job description is a set of requirements from the recruiter having a set of skill statements.

Job Seeker ≡ Graduate Π $\exists_{\geq 1}$ has Skill .Skill Statement

Where,

Skill Statement

- ≡$\exists_{=1}$hasSkill.Skill Π
- $\exists_{=1}$ hasCompetencyLevel Π
- $\exists$ hasTrainingExperience

Proper mapping is necessary to match the job requirement and the skills. For example each job has a description;

Job Description

- ≡ $\exists_{=1}$hasTitle.Title Π
- $\exists_{=1}$forCompany.Company Π
- $\exists$ hasIndustry.Industry Π
- $\exists$ hasFunction.JobFunction Π
- $\exists_{=1}$hasType

An Industry has a job notification with a set of criteria. A qualified match shows that a candidate satisfies all the criterions make by the Industry. The first case involves finding the right candidate in the set of all qualified (those that satisfy the qualified match criteria) for industries job notification. The second case involves ranking the set of applications satisfying the matching criteria. In this case some sort of a similarity measure needs to be taken into account. The third case involves all the scenarios in which one or more of the required criteria not satisfied at all. Many job notifications require more than one skill. Fig 5 shows mapping for a particular job position .NET Web Developer and its selection criteria set by the employer.

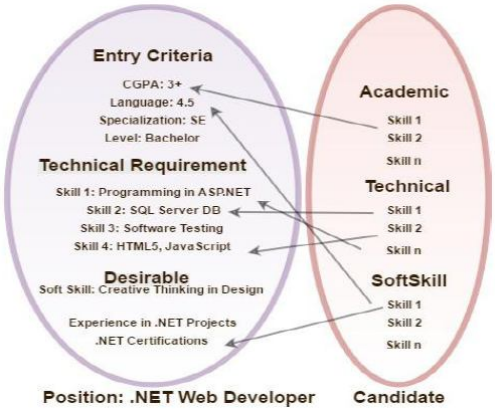


Fig. 5 A Specific Job's Criteria and its Skill Mapping

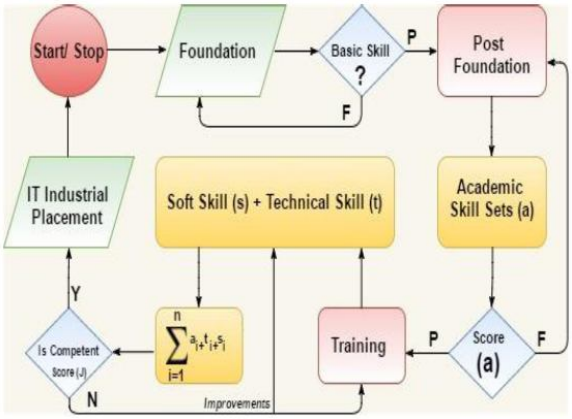


Fig. 6 proposed skill set measurement in each module

The proposed model as shown in Fig. 6 is the extended version of the current educational processes. It shows every stages of education with the required score to compete with placements. Fig. 7 shows the ontological representation of expected job skills, technical, academic and soft skill requirements. If the competency level is low with a job score less than the given condition, the recommendation engine notifies the candidate the skills which are lacking in them and how they can improve the score.

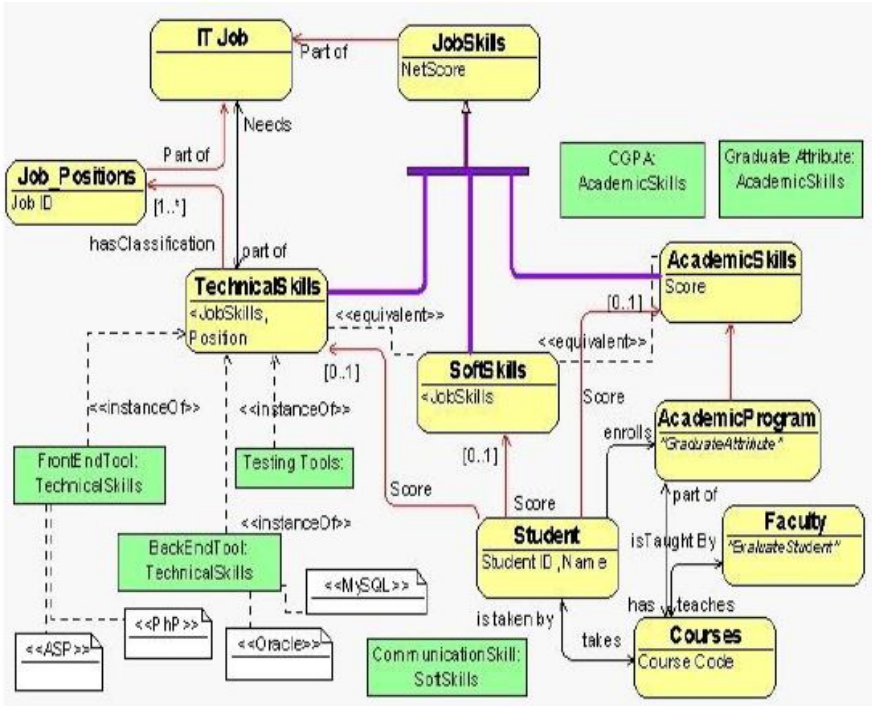


Fig. 7: Ontological classification of expected Job Skills to satisfy the business needs within the IT sector

Job skill is the outcome of other skill sets as shown in the Fig.7. The score value used on the job skill will be the major measurement to predict the employability of candidate. Here a candidate is able to see the requirements of the employer with all weightage given for a domain. As a result, it is noticed that ASP and

PHP comes under the front end development, MySQL and Oracle in back end and testing tools defined all are part of the technical requirements.

Fig. 8 shows the trend in the job postings based on various popular programming languages during the period from 2012-2016[21].

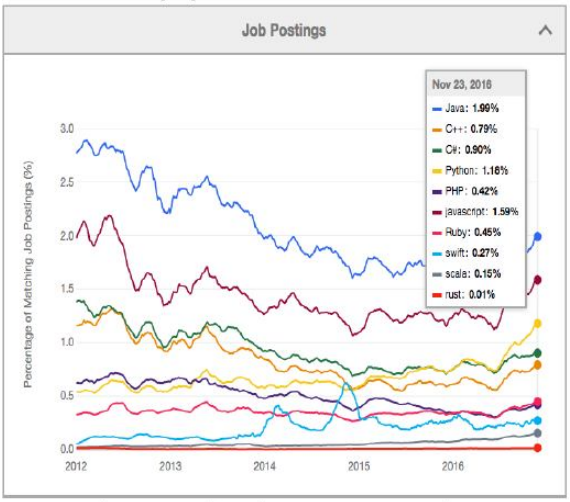


Fig.8: Job Postings based on programming languages

The classification of domain in the proposed model helps the candidates and faculties at the same time to prepare for the curriculum and learning. Moreover, soft skills are considered as added advantages with preset scores as part of assessment. Graduate attribute is a major factor to project the academic score which is explained in section V.

Fig 9 shows how a skill analyzer and skill match functionality work with JobSet model and SkillSet model to filter the right candidate based on the profile. Here an employer will define the required skills and will store the related data within the database. The analysis program will do a repository skill match and the result will be updated frequently. A detailed report will be generated for timely feedback and appropriate action. The required skill set is placed in a table in the form of a data dictionary which updates the jobs and its requirements based on the current postings. An appropriate algorithm is being used to extract the job skills from the postings and saved into the data dictionary. The outcome of Job skill will upgrade in regular basis as per the candidates performance in an educational set up and the score value will project through candidate's profile. Any employer or faculty within the network can login and see the candidate profile in a digitalized way and through graphical representations.

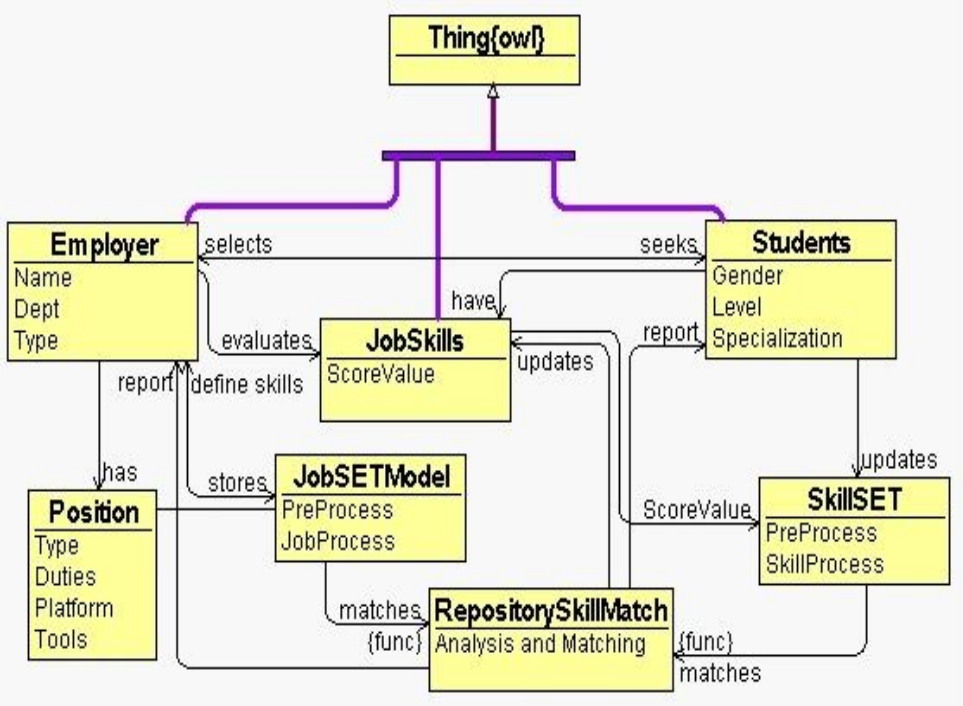


Fig. 9: Skill Analyzer's Mechanism in Ontology

Fig. 10 shows the skill analyzer program in a cloud data center framework. The diagram consists of three entities such as Student, Faculty and Industry. They will play their role in a virtual environment by the computation of data, information, services, reports and feedback. This model will be managed by the cloud provider; it can be private or public. Employers can make use of the system for their recruitment, selection and training processes. Candidates can get placed, improve skills, self-assessments and can upgrade knowledge based on feedback given from the employers and faculties.

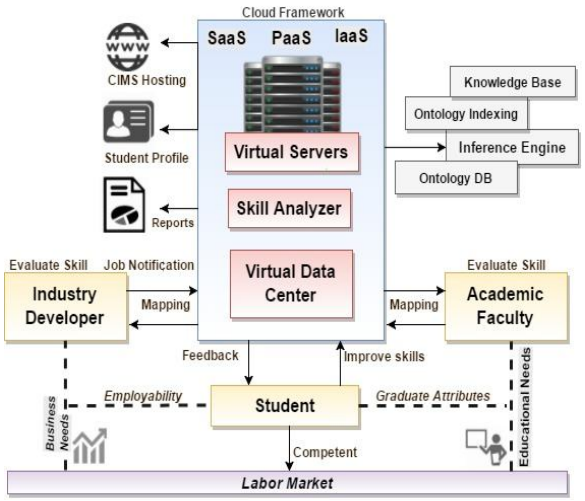


Fig.10: Skill Analyzer Recommender System in a Cloud Computing Framework

All stakeholders will target labor market and the competent student will be pushed onto that. An analysis program will work on the virtual data center to process data based on the above mentioned ontological representations and indexing. The represented data will store and inference from the knowledge base. All stakeholders can see student's profile with score and summated results, reports and feedbacks whenever required. Any results can easily access since it can be integrated in a cloud set up. Students can improve their skills based on the feedback processed within the program installed on the server. A College Information Management System can be hosted in the virtual data center for the access of profiles, reports and feedback regardless of time and place.

V. DATA ANALYSIS AND COMPUTATION OF RESULTS

The proposed system has the following features in the perspective of a cloud framework:

1) Infrastructure in cloud to store and compute records in a virtual data center and to analyze the defined skill sets.
2) Student profile will be generated in the digitalized way and it can show graphical representation of results.
3) Employer can search and select right candidate for the right job from the industrial perspective.
4) Students have the possibility to choose the right career and right employer.
5) Virtualization of Educational Management, Job Notifications and Training.
6) Virtualization of Candidate's Self-assessment.
7) Virtually generated reports for all stakeholders.
8) Promotes self-paced learning in students
9) The Pass outs have a greater value in the market and the standard of institution gets increased in the global level
10) The timely feedback also helps all stakeholders to upgrade themselves based on the needs.
11) The score values for the employability of candidates in terms of their assessments are show below.

A. Academic Assessment:

It is a common for any type of placements and the weightage will be given according to educational norms and policies as shown in Table 1.

No	Academic Skill Set	Obtained	Score	Weight
1	Transcript	28	30	9.33
2	Course Work	8	20	4.00
3	Communication	4	5	8.00
4	College Achievement	2	5	4.00
	TOTAL SCORE	42	60	25.33

Table 1: Academic Scoring

B. Industrial Assessment:

The Industry will set the weightage according to their norms and the assessment for a position ".NET Web Developer" as shown in Table 2

No	Industrial Skill Set	Obtained	Score	Weight
1	ASP.NET programming	6	7	8.57
2	Database (SQL Server)	4	6	6.67
3	Visual Studio 2013	1.5	3	5.00
4	HTML5,JavaScript,C#,CSS	1	3	3.33
5	External Funding Projects	1	3	3.33
6	Communication (R,W,S)	2	6	3.33
7	Decision-making	0.5	2	2.50
	TOTAL SCORE	16	30	32.74

Table 2: Industrial Scoring

C. Soft skill Assessment:

As mentioned in Table 3, employer will test the soft skills conducted by interviews.

No	Soft Skill Set	Obtained	Score	Weight
1	External IELTS	3	5	5.00
2	Certifications	1	2	5.00
3	Research - Publication	0.5	2	2.50
4	Creative Assignments	0	1	0.00
	TOTAL SCORE	4.5	10	12.50

Table 3: Soft Skill scoring

D. Score Value:

It is the outcome of the skills as shown in Table 4, employability score found as 5.52

Skill Sets	Obtained Score	Total Score	Weight
Academic	42	60	6.33
Industrial	16	30	4.68
Soft Skill	4.5	10	3.13
Job Skills	62.5	100	5.52

Table 4: Score Value

As per the date shown in the above tables, job skills for a particular candidate could be calculated as

$J = 0.6\ a + 0.3\ t + 0.1\ s$

And the skill computation for a number of candidates as $J_i = 0.6\ a_i + 0.3\ t_i + 0.1\ s_i$

Where a, t, s represents various skill sets. To recommend the appropriate candidate from a pool of candidates, we take into consideration the requirement level values, u (ds_i), assigned to each desire by the employer and normalize them to 1 (i.e., $\Sigma\ u\ (ds_i) = 1$). The match is shown as the sum of the desire levels of the required skills or degrees.

$Sim_j = \Sigma x_{ji} * u\ (ds_i)$

Where x_{ji} is a value shows whether the requirement is satisfied for each candidate from a set of students. The score level gets updated based on the new skills achieved by the candidate. The ontology framework provides relationship between the skills. In this framework, a skill can be similar to another skill posted in the requirement of the employer. We illustrated an ontology in which we classify the skills. Using ontology framework, we compute the similarity λ_s among skills itemized in job object s_j and skills itemized in skill table s_r as follows:

$$\lambda s(Sj, Sr) = \frac{1}{n}\sum_{i=1}^{n}(a_m \max\{sim(sjn, srm)\})$$

Where the similarity sim (s_{jn}, s_{rm}) between skills sj_n and sr_m is computed, n is the number of skills shown in the job criteria, and m is the number of skills shown in the student's candidature.

CONCLUSION

In this paper, we recommend a system to improve the productivity and employability of fresh IT graduates to prepare them for choosing right career, right employer and right working platform. Finding a professionally skilled IT candidate is a challenging task in this rapidly changed technological world, therefore our findings will be added advantage for any employer to find suitable candidates even during the time of their studies in an academic institution. A platform is opened to improve and upgrade the skills as per the feedback given from various stakeholders. This paper used ontological representation of skill analysis program and its functionalities to visualize the recommended system. The proposed system can be implemented in an academic cloud set up by ensuring proper security on data over the cloud infrastructure. All stakeholders can work over a virtualized environment with their assignments and an academic course management system can act as a carrier to create interface between the users. However the future work is to enhance methods of constructing the ontology in order to match between the set of ontologies developed to get the proper match between Industrial jobs and applicants.

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