A Novel Design of Smart Evaluation on Job Vacancy Application System (SEJVAS) Using UML

Noraziah Binti Ahmad
University Malaysia Pahang
<noraziah@ump.edu.my>

ABSTRACT: *Nowadays, job application is more preferred online than paper resumes. Smart Evaluation on Job Vacancy Application System (SEJVAS) has been developed by using Rapid Application Development (RAD). In this paper, new designs of the job vacancy application module are presented by using UML diagrams. In addition, this system applies the Rule-based technique in order to generate a shortlist for the job applications file that fulfills the company requirement. SEJVAS has been developed by using php programming language, php myadmin for the database and css for the interface. It can screen a range of applications and generate a short list of applicants to call for an interview. The simulation result shows the right candidate for the right profession can be selected without the worry of cost and time consuming.*

1. Introduction

Today's hiring procedure involves a lot of people, paper work and time. The applications received for a vacant job are often countless. The company also has to hold time-consuming meetings to go through all the applicants that fulfill the minimum qualifications from the unsuitable. The process of evaluation and hiring decision making often takes weeks. Hence, a system that can cut the time and cost in this field is necessary. To assist in the process, the utilization of information technology, automated software and database can provide efficiency and effective solutions to the problems of mass data and information handling [1, 2].

Expert knowledge is often represented in the form of rules or as data within the computer. A rule- based system consists of IF-THEN rules, facts, and an inference engine controlling the application of the rules based on the facts [3]. Rapid Application Development (RAD) was developed initially by James Martin in the 1980s [4]. The RAD approach involves conciliation in usability, features, and execution speed. In the design phase through RAD, information gathered from the requirement and analysis are defined in a visual representation of the system. The system design includes developing action diagrams that define the interactions between processes and data and workflow of the intended system. The workflow and procedures of the job vacancy application module by deploying four types of UML diagrams include Use case, flowchart, sequence diagram and state diagram.

The Rule-based technique, also called Knowledge-based technique is a conventional rule-based expert systems using human expert knowledge to solve real world problems that normally would require human intelligence[5]. Online Job Application (OJA) system also used Java Server Pages (JSP) a server-side technology used to make the HTML more functional, and used in dynamic database queries. A Decision Support System (DSS) is a group of computer-based information systems including knowledge based systems that support decision making activities [6]. There are many approaches in DSS; one of them is Artificial Intelligence (AI).

The Smart Evaluation on Job Vacancy Application System (SEJVAS) based on Rule-based expert system technique. This technique is applied to check the applications for applicants that fulfill the minimum qualification for the job and eliminate the not. The rule-based technique is also able to sort the suitable candidates according to the degree to which he/she is more suitable for the position using merit value. Hence, produces a more reliable decision-support results from which the admin can select the candidate to call for an interview. The Smart Evaluation for Job Vacancy Applicationwas developed for Bina Integrated Technology Sdn. Bhd.

2. Methodology

The objective of Smart Evaluation for Job Vacancy Application is to develop a successively running web application for the back-end user only [7]. Knowledge base contains knowledge concerning the problem-solving area of domain. Knowledge of the domain is presented in IF (antecedent) THEN (consequent) form. The rules in the knowledge base are retrieved from the Position requirement table. The Database contains the database whereas to match against the rules stored in the Knowledge base. The data in the Applicant's table is weighed against the data in the knowledge base. When the antecedent part of a rule is satisfied by a fact, the consequent is said to be fired. For each antecedent that is fulfilled, a consequent of merit or weight is assigned. The inference engine carries out the reasoning. The applicant's database is screened and applications that do not fulfill the minimum qualifications are dismissed from the workflow. While applications that fulfill the minimum requirements of the position are then sorted according to the degree to which they are qualified. The system then displays the decision-supported results of the process. A system admin then selects which applicants are most suitable candidates for the job. The applicants who are not suitable are discharged from the workflow.
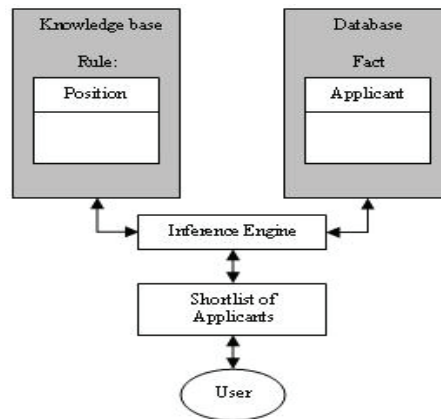

Figure 1. Block diagram of the Smart Evaluation for Job Vacancy Application system

2.1 Rapid Application Development

Rapid Application Development thus enables quality products to be developed faster, saving valuable resources. The RAD process model consists of five (5) phases, which are: Requirement and analysis; Design; Implementation; Testing; and Deployment RAD is a methodology for compressing the analysis, design, build, and test phases into a series of short, iterative development cycles. Iteration allows for effectiveness and self-correction. Studies have shown that human beings almost never perform a complex task correctly the first time. However, people are good at making an adequate beginning and then making many small refinements and improvements. This has a number of distinct advantages over the traditional sequential development model which has a rigid order of stages.

Unified Modeling Language (UML) is a standardized specification language for object modeling. A UML model is a graphical notation used to create an abstract model of a system. The workflow and procedures of the job vacancy application module is defined using UML diagrams;

  i.   Use case
 ii.   Sequence diagram
iii.   State diagram
iv.   Flowchart

2.1.1 Use Case

Figure 2 shows the interaction between the Job Vacancy Application module use case and the actors. The actors consist of two (2) actors which are; Applicant which is the class of all applicants who apply for the job and Admin which refers to the system admin.

Figure 2. Use case diagram for Job application process

The Job vacancy application use case is initiated by the applicant where the applicant submits his/her application to the system. The Job vacancy application module screens the applications and rules out applications that do not qualify with the minimum qualifications. The Job vacancy application module then sorts the possible candidates according to the criteria required for the job. The Job vacancy application module then delivers the decision-supported results to the system admin where the admin selects which applicant is most suitable for the job. The job vacancy application starts when an applicant submits an application. The job vacancy application module automatically screens all the applications for a suitable applicant that fulfill the minimum requirement for the job such as; minimum CGPA of 3.00, minimum work experience more than 1 year, etc. Applications that do not fulfill the minimum qualifications are dismissed from the workflow. While applications that fulfill the minimum requirements of the position are then sorted according to the degree to which they are qualified. The system then displays the decision-supported results of the process. A system admin then selects which applicants are most suitable candidates for the job. The applicants who are not suitable are discharged from the workflow. The flow chart ends with the suitable candidates are sent an email to call for an interview.

2.1.2 Sequence diagram
One of the types of UML diagram is the sequence diagram. A sequence diagram shows different processes or objects that run simultaneously as parallel vertical lines and the messages exchanged between them in the order in which they occur [2]. Figure 3 displays the sequence diagram for the job vacancy application module.
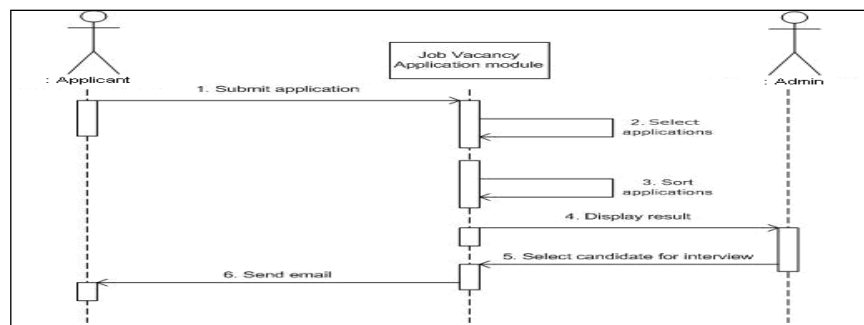

Figure 3. Sequence diagram for Job vacancy application module

This is the scenario for the job vacancy application process. The list of sequence from the diagram is:

a. The Job vacancy application module screens the applications submitted and dismiss applications that do not fulfill the minimum qualifications.

b. The Job vacancy application module sorts the competent applications.

c. The Job vacancy application module displays the results to the administrator.

d. The Administrator selects the most suitable applicant for an interview.

e. The Job vacancy application module sends an email to the interview candidate to call for an interview.

2.1.3 State Diagram
The state diagram, also known as the activity diagram in UML 1.0, is categorized under the Behavior diagrams in the UML diagram which emphasize what must happen in the system being modeled. A state diagram describes all of the possible states of an object as events occur. Figure 4 represents the state diagram for the job vacancy application module.
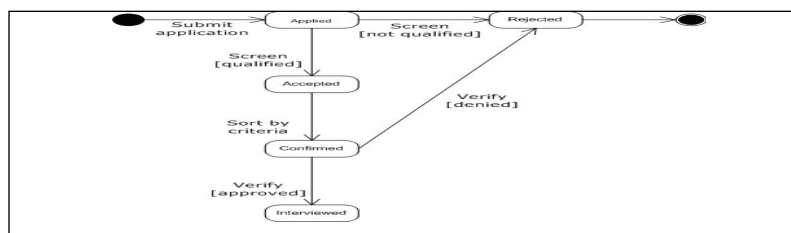

Figure 4. State diagram for Job vacancy application module

The arrows in Figure 4 represent transitions, from one state progressing to another one state. Transitions are the result of the invocation of a method that causes an important change in state. The filled circle refers to the initial state of an application. However, when an application in the Applied state is screened, it can either change into the Rejected state or the Accepted state. An application is in the Rejected state when it is not qualified in the screening process using the Rule-based technique. The application in the Accepted state change to the Confirmed state when it engages with the sort by criteria method where the Confirmed state is verified to change into the Interviewed state if approved or Rejected state if denied. The hollow circle containing a smaller filled circle indicates the final state of the application.

2.2 Rule-based Expert System Technique
The Rule-Based Expert system technique is the shell of knowledge-based systems. By associating the initiated rules with the database objects it is possible to build models and to apply these models to real world problems. Expert knowledge is often represented in the form of rules or as data within the computer. A rule-based system consists of IF-THEN rules, facts, and an inference engine controlling the application of the rules based on the facts.

3. Proposed Method

SEJVAS is developed for the use of the back-end user only, which is the administrator. The administrator can initiate requirements in accordance with the weighting of requirements and the system will examine all applications for the ones that are most suitable for the job [8]. The Rule-based expert system technique was implemented into the system using PHP language. The facts to be matched up against the rules were the applicant's data, whilst the rules were re-trieved from the position's *requirements data.* The rules in the knowledge base were partitioned into six (6) categories, which are:

3.1 Prior rules
The prior rules are the rules that if not satisfied, the respected application will be eliminated from the workflow. The IF an-tecedent include; nationality, minimum and maximum age range and availability date. For an example, if an applicant does not fulfill the Malaysian nationality rule, the applicant will be removed from the process.

3.2 Highest qualification rules
In this category, and the categories after, the applicants have already fulfilled the prior rules requirement. The qualification rules are the rules concerning the education level of the applicant. This category includes three (3) entities, which are qualification field, qualification level and grade/CPA.

3.3 Required skills rules
In the required skills rules category, the IF domain includes the skills required for the position and its level of proficiency. For example, the required skill for an enterprise application developer position is MS Sharepoint, and the proficiency level is intermediate.

3.4 Preferred languages rules
In the preferred language rules category, the antecedent consists of the languages necessary for the position and its level of proficiency of 0 to 10. For example, the preferred language for a mandarin columnist position is Mandarin with a spoken Mandarin proficiency of 10 and a written Mandarin proficiency of 10.

3.5 Work Experience rules
Work experience category comprises of three (3) entities, which are; work experience, company industry and position level.

3.6 Salary rules
The minimum salary rule, the applicant's requested salary is measured up to the minimum salary for the position.
A flowchart diagram is a graphical notation of a system's workflow. Figure 5 illustrates the workflow of the job vacancy application use case.

The antecedent and consequent in each category in the knowledge base is defined by an array, and each array carries a merit/weight that is assigned according to the degree to which an applicant conforms to the position's requirements. At the end of each category, the total of the merit is calculated. For an example, in the highest qualification rules category;
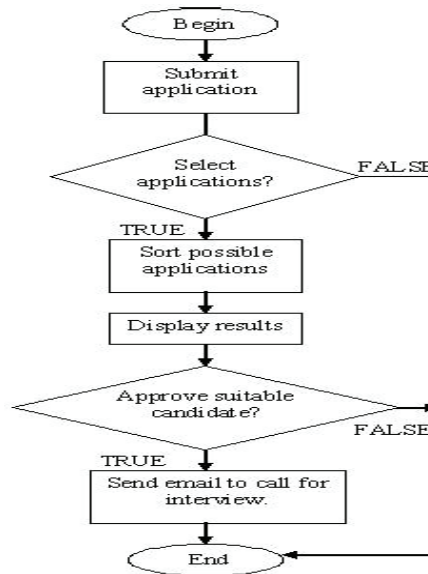
Figure 5. Flowchart for job vacancy application module

```
if ( $applicant_qualification_field = = $position_qualification_field ){ $point['field']=10; }
if ( $q_field != $row['qualification_field'] ){ $point['field']=5; }
if ( $applicant_qualification_level >= $position_qualification_level ){ $point['level']=10; }
if ( $q_level < $row['qualification_level'] ){ $point['level']=5; }
if ($applicant_qualification_grade >= $position_qualification_mingrade ){$point['grade']=10; }
if ( $applicant_qualification_grade < $position_qualification_mingrade){ $point['grade']=5; }
$qualification = (( $point['field'] + $point['level'] + $point['grade'] )/30)*20;
```

Figure 6. Antecedent and consequent

At the end of the workflow, each applicant's degree of suitability to the position is calculated in percentage. Figure 7 shows an example of the calculation. After the percentage of each applicant is calculated, the suitable candidates are sorted according to the degree to which they fit the position.

```
$percentage = $qualification + $work + $skills + $languages + $salary;
```

Figure 7. Total of the merit is calculated

4. Result

This system was developed using several applications and languages including; HTML, CSS, JS, and PHP using Editplus, MySQL for the database, Adobe Photoshop CS2 for graphical design, MS Visio for planning and MS Word for documentation. The hardware specification needed in the development of the Smart evaluation for job vacancy application system, Pentium M 1.73MHz and above, 1GB RAM, Minimum 4 GB free hard disk space, Network Adapter / Modem, DVD Writer 52X. There are three (3) tables created for this system; Admin, Position and Applicant. Figure 8-11 show SQL queries executed in creating these three (3) tables. Figure 5 refers to the new position page. In this page, the Bina web administrator is able to add new positions to offer at Bina Intergrated Technology.

Figure 9, Bina's web administrator is able to view all available positions posted. On this page, the admin can edit the position requirements, edit status of the position and delete the position. The admin can edit the position by clicking on the position title link where he/she will be redirected to the edit position page. The admin can also edit the status of the position (Vacant, In process, Closed). By default, the status of the position is 'Vacant'. Finally, the admin can delete the position by clicking on the 'Delete' icon.
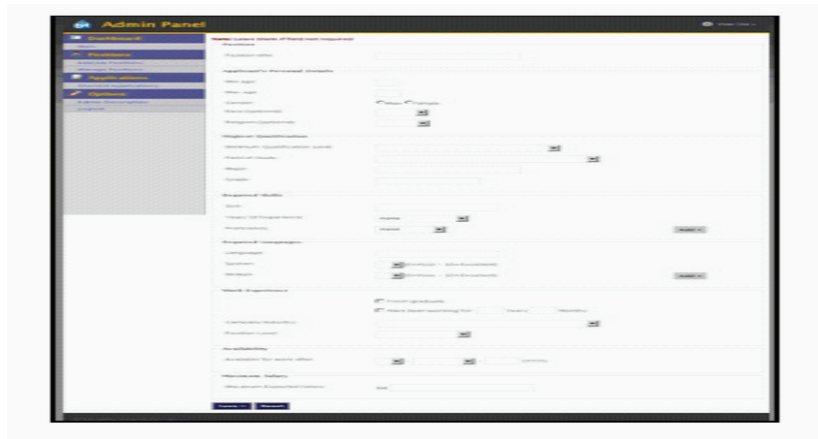
Figure 8. Add new position

Figure 9. Manage positions

Figure 10, the admin selects a position title from the dropdown menu and clicks the "Go" button. Then, the system will display all the applicants that applied for the respective position. There are many functions in this page. The admin can view the text resumes of the applicants by clicking on the applicant's name link. The admin can also skip the shortlist process and mark the applicants he/she want to call for an interview and click the Email button where an automatic email will be sent to the applicants. The admin can also rate the applicants where a certain leverage is given to the applicant when the short listing process. Finally, the admin can also mark and remove the applicants.
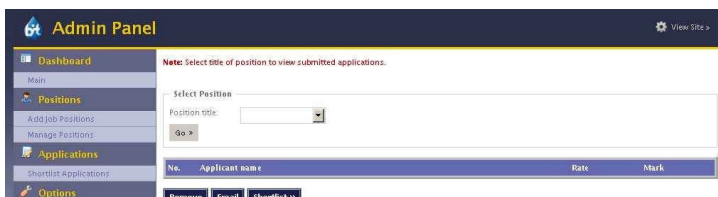

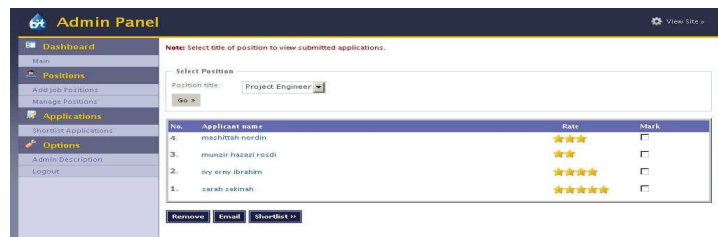Figure 10. Shortlist applications – select position

Figure 11. Shortlist list of applications for a position

5. Conclusion

SEJVAS is a web application that applies rule-based decision making to serve the purpose of cutting time and cost of a job application evaluation procedure. Current manual employee evaluation mostly relies on file-based method which is inefficient and disorganized. The process of screening these applications for the most suitable for the interview is tedious and takes a lot of time. It is particularly time-consuming and tiresome for jobs that receive a wide range of applications. Having to go through these applications one by one requires a lot of patience and professionalism. That is why most employee hiring decisions are often biased by personal opinions and emotions. Consequently, hiring the wrong person for the job will result in a waste of resources or even lose a lot of money.

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