

## AUTOMATIC TEXT INTERVIEW ASSESSMENT USING IM DECISION SUPPORT SYSTEM

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### ABSTRACT

In existing studies of human resource selection, individual performance of a single candidate is usually considered, whereas the collaborative performance among the interviewee using the on-line instant messaging is not taken into consideration. Time is also very consuming to choose and short list thousands of applicants. Usually short listed interviewees are generated by looking at academics performance without really evaluate the applicants' skills and knowledge. An integrated approach and its prototype for employee selection using an instant messaging as a collaborative tool during the interview process is developed using IM-DSS framework. It includes automatic technical answer scoring and automated ways of extracting ethical values from the interview answer log. Submission count and response time are among supporting features introduced to reduce problem in live interview sessions.

**Keywords:** *Decision Support System, Instant Messaging, Expert System, Interview Online, Human Resource*

### 1. INTRODUCTION

Human resource is an important asset in a business organization. The selection of human resource is part of human resource management process and it must be done very carefully to ensure the achievement of organizational objectives. Decision making related to human resource selection is not an easy task as it is limited to decision makers' computation, foresight, analytical powers, and sometimes to psychosocial biases such as political factors, negative and cost consequences, and also to gains rather than loss alternatives.

Advances in computer and internet technologies as well as related software applications should be exploited by these organizations to improve the quality of human resource evaluation or selection process. Today, many web-based application tools such as instant messaging (IM), email, problem analysis and others are available to be utilized and explored.

A new approach in performing job interview process via the use of IM can be deployed by enterprises not only as a communication tool, but also as a supporting tool in decision making process. Electronic job interview process using

IM can be designed to reveal the real characters of interviewees during their interaction with other interviewees or with the interviewers themselves. Interviewers can send questions via IM to discover various skills of the interviewees such as technical, communication, job domain knowledge and various other skills. Collaborative practices among interviewee where they can share best practices and engage in joint problem-solving can be identified.

Recorded electronic question-answer sessions will enable decision makers to identify candidates who can be entrusted with the future of the organization as quickly and inexpensively as possible. The interview session can be attended with many more candidates using virtual room.

We have designed a framework for instant interview; IM-DSS software to be used for electronic interview session. The evaluation criteria data obtained from the process using IM-DSS will be stored in a log file for manual assessment. In such a way, we have tested the IM-DSS system integrated tools to handle interview process which leads to evaluation and selection of the most potential candidates for jobs offered in an organization.



## 2. RELATED WORKS

### 2.1. Conventional Job Interview

Conventional job interviewing process requires interviewees and interviewers to be present at one particular place. The process is carried out by the selection committees that normally constitute more than two members. Each committee member usually has certain expertise such as knowledge about the job, and who have some relation to the job. Usually, the selection committee will interview one interviewee at one time. During the interview session, the interviewers can take turn asking questions to the interviewee. The interviewee will verbally answer the questions one after another according to his knowledge and ability. During this question-answer process, necessary information about the interviewee is written down. This process is repeated until all interviewees have been interviewed. At the end of the session, the interviewers will discuss among themselves in order to reach the agreement on the most potential candidates to be selected for a job or for a number of jobs.

In conventional interviewing approach; comparing, evaluating and reaching to an agreement is not easy. There are tendencies for the interviewers to miss certain points and sometimes they have to recall what have been said by the interviewees during the interview sessions. This may lead to unfair judgment as the value of evaluation criteria varies among each interviewee.

### 2.2. Evaluation Criteria for Job Interview

The purpose of an interview is to gather information about the applicants' competencies, behaviors, collaboration abilities, communication skills, and work experience so that best qualified candidates can be selected. The website for University of Melbourne proposed a combination of qualifications, attributes, skills and knowledge as criteria to be considered in the selection process [1]. The criterion attributes consist of specific behaviors such as flexibility in adapting and accepting new ideas, challenges, and priorities; achievement oriented for certain goals; initiative to contribute ideas, project work and assignments; professionalism in behavior and execution of duties; integrity in terms of honesty and trustworthiness, and ability to handle any conflict of interests; and service orientation that

displays quality client service. These information can be collected automatically and stored instantly in log file [2][3] of IM for further analysis about certain criteria of interviewees.

### 2.2. Instant Messaging and Interview

Instant messaging refers to the process of exchanging real time messages to other invited users over the internet. Only those who have been invited can participate in the conversation. This technology enables exchanges of messages almost instantaneously across an internet connection. Using IM, users are able to chat, be involved in videoconference, share applications and videos, transfer files, use the audio communication. In addition, IM also allows users to use the short messaging service (SMS) and even provide computer-telephone communication.

IM has gained popularity in many organizations as it adds speed and ease of communication among staffs and management from home, workplace, or social settings [4] IM have also been applied in the learning environment [5] and also in the military [6]. In terms of learning behavior analysis, IM has been used in order to keep track of learners' actions while performing various learning activities.

IM was specially designed for informal communication among community. Issues for adapting the tool in interview process are kept recurring because no specific IM interview framework has been proposed. [7] has conducted several interview sessions using standard Instant Messaging features and reported that 3 major complications need to be considered in a live interview session; lack of interviewees' attention; time consuming in typing and reading the submitted words; and misunderstanding on the sentences due to lack of voice's tone and body languages.

Online screening application was proposed by [8] composing of interview module, scoring module and tracking module. Although the proposed online interview cannot replace the traditional face-to-face interview, it can definitely provide the means to help recruiters and hiring managers with interviewing challenges.

Scoring of the interview session answer log can be done automatically using information retrieval techniques. One of popular techniques is Term-frequency inverse document-frequency (TF-IDF). Given a document collection (D), a word (w), and

an individual document ( $d \in D$ ), we calculate word weightage as :

$$w_d = L_w * G_w \quad (\text{eq. 1})$$

$$L_w = f_{w,d} / f_d \quad (\text{local weight})$$

$$G_w = \log(|D|/f_{w,D}) \quad (\text{global weight})$$

where  $f_{w,d}$  equals the number of times  $w$  appears in  $d$ ,  $f_d$  is the number of words in  $d$ ,  $|D|$  is the size of the corpus, and  $f_{w,D}$  equals the number of documents in which  $w$  appears in  $D$  [9]. The formula tries to set a weight of each terms (words) in a document by considering the terms occurrence in the document which is a local weight,  $L_w$ , and multiply it with the terms occurrence at other related documents which is a global weight,  $G_w$ . The global weight here is an inverse calculation of a fraction (denominator per numerator) because it considers the most infrequent term is weighed higher than frequently words. Such assumption can help in setting higher weightage to a term in a document which is obviously not mentioned in other document. Thus this document can be easily located in matching against the queried or searched word.

Realizing the applicability of IM in various fields, it is anticipated that the use of IM during the job interviewing process has a potential to be utilized for the analysis of interviewees' behavior. Framework was designed to cater the related issues pertaining interviewing over IM. Answer log of interview session was evaluated automatic using our own formula based on TFIDF method.

### 3. IM-DSS FRAMEWORK

A framework for Instant Messaging Decision Support System (IM-DSS) software has been designed to create electronic interviewing session together with IM environment that can be embedded with Decision Support System (DSS) characteristics and intelligent elements to form an integrated DSS (IDSS). IDSS has the capability to retrieve log file data (captured during the IM interviewing session), evaluate their quality, and able to support the evaluation of alternative candidates. IM-DSS could assist in improving collaboration and communication, eliminating geographical distance, reducing emotional distraction, and leading to support in decision making activities.

The framework has identified of three external actors that will participate to start an instant live text-based interview session:

(a) Interviewers (In), are those that will ask questions or provoke answers to gain instant feedback from the interviewees. Apart from that, they will also evaluate and assess the answer logs (explained later in this section) that represent one of the criteria in the evaluation process.

(b) Interviewees (in) are those that will provide answers and feedback to present his/her knowledge, skills and attitude towards any issues pertaining to the raised questions or situations posted by the interviewers; and

(c) A moderator who will actively monitors the interview process such as controlling the start and ends of the interview session, suspending or terminating unethical interviewees, controlling interviewees' participation, or modifying certain parameters of the decision support system attributes.

Each IM-DSS session requires interviewees to be present in a specific interviewing lab equipped with networked PCs. This is to avoid identity of interviewee being misused and queried answers from internet access. Interviewers may need not to present at the same place with the interviewees and the moderator, as they can be online during the session.

Any activities while interacting with the system will be monitored and controlled by a moderator. The moderator has to be a technical know-how person to manipulate system attributes.

#### 3.1. Automated Answer Score

Automatic scoring technique can help interviewers to automatically shortlist interviewees for further manual and thorough evaluation. For example, this technique can list the top 20 of best interviewees' answer out of 200 persons. Answer texts submitted by interviewees during the interview session will be automatically evaluated using our own techniques; keyword and cooperative answer assessment.

##### 3.1.1. Keyword Assessment

Automatic text assessment will contribute to help sorting and ranking the answers given by the interviewees. In IM-DSS, matched keywords that were submitted by more than one interviewers is done by assigning the weightage of the submitted answers or keywords. For local weightage, each



keyword submitted by each interviewer must be accompanied with its weightage value. The values range from 1 to 3 representing normal, best and excellent answer terms respectively. This weightage value can be considered as the frequency number in term-frequency (TF) formula. Thus, the local weightage formula is defined as

$$L_w = W_{w,d} / W_d \quad (\text{eq.2})$$

where  $W_{w,d}$  equals the weightage value of keyword- $w$  in interviewer's keywords set- $d$ ,  $W_d$  is the total weightage in interviewer's keywords set- $d$ .

Meanwhile, we also need to get the global weightage of the keywords among other interviewers. This can be done by calculating the normal fraction which is:

$$G_w = f_{w,D} / |D| \quad (\text{eq. 3})$$

where  $f_{w,D}$  equals the number of interviewers' keywords set in which keyword- $w$  appears in all interviewers' keyword set ( $D$ ), and  $|D|$  is the total number of interviewers' keyword set. In other word, if the keywords occurred in all interviewers' answer document, the global weightage for the keyword is considered as full or 1. Thus, the whole matched-keyword weightage formula is defined as:

$$mk_w = G_w * \sum_{d=1}^D L_{wd} \quad (\text{eq. 4})$$

where  $w$  is the keyword,  $d$  is the interviewer's keywords set (each interviewer only has one keyword set) and  $D$  is the total number of interviewers.

The full steps taken are described as below:

a) All keywords submitted from interviewers will be stemmed using [10] and gathered into keyword vs interviewer's keyword set matrix.

Table 1.0 : Keyword – Set matrix

	set-1	set-2	set- $d$
word-1	3	3	0
word-2	0	2	0
word- $w$	1	1	3

b) Modify the above matrix to get the local weightage using equation 2.

Table 2.0 : Keyword – Set local weightage

	set-1	set-2	set- $d$
word-1	0.75	0.5	0
word-2	0	0.3333	0
word- $w$	0.25	0.1667	1

c) Calculate the global weightage according to the majority keywords submitted by the interviewers using the equation 3.

Table 3.0 : Keyword – Set global weightage

	Weightage ( $w_d$ )
word-1	0.6667
word-2	0.3333
word- $w$	1

d) Calculate the overall weightage using the equation 4 by multiplying Table 2 with Table 3.

Table 4.0 : Keyword – Set matched weightage

	set-1	set-2	set- $d$	$mk_w$
word-1	0.5	0.3333	0	0.8333
word-2	0	0.1111	0	0.1111
word- $w$	0.25	0.1667	1	1.4167

c) Based on the word submitted from interviewers; calculate the score weightage of each interviewees' answer by total up all the word matched with the interviewers' keyword set. Normalize the result by dividing all the total score with the highest score.

Table 5.0 : Keyword Text Score

	$mk_w$	i-1	i-2	i-3	i-4
word-1	0.8333	1	1	1	0
word-2	0.1111	0	1	0	1
word- $w$	1.4167	0	1	1	1
Total	0.8333	2.3611	2.25	1.5278	
Normaliz	0.3529	1	0.9529	0.6471	

Note :  $i$  is the interviewee.

Based on the Table 5.0, interviewee number 2 is the highest in the automated score, followed by i-3, i-4 and i-1.

### 3.1.2. Cooperative Answer Assessment

In public chatting environment, IM-DSS was much concerned on the level of interaction among interviewees' answer. Evaluation on how each interviewee response on other's answer somehow provides some indication on his/her teamwork skills.

Table 6 maps the frequency of each interviewee quoting or commenting on other interviewees' answer.

Table 6.0 : Cooperative Answer Response

	i-1	i-2	i-3	i-4	Total
i-1	-	3	2	1	7
i-2	1	-	2	2	4
i-3	0	1	-	1	2
i-4	1	1	1	-	3

In order to shortlist interviewees, IM-DSS provides multi sorting score based on keyword and cooperative score. Administrator or chief of interviewer panel can sort the scores by highest keyword followed by cooperative score. They can later decide to choose certain number of interviewees to proceed for the next face-to-face interview.

### 3.2. Instant Reports

Live data analysis on the interview conversational texts were made available to all interviewers and interviewees to stimulate the session to remain active. This feature can automatically alert unresponsive interviewees before rejecting them if they did not submit any words within a certain time delay. The feature can also reject irresponsible interviewee who continuously submitted characters on each seconds.

Figure 2 shows the screen shots representing these reports which were lines/word counts and average response time.

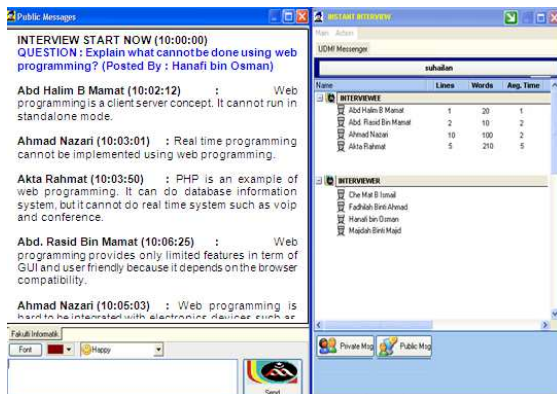


Figure 2. Screenshots in IM-DSS Live Reports

consecutive words. These words will be counted and the result will be displayed live to all users. However, only unique words are counted in order to provide automatic sense of participation recognition based on the interviewees' posted messages. Thus, repeated words/messages shall not be counted as new words.

### 3.2.2. Average response time

Response time derived from the conversational texts among interviewees will help interviewers to automatically identify candidates who are quick and active in thinking. The enthusiasm of the interviewees' about the raised problems can also be described using this attribute.

### 3.3. Instant Messaging

The outer layer provides input/output access such as ASCII character codes from the standard input. This layer is accessible to all interviewers and interviewees participating in the interview session. It provides instant messaging features such as text, image, video, audio messages and other features that are available in common IM tools. Interviewers and interviewees can interact among them to facilitate collaboration and participation during the interviewing process via public instant messages board.

In supporting the cooperative answer, instant messages board must provide quoting feature to link a message with other messages submitted by other interviewees. Figure 3 shows the comment feature for cooperation answer. While figure 4 shows the public chatting comment (quote) message.

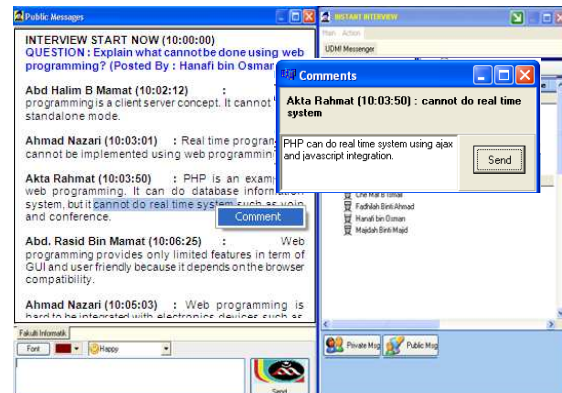


Figure 3. Cooperative Answer

### 3.2.1. Lines and words counts

Answers by the interviewees during the interview session will be considered as

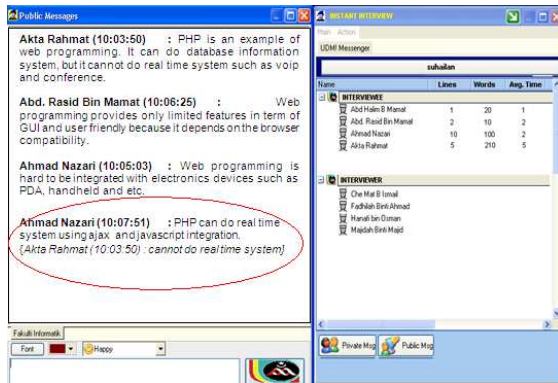


Figure 4. Public Quoting Message

annoys	2	0	1	0.0844
load	1	2	2	0.2280
speed	2	0	0	0.0303
time	0	1	2	0.0847
debug	3	2	2	0.3189
faster	0	0	2	0.0238

After instant messaging public interview session, all the answers given will be saved into individual answer logs. Keywords were then matched from each interviewees' answer logs to form a matched keywords matrix as in Table 8.0.

Table 8.0 List of Matched Keywords

Keywords	i1	i2	i3	i4	i5	i6	i7	i8
size	1	0	0	0	0	0	0	0
maintain	0	1	0	0	1	0	1	0
re-usability	0	0	0	0	0	0	1	0
testing	0	0	0	0	0	0	1	0
understanding	0	0	0	0	0	0	1	0
inconsistencies	0	0	0	0	0	0	1	0
isolate	0	0	0	0	0	0	1	0
overhead	0	0	0	0	0	0	0	1
latency	0	0	1	0	1	0	0	0
download	0	0	1	0	1	0	0	0
cache	0	0	1	0	0	0	0	0
annoys	0	0	0	1	0	1	0	0
load	1	0	0	0	1	0	0	0
speed	0	0	0	0	1	0	0	0
time	0	0	0	0	1	1	0	0
debug	0	0	0	0	1	0	0	0
faster	0	0	1	0	1	0	0	0
Total Matches	2	1	4	1	8	2	6	1

#### 4. EXPERIMENT

The prototype of IM-DSS framework was tested for 8 persons with IT background who act as interviewees in the session. They need to be in a special and monitored lab in order to participate in the interview session. The session started after all the interviewees have successfully login after the prototype. A question was given to them asking which one is better whether using inline or external CSS. They have to response to the questions by giving answers and opinions via public chatting. The interviewers and moderator who were online at the same time monitored the session anywhere in their own place. Results were generated instantly during and after the session. In this experiment, results were automatically generated based on the 2 criteria; keyword score and cooperative score.

##### 4.1 Results

Interviewers were required to submit keywords and its weightage. System will gather all the submitted keywords into a matrix as shown in Table 7.0.

Table 7.0 Keywords and weightage

Keywords	I1	I2	I3	Overall Weightage (mk)
size	1	1	3	0.2082
maintain	3	2	1	0.2832
re-usability	3	0	3	0.1623
testing	0	2	3	0.1455
understanding	0	3	2	0.1587
inconsistencies	3	1	0	0.1280
isolate	0	0	2	0.0238
overhead	1	0	0	0.0152
latency	0	0	2	0.0238
download	3	1	1	0.2276
cache	0	3	2	0.1587

Get the overall weightage for each of the keywords. On each matched keywords of each interviewee, total up the associate keyword overall weightage to get the score and normalized score. Order the scores in descending order to get the highest score to be on top as in Table 9.0.

Table 9.0 Total Score of Normalize Score

Interviewee ID	Total Matches	Score	Normalize Score
i5	8	1.2203	1.0000
i7	6	0.9015	0.7388
i1	2	0.4361	0.3574
i3	4	0.4340	0.3557
i2	1	0.2832	0.2321
i6	2	0.1691	0.1386
i4	1	0.0844	0.0692
i8	1	0.0152	0.0125



## 4.2 Discussion

Based on the result in Table 9.0, we can see that although keywords (download, cache, latency, faster) from i3 has a total matches higher than i1, i1 was scoring better because of the interviewer overall weightage keywords (size, load). Keywords “size” and “load” were submitted by all the 3 interviewers, while the keywords of “cache”, “latency”, “faster” only rated by one or two interviewers. It was clear that global weightage do influence in the scoring because we want to choose candidates that favorable to all interviewers.

The prototype of IM-DSS framework assists management people to execute interview process in efficient and transparent manner. The time taken for interview session is significantly reduced by allowing interviewees to be interviewed at the same time in a group using instant text-based messaging features. The prototype has successfully ranked the interviewees using the 2 ranking criteria represented as best answer and most collaborative person.

The marks of total score enable the system to automatically sort and rank the interviewees. Thus, this prototype successfully supported organization to have candidates shortlisted after they all had been given chance to prove their competency in the specific domain required by the interviewers, not only limited to their certificates or academic result as implemented in normal practices.

## 5. CONCLUSION

The selection of human resource has to consider multi-criteria factors that include individual performance, collaborative performance among candidates, and also other factors such as individual competencies and behaviors. IM-DSS integrates DSS into instant messaging (IM) application which is believed to be able to overcome the limitation for capturing and evaluating values from the instant interview session. The major contribution of the IM-DSS framework include the use of decision making analysis using information retrieval models to automatically assess best answer and collaborative aptitude from the log file recorded during the IM interviewing sessions. This is a new idea that utilizes integrated versatile technologies for human resource selection process. IM-DSS has its own strengths in terms of

supporting transparent evaluation, easy to recall of text interview session and fasten the short listing process. It also helps to reduce uncertainties during the evaluation process as all the required data can be retrieved, shared, and evaluated among many interviewers. However, our keyword assessment model is much depending on the exact keywords submitted by the interviewers without considering their synonym and semantic context usage. Beside keywords and collaborative assessment, the interview session is not dealing with one of the human resource selection criteria which is to assess the candidate ethics and morale using provocation questions. In terms of future work, we intend to include ethics automatic assessment into our IM-DSS using sentiment analysis and suitable psychometric test while embedding clever robot (chat bot) acting as the interviewers.

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