Intelligent Recruitment Management Architecture

J.N. Marasinghe, T.P. Samarasinghe, S.U. Weerasinghe, N.S Hettiarachchi, and S.S. Sumanadasa

Abstract – **The IRMT (Intelligent Recruitment Management Tool) architecture is to develop a real environment application that can assists in Recruitment and Selection process in a company. It uses the power of the web to recruit online. Modern technology is available to meet new needs, where this handy web application helps the harried employer take care of a host of employee resourcing functions using just one versatile tool to get the right people in the right place at the right time. The system has mainly four components called categorizer and tokenizer for handle applicants' resume and short listing, psychometric evaluator for evaluate qualified applicants, scheduling component for generate interview schedules and remote evaluator to hold video interviews and provide suggestions. In the current state of affairs, no company uses a system or a tool which can band together the above mentioned functions together in Sri Lanka. Intelligent Recruitment Management Tool provides an enhanced means of dealing with this issue. In this implementation, technologies such as XML, special algorithms and fuzzy logic were used. Through Intelligent Recruitment Management Tool, intends to overcome the inconveniences face during the manual procedures within employee resourcing process. The article further describes product structure, its benefits and why it's being unique among other existing tools.**

Keywords —— **Automatic Data Processing (ADP), Extensible Markup Language (XML), Human Resource (HR), Intelligent Recruitment Management Tool (IRMT), Information Technology (IT), Systems, Applications and Products in Data Processing (SAP)**

I. INTRODUCTION

As a consequence of the rapid revolution in computer and software technology, Human Resource Information System or Human Resource Management System - related products are constantly upgrading and changing. [1] Human resources form an integral part of the organization. Hence, choice of exact people and placing them at right place becomes essential, which turn out to be very challenging with the existing systems. [2] Currently HR Management Systems encompass of Payroll, Work Time, HR Management Information System, Benefits Administration, Training / Learning Management System, Performance Record, Employee Self-Service and Recruitment and Selection. [3]

Several major software companies provide HR Management Systems packages such as SAP, PeoleSoft, Oracle, and ADP are among the most common ones. Depending on the company's needs and size, package options may include different services. [4]

However when focusing Sri Lankan context those systems are really support for the organizational requirements of Sri Lankan companies. Some of the persistent problem that identified with the above mentioned systems is that, none of them are not providing facilitates for categorizing and tokenizing, psychometric evaluation, interview scheduling and remote evaluation in a one piece of tool. [5]

It is very useful since those all operations are interrelated, and having such an integrated tool provides significant benefits to the organization particularly to the HR functions. Furthermore, HR Management Systems are used large scale in globally, in Sri Lankan context most of the organizations perform HR tasks manually. [6]

J.N. Marasinghe is with the Sri Lanka Institute of Information Technology, Malabe, Sri Lanka. (e mail: jennifermarasinghe@yahoo.com)

T.P. Samarasinghe is with the Sri Lanka Institute of Information Technology, Malabe, Sri Lanka. (e mail: tilia1008@gmail.com)

S.U. Weerasinghe is with the Sri Lanka Institute of Information Technology, Malabe, Sri Lanka. (e mail: ianshanimail@yahoo.com)

N.S Hettiarachchi is with the Sri Lanka Institute of Information Technology, Malabe, Sri Lanka. (e mail: sashenkahettiarachchi@gmail.com)

S.S. Sumanadasa is with the Sri Lanka Institute of Information Technology, Malabe, Sri Lanka. (e mail: sujani.s@sliit.lk)

Since it is a core function to an organization it is very useful if organization can facilitate with HR system to enhance their productivity. Having identifying that gap this research intended to provide cost effective IT solution to operate HR functions. This could overcome common problem associated with Recruitment and Selection process and thereby organization can receive extensive benefits and performance enhancements.

The aspire is to develop a web based Intelligent Recruitment Management Tool for the HR department of a company, to automate the process and coalesce categorizing and tokenizing, psychometric evaluation, interview scheduling and remote evaluation utilities of recruitment and selection process in to a one piece of tool, along with added new features, which help in decision making of employee resourcing. Since there is no tool at the moment in Sri Lanka, this turn out to be exceptionally beneficial to handle employee resourcing.

II. LITERATURE REVIEW

With the development of the information systems in HR management field, several efforts have been made on this subject. Several systems have been inspected in order to design effective and efficient software.

OrangeHRM allows generating templates and documentation to streamline the whole recruitment process, from reaching out to applicants to filling resumes and supplemental materials. The recruitment process including requests for staff approval of vacancies entering requirements capturing candidates' information short-listing interview notes and other features are all covered under this one module. [7] However it does not have the facilities to publish vacancies online, automatically closing of the vacancy and qualified applicant.

Psytech International is one of the world's leading developers of psychometric tests and assessment software for the workplace. Products include: Personality Measures, Ability & Aptitude Tests, Competency Based Assessments and Pressure Management Indicators. [8] However this service runs independent of a recruitment and selection tool.

Scheduling projects by cyber matrix cooperation is one of the leading cooperation for developing the scheduling projects. There are various software's developed to schedule time such as Pro Scheduler [9], Project Meeting Manager [10], Employee Project Clock etc. [11] However these systems implemented

the schedules based on linear algorithms. Therefore systems are not intelligent to make decisions when conflict occurs.

Dragon Naturally Speaking Home Edition gives features such as up to 99% speech recognition accuracy right out of the box Creation of documents, reports, or messages just by speaking, Nuance Text-to-Speech technology that reads on-screen text in human-sounding synthesized speech. [12] But the only disadvantage of this system it is unable to recognize multiple voices.

In Sri Lankan context still there is no system available which is capable of short listing candidates, conducting psychometric testing and intelligently scheduling and conducting interviews. Therefore this effort is to design and implement a system which facilitates all of the above mentioned features as a holistic approach.

Commencing from the subsequent section onwards paper describes on the methodology, which document the design and implementation of the IRMT system. Next the paper describes the details of test results and finally paper organizes discussion section and the conclusion which will illustrate the problems faced and future works which can be added to the system.

III. RESEARCH METHODOLOGY

After identifying the main issues in existing systems research have developed an architecture which comprises of following components.
a.   Categorizer and Tokenizer.
b.   Psychometric Evaluation Module.
c.   Scheduling Module.
d.   Remote Evaluation Module.

Categorizer and tokenizer module will shortlist the qualified people of a particular vacancy by analyzing candidates qualifications in resumes against the vacancy requirements. Shortlisted candidates from that module will have to go through the psychometric evaluation process, which will assess attributes like intelligence, aptitude and personality of a candidate, then the selected candidates will be directed to either one-on one interview or board interview which will be scheduled by the scheduling component of the system or else for a remote evaluation process. Detailed description of each module is listed below.

A. Categorizer and Tokenizer

Main objective of categorizer and tokenizer module is to provide potential candidate profile management module with semantic capabilities and shortlist the right candidate for the right position. This contains four main features.

1) Publish current job openings:
System provides facility to publish current job openings online. Administrators of a company can input the relevant details of a current vacancy into the system then the system will automatically create the vacancy advertisement and store the necessary details of those vacancies for future processes.
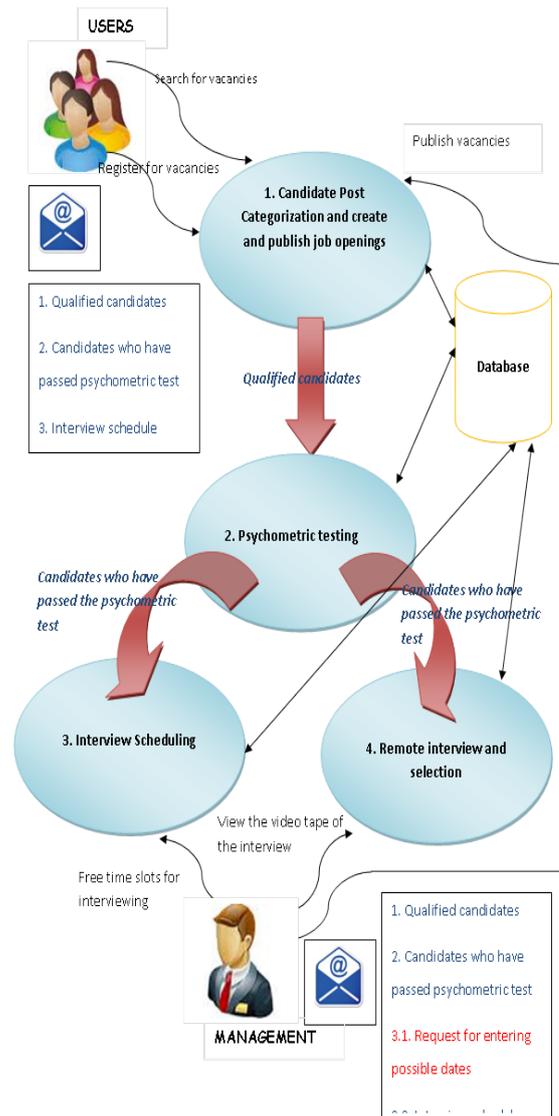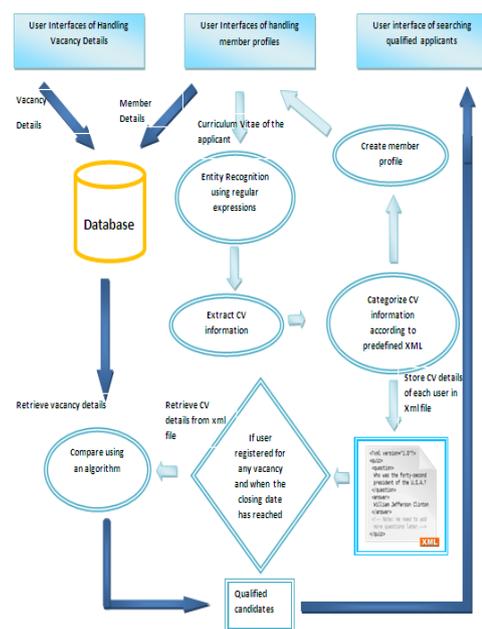

Fig. 1. System Diagram

Fig. 2. Basic architecture of categorizer and tokenizer module

2) Attract outside job seekers:

If any outside job seeker wants to apply for a vacancy first a profile should be created within the system. When creating the profile, profile creator must provide their resume along with their photograph. Resume does not need to be in any predefined format. After creating the profile applicants can register for suitable vacancies by providing necessary details. System also has the facility to update applicant profiles with current details when there is a need.

3) Extracting and maintaining resume details:

System uses a special algorithm to identify and extract resume details. When an applicant upload their resume system will go through the resume and identify each and every field one by one using regular expressions, after that the identified fields will be replaced by a special keyword, then the system will extract resume details using that special keyword. This is also done by using regular expressions. After extracting the details it will be stored in an XML file.

4) Short listing qualified applicants:

System will automatically find the qualified applicants of each vacancy by using an algorithm. This algorithm will use a thread which will wake up once for every twenty four hours and find whether there is any vacancy where the closing date has reached, if there is any it will automatically retrieve the details of applicants who has registered for the relevant vacancy and compare it against the vacancy details and find the most suitable applicants. When the selection process is complete each manager of the company will be notified through a mail. Finally the managers can log in to the system and confirm the selection, and then the system will notify each short listed applicant through a mail.

B. Online intelligent psychometric evaluation

Psychometric tests may measure intelligence, aptitude, personality and psychology of a person. Large, medium, and an increasing number of small firms use psychometric tests to gather vital information from potential and current employees. [13] Online Intelligent Psychometric Evaluation Module is using a three-tier system architecture design. The features are identified for the component is listed below.

1) Online examination:

Online intelligent psychometric evaluation component is a web-based intelligent allotted time multiple-choice-question examination system. System will determine the applicant's performance depending on his or her answer and the next question will be generated according to the applicant's performance. This happens through a special algorithm. System does the initialization and randomly selects a question with the highest difficulty level from the database associated with the relevant vacancy type the applicant applied. If answer given by the applicant is correct system again randomly selects a new question with a higher difficulty level or if the answer is incorrect system randomly selects a new question with lower difficulty level. This repeats until the allotted time is expired. Applicants can attend in a quiz from anywhere in the world by using this system.
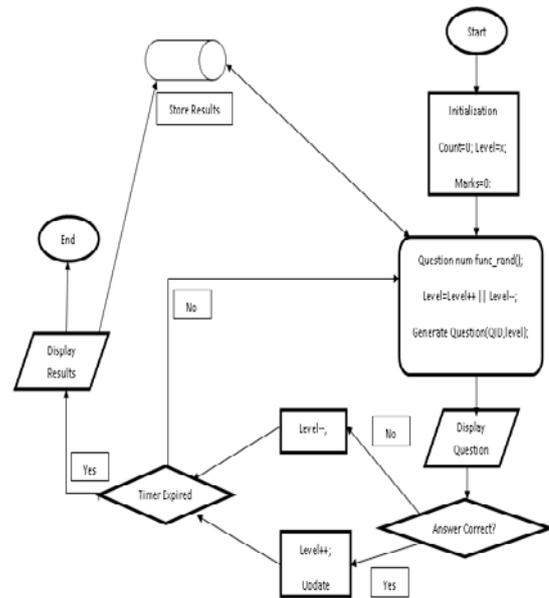

Fig. 3. Difficulty level increasing and decreasing flow

2) Verification of marks:

System does automated marking while it generates new questions for the applicant. Marks allocated for questions depend on its difficulty level and for each applicant; marks are updated though doing the examination. As soon as the allotted time is expired applicant is redirected to the result page where system shows applicants marks.   Therefore no need for examination of heaps of answer scripts manually.

3) Record maintenance:

All the statistical data involves examination activities in examination process and the question bank is tracked by the system. All the records are stored in the data repository for future and present use. The statistical data is used in applicant selection process and it overcomes the problems allied with inability to access information quickly and reporting.

4) Applicant selection:

Many companies report problems with large numbers of applicants dropping out after they have been invited to interview or attend an assessment centre. Part of the reason for this is the common practice of companies holding applications on file, sometimes for significant periods of time. [14]

Understandably, many applicants will already have found other employment by the time they receive an invitation to attend for an assessment. Unwillingness to travel to assessments and self-assessment against job specifications may also play a significant part. [14] Online intelligent psychometric evaluation affords a first-class response meant for that. Since the tests can be taken online, can conquer the tribulations allied to refusal to travel and reduce the time of companies holding applications on file with scheduling everything on time. With this approach applicants with higher marks get opportunity to be selected for the interviews.

C. Scheduling

Scheduling components' main focus is to provide interview schedules in a more flexible, accurate way as same done by a human. The main procedure of the component is described in the above diagram.
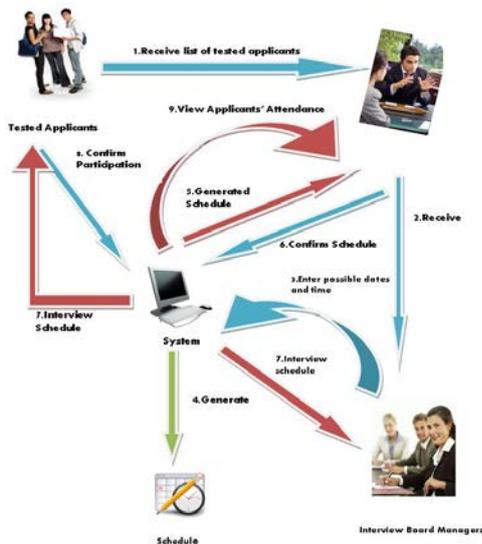
Fig. 4. Basic architecture of scheduling module

1) Retrieve free days from interview board managers:

To get free days from interview board members interview scheduler inform them about the interview. First interview scheduler will set the date range which is better to hold the interview, then scheduler will find the relevant interview board mangers by providing the vacancy category to the system and send an email to managers asking them to enter their possible dates and time slots to the interview. After receiving the mail, managers can log in to the system and enter free dates and time slots for the relevant interview.

2) Generate interviews:

System automatically starts to generate interview schedules by considering free dates and time slots entered by the managers. System use its rule based system to come up with schedules.

Procedure of generating interview is as follows,

There are five board members for one interview including one manager from organization's HR department. System first considers whether all five members have entered the same date, if so the interview will be scheduled on that date and time. If not, system considers whether three members are free on a particular date. If so the interview will be scheduled on that date because majority of members are free. If five members have entered different dates, system gives priority to the member of organization's HR department and interview will be scheduled on that date. Same procedure will be followed when allocating time slots for the interview.
Then scheduler can view the generated schedules and can confirm it if he is satisfied with the schedule or else it can be modified. Then generated schedules will be mailed to the interview board members and applicants of the relevant interview.

3) Retrieve applicants' confirmation for the interview:

Applicants must be logged in to the system and confirm their participation after receiving the interview schedule. If in case any applicant is unable to come for the interview their preferred dates for the interview can also be entered to the system.

Then scheduler can view applicants' participation to the interview. If sufficient number of applicants are not attending to the interview scheduler can change the interview date also.

D. Remote evaluation

The initiative of the remote evaluation is to verify the answers giving by the applicant in the webcam interview and match applicant answers with correct answers in order measure the knowledge of the applicant regarding the domain he is keen on in order to help managers in decision making by providing suggestion regarding the applicant. This would help to save time, resources and also reduce the cost of interviewing. In order to make the remote interview feature, two main components are used which are mention below.

1) Voice detection and recognition module:

The Voice Detection and Recognition module will mainly focus on detecting applicant voice to process. The main objective is to detect correct words form the applicant and convert it into text to pipeline the answer to the answer analysis system using fuzzy logic [15] component. Voice detection and Recognition is done in the client machine in order to reduce the server becoming busy. The ultimate result of this component is to recognize voice correctly separate each answer given by the applicant and convert it to text. The main user of the component is the applicant since he is the person who is sitting for the interview.

This module will cover only one of the main aspects of conducting interview. This module doesn't consider about accuracy of the answers. Instead of that this contains questions for a whole interview for each post which will help to conduct the interview in an unbiased manner. When applicant sits for the interview from the database the questions will be extract which is in text format and convert it to voice. The voice input will receive from a general microphone and the video will be captured via a general purpose webcam. Then the module detects the voice and recognizes it correctly and converts it to text and save it in the client local machine. But to provide accurate results user need to speak clearly and the environment should be noise free.

2) Answer analysis using Fuzzy Logic:

Answer analysis system using Fuzzy Logic is used to analyze the answers with the correct answers which are the output of the Voice Detection and Recognition Module. Fuzzy logic is used to compare the two strings and get the ratio of the accuracy of the applicant answer. Component will assign a weight for the each correct. System will display the best suggestion as the applicant who has scored the highest score. The ultimate result will be to give suggestions to the managers when it comes to decision making regarding employing the applicant.

IV. RESULTS AND DISCUSSION

Recruiting the right person for the right position is not an easy task, where it needs to be going through a careful step by step procedure. IRMT will help in such a scenario to make that process efficient and accurate. After carrying out several surveys of existing systems in the industry, IRMT has designed to address the inconsistencies in those systems. The IRMT,

new revolutionary system is designed with nearly 80% accuracy.

Categorizer and tokenizer module will do the whole short listing process of applicants without any human interaction. Therefore the system is capable of recruiting right people for the right position without any internal and external favourations. This will also help to maintain an organizational culture that attracts competent people to the company. System has the capability to maintain the updated employees and applicant details through the profiles they create. In order to create these profiles the system will do the resume field identification and data extraction process accurately. Extracted data from resumes will be stored in an XML file.

```xml
<?xml version="1.0"?>
<CVObject xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">

   <Civilstatus> Unmarried
</Civilstatus>
   <FullName>   Don Asanka Sanjaya Wijerathne
</FullName>
   <Address>  No.100/1 Batagama,Kandana
</Address>
   <Telephone>  +94 (0) 790123456,+94 (0) 112345678
</Telephone>
   <Email> asanka@yahoo.com
</Email>
   <Age>23
</Age>
   <DoB> 31st December 1988
</DoB>
   <Gender> Male
</Gender>
   <SchoolAttended> Ananda College,Colombo
</SchoolAttended>
   <EducationalQualifications>
2004 Successfully completed G.C.E.
Ordinary Level  Examination
</OL>
   <OLsub1>Science</OLsub1>
   <OLsub1result>A</OLsub1result>
   <OLsub2>Mathematics</OLsub2>
   <OLsub2result>A</OLsub2result>
   <OLsub3>Social studies</OLsub3>
   <OLsub3result>A</OLsub3result>
   <OLsub4>Catholicism</OLsub4>
   <OLsub4result>A</OLsub4result>
   <OLsub5>English</OLsub5>
   <OLsub5result>A</OLsub5result>
   <OLsub6>Sinhala</OLsub6>
   <OLsub6result>A</OLsub6result>
```

Fig. 5. A part of sample XML File

The system is also capable of automatically selecting qualified candidates when the closing date of the vacancy has passed. The entire qualified applicant selection process will take less than one minute to go through one applicant profile, however it is done as a background process and therefore time limit will not become an issue. Qualified applicant selection process will select the best suitable candidates for a particular position therefore this will help to see how a candidate fits with the job he or she has applied for, individually and in comparison with all other applicants.

Online intelligent psychometric evaluation module is a web-based intelligent allotted time multiple-choice-question examination system. This used to assess attributes like intelligence, aptitude and psychology of a candidate. Measuring these subjective traits quantitatively is composite. System will determine the applicant's performance depending on his or her answer and the next question will be generated according to the applicant's performance associated with the

relevant vacancy type the applicant applied. However the personality questions are created in a way that it cannot increase or decrease the difficulty level. In multiple choice questioning systems with increasing and decreasing facility of difficulty level, it is difficult to implement these types of questions. Though, lacking this element does not affect the system, because competency and personality goes hand in hand, where the system is proficient to appraise.

This system provides online examination, verification of marks, record maintenance and applicant selection facilities. System is endow with difficulty level increasing and decreasing ability of psychometric testing questions, Reduce the obscurities of conducting manual evaluation process, Automatic preparatory and termination of psychometric testing periods for each vacancy type and Effectiveness of methods used for sifting, short listing and final selection decisions. Neither one of Recruitment and Selection management tools implemented in Sri Lanka are incorporated with psychometric evaluation.

Scheduling component is capable of generating interview schedules in a more realistic way. Most of the scheduling systems generate schedules using linear algorithms. As a solution for that, scheduling component is introduced, which generate schedules based on its rule based system. This rule based system includes all necessary aspects as human thinks when generating interviews. Many existing systems close its scheduling process after generating the schedule; however this component is capable of getting applicants' confirmation for the interview. By considering the applicants' participation to the interview, organization can cancel the interview if there are no sufficient applicants. This helps to avoid allocating resources unnecessarily.

Currently the concept of automated webcam interview is whole new to the community; experience behind the current research is shown lack of recognizing voice accurately rather than matching the string. Therefore from the beginning of the research, main focus was to improve the accuracy of recognizing voice in the remote evaluation feature. This contains voice detection and recognition modules which will recognize the answers of applicant and convert it to text. Answer analysis system using fuzzy logic will compare the applicant answer with the actual answer and give the weight to it. To implement the answer analysis component, fuzzy logic is used. Custom grammar is maintained to increase the accuracy of the system.

V.   CONCLUSION AND FUTURE WORK

The main objective of this architecture is to develop a web-based application that can assists in Recruitment and Selection process in a company. The architecture also enhances greater benefits of Recruiting and Selecting namely, the flexibility, convenience, reduced time and cost, help in better decision making and freedom from paper work.

The presented system can be improved in following ways.
a.   Support multiple databases.
b.   Embedding a report generation module.

REFERENCES

[1] "Human resource information system (HRIS)", Encyclopedia of Business, Available at:"http://www .enotes.com/biz-encyclopedia/human-resource-information-system-hris", [Accessed on: 20th September 11]

[2] A project study on "Recruitment and Selection in IMS Learning Resources Pvt. Ltd", Slide Share, Available at : "http://www.slideshare.net/harshalsk/ recruitment-and-selection, [Accessed on: January 11]

[3] "Human resource management system," wikipedia.org, Available at: "http://en.wikiped ia.org/wiki/Human resource management system", [Accessed on: January 11]

[4] "The employee resourcing process", HRM Guide, Available at:"http://www.hrmguide.co.uk/employee_reso urcing/", [Accessed on: January 11]

[5] "The impact of implementing a hris", Insight consulting partners, Available at:"http://www. ins ightcp.com/res_09.html", [Accessed on: January 11]

[6] "Global human resources management and organizational development", ITAP International, Available at: "http://www.itapintl.com/whatwedo

[7] /globalhrmod.html", [Accessed on: January 11]

[8] "Orange HRM", Orange HRM Open source HR Management, Available at: http://www.orangehrm .com/, [Accessed on: 20th March 11]
"Psytech International", psytech.com, Available at: "http://www.psytech.com/", [Accessed on: May 11]

[9] "Cyber Matrix Pro Schedule™: Appointment Booking for Professionals", Cyber Matrix Coporation, 1998, Available at: http://www.cyber-matrix.com/pro_schedule.html/, [Accessed on: 30th August 11]

[10] "Time CyberMatrix Meeting Manager™: Office Meeting Scheduler ", Cyber Matrix Coporation, 1998, Available at: http://www.cyber-matrix.com/meeting_manager.html /,[Accessed on: 30th August 11]

[11] "Time management Software Specialist", Cyber Matrix Coporation, 1998, Available at: http://www.cyber-matrix.com/, [Accessed on: 30th August 11]

[12] "Dragaon Natural Speaking", nuance, Available at: http://www.nuance.com/naturallyspeaking/products/ whatsneupgrade.asp, [Accessed on: 20th May 11]

[13] "The use of psychometric tests in selection and recruitment", Association of Graduate Careers Advisory Services, Available at:"http://www.agcas. org.uk/assets/download?file=442&parent=222", [Accessed on: February 11]

[14] "Psychometric Testing - A review of the train driver selection process", Rail Safety and Standards Board Ltd, Available at: "http://www.rssb.co.uk/SiteCollection Documents/pdf/reports/Research/", [Accessed on: February 11]

[15] "Fuzzy logic", Wikipedia, Available at:"http://en.wikipedia.org/wiki/Fuzzy_logic",[Accessed on: 20th September 11]