Personality Based E-Recruitment System

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Abstract: Nodes in Mobile Ad Hoc Networks (MANETs) are limited battery powered. That's why energy efficient routing has become an important optimization criterion in MANETs. The conventional routing protocols do not consider energy of the nodes while selecting routes which leads to early exhaustion of nodes and partitioning of the network. This paper attempts to provide an energy aware routing algorithm. The proposed algorithm finds the transmission energy between the nodes relative to the distance and the performance of the algorithm is analyzed between two metrics Total Transmission energy of a route and Maximum Number of Hops. The proposed algorithm shows efficient energy utilization and increased network lifetime with total transmission energy metric.

Keywords: Personality; Recruitment; Job suggestions; Information technology; Skills; Chatbot; AI; Career; Talent; Path; E-recruitment; Skill improvement; Personality assessment

I.   INTRODUCTION

When applying for a job, the first thing a job seeker does is access one of the many job sites available. They go through the listings on the site and finally apply for one or more of the positions for which they seem suited. They then wait until they get a reply from a recruiter or hiring manager. On the flip side, the hiring managers for each company have to weed out the unqualified applicants and hire someone who would potentially be a great fit for their company, both skill-wise as well as in terms of personality. This process usually takes weeks or even months to complete, so jobseekers are left hanging until a decision is made one way or another. In addition, if rejected, the candidate is often not given a reason for the rejection – they have to figure out for themselves what they were lacking. With the advent of technology, particularly the recent rise of AI, as well as the new insights into Personality prediction, a gap in the current job recruitment system can be seen, where a system that focuses on placing a candidate in a given company based not just on skill, but also personality, would fill said gap. Currently, there are a few systems that focus on matching candidates with job openings, with a couple even based on personalities. One in particular, titled "An integrated e‑recruitment system for automated personality mining and applicant ranking", focuses on matching candidates with jobs based on personality [1]. None however, are focused on the candidate – they address the concerns of the recruiter/company while ignoring the uncertainty and concerns of the candidate. This paper documents a fully functional candidate focused e-recruitment system in the form of a web application, through which candidates can be successfully matched with jobs based on skills as well as their personality. The system suggests jobs to jobseekers based on their skills, experience and personality, matching them with an opening while taking into account the skills required and culture of the organization. In addition, the system also makes suggestions as to what areas the candidate can improve upon, in case of an unsuccessful application.

II.   LITERATURE REVIEW

Faliagka et al. proposed an Integrated E-Recruitment System for Automated Personality Mining and Applicant Ranking in 2014. In it, the system implemented an automated candidate ranking, based on objective criteria that was to be extracted from the applicant's LinkedIn profile. The candidates' personality traits were automatically extracted from his/her social presence using linguistic analysis. The applicant's rank was derived from individual selection criteria using analytical hierarchy process (AHP), while their relative significance (weight) was controlled by the recruiter. The system was limited by the fact that senior positions that required domain experience and specific qualifications were screened inconsistently [1]. Linden et al. published The General Factor of Personality: A meta-analysis of Big Five intercorrelations and a criterion-related validity study in 2010. In their paper, they analysed the intercorrelations among the Big Five personality factors (Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) to test

for the existence of a GFP. They found that the meta-analysis provided supporting evidence for a GFP at the highest hierarchal level and that the GFP had a substantive component as it is related to supervisor-rated job performance. However, they also realized that it was important to note that the existence of a GFP did not mean that other personality factors that were lower in the hierarchy lost their relevance [2]. Inceoglu et al. published a paper titled "Personality and Job Engagement" in 2012. In it, they predicted that aspects of personality that are themselves more activated and energized would be reflected in engagement. Stronger links with job engagement were predicted for the more energized components of Extraversion and Conscientiousness, namely Social Potency and Achievement Orientation [3]. Those predictions were tested through three studies on an international website offering free advice to individuals about assessment processes for staff recruitment and development. The findings confirmed that shorter-term job engagement is indeed a significant function of longer-term attributes of personality, and point to particular personality factors and traits that are either more important or less important in that respect. Emotional Stability and Conscientiousness independently accounted for most of the variance in job engagement [4]. The AI chatbot designed is primarily used for maintaining a friendly conversation with the applicant and mapping out his responses so that an accurate prediction can be made on his personality. The questions to be asked to judge the personality are pre-defined based on the research on personality. These questions were mapped out into a conversation tree. The response given to a particular question are used to refine the questions to be asked next and response to those in turn will be used to refine the other questions to asked (computer adaptive testing) as suggested by D Tantam [5]. The chatbots AI was designed to imitate the conversational patterns of an empathetic recruiter similar to the chatbot designed by B. Heller et al. [6,7]. The conversation tree was designed in such a way that the chatbot is able to respond to the applicants' queries empathetically. The chatbot will parse the responses of the applicant to another web application where the responses will be used to decide on a personality. That result in turn will be used to find relevant job openings. These will be presented to the applicant via the chatbot. The primary language used will be AIML and web application will be designed to interface with the chatbot to modify its core structure (conversation tree etc) as suggested by B. AbuShawar [8]. D. Tatum et al. used a virtual assistant to provide psycho-therapy. This approach used online questionnaires to get responses from the patients and tabulate the results. These results were in turn mapped out using software such as Microsoft Visio to reach conclusions about the patient's health. The virtual assistant was also used to ask questions and it was designed to use computer adaptive testing where the responses given to the questions asked where used to decide which kind of questions should be followed up [5]. B AbuShawar et al. had made modifications to the famed ALICE chatbot by building a third-party application using java to modify the knowledge base of the chatbot so that it could operate various different knowledge bases (e.g. history, music). This approach made it easier to change the knowledge base without modifying the AIML code underneath by hand. The advantage of this chatbot was that it used AIML which is a standard language in the development chatbots. The addition of the third-party application to make modification easier made the chatbot even more customizable and adaptable [8]. The AHP is used to score and rank applicants when an applicant uploads the CV (Curriculum Vitae) and fills out a form template. When a position opens, the System follows a 3- stage online recruitment process. These stages include a pre-screening of unqualified candidates, an automatic online background search and finally the ranking of candidates as suggested by Faliagka, Evanthia et al. [9-16]. In what follows, they present in detail the implementation of the system modules. The filtering module performs an automatic pre-screening of candidates, to identify those that meet the minimum requirements of the offered position. After that system, also will suggest the job to applicant which area will be good to continue the career. If the applicant does not meet the requirement the system will suggest what the applicant need to make successful in ranking. Most of companies will recruit new employee through HR Recruitment agencies but E. Faliagka et al. followed the XML based CV submission [15,16]. De Meo, Pasquale et al. proposed a system which supports both individuals looking for a job and companies looking for employees. In such a context, generally, companies populate a database of job proposals, and individuals are supported in their job search by an engine based on classical Information Retrieval (IR) techniques. They system was based on agent technology. A User Agent is associated with each user and manages his profile as well as any interaction with him; a Recruitment Agent supports each User Agent in the selection of those job proposals that appear to be the most adequate for the corresponding user. In the ranking stage, the system derives and ranks the candidates that have passed the filtering stage, based on classic IR techniques. Each candidate's rank acts as a score of how well his profile fits the recruiter's specifications. Ranking is based on the analytic hierarchy process, or AHP [17].

III.   METHODOLOGY

The methodology that the research group used to develop the application was 'Prototyping'. The Prototyping Model is a systems development method (SDM) in which a prototype (an early approximation of a final system or product) is built, tested, and then reworked as necessary until an acceptable prototype is finally achieved from which the complete system or product can now be developed [10]. The basic idea in the Prototype model is that instead of freezing the requirements before a design or coding can proceed, a throwaway prototype is built to understand the requirements. This prototype is developed based on currently known requirements. By using this prototype, the client can get an "actual feel" for the system, since interaction with prototype will potentially enable the client to better understand the requirements of the desired system (Figure 1).
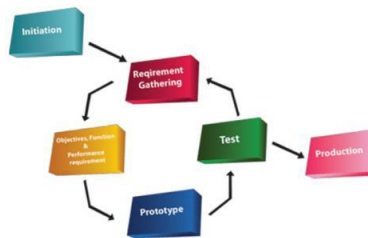

Figure 1: Methodology.

3.1 Planning
The planning phase is the most important part in the Software Development Life Cycle (SDLC) [11].
- Identifying the problem – During this stage, project problems were identified and discussed among the group members.
- Feasibility analysis – The feasibility analysis helped to identify the risk associated with the project. Within existing technology and limitations, the costs and benefits of the system were determined.
- Work plan – A Work Breakdown Structure (WBS) was designed to illustrate the tasks to be carried out. Further, a Gantt chart was developed using the WBS to show the project schedule. It helped to assess how long the project should take, determine the resources needed, and plan the order in which tasks should be completed. It was also used for managing the dependencies between tasks. Project risks were identified and methods developed to minimize or avoid identified risks.
- Work distribution plan – Each member was assigned specific tasks which included developing at least one function of the system. Apart from that, other tasks were assigned to each member based on the skills they possessed.

3.2 Requirement Gathering and Analysis
Before developing the system, the requirements of the system had to be defined in detail. This process of requirement gathering had two main components - Primary and Secondary Data gathering.

3.2.1   Primary data gathering:
The main requirements for the system were obtained through a series of interviews with five companies. Their Recruitment Managers, HR Managers and CEOs were interviewed to obtain information about what they looked for in potential candidates for IT related positions at their companies. Additionally, a questionnaire was sent out to the final year IT undergraduates of SLIIT (Sri Lanka Institute of Information Technology) at the Metro and Malabe campuses, as well as the final year IT undergraduates of NSBM (National School of Business Management). Please refer to the appendix for the questionnaire and results [12].
Based on the results of the survey, it was seen that a significant majority of respondents looked for a job role that suited their existing skills and which was also something they loved to do. In addition, they felt it was important that they were valued and appreciated wherever they were and that they created a positive impact on the world around them. Further, the importance of feeling that they were challenged and pushed to grow is clearly shown in the survey. The

majority also looked forward to working successfully with colleagues at a company with a well-defined career path as well as a good compensation package. Of less importance was the option to telecommute or even flexible working hours. Similarly, not much importance was placed on working for a company whose values aligned with theirs personally. A summary of the results of the interviews with the companies showed a marked preference for technical skills at the initial interview. However, once the technical interviews were complete, focus was placed almost fully upon personality, language and communication skills, attesting to their importance. The results of this survey and the interviews with the companies allowed the Analytical Hierarchy Process (which is used to match candidates with suitable openings) to be fine-tuned and refined so as to provide accurate job suggestions for candidates. These suggestions will match candidates and companies in terms of both personality and technical skills to ensure that both parties are satisfied with the end result – the successful placement of a candidate at a company [14].

3.2.2   Secondary data gathering:
This information was obtained through reviewing related research literature. Please refer to Chapter 2 for a detailed review of the related research papers.

3.3 Design
The system operates as a web-based application. The client (the jobseeker or recruiter) can access the system via a client pc through the internet. The Cloud server where the website is hosted serves clients' requests such as sending job listings and responses from the AI chatbot. The chatbot and the personality analysis process runs on the cloud server along with the AHP process. Management of the web application is done by logging into a special admin session on the website [15]. The pc used to connect to the admin session (admin pc) can be used to modify certain aspects of the web application, for instance, to make modifications to the AHP and the personality analysis. The admin will also be able to make modifications to the AI chatbot. All users of the web applications will have to login and each user will have his/her own session. Depending on the user the functions presented by the web applications will vary. A jobseeker can login and search for jobs, converse with the chatbot, search for job listings and modify certain aspects of his profile. A hiring manager, once logged in, can list jobs and make modifications to his profile as well. The admin will have more control over the whole web application as he can modify nearly all aspects of the applications [13] (Figure 2).
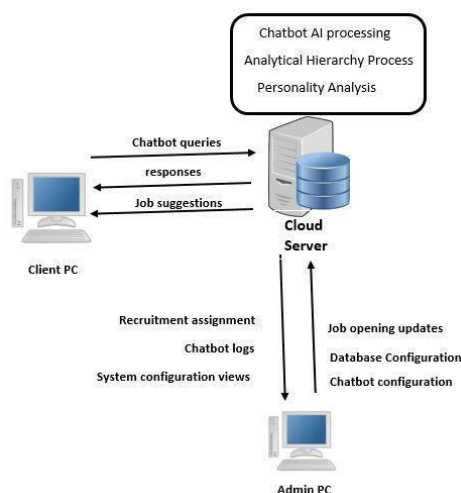

Figure 2: System architecture.

3.3.1 Chatbot methodology:

The chatbot is based on the recast.ai API. It is an API that is used to build Chatbots that fit ones' particular needs. Each chatbot consists of a set of intents. Each intent consists of a set of questions or question and a pre-defined and expected set of responses for the questions asked by the chatbot.

Ex: Intent = life of The Party
Expected Response/notion (LIFEOFTHEPARTY) = Yes, I'm the life of the party.
If notion is not found the questions to be asked. = Are you the life of the party?

These responses are called notions within the context of the chatbot. The main goal of the intent is to look for a particular notion – until that notion is found, the chatbot will continuously ask questions. Once the expected response is found the chatbot can be designed to move onto another intent. A trigger phrase can be used to activate an intent or an intent can be activated immediately after another intent is completed. This is how the conversation tree of the chatbot is designed. A red line connecting two intents denotes that once the first intent is completed, the next intent is immediately activated. The later intent cannot be activated till the former intent is completed. This ensures a flow within the conversation tree. A blue line suggests that the particular intent can be activated without the other linked intent having been completed. Intents that are not connected to the conversation tree are not part of the flow and can be activated and completed without any interruption to the regular conversation flow [18] (Figure 3).
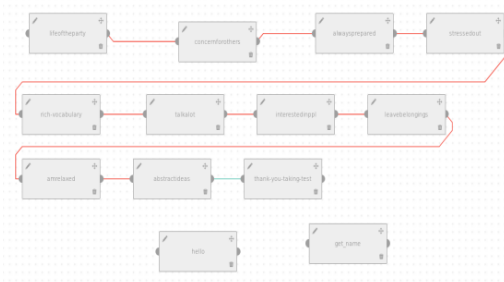

Figure 3: Conversation tree.

The chatbot interface of the "Jobnapper" website is designed to send each response to the "Recast.ai" API. The API uses a "conversation token" to keep track of each conversation. This token is generated at the start of each conversation. The chatbot interfaces saves this token at the start of each conversation to be sent with every response that follows and all those following responses will be considered as part of the same conversation. When a user enters a response that response is sent to the chatbot API. When the chatbot sends back a response it is checked against a database containing questions related to the personality test. If the response is found within the database a new "Question" object is created. Each question contains a predefined set of responses within the database. These questions are then presented to the user to be selected as an answer to the question. Once a user selects a response it is sent to the chatbot as well as being stored in the database to be used later for scoring the personality. Since the responses stored in the chatbot and the database is the same a notion gets satisfied and the chatbot moves onto the next intent in the conversation flow. This is how the personality test is carried out by the chatbot.

3.3.2 Personality analysis:

Before Personality Analysis can take place, the applicant has to be first asked a series of questions according to a Standardized personality test. The questions for this test were obtained from the International Personality Item Pool, found at ipip.ori.org. This test is then administered to the applicant through the Chatbot interface implemented in the system. The responses to each question are stored in a database which also keeps track of the question category (Extraversion, Conscientiousness, Neuroticism, Agreeableness and Openness). The Personality Analysis algorithm retrieves the response to each question from the database, and based on the category, calculates a personality score for that category. A separate counter keeps track of the total number of questions retrieved from the database. Once the

personality score for a particular question is calculated, the total count is incremented by one. This continues until the count reaches fifty. Once this happens, the main body of the algorithm terminates, and the Personality Test score is displayed to the user, categorized by factor (Figure 4).
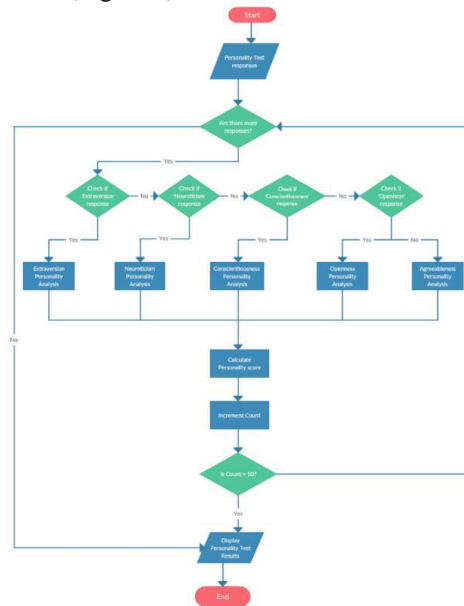

Figure 4: Personality algorithm flowchart.

3.3.3   Analytical hierarchy process:

For this process, skill trees were designed, with a predefined score for each skill. After the CV is uploaded, the data is saved in the database as per the following categories – Experience, Education, Skills and Personal info. Following that, the data is retrieved and processed through the AHP algorithm to create a summary that gives the final score for the CV. Finally, the CV score from the AHP algorithm and the Personality Test Score from the Personality Analysis algorithm are added together to come up with an overall score for a particular candidate. This overall score is used to suggest suitable jobs to the applicant, which he/she can then apply for, through the job suggestion page (Figure 5).
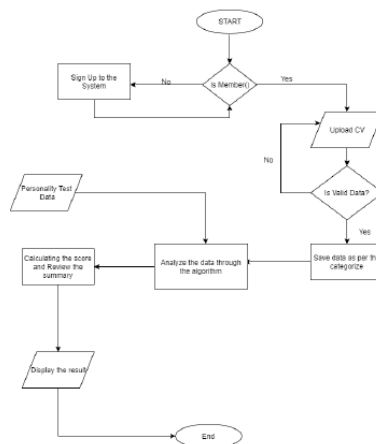

Figure 5: AHP algorithm flowchart.

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3.3.4   Database development:

User input is taken via a form in the web interface and stored in a database. From this data, the users' skills and designation (if any) are used in order to suggest a possible career path to the user. This suggestion is based on predefined combinations of skills and designations for particular career paths.

IV.   RESULTS

This system used a few publicly available APIs in its implementation. The chatbot used a free and publicly available API called Recast.AI in its implementation. The features offered by this service allowed the chatbot to be customized according to the developers' requirements and the resulting chatbot was scalable. Future implementations can use other services for the chatbot such as Wit.AI etc. The first release was not designed to interface with any other recruitment solutions other than what was required for the operation of its individual components. The login and registration page shown below shows the interface through which the user can register and login to the system. Once the login button is clicked, the entered details are validated and if correct, the user is taken to the landing page.
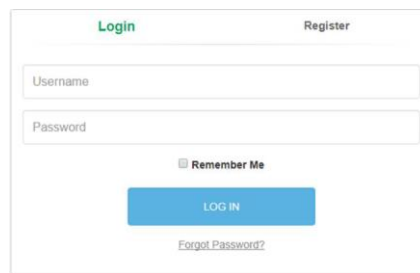

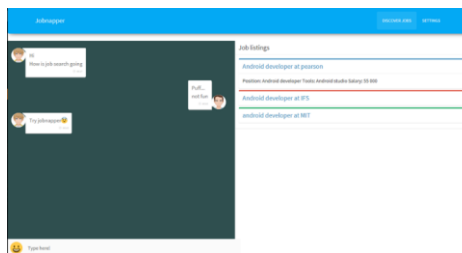**Figure 6: Login and registration interface.**

Figure 7: Landing page.

Figures 6 and 7 illustrates the main landing page for this web application. Once a user logs in, he/she would be redirected to this page where they would be able to interact with the chatbot as well as upload their details and search for openings. In addition to the standard testing that was carried out during and after development (Unit Testing, Integration Testing, Functional Testing, System Testing, Performance Testing, Usability Testing and Acceptance Testing), additional testing such as cross-browser testing was performed to test the rendering compatibility of the website on different web browsers. Further, the website was tested on the most popular handheld devices and links, fonts and styles were validated to ensure the smooth functioning of the system across all devices.

V.   DISCUSSION

In order to demonstrate the ideas proposed and discussed in this research paper, this fully functional candidate focused e-recruitment system was developed, in the form of a web application through which candidates are successfully matched with jobs based on skills as well as their personality. The system suggests jobs to jobseekers based on their skills, experience and personality, matching them with an opening while taking into account the skills required and

culture of the organization. In addition, the system also makes suggestions in regards to the areas the candidate can improve upon, in case of an unsuccessful application. In terms of accuracy and reliability, the Personality Test conducted through the Chatbot is both reliable and accurate, as it is based on a standardized personality test used by multiple organizations and educational institutes worldwide. The test is scored using a Personality Analysis algorithm which compares the results of a particular candidate with standard values in order to give each candidate a personality score. The accuracy of the Chatbot depends on the vocabulary of each intent. Each intent contains a set of possible responses the user is likely to give. The greater the number of predefined responses and intent has the more accurate the chatbot will be. Currently the main intents that areas available are for the personality test and as such the accuracy of the chatbot responding to personality test related responses are high. However, the accuracy of the chatbot when it comes to other areas is not as high. The accuracy of the chatbot will increase over time as more intents are created, along with additional responses. Therefore, at the moment, personality test-wise conversations will be very accurate while conversations related to job-finding and profile management are only somewhat accurate. The Analytical Hierarchy Process is used to suggest suitable jobs to an applicant, which he/she can then apply for, through the job suggestion page. This process, carried out through the AHP algorithm, is only as accurate as the data entered into his/her profile by the candidate. If the candidate provides the system with all the data it requests, it can then use that data and combine it with the results of the Personality Analysis to provide accurate job suggestions.

VI.   CONCLUSION

As there is currently no candidate focused e-recruitment system on the market, this solution fills a gap in the current market and can potentially make a major impact in the lives of job applicants as they search for a job by:

- Streamlining the job application process.
- Giving them job suggestions tailored to their interests and skills.
- Providing them with insight into their own personality.
- Showing applicants potential career paths that they could take.

6.1 Limitations

The final solution presented by this research group is a product that meets the functional and non-functional requirements identified earlier by the team. However, the quality of this system could have been improved if the development team had more knowledge regarding the tools and technologies used. The algorithms used to analyse personality and in the Analytical Hierarchy process could have been be refined further with more advanced knowledge. In addition, the accuracy of the job suggestions, as mentioned previously, is limited by the accuracy of the data entered into the system by the applicant. If the data entered is incomplete, or if inaccurate responses are given during the personality test, the personality analysis and final job suggestions will not be accurate.

6.2 Recommendations

This system was developed for use by anyone searching for jobs, at any stage of their career. In order to use this system, it is recommended that users have access to a PC or laptop, a stable internet connection, be familiar with how to operate a web browser and fair knowledge of English.

VII.   FUTURE WORK

This e-recruitment system can be developed further in order to provide more features to the user, as well as to make it more user friendly. From a technical perspective, a number of improvements can be made as follows:

- The accuracy of the Chatbot can be improved so that the user will feel as if he/she is conversing with a real person.
- The Personality test and analysis can be refined so that the results are analysed according to the locale.
- Refine the scoring process and increase its scope so that more factors are taken into account in the AHP algorithm.
- The system can be optimized for mobile viewing so as to provide user access for users on the go.

- Increasing the user friendliness of the system.
- This system was implemented for a subsection of the IT industry only. In the future, this can be expanded in order to reach a wider audience and encompass a variety of industries and domains.

VIII.   ACKNOWLEDGEMENTS

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