

Considerations for a Virtual Training System to Improve Job Interview Skills for Software Engineers

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ABSTRACT

Nowadays, engineers have to face a lot of challenges before going to a job interview. Introversion, insecurity or lack of experience are some of the reasons that can lead to poor interview performances. Through training, such difficulties can be overcome, leading to significant skill improvement. Our paper presents the advantages of using emerging technologies to facilitate job interview training. Our proposed model for a training system is based on virtual reality and chatterbots. Hard skills and soft skills training, various 3D virtual environments and domains modularity could ensure the personalization of the system for any job training situation.

Author Keywords

Interview; engineering; training; chatterbot; virtual reality.

ACM Classification Keywords

H.5.1. Information interfaces and presentation (e.g., HCI):
Multimedia Information Systems.

General Terms

Human Factors; Documentation; Theory.

INTRODUCTION

In the 21st century, engineering is one of the most appreciated and successful domains. Engineers must have various competencies, including mathematics, science, economics, or social knowledge in order to create, research and innovate. The field is quite large, as engineers are capable of creating impressive inventions related to mechanics, chemistry, electricity or software.

It is thus obvious why small, medium or big companies are always searching for competent engineers. Over the last few years, a small tendency of growth was observed regarding the employability of engineers on the job market, and it is most likely that this increase will continue in the following years. Software engineering and IT fields are

probably the most successful ones, having the biggest employment growth after the economic recovery [1].

Even if the numbers show that software engineers are sought in all companies, their interview performances do not always have the expected results. Engineers usually have to face numerous difficulties when applying for their first job. Even worse, some of these problems still exist after the first interview: introversion, insecurity, lack of experience or lack of social contact are just a few reasons which can lead to poor interview performances.

There are many articles that try to give pertinent advice for engineers in order to help them prepare for an interview. There are various aspects which must be carefully arranged, as they are essential for performing well at an interview [2]:

- Revising previously acquired knowledge from university;
- Getting ready to handle unpredictable scenarios;
- Analyzing important personal accomplishments related to engineering;
- Researching company-related information and issues;
- Remaining calm and true to oneself.

Unfortunately, all these aspects are difficult to accomplish by young graduates, with little to no experience. Therefore, we can say that the real key for obtaining good performances at a job interview is training. By definition, training is an activity which must be undertaken by a person in order to achieve a certain degree of knowledge or competencies. By training, new information and instructions are communicated to the trainee, helping them improve and gain the required skills [3]. If we practice some standard questions and revise our previous knowledge, our chances of obtaining better results at interviews increase. Learning through experience is always better, as the Chinese philosopher Lao Tse says: “If you tell me, I will listen. If you show me, I will see. But if you let

me experience, I will learn”. Training methods relying on theory are not always successful, and job interview training should be based on practice.

There are several methods of simulating an interview situation: practicing in front of a mirror, asking a friend for help or, even better, seeking advice from career counseling experts. Each one of these possibilities has some advantages and some drawbacks. Firstly, the idea of practicing in front of a mirror can boost one’s confidence, help them put their ideas in order and formulate a possible speech. On the other hand, since there is no actual feedback, the person cannot be sure if their speech is a good one; they are not taking part in a dialogue and can only practice the questions they perceive as being relevant. If they practice with a friend, there is some feedback, but the lack of technical (or even social) experience can make the interlocutor formulate irrelevant questions. Finally, the idea of hiring a career counseling expert can offer the most accurate experience. Unfortunately, several counseling sessions are needed, which, in turn, can be quite expensive. Human subjectivity is a permanent factor, which can influence erroneously our training process

Our current paper will propose an innovative training system which can be used to facilitate job interviews for engineers. In the following chapters, we will present some emerging technologies which can be used to create training systems, we will analyze the existing computer-based systems for job interview training and finally, we will propose our model based on emergent technologies.

EMERGING TECHNOLOGIES FOR TRAINING SYSTEMS

We live in an era of technology, so the time has come to try and integrate it in as many domains as possible. Traditional training methods can therefore be replaced by the use of emerging technologies, which can thus facilitate the training process.

Virtual Reality

Such an example is Virtual Reality (VR), a current trend, an emerging technology which has the capacity of creating virtual environments with the help of computer-based means, simulating, thus, real-life situations. Since 1950, when the term was coined, this technology has never ceased to evolve. Additional devices, such as head mounted displays (HMD), joysticks, gloves or steering wheels are invented and perfected continuously, providing the authenticity of the immersion. In the past, we were talking about “classical virtual reality”, focusing on equipment. Now, we are talking about “immersion-centered VR”, which concentrates on stimulating the two main senses of the user (sight and hearing) in order to create an authentic, realistic and immersive experience [4] [5]. The capacity of creating a great variety of virtual environments, the accessibility and flexibility of the process, or the reduced costs and instant feedback are just a few reasons which justify the idea of using virtual reality to create training

systems. We have analyzed several researches regarding the use of VR for training and we have realized that it is a promising technology, which could be used in many domains, such as education [6], medicine [7], army [8], architecture [9] or entertainment [10].

Cognitive Services and Chatterbots Frameworks

Microsoft’s cognitive services represent a group of APIs which use machine learning-based models in order to ensure a natural interaction between users and their various tools. By using cognitive services, algorithms from a large variety of fields can be exploited, such as Computer Vision, Voice Recognition, Recommender Systems, Face and Emotion Recognition, Text Analytics (Figure 1). They are based on artificial intelligence principles and can facilitate a great variety of tasks which require fast extraction of information from data. These APIs can be easily imported in any programming language and integrated into any platform, such as Android, iOS or Windows [11] [12].

A chatterbot or chatbot is a software-based program capable of simulating a conversation with human interlocutors, especially through the Internet [13]. The conversational partner might believe they are talking to a real human being, so chatterbots must be capable of passing the Turing Test. This test was developed by Alan Turing in 1950 and has the goal of verifying if a machine is capable of reproducing intelligent behavior equivalent to that of a human being. Passing the Turing Test can be challenging, as machines do not require just the simulation of intelligence: they should also be capable of reproducing unintelligent human behavior (Figure 2) [14]. Chatbot frameworks represent places where bots are actually built and where their behavior is conceived. There are many development frameworks for creating chatbots, most of them being based on natural language processing (NLP).

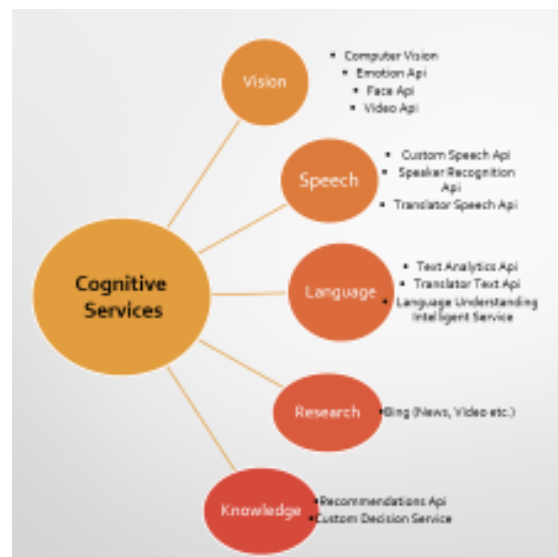


Figure 1: Cognitive Services and their APIs.

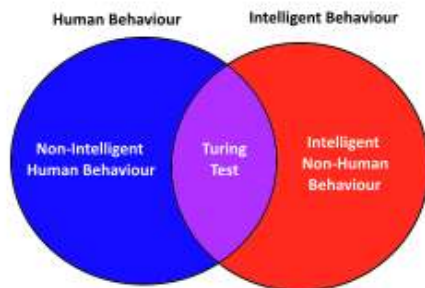


Figure 2: Turing Test Principle.

NLP applications take as input natural language and process it at low or high level in order to accomplish certain tasks (recognize parts of speech, find information or answer questions) [15]. Some well-known frameworks for chatbots are [16]:

- API.ai, which includes support for various messaging platforms, such as Facebook or Slack.
- Wit.ai, entirely free, ideal for software developers, capable of being integrated in many messaging APIs and SDKs.
- Microsoft Bot Framework, which offers the capacity of using multiple interconnected bots, able to interact in a natural manner with users, through text, email, Skype or Slack.

If we take into account all the previously analyzed aspects, chatterbots and virtual reality can represent useful tools for facilitating the training process, in various domains. For instance, sales departments can benefit from these emerging technologies as their time and budget limitations are the main obstacles preventing them from investing in their personnel's training. Regular training can involve high costs, can affect the company's productivity and does not include actual interaction with real clients. Therefore, many sales teams do not receive the appropriate training in order to achieve their maximum potential. A possible solution is the use of e-learning, but the experience is not immersive enough to ensure an accurate simulation of real-life situations. An alternative is represented by the use of virtual reality and chatbots – it can facilitate the transition of the training process from a static, often boring experience, to a dynamic, immersive one. The use of these emerging technologies can bring many advantages, such as the total implication and immersion of the trainee, reduced costs, great accessibility, flexibility and commodity of virtual learning. By using HMDs, employees who receive training can find themselves in the right position: face to face with the bot. This can ensure a profound, significant and relevant training experience [17].

Another situation presents the use of chatbots for security training in an enterprise. Two case studies conducted with 106 users and security specialists show qualitative progress

in the training process. By using an e-learning package, including a chatbot named Sally, various areas of questions, such as knowledge, behavior and attitude towards security, were tested. The attitude of trainees which participated to the case studies was more positive when chatterbots were used, as opposed to the traditional use of conventional e-learning for security training [18].

One of the domains which show great potential in the use of chatbots for training is human resources (HR). Even though we are still at the beginning of chatterbots' evolution, there are already several prototypes which bring many advantages in HR training. Chatbots can be an excellent alternative to the various tools employed in a company, which can be too complex or difficult to use. Chatbots are simple, intuitive and can be successfully used for HR functions and interacting with the employees. The use of this technology has many advantages, as chatterbots programs can be easily and rapidly implemented if there is already an internal communication system in the company. In addition, the recruitment process can also be facilitated by the use of chatbots, which are capable of filtering the spams received by the recruiters. Therefore, only the best candidates will get to interviews, making the recruiters' job easier [19]. Other advantages of using chatbots include the capacity of solving the problem of specific terminology and jargon for unfamiliar users or the objectivity and politeness of bots when having to deal with rude clients, intense traffic, repeated requests of the same information [20].

COMPUTER-BASED SYSTEMS FOR JOB INTERVIEW TRAINING

Job interview training can be accomplished through the use of online courses: Udemy, English Online Learning or Impact Factory are just a few examples of websites which offer video tutorials meant to train specific competencies. Recent technologies, such as virtual reality and chatbots can be combined in order to obtain better results.

Such an example is the program "Job interview with Molly Porter", developed by the universities of Yale and Northwestern in collaboration with professional rehabilitation specialists. The system is quite complex and allows users to practice computer-based job interviews in a stress-free environment. A practical simulation with a fictional interviewer (Molly Porter), user-based teaching material, interactive hiring process and constant, advanced feedback are some of the characteristics included in the system. Advanced simulation technologies make each conversation with Molly unique, helping the trainees acquire useful competencies and gain confidence during an interview. Feedback is given permanently by the virtual trainer during the interview and a complete critique is available at the end of the process. The Molly Porter system has also been tested with adults suffering from various mental disabilities, such as schizophrenia, autism or post-traumatic stress disorder. Results are encouraging, showing that similar systems could have a large specter of efficient

uses [21] [22]. Using virtual reality to train mentally disabled people is often the subject of current researches, their goal being that of increasing their employability and integration on the job market [23].

One essential aspect related to VR-based job interview training is the need of ensuring high immersion of the experience and a high degree of realism. Various studies analyze how realism can influence anxiety in a virtual environment and the efficiency of job interview training. One particular research conducted by specialists from the UK and South Korea shows the results of training in a virtual environment with various levels of realism. In order to create these different levels, the avatar changed from a realist photo to a cartoonish 3D model and finally, to a highly realistic 3D model. Results show that levels of stress were most elevated with the most realistic avatar, but the differences between situations were almost insignificant. This confirms the theory that anxiety is determined by the idea of taking part in a stressful situation, not by the graphical realism of the avatar [24]. The job interview situation might cause a lot of stress because it is outside the person's control, being also evaluative and competitive [25]. Therefore, the virtual environment should rather ensure the emotional immersion, by using head mounted displays and trying to reproduce the situation as accurate as possible (in terms of dialogue, user-bot interaction). VR-based systems are not meant to replace real interviewers, as there are specifically trained psychologists on that job which cannot be replicated by virtual reality. Their goal is to create a sufficiently immersive environment which can induce the appropriate emotional response from the user. Studies show that virtual environments for training job interview skills can be really successful, if an appropriate degree of immersion is provided [26].

VR-JOB: AN INNOVATIVE MODEL FOR A JOB INTERVIEW TRAINING SYSTEM BASED ON EMERGING TECHNOLOGIES

Our proposed system will mix together the advantages of both virtual reality and chatbots emerging technology in order to create a job interview training system. There is little research regarding the use of both virtual reality and chatterbots in order to improve job interview skills of software engineers. The two emerging technologies can bring many advantages when being combined, such as creating an immersive realistic environment, simulating accurately a great variety of job-training situations, providing knowledge from many technical fields, offering accurate real-time reactions to the trainee's responses. Already existing systems focus mostly on job interview training for social categories, which is significantly different from training for software engineers. "Job interview with Molly Porter", although complex and stable, focuses on work history, future plans and social skills, lacking the technical part, essential for software engineering interviews. Technical skills can be easily practiced and evaluated through a VR and chatterbot-based system, while

software engineers can show less adversity towards this genre of training. Furthermore, if we take into account how effective these systems are for training in various fields, we can be convinced that a well-designed system can prove to be successful for our purpose.

In the VR-JOB system, the chatbot is connected to a knowledge base, which is fed by a different component, managed by the administrator. The knowledge base can be either a database or a series of XML files which contain various information needed for training the chatbot: reactions to the candidate's answers, general facts, questions asked by the chatbot itself etc.

Firstly, the knowledge base will include information which is meant to test the "hard skills" of the candidate. The user will thus practice their technical knowledge, by receiving different questions from specific domains, related to the job description, such as data structures, algorithms, databases, web programming or various programming languages. For training "soft skills" such as social competencies, communication or personality related traits, the chatbot must be trained to ask general questions, related to hobbies, passions, extracurricular activities.

Artificial intelligence is a wide domain, therefore training a chatbot and ensuring its pertinent behavior can be a challenging task. We will thus limit the domain (the available inputs/outputs) in order to reduce the complexity of the system. The user must be capable of asking several questions (related to the company, the benefits of the job etc.), but the domain of these questions must be narrowed. Each candidate can create an account, login and select an enterprise from a predefined list where they want to apply for the job. Different virtual environments and different avatars will be generated based on the previously chosen enterprise. All the high-level functionalities are specified in the use case diagram (Figure 3).



Figure 3: VR-Job Use Case Diagram.

The evaluation of the candidate's performance is based on the answers given to the technical and soft skills questions. For the technical questions, which will be saved in the database / XML files, the system will check the presence of certain keywords. If they are present, the answer will be validated as being correct; if not, it will be erroneous. In order to achieve this, various semantic models could be used, based on ontologies [27] or NLP. The performance of this type of system is usually evaluated based on "semantic tasks", such as synonyms detection, analogy recognition or verb selection preferences. As far as soft skills are concerned, feedback can be given by combining semantic models and emotion analysis. The latter is useful for identifying positive or negative emotions felt by the candidate when answering non-technical questions. Researches show that emotion detection is also possible by using text analysis, based on "emotion words" and being capable of recognizing the eight basic emotions: joy, surprise, expectation, love, anxiety, pain, anger and hatred [28].

In order to ensure relevant feedback, the 3D model representing the avatar must have small changes in its facial expressions, varying from joy to anger, based on the answers received. In the end, a performance module will allow the user to visualize their final evaluation: how many questions were answered correctly, how the soft skills were represented.

The technologies used for creating the chatbot will be integrated in Unity3D. It is a well-known and used game engine, which focuses on portability, being capable of working on a great variety of operating systems. In addition, the applications created in Unity can be exported on different platforms, such as mobile, web, desktop or consoles, allowing also the integration of virtual reality additional devices. Unity uses scripts written in C# or JavaScript and allow the import of 3D models created in well-known 3D modeling programs, such as Blender, Maya or 3ds Max [29].

Regarding chatterbots APIs, there are several available options which can be integrated in Unity and have already been used for creating successful games, such as *Event 0* or *Talos Principle*. SpiritAI, PullString or Alicebot AIML are some example of chatbot AIs systems, with the latter being the most stable and accessible. Artificial Intelligence Markup Language (AIML) is a language similar to XML, easy to learn, which can be easily used for creating and personalizing a dialogue with a chatbot [30].

The VR-JOB system uses an original solution, with a modular architecture, personalized to better fit the purpose of training software engineers. The knowledge base can be easily extended or modified in order to provide training for any engineering field.

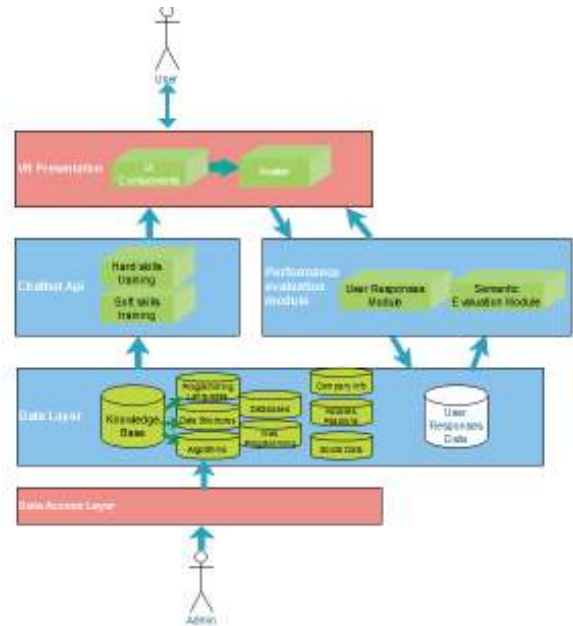


Figure 4: VR-Job System Architecture Diagram.

In Figure 4, the system's architecture diagram presents the modules contained in our application. Therefore, the VR Presentation layer contains the UI elements necessary for the user-system interaction (main menu, available domains, input and output fields etc.), as well as the 3D Avatar, which reacts based on the user's responses. The Chatbot API layer contains the Alicebot services integrated in Unity, which are trained for hard and soft skills using a knowledge base. The latter is included in the data layer and contains various programming or social-based domains. It can be easily modified and accessed by the administrator via the data access layer and using the AIML. Free alternatives, such as Gaitobot AIML editor are available and easy to use for writing AIML files [31]. Another important part of the system is the performance evaluation module, which collects the user's responses and saves them in a database. Afterwards, a semantic evaluation module interprets the data collected in the database and gives the feedback to the user, who can evaluate their performance.

Our proposed solution does not exclude the integration of other computer-based technologies, such as augmented reality or videos of successful or failed interviews. After the finalization of the initial prototype, quantitative and qualitative indicators will be used in order to evaluate the success or the failure of the system, using as target group software engineering students, teachers and employees.

CONCLUSION

In conclusion, the evolution of artificial intelligence and virtual reality can facilitate the development of revolutionary applications for training. Preparing for an interview can cause a lot of stress for many people, especially engineers. By creating a realistic virtual

environment and using an “intelligent” chatbot as a conversational partner, candidates can practice and improve their knowledge and competencies before the actual interview. However, chatbots shouldn’t be viewed as tools meant to replace traditional interviews and the human factor, they are simply a method of training in order to improve one’s performance. In fact, training represents the key to success and virtual reality, the opportunity of achieving this success.

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