



HUMAN RESOURCES CHATBOTS: A COMPARISON STUDY

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Abstract

Processing large amounts of data that are often collected by different departments and accessed using a multitude of programs, the need to streamline processes and reduce data processing time, the desire to reduce costs or the pressure for the workforce to perform in a short time repetitive processes that require a high degree of accuracy are professional tasks solved not long ago by employees. The chatbot is the saving, innovative, intelligent solution that comes to the aid of companies, and people in solving all the tasks listed above, the man being only an observatory that brings improvements/corrections to the intelligent application. This article begins by highlighting the need for a chatbot in HR. The following shows how we thought and designed the Guardian chatbot in this sector of activity, but also additional ideas that we identified and which can be applied to improve the chatbot. The next chapter identifies the pros and cons of comparing the Guardian chatbot with three other chatbot models. Finally, the usefulness of the article is shown, which serves as a model of approach and finding solutions in thinking/designing/ developing a chatbot in the field of HR and even expanding its use in

all sectors of activity. The IT solution is designed to respond to the needs of the users regarding the product, to the needs of the company, to the number of people who would use the solution, to the price of the IT solution with the demand and supply on the labor market.

Keywords: Chatbot, Artificial intelligence, SeqtoSeq, Professional conversation, Resources

INTRODUCTION

History tells us, according to the recent entrances within, that, in the last centuries, humans have made significant technological advances, developing an environment with many industrial qualities. This resulted in design services and products that helped achieve wealth and conditions never seen before. However, the system as a whole was too complex to be understood.

Nowadays, things have evolved even more, and the ambition and desire for development based on scalability must consider the importance of understanding the engulfing system from which it operates. Thus, new products, services, functionalities, and adjuvants were designed and developed to make sure that we will face no other blockages than material (*we have an infinite amount of wishes, but we live on an entity with finite resources*) and imagination related (*we have all the material and workforce to build amazing things, but what exactly are we going for?*). One relevant example of such enhancement is represented by **Artificial Intelligence (AI)**, which is a well-disputed concept that can help switch from a static economic perspective to a more flexible and circular one.

Among others, here are some examples of ways of action of the concept explained above:

- **Timeseries analysis** – monitoring a variable evolution across a determined period (usually, 12 or 24 months).
- **Summarization** – ignoring the randomness and redundancy, keeping the essential.
- **Natural Language Understanding (NLP)** – transforming words into complex structures that can be understood by the machine.
- **Clustering** – collecting data from a single 'source of truth, creating groups based on various characteristics or data points.
- **Entity recognition** – receives digital text as input and outputs relevant information. This can be used to identify pieces of text.

- **Object detection** – the process of discovering whether a specific entity (or object) can be distinguished among many others from a picture. For example, finding a smartphone on a table with several other electronic devices.
- **Chatbots** – human-made programs specially tailored to interact with humans. They can express human-like behavior, such as responding to questions, basic communication, and providing information, and they continuously learn using complex algorithms. (Fountech.Solutions, 2020)

We left the chatbots for last because this is the subject we are going to address in this paper. They represent automated conversational delegates that are meant to interact and communicate with their creators (humans per se). As for the basic version of their implementation, they provide useful information about various subjects, can respond to questions, and can address new ones, but can also possess functionalities whose main objective is to enhance and make the experience more immersive.

The domain we chose to investigate regarding the implementation is human resources (HR). So, we will begin by making a detailed analysis of three existing chatbots, putting them in the spotlight and enumerating and describing their capabilities (both strengths and weaknesses). Then, we will present our perspective on the matter, by doing the same with our implementation. An antithesis will follow, in which we will try to evoke the advantages and disadvantages of our chatbot over what the market has to offer. In a conclusion, we will see the actual state of the former and try to propose different ways of improving the implementation using the concepts and ideas that resulted from the comparison.

THREE HR CHATBOTS

Humanly.io

The AI recruiting bot made by **Humanly.io** is very proficient in offloading, optimizing, and automating the repetitive tasks and interactions done by recruiters inside the processes of scheduling and screening, reference checking, and candidate engagement and re-engagement. The tool is very good when it comes to early career hiring, but it stands out if we also speak about professional volume and “in place” recruiting.

Humanly.io has designed a chatbot that is powered by artificial intelligence and is specifically built and optimized for medium-range companies who just need a tool that is very fast to implement and set up. It allows for screening and scheduling, considering the diversity, equity, and inclusion (DEI) principles (because of its unbiased nature), and manages to perfectly integrate itself into any automatic tracking system (ATS) so that recruiters will have all the information in a single place (centralized). Given its artificial intelligence foundations, it used

data from various sources, including performance management, to continuously get better and to give the right choices, helping in the hiring process. Moreover, the chatbot helped achieve the following:

- The average candidate experience score falls within the range of 4.8-5.0
- 95% complete background checks within 48 hours
- Increase in candidate diversity
- 60 hours saved in scheduling and screening

As for the key feature, the tool presents the following:

- **Automated AI screening** – it can engage with and qualify candidates from all around the world. It does not only find the candidates that fit with the existing culture, but rather adds to it as the company evolves. It can analyze the existing engagement data and suggest the top-culture questions that could be asked when coming to an interview of specific candidates.
- **Reference Checks** – they now have a conversational approach; the candidates complete them through the chatbot. Moreover, it prevents reference checks from slipping through the cracks, as it makes the once-known tedious process pain-free, honest, and confidential. This helps companies to get reference check data about all the candidates, not just about the ones who made it to the final interview.

Humanly's chatbot can also retrieve candidates from all the niche sites (LinkedIn, Glassdoor, Facebook, Indeed, ZipRecruiter) and sort them accordingly. (Pulver, 2022)

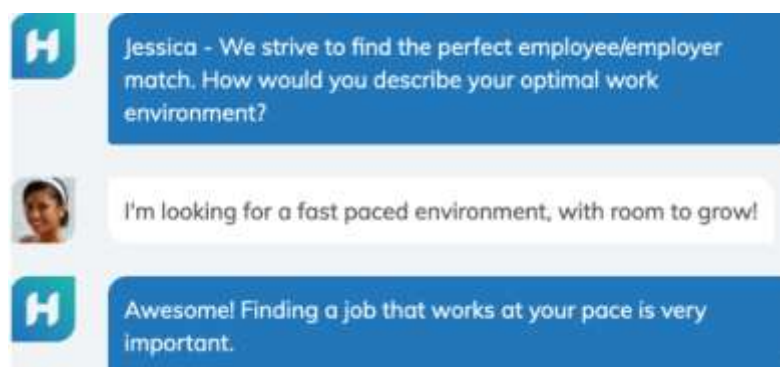


Figure 1. Did someone say questions?

Source: <https://www.selectsoftwarereviews.com/reviews/humanly>

According to the official website, *“the chatbot asks all the candidates the right set of questions to get an overview of their current skillset and background without unwanted bias. Because of our library which contains role-specific templates, we ask the right question, at the right time, easier than ever. Thus, an awesome experience for all our candidates is developed.*

This helps turn all of those who did not get a job into future candidates, brand advocates, or even customers. With our scheduled and automated outreach, we keep our candidate's profiles updated at any time. No longer do you have to chase down numerous applicants by email and phone. And ask some tedious qualification questions...over and over. The chatbot helps you reclaim your time back. While enabling global engagement.”

At the moment, it is available as a website. A demo can be requested, but, for the full version, the company must pay to integrate it. (Humanly.io, 2022)

HireVue

HireVue is hiring software that is powered by AI. It uses an HR chatbot that converses with the candidates using text messages. After a candidate initially converses with it, the former continues this process throughout the hiring lifecycle. It schedules, sets reminders, and reschedules, therefore saving time and bandwidth. (HireVue, 2022)

It stands out because of its AI-powered on-demand interviews that help recruiters conduct the initial screening of candidates. Among the pros of the tool, we can find the following:

- the implementation team and customer support are very responsive
- great on-demand interviewing features. The ability to change the speed of the interview can help in reducing the recruiter's necessary time.
- It is very useful when it comes to screening a large number of job candidates in a short frame of time

As for the cons, we have:

- the tool is not very affordable, compared to its alternatives. The pricing plans are made for companies with at least 2500 employees and, even then, a very small range of features is provided
- it does not have a large variety of integration partners (mostly ATS)
- implementing too much automation sometimes leads to unwanted candidates. As an example, the asynchronous feature permit candidates to adjust their responses to fit a specific job criterion. An additional human-verified layer of intervention may be necessary to filter the candidates correctly. (Hans, 2022)

Espressive

Espressive's employee assistant chatbot's main objective is to improve employee productivity by promptly resolving their problems, anywhere, anytime. In addition, it walks employees through workflows, such as onboarding and vacation requests. The solution is

specifically designed to help employees get answers to their most common questions (PTO, benefits), without requiring the attention of the HR team. It has a virtual support agent (VSA) called Barista which can enable platform interaction (such as Stack, Teams, and more). (Mellado, 2022). Its key features are:

- **Employee language cloud** – it has an expressive vocabulary integrated via Barista
- **Notifications** – Barista helps with outages and other relevant announcements
- **Expert hand-off** – the chatbot can delegate work to humans if there is a need for it (Espressive, 2022)



Figure 2. Espressive

Source: <https://www.selectsoftwarereviews.com/reviews/espressive>

The Guardian Chatbot

The application (the Guardian chatbot) aims to help replace HR specialists in firms, companies, public institutions, etc., and have their tasks taken over by a chatbot. In this way, employees in firms/companies/institutions will be able to focus on solving other professional tasks. This artificial intelligence solution can bring multiple benefits to a company, including:

- reduction of employee salary costs;
- reducing the time spent on conducting interviews, and analyzing candidates' CVs;
- increasing productivity, even when working from home;
- covering related human resources administration tasks with the help of process automation through chatbot;
- more effective communication of employees, customers, and partners with business and enterprise systems. (Nibusinessinfo, 2022)

Our research aimed to find, study, analyze, and sort information on how a chatbot model could be made using NLP + DP (DNLP) using SeqtoSeq Recurrent Neural Networks (RNN) model. We identified different NLP techniques that were used to process and prepare the collected data to train the chatbot. These techniques are meant to help the chatbot better understand user intent. After the collected data were processed using NLP techniques, the SeqtoSeq model (the brain of the chatbot) was implemented.

In designing the chatbot we used the Seq2Seq model. It uses sequence-to-sequence modeling and has an encoder-decoder architecture built using unidirectional or bidirectional Long Short Term Memory cells. Thus, the model sentence (encoder) is loaded for the first time, an action whose objective is to understand the user's intention. For the chatbot to be able to find an answer as clearly, as well as possible, and as close as possible to what the user wants to know, each word is assigned a number. By repeating this process as many times as needed, all the numbers resulting from the encoding process will form a vector. Based on this vector, the words in the sentence are classified, and selected and each word used will have a specific importance in the source sentence. In this way, the first word of the message that the chatbot sends to the user is obtained. This whole process is repeated following the same steps until the whole sentence / whole message is classified based on the importance of each word and the final answer obtained by the chatbot is sent to the user.

The process by which a response is obtained from the chatbot is described in figure 3. The user asks a question to the chatbot using a messaging platform. After the question is picked up by the platform and sent to the chatbot, NLP techniques come into play. These are the same techniques that were used in data collection. They have the role of making the question as easy as possible for the chatbot to understand. After processing the question through NLP techniques, the words in the question will end up in the Seq2Seq pattern forming the encoder. Based on this model and the basis of the weights obtained from the training, the chatbot will obtain a decoder (the answer). This response will be provided in the logic of the algorithm that is a mediator between the messaging platform and the chatbot. Based on additional rules added by the developer in this algorithm, it can be determined whether the answer is correct/incomplete/unclear. If the chatbot cannot give a complete answer to the user's question and the intervention of external services is also needed to obtain a complete answer, the thought algorithm will have to call the external service after obtaining the chatbot's answer. After calling the service, the two responses will be concatenated to get the final response that is provided to the user. If the chatbot's answer is unclear, the algorithm can determine that human intervention is needed by notifying the development team of this and providing the user with an error response (a sign that it cannot understand the user's message).

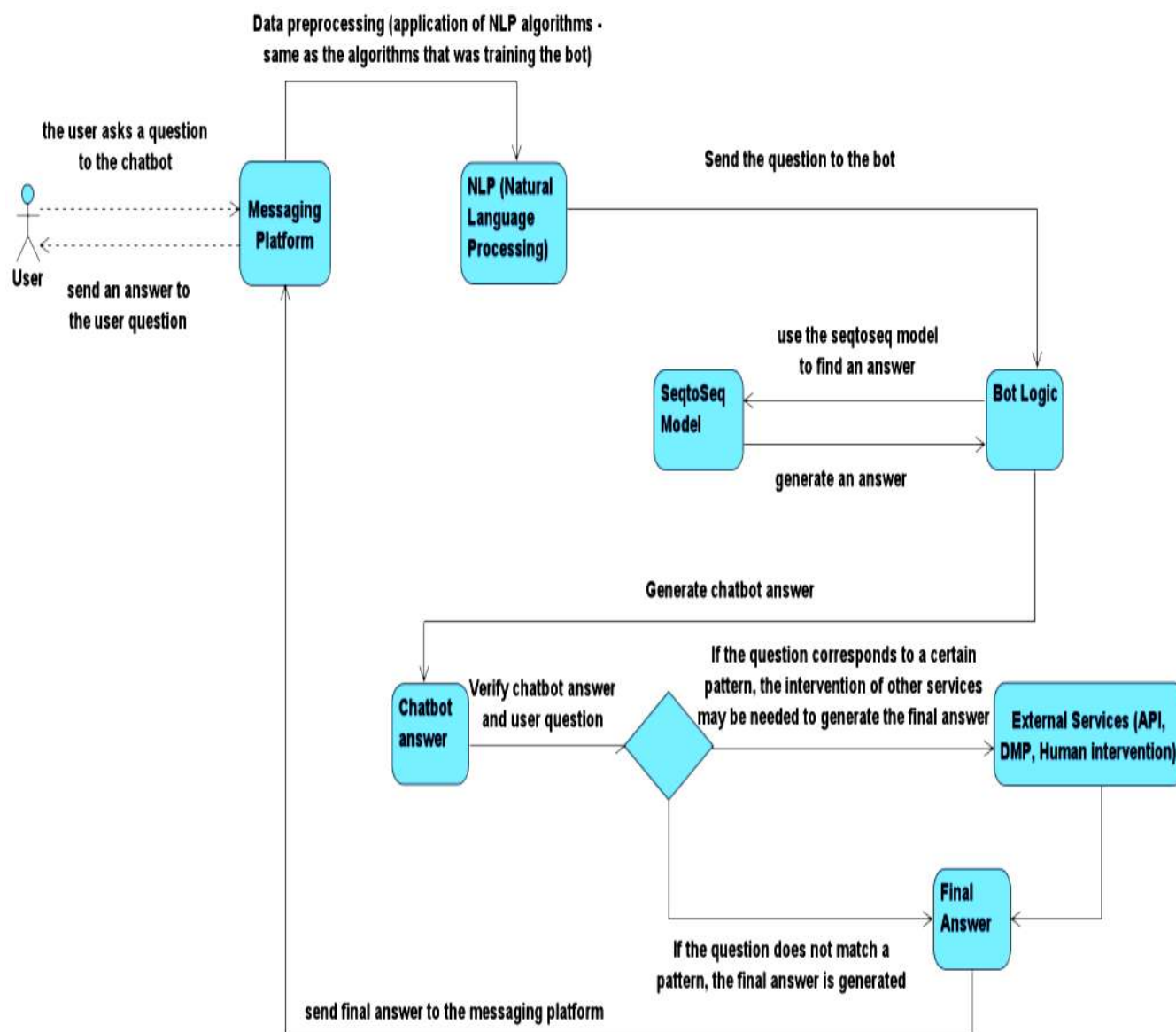


Figure 3. Generate chatbot response

Source: (Ahmad Abdellatif, 2018)

Chatbot development was done in Python. I used the following libraries: NumPy, tensorflow, re, time.

Numpy has the role of processing data from arrays/matrices depending on what the developer wants to achieve in the application (Numpy, 2022). TensorFlow is a software library used for machine learning and artificial intelligence. It focuses in particular on the training and inference of deep neural networks (TensorFlow, 2022). Re (Regular Expression) provides regular expression matching operations and Time provides various time-related functions.

COMPARISON BETWEEN THE GUARDIAN CHATBOT AND THE OTHER THREE CHATBOTS


The two tables below represent the similarities (Table 1) and differences (Table 2) between the Guardian chatbot and the three chatbot models described above. In these tables, elements common to the four applications have been included, but they also have additional details or small differences in the way they were thought of and implemented. The tables also reflect elements that are only found in one of the chatbots. To easily notice the elements that are only found in one / two applications, they have been colored green. Missing elements of the applications described above, compared to the Guardian chatbot, can be found in Table 2 by the **x**. The elements that are found in two or all applications in table 1 are found in table a check .

Table 1. Similarities between the Guardian chatbot and the other three chatbot models





















Guardian	Humanly.io	HireVue	Espressive
Fast resolution of professional issues from anywhere, anytime			
Increasing employee productivity			
Dealing with leave requests			
Integration with different messaging platforms			
Interview support			
Screening a large number of candidates in a short period			
Increasing candidate diversity			
Asking all candidates a set of questions to get an overview of the candidate			

Table 2. Differences between the Guardian chatbot and the other three chatbot models

Guardian	Humanly.io	HireVue	Espressive
			Can delegate professional tasks
Conversation based on text and voice messages	Conversation based on text and voice messages	Conversations based on text messages	Conversation based on text and voice messages
Professional conversation for employment	Professional conversation for employment	Professional conversation throughout the professional life cycle	Professional conversation for employment
The application used in any company	The application used in any company	The application is used in companies with at least 2,500 employees	The application used in any company

Easy to deploy and configure the application	Easy to deploy and configure the application	More difficult implementation and configuration process	Easy to deploy and configure the application
✗	Background checks within 48 hours	✗	✗
✗	Retrieving candidates from all niche sites	✗	✗
✗	Integration with any tracking system (ATS)	Integration with a few tracking systems	✗
✗	Automated AI screening – finding and adding suitable candidates from around the world	✗	✗
Possibility of expansion for other departments, depending on the needs of the company	✗	✗	✗
Analyze the candidate's CV to form an overall picture	Screen candidates through niche sites	✗	✗
Possibility of using digital signature in professional documents	✗	✗	✗

CONCLUSIONS

We are constantly researching documents/news/information about the development, implementation, and usefulness of chatbots in different fields of activity. The goal is to build our chatbot to be implemented, firstly, in the field of HR, then we want to improve it by adding additional options to be used in the field of smart cities. The Guardian chatbot aims to help replace HR specialists in firms, companies, public institutions, etc., and have their tasks taken over by a chatbot. In this way, employees in firms/companies/institutions will be able to focus on solving other professional tasks. This artificial intelligence solution can bring multiple benefits to a company, but it can be improved with a multitude of creative ideas/solutions that increase the efficiency of the chatbot and give it much greater efficiency in various business sectors.

Comparing the Guardian chatbot with other three chatbots presented in this article helped us identifying new ideas that we would like to implement in our chatbot. These ideas include the following:

- integration with tracking systems (ATS)
- retrieving candidates from niche sites
- background checks of candidates

- conversation with candidates admitted to the company throughout their professional life to follow their progress.

This article reflects the evolution of society that requires developers, at the request of managers and business owners, to build customized chatbots that perform particular tasks, customized according to the needs of the company, and of the employees. It is an upward trend that reflects the high demand for such models thought, built, developed, and implemented especially for people who work in different branches of activity and face specific problems in solving professional tasks.

Developing and implementing a chatbot also requires advanced technical knowledge. The specialists in the IT field are constantly evaluating and updating the creativity and originality of a multitude of IT solutions. Implementing such IT solutions can bring progress and profit for a company, but also can bring benefits for the whole society (Ahmad Abdellatif, 2018). Our article contributes to the fulfillment of these ideas, especially since we, who designed and thought this chatbot, also want to improve it by adding new options observed in other chatbots, which can bring benefit to the Guardian chatbot.

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