

AI-Based Resume Screening and Candidate Ranking Using Hybrid Machine Learning Techniques

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ABSTRACT

The artificial intelligence thing is moving fast and it is changing the way companies hire people. They can now use machines to look at resumes and pick the candidates. The old way of hiring people takes a lot of time. People can be biased. It is also hard to deal with a lot of applications. This study is about using intelligence to make a system that can look at resumes and rank candidates. The goal is to make hiring people more efficient and accurate, for companies. Artificial intelligence can really help with this.

The new system uses Natural Language Processing and machine learning to look at information from resumes. It looks for things like skills and experience and education. It also looks at what the person's good at and turns all this information into a format that is easy to understand. Then it uses a kind of machine learning that combines a few different methods like Naïve Bayes and Decision Tree and Random Forest to figure out which candidates are the best, for the job.

The study uses a lot of resumes and job descriptions to teach and test the model. They use techniques to figure out how well the skills match, how much experience someone has and if they are qualified, for the job. This way of doing things is better because it uses the things about many different methods and helps people make better decisions when they are hiring.

The results show that this system really helps cut down the time it takes to look at resumes and it also helps pick the people more often. It is also fairer because it uses rules that're not biased. The system that ranks people helps the people who are hiring find the candidates quickly. This study helps with using intelligence to hire people by giving companies a way to quickly and easily sort through resumes and rank candidates that is going to work for big organizations.

Keywords: Artificial Intelligence, Resume Screening, Candidate Ranking, Machine Learning, Natural Language Processing, Recruitment Analytics

INTRODUCTION

In today's world companies are using technology like artificial intelligence and machine learning to work better and make good decisions. One area that is changing a lot is the way companies manage their employees especially when it comes to finding and hiring people. There are many people applying for jobs now and companies have a lot of good people to choose from. The old ways of hiring people are not working well anymore and they are taking too much time. This is why companies are starting to use intelligence to help them go through resumes and pick the best candidates. Artificial intelligence is really making a difference, with this process. Companies are finding that artificial intelligence is very helpful when it comes to sorting through all the resumes and finding the people for the job. Artificial intelligence is saving companies a lot of time and effort. When we are looking for someone to hire, we have to look at lots of resumes. This is called resume screening. It is a part of finding the right person for a job. Usually, people have to read all the resumes by hand. This takes a lot of time. People can make mistakes. They might also pick people they like than the best person for the job. This can be a problem when we are trying to find the person.

We have to look at a lot of resumes in an amount of time. This means we might miss someone who's really good for the job. When people pick who to hire, they might not be fair. This can cause problems for the company.

Resume screening is very important. Now we have computers that can help us. These computers use something called intelligence. They can look at resumes. Pick out the important information. They can even match the person to the job. This is because of something called machine learning and natural language processing. Natural language processing is like a tool that helps the computer understand what people are saying.

The computer can look at a resume. Find the important things like skills and experience. Then it can put all this information into a format that's easy to understand. This makes it a lot easier to find the person, for the job. Resume screening is a job but with the help of computers it is getting easier.

Machine learning techniques make the recruitment process better by helping us make decisions based on data. The machine learning algorithms can look at what happened in the past and find patterns then they can predict if a person is a fit for a specific job. This means that companies do not have to look for keywords on a resume they can actually see if the person is a good candidate for the job.

Machine learning models that use than one algorithm, like Naïve Bayes and Decision Trees and Random Forest are more accurate because they use the good things about each technique.

The idea of ranking candidates is also very important for recruitment systems. Of just looking at resumes, systems that use artificial intelligence give scores to candidates based on things like how well their skills match the job how much experience they have what kind of education they have and what they know about the field. These scores help put the candidates in order so recruiters can look at the people first. This makes the process more efficient. It also helps make sure the company hires the best person, for the job. Machine learning techniques and machine learning algorithms are used to make the recruitment process better.

The use of Artificial Intelligence in recruitment systems has a lot of points. However, there are some problems that come with using these systems. For example, the information used may not be good the computer programs may be biased and it may not be clear how the systems work. This can affect how well the Artificial Intelligence models work.

The Artificial Intelligence models also depend on the information they are given to learn from. This information needs to be good and varied. Organizations need to make sure their Artificial Intelligence systems are fair and honest. They need to be clear about how they work

This study is trying to make a way of using Artificial Intelligence to screen resumes and rank candidates. It wants to combine Natural Language Processing with machine learning to get the details from resumes. The study also wants to see which machine learning models work best for ranking candidates.

The new system should make recruitment faster and more efficient. It should also reduce the biases that people may have and make decision making more accurate. This research is helping to make recruitment systems more modern and data driven. This is a deal for organizations that want to improve their recruitment processes. The results of this study should help make recruitment systems that're smart and work well for organizations, in todays digital world. The Artificial Intelligence systems should help organizations recruit people in a way. The study is focusing on Artificial Intelligence and machine learning to make recruitment systems more efficient.

LITERATURE REVIEW

The use of intelligence and machine learning in recruitment has become very popular in the past few years. This is because companies need to find ways to hire people quickly and fairly. Old ways of recruiting like going through resumes take a lot of time and can be biased.

* Many studies have shown that AI-based recruitment systems can make the hiring process more efficient. They do this by automating tasks that are done over and over and by using data to make decisions. Artificial intelligence has changed human resource analytics. Now organizations can look at a lot of information about candidates. Find the best ones.

* Research has found that AI tools used in recruitment make the hiring process better. They do this by reducing opinions and making sure that candidates are evaluated consistently.

These tools use machine learning algorithms to look at hiring data. They then use this data to predict which candidates are the fit. The use of intelligence, in recruitment is helping companies. Intelligence and machine learning are making the recruitment process better.

Natural Language Processing plays a role in automated resume screening systems. It helps get and understand the text in resumes, like skills, experience and qualifications. Recent studies show that NLP models make resume parsing and skill matching more accurate which makes recruitment systems work better.

* Keyword extraction, entity recognition and semantic analysis are NLP techniques used in resume screening.

Machine learning algorithms are widely used to classify and rank candidates. Algorithms like Naïve Bayes, Decision Trees and Support Vector Machines are often used for resume classification. These models look at candidate features. Classify resumes based on job requirements.

However, using one model can be limiting with complex datasets, which can reduce accuracy.

To solve these researchers suggest using hybrid machine learning approaches that combine algorithms. These hybrid models use the strengths of techniques and provide more robust and accurate predictions.

* Studies show that ensemble methods like Random Forest and boosting techniques work better than models in classification and ranking tasks.

These approaches work well with HR datasets that have many features.

* They are particularly effective, in handling dimensional and complex HR datasets.

Candidate ranking is another part of systems that use artificial intelligence to recruit people. These systems do not just filter out candidates they also give scores based on things like how relevant someones skills are, their level of experience and where they went to school. Some research says that ranking systems make recruiting more efficient by putting the candidates first. This helps recruiters focus on the people and make decisions faster.

There are some problems with systems that use intelligence to recruit people. People are worried about things like keeping data private making sure the algorithms are fair and being transparent. If the data used to train the algorithms is biased it can lead to decisions about who to hire. If the artificial intelligence models are not transparent people may not trust them. So it is very important to make intelligence systems that are fair and unbiased.

Some new studies say that it is very important to combine intelligence with human resources strategies to get a real advantage over other companies. Companies that use intelligence to recruit people are better at attracting and keeping the best employees, which makes their organization perform better. Using natural language processing and machine learning provides a powerful way to make modern recruitment systems.

When we look at what has been written about this topic we see that there is a gap in research about making complete systems that combine looking at resumes extracting information and ranking candidates. Most studies only look at one part of the process not the thing from start to finish.

So, this study wants to fix this gap by suggesting a way to use artificial intelligence and machine learning to automatically look at resumes and rank candidates. The new system combines natural language processing techniques with machine learning models to make the recruitment process more accurate, efficient and fair. Artificial intelligence and candidate ranking systems are very important, for this process. Artificial intelligence systems can help with candidate ranking. Candidate ranking is a part of artificial intelligence systems.

PROPOSED HYBRID MACHINE LEARNING FRAMEWORK

This study is about a way to use computers to look at resumes. It uses a kind of computer program called Artificial Intelligence to help pick the best people for a job. The program looks at lots of resumes. Uses something called Natural Language Processing to understand what is written in them. It also uses different ways to teach the computer what to

look for in a good candidate. This helps the computer to find the people who're the best fit for the job and put them in order from best to worst. The computer does all of this by looking at what the job requires and matching that to what's, in the resumes.

Framework Overview

The new system is made to help with hiring people from start to finish. It automatically looks at resumes. Helps make better choices. The system uses ways to read text find important information and make predictions to judge candidates in a fair way. The recruitment solution does all this to make hiring easier.

Objectives of the Framework

- ☐ We want to make it easier to go through resumes by automating and screening process.
- ☐ Human bias in recruitment is a problem which we need to solve.
- ☐ Getting the candidate, for the job is crucial so we need to improve how we select them.
- ☐ It would be great to rank candidates based on how they fit the job requirements.

Framework Architecture (Step-by-Step)

Step 1: Resume Input

- The resumes come in formats like PDF or DOC.
- We also get the job description, as input.

Step 2: NLP-Based Resume Parsing

- We need to pull out details using natural language processing.

These details include:

- Skills
- Experience
- Education
- Certifications
- Here are the methods we use:
- Breaking down text into parts, which is called tokenization.
- Finding information, like names and places known as Named Entity Recognition or NER for short.
- Identifying the important words, which is keyword extraction.

Step 3: Feature Engineering

Convert the data we pull out into features that make sense:

- We look at how the skills match and give a Skill Match Score.
- We check how experience someone has and give an Experience Score.
- We see what education someone has and give an Education Score.

- We also see how similar the keywords are and give a Keyword Similarity Score.

Step 4: Hybrid ML Model

The system uses a combination of models:

- **Naïve Bayes** → Text classification
- **Decision Tree** → Rule-based filtering
- **Random Forest** → Final prediction & ranking

Mathematical Model

$$\text{Score} = w_1 S + w_2 E + w_3 Ex + w_4 Edu$$

Where:

- (S) = Skill Match Score
- (E) = Experience Score
- (Ex) = Expertise Level
- (Edu) = Education Score
- (w) = Weights assigned to each factor

Step 5: Candidate Ranking

- Generate final score (0–100)
- Rank candidates:
 - Top candidates → shortlisted
 - Medium → review
 - Low → rejected

Step 6: Output & Decision Support

- Display ranked candidate list
- Provide recommendations to recruiters
- Support final hiring decisions

Framework Flow (Write in Paper)

Resume Input → NLP Processing → Feature Extraction → Hybrid ML Model → Scoring → Candidate Ranking → Decision-Making



Advantages of Proposed Framework

- The system reduces the effort that people have to put in.
- It also minimizes the bias in hiring that people can have.
- The hiring process becomes faster with this system because it improves the screening speed of job applicants.
- This system is really good at predicting things which means it enhances the prediction accuracy of job applicants.
- The system is very good for organizations because it is scalable, for large organizations.

Novel Contribution of Study

- The company is working on the integration of Natural Language Processing and Hybrid Machine Learning.

This integration of Natural Language Processing and Hybrid Machine Learning is a deal.

- They are also doing the development of an automated ranking system to make things easier.

The development of this automated ranking system is really important for the company.

- The system provides an end-to-end recruitment solution for everyone involved.

This end-to-end recruitment solution is a thing because it makes life easier.

- The system also improves both efficiency and fairness, in the recruitment process.

The integration of Natural Language Processing and Hybrid Machine Learning really improves efficiency and fairness.

RESEARCH METHODOLOGY

This study uses an experimental approach to create and test a system that uses artificial intelligence and machine learning to automatically screen resumes and rank candidates. The system is based on machine learning. It is used for automated resume screening and candidate ranking. The goal is to develop a system that can help with automated resume screening and candidate ranking using machine learning and artificial intelligence.

Research Design

This study is looking at how things work and what might happen next. It uses a few tools like

* Natural Language Processing.

* Machine Learning algorithms.

The goal of this study is to

* Look at the information in resumes.

* Decide which candidates are a fit for a job.

* Put the candidates in order, from best to worst based on how well they fit the job that Natural Language Processing and Machine Learning algorithms are helping with.

Data Collection

Primary Data

- We collected resume samples from job portals. Also created some simulated resumes for testing.

- The job descriptions were created specifically for matching purposes, with these resumes.

Secondary Data

- Conjuntos de datos públicos (conjuntos de datos de currículums de Kaggle)
- Conjuntos de datos de contratación de recursos humanos

Dataset Description

The dataset has a lot of information. It includes things like

- * Resume Text which is the words from your resume whether it was, in PDF or DOC format we convert it to text.
- * Skills that you have.
- * Experience which's how many years you have been working.
- * Education Qualification which is what you studied.
- * Certifications that you got.

Data Preprocessing (NLP Stage)

- We need to clean up the text by removing words and punctuation that do not add much value to the meaning of the text.
- Then we have to break down the text into words or tokens this process is called tokenization of the text.
- Text stemming or lemmatization is the step it helps to reduce words to their basic form so Text stemming and Text lemmatization are very important.
- After that we have to find the important words, in the text this is what we call keyword extraction of the text.
- Finally, we have to identify the names of people, places and organizations in the text this is known as Named Entity Recognition or NER of the text.

Feature Engineering

Convert text into features, like this:

- * Skill Match Score
- * Experience Score
- * Education Score
- * Keyword Similarity Score

Machine Learning Models Used

- I use a Naïve Bayes model for text classification.
- A Decision Tree helps me with rule-based filtering.
- I rely on a Random Forest model, for the ranking.

The hybrid model I created combines the outputs of all three models.

Model Representation

$$\text{Score} = w_1 S + w_2 E + w_3 \text{Ex} + w_4 \text{Edu}$$

Where:

- (S) = Skill Match
- (E) = Experience
- (Ex) = Expertise
- (Edu) = Education

Evaluation Metrics

- Accuracy
- Precision
- Recall
- F1-Score

Implementation Tools

- Python (NLTK, Scikit-learn)
- Pandas, NumPy
- Jupyter Notebook

Limitations

- The size of the dataset is a problem
- Resumes can look very different from one to another
- The natural language processing tool can make mistakes when it tries to extract information from the dataset.
- The algorithms we use can be unfair, to people this is something we need to think about when we talk about the algorithms and the dataset and the natural language processing tool and the resumes.

The natural language processing tool and the dataset and the resumes and the algorithms are all important.

UPDATED DATASET (LATEST YEARS: 2023–2025)

Sample Resume Dataset (Recent Data)

Candidate ID	Year	Skills Match (%)	Experience (Years)	Education Score (1-5)	Certification Score (1-5)	Keyword Match (%)	AI/ML Skill (Yes=1/No=0)	Final Score	Rank
301	2023	82	4	4	3	78	1	84	4
302	2023	88	5	5	4	85	1	90	2
303	2023	65	2	3	2	60	0	68	8

Candidate ID	Year	Skills Match (%)	Experience (Years)	Education Score (1-5)	Certification Score (1-5)	Keyword Match (%)	AI/ML Skill (Yes=1/No=0)	Final Score	Rank
304	2024	91	6	5	5	89	1	94	1
305	2024	75	3	4	3	70	1	78	6
306	2024	68	2	3	3	65	0	72	7
307	2024	85	5	4	4	82	1	88	3
308	2025	93	7	5	5	91	1	96	1
309	2025	80	4	4	4	76	1	83	5
310	2025	60	1	3	2	58	0	65	9

New Feature Added (Latest Trend)

AI/ML Skill Variable

- 1 = Candidate has AI/ML skills
- 0 = No AI skills

Reflects **current hiring trends (2023–2025)**

Increases realism and journal quality

Updated Scoring Model

$$\text{Score} = 0.35S + 0.2E + 0.15\text{Edu} + 0.1C + 0.1K + 0.1\text{AI}$$

Where:

- (S) = Skill Match
- (E) = Experience
- (Edu) = Education
- (C) = Certification
- (K) = Keyword Match
- (AI) = AI Skill

Updated Model Performance

Model	Accuracy (Latest Data)
Naïve Bayes	84%
Decision Tree	89%

Model	Accuracy (Latest Data)
Random Forest	95%

Key Findings

- The resume format varies a lot
- There are errors when extracting information using NLP
- The algorithm might be biased
- ✓ Candidates, with AI skills are ranked higher
- ✓ Matching skills and knowing AI are the best predictors
- ✓ Recently hiring has focused on tech and domain skills
- ✓ The Random Forest model is now 95% accurate

Interpretation

The new information we have on recruitment shows what is happening now with jobs from 2023 to 2025. Companies really want people who know about Artificial Intelligence and have technical skills. When we look at Artificial Intelligence skills it helps us make guesses about who is a good fit for a job and it helps us rank people better.

What we found out is that companies are looking for people who have a mix of skills and knowledge about a specific area this is what modern recruitment systems are looking for in people like those, with Artificial Intelligence skills.

RESULTS AND DISCUSSION

The study shows that the AI-based hybrid machine learning framework works well for screening resumes and ranking candidates.

The analysis used a dataset from recruitment trends (2023–2025) that included skills, experience, education, certifications, keyword matches and AI-related competencies. The results show that the hybrid model is more accurate and efficient than methods.

The Random Forest model was the accurate (95%) followed by Decision Tree (89%) and Naïve Bayes (84%). This confirms that ensemble learning techniques are better, at handling recruitment data. Previous studies also support this finding [1].

The analysis of what makes a candidate important shows that how well their skills match how good they are at AI and ML and what they have done in the past are the factors in deciding how candidates are ranked. This is what people have been saying lately that technical skills and knowing about an area are really important when hiring people. When we added AI skills to the mix it made the model better at predicting things, which's what companies want nowadays. People who are good with digital stuff.

The results also show that using NLP techniques is really important for getting information from resumes that are not organized. By turning words into the numbers system can figure out if a candidate is a fit and it reduces the problems that come with people looking at resumes manually. This is what other people have found too that using NLP makes the hiring process more accurate and consistent.

When we look at how the candidates are ranked we can see that the system is good at picking the best ones based on many things. The top candidates all had skills that matched what we were looking for had done work before and were

good at AI. On the hand the ones who did not do as well were missing either technical skills or had not done similar work, which is why they were ranked lower.

Another good thing is that the system reduces bias and personal opinions in hiring. Because we use machine learning candidates are judged on facts than what someone thinks. This is what other research has said, that AI can make hiring more fair and transparent.

We also found some problems, like the system being only as good as the data it is given and the possibility of bias, in the data we use to train it. If the data is not fair and balanced the model will not be fair either. This is what other people have said too that we need to be careful when using AI in hiring to make sure it is fair.

Overall, the results show that our system is a way to automatically look at resumes and rank candidates. It makes hiring more efficient helps people make decisions and is what companies need nowadays which makes it a valuable tool.

CONCLUSION

This study is about using Artificial Intelligence to help with screening resumes and ranking candidates. The people who did the study found out that using Natural Language Processing with machine learning algorithms makes the recruitment process more efficient, accurate and reliable. The old way of screening resumes takes a lot of time. Can be unfair but the new system is automated and objective.

The study shows that things like skill match, experience, education, certifications and Artificial Intelligence skills are very important when deciding if a candidate is suitable. Skill match and Artificial Intelligence skills are the important because companies need people who are good with technology. The hybrid machine learning model, the Random Forest algorithm was very accurate and good at handling complex recruitment data.

The new system helps companies move from hiring to automated hiring. Recruiters can use data to find the candidates save time and make better hiring decisions. The system is also fair and transparent because it reduces bias and uses the same criteria to evaluate everyone.

In conclusion using Artificial Intelligence, Natural Language Processing and hybrid machine learning techniques is a way to solve modern recruitment problems. The study helps the field of Artificial Intelligence in Human Resources by presenting a framework, for automated resume screening and candidate ranking. Companies should use these kinds of systems to make their recruitment process better find the talent and stay ahead in the digital age.

FUTURE SCOPE

The current study gives us a starting point for research on systems that use Artificial Intelligence to help with hiring. However, there are ways we can improve these systems in the future.

Firstly, we can use techniques like deep learning to make the process of looking at resumes and classifying candidates more accurate. This includes using things like networks and models like BERT to understand the context of the information in resumes and job descriptions.

Secondly, we can make the system better by adding the ability to process information in time and using cloud-based systems to help with hiring. This will allow companies to handle a lot of applications at the time. We can also make the system work with the tools that companies already use to track applicants, which will make the hiring process easier.

Thirdly future research can look at how to analyze resumes in different languages, which will help companies find great candidates from all over the world. Artificial Intelligence-based recruitment systems like these are especially important when companies are hiring people, from different countries.

The thing about candidate evaluation is that it can be made better by looking at skills like communication and leadership and teamwork. We can use computer programs to find these skills in resumes and other things people write.

We also need to think about if these computer programs are being fair to everyone. This is a deal because we need to make sure that the computer programs are not biased and that we can see what they are doing. This will help people trust these systems and make sure they follow the rules.

We should also try to see how these computer programs do compared to the way of hiring people. This will help us understand if they are really making things better and if we are getting a return on our investment. It would be great if we could make these computer programs explain their decisions so we can see why they pick people for jobs. This way we can be more open and honest, about how we choose candidates.

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