Application of Data Mining to Detect Fraudulent Job Advertisements in the Age of social media and Electronic Platforms

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ABSTRACT

In contemporary times, advancements in the industry and technology sectors have created extensive prospects for job searchers, offering a wide range of fresh and varied employment opportunities. Through the utilization of job adverts, individuals seeking employment are able to discover various opportunities that align with their availability, qualifications, experience, and suitability. The recruitment process is currently being altered by the pervasive influence of the internet and social media. The effectiveness of a recruitment process heavily relies on its advertisement, and social media has a significant influence on this. The emergence of social media and electronic media marketing has provided increasingly diverse avenues for disseminating job information. The proliferation of job ad sharing platforms has led to a surge in fraudulent job posts, resulting in greater harassment and inconvenience for job seekers. Individuals often refrain from expressing interest in new job listings in order to safeguard the security and consistency of their personal, academic, and professional information. Therefore, the genuine intention behind legitimate job advertisements on social and electronic platforms encounters a formidable obstacle in gaining people's trust and dependability. Technologies exist to enhance and simplify our lives, but they should not be used to create an insecure professional atmosphere. Accurate filtering of job ads to identify fake job ads would represent a significant breakthrough in the recruitment of new personnel. Hence, this project aims to employ various data mining techniques and classification algorithms, such as K-nearest neighbor, decision tree, support vector machine, naive Bayes classifier, random forest classifier, and multi-layer perceptron, to accurately predict the authenticity of job advertisements. We conducted experiments on the Employment Scam Aegean Dataset (EMSCAD), which consists of 18,000 samples. The deep neural network functions exceptionally well as a classifier for this particular classification assignment. This deep neural network classifier incorporates three thick layers. The classifier, which has undergone training, demonstrates an estimated classification accuracy of 98% (DNN) in predicting a bogus job advertisement.

Keywords: Fraud job advertisements, Employment Scam Aegean Dataset, Machine learning, Deep neural networks.

1. INTRODUCTION

In modern time, the development in the field of industry and technology has opened a huge opportunity for new and diverse jobs for the job seekers. With the help of the advertisements of these job offers, job seekers find out their options depending on their time, qualification, experience, suitability etc. Recruitment process is now influenced by the power of internet and social media. Since the successful completion of a recruitment process is dependent on its advertisement, the impact of social media over this is tremendous [1]. Social media and advertisements in electronic media have created newer and newer opportunity to share job details. Instead of this, rapid growth of opportunity to share job posts has increased the percentage of fraud job postings which causes harassment to the job seekers. So, people lack in showing interest to new job postings due to preserve security and consistency of their personal, academic and professional information. Thus, the true motive of valid job postings through social and electronic media faces an extremely hard challenge to attain people's belief and reliability. Technologies are around us to make our life easy and developed but not to create unsecured environment for professional life. If jobs posts can be filtered properly predicting false job posts, this will be a great advancement for recruiting new employees. . Fake job posts create inconsistency for the job seeker to find their preferable jobs causing a huge waste of their time. An automated system to predict false job post opens a new window to face difficulties in the field of Human Resource Management [2].

1.1 Fake Job Posting

Job Scam Online job advertisements which are fake and mostly willing to steal personal and professional information of job seekers instead of giving right jobs to them is known as job scam. Sometimes fraudulent people try to gather money illegally from job seekers. A recent survey by ActionFraud from UK has shown that more than 67% people are at great risk who look for jobs through online advertisements but unaware of fake job posts or job scam. In UK, almost 700000 job seekers complained to lose over $500000 being a victim of job scam. The report showed almost 300% increase over the last two years in UK. Students, fresh graduates are being mostly targeted by the frauds as they usually try to get a secured job for which they are willing to pay extra money. Cybercrime avoidance or protection techniques fail to decrease this offence since frauds change their way of job scam very frequently [3].

1.2 Common types of Job Scam

Fraudsters who want to gain other people's personal information like insurance details, bank details, income tax details, date of birth, national id create fake job advertisements. Advance fee scams occur when frauds ask for money showing reasons like admin charges, information security checking cost, management cost etc. Sometimes fraudsters act them- selves as employers and ask people about passport details, bank statements, driving license etc. as pre-employment check. Illegal money mulling scams occur when they convince students to pay money into their accounts and then transfer it back [4]. This 'cash in hand' technique causes to work cash in hand without paying any tax. Scammers usually create fake company websites, clone bank websites, clone official looking documents etc. to trap job seekers. Most of the job scammers try to trap people through email rather than face to face communication. They usually target social media like Linkedln to prove themselves as recruitment agencies or headhunters. They usually try to represent their company profile or websites to the job seeker as realistic as possible. Whatever the type of job scam they use, the always target the job seeker to fall in their trap, collecting information and making benefit either earning money or any other things.

Employment scam is one of the serious issues in recent times addressed in the domain of Online Recruitment Frauds (ORF). In recent days, many companies prefer to post their vacancies online so that these can be accessed easily and timely by the job-seekers. However, this intention may be one type of scam by the fraud people because they offer employment to job-seekers in terms of taking money from them. Fraudulent job advertisements can be posted against a reputed company for violating their credibility. These fraudulent job post detection draws a good attention for obtaining an automated tool for identifying fake jobs and reporting them to people for avoiding application for such jobs. For this purpose, machine learning approach is applied which employs several classification algorithms for recognizing fake posts. In this case, a classification tool isolates fake job posts from a larger set of job advertisements and alerts the user. To address the problem of identifying scams on job posting, supervised learning algorithm as classification techniques are considered initially. A classifier maps input variable to target classes by considering training data. Classifiers addressed in the paper for identifying fake job posts from the others are described briefly. These classifiers-based prediction may be broadly categorized into -Single Classifier based Prediction and Ensemble Classifiers based Prediction.

2. LITERATURE SURVEY

Habiba et. al [6] proposed to use different data mining techniques and classification algorithm like KNN, decision tree, support vector machine, naïve bayes classifier, random forest classifier, multilayer perceptron and deep neural network to predict a job post if it is real or fraudulent. We have experimented on Employment Scam Aegean Dataset (EMSCAD) containing 18000 samples. Deep neural network as a classifier, performs great for this classification task. We have used three dense layers for this deep neural network classifier. The trained classifier shows approximately 98% classification accuracy (DNN) to predict a fraudulent job post.

Amaar et. al [7] used six machine learning models to analyze whether these job ads are fraudulent or legitimate. Then, we compared all models with both BoW and TF-IDF features to analyze the classifier's overall performance. One of the challenges in this study is our used dataset. The ratio of real and fake job posts samples is unequal, which caused the model over-fitting on majority class data. To overcome this limitation, we used the adaptive synthetic sampling approach (ADASYN), which help to balance the ratio between target classes by generating the number of samples for minority class artificially. We performed two experiments, one with the balanced dataset and the other with the imbalanced data. Through experimental analysis, ETC achieved 99.9% accuracy by using ADASYN as over-sampling ad TF-IDF as feature extraction. Further, this study also performs an in-depth comparative analysis of our proposed approach with state-of-the-art deep learning models and other re-sampling techniques.

Mehboob et. al [8] handles the recruitment fraud/scam detection problem. Several important features of organization, job description and type of compensation are proposed and an effective recruitment fraud detection model is constructed using extreme gradient boosting method. It develops an algorithm that extracts required features from job ads and is tested using three examples. The features are further considered for two-step feature selection strategy. The findings show that features of the type of organization are most effective as a stand-alone model. The hybrid composition of selected 13 features demonstrated 97.94% accuracy and outperformed three state-of-the-art baselines. Moreover, the study finds that the most effective indicators are "salary_range," "company_profile," "organization_type," "required education" and "has multiple jobs." The findings highlight the number of research implications and provide new insights for detecting online recruitment fraud.

Ranparia et. al [9] minimized the number of such frauds by using Machine Learning to predict the chances of a job being fake so that the candidate can stay alert and take informed decisions, if required. The model will use NLP to analyze the sentiments and pattern in the job posting. The model will be trained as a Sequential Neural Network and using very popular GloVe algorithm. To understand the accuracy in real world, we will use trained model to predict jobs posted on Linked In. Then we worked on improving the model through various methods to make it robust and realistic.

Sudhakar et. al [10] proposed a novel algorithm for classifying phony information and actual news. This study deals with logistic regression, SVM, and novel ensemble approach based on machine learning algorithms. It is divided into sample size values of 620 per group. The experiment uses a dataset of 10,000 records with binary classes (fake news, real news). The result demonstrated that the proposed novel ensemble approach obtains a better accuracy value of 95% and a loss value of 05% compared with other algorithms. Thus, the obtained results prove that the proposed algorithm is an ensemble approach that combines decision tree techniques with AdaBoost by varying parameters and can get a significantly higher accuracy value.

3. PROPOSED SYSTEM

EMSCAD Dataset

The Employment Scam Aegean Dataset (EMSCAD) is a publicly available dataset containing 17,880 real-life job ads that aims at providing a clear picture of the Employment Scam problem to the research community and can act as a valuable testbed for scientists working on the field. To train the system, this project used EMSCAD dataset, where first row represents dataset column names and remaining rows contains dataset values such as Company profile, job description, salary etc. In dataset last column contains 'fraudulent' values as 'f' for Fake and 't' for "True" jobs.

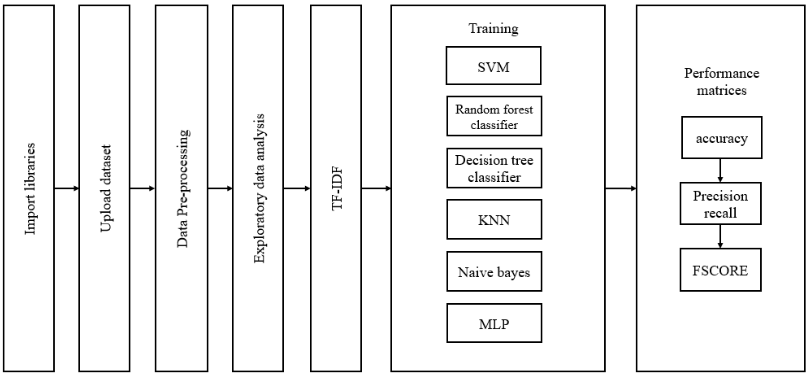


Fig. 1: Block diagram of proposed system.

TF-IDF Feature extraction

TF-IDF which stands for Term Frequency – Inverse Document Frequency. It is one of the most important techniques used for information retrieval to represent how important a specific word or phrase is to a given document. Let's take an example, we have a string or Bag of Words (BOW) and we have to extract information from it, then we can use this approach. The TF-IDF value increases in proportion to the number of times a word appears in the document but is often offset by the frequency of the word in the corpus, which helps to adjust with respect to the fact that some words appear more frequently in general. TF-IDF use two statistical methods, first is Term Frequency and the other is Inverse Document Frequency. Term frequency refers to the total number of times a given term t appears in the document doc against (per) the total number of all words in the document and the inverse document frequency measure of how much information the word provides. It measures the weight of a given word in the entire document. IDF show how common or rare a given word is across all documents. TF-IDF can be computed as tf * idf

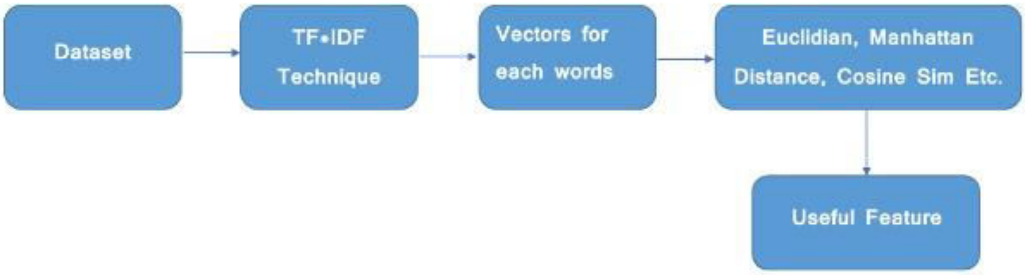


Fig. 2: TF-IDF block diagram.

TF-IDF do not convert directly raw data into useful features. Firstly, it converts raw strings or dataset into vectors and each word has its own vector. Then we'll use a particular technique for retrieving the feature like Cosine Similarity which works on vectors, etc.

Terminology

t — term (word)

d — document (set of words)

N — count of corpus

corpus — the total document set

Term Frequency (TF): Suppose we have a set of English text documents and wish to rank which document is most relevant to the query, "Data Science is awesome!" A simple way to start out is by eliminating documents that do not contain all three words "Data" is", "Science", and "awesome", but this still leaves many documents. To further distinguish them, we might count the number of times each term occurs in each document; the number of times a term occurs in a document is called its term frequency. The weight of a term that occurs in a document is simply proportional to the term frequency.

$$tf(t,d) \ = \ count\ of\ t\ in\ d\ /\ number\ of\ words\ in\ d$$

Document Frequency: This measures the importance of document in whole set of corpora, this is very similar to TF. The only difference is that TF is frequency counter for a term t in document d, whereas DF is the count of occurrences of term t in the document set N. In other words, DF is the number of documents in which the word is present. We consider one occurrence if the term consists in the document at least once, we do not need to know the number of times the term is present.

$$df(t) \ = \ occurrence\ of\ t\ in\ documents$$

Inverse Document Frequency (IDF): While computing TF, all terms are considered equally important. However, it is known that certain terms, such as "is", "of", and "that", may appear a lot of times but have little importance. Thus, we need to weigh down the frequent terms while scale up the rare ones, by computing IDF, an inverse document frequency factor is incorporated which diminishes the weight of terms that occur very frequently in the document set and increases the weight of terms that occur rarely. The IDF is the inverse of the document frequency which measures the informativeness of term t. When we calculate IDF, it will be very low for the most occurring words such as stop words (because stop words such as "is" is present in almost all of the documents, and N/df will give a very low value to that word). This finally gives what we want, a relative weightage.

$$idf(t) \ = \ N/df$$

Now there are few other problems with the IDF, in case of a large corpus,say 100,000,000 , the IDF value explodes , to avoid the effect we take the log of idf . During the query time, when a word which is not in vocab occurs, the df will be 0. As we cannot divide by 0, we smoothen the value by adding 1 to the denominator.

$$idf(t) \ = \ log(N/(df \ + \ 1))$$

The TF-IDF now is at the right measure to evaluate how important a word is to a document in a collection or corpus. Here are many different variations of TF-IDF but for now let us concentrate on this basic version.

$$tf - idf(t,d) \ = \ tf(t,d) \ * \ log(N/(df \ + \ 1))$$

Implementing TF-IDF: To make TF-IDF from scratch in python, let's imagine those two sentences from different document:

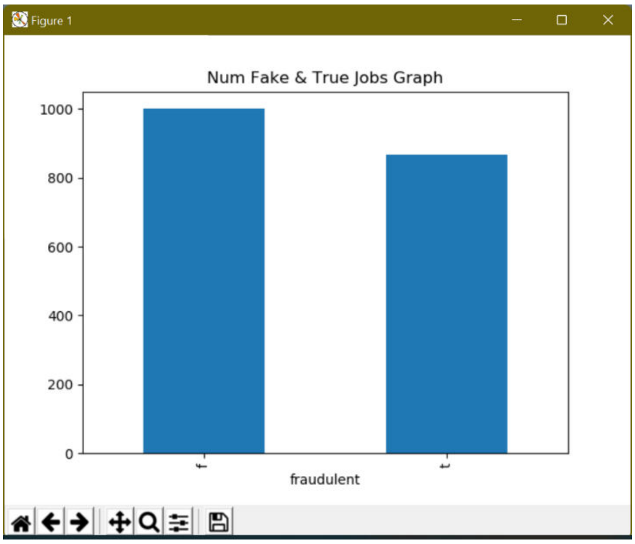
first_sentence: "Data Science is the sexiest job of the 21st century".

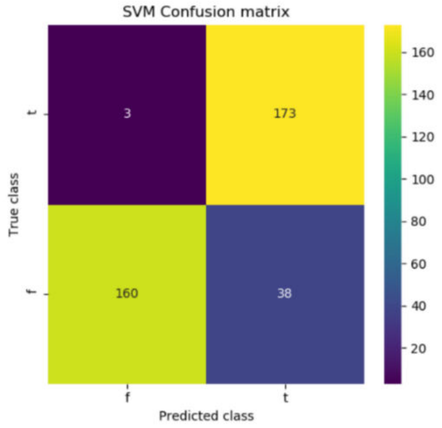
second_sentence: "machine learning is the key for data science".

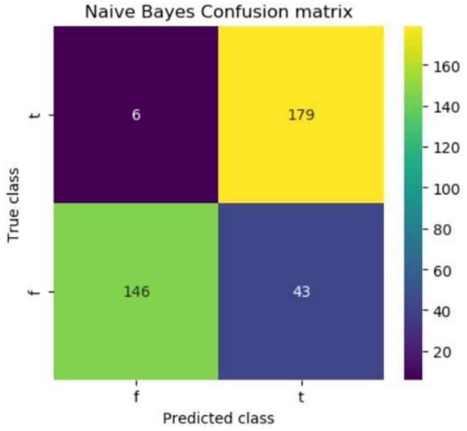
First step we have to create the TF function to calculate total word frequency for all documents.

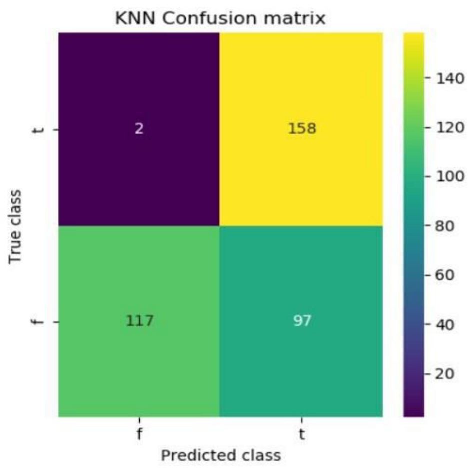
4. RESULTS AND DISCUSSION

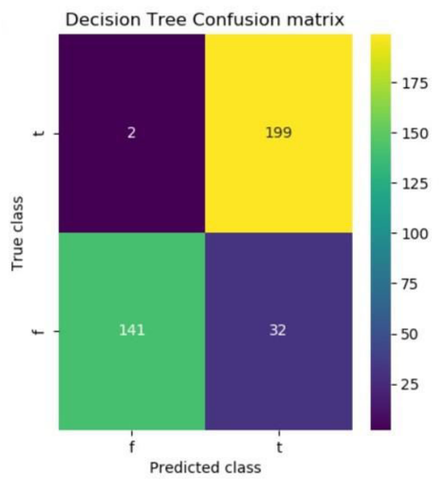
To train the existing and proposed models, this project has used EMSCAD as a dataset, where first row represents dataset column names and remaining rows contains dataset values such as Company profile, job description, salary etc. In dataset last column contains 'fraudulent' values as 'f' for Fake and 't' for "True" jobs.

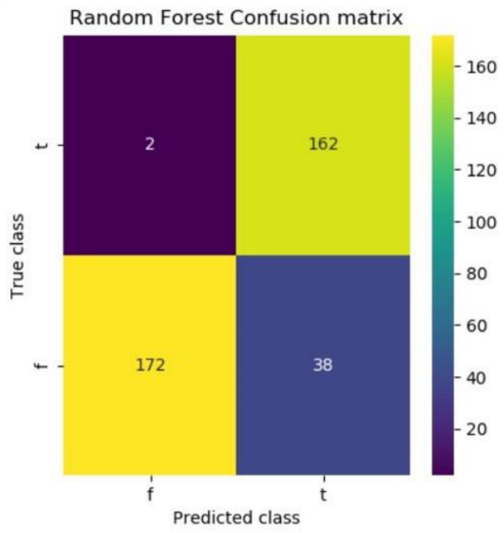


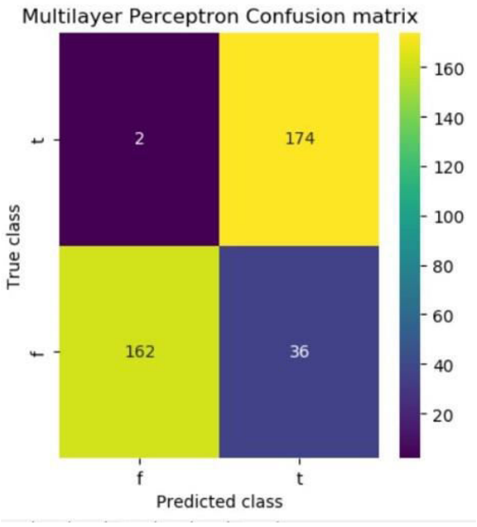





KNN Confusion matrix
True class
t
f
2
158
117
97
f
t
Predicted class
140
120
100
80
60
40
20


Decision Tree Confusion matrix
True class
t
f
2
199
141
32
f
t
Predicted class
175
150
125
100
75
50
25


Random Forest Confusion matrix
True class
t
f
2
162
172
38
f
t
Predicted class
160
140
120
100
80
60
40
20


Multilayer Perceptron Confusion matrix
True class
t
f
2
174
162
36
f
t
Predicted class
160
140
120
100
80
60
40
20

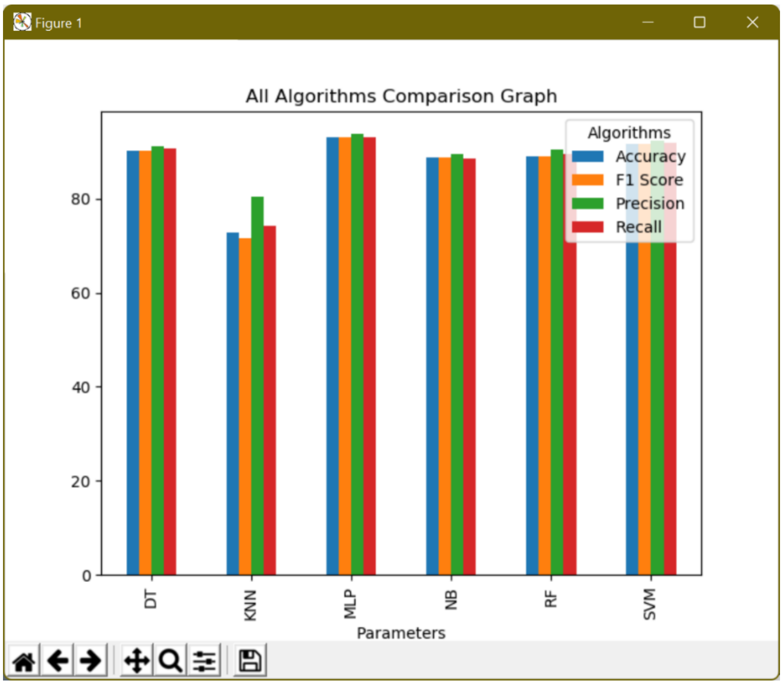


Figure 1
All Algorithms Comparison Graph
Algorithms
Accuracy
F1 Score
Precision
Recall
80
60
40
20
0
DT
KNN
MLP
NB
RF
SVM
Parameters

5. CONCLUSION

Job scam detection has become a great concern all over the world at present. In this project, we have analyzed the impacts of job scam which can be a very prosperous area in research filed creating a lot of challenges to detect fraudulent job posts. We have experimented with EMSCAD dataset which contains real life fake job posts. In this paper, we have experimented both machine learning algorithms SVM, KNN, Naive Bayes, Random Forest and a neural network concept called MLP. This work shown the evaluation of machine learning and MLP-based classifiers.

REFERENCES

[1] S. Vidros, C. Kolias, G. Kambourakis, and L. Akoglu, “Automatic Detection of Online Recruitment Frauds: Characteristics, Methods, and a Public Dataset”, Future Internet 2017, 9, 6; doi:10.3390/fi9010006.

[2] B. Alghamdi, F. Alharby, “An Intelligent Model for Online Recruitment Fraud Detection”, Journal of Information Security, 2019, Vol 10, pp. 155-176, https://doi.org/10.4236/iis.2019.103009.

[3] Tin Van Huynh1, Kiet Van Nguyen, Ngan Luu-Thuy Nguyen1, and Anh Gia-Tuan Nguyen, “Job Prediction: From Deep Neural Network Models to Applications”, RIVF International Conference on Computing and Communication Technologies (RIVF), 2020.

[4] Jiawei Zhang, Bowen Dong, Philip S. Yu, “FAKEDETECTOR: Effective Fake News Detection with Deep Diffusive Neural Network”, IEEE 36th International Conference on Data Engineering (ICDE), 2020.

[5] B. Alghamdi and F. Alharby, ―An Intelligent Model for Online Recruitment Fraud Detection,” J. Inf. Secur., vol. 10, no. 03, pp. 155–176, 2019, doi: 10.4236/jis.2019.103009

[6] S. U. Habiba, M. K. Islam and F. Tasnim, "A Comparative Study on Fake Job Post Prediction Using Different Data Mining Techniques," 2021 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 2021, pp. 543-546, doi: 10.1109/ICREST51555.2021.9331230.

[7] Amaar, A., Aljedaani, W., Rustam, F. et al. Detection of Fake Job Postings by Utilizing Machine Learning and Natural Language Processing Approaches. Neural Process Lett 54, 2219–2247 (2022). https://doi.org/10.1007/s11063-021-10727-z

[8] Mehboob, A., Malik, M.S.I. Smart Fraud Detection Framework for Job Recruitments. Arab J Sci Eng 46, 3067–3078 (2021). https://doi.org/10.1007/s13369-020-04998-2

[9] D. Ranparia, S. Kumari and A. Sahani, "Fake Job Prediction using Sequential Network," 2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS), 2020, pp. 339-343, doi: 10.1109/ICIIS51140.2020.9342738.

[10] Sudhakar, M., Kaliyamurthie, K.P. (2023). Efficient Prediction of Fake News Using Novel Ensemble Technique Based on Machine Learning Algorithm. In: Kaiser, M.S., Xie, J., Rathore, V.S. (eds) Information and Communication Technology for Competitive Strategies (ICTCS 2021). Lecture Notes in Networks and Systems, vol 401. Springer, Singapore. https://doi.org/10.1007/978-981-19-0098-3_1