

MACHINE LEARNING AND AI BASED HUMAN RESOURCE MANAGEMENT IN KGI: AN INNOVATIVE ALGORITHM BASED CROSSOVER

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ABSTRACT

Artificial Intelligence (AI) and Machine learning techniques forms the building blocks of a strong organizational growth in recent years. Starting from startups to the game changers in the field is implementing the core of these two technologies in their growth model. This study proposes a detail framework of artificial intelligence (AI) technology application for human resource management (HRM). Having rooted on the theory of the six basic dimensions of human resource management, which includes human resource strategy and planning, recruitment, training and development process, performance management, salary evaluation, and the employee relationship management, that consequently combines with its potential corresponding AI technology application. This proposed AI-HRM conceptual model provides suggestions and directions for the development of AI in enterprise human resource management. Lastly it is added and implemented to the practical organization KGI.

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1. INTRODUCTION

A new generation of labor, such as the human intelligence of artificial intelligence, has become essential for businesses to survive and evolve in a changing environment as a result of the advancement of artificial intelligence (AI) technology (Ertel, 2018). Artificial intelligence has caught the interest of both researchers and practitioners after Google's AlphaGo system defeated South Korean player Lee Sedol by a wide margin (AlphaGo, 2016). An interdisciplinary discipline called artificial intelligence, commonly referred to as machine intelligence, imitates human talents and intellectual conduct (Paesano, 2023). Artificial intelligence (AI) is defined by Elaine Rich as "the study of how to make computers do things at the moment at which people are better" (Rich, 1983, p. 48). When modeling the information flow that underlies human mind and thought, it can quickly retrieve the

database, extract information, answer our doubts efficiently, and provide the best answer directly and rationally (Cugola & Margara, 2012). Artificial intelligence theory and technology applications are also expanding, and many artificial intelligence tools (Pannu, 2015), such as artificial neural networks, intelligent decision systems, and fuzzy sets, are used in various fields (Holland, 1992). Among them, the application of AI in the field of human resource management is still in the exploration stage (Sheela et al., 2018). AI has been gradually applied to enterprise management decision making, taking on and helping managers to speed up their tedious and repetitive daily work (Chui & Francisco, 2017). It provides powerful database and analytical support, allowing managers to get out of mechanical work and engage in more valuable work (Partridge & Hussain, 1992). According to the Accenture strategic report, for coordination and governance, problem solving and collaboration,

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employee and community, strategy and innovation work, the utility and impact of intelligent systems can change the manager's work contents. Artificial intelligence can undertake and help managers speed up their daily tedious and repetitive work. It can also provide powerful database and analytical support, so that managers can get away from the repetitive work and get devoted to more valuable work. Human resource management refers to a series of human resources policies and corresponding management activities of enterprises (Vrchota & Rehor, 2019). These activities mainly include the formulation of corporate human resources strategies, recruitment and selection of employees, training and development, performance management, compensation management, employee mobility management, employee relationship management, employee safety and health management (Denise, 2017). In the process of human resource management, the use of artificial intelligence technology can bring greater economic benefits. Improving the efficiency of human resource management through the application of AI technology has become an important trend in the future development of human resource management (Jia et al. 2018). However, in the research area of human resource management, there is still a lack of an overall AI application framework, combined with the specific dimensions of human resource management, to analyze its specific application (Chowdhury et al., 2023). Therefore, based on the six dimensions of human resource management and the main technical applications of AI, this paper proposes a conceptual AI application to HRM model to guide enterprises how to use AI technology to assist human resource management. Based on the analysis of the Leap.ai and Baidu industrial cases, we discuss the AI application practice of recruitment and training (Dom, 2018). The proposed AI-HRM framework provides theoretical guidance and application recommendations for the combination of human resource management and AI technology. Potential future research areas are also proposed. The next part of this paper discusses the relevant theoretical literature. The third part presents the conceptual framework model of AI in HRM application (Kaushal et al., 2023). The fourth part is a case study in conjunction with Leap.ai. The last section is the conclusion.

2. LITERATURE REVIEW

Artificial Intelligence

The status quo of artificial intelligence technology can be analyzed from three levels, the basic support layer, the platform framework layer and the domain technology layer (Brooks, 1991).

The Basic Support Layer

Big data, computational power, and novel models are the three main components that will determine the success of this layer of AI technology. AI is developed

with the use of big data. The capabilities of machine learning have been substantially expanded in recent years by the new enhanced algorithm model. Deep learning is a prevalent example of this characteristic. It excels at tasks like intensive learning, supervised learning, and unsupervised learning.

Platform Framework Layer

Internet companies such as Google, Facebook, Microsoft, Baidu and Amazon, as well as universities such as the University of California at Berkeley and the University of Montreal in Canada have launched their own deep learning framework. It is anticipated that advanced deep learning systems will only require a minimal level of customization and deployment, dramatically lessening the workload for developers and enterprises.

The Technology Layer

Artificial intelligence technology has been applied to various fields. The technology application network is shown in Figure 1. Depending on the problem domain, the main technologies include the computer vision and natural language processing technologies. At present, more mature technologies include face recognition technology applied in the airports and payment, such as Alipay. Natural language processing programs computers to process and analyze large amounts of natural language data. Related technologies have been widely used in translation software (such as correct translation), search engines, question and answer systems (such as knowledge), sentiment analysis and automatic answering; speech recognition and so on. For example, voice assistants represented by Apple Siri, Microsoft Cortana and Google Now has be setup on the user's mobile phone and computer. Smart speakers represented by Amazon Echo, already have tens of thousands of family-users. Speech recognition technology is one of the core technologies of these devices.

Six Dimensions of Human Resource Management

The six dimensions of human resource management are interconnected and interact to form an effective human resource management system, as shown in Figure. Among them,

- 1) Human resource planning is the starting point of human resource management. It mainly helps the organization to predict the future needs of personnel and the basic qualities of personnel through the plan.
- 2) Recruitment and deployment, with human resource planning as input, is equivalent to the organization's blood, providing nutrition to the organization, solving organizational staffing and staff matching issues.
- 3) Training and development, the theme is "education";
- 4) Performance management is the core of the six dimensions. It is also the main input for other dimensions.
- 5) Compensation management aims to motivate employees to solve problems in the company.

- 6) Employee relationship management aims to manage personnel and help the company form an effective cycle of rational allocation of human resources (Noe et al., 2006).

AI Study in Human Resource Management

The development of Human Resource Information System (HRIS) has provided a foundation for AI application. HRIS With the development of human-computer interaction functions of AI, there is also possibilities for managers to improve management efficiency by using AI. HRIS is a procedure for collecting, storing, maintaining, retrieving and validating data needed by an organization about its human resources, personnel activities, and organization unit characteristics (Kovach & Cathcart, 1999; Lippert & Michael Swiercz, 2005). HRIS can assist the strategic planning with information for labor force supply and demand forecasts; dealing with applicant qualifications; development with information on training; and evaluating performance with information and so on. However, compared with AIHRM, the information system is more dealing with data input and storage, the intelligence decision assistance function is still limited. The artificial intelligence can further strengthen the business analytic abilities of the system to provide further references output for decision making. Data mining methods are also proposed for scanning the e-resume. Expert systems are proposed to solving the knowledge management in the enterprises. The controversy on whether AI can replace the human resources is also discussed (Frenzel & Turban, 1992). There is still a research gap between the AI technology application study in HRM fields.

AI-HRM Frameworks: There are five key AI technologies that can be implemented into HRM to get a AI-HRM framework for an organization. These are:

- AI Research methods;
- AI applications;
- AI Learning foundations;
- AI Open source Library;
- AI Achievements.

3. PROPOSED MODEL FOR AI-HRM IN KGI

The design of the "AI+HRM" model framework is mainly to assist the human resource managers to make better decisions more efficiently facing large amount of information. The framework answers how the AI can be combined with Human Resource Management.

The corresponding relations among the human resource management, AI detailed technology, and the formed Intelligent System are described and explained, as shown in Figure 1.

KGI HUMAN RESOURCE MANEGEMENT + AI TECHNOLOGY= KGI AI-HRM

KGI AI-HRM based Strategy & Planning:

Human resource strategic planning and building the framework is the starting point of HRM. KGI AI-HRM uses artificial intelligence technology (AI) as an auxiliary decision-making system, which can carry out strategic planning more comprehensively. First, technologies such as data mining and knowledge discovery are needed to collect global information and combine with existing internal and external information.

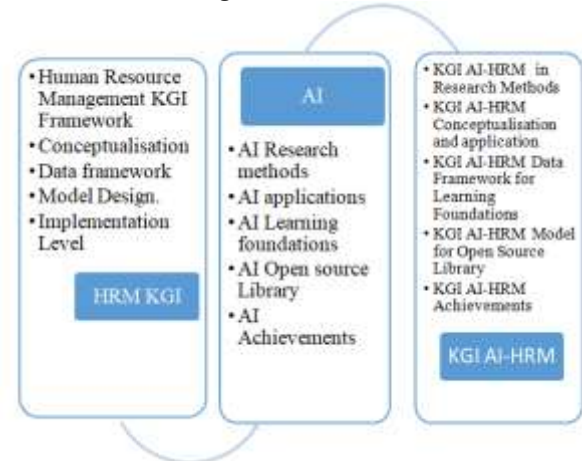


Figure 1. KGI AI-HRM

After summarizing the information, we can understand the current rationality of the human resources situation and forecast, evaluate and adjust the organization's future management. Relying on the statistical and modification functions of the intelligent decision support system, the report is finally provided with various required information.

KGI AI-HRM based Recruitment:

The recruitment process includes review, screening resumes, interviewing candidates, matching suitable positions, etc. Artificial intelligence can learn the qualifications for successful employees in a particular position and apply this knowledge to select qualified candidates and score and rate candidates. First, the Optical Character Recognition (OCR) is used to identify paper resumes and pictures, or use the big data method to filter electronic resumes, analyze resumes, combines the characteristics of resume and text information extraction techniques, through matching, correlation analysis and statistical analysis. The database can be converted into a structured resume in seconds and push the candidate's resume to the company accurately and quickly. At the same time, through the analysis of resume and job matching, the system can recommend suitable positions to candidates, especially for some high-end talents. In this process, AI has the characteristics of screening the candidates without prejudice (Hutson, 2017).

During the interview process, the company set up a recruitment model and the robot asks questions to the candidate. The enterprise can set the corresponding problem of matching posts and the keyword extension

problem from candidates' answers. For example, if the candidate has engaged in data development related work, the robot will query the operation flow, and query which database to use according to the answer. The answer can be evaluated by collecting the keywords and similar word meanings. If the interviewer has doubts, he can re-watch the video. Artificial intelligence converts a 15-minute video interview into a set of 20,000 data points for facial movements, intonation and word selection. The system can help the interviewer greatly improve the efficiency of the interview without reducing the quality of the interview. Face recognition techniques can be used in the exam to determine if the candidate is consistent with the document, thereby preventing others from taking the test instead of the candidate (Jain & Li, 2011). The use of natural language processing technology eliminates the need for typing, and the conversion from speech to text does not require much time, which will greatly improve the efficiency and accuracy of the recruiter's work. In addition, the system can also choose a reasonable interviewer by using the voice test method to carry out effective recruitment. After that, the big data method is used to collect candidate information, screen vacancies, match the interview results of the hired personnel, analyze their personality characteristics, advantages and disadvantages, and match the corresponding positions through analysis of personality and IQ/EQ test. At the same time, employees can be tested regularly (such as the annual). Using artificial intelligence can help managers to identify new employees with the greatest potential for success and deploy them in the right team. The intelligent system can also help employees to matching the right supervisors, recommend learning opportunities and career paths, and even suggest that they are at risk of leaving. It can also help to re-match jobs for employees who have a willingness to change jobs.

KGI AI-HRM based Performance Management

In performance management, the performance appraisal model can be embedded into the system with collecting and analyzing the information about employees' work performance. Using the intelligent decision support system, some scientific evaluation methods, such as 360-degree performance evaluation methods, can be used more automatically and quickly (Otley, 1999). These assessment methods are programmed and entered into the decision support system to more effectively count employee evaluation results.

At the beginning of the year, the business objectives of each department of the company can be setup. The system can evaluate the individual performance targets, access control punch card system records, resignation system, department manager score, personal score, peer score, customer score and make other comprehensive analysis and evaluation. With the AI assistance, the decision makers can analyze the achievement of each indicator, propose the defects of the failed indicators, formulate and implement practical new indicators, and

propose upgrade plans. The future performance objectives can also be setup with forecasting the future trend.

KGI AI-HRM based Compensation Management & Employee Relationship Management

Compensation management, or salary management is a dynamic management process which determines, assigns, and adjusts employee compensation principles, strategies, levels, structures, and factors that with the guidance of organizational development strategies (Henderson, 2003). AI application can assist to facilitate fairness of the compensation management. BP neural network is a supervised artificial intelligence technology based on biology, neurology, psychology and statistics. It can imitate the human brain nervous system, establish a regular computing model, and integrate multiple neural network nodes (Richard & Lippmann, 1991). BP neural network system can be used to design an intelligent decision support system to form a fair salary evaluation system with the input of the big data .Today most organization is following the rule of popular scientific formula.

$$E = MC^2$$

E=Employee Engagement

M=Motivation

C=Compensation

C=Career

This is the new recruitment and employee satisfaction rule.

Employee relationship management includes corporate culture and labor relations, coordinating the relationship between employers and employees. In terms of labor relationship management and communication management, artificial intelligence technology can be used as an auxiliary system to solve many complicated process stereotypes, undertake management tasks, and act as performers, assistants, and consultants. The assistant primarily supports the manager and his team, such as recording, scheduling, reporting, or maintaining a scorecard. Examples of artificial intelligence applications in this area include the "Virtual Assistant System", which organizes meetings by reading and composing emails, coordinating participants, and managing calendars. In the process, these intelligent systems will gradually improve relevant knowledge and expand service areas by absorbing the experience of themselves and their colleagues.

These systems extend the definition of workplace artificial intelligence and become the so-called "advisor system".

4. CASE STUDY

KGI Framework:

KGI is formally founded in 1999 in odisha as a reputed academic organization which impart quality education starting from diploma to degree courses along with post graduation courses. It is focusing on building career

development platform for all positions in high-tech companies for its students. It's a one of a kind organization which emphasizes on skillful employee with adequate technologies. They match job seekers and recruiters in a high-quality manner through the use of artificial intelligence technology.

Business Model of KGI

First, job seekers make related applications on the website and improves relevant information, including professional experience, advantages, career preferences, etc..The platform uses artificial intelligence algorithms to compare the resumes uploaded by individual users with the corporate recruitment criteria. The final recommended positions will be further confirmed to improve accuracy. Most of the recruitment-related companies in the market mainly emphasize what the job seekers have done. In contrast, KGI not only presents the job experience of job seekers, but also integrates factors such as work ability and job search preferences to job seekers to recommend more matching job opportunities.

Although KGI HRM model is the same as that of traditional headhunting companies or recruitment websites, KGI leverages artificial intelligence to provide customized, refined, and standardized services. For example, if a job seeker looks for any technical position on a traditional recruitment website, the general process is to first search for "technical position", and then the website extracts all technical position related information from the database according to keyword extraction. Then the user may receive thousands of results even they don't have time to read. KGI AI-HRM analyzes the user based on the data and directly presents the required results, providing users with efficient and convenient choices. In addition to providing accurate choices for job seekers, it also provides targeted guidance and feedback, and helps establish standardized builds and transform them into high-quality resume formats. At present, KGI has accumulated thousands of end users, mainly in the Odisha and in India.

Matching AI-HRM Mechanism of KGI

KGI's key AI solution is subtly referred to as JUMP in KGI - Job User Matching Forecast KGI. The team uses a variety of artificial intelligence techniques, including natural language processing, to understand each job and each user, and then predicts the likelihood that the user will be hired to work. For example, KGI considers the user's values, skills, strengths, location, company and job preferences, recruiting company requirements and culture, and uses machine learning to determine the best match for each user. The team also uses AI technology throughout the product experience. For example, users can upload resumes on the welcome page and immediately get real-time results to determine which positions match may be appropriate for the system. After the artificial intelligence system is matched, there is also a human review of the matching results by the human expert before the notification is

obtained. Results are available within one business day. By intelligently matching resumes, users get the best chance. By understanding each other's matching reasons, users can explore their own strengths and weaknesses hidden in them, and even explore more hidden opportunities and better present them on their resumes. KGI mainly uses AI technology, which simplifies the matching of job seekers and corporate talent needs. In countless resumes or job requirements, it screens out several candidates matching each other and provides them to cooperative enterprises, which greatly simplifies recruitment (Figure 2). The process better presents the advantages and individuality of the job seekers and recruits the right talents for the company. The company uses professional experience, work ability and corporate culture as three key factors to explore talent preferences and personality characteristics, and combine with the company's cultural background to achieve the needs of both parties.

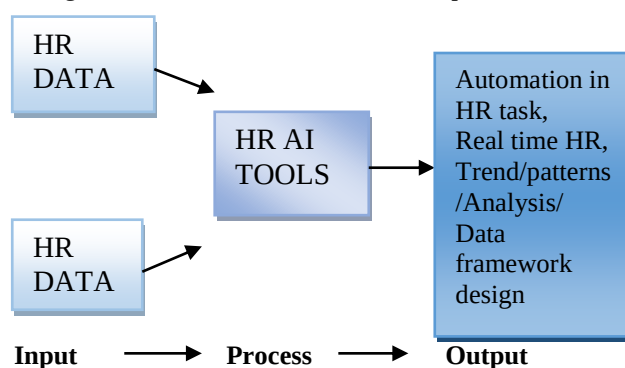


Figure 2. KGI AI HRM Data Analysis

5. PROPOSED ML ALGORITHM FOR THE HRM

We propose a model which takes different dataset for calculating the efficiency of the system by implementing the different algorithm of machine learning and deep learning into the HRM.

Data set:

This study collects data from various domains, including KGI Career Website, Resume finder and the raw data from LinkedIn along with different institutes. It includes relevant samples from various sources, such as previous resume records and present information from social media platforms. The collection also includes sentiment analysis and fraud detection. The data is collected and curated to ensure its relevance and quality. Various preprocessing techniques are utilized to deal with data-related issues, such as outliers, missing values, and data normalization. The objective of the dataset is to provide a framework for the analysis and evaluation of ML algorithms. It facilitates the generation of meaningful conclusions and the selection of suitable algorithms for each discipline.

Data Preprocessing:

Preparing raw data for analysis and the creation of prediction models requires a critical step called data preparation. It entails preparing the data for machine learning algorithms by cleaning, converting, and organizing it. Enhancing data quality, handling missing values, eliminating inconsistencies, and creating features that more. Training data is utilized to create predictive machine learning models. We assess the model's effectiveness using various measures.

Algorithm Implemented:**1.ML Algorithm: Random Forest:**

Random Forest is an ensemble learning method that combines multiple decision trees to make predictions. The algorithm operates by creating a multitude of decision trees and aggregating their results. The prediction is made by taking the majority vote or average of the predictions from individual trees. The mathematical formula for Random Forest can be expressed as

$$\hat{y} = \frac{1}{N} \sum_{i=1}^N h_i(x) \dots \dots 1$$

Where $\hat{y}$ = predicted output, N =no. of decision tree, $h(x)$ = prediction of the i th decision tree.

2. ML Algorithm: Support Vector Machines (SVM):

SVM is a powerful classification algorithm that separates data points by constructing hyper planes in a high-dimensional feature space. It finds the optimal hyper plane that maximizes the margin between the classes. The decision boundary is determined by support vectors, which are the closest data points from each class. The mathematical formulation of SVM is given by the below formulas:

You can represent this hyper plane by:

$$W \cdot X + B = 0$$

SVM's decision meaning is described as follows:

$$F(x) = \text{sign}(W \cdot X + B)$$

SVM minimises the classification error while maximising the margin between the classes. As a result, the optimisation problem is formulated as follows:

$$\begin{aligned} \text{minimize: } & \frac{1}{2} \|w\|^2 + C \sum_i \xi_i, \\ \text{subject to: } & y_i(w \cdot x_i + b) \geq 1 - \xi_i, \end{aligned}$$

3. ML Algorithm: Naive Bayes Algorithm:

Based on the Bayes theorem, the Naive Bayes automated learning method is used to address a number of categorization issues. In this piece, we'll go into greater detail on the Naive Bayes method to clear up any misunderstandings.

Recompile and Prepare Data: Gather an input vector-and class-labeled training dataset.

Calculate each class's preliminary probability, $P(Y_i)$, using the occurrences from the formation table. For calculating a class's preliminary probability, use the following formula:

$$P(Y_i = y_t) = \frac{\text{count}(Y_i = y_t)}{N}$$

Where $\text{count}(Y_i = y_t)$ is the number of instances of the class y_t in the series of formation instances, and N is the total number of formation instances.

Calculate the residual probabilities: Calculate the posterior probabilities of the entry vector $P(Y|X)$ for each specific class using the Bayes theorem:

$$P(Y_i|X_i) = (P(X_i|Y_i) * P(Y_i)) / P(X_i)$$

The class with the highest likelihood of returning must be chosen in order to predict the name of the class for an impending and unknown vector of entry.

6. RESULT ANALYSIS

The result of various algorithms in various domain are as follows Table 1:

Table 1 Performance of various algorithm in various domains

SL NO	ML scheme used	Accuracy in Selection/ Recruitment	Accuracy in Finance	Accuracy in Career/skill Growth
1	RF	0.80	0.78	0.83
2	SVM	0.86	0.84	0.88
3	NB	0.84	0.82	0.84

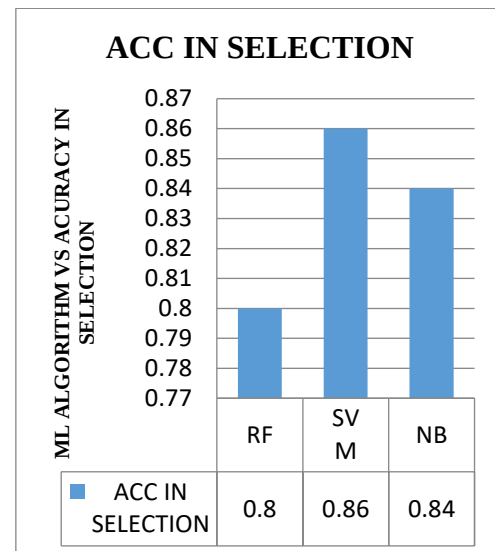


Figure 3: Accuracy in selection in different ML algorithm

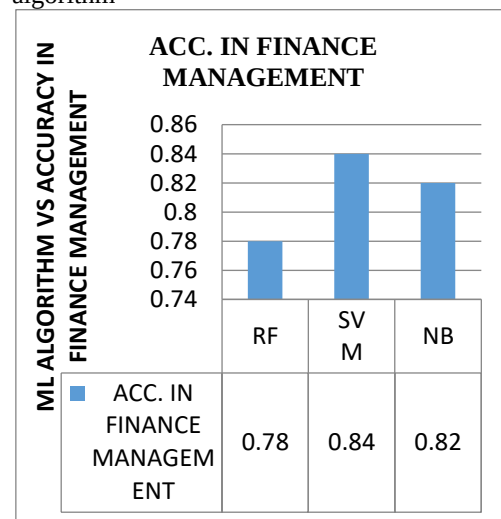


Figure 4. Accuracy in Finance management in different ML algorithm

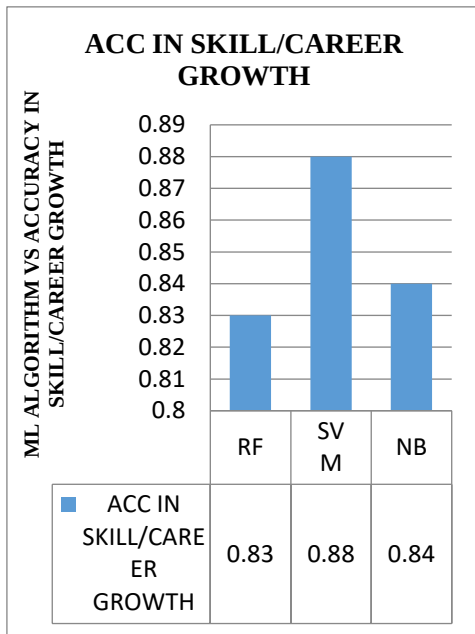


Figure 5. Accuracy in skill management in different ML algorithm.

As per the result analysis it is found that the SVM based ML algorithm proposed for the model has given highest percentage of accuracy in recruitment and selection

(86%), in finance management(84%) and in skill/career growth(88%).Thus this SVM based ML algorithm is suitable for the AI-HRM of KGI (Figures 3, 4, 5).

7. CONCLUSION

This paper gives a detail study about the various AI based HRM model and proposed different ML algorithm for the organization. The dataset included various records with three parameters including recruitment, Finance management, Career / skill growth. The percentage of accuracy of different ML algorithms implemented to HRM like Support Vector Machine (SVM), Random forest (RF) and Naïve Bays (NB) were assessed. The outcomes showed that SVM was the best-performing classifier, with a remarkable accuracy of 86%,84% and 88% respectively. This study emphasizes the importance of machine learning in HRM system to predict different aspects of resource management and offers helpful information for the creation of effective database. The findings imply that SVM is a potential contender for precise and trustworthy AI-HRM system of KGI.

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