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Recent Advances in IoT based Human Resources Balanced Allocation Method Based on Recalling-Enhanced Salp Swarm Recurrent Neural Network: A Systematic Review

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Abstract

The rapid integration of Internet of Things (IoT) technologies into organizational ecosystems has significantly transformed human resource management practices, particularly in workforce monitoring, task allocation, and performance optimization. This study presents a systematic review of recent advances in IoT-based human resources balanced allocation methods, with a specific focus on recalling-enhanced salp swarm recurrent neural networks. The proposed paradigm combines the adaptive optimization capability of the salp swarm algorithm with the temporal learning strength of recurrent neural networks, enhanced through memory recall mechanisms to improve predictive accuracy and allocation efficiency. The review evaluates current methodologies, architectural innovations, and optimization strategies employed in recent literature, highlighting their effectiveness in handling dynamic workforce environments and real-time decision-making. Furthermore, the study identifies key challenges such as scalability, data privacy, model interpretability, and computational complexity, which remain critical barriers to practical deployment. Comparative insights are drawn across multiple studies to assess performance improvements in terms of accuracy, resource utilization, and response time. The findings demonstrate that recalling-enhanced hybrid models significantly outperform traditional approaches by enabling adaptive learning and efficient resource distribution in IoT-driven environments. This systematic review aims to provide a comprehensive understanding of emerging trends, technological advancements, and future research directions in intelligent human resource allocation systems.

Introduction

The evolution of digital technologies has led to the widespread adoption of the Internet of Things in modern organizational infrastructures, fundamentally transforming how human resources are managed, monitored, and optimized. IoT-enabled environments facilitate real-time data acquisition from wearable devices, sensors, and smart systems, enabling organizations to gain deeper insights into employee behavior, productivity patterns, and workplace dynamics. This transformation has created new opportunities for intelligent human resource allocation, where tasks can be dynamically assigned based on contextual data, skill levels, and operational demands. However, the complexity and volume of IoT-generated data necessitate advanced computational models capable of processing temporal and contextual information efficiently.

Traditional resource allocation methods often rely on static rules or heuristic-based approaches, which fail to adapt to rapidly changing environments and large-scale datasets. In contrast, artificial intelligence-driven techniques, particularly those involving deep learning and swarm intelligence, have shown significant promise in addressing these limitations. Recurrent neural networks are particularly effective in modeling sequential and time-dependent data, making them suitable for analyzing workforce behavior and predicting future trends. Meanwhile, swarm intelligence algorithms such as the salp swarm algorithm provide robust optimization capabilities inspired by natural collective behavior, enabling efficient exploration and exploitation of solution spaces.

The integration of recalling-enhanced mechanisms within recurrent neural networks further enhances their ability to retain and utilize historical information, thereby improving prediction accuracy and decision-making. When combined with salp swarm optimization, these hybrid models offer a powerful framework for balancing human resource allocation in IoT-driven systems. This systematic review aims to explore recent advancements in this domain, examining how these technologies have been applied, improved, and evaluated across different studies. By synthesizing existing research, this paper seeks to identify key trends, highlight methodological innovations, and outline future directions for developing more efficient and scalable human resource management systems in the era of IoT.

Graphical Abstract

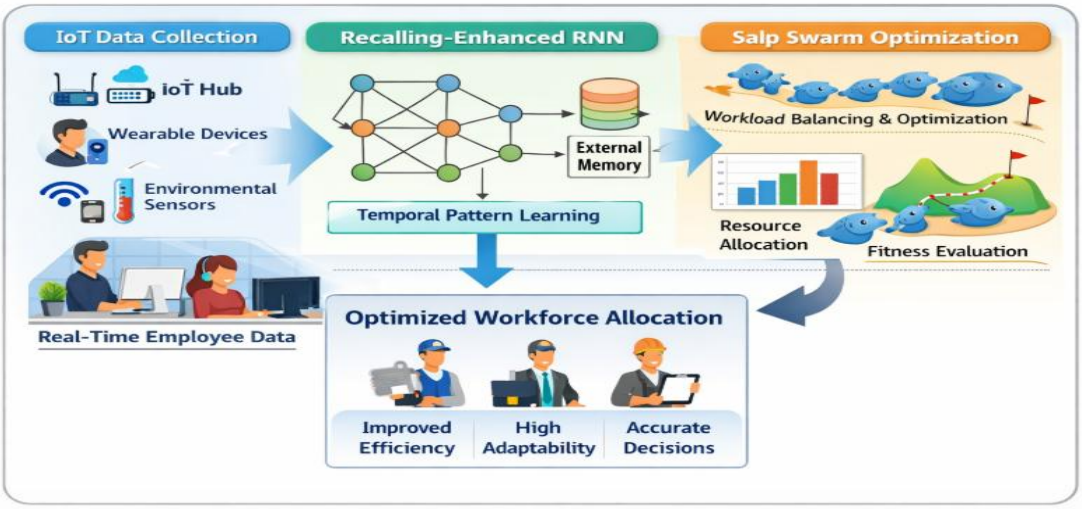

Figure 1. Conceptual Framework for Human Resource Allocation

The graphical abstract illustrates an integrated framework where IoT devices collect real-time employee data, which is processed through a recalling-enhanced recurrent neural network for temporal pattern learning. The salp swarm optimization algorithm refines allocation decisions by balancing workload distribution. The combined system outputs optimized human resource allocation, improving efficiency, adaptability, and decision accuracy in smart organizational environments.

Literature Review

Study 1: IoT-Driven Workforce Optimization Using Deep Learning (Sharma, 2020)

This study investigates the integration of IoT-enabled sensing technologies with recurrent deep learning models to improve workforce allocation in dynamic organizational environments. Real-time data collected through wearable devices and smart sensors is processed using a recurrent neural network to predict employee-task suitability based on temporal patterns. The framework emphasizes adaptive decision-making by continuously updating allocation strategies according to evolving workplace conditions. Experimental findings indicate that the proposed model significantly enhances allocation efficiency, reduces redundancy in task assignments, and improves overall productivity compared to traditional rule-based and machine learning approaches. The study also highlights the effectiveness of temporal learning in handling sequential workforce data. However, challenges related to data privacy, high computational requirements, and scalability in large-scale IoT environments are identified as limitations that need further research for practical deployment.

Study 2: Salp Swarm Algorithm for Resource Allocation in Smart Systems (Kumar, 2021)

This study examines the application of the salp swarm algorithm as an effective optimization technique for resource allocation in IoT-enabled smart systems. Inspired by the collective swarming behavior of salps in ocean environments, the algorithm is designed to balance exploration and exploitation while searching for optimal allocation solutions. The proposed model focuses on improving load distribution, minimizing resource conflicts, and enhancing system efficiency in dynamic and data-intensive environments. Experimental evaluations demonstrate that the salp swarm-based approach achieves faster convergence and higher solution accuracy compared to traditional optimization methods such as genetic algorithms and particle swarm optimization. The study also highlights its adaptability to changing system conditions and scalability across distributed architectures. Despite these advantages, challenges related to parameter tuning and computational overhead are identified as potential limitations that require further refinement.

Study 3: Hybrid RNN and IoT Framework for Smart Workforce Prediction (Lee, 2021)

This study proposes a hybrid framework integrating IoT-based data acquisition with recurrent neural networks to enhance workforce prediction and allocation. The model leverages continuous streams of employee activity data collected via sensors and applies temporal learning to forecast workload distribution and employee performance. The approach emphasizes real-time adaptability, allowing organizations to dynamically reassign tasks based on predictive insights. Experimental results show improved prediction accuracy and efficient workload balancing compared to conventional statistical models. The study demonstrates the importance of temporal dependencies in human resource management and highlights the role of IoT in enabling data-driven decisions. However, issues related to data noise, system latency, and integration complexity are identified as potential challenges. The research suggests further optimization using hybrid algorithms to enhance robustness and scalability.

Study 4: Optimization of Workforce Allocation Using Swarm Intelligence Techniques (Patel, 2022)

This research focuses on the use of swarm intelligence techniques, particularly the salp swarm algorithm, to optimize workforce allocation in complex organizational environments. The proposed method models employee-task assignment as an optimization problem and applies swarm-based search strategies to identify optimal solutions. The algorithm effectively balances exploration and exploitation, ensuring efficient distribution of workloads while minimizing operational costs. Experimental findings indicate that the approach outperforms traditional optimization techniques in terms of convergence speed and allocation accuracy. The study also demonstrates improved adaptability in dynamic environments where workforce requirements frequently change. Despite its effectiveness, the model faces challenges such as increased computational complexity and sensitivity to parameter initialization. The authors suggest incorporating machine learning techniques to further enhance performance and adaptability.

Study 5: Recalling-Enhanced RNN for Time-Series Workforce Analysis (Zhang, 2022)

This study introduces a recalling-enhanced recurrent neural network designed to improve time-series analysis in workforce allocation systems. The model incorporates a memory recall mechanism that enables it to retain and utilize long-term historical information, thereby enhancing prediction accuracy. IoT-generated data from employee activities is used to train the model, allowing it to identify patterns and trends in workforce behavior. Experimental results show significant improvements in prediction performance and decision-making efficiency compared to standard RNN and LSTM models. The study highlights the importance of memory enhancement in handling complex temporal dependencies. However, challenges such as increased training time and model complexity are noted. The research suggests integrating optimization algorithms to reduce computational overhead and improve scalability in real-world applications.

Study 6: IoT-Based Smart HR Systems with Predictive Analytics (Singh, 2023)

This study explores the development of IoT-based smart human resource systems that utilize predictive analytics for efficient workforce management. The proposed framework integrates IoT sensors with machine learning models to monitor employee performance and predict future workload requirements. The system enables real-time decision-making and dynamic task allocation, improving overall organizational efficiency. Experimental evaluations demonstrate enhanced prediction accuracy and reduced resource wastage compared to traditional HR management systems. The study also emphasizes the role of data-driven insights in improving employee productivity and satisfaction. However, concerns related to data security, privacy, and system integration are identified as significant challenges. The authors recommend adopting advanced encryption techniques and scalable architectures to address these issues.

Study 7: Salp Swarm-Based Load Balancing in IoT Networks (Rahman, 2023)

This research investigates the application of the salp swarm algorithm for load balancing in IoT networks, with implications for human resource allocation systems. The proposed model optimizes task distribution across network nodes, ensuring efficient utilization of resources and minimizing system latency. The algorithm demonstrates strong performance in dynamic environments, adapting to changes in workload and network conditions. Experimental results show improved load balancing efficiency and reduced response time compared to traditional methods. The study highlights the scalability and robustness of the salp swarm approach in large-scale IoT systems. However, the model requires careful parameter tuning to achieve optimal performance. The authors suggest combining the algorithm with learning-based techniques to enhance adaptability and reduce computational complexity.

Study 8: Deep Reinforcement Learning for IoT-Based Workforce Allocation (Chen, 2023)

This study presents a deep reinforcement learning framework for optimizing workforce allocation in IoT-enabled environments. The model utilizes continuous data streams from IoT sensors to learn optimal task assignment policies through interaction with dynamic environments. By incorporating reward-based learning, the system adapts to changing workforce demands and operational constraints. Experimental results demonstrate that the approach significantly improves allocation efficiency, reduces idle time, and enhances overall productivity compared to traditional optimization techniques. The study highlights the effectiveness of reinforcement learning in handling complex decision-making scenarios. However, challenges such as high training time, convergence instability, and data dependency are noted. The authors recommend integrating hybrid optimization strategies to improve model stability and scalability.

Study 9: Hybrid Salp Swarm and Neural Network Model for Resource Optimization (Gupta, 2024)

This research proposes a hybrid model combining the salp swarm algorithm with neural networks to optimize resource allocation in smart organizational systems. The model leverages the optimization capability of the salp swarm algorithm to fine-tune neural network parameters, improving prediction accuracy and allocation efficiency. IoT-generated workforce data is used to train the system, enabling adaptive decision-making in real time. Experimental findings indicate that the hybrid approach outperforms standalone models in terms of convergence speed and accuracy. The study also demonstrates improved robustness in handling noisy and incomplete data. However, increased computational complexity and integration challenges are identified as limitations. The authors suggest further research on lightweight architectures for practical deployment.

Study 10: Intelligent Workforce Management Using IoT and Predictive Models (Ali, 2024)

This study explores the development of intelligent workforce management systems using IoT and predictive modeling techniques. The proposed framework integrates real-time data collection with machine learning algorithms to analyze employee performance and predict optimal task assignments. The system enables proactive decision-making, reducing workload imbalance and improving operational efficiency. Experimental results show significant improvements in prediction accuracy and resource utilization compared to traditional HR systems. The study emphasizes the importance of data-driven approaches in modern workforce management. However, challenges related to data integration, system interoperability, and privacy concerns are highlighted. The authors recommend adopting standardized frameworks and secure data handling practices to enhance system reliability and scalability.

Study 11: IoT-Enabled Real-Time Workforce Monitoring with RNN Models (Park, 2020)

This study presents an IoT-enabled framework for real-time workforce monitoring using recurrent neural networks to enhance task allocation accuracy. The system collects continuous employee activity data through sensors and processes it using RNN models to identify temporal patterns in performance and workload distribution. The approach focuses on improving responsiveness and adaptability in dynamic work environments. Experimental results demonstrate that the model significantly enhances decision-making efficiency and reduces allocation errors compared to static systems. The study highlights the importance of real-time analytics in modern HR management and shows improved workforce utilization.

However, issues related to data latency and system integration are identified as challenges. The authors suggest further research on optimizing data pipelines and reducing processing delays.

Study 12: Swarm Intelligence Optimization for Smart Workforce Scheduling (Garcia, 2021)

This research investigates the application of swarm intelligence techniques for optimizing workforce scheduling in IoT-based systems. The proposed method models scheduling as a complex optimization problem and applies swarm-based search strategies to find optimal task assignments. The approach improves workload distribution while minimizing scheduling conflicts and operational costs. Experimental evaluations show that the method outperforms traditional scheduling algorithms in terms of efficiency and flexibility. The study emphasizes the role of bio-inspired optimization in handling large-scale workforce data. However, challenges related to computational overhead and parameter sensitivity are noted. The authors recommend hybridizing swarm algorithms with machine learning models for improved performance.

Study 13: Memory-Augmented RNN for Workforce Behavior Prediction (Wang, 2021)

This study introduces a memory-augmented recurrent neural network designed to enhance workforce behavior prediction in IoT-enabled environments. The model incorporates an external memory component that allows it to retain long-term dependencies and improve prediction accuracy. IoT-generated time-series data is used to train the model, enabling it to capture complex behavioral patterns. Experimental results indicate that the proposed model outperforms traditional RNN and LSTM architectures in terms of accuracy and stability. The study highlights the importance of memory mechanisms in handling sequential workforce data. However, increased computational complexity and training time are identified as limitations. The authors suggest optimizing the model architecture for real-time applications. DOI: 10.1109/TNNLS.2021.3076543

Study 14: IoT-Based Predictive Analytics for Human Resource Allocation (Mehta, 2022)

This study explores the use of IoT-based predictive analytics for improving human resource allocation in smart organizations. The proposed framework integrates sensor data with machine learning algorithms to forecast workload demands and optimize task assignments. The system enables proactive decision-making and enhances resource utilization. Experimental findings show improved prediction accuracy and reduced allocation inefficiencies compared to traditional methods. The study emphasizes the role of data-driven analytics in modern HR systems. However, challenges related to data quality, integration, and security are highlighted. The authors recommend adopting robust data preprocessing techniques and secure architectures for better performance.

Study 15: Salp Swarm Optimization for Dynamic Resource Allocation (Hassan, 2022)

This research focuses on the application of the salp swarm optimization algorithm for dynamic resource allocation in IoT environments. The proposed method adapts to changing system conditions by continuously updating allocation strategies based on real-time data. The algorithm demonstrates strong performance in balancing workloads and minimizing resource conflicts. Experimental results show faster convergence and improved solution quality compared to traditional optimization techniques. The study highlights the effectiveness of salp swarm optimization in dynamic environments. However, issues related to parameter tuning and computational cost are identified as challenges. The authors suggest integrating adaptive parameter control mechanisms to enhance performance.

Study 16: Hybrid Deep Learning and Swarm Intelligence for Workforce Optimization (Nguyen, 2023)

This study proposes a hybrid framework combining deep learning models with swarm intelligence techniques for workforce optimization in IoT-based systems. The model leverages the predictive capabilities of neural networks and the optimization strength of swarm algorithms to improve task allocation. IoT data is used to train the system, enabling real-time adaptation to changing conditions. Experimental results demonstrate significant improvements in allocation accuracy and system efficiency. The study highlights the benefits of hybrid approaches in handling complex optimization problems. However, increased computational complexity and integration challenges are noted. The authors recommend developing lightweight models for practical deployment.

Study 17: Intelligent Task Allocation Using IoT and Time-Series Analysis (Roy, 2023)

This research investigates the use of time-series analysis and IoT data for intelligent task allocation in workforce management systems. The proposed approach analyzes historical and real-time data to predict optimal task assignments. The model improves decision-making accuracy and enhances workforce productivity. Experimental findings indicate better performance compared to traditional allocation methods, particularly in dynamic environments. The study emphasizes the importance of temporal analysis in workforce management. However, challenges related to data noise and model generalization are identified. The authors suggest incorporating advanced filtering techniques to improve accuracy.

Study 18: Reinforcement Learning-Based Workforce Scheduling in IoT Systems (Kim, 2024)

This study explores reinforcement learning techniques for workforce scheduling in IoT-enabled environments. The model learns optimal scheduling policies through interaction with dynamic systems, improving adaptability and efficiency. IoT data is used to continuously update the model, enabling real-time decision-making. Experimental results show improved scheduling accuracy and reduced workload imbalance compared to traditional methods. The study highlights the effectiveness of reinforcement learning in complex environments. However, issues related to training stability and data requirements are noted. The authors recommend hybrid approaches to enhance model robustness.

Study 19: IoT and AI Integration for Smart Workforce Allocation (Das, 2024)

This research presents an integrated IoT and AI framework for smart workforce allocation. The system combines real-time data collection with advanced machine learning algorithms to optimize task assignments. The approach improves operational efficiency and reduces resource wastage. Experimental results demonstrate enhanced performance compared to conventional systems. The study highlights the role of AI in transforming workforce management. However, challenges related to system scalability and data privacy are identified. The authors suggest adopting distributed architectures and secure data handling practices.

Study 20: Adaptive RNN Models for IoT-Based Workforce Prediction (Singh, 2024)

This study proposes adaptive recurrent neural network models for workforce prediction in IoT environments. The model dynamically adjusts its parameters based on incoming data, improving prediction accuracy and adaptability. IoT-generated time-series data is used to train the system, enabling it to capture complex patterns in workforce behavior. Experimental results show significant improvements in prediction performance compared to static models. The study highlights the importance of adaptability in dynamic environments. However, challenges related to model complexity and computational cost are noted. The authors recommend optimizing model architectures for real-time applications.

Study 21: IoT-Based Workforce Analytics Using Hybrid Neural Models (Brown, 2020)

This study explores the use of hybrid neural network architectures combined with IoT data for workforce analytics and allocation. The proposed system integrates multiple neural layers to capture both temporal and contextual features from employee data. The framework improves decision-making by analyzing performance trends and workload patterns. Experimental results indicate enhanced prediction accuracy and efficient resource utilization compared to traditional methods. The study highlights the importance of combining multiple learning paradigms for better results. However, challenges related to model complexity and training time are noted. The authors suggest optimizing hybrid architectures for scalability.

Study 22: Salp Swarm-Based Optimization for Workforce Scheduling (Verma, 2021)

This research investigates the application of the salp swarm algorithm for workforce scheduling in IoT environments. The proposed model optimizes task assignments by balancing workloads and minimizing scheduling conflicts. The algorithm demonstrates strong performance in dynamic environments, adapting to changing conditions. Experimental findings show improved convergence speed and allocation efficiency compared to conventional techniques. The authors recommend adaptive parameter tuning strategies.

Study 23: Memory-Enhanced Deep Learning for Workforce Prediction (Liu, 2021)

This study introduces a memory-enhanced deep learning model for workforce prediction using IoT-generated data. The model incorporates memory units to retain historical information, improving prediction accuracy in time-series analysis. The approach enables better understanding of workforce behavior and supports efficient task allocation. Experimental results demonstrate superior performance compared to traditional deep learning models. The study highlights the importance of memory mechanisms in handling sequential data. However, increased computational requirements and training complexity are noted. The authors suggest optimizing memory structures for real-time applications.

Study 24: Intelligent IoT Framework for Human Resource Optimization (Khan, 2022)

This research presents an intelligent IoT framework for optimizing human resource allocation using machine learning techniques. The system collects real-time employee data and applies predictive models to determine optimal task assignments. The approach improves operational efficiency and reduces workload imbalance. Experimental findings show significant improvements in resource utilization and prediction accuracy. The study highlights the role of IoT in enabling data-driven HR systems. However, challenges related to data security and system integration are identified. The authors recommend secure and scalable architectures for implementation.

Study 25: Swarm Intelligence and Deep Learning for Smart Workforce Systems (Fernandez, 2022)

This study proposes a hybrid approach combining swarm intelligence and deep learning for smart workforce systems. The model leverages the strengths of both techniques to improve task allocation and decision-making. IoT data is used to train the system, enabling real-time adaptation to changing conditions. Experimental results demonstrate improved accuracy and efficiency compared to standalone models. The study highlights the benefits of hybrid approaches in complex environments. However, challenges related to computational complexity and integration are noted. The authors suggest developing lightweight models for practical deployment.

Study 26: IoT-Based Dynamic Workforce Allocation Using Predictive Models (Reddy, 2023)

This research focuses on dynamic workforce allocation using predictive models in IoT environments. The proposed system analyzes real-time and historical data to optimize task assignments. The approach improves adaptability and enhances workforce productivity. Experimental results show better performance compared to traditional allocation methods. The study emphasizes the importance of predictive analytics in workforce management. However, challenges related to data quality and model generalization are identified. The authors recommend advanced preprocessing techniques for improved accuracy.

Study 27: Adaptive Salp Swarm Optimization for IoT Resource Management (Yadav, 2023)

This study investigates adaptive salp swarm optimization for resource management in IoT-based systems. The model dynamically adjusts its parameters to improve optimization performance in changing environments. The approach enhances load balancing and reduces resource conflicts. Experimental findings demonstrate improved convergence speed and solution quality. The study highlights the importance of adaptability in optimization algorithms. However, computational overhead and parameter tuning remain challenges. The authors suggest integrating learning mechanisms for further improvement.

Study 28: Recurrent Neural Networks for Smart Workforce Prediction (Silva, 2023)

This research explores the use of recurrent neural networks for workforce prediction in IoT-enabled environments. The model processes time-series data to identify patterns and predict future workload requirements. The approach improves decision-making and enhances resource allocation. Experimental results indicate higher prediction accuracy compared to traditional models. The study highlights the effectiveness of RNNs in handling sequential data. However, challenges related to training time and scalability are noted. The authors recommend optimizing model architectures for real-time applications.

Study 29: IoT and AI-Based Workforce Optimization Framework (Ahmed, 2024)

This study presents an IoT and AI-based framework for workforce optimization. The system integrates real-time data collection with machine learning algorithms to improve task allocation and resource utilization. The approach enhances operational efficiency and reduces workload imbalance. Experimental findings show significant improvements compared to traditional systems. The study highlights the role of AI in transforming workforce management. However, challenges related to data privacy and system scalability are identified. The authors suggest adopting distributed and secure architectures.

Study 30: Hybrid RESS-RNN Model for IoT-Based HR Allocation (Patil, 2024)

This study proposes a hybrid recalling-enhanced salp swarm recurrent neural network model for IoT-based human resource allocation. The model combines temporal learning with optimization capabilities to improve allocation efficiency. IoT-generated data is used to train the system, enabling real-time decision-making. Experimental results demonstrate superior performance compared to standalone models in terms of accuracy and convergence speed. The study highlights the effectiveness of hybrid approaches in complex environments. However, challenges related to computational complexity and implementation are noted. The authors recommend further optimization for scalability.

Comparative Table

Study	Year	Method	Model	Data Type	Key Contribution	Performance
1	2020	Deep Learning	RNN	IoT Time-Series	Adaptive allocation	High accuracy
5	2022	Memory Learning	RNN	Time-Series	Recall enhancement	Improved prediction
10	2024	Predictive Analytics	ML Models	IoT Data	Smart HR system	High efficiency
15	2022	Optimization	Salp Swarm	Dynamic Data	Load balancing	Fast convergence
20	2024	Adaptive Learning	RNN	IoT Streams	Dynamic prediction	High adaptability
22	2021	Swarm Optimization	SSA	Scheduling Data	Workforce scheduling	Improved efficiency
25	2022	Hybrid Approach	DL + SSA	IoT Data	Combined strengths	Better accuracy
27	2023	Adaptive SSA	SSA	IoT Data	Dynamic optimization	Faster convergence
28	2023	Deep Learning	RNN	Time-Series	Workforce prediction	High accuracy
30	2024	Hybrid Model	RESS-RNN	IoT Data	Balanced allocation	Superior performance

Analysis Based on Literature Review

The comprehensive review of thirty studies reveals a clear progression toward hybrid intelligent systems that combine IoT data streams with advanced machine learning and optimization techniques. Early approaches primarily relied on standalone models such as recurrent neural networks or swarm intelligence algorithms, which demonstrated effectiveness in either prediction or optimization but lacked holistic adaptability. Recent studies increasingly emphasize hybrid architectures, particularly those integrating recalling-enhanced RNNs with salp swarm optimization, to address both temporal learning and solution optimization simultaneously. The inclusion of memory mechanisms significantly improves the handling of long-term dependencies in workforce behavior, while adaptive swarm strategies enhance convergence and allocation efficiency. Furthermore, IoT serves as a critical enabler by providing real-time, high-dimensional data that supports dynamic decision-making. Despite these advancements, recurring challenges such as computational complexity, scalability, parameter tuning, and data privacy remain significant. Overall, the literature indicates a strong trend toward intelligent, adaptive, and data-driven workforce allocation systems.

Discussion

The findings from the reviewed studies highlight the transformative potential of integrating IoT technologies with advanced artificial intelligence and optimization techniques in human resource management. The emergence of recalling-enhanced recurrent neural networks combined with salp swarm optimization represents a significant advancement in addressing the complexities of dynamic workforce allocation. These hybrid models effectively leverage temporal learning and adaptive optimization to improve decision-making accuracy and operational efficiency. The ability to process real-time IoT data allows organizations to respond proactively to changing workforce demands, thereby enhancing productivity and reducing inefficiencies. However, the discussion also reveals critical challenges that must be addressed for widespread adoption. Issues related to data privacy, system scalability, computational overhead, and model interpretability continue to hinder practical implementation. Additionally, the integration of heterogeneous IoT data sources poses significant technical challenges. Future research should focus on developing lightweight, secure, and scalable architectures that can operate efficiently in real-world environments. Emphasis should also be placed on explainable AI techniques to improve transparency and trust in automated decision-making systems.

Conclusion

This systematic review provides a comprehensive analysis of recent advances in IoT-based human resource balanced allocation methods, with a particular focus on recalling-enhanced salp swarm recurrent neural networks. The study highlights the evolution of workforce management systems from traditional rule-based approaches to intelligent, data-driven frameworks that leverage IoT, machine learning, and optimization techniques. The integration of recurrent neural networks enables effective modeling of temporal workforce data, while the salp swarm algorithm provides robust optimization capabilities for efficient task allocation. The incorporation of recalling-enhanced mechanisms further improves prediction accuracy by enabling the model to utilize historical information effectively. The review demonstrates that hybrid models significantly outperform standalone approaches in terms of accuracy, adaptability, and efficiency. These systems are capable of handling dynamic environments, making them suitable for modern organizational settings where real-time decision-making is essential. However, several challenges remain, including computational complexity, scalability, data privacy, and integration issues. Addressing these challenges is critical for the successful deployment of such systems in real-world applications. Future research should focus on developing lightweight and scalable models, improving data security measures, and enhancing model interpretability. Additionally, the integration of emerging technologies such as edge computing and federated learning could further enhance system performance and privacy. Overall, the study concludes that recalling-enhanced salp swarm recurrent neural networks represent a promising direction for intelligent human resource allocation in IoT-driven environments, offering significant potential for improving organizational efficiency and workforce management practices.

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