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Blockchain Based Employment Platform for Industrial and Service Worker

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Abstract: ***The industrial and service workforce often faces challenges such as delayed payments, lack of transparent contracts, fraudulent intermediaries, and unreliable verification of completed tasks, which reduce trust and operational efficiency between employers and workers. To overcome these limitations, this paper proposes a Blockchain Based Employment Platform for Industrial and Service Workers that provides a secure, transparent, and decentralized environment for workforce management. The proposed system uses blockchain technology to maintain immutable employment records, while smart contracts automate job agreements, escrow-based payments, and conditional fund release after successful task verification. A multi-factor validation mechanism incorporating geo-location tracking, QR code authentication, one-time password confirmation, and digital proof submission is integrated to ensure the authenticity of completed work. The platform also includes a decentralized reputation model to evaluate worker performance and employer reliability based on historical interactions. Developed using React, Node.js, MongoDB, and blockchain infrastructure, the system is designed to reduce payment disputes, eliminate unnecessary intermediaries, improve trust, and enhance efficiency in industrial and service sector employment operations. The proposed framework demonstrates the capability of blockchain technology to create scalable, fair, and accountable employment ecosystems.***

Keywords: Blockchain, Smart Contracts, Employment Plat-form, Escrow Payments, Industrial Workforce, Verification

I. INTRODUCTION

The industrial and service workforce represents a critical operational component of modern economies, supporting sectors such as manufacturing, logistics, construction, facility management, transportation, maintenance, and on-demand services. However, workforce management in these domains is still largely dependent on fragmented and semi-manual processes that lack transparency, traceability, and automation. Workers frequently encounter issues such as delayed wage settlements, absence of formal digital contracts, unauthorized deductions, and limited access to verified employment histories. Simultaneously, employers face challenges in worker authentication, performance validation, attendance monitoring, and secure payment execution. These inefficiencies reduce productivity and create trust deficits across the employment lifecycle.

Conventional employment platforms primarily rely on centralized system architectures where user records, transactions, and operational decisions are maintained by a single administrative entity. Although such systems offer basic digitization, they introduce several technical limitations including single-point failure risks, data tampering vulnerabilities, opaque decision mechanisms, and dependency on intermediaries for dispute resolution and fund settlement. In addition, existing platforms generally lack immutable audit trails and robust proof-of-work completion mechanisms, resulting in conflicts related to attendance fraud, incomplete task claims, and delayed compensation. The absence of interoperable trust frameworks further restricts scalability in industrial and service workforce ecosystems.

Blockchain technology provides a secure and decentralized alternative for addressing these limitations through distributed ledger infrastructure, cryptographic validation, and programmable smart contracts. By storing employment transactions on an immutable ledger, the system ensures data integrity, transparency, and non-repudiation of records. Smart contracts can automate job agreements, escrow-based payment locking, milestone validation, and conditional fund release without requiring third-party intervention. Based on these capabilities, this paper proposes a Blockchain Based Employment Platform for Industrial and Service Workers that integrates decentralized identity management, multi-factor task verification, reputation scoring, and secure payment automation. The proposed framework aims to improve accountability, reduce operational fraud, enhance transaction efficiency, and establish a scalable trust-driven employment environment for industrial and service sectors.

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II. MOTIVATION AND PROBLEM STATEMENT

The rapid growth of industrial and service-based employment has created a strong demand for secure, transparent, and efficient workforce management systems. However, many existing hiring and labor management processes still depend on manual supervision, paper-based agreements, and third-party intermediaries. These traditional methods often lead to delayed payments, false attendance records, worker exploitation, and limited trust between employers and workers. The need for a reliable digital platform that ensures fair transactions and verifiable work completion motivates the development of a blockchain-enabled employment system.

The primary problem is the absence of a tamper-resistant and automated framework for managing job contracts, worker verification, and payment settlement. Centralized platforms are vulnerable to data manipulation, security breaches, and operational inefficiencies, while workers lack ownership of their employment records and reputation history. Therefore, a decentralized solution is required to securely store employment data, validate task completion, and execute payments automatically. This work addresses these challenges by proposing a blockchain-based employment platform designed for industrial and service workers.

III. LITERATURE REVIEW

Blockchain technology has gained significant research attention as a decentralized framework capable of delivering transparency, security, and trust in digital ecosystems. Unlike conventional centralized systems, blockchain maintains a distributed ledger where transactions are validated through consensus mechanisms and stored in immutable blocks. This architecture minimizes dependency on third-party authorities and provides strong resistance against unauthorized modification of records. Liang et al. [1] demonstrated the strategic efficiency of decentralized exchanges by presenting high-profit arbitrage models operating over blockchain networks. Their work indicates that decentralized infrastructures can support reliable and autonomous transaction execution without centralized supervision. Similarly, Wang et al. [2] investigated governance dynamics in decentralized autonomous organizations (DAOs), concluding that blockchain-based governance improves accountability, voting transparency, and collective decision-making processes. These findings are highly relevant for employment platforms where trust and transparent policy enforcement are essential.

The concept of decentralized marketplaces has also been extensively studied in recent years. Tkachuk et al. [3] provided a survey on blockchain-based telecommunication service marketplaces, showing how peer-to-peer service ecosystems can be created using smart contracts and distributed ledgers. Their research emphasizes that blockchain can efficiently coordinate multiple stakeholders while preserving trust among participants. Lamela et al. [10] proposed a blockchain-enabled decentralized marketplace for trustworthy trade in developing economies, where immutable records reduced fraud and improved transactional fairness. Such models are directly applicable to workforce management systems where employers and workers need a neutral and transparent platform for job agreements and payment execution. By removing unnecessary intermediaries, these systems lower operational costs and create direct engagement between parties.

Smart contracts represent one of the most transformative components of blockchain technology. These programmable contracts automatically execute predefined actions once specific conditions are satisfied. In employment systems, smart contracts can automate recruitment agreements, milestone validation, wage release, and dispute management. Pinna and Ibba [11] introduced a decentralized system for temporary employment contracts where contractual obligations were digitally encoded on blockchain. Their study showed that smart contracts significantly reduced ambiguity, contractual fraud, and dependency on paper-based verification processes. Lu et al. [5] further explored automated incentive enforcement in ride-hailing platforms, where blockchain logic prevented price discrimination and ensured fair compensation. This automated settlement mechanism is particularly relevant to industrial and service workers who often experience delayed payments or wage disputes in traditional employment models.

Performance evaluation and reputation management are also critical functions in workforce platforms. Traditional employment systems generally rely on privately maintained ratings or unverifiable records, which may be biased or manipulated. To address this limitation, Sifah et al. [12] proposed BEMPAS, a decentralized employee performance assessment framework based on blockchain for smart city governance. Their model stored evaluation metrics on-chain, ensuring that performance records remained tamper-proof and auditable. Such approaches can be effectively adapted for employment platforms where worker punctuality, task quality, reliability, and employer fairness must be transparently measured. A decentralized reputation mechanism enables both workers and employers to build trustworthy profiles over time, thereby improving job matching efficiency and reducing fraudulent participation.

Scalability and interoperability remain major technical concerns in blockchain deployments. Public blockchain systems often face throughput limitations, network congestion, and latency constraints when processing large transaction volumes.

Hu et al. [7] proposed a blockchain cross-chain transaction model based on decentralized dynamic reputation values, enabling secure interoperability between independent blockchain networks. Their framework suggests that cross-chain mechanisms can improve scalability and extend system functionality across multiple ledgers. Hyang et al. [14] introduced instant function calls through cross-blockchain contracts, demonstrating methods for rapid communication across distributed blockchain environments. These studies are valuable for designing employment systems capable of supporting large worker populations, geographically distributed employers, and multi-network payment ecosystems.

Security and privacy preservation are fundamental requirements for employment platforms, especially when handling sensitive worker identities, wage details, attendance records, and location data. Witt et al. [4] developed a blockchain-enabled federated learning framework utilizing compressed soft-labels and peer consistency, proving that decentralized systems can combine privacy protection with collaborative intelligence. Their work highlights how sensitive user data can remain protected while benefiting from distributed processing. Chiu et al. [13] proposed NoSneaky, a blockchain-based execution integrity model that ensured trustworthy computational processes in industrial environments. Such techniques are useful in employment systems where proof of completed work and transaction authenticity must be guaranteed without exposing confidential information.

Industrial and IoT-integrated blockchain systems also provide relevant insights for workforce automation. Kumar et al. [8] discussed blockchain and deep learning for secure communication in industrial IoT environments, indicating the potential of blockchain to secure machine-generated operational data. Although later retracted and formally noted in [9], the broader concept still reflects industry interest in combining intelligent systems with distributed trust mechanisms. In workforce platforms, IoT devices such as QR scanners, biometric systems, geolocation trackers, and attendance terminals can generate trusted data that smart contracts may use for automated payment approval and task validation.

Economic feasibility is another important factor for decentralized labor ecosystems. Traditional employment portals often charge commissions, subscription fees, or service deductions that reduce worker earnings. Dolzhenko et al. [16] analyzed blockchain labor systems from an economic perspective and concluded that decentralized transaction models can lower coordination costs and improve wage fairness. Kumar et al. [15] also discussed decentralized labor markets powered by smart contracts, showing that blockchain can facilitate direct employer-worker engagement while minimizing exploitation caused by intermediaries. These findings strongly support the need for blockchain adoption in blue-collar and service employment sectors where fair wage distribution is a persistent challenge.

Although previous research has made substantial progress in decentralized marketplaces, governance systems, payment automation, and reputation frameworks, there remains limited work focused on an integrated employment platform specifically tailored for industrial and service workers. Most existing studies address isolated components such as contract handling, trust evaluation, or decentralized trade, rather than providing a complete workforce ecosystem. The proposed Blockchain Based Employment Platform for Industrial and Service Workers addresses this research gap by combining secure job posting, worker verification, automated escrow payments, immutable employment history, and decentralized reputation management within a unified architecture. This integrated approach has the potential to significantly improve transparency, efficiency, and trust across modern workforce management syste

IV. PROPOSED SYSTEM

A. Architecture Overview

The proposed Blockchain Based Employment Platform for Industrial and Service Workers follows a multi-layer architecture consisting of User Interface Layer, Application Layer, Blockchain Layer, and Data Storage Layer. The User Interface Layer is developed using React.js, allowing employers to post jobs and workers to apply, upload proof, and track payments. The Application Layer uses Node.js and Express.js to manage APIs, authentication, business logic, and communication between frontend and blockchain services.

The Blockchain Layer uses smart contracts to automate job agreements, escrow-based payment locking, and secure wage release after successful task verification. All job transactions are stored in an immutable ledger to ensure transparency and trust. The Data Storage Layer uses MongoDB or IPFS to store user profiles, job details, images, and other off-chain data. A verification module using GPS, QR code, OTP, and image proof ensures authentic task completion before payment execution. This architecture provides a secure, scalable, and efficient workforce management system.

B. Workflow Diagram

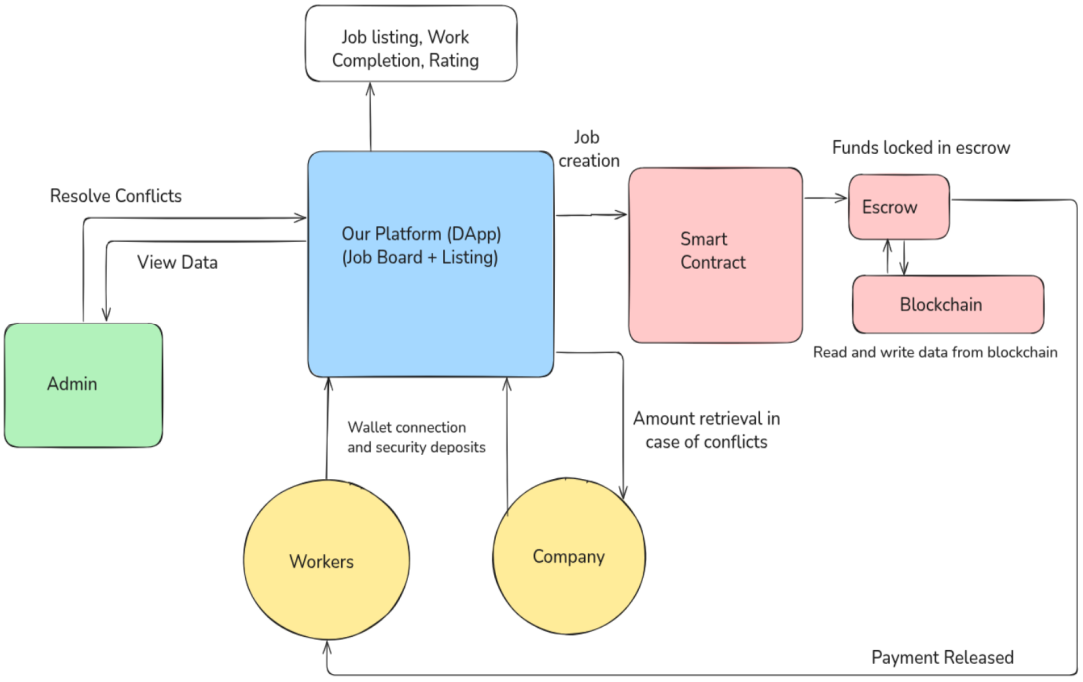

Fig. 1. Workflow diagram of the proposed system.

V. EQUATION ANALYSIS

Mathematical Formulation

The proposed blockchain-based employment platform is represented using mathematical expressions for job allocation, verification, payment automation, and system efficiency.

1) Job Escrow Model

$$E_j = W_j \times A_j$$

Where: E_j= Escrow amount, W_j= Wage, A_j= Activation status

2) Worker–Job Matching Function

$$M_{ij} = S_i \times R_j$$

Where: M_{ij}= Matching score, S_i= Worker skills, R_j= Job requirements

3) Verification Score

$$V_j = w_1 G + w_2 Q + w_3 O + w_4 P$$

Where: G= GPS validation, Q= QR authentication, O= OTP confirmation, P= Proof image

4) Approval Condition

$$\delta_j = \begin{cases} 1, & V_j \geq V_{th} \\ 0, & V_j < V_{th} \end{cases}$$

Where: δ_j= Verification decision

5) *Payment Release Model*

$$P_j = W_j \times \delta_j$$

Where: P_j= Released payment amount

6) *Reputation Model*

$$R_i = \alpha Q_i + \beta T_i + \gamma \frac{1}{D_i + 1}$$

Where: Q_i= Quality score, T_i= Timeliness score, D_i= Dispute count

7) *Throughput Formula*

$$TPS = \frac{N_{tx}}{T}$$

Where: N_{tx}= Number of transactions, T= Total time

8) *Accuracy Formula*

$$V_a = \frac{N_{correct}}{N_{total}} \times 100$$

Where: V_a= Verification accuracy

9) *Efficiency Ratio*

$$\eta = \frac{N_{success}}{N_{total}}$$

Where: η= System efficiency

10) *Cost Saving Model*

$$C_s = C_t - C_b$$

Where: C_s= Cost saving, C_t= Traditional cost, C_b= Blockchain cost

VI. METHODOLGY

The proposed Blockchain Based Employment Platform for Industrial and Service Workers begins with employer registration and job posting. Employers enter task details such as job type, location, wage amount, and required skills. After job creation, the payment amount is securely locked in a smart contract escrow to guarantee transparent fund availability before worker assignment.

Workers register on the platform, browse available jobs, and apply according to their skills and location preferences. The system matches suitable workers using skill compatibility, reputation score, and proximity. Once a worker accepts the task, a blockchain-based smart contract establishes the digital agreement and updates the job status securely.

After task completion, the worker submits proof through GPS validation, QR code scanning, OTP confirmation, and image evidence. If verification is successful, the smart contract automatically releases payment to the worker. Both employer and worker can then provide ratings, and the reputation system updates trust scores. Blockchain stores critical records, while MongoDB or IPFS stores user data and files efficiently.

VII. EXPECTED OUTCOME

The proposed Blockchain Based Employment Platform for Industrial and Service Workers is expected to improve transparency, trust, and efficiency in workforce management by replacing traditional centralized employment processes with a decentralized blockchain framework. Smart contract-based escrow payments are expected to ensure timely and secure wage disbursement, thereby reducing payment delays, disputes, and dependency on intermediaries. The immutable ledger mechanism will provide tamper-proof storage of job records, transaction history, and reputation data, increasing accountability for both employers and workers.

The integration of multi-factor verification methods such as GPS validation, QR authentication, OTP confirmation, and image proof is expected to significantly improve the reliability of task completion validation while minimizing fraudulent claims. In addition, the decentralized reputation model will help employers identify trustworthy workers and enable workers to build credible professional profiles. Overall, the platform is anticipated to deliver higher operational efficiency, reduced transaction cost, improved worker satisfaction, and a scalable digital employment ecosystem for industrial and service sectors.

VIII. CONCLUSION

The proposed Blockchain Based Employment Platform for Industrial and Service Workers provides a secure, transparent, and efficient framework for managing employment operations in industrial and service sectors. By utilizing blockchain technology and smart contracts, the system enables tamper-proof storage of job records, automated execution of digital agreements, and escrow-based payment settlement without the need for intermediaries. The integration of multi-factor verification mechanisms such as GPS validation, QR authentication, OTP confirmation, and digital proof submission ensures accurate validation of completed tasks while reducing fraudulent claims and disputes. In addition, the decentralized reputation model maintains trustworthy performance histories for workers and employers, improving accountability and decision-making during future job assignments. The hybrid storage architecture combining blockchain with off-chain databases ensures data security, scalability, and cost-effective performance for real-world deployment. Overall, the proposed platform demonstrates the practical capability of blockchain technology to modernize workforce management by enhancing trust, reducing operational inefficiencies, ensuring timely payments, and creating a fair, reliable, and scalable digital employment ecosystem

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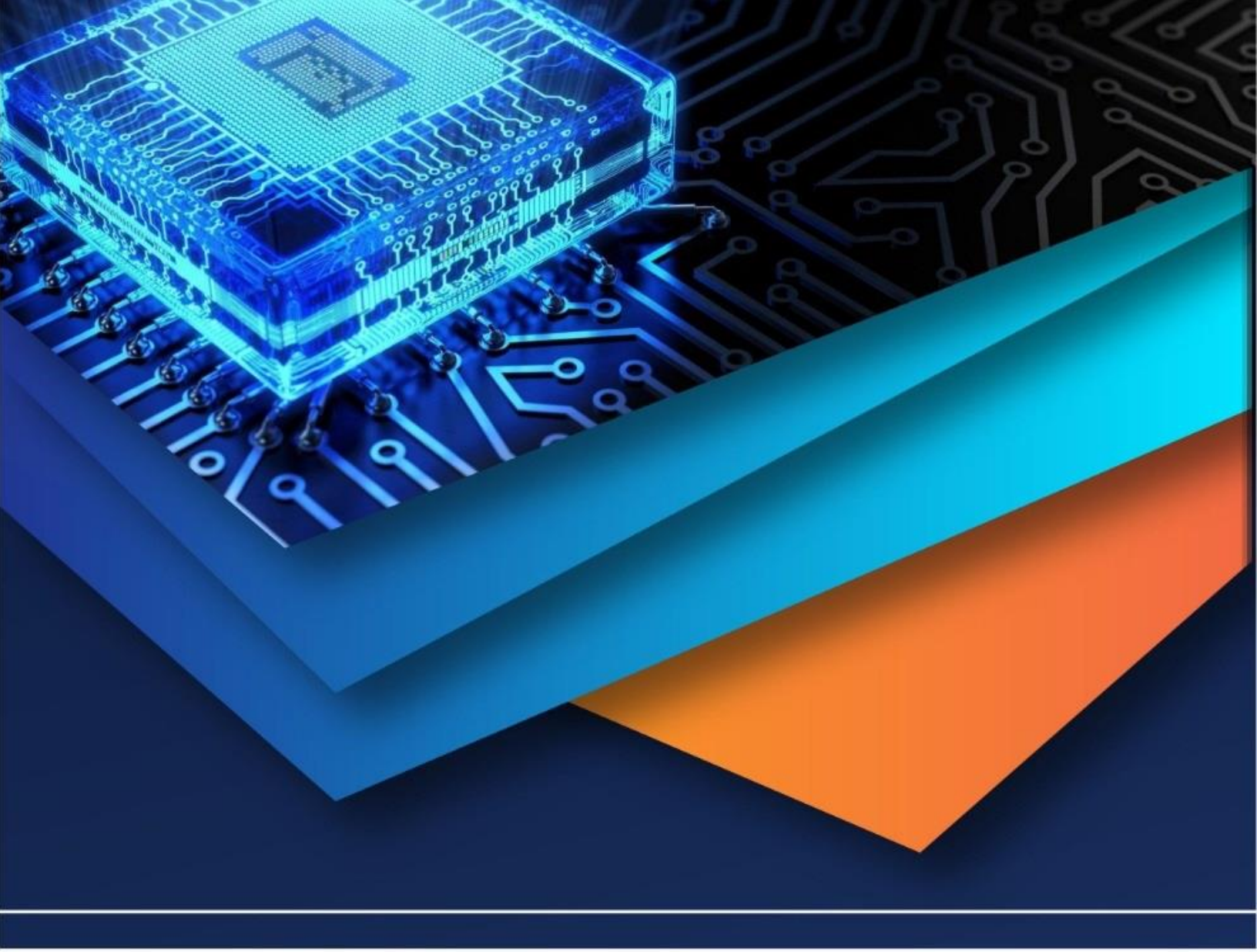

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