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AI and Blockchain-Enabled Smart Business Management Framework Using Cloud-Based Deep Learning

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Abstract

The suggested research provides the design of an intelligent framework of Smart Business Management, which is based on Cloud Computing, Deep Learning, and Blockchain technologies. Modern business generates vast amounts of both structured and unstructured data, so there are problems in managing this data and making decisions about possible risks. These issues are resolved by implementing the mentioned technologies in the business environment and creating an innovative, safe, and efficient system. Cloud computing is the base for the framework that uses powerful computational resources needed for training and deploying of Deep Learning models. As Deep Learning algorithms need considerable computational resources, the cloud platforms allow analysing big volumes of business data without spending huge money on the construction of the on-premise data center. The trained models will be constantly working with the real-time business information, analysing the tendencies in the market, finding possible anomalies, evaluating the risks, and taking strategic decisions. It will help to adapt to the market conditions and improve the business performance.

Keywords: *Artificial Intelligence, Blockchain, Deep Learning, Cloud Computing, Smart Business Management.*

1. Introduction

Companies generate a significant amount of data from different sources, such as IoT devices, CRM, product movement throughout the supply chain, in the age of Industry 4.0 (Mohsen, 2023). Traditional Business Management solutions become sufficient to use independently due to their siloed nature and lack of analytical capabilities. However, while artificial intelligence and deep learning can reveal sophisticated patterns within large datasets, they require computational resources. Cloud computing can provide such resources as well as managed AI services.

The performance of the proposed framework is tested by analysing the efficiency of different Deep Learning models according to their throughput and latency. The throughput is measured as the amount of transactions and predictions processed by the framework per unit of time, which is a good indicator of system's scalability and capabilities. Latency, on the other hand, is the time taken to perform a prediction or business transaction. Thus, by comparing different Deep Learning models according to these parameters, the most appropriate one is chosen. To ensure that data is secure, transparent and trustworthy, the permissioned Blockchain technology is used in the framework. Unlike public blockchains, a permissioned blockchain limits the network access only to authorized users, which makes this technology ideal for use in enterprise-level solutions. All the business transactions are recorded into an immutable and distributed ledger in a way to ensure data provenance, integrity and traceability. This approach not only eliminates unauthorized modification of data, but also makes data transparent and minimizes risks of any fraud activities among the business stakeholders. Moreover, smart contracts could be used for automation of business transactions and agreements.

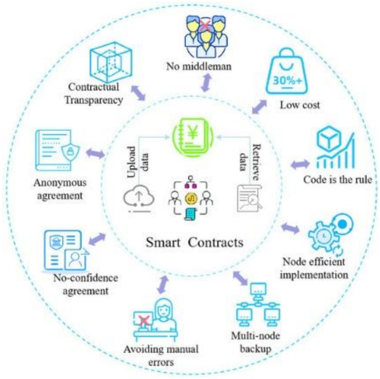

Figure 1: AI-Driven Optimization of Blockchain

(Source: Yuan et al. 2025)

Better data security and transparency in business dealings is what people are after. Blockchain provides decentralization, immutability, and cryptographically secure features, which imply having a shared, immutable ledger with high levels of trust (Dong et al. 2023). However, there is still one drawback as a lack of a single integrated platform for integrating the technologies. It is exactly what this research is supposed to address through its development of Secure and Intelligent Business Management Framework.

2. Literature Review

From simple rule-based AI technologies, business uses advanced machine learning and Deep Learning approaches. Such technologies have excellent prediction capabilities which become one of the primary requirements for modern business intelligence. For instance, the popular techniques in forecasting time series for demand planning and financial market analysis are the Long Short-Term Memory networks and Convolutional Neural Networks. Among successful applications of AI, there are such tasks as customer churn prediction, supply chain improvement, and risk management (Imani et al. 2025).

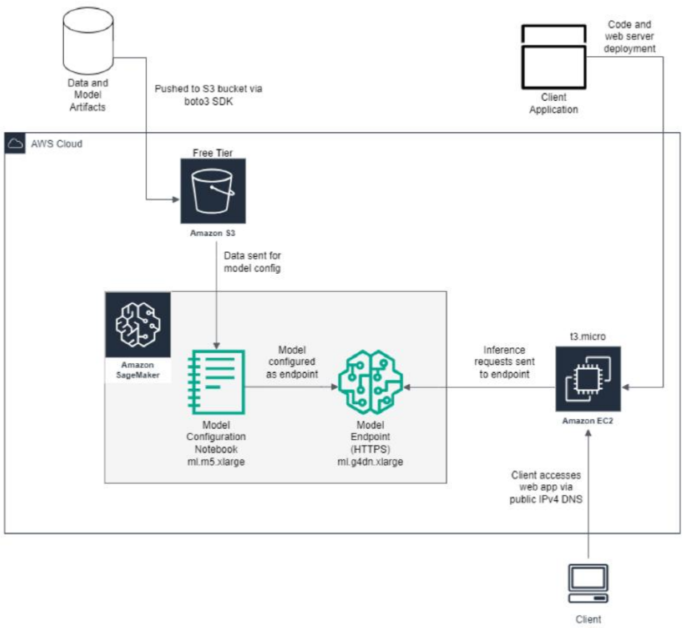

Figure 2: Comparison of Cloud-Computing Providers

(Source: Rajendran et al. 2023)

The major factor driving this evolution is the increase of computing power and the availability of big data. At the same time, the training and deployment of deep neural networks require considerable computing power; thus, cloud-based AI solutions are often used by corporations. There are multiple cloud platforms providing AI development services including AWS SageMaker, Google AI Platform, and Azure Machine Learning. All these platforms provide scalable infrastructure, algorithms, and MLOps services which simplify the implementation of AI into business (Ramesh et al. 2025). In such a way, it becomes possible to create Smart Business Management systems that adapt to new data.

Blockchain technology was originally associated with cryptocurrencies; however, nowadays it has several important applications in business other than currency exchange. The blockchain is a distributed, decentralized and immutable ledger of transactions stored in many computers. Main characteristics of blockchain are decentralization (there is no central authority), immutability (transaction history cannot be easily altered) and transparency/auditability (the participants of a permissioned network can access transaction history). Smart contracts are self-executing contracts with agreement terms defined by code and automated execution of business logic (Kaur, Ali A., & Faisal 2022). In business management, blockchain is currently being applied for tracking products in the supply chain, secure cross-border payments and digital identity management. For instance, blockchain can trace a product from raw material through all stages of its production to delivery to the customer, providing its authenticity and ethically correct sourcing. Blockchain is characterized by high level of security and trust, however, the problem with public networks is low speed of transactions and high latency, which is important in case of big volumes of business operations.

Blockchain technology is combined with AI in emerging, fast-growing field of research (Alhur et al. 2025). Blockchain systems can be made smarter and more efficient by using AI, at the same time, blockchain can add transparency and trust to AI. Several studies investigate decentralized AI marketplaces that enable selling and buying AI algorithms and data in secure and open manner. Data provenance for AI is using blockchain for tracking source of training data and increasing data trustworthiness and preventing bad data, which is critical in federated learning (Trawinski, 2022). AI can help in optimization of blockchain operation like finding better consensus algorithms or predicting network congestion. Smart contract can utilize AI for performing more complicated and condition-based business logic (Quan *et al.,* 2024). There are some existing platforms that combine blockchain and analytics for particular needs of the supply chain. However, there is currently no universal platform combining cloud-based deep learning algorithms and blockchain for core business management processes like finance, inventory, and human resource management. This paper tries to fill that gap by developing a framework integrating those technologies for building solid backbone of the business.

3. Proposed Methodology

Architectural Overview

The architecture comprises five layers. Data Ingestion Layer gathers data from internal and external sources. Preprocessing Layer cleanses and transforms the data and saves private data off-chain in IPFS with blockchain references. Core Blockchain Network Layer applies a permissioned blockchain with the execution of smart contracts and maintaining an immutable ledger (ALENOGHENA, 2024). Cloud-Based Deep Learning Layer leverages cloud technologies for training, deployment, and management of AI models. Application Layer delivers user interfaces and dashboards.

Data Flow and Integration

Data flows from ingestion through validation, encryption-hashing data on the blockchain, execution of actions within smart contracts based on business events, calling an AI model for prediction, logging results on the blockchain, and continuous learning with feedback (Magoni,, 2024).

Smart Contract Implementation

Smart contracts facilitate automation of business processes (Chakravarty, 2025). A smart contract for supply chain payment will contain actions to confirm delivery and make payment under predefined conditions.

4. Analysis and Results

This section provides an evaluation of the proposed framework performance. This evaluation has three main components: analysis of the accuracy of Deep Learning model, performance and overhead analysis for the combination of Blockchain and Cloud computing, and security and scalability analysis.

Deep Learning Model Performance Analysis

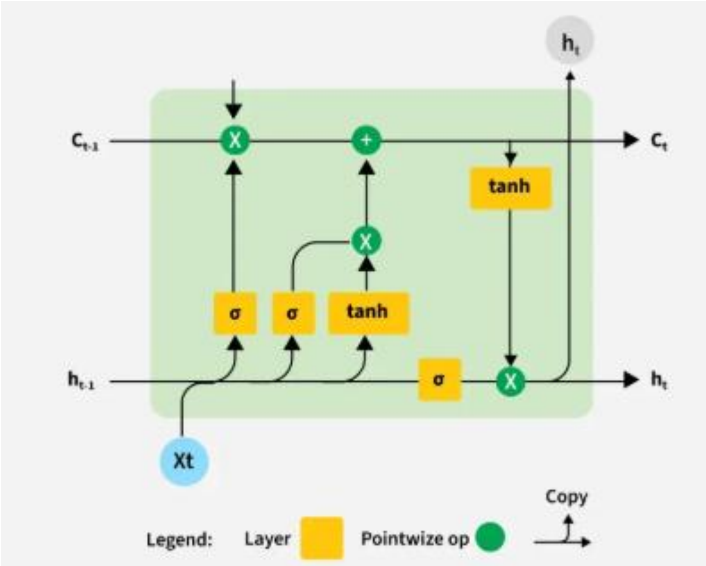

Figure 3: Long Short-Term Memory (LSTM) network

(Source: Geeksforgeeks, 2026)

The accuracy of the Deep Learning model will be evaluated by conducting a demand forecast task for a retail company on historical data about sales from a big retail shop. The purpose of this task is to predict the daily demand for a specific product in the next 30 days. For this experiment, the Long Short-Term Memory (LSTM) network that is designed to work with time-series data will be applied using AWS SageMaker (Trawinski, 2022). It will consist of two LSTM layers, each containing 128 neurons, followed by the dropout layer with the rate of 0.2 and the dense output layer. The model will be trained with historical data for 2017-2019 years split into 70% train and 30% test sets for 100 epochs, batch size of 64.

The model performance is assessed using three standard regression evaluation measures. MAE (Mean Absolute Error) is the arithmetic average of the absolute error between the actual value and the predicted one. It could be mathematically formulated as follows:

- “Mean Absolute Error (MAE): MAE = (1/n) ∗ Σ|y_i − ŷ_i|
- Root Mean Squared Error (RMSE): RMSE = sqrt((1/n) * Σ(y_i - ŷ_i)^2)
- Mean Absolute Percentage Error (MAPE): MAPE = (100%/n) ∗ Σ |(y_i − ŷ_i) / y_i|”

The summary of the above metrics for both training and testing datasets could be found in Table 1 below. From the results, it becomes clear that the performance of LSTM is pretty high, with less than 7% of MAPE for the unseen data. Such accuracy is sufficiently high for real-world decision making. The cloud training took less than two hours on a p3.2xlarge machine.

Table 1: Performance Metrics for LSTM Demand Forecasting Model

Metric	Training Data	Testing Data
Mean Absolute Error (MAE)	12.4	18.6
Root Mean Squared Error (RMSE)	25.1	35.3
Mean Absolute Percentage Error (MAPE)	4.2%	6.8%

Blockchain and System Performance Analysis

The biggest challenge in using blockchain technology is the overhead associated with blockchain, specifically the delay in transaction times and throughput. To investigate this problem, a blockchain test network was deployed on the cloud infrastructure using Hyperledger Fabric. We conducted the experiments with different workloads. In particular, the most important metrics used in the tests are transaction latency (time difference between when the transaction was submitted and completed) and transaction throughput (amount of transactions per second).

Table 2 provides the results of our blockchain transaction latency tests. It displays average transaction latency and 95th percentile transaction latency at different levels of concurrent clients. As it is clear from the table, transaction latency increases as the number of concurrent clients increases, increasing from 210 milliseconds with 50 concurrent clients to 620 milliseconds with 200 concurrent clients.

Table 2: Blockchain Transaction Latency

Number of Concurrent Clients	Average Latency (ms)	95th Percentile Latency (ms)
50	210	340
100	380	570
200	620	910

Table 3 depicts the transaction throughput performance of the blockchain. This table provides the total number of transactions as well as the average transaction throughput based on various test periods. From the results depicted, it is clear that there is an average throughput of 24 transactions per second.

Table 3: Blockchain Transaction Throughput (TPS)

Test Duration (seconds)	Total Transactions	Average Throughput (TPS)
120	2850	23.75
300	7200	24.00

The analysis also reveals that the introduction of the blockchain leads to some additional latency. Specifically, 100 users take on average about 380 milliseconds to complete the process; however, the system is capable of fulfilling requirements for many enterprise operations. In the test environment, there were up to 24 transactions per second processed which is sufficient for the proof-of-concept system. However, the latency may become a problem when the system is used for extremely high throughput use cases such as high-frequency trading.

Security and Scalability Assessment

Three major ways the proposed framework increases the security include ensuring the integrity of the data through storing data hashes on the blockchain; creating an immutable audit trail because all the key business processes are recorded on the blockchain, thus making the audit trail verifiable and non-repudiable; future updates of the models are going to be managed through the smart contract and the deployment will be possible only after model validation. As for scalability, the Deep Learning portion utilizes scalable cloud services, whereas scalability of the blockchain can be improved through ongoing research in such areas as sharding and layer two solutions and then incorporated into the framework (Quan et al. 2024).

5. Discussion

Proposed Secure and Intelligent Business Management Framework leverages three robust technologies cloud-based deep learning, blockchain, and artificial intelligence which are commonly used independently of each other (Umer, Belay & Gouveia, 2024). The analysis proves that the integration of all three technologies is both feasible and beneficial. The deep learning technology provides the intelligent capacity to the framework. In particular, it enables the system to predict the demand with a Mean Absolute Percentage Error of less than 7%. This feature will help optimize inventory and minimize losses associated with the shortage or surplus of goods.

However, the blockchain layer introduces additional delays. However, it adds important value to the system as reliability. In the context of the ever-growing globalization, it becomes very useful to have the means of confirming that the record is authentic and immutable (Ogunmola, Zia & Kumar, 2024). For instance, during the financial audit, an auditor is capable of verifying the accuracy and completeness of the company's financial records using blockchain and avoiding depending on the internal controls of the company. Smart contracts allow automating the execution of complicated business rules and eliminating the necessity to do anything manually or engage a trusted third party.

Balancing performance and security is one of the crucial points in the framework. While the introduction of the blockchain layer reduces performance, it is worth mentioning that for many non-real-time operations such as auditing, compliance, and resolution of disputes between several entities, the benefits of transparency and immutability are more significant than the costs (Veloso et al. 2026). Moreover, there is a way to combine the advantages of both real-time and off-chain approaches for the operations that require prompt execution. Namely, small-value transactions can be processed in the off-chain payment channel, and the result will be recorded in the blockchain.

Thus, the cloud allows scaling the artificial intelligence part in terms of computation power as the amount of data increases. As for the blockchain part, it is possible to increase performance by choosing a more effective consensus mechanism or taking into account future approaches like sharding.

6. Conclusion and Future Work

In concussion, this paper proposes an innovative cloud computing enabled deep learning and Blockchain enabled smart business management framework. This research provides top-level predictions and good level of Blockchain overhead cost. Future scope may include exploration of on-chain machine learning inference, federated learning, scalable architecture, and application to business use case scenarios.

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