TRANSFORMING AUDITING AND CONTROL IN AGRICULTURE WITH BLOCKCHAIN AND AI

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Abstract

In this article, we introduce a comprehensive framework that integrates blockchain, digital signatures, and artificial intelligence (AI) into the auditing and accounting procedures of the agricultural industry. This framework merges the decentralized aspects of blockchain technology with the heightened security of digital signatures and the sophisticated analytics provided by AI, leading to a more effective and transparent auditing method in agriculture. We offer an in-depth description of how blockchain can securely document transactions, monitor assets, and guarantee product traceability, thus preventing fraud and fostering trust among participants. We also explore how digital signatures can enhance data integrity by verifying authenticity and confirming the information's origin within the system. Moreover, we examine the use of AI and machine learning algorithms in automating standard audit tasks, identifying anomalies, and analyzing agricultural data. This not only expedites the auditing process but also elevates audit quality by minimizing human errors and biases. The article also addresses the potential challenges of incorporating these technologies, such as managing the risks linked to AI adoption, including bias, transparency, and ethical considerations. We discuss the significant expenses involved in implementing these technologies, along with the requirement for suitable regulatory frameworks and policies to direct their application. Additionally, we propose future research avenues to further improve the amalgamation of blockchain, digital signatures, and AI, thereby fostering ongoing innovation in the auditing and control processes of the agricultural sector.

Keywords: blockchain, digital signatures, accounting, auditing, AI applications

In recent years, digital technologies such as blockchain and artificial intelligence (AI) have been investigated and even adopted to simplify business processes and transform business models to innovate operations. These technologies are changing organisations greatly and providing new opportunities to create value and enhance trust and resilience to digital transformation. In particular, these technologies have been applied in the accounting and auditing fields to improve transparency, trust, and audit quality.

This article reviews the literature on using blockchain technology and AI in accounting and auditing. Specifically, it explores the potential of these technologies to improve decision-making by providing immutable, append-only, shared, verified, and agreed-upon data, which can enhance transparency and trust in accounting practice. It also discusses how AI can impact audit quality and efficiency.

MATERIAL AND METHOD

This article proposes a software architecture for accounting and auditing reusable solutions that integrates blockchain technology, digital signatures, and AI across four layers: Distributed Ledgers & Cryptography, AI Centric Ontology Standardisation, Integration and Customisation, and Applications. This architecture enhances transparency, trust, and audit quality while reducing costs by providing a secure and tamper-proof way of storing and managing data, standardising the representation and exchange of data for efficient processing by AI systems, integrating technologies to meet individual needs, and providing end-user applications for fraud detection, financial risk assessment, revenue analysis, and more.

Recent studies like "Accounting and Auditing with blockchain technology and Artificial Intelligence: A literature review" by Hongdan Han et al, "Is artificial intelligence improving the audit process?" by Anastassia Fedyk et al, and "Artificial Intelligence to Improve the Food and Agriculture

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Sector" discuss the application of blockchain technology to accounting and auditing, as well as the use of AI in improving audit quality and efficiency.

This scientific literature study identified specific AI applications in audit practices, including anomaly detection, fraud prevention, revenue analysis, financial risk assessment, bank secrecy, anti-money laundering, and analysis of large public databases. AI audit tools are typically developed in centralised hubs and implemented as standard top-down procedures, with larger firms using a combination of in-house algorithm development and external software purchases. In comparison, smaller firms rely more on external solutions and partnerships. The AI labour force is relatively small, with a few individuals directing the process and educating others. However, the assumption is that this area will grow and become more sophisticated, with general tools and solutions emerging. While there are advantages to using AI in audits, there are also significant challenges, such as privacy, the threat of unemployment due to automation, biases, high costs associated with creation and maintenance, and concerns about sustainability, market concentration, and ethical implications. In this paper, we propose a software architecture that can be integrated into companies' business processes, enabling a reduction in audit costs through the use of blockchain technology, digital signatures, and artificial intelligence.

RESULTS AND DISCUSSIONS

This article proposes a software architecture for accounting and auditing reusable solutions that integrates blockchain technology, digital signatures, and AI across four layers: Distributed Ledgers & Cryptography, AI Centric Ontology Standardisation, Integration and Customisation, and Applications. This architecture enhances transparency, trust, and audit quality while reducing costs by providing a secure and tamper-proof way of storing and managing data, standardising the representation and exchange of data for efficient processing by AI systems, integrating technologies to meet individual needs, and providing end-user applications for fraud detection, financial risk assessment, revenue analysis, and more.

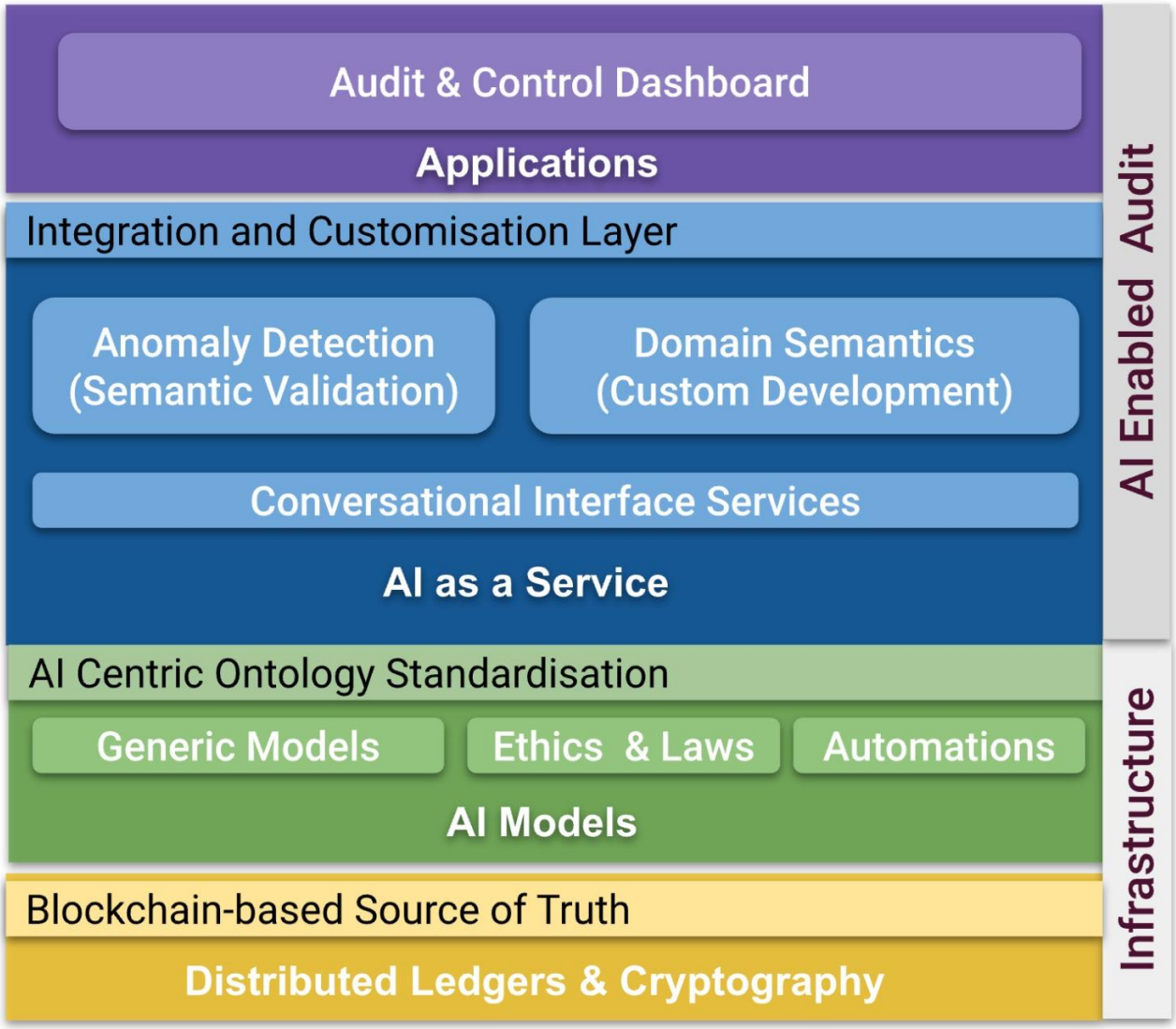

Figure 1 **AI System arhitecture**

The first layer, Distributed Ledgers & Cryptography, is responsible for securing data using cryptographic techniques and ensuring the immutability of transactions through distributed ledgers. In this layer, we propose using technologies such as OpenDSU, which has been validated in the pharmaceutical industry but can also be utilised as a cost-reducing technology for working with distributed ledgers. OpenDSU provides a single source of truth for a company's accounting and business data by allowing for secure, decentralised data storage and management. Data confidentiality should be of paramount importance and will follow the approach envisioned in Alboaie, Sînică, Nicu-Cosmin Ursache, and Lenuța Alboaie, 2020 - Self-Sovereign Applications: return control of data back to people. Procedia Computer Science by prompting the concept of digital wallets on the proposed application in layer 4 and where possible as advice for thecompany enterprise systems.

The second layer, the AI Centric Ontology Standardisation layer, focuses on standardising the representation and exchange of data in a manner that is easily accessible and understandable for AI systems. This layer leverages the latest advancements in semantic web technologies to develop ontologies that can represent complex concepts in a structured manner. At this level, we also propose the existence of pre-trained AI models for detecting anomalies in business, fraud prevention, revenue analysis, financial risk assessment, bank secrecy, and anti-money laundering. Additionally, we suggest integrating trained models based on large public databases to enhance further the accuracy and efficiency of the auditing and accounting process. These models can be customised and adapted to meet the specific needs of individual companies and can significantly improve decision-making processes by providing reliable, data-driven insights.

The third layer, Integration and Customisation Layer, integrates the technologies used in the implementation of the architecture, such as conversational interfaces, domain-specific models and semantic validation rules but also distributed ledgers, AI systems, and digital signatures. This layer also allows for customisation to meet the specific needs of individual companies and organisations. An important element is the Anomaly Detection component that plans to build and extend our previous research from Sînică A et al, .

Finally, the Applications layer is responsible for providing end-user applications that leverage the features of the underlying layers to enable cost-effective auditing and accounting practices. This proposed application will include, for example, a dashboard that will flag fraud detection attempts, financial risk assessment, and revenue analysis tools.

CONCLUSIONS

This article presents a software architecture proposal for integrating blockchain technology, digital signatures, and AI into accounting and auditing practices. The proposal is based on a literature review that explores the potential of these technologies to improve decision-making, enhance transparency and trust, and impact audit quality and efficiency. The proposed architecture includes four layers, each with its functions: securing data, standardising data exchange, integrating technologies, and providing reusable end-user applications that can be adapted for each specific integration. The architecture also incorporates pre-trained AI models and large public databases to improve the accuracy and efficiency of the auditing and accounting process. Overall, the proposed architecture has the potential to significantly reduce audit costs while increasing transparency and trust in accounting practices.

ACKNOWLEGMENTS

This research is co-financed by the European Fund for Regional Development through the Competitiveness Operational Program 2014 – 2020, project “Establishment and implementation of partnerships for the transfer of knowledge between the Iasi Research Institute for Agriculture and Environment and the agricultural business environment”, acronym “AGRIECOTEC”, SMIS code 119611.

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