Petr David, Hana Vránová (eds.)

PEF*net* 2025

29th European Scientific Conference of Doctoral Students

November 20, 2025
Extended Abstracts

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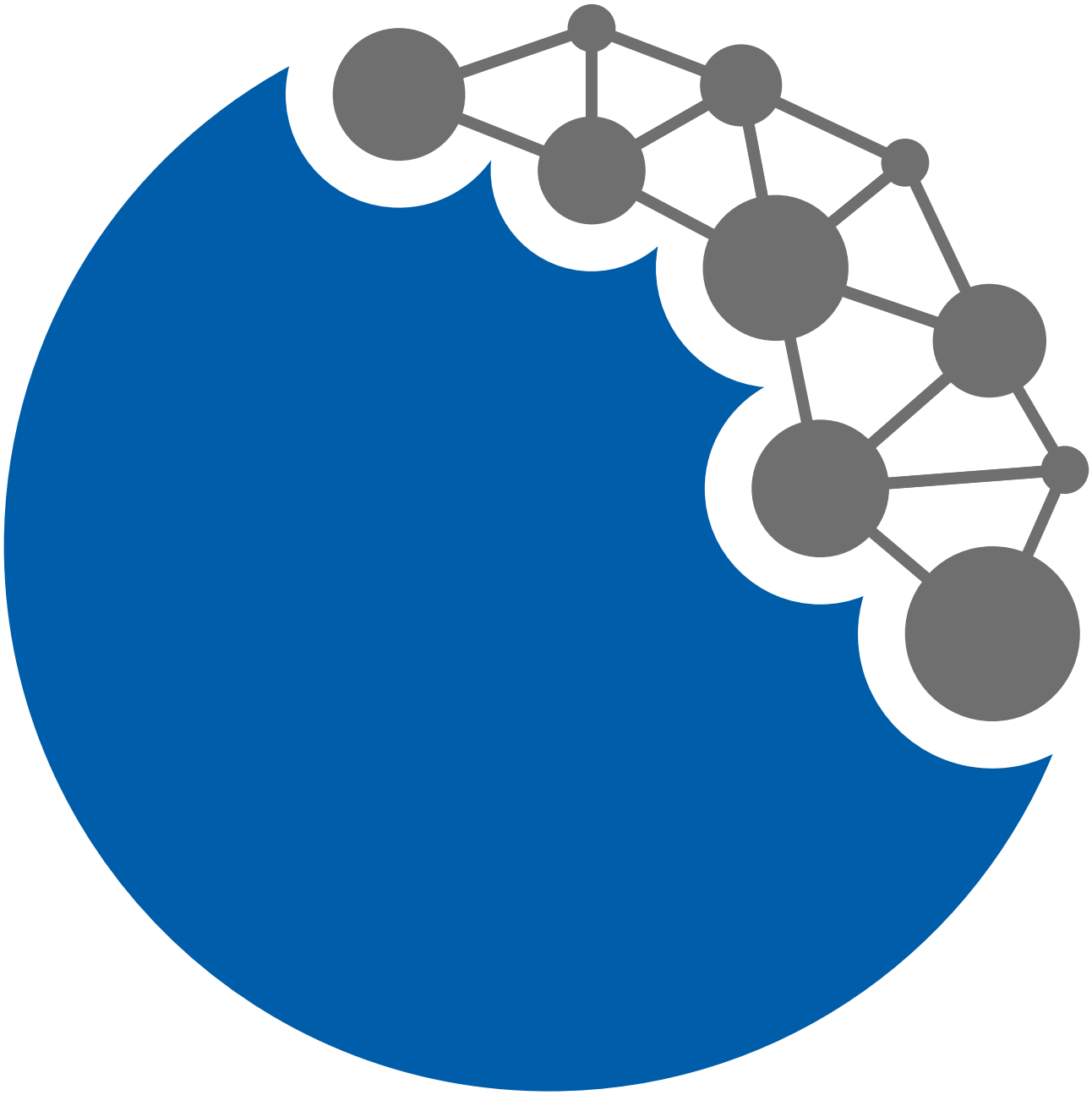

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CONTENTS

CONNECTING AI AND BLOCKCHAIN: A CASE STUDY OF A DIGITAL CERTIFICATES PLATFORM

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artificial intelligence, blockchain, digital certificates, smart contracts

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1 INTRODUCTION

Existing centralized systems for managing certificates face fundamental challenges. These include vulnerability to fraud, falsification, and inefficiency associated with manual verification. These inefficiencies not only reduce trust but also represent a significant administrative load for institutions and employers. In response to these issues, solutions have emerged in recent years in the form of digital certificates, which represent a modern and secure way to verify education and professional qualifications in today's society. However, the security of digital certificates can be taken to the next level by leveraging blockchain technology, which, thanks to its decentralized and immutable nature, offers a robust base for creating a transparent and secure ecosystem for certificate management [1]. If we add AI to this, we get a system with high user-experience.

Current research is increasingly focused on the synergistic integration of blockchain with artificial intelligence (AI), which promises to overcome the limitations of both technologies. As Witt (2024) point out, the main benefit lies in the complementary relationship, where blockchain ensures data integrity, privacy, and decentralization, while artificial intelligence provides the ability to process, analyze, and use this data for intelligent decision-making [2]. Blockchain thus solves one of the fundamental problems of AI. The need for trustworthy and verifiable data for training models, thereby reducing the risk of manipulation and bias. Conversely, AI can optimize and automate processes on the blockchain that would otherwise be static and rigid. Despite this potential, the two technologies are still in a relatively early stage of convergence and require further exploration and systematization [3].

Existing studies, such as the overview by Salah et al. (2019), have already mapped out the wide range of blockchain applications for AI, including the creation of decentralized data marketplaces, increasing the transparency of AI models, and securing their lifecycle [4]. These works have laid the theoretical groundwork, but they often focus on general frameworks or specific domains such as finance or healthcare, and less on concrete implementations in the field of digital credentials. The goal of this work is therefore to build on these insights and propose a concrete architecture for a digital certificate management system that fully uses the synergistic potential of both technologies. This article presents a conceptual model that not only uses blockchain for secure certificate issuance and verification, but also integrates two layers of artificial intelligence. The first for automating bulk certificate issuance and the second for creating an intelligent recommendation system that actively matches verified holder skills with relevant job opportunities. With this approach, we seek to bridge the gap between theoretical concepts and practical application and demonstrate how the combination of AI and blockchain can transform static certificates into dynamic tools for career development.

2 MATERIAL AND METHODS

The methodology of this work consists in proposing a conceptual framework for integrating blockchain and artificial intelligence with the aim of creating a decentralized system for verifying digital credentials. We describe an architecture where blockchain ensures the security and independent verifiability of digital certificates. AI provides the basis for automated processes and intelligent data analysis. The goal is to enhance the efficiency of certificate management and improve their usefulness.

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3 RESULTS

The proposed system is designed as a multi-layered architecture that combines a decentralized trust foundation with artificial intelligence modules for automation and intelligent analysis. The base layer consists of a blockchain network [5] that serves as an immutable and transparent platform for veryfing digital credentials [1]. The system uses open standards from W3C like Verifiable Credentials and Decentralized Identifiers (DID) for the representation of certificates, which is in line with the principles of self-sovereign identity. In compliance with the GDPR, no personal data is stored on the public blockchain, only the document hash and DID.

Two main artificial intelligence modules are implemented above this base layer. The first module, designed for automated certificate issuance, is designed as an AI agent capable of autonomously extract and structure data from input sources such as student databases or CSV files. After validating and standardizing the data, the AI agent initiates a call to a specific function in the smart contract, such as issueCredential(), which starts the on-chain process of creating new certificates. This ensures more accurate certificate issuance without the need to manually rewrite students into certificates and also saves time.

The second module is a smart job recommendation system. This system is based on machine learning models and its job is to analyze the skills and qualifications extracted from the user. The matching methodology combines linguistic feature extraction and semantic embeddings for a deeper understanding of the relationships between the skills listed in the certificates and the requirements specified in job advertisements. The system connects to external job portals via API, from which it obtains data on open positions. It then compares the user's profile with these positions and generates personalized recommendations based on the degree of match.

4 CONCLUSIONS

The implementation of the proposed system is expected to achieve several key results that directly address the limitations of current certification processes. First, the deployment of an AI agent for automated certificate issuance will lead to an increase efficiency and scalability. It is expected to reduce the administrative workload and operating costs for educational institutions. A process that previously required hours of manual work will now be possible to complete in a matter of minutes. It will also minimize the risk of human error when entering data, which will contribute to greater precision in the issuance of credentials.

The biggest benefit is the transformation of the certificate from a static document into a dynamic career tool. The system actively links their verified skills to opportunities in the labor market, thus increasing their employability.

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