ZimCred: A National Framework for Secure Academic Credential Verification in Zimbabwe

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ABSTRACT

Academic certificate fraud has become a growing concern in Zimbabwe, eroding confidence in both the education system and the job market. Many organisations still rely on slow, manual ways of checking qualifications, and this often disadvantages genuine graduates while allowing forged documents to slip through. The lack of a unified, trusted verification method also places universities and colleges at risk of reputational damage. In response to these challenges, this study introduces a national Academic Document Verification Framework that brings together AI, blockchain technologies, and 4IR principles to create a fair, reliable, and modern approach to credential verification.

The proposed framework is built around three major components. The first is an AI-powered forgery detection module that uses advanced computer vision techniques including convolutional networks and transformer-based models to spot signs of tampering, altered text, fabricated seals, and other irregularities. The second component uses blockchain to store tamper-proof hashes of legitimate credentials, allowing anyone to confirm authenticity without accessing sensitive institutional records. The third element is a Public Key Directory (PKD) supported by lightweight verification endpoints hosted by each accredited institution. These endpoints publish public keys and essential verification metadata, while private keys remain securely held by the issuing institution. When a certificate is submitted, the system reads the embedded signature, fetches the appropriate public key, and verifies both the signature and the blockchain record.

Additional safeguards such as key rotation, certificate revocation processes, mutual TLS, and cryptographically signed verification responses help maintain trust and protect privacy. Overall, the framework aims to create a more transparent, equitable, and secure national approach to academic credential verification in Zimbabwe's digital future.

Keywords:

AI, Blockchain, Digital Trust, Academic Document Verification, 4IR, PKD