Scopus

Documents

Saleh, O.S.[a b] , Ghazali, O.[b] , Idris, N.B.[c]

A New Privacy-Preserving Protocol for Academic Certificates on Hyperledger Fabric
(2023) *International Journal of Advanced Computer Science and Applications*, 14 (2), pp. 595-609.

DOI: 10.14569/IJACSA.2023.0140271

[a] Planning and Follow-up Directorate, Ministry of Higher Education and Scientific Research, Baghdad, Iraq
[b] School of Computing, Universiti Utara Malaysia, Kedah, Malaysia
[c] Kulliyyah of Information and Communication Technology, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract
Academic certificates are integral to an individual's education and career prospects, yet conventional paper-based certificates pose challenges with their transport and vulnerability to forgery. In response to this predicament, institutions have taken measures to release e-certificates, though ensuring authenticity remains a pressing concern. Blockchain technology, recognised for its attributes of security, transparency, and decentralisation, presents a resolution to this problem and has garnered attention from various sectors. While blockchain-based academic certificate management systems have been proposed, current systems exhibit some security and privacy limitations. To address these issues, this research proposes a new Decentralised Control Verification Privacy-Centered (DCVPC) protocol based on Hyperledger Fabric blockchain for preserving the privacy of academic certificates. The proposed protocol aims to protect academic certificates' privacy by granting complete authority over all network nodes, creating channels for universities to have their private environment, and limiting access to the ledger. The protocol is highly secure, resistant to attacks, and allows improved interoperability and automation of the certificate verification process. A proof-of-concept was developed to demonstrate the protocol's functionality and performance. The proposed protocol presents a promising solution for enhancing security, transparency, and privacy of academic certificates. It guarantees that the certificate's rightful owner is correctly identified, and the issuer is widely recognised. This research makes a valuable contribution to the area of blockchain-based academic certificate management systems by introducing a new protocol that addresses the present security and privacy limitations

Author Keywords
academic certificates; Blockchain technology; decentralized control verification privacy-centered (DCVPC) protocol; hyperledger fabric blockchain; privacy preservation

Index Keywords
Decentralized control, Decentralized systems, Distributed ledger, Privacy-preserving techniques, Transparency; Academic certificate, Block-chain, Blockchain technology, Certificate management, Decentralised control, Decentralized control verification privacy-centered protocol, Hyperledg fabric blockchain, Management systems, Privacy preservation; Blockchain

References

- (2021) *Caddo school employee accused of selling fake diplomas, transcripts*, [1] KTBS.com Retrieved July 10, 2021, from
- Abreu, A. W. S., Coutinho, E. F., Bezerra, C. I.
  A blockchainbased architecture for query and registration of student degree certificates
  (2020) *Proceedings of the 14th Brazilian Symposium on Software Components, Architectures, and Reuse*, pp. 151-160.
  [2]
- Aini, Q., Rahardja, U., Tangkaw, M. R., Santoso, N. P. L., Khoirunisa, A.
  Embedding a blockchain technology pattern into the QR code for an authentication certificate. Jurnal Online Informatika, 5(2), 39-244.Alam, S. (2021). A blockchain-based framework for secure educational credentials
  (2020), 12.
  [3] Turkish Journal of Computer and Mathematics Education, (10), 5157-5167
- Atajen, K., Aslan, B. A.
  Blockchain Based Digital Certification Platform: CertiDApp

(2020) *Journal of Multidisciplinary Engineering Science and Technology*, 7 (7), pp. 12252-12255.
[4] From

- Caldarelli, G., Ellul, J.
Trusted academic transcripts on the blockchain: a systematic literature review
(2021) *Applied Sciences*, 11 (4), p. 1842.
[5]

- Capece, G., Levialdi Ghiron, N., Pasquale, F.
Blockchain technology: redefining trust for digital certificates
(2020) *Sustainability*, 12 (21), p. 8952.
[6]

- Castro, R. Q., Au-Yong-Oliveira, M.
Blockchain and higher education diplomas
(2021) *European Journal of Investigation in Health, Psychology and Education*, 11 (1), pp. 154-167.
[7]

- Chaniago, N., Sukarno, P., Wardana, A. A.
Electronic document authenticity verification of diploma and transcript using smart contract on Ethereum blockchain
(2021) *Register: Jurnal Ilmiah Teknologi Sistem Informasi*, 7 (2), pp. 149-163.
[8]

- Kshetri, N.
Blockchain's roles in strengthening cybersecurity and protecting privacy
(2017) *Telecommunications policy*, 41 (10), pp. 1027-1038.
[9]

- Vidal, F. R., Gouveia, F., Soares, C.
Revocation mechanisms for academic certificates stored on a blockchain
(2020) *2020 15th Iberian Conference on Information Systems and Technologies*, pp. 1-6.
[10] (a)

- Karamachoski, J., Marina, N., Taskov, P.
Blockchain-based application for certification management
(2020) *Technical Journal*, 14 (4), pp. 488-492.
[11]

- Rahardja, U., Kosasi, S., Purnama Harahap, E., Aini, Q.
Authenticity of a diploma using the blockchain approach
(2020) *International Journal of Advanced Trends in Computer Science and Engineering*, 9 (1), pp. 250-256.
[12] (2)

- Bapat, C.
(2020) *Blockchain for Academic Credentials*,
[13] from

- Baldi, M., Chiaraluce, F., Kodra, M., Spalazzi, L.
(2019) *Security analysis of a blockchain-based protocol for the certification of academic credentials*,
[14] from

- Nakamoto, S.
Bitcoin: A peer-to-peer electronic cash system
(2008) *Decentralised Business Review*, p. 21260.
[15]

- Wang, Y., Kogan, A.
  Designing confidentiality-preserving blockchain-based transaction processing systems
  (2018) *International Journal of Accounting Information Systems*, 30, pp. 1-18.
  [16]

- (2020) *A blockchain platform for the enterprise*,
  [17] Hyperledger Retrieved July 10, 2021, from

- Li, R., Wu, Y.
  (2018) *Blockchain based academic certificate authentication system overview*, p. 8.
  [18] IT Innov. Centre, Univ. Birmingham

- (2021) *Block.co*,
  [19] Retrieved July 10, 2021, from

- Andreev, O., Daskalov, H.
  A framework for managing student data through blockchain
  (2018) *Proceedings of international scientific conference e-governance and e-communications*,
  [20]

- Han, M., Li, Z., He, J., Wu, D., Xie, Y., Baba, A.
  A novel blockchain-based education records verification solution
  (2018) *Proceedings of the 19th annual SIG conference on information technology education*, pp. 178-183.
  [21]

- Bessa, E. E., Martins, J. S.
  (2019) *A blockchain-based educational record repository*,
  [22] arXiv preprint arXiv:1904.00315

- Hope, J.
  Give students ownership of credentials with blockchain technology
  (2019) *The Successful Registrar*, 19 (1), pp. 1-7.
  [23]

- Wang, R., He, J., Liu, C., Li, Q., Tsai, W. T., Deng, E.
  A Privacy-Aware PKI System Based on Permissioned Blockchains
  (2019) *Proceedings of the IEEE International Conference on Software Engineering and Service Sciences, ICSESS, 2018-Novem*, pp. 928-931.
  [24]

- Fabric, H.
  (2018) *A Distributed Operating System for Permissioned Blockchains*,
  [25]

- Brotsis, S., Kolokotronis, N., Limniotis, K., Bendiab, G., Shiaeles, S.
  On the security and privacy of hyperledger fabric: Challenges and open issues
  (2020) *2020 IEEE World Congress on Services (SERVICES)*, pp. 197-204.
  [26] (October) IEEE

- Liang, Y. C.
  Blockchain for dynamic spectrum management
  (2020) *Dynamic Spectrum Management*, pp. 121-146.
  [27] Springer, Singapore

- Alammary, A., Alhazmi, S., Almasri, M., Gillani, S.
  Blockchain-based applications in education: A systematic review
  (2019) *Applied Sciences*, 9 (12), p. 2400.
  [28]

- Iftekhar, A., Cui, X., Tao, Q., Zheng, C.
  Hyperledger fabric access control system for internet of things layer in blockchain-based applications
  (2021) *Entropy*, 23 (8), p. 1054.
  [29]

- Verma, K., Singh, R., Verma, A.
  Blockchain technology for secure and efficient management of academic certificates
  (2018) *International Journal of Advanced Research in Computer Science*, 9 (1), p. 17.
  [30]

- Kshetri, A.
  Blockchain technology for privacy and security in online social networks
  (2018) *IEEE Communications Magazine*, 56 (9), pp. 34-40.
  [31]

- Chen, Y., Liu, Y., Zhang, Y., Li, D.
  A privacy-preserving blockchain-based framework for academic certificate verification
  (2020) *IEEE Access*, 8, pp. 152428-152437.
  [32]

- Leong, S. H. L., Lee, J. H. M., Chan, K. W.
  A blockchain-based framework for secure and privacy-preserving academic certificate verification
  (2020) *IEEE Access*, 8, pp. 57826-57835.
  [33]

- Lee, J. H., Kim, H. S., Lim, Y. S.
  A blockchain-based secure and privacy-preserving framework for academic certificate verification
  (2019) *IEEE Access*, 7, pp. 123361-123369.
  [34]

- Verma, K., Singh, R., Verma, A.
  Blockchain technology for secure and efficient management of academic certificates
  (2018) *International Journal of Advanced Research in Computer Science*, 9 (1), pp. 1-7.
  [35]

- Islam, T., Chowdhury, M. R., Hossain, S. A. R.
  A blockchain-based secure and privacy-preserving framework for academic certificate verification
  (2020) *IEEE Access*, 8, pp. 99788-99798.
  [36]

- Xiong, J., Li, Y., Shen, X.
  A blockchain-based secure and privacypreserving framework for academic certificate verification
  (2020) *IEEE Access*, 8, pp. 141530-141538.
  [37]

- Chen, Y., Liu, Y., Zhang, Y., Li, D.
  A privacy-preserving blockchain-based framework for academic certificate verification
  (2020) *IEEE Access*, 8, pp. 152428-152437.
  [38]

- Leong, S. H. L., Lee, J. H. M., Chan, K. W.
A blockchain-based framework for secure and privacy-preserving academic certificate verification
(2020) *IEEE Access*, 8, pp. 57826-57835.
[39]

- Lee, J. H., Kim, H. S., Lim, Y. S.
A blockchain-based secure and privacy-preserving framework for academic certificate verification
(2019) *IEEE Access*, 7, pp. 123361-123369.
[40]

- Saleh, O. S., Ghazali, O., Rana, M. E.
Blockchain based framework for educational certificates verification
(2020) *Journal of critical reviews*, 7, pp. 79-84.
[41] (03)

- Pathak, S., Gupta, V., Malsa, N., Ghosh, A., Shaw, R. N.
Blockchain-Based Academic Certificate Verification System—A Review
(2022) *Advanced Computing and Intelligent Technologies: Proceedings of ICACIT*, 2022, pp. 527-539.
[42]

- Awaji, B., Solaiman, E., Albshri, A.
Blockchain-based applications in higher education: A systematic mapping study
(2020) *Proceedings of the 5th international conference on information and education innovations*, pp. 96-104.
[43] (July)

- Nguyen, B. M., Dao, T. C., Do, B. L.
Towards a blockchainbased certificate authentication system in Vietnam
(2020) *PeerJ Computer Science*, 6, p. e266.
[44]

- Cheng, H., Lu, J., Xiang, Z., Song, B.
A permissioned blockchain-based platform for education certificate verification
(2020) *Blockchain and Trustworthy Systems: Second International Conference, BlockSys 2020*, pp. 456-471.
[45] Dali, China, August 6-7, 2020, Revised Selected Papers 2 Springer Singapore

- Curmi, A., Inguanez, F.
Blockchain based certificate verification platform
(2019) *Business Information Systems Workshops: BIS 2018 International Workshops*, pp. 211-216.
[46] Berlin, Germany, July 18-20, 2018, Revised Papers 21 Springer International Publishing

- Din, I. U., Guizani, M., Kim, B. S., Hassan, S., Khan, M. K.
Trust management techniques for the Internet of Things: A survey
(2018) *IEEE Access*, 7, pp. 29763-29787.
[47]

- Peffers, K., Tuunanen, T., Rothenberger, M. A., Chatterjee, S.
A design science research methodology for information systems research
(2007) *Journal of management information systems*, 24 (3), pp. 45-77.
[48]

Correspondence Address
Ghazali O.; School of Computing, Kedah, Malaysia

Publisher: Science and Information Organization

ISSN: 2158107X
Language of Original Document: English
Abbreviated Source Title: Intl. J. Adv. Comput. Sci. Appl.
2-s2.0-85150991755
Document Type: Article
Publication Stage: Final
Source: Scopus