RESEARCH ARTICLE

Efficient Algorithms for Privacy-Preserving Blockchain-Based Voting Systems

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Abstract:

We present EthVote, a blockchain-based electronic voting system that achieves both voter privacy and end-to-end verifiability through novel cryptographic protocols. Our system combines homomorphic encryption with zero-knowledge proofs on an Ethereum Layer-2 network to enable vote casting, tallying, and verification while maintaining complete voter anonymity. Performance evaluation shows the system can process 10,000 votes per second with verification costs of less than $0.001 per vote. Security analysis demonstrates resistance to common attack vectors including double voting, vote buying, and coercion. A pilot deployment in a university election with 15,000 eligible voters validated the system's practical viability.