

ABSTRACT

The implementation of a Blockchain-based e-voting system with a Hybrid Model is proposed as a solution to strengthen security, transparency, and efficiency in organizational-scale elections. This model combines centralized voter validation with decentralized vote recording using the Polygon Network, which implements the Proof of Stake (PoS) Consensus mechanism. The system prototype was designed through the `Election.sol` Smart Contract, which automates the entire voting process from voter registration to result announcement, and was tested on the Polygon Testnet. Evaluation results demonstrate an average gas cost of ≤ 0.02 POL, adequate throughput performance of 0.1-0.125 TPS, and reliable authentication mechanisms including double-voting prevention and immutability assurance through distributed validator verification. These findings confirm that the Hybrid Model effectively bridges the limitations of centralized and fully Blockchain-based systems by maintaining operational efficiency while ensuring data integrity and public verifiability, making it a practical reference for developing secure, efficient, and transparent e-voting systems for organizational contexts.

Keywords: Blockchain, e-voting, Hybrid Model, Smart Contract, Proof of Stake, Polygon.

ABSTRAK

Penerapan sistem *e-voting* berbasis *Blockchain* dengan *Hybrid Model* diusulkan sebagai solusi untuk memperkuat keamanan, transparansi, dan efisiensi dalam pemilihan skala organisasi. Model ini menggabungkan validasi pemilih terpusat dengan pencatatan hasil *voting* terdesentralisasi menggunakan jaringan *Polygon* yang menerapkan mekanisme konsensus *Proof of Stake* (PoS). Prototipe sistem dirancang melalui *Smart Contract Election.sol* yang melakukan otomatisasi seluruh proses *voting* dari registrasi pemilih hingga pengumuman hasil, dan diuji pada *Polygon Testnet*. Hasil evaluasi menunjukkan *gas fee* rata-rata $\leq 0,02$ POL, kinerja *throughput* yang memadai pada kisaran 0,1-0,125 TPS, serta mekanisme autentikasi yang andal mencakup pencegahan *double voting* dan jaminan *immutability* melalui verifikasi validator terdistribusi. Temuan ini membuktikan bahwa *Hybrid Model* secara efektif mengatasi keterbatasan sistem terpusat dan sistem berbasis *Blockchain* sepenuhnya dengan mempertahankan efisiensi operasional sekaligus memastikan integritas data dan verifikasi publik, menjadikannya acuan praktis untuk mengembangkan sistem *e-voting* yang aman, efisien, dan transparan dalam konteks organisasi.

Kata Kunci: *Blockchain, e-voting, Hybrid Model, Smart Contract, Proof of Stake, Polygon.*