

Two-Bit Error Detection and Correction in Data Transmission by Quantum - Inspired Error Detection Protocol (QIEDP)

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ABSTRACT

Embodiments provide a quantum-inspired error detection and correction protocol for low-power IoT devices in noisy communication environments. The system (200) includes an encoder (230) configured to generate a codeword (235) by computing primary parity bits (231) and secondary parity bits (232) from a data word (220) using predefined XOR equations. The codeword is transmitted via a transmission module (240) and received by a receiving module (250), which forwards it to a decoder (260). The decoder calculates an error syndrome (261), accesses a precomputed lookup table (270), and applies a correction mask (262) to restore the original data word. A collision mitigation module (280) utilizes secondary parity bits to resolve ambiguous syndromes, and an optional ARQ module (290) requests retransmission when necessary. The system achieves constant-time correction for single- and double-bit errors with minimal memory overhead.

KEY APPLICATION AREAS

1. IoT and edge-device communications.
2. Industrial automation networks.
3. Smart agriculture systems.
4. Wearable healthcare devices.
5. Embedded and low-power serial communication systems.

POTENTIAL USE

1. Reliable sensor data transmission in noisy environments.
2. Error correction for UART, SPI, and RS-485 communications.
3. Battery-powered IoT nodes requiring low-memory, low-energy communication.
4. Industrial monitoring and control systems.
5. Remote agriculture and healthcare monitoring devices.
6. FPGA/ASIC-based embedded communication modules.