Abstract

The development of decentralized computational marketplaces has the potential to revolutionize how high-performance computing resources are accessed and utilized. This research project aims to design, implement, and evaluate GPU-CHAIN: The World's First Decentralized P2P GPU Marketplace. GPU-CHAIN leverages blockchain technology and peer-to-peer networking to create a global ecosystem where GPU owners can monetize their idle hardware, while users in need of high-performance computation (e.g., for AI model training, rendering, and gaming) can rent GPUs on demand.

The platform integrates smart contracts on the Ethereum blockchain for secure, trustless payments and transparent transaction histories. Real-time peer-to-peer connections are enabled through WebRTC, allowing direct, efficient communication and data transfer between users and providers. The frontend is built with React 18 and Vite for a modern, responsive user experience, while the backend uses Express.js and Dockerized GPU workers for scalable task execution.

Research objectives include

1. Analyzing the technical feasibility and scalability of decentralized GPU sharing across diverse geographies.
2. Evaluating security and fraud-prevention mechanisms using smart contracts.
3. Benchmarking performance in real-world compute tasks against centralized cloud GPU providers.
4. Exploring the economic incentives for both GPU owners and renters within the marketplace.

This project contributes to the state of decentralized resource sharing, demonstrating that a distributed, peer-to-peer GPU rental marketplace can be both technically viable and economically attractive. The research will further discuss limitations, potential security threats, and propose future enhancements for broader adoption of distributed computational marketplaces.