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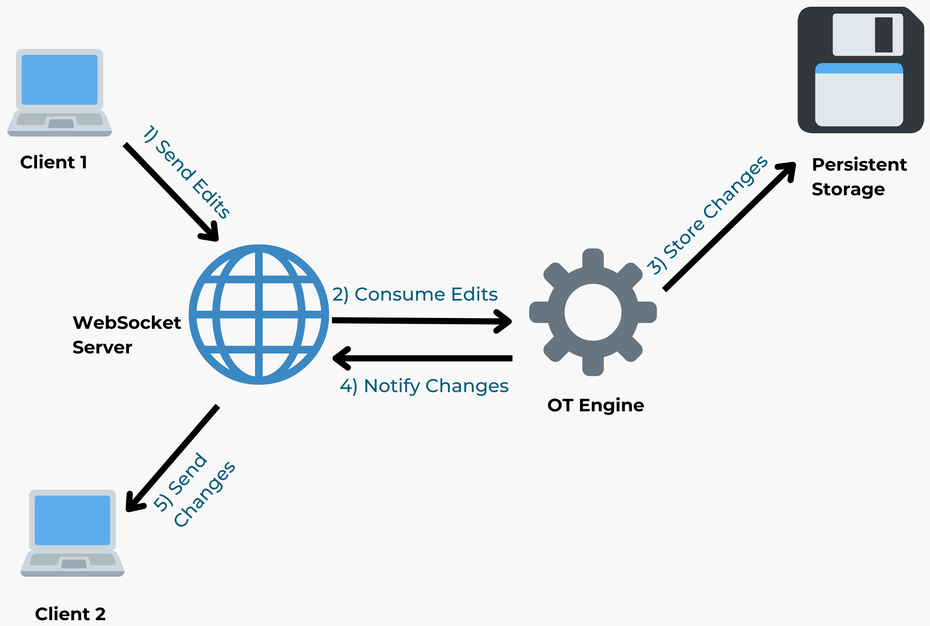
PULSE: Real-Time Collaborative Text Editor

WE AIM TO BUILD A SIMPLIFIED VERSION OF GOOGLE DOCS THAT ALLOWS MULTIPLE USERS TO SIMULTANEOUSLY EDIT THE SAME DOCUMENT WHILE MAINTAINING CONSISTENCY ACROSS DISTRIBUTED CLIENTS.

THE MOTIVATION BEHIND THIS PROJECT IS EXPLORE THE COMPLEXITIES OF DISTRIBUTED SYSTEMS WHILE CREATING A PRACTICAL COLLABORATIVE TOOL FOR STUDENTS TO INCREASE THEIR TEAM-WORKING CAPABILITIES.

1.



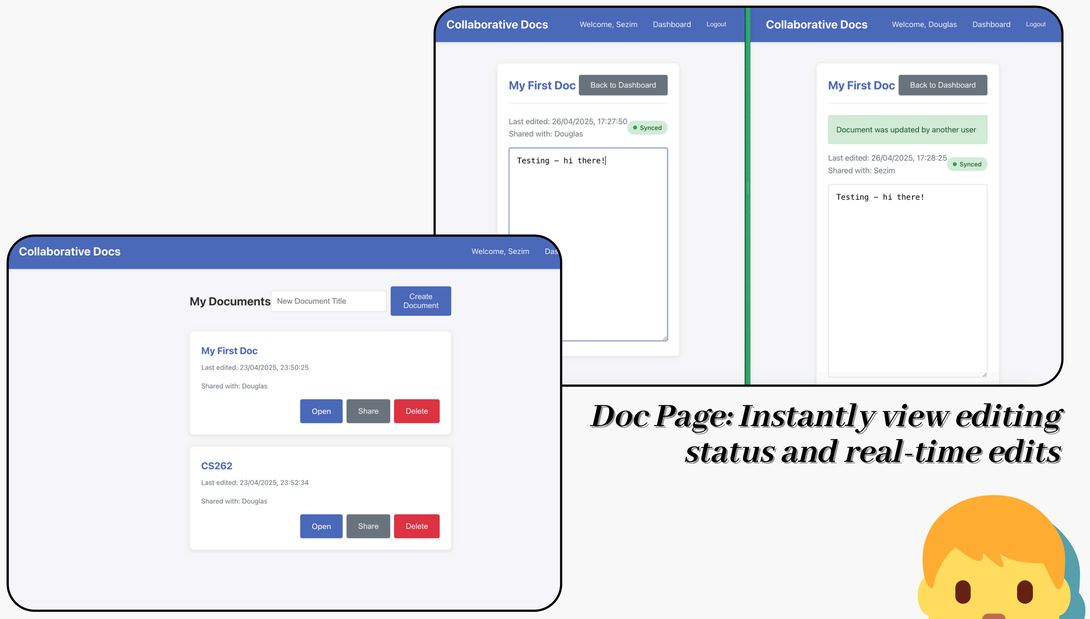
SYSTEM DESIGN

2.

A client-server architecture with three main components:

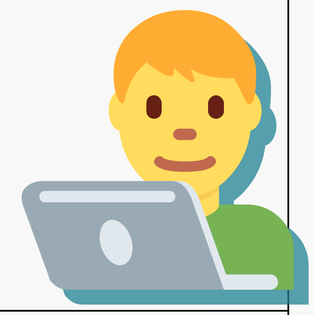
1. Web Client: A React-based interface with rich text editing tools
2. Coordination Server: Flask-based server with gRPC for handling client requests and operational transformations
3. Persistent Storage: Local file storage system

3.



Doc Page: Instantly view editing status and real-time edits

Home page: Streamlined view of all documents, and easily create and share documents



4.

OPERATIONAL TRANSFORMATION

The core algorithm that enables real-time collaboration by ensuring consistency across distributed clients.

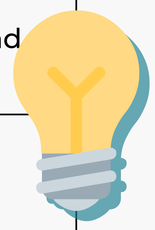
1. Each edit by a user is represented as an operation (insert or delete)
2. When operations arrive at the server, they may be out of order
3. OT transforms these operations to preserve user intent while maintaining document consistency

For example, if User A inserts text at position 10 and User B deletes text at position 5, the server will transform User A's operation to account for the shift in position.

This approach ensures that all clients eventually converge to the same document state regardless of network delays or the order in which operations are received.

2-FAULT TOLERANCE

The system is designed to be 2-fault tolerant, meaning it can continue functioning correctly even if two server nodes fail simultaneously. This is achieved through server replication and a consensus mechanism for leader election and data consistency.



5. IMPROVEMENTS

1. Enhanced Operations: Add formatting operations beyond basic insert and delete
2. Collaborative Features: Implement user cursors, comments, and suggestion modes
3. Version History: Add document versioning and rollback capabilities
4. Access Control: Implement fine-grained permissions for document sharing
5. Performance Optimization: Improve operation transformation algorithms for better scalability. Add load balancer.

RELATED LITERATURE Chengzheng Sun and Clarence Ellis. 1998. Operational transformation in real-time group editors: issues, algorithms, and achievements. In Proceedings of the 1998 ACM conference on Computer supported cooperative work (CSCW '98). Association for Computing Machinery, New York, NY, USA, 59–68. https://doi.org/10.1145/289444.289469