TECHNICAL SUMMARY – SignSense AI Quiz Platform (2 Pages)

Submission for IIT Bombay AI Sprint – Prototype Round

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1. Problem Statement

Traditional quiz and assessment platforms lack:

- **Accessibility** for learners with dyslexia, ADHD, or hearing impairments.
- **Real-time engagement**, which limits participation in classrooms and online events.
- **AI automation**, making quiz creation slow and dependent on manual input.
- **Analytics and adaptivity**, preventing personalized learning paths.

In fast-paced digital learning environments, educators and organizations need tools that:
✓ Auto-generate quizzes using AI
✓ Support real-time multiplayer sessions
✓ Provide live scoring and leaderboards
✓ Adapt difficulty to individual learners
✓ Offer accessibility-first learning modes

SignSense solves these gaps by delivering a next-generation **AI-powered, accessible, real-time quiz ecosystem**.

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2. Approach & AI Components

SignSense combines **AI-driven quiz generation**, **real-time interactivity**, and **inclusive learning modes** to deliver an intelligent assessment platform.

2.1 AI Components

(a) AI Quiz Builder

Users can upload:

- PDFs
- Text files
- Typed content
- Topics

AI performs:

1. **OCR/text extraction** (for PDFs)
2. **Keyword and concept detection**
3. **Difficulty-balanced question generation**
4. **MCQ creation with distractors**

5. **Answer validation**

This produces a structured JSON quiz ready for use.

(b) Adaptive Difficulty Engine

The engine adjusts question difficulty using:

- Past performance
- Response time
- Streaks
- Accuracy trends

Learners receive progressively challenging or supportive questions.

(c) Accessibility Intelligence

Three specialized modes improve inclusivity:

Mode	Features
Dyslexia Mode	Large fonts, high readability, minimal visual clutter, animated focus guide
ADHD Mode	Visual anchors, minimal stimuli, clear progression indicators
ISL Mode (Indian Sign Language)	GIF/video avatar explaining questions, text-to-sign conversion

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3. Technical Architecture

SignSense follows a modular, scalable architecture.

3.1 High-Level Architecture

Frontend (Streamlit UI)

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├── Accessibility Layer (Dyslexia, ADHD, ISL modes)

├── AI Quiz Builder UI

├── Live Session UI

└── Dashboard & Revision UI

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Backend

├— Quiz Engine (scoring, adaptivity, history tracking)

├— AI Module (question generation)

├— Real-time Sync Module

| └— WebSocket / polling simulation

└— Data Layer

├— JSON Question Banks

└— User performance logs

3.2 Core Components

A. Frontend (Streamlit)

- Mode selection
- Subject selection
- Sign-language enabled question rendering
- Dynamic animations (confetti, glow effects, transitions)
- Leaderboard + dashboard

B. Backend

- QuizEngine (timing, scoring, streak bonuses)
- Adaptive difficulty logic
- History tracking
- Revision mode generation

C. AI Module

- AI quiz generation from textual content
- PDF → text → MCQs
- Optional transformer-based model support

D. Live Session Module

Simulates real-time multiplayer:

- Host session
- Join session
- Live leaderboard refresh

(No external server needed, works entirely inside Streamlit prototype.)

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4. Challenges and Mitigations

Challenge 1: Making Streamlit behave like a real-time app

Problem: Streamlit is not designed for multiplayer real-time interactions.
Mitigation: Created a simulated WebSocket using session state + timed re-renders.

Challenge 2: Accessibility modes causing layout conflicts

Mitigation:

- Created separate CSS blocks loaded conditionally
- Simplified UI for ADHD/Dyslexia
- Ensured ISL avatars are lightweight and stream-safe

Challenge 3: AI quiz generation without heavy GPU

Mitigation:

- Modular design that allows either:
    - Embedded lightweight QA model OR
    - External API call to larger LLM (if available)
- Ensured fallback when external model unavailable

Challenge 4: Maintaining Streamlit stability under animations

Mitigation:

- Used CSS-based animations instead of JS
- Limited re-renders using sidebar_navigation() logic

Challenge 5: Unifying all modules into one coherent workflow

Mitigation:

- Standardized JSON question schema
- Built consistent routing system
- Integrated quiz → dashboard → revision seamlessly

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5. Roadmap to Final Build

Phase 1 – Core Completion (Next 2 Weeks)

- Add full multiplayer synchronization
- Persist user profiles + cloud storage
- Expand question banks for Math, English, Science

Phase 2 – AI Enhancement

- Add transformer-based summarization and distractor generation
- Add difficulty-based question selection using embeddings

Phase 3 – Deployment & DevOps

- Deploy backend on Render/Heroku
- Deploy frontend on Streamlit Cloud
- Add monitoring and logging

Phase 4 – Final Features

- Leaderboard animations + sound effects
- Full ISL avatar generation (beyond GIF placeholders)
- Certification module
- Adaptive learning pathways using score analytics