INVOICE

Project Title: Consultancy Service for the OECS Digital Learning Ecosystem
Output: 5
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Project Overview

This consultancy phase focused on developing a comprehensive AI-powered educational desktop application prototype designed for offline use. Built using the Electron framework, the application functions as a fully standalone solution that can be deployed on Windows systems without external dependencies.

The prototype showcases core functionality through two representative tools from the OECS Digital Learning Ecosystem platform, demonstrating real-world educational capabilities. To ensure seamless deployment across diverse computing environments, the package incorporates an embedded Python runtime, allowing the application to execute on any compatible PC without requiring users to have Python pre-installed on their systems.

This architecture provides maximum accessibility and ease of deployment for educational institutions with varying technical infrastructure.

Work Completed

1. AI Integration

a. Real-Time Streaming Architecture

- **WebSocket-based bidirectional communication** for live AI responses
- **Character-by-character streaming** with <50ms latency
- **Automatic reconnection handling** and connection state management
- **Graceful error handling** and recovery mechanisms
- **Streaming response generation** with real-time markdown parsing and rendering
- **Message sanitization** removing model artifacts and garbage filtering

b. Customized LLM Incorporation

- **Llama 3.2 1B Instruct** model integration using GGUF quantized format (Q5_K_M)
- **Local AI model** implementation for offline capability
- **Custom prompt engineering** specifically tailored for educational context
- **System message customization** for teaching assistant persona
- **LLM integration layer** with subprocess management (llama-cli.exe)
- **Prompt template system** with timeout and error handling
- **Response parsing** with real-time processing and formatting

c. Conversation Management

- **Persistent chat history** with JSON-based storage system
- **Multi-conversation support** with auto-save functionality
- **Chat session loading and restoration** capabilities
- **Message timestamp tracking** and display
- **Search and filter capabilities** for chat archives
- **Conversation history API** (GET, POST, DELETE endpoints)
- **Automatic file initialization** for data persistence

2. Desktop Application Architecture

a. Electron Framework Integration

- **Cross-process communication setup** between main and renderer processes
- **Main and renderer process coordination** for secure data flow
- **Preload script security implementation** following best practices
- **Window management and lifecycle handling** for application state
- **IPC (Inter-Process Communication)** for frontend-backend coordination

b. Embedded Python Runtime

- **Standalone Python distribution** (python-embed) for portability
- **Dependency bundling and isolation** within application package
- **FastAPI backend packaging** with all required libraries
- **Uvicorn server integration** for local API serving

- **Automated backend bundling** eliminating external dependencies
- **Complete offline functionality** with embedded AI model

c. Build & Packaging System

- **Automated backend bundling script** using PowerShell automation
- **Frontend production build optimization** with Vite
- **NSIS installer creation** for Windows deployment
- **Resource extraction and path management** for runtime assets
- **ASAR packaging with selective unpacking** for protected resources
- **Multi-stage build process** with dependency verification
- **File integrity verification** and bundle completeness checks
- **Size optimization** resulting in ~1.2 GB production package
- **Desktop shortcut and Start menu integration** for user convenience

3. Tab Manipulation

a. Multi-Tab Interface

- **Dynamic tab creation and management** system
- **Tab grouping by tool type** for organized workspace
- **Collapsible groups with visual indicators** for better navigation
- **Maximum tab limits per tool** (3 tabs) preventing overload
- **Tab persistence with localStorage** maintaining user state across sessions
- **Color-coded tab borders by tool type** for quick identification
- **Active tool highlighting with glow effects** showing current focus

b. Split-View Functionality

- **Side-by-side tool comparison** capability
- **Context menu for split creation** with right-click functionality
- **Independent panel interactions** allowing simultaneous work
- **Responsive split layout** adapting to screen size
- **Dynamic content loading** in each split panel

- **Synchronized or independent scrolling** based on user preference

4. Video Creation

Ministry video for OLH

TOTAL	3,500 XCD