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SkillSwap – Future of Barter Learning

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***Abstract*— In a world dominated by structured online courses, we introduce a more intuitive and human-centered approach to learning. Our project, SkillSwap, is built on the premise that your knowledge is your currency, creating a community where skills are exchanged directly between peers without any financial transactions.**
Our system intelligently connects individuals with complementary learning goals, matching a user's existing expertise with another's desired skill to enable a reciprocal exchange where both participants act as teacher and student. Once matched, users engage in live, one-on-one video sessions, fostering a dynamic and personal learning experience that prerecorded content cannot replicate.
To enhance this interaction, an integrated AI assistant provides real-time guidance, ensuring a smooth and effective process. SkillSwap reimagines skill acquisition by removing financial barriers and fostering a collaborative, community-driven environment, acting as a catalyst for a more accessible, interactive, and connected way of learning.

***Keywords*— Peer-to-Peer Learning, Real-Time Communication, AI Chatbots, Collaborative Learning, Skill Exchange, Educational Technology, Recommender Systems.**

I. INTRODUCTION

While online education has broadened access to information, its prevailing model often fosters a disconnected, one-way experience where users consume content behind a paywall. These platforms largely lack the dynamic, interactive exchange that defines genuine learning. This gap has created a landscape of powerful tools that fail to foster a true community of learners.

This paper presents SkillSwap, a platform that reintroduces human connection to digital learning through a barter system where knowledge is the sole currency. Instead of purchasing a course, a user can share an existing skill in exchange for acquiring a new one. This shift transforms learning from a passive transaction into an active, shared experience.

Our approach matches individuals based on complementary skills, facilitating a live, one-on-one video session. In this environment, every user is both a mentor and an apprentice, fostering mutual growth. To support this interaction, an integrated AI assistant provides on-demand guidance, ensuring an engaging and productive process. This paper details the architecture of SkillSwap, from its intelligent matching algo- rithm to its real-time communication infrastructure. We demonstrate a practical and scalable model for a more collaborative, accessible, and human approach to online
learning.

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II. Objectives and Scope

Our primary objective in this study is to design, implement, and validate a novel platform for synchronous, peer-to-peer skill exchange, moving beyond traditional mon- etary systems to a barter-based model. This work is specifically designed to address the integration gap prevalent in existing educational technologies. We set out to archi- tect a scalable three-tier system that not only integrates a content-based matching algorithm but also seamlessly delivers low-latency, real-time video communication.

A second key objective was to tangibly enhance the collaborative experience by embedding a real-time, voice-enabled AI assistant for contextual guidance. Finally, we aimed to validate the platform's effectiveness as a viable alternative to traditional asynchronous models, with a focus on measuring user engagement and accessibility.

The scope of this research is intentionally focused on the successful integration of these core components within a single web application framework, building upon recent advancements in collaborative learning models [9] and the growing role of AI in real-sealtim educational support [10]. We have deliberately limited this current imple-mentation to the web platform; a native mobile application is a planned component of future work. Furthermore, this project's focus is on the facilitation of the skill exchange, not on the formal certification or accreditation of the skills learned.

III. Literature Survey

Although established online learning platforms provide a wealth of content, their cen- tralized, one-way delivery model often falls short in offering the real-time interactivity necessary for engaging active learners. This limitation has spurred research into more collaborative and community-driven educational frameworks.

Studies on peer-learning systems highlight the importance of student-driven inter- actions, but many implementations are restricted to static, text-based formats. An earlier implementation, the SkillsMe platform, utilized a barter-style skill exchange. However, this platform faced significant challenges due to its dependence on manual skill matching and the absence of integrated, real-time communication tools.

The technical components for a more integrated platform are well-established. Research indicates that backend services like Firebase perform well for real-time data synchronization, which is crucial for effective session management. Proposed models for maintaining system integrity and fairness in peer-to-peer (P2P) architectures have emerged, while studies on video conferencing privacy emphasize the importance of secure session handling. Additionally, systematic reviews indicate that AI chatbots can greatly enhance learner engagement, although most AI systems currently lack the contextual awareness needed for the dynamic nature of peer-to-peer interactions.

The literature reveals a significant integration gap. While the core technologies for peer matching, real-time communication, and AI support are mature, they remain fragmented across different applications. SkillSwap addresses this challenge by creating a unified platform that seamlessly integrates these functions.

IV. Methodology

Our approach to building SkillSwap was guided by a central goal: to create a seamless, human-centered platform that directly addresses the integration gap in current educa- tional technology. We chose a scalable, three-tier architecture as our blueprint, which allowed us to build a cohesive ecosystem where peer-to-peer learning could thrive. This platform is brought to life by a modern technology stack, with each component selected for its specific strengths: ReactJS for a fluid user experience, Firebase for its powerful serverless backend, and Jitsi/VideoSDK for robust, real-time video communication.

A. System Design and Implementation

We intentionally structured SkillSwap into three distinct and interconnected layers. This design choice was fundamental to ensuring the platform is maintainable, scalable, and that each part of the system has a clear, defined purpose.

The Frontend

The user's journey begins with our frontend, a dynamic single-page application built with ReactJS. We chose React for its ability to create a responsive and intuitive inter- face, from the secure login process managed by Firebase Authentication to a personal dashboard for organizing skills and sessions. To build a truly accessible platform, we integrated the browser's native Web Speech API for voice commands and Eleven- Labs for natural-sounding audio feedback, ensuring the experience is welcoming for all learners.

The Backend

The core logic of SkillSwap resides in our serverless backend, powered by Firebase Functions. This is the engine room where the key operations happen: our content- based filtering algorithm intelligently pairs users, the entire lifecycle of a video session is managed from creation to termination, and all API requests to the OpenAI GPT-3.5 model that powers our AI assistant are handled securely and efficiently.

The Data Tier

A live learning platform is only as good as its data synchronization. For this critical task, we chose Firebase Firestore, a real-time NoSQL database. This is where we store all essential information, including user profiles, session logs, and evaluation results. Firestore's ability to instantly sync data across all connected users is what ensures a smooth, collaborative experience, eliminating lag and keeping everyone on the same page during a session.

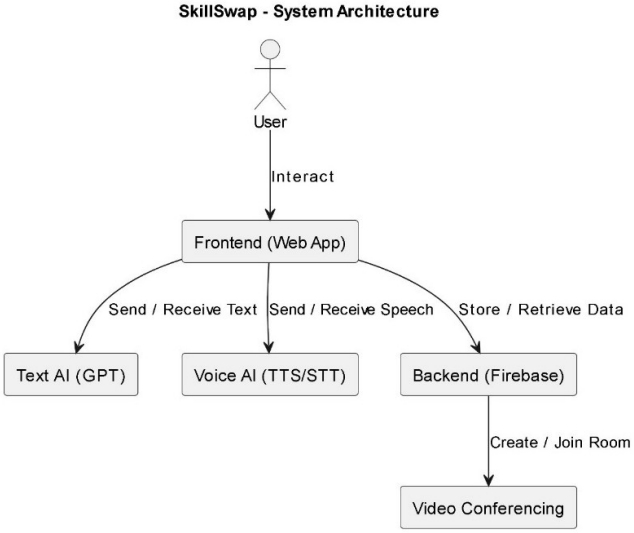

Fig. 1 SkillSwap-System Architecture

B. Modular Components

To keep the system organized and easy to maintain, we engineered SkillSwap as a col- lection of distinct, reusable modules. Each module serves as a building block with a specific purpose.

User Module: Handles everything related to a user's identity, from registration and authentication to their profile data in Firestore.

Skill Matching Module: Acts as our smart matchmaker, using a content-based algorithm to find the perfect learning partner for each user.

AI Assistance Module: Integrates our GPT-3.5 assistant, managing the conversa- tional flow for both text and voice queries to provide helpful, in-the-moment support. Video Communication Module: Manages the technical side of our live sessions, ensuring a stable and clear connection via the Jitsi/VideoSDK API.

Evaluation Module: Provides quizzes for self-assessment after a session, helping users track their growth and solidify new knowledge.

C. Operational Flow

A user's journey on SkillSwap is designed to be intuitive and straightforward. After logging in, a user defines their skill profile, and the platform's algorithm finds a com- patible peer. A unique session link is then generated and shared. Upon joining, a real-time video call starts instantly via Jitsi. During this live interaction, the AI chat-bot is always on hand to assist. After the session, users can take a quiz to reinforce what they've learned. Every step of this process is secured by Firebase's rules to protect user data and privacy.

D. Why We Chose This Path

Scalable: The serverless foundation means SkillSwap is ready to grow with its com- munity, handling more users without a major redesign.

Reliable: By building on Firebase's managed infrastructure, we ensure the platform is dependable, with high uptime and smooth data syncing backed by Google Cloud. Accessible: The thoughtful UI and integrated voice support make the platform easy to use for a diverse community of learners.
Interactive: Our use of real-time technologies creates an engaging, low-latency experience that feels as personal and immediate as learning in person.

E. The Road Ahead

Our Future Development Roadmap This strong foundation paves the way for an excit- ing future. Our roadmap includes:
Going Mobile: Developing a cross-platform mobile app with React Native to take learning on the go.
Making Learning Fun: Integrating gamification with points and achievement badges to boost motivation.
Connecting the World: Adding multilingual support and auto-translation to build a truly global community.
Verifying Skills: Exploring a blockchain-based system for skill verification to create trustworthy credentials for our users.

V. DATASETS

The intelligent operations of the SkillSwap platform are powered by a diverse collec- tion of data sources that include dynamic user interactions, structured educational repositories, and curated external APIs. A robust preprocessing and data-validation pipeline ensures that all datasets—both static and real-time—are consistent, relevant, and ethically sourced.

A. Sources of Data

Application Data
User-generated content, such as registration details, skill preferences, quiz scores, and AI chat interaction, is stored within Firebase Firestore, which functions as a real- time database for the platform. It ensures synchronization of live learning sessions and instant reflection of changes across user devices.

AI Knowledge Base
The platform's AI assistant—comprising both text and voice components—is trained and fine-tuned on trusted educational sources to ensure factual accuracy and con- textual learning. The base model uses OpenAI's GPT-3.5 for text generation and ElevenLabs for natural speech synthesis.
To provide domain-relevant responses, training prompts, and contextual references are derived from the following curated educational repositories:
FreeCodeCamp: ~ 7,142 characters of structured web content for foundational cod- ing tutorials.
Codecademy: ~ 17,762 characters of processed instructional text focusing on inter- active programming courses.
GeeksforGeeks: ~ 10,870 characters of algorithmic and problem-solving content. These datasets are used as reference text sources to ground the AI's responses in ver- ified educational material, ensuring reliability and reducing hallucination rates during text and voice interactions.

External APIs
YouTube Data API: Supplies context-aware video recommendations based on user-selected skills and topics.
Web Speech API and ElevenLabs API: Handle real-time Speech-to-Text (STT) and Text-to-Speech (TTS) operations for voice interaction.
OpenAI API: Processes text queries and contextual responses during live learning sessions.

Static Data
The system includes predefined datasets such as skill categories, sample quiz banks, and matching tags for content-based filtering. These static files ensure consistent user onboarding and facilitate skill classification across domains like programming, design, communication, and languages.

B. Data Preprocessing Pipeline

A multi-stage preprocessing pipeline ensures that all incoming data is normalized, validated, and secured before being consumed by the AI or stored in Firestore.

Data Cleaning and Schema Validation
All user inputs and API responses are validated using schema-based constraints defined within the Firebase Security Rules and Zod schema definitions. This guarantees structural consistency and mitigates injection risks.

Knowledge Source Structuring
The text data collected from FreeCodeCamp, Codecademy, and GeeksforGeeks is tok- enized, stripped of HTML tags, and structured into JSON segments containing topic, concept, description, sourceURL. These structured references are linked contextually during user interactions.

Voice and Text Normalization
Speech input is transcribed into text using the Web Speech API. ElevenLabs converts AI-generated text back into natural voice output, ensuring fluid and human-like con- versation. Audio data is handled in Base64-encoded format for compatibility across browsers.

Recommendation Filtering
The YouTube Data API integrates topic-relevance filtering to ensure that video recommendations remain educational and contextually aligned with user skill domains.

C. Data Security and Governance

All datasets and API integrations are governed by Firebase's access control rules, ensuring data confidentiality and integrity. All communication channels are secured using HTTPS and environment-protected API keys. User identities are managed via Firebase Authentication tokens. Chat logs and user interactions are stored with anonymized IDs to maintain privacy compliance.

VI. RESULTS

Our implementation of the SkillSwap platform was successful, serving as a practical validation of the proposed three-tier architecture. We confirmed that all core mod- ules—including user authentication, real-time video, AI assistance, and content-based matching—could be effectively integrated into a single, cohesive system. In this section, we analyze our findings, focusing first on a direct comparative analysis against prior art and second on the results from our preliminary user validation.

A. Comparative Analysis

To contextualize our contribution, we conducted a comparative analysis of SkillSwap against existing learning models.
The results of this analysis are presented in TABLE 1.

TABLE I: COMPARATIVE ANALYSIS OF LEARNING PLATFORMS

Attribute	SkillSwap (Proposed)	Traditional MOOCs	SkillsMe (Prior Art) [1]
Learning Model	Peer-to-Peer Barter	Instructor-to-Learner	Peer-to-Peer Barter
Interaction	Synchronous (Live Video)	Asynchronous	Asynchronous
User Matching	AI-driven (Content-Based)	Course Catalog Search	Manual Search
AI Support	Integrated Real-time Assistanta	Limited / None	None
Monetization	Non-monetary	Subscription / Fee-based	Non-monetary

aReal-time AI guidance is a key architectural feature of the proposed system
The analysis in TABLE I highlights the core contribution of our work: solving the integration gap. While prior art like the SkillsMe platform proposed a similar barter concept, its practical utility was constrained by manual, asynchronous processes.
Our platform overcomes these critical limitations by introducing two key integrations: (1) an AI-driven, content-based matching algorithm that automates and signifi- cantly improves the relevance of peer connections, and (2) synchronous, real-time video communication, which transforms the interaction from a static exchange into a dynamic, collaborative learning session. This synthesis of automated matching and live interaction represents a significant and novel advancement.
Dual-Role System: The platform supports both learners and teachers through a unified interface, allowing any user to act as either depending on their skills and learning needs.
Secure Authentication: Users register and log in securely using Firebase Authen- tication. Session management ensures smooth and safe transitions into video rooms. Skill-Based Matching: An AI-powered, content-based matchmaking algorithm pairs users by analyzing "skills they have" and "skills they want" ensuring highly relevant peer-to-peer connections.
Live Interactive Sessions: Once matched, users are automatically directed to a Jitsi-powered video room. Sessions support real-time audio/video, text chat, and collaboration without external downloads.

AI Assistant: A voice-enabled AI chatbot (OpenAI + ElevenLabs) provides instant explanations, study tips, and learning guidance. It converts text into natural-sounding speech for accessibility. It assists during live sessions and helps with clarifications.
Quiz and Evaluation Module: A self-assessment quiz system is built in to help learners test their understanding, measure progress, and improve skills.
Dashboard and Profile Management: A user-friendly dashboard integrates profile data, quiz scores, and session history. Learners and teachers can track their progress and manage skill exchange history.
Scalable Architecture: ReactJS frontend with Tailwind CSS for responsive design. Firestore database to manage users, sessions, and matches. It is easily extensible to add certifications, leaderboards, or multilingual support.

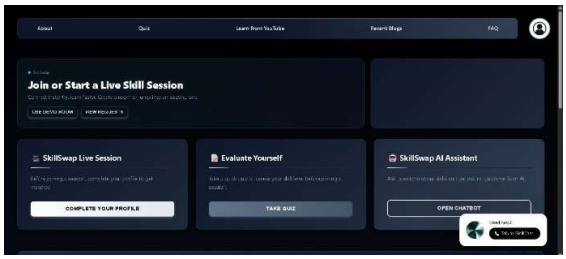

Fig. 2 SkillSwap Homepage

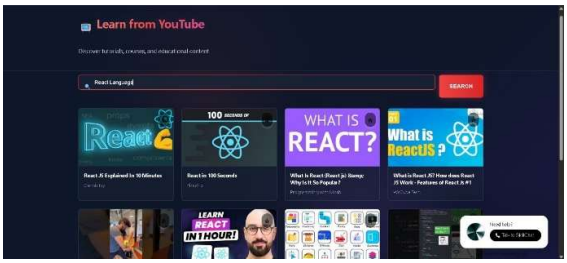

Fig. 3 SkillSwap-Youtube Video Recommender for learning

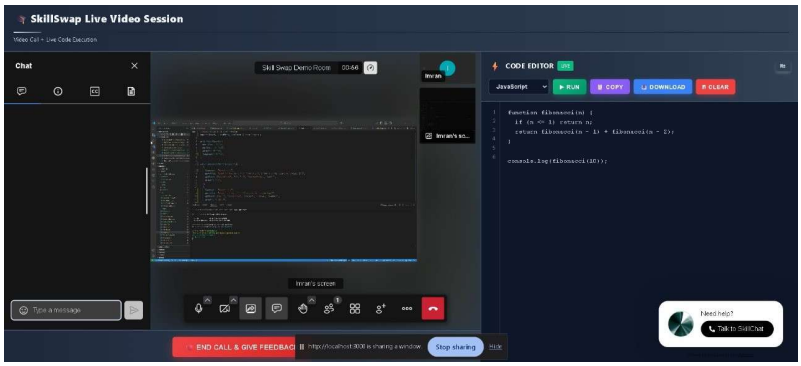

Fig. 4 Live Video Session (integrated with compiler)

VII. Conclusion

Our work has successfully demonstrated that the fragmented components of peer-to- peer learning can be unified into a single, cohesive platform. By architecting a system that integrates intelligent user matching, live video, and real-time AI assistance, we have created a functional and engaging ecosystem for collaborative education. This project moves beyond theory to provide a practical solution to a long-standing challenge in educational technology.
The successful deployment of SkillSwap validates our central premise: a non- monetary, barter-based model for skill exchange is a powerful and viable alternative to traditional online learning. By putting direct human connection at the heart of the educational process, our platform offers a compelling and necessary counterpoint to the isolated, asynchronous experience that dominates the digital landscape today.
This implementation serves as a strong foundation for the future development of the platform. Our immediate roadmap includes extending our reach with a mobile application, deepening user engagement through gamification, and fostering a global community with multilingual support. Ultimately, SkillSwap provides a tangible blueprint for a future where technology is leveraged not to replace human interaction, but to amplify and enable it, restoring collaborative learning to its central place in the digital experience.

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