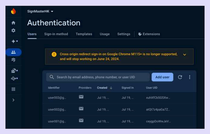
XCODE

SignMaster was developed using Swift on Xcode, which provides a comprehensive suite of tools that streamline the app development process, including a powerful code editor, debugging tools, and Interface Builder for designing user interfaces.

Xcode's integration with CoreML made it particularly suitable for our project, as it allows for easy incorporation of machine learning models for real-time hand gesture recognition. This capability was essential for providing immediate feedback to users, which is a core aspect of SignMaster. Overall, Xcode's comprehensive tools and frameworks enabled us to efficiently develop a high-quality app that meets our goals for accessibility and user engagement in HKSL education. Additionally, Xcode's built-in simulators and testing features facilitated rapid prototyping and iteration, enabling us to refine the app based on user feedback.

FIREBASE



1. Authentication

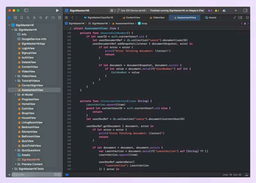
We utilized Firebase Authentication to facilitate a seamless account creation process with their emails, ensuring they can log into the SignMaster app with their preset password easily.

2. Cloud Firestore

In addition to authentication, Firebase's analytic tools enable us to keep track of user engagement by monitoring various metrics, such as the number of actions performed within the app and the furniture purchased for their virtual homes. This data is stored in a structured manner, allowing us to manage and analyze user interactions effectively.

3. Real-time Capabilities

Firebase's real-time database capabilities allow users to view their progress in the progress tracking page, providing insights into their learning journey.



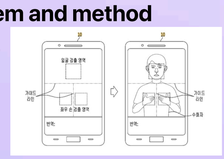
This feature enhances learning efficiency by offering clear visual representations of their achievements, such as the number of signs learned and quizzes completed. When users are able to see tangible evidence of their progress, they are more motivated to set and achieve personal goals.

Overall, Firebase's extensive features support the app's functionality, enabling a dynamic and engaging learning environment for users of SignMaster.

PATENT SEARCH

1. Sign language translator, system and method

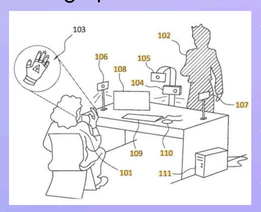
This portable sign language translator uses image input from a camera to recognize hand gestures and facial expressions, translating them into text or speech.



However, it solely focuses on translating sign language into text in real-time, not on teaching sign language. While useful for occasional translation needs, relying on such a system for all communication between individuals who use sign language is impractical. **(KR101777807B1)**

2. Computer vision based sign language interpreter

This computer based interpreter translates sign language into a target language using a combination of data from a camera and a data glove worn by the user. The system, while offering a potential method for sign language translation,



(KR101777807B1)

heavily relies on specialized and potentially costly hardware, such as a data glove and camera, creates a significant barrier to accessibility. The data glove itself may be cumbersome and interfere with natural signing, impacting accuracy and limiting its real-world applicability.

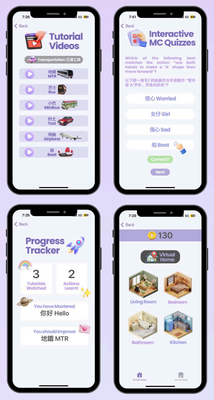
SignMaster, however, will significantly benefit users by reducing learning costs (potentially exceeding $10,000 per learner compared to traditional methods), increasing user engagement and satisfaction through convenience and accessibility, and ultimately impacting our society by reducing communication barriers and fostering inclusivity.

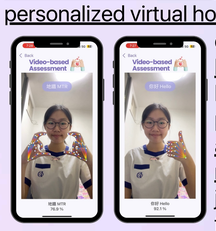
ABSTRACT

SignMaster, a mobile application developed in Swift, offers an interactive platform for learning Hong Kong Sign Language (HKSL). Its core feature is real-time AI-powered assessment of signing accuracy, driven by a custom-trained CoreML model. This model, trained on a 1,750-video dataset, analyzes user signing via the device's camera and provides instant feedback. Interactive design elements, including rewards and progress tracking, encourage HKSL fluency. SignMaster aims to contribute to SDG 10 by reducing communication barriers and promoting inclusivity.

OUR SOLUTION

SignMaster is the first-ever app specifically created to teach Hong Kong Sign Language (HKSL) on both iPads and iPhones, offering users an additional platform for convenient access. The app utilizes Firebase authentication to simplify the login and account creation process, enabling seamless navigation once users are logged in. To begin their learning journey, users can watch tutorial videos that introduce commonly used signs, such as "goodbye" and "MTR." They can then assess their signing skills through an AI-powered video assessment that provides real-time feedback on their proficiency. Additionally, the app includes a progress tracker to help users monitor their learning advancements and a multiple-choice quiz with randomized questions to enhance their understanding of HKSL. To encourage ongoing engagement, users can earn virtual coins within the app, which can be spent on furniture and customization options for their personalized virtual home. A standout feature of the app is its capacity to assess users' sign language postures, facilitating precise learning and practice. This is made possible through machine learning algorithms that analyze hand and arm movements, using approximately 30 joint points, and compare them against the training dataset.





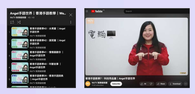
COMPETITIVE ADVANTAGES

1. HKSL Dictionaries

HKSL dictionaries lack interactive and engaging learning experiences, leading to misunderstandings and incorrect sign execution, which can hinder motivation and retention.

2. Youtube Tutorial Videos

YouTube tutorial videos lack interactive elements, personalized feedback, and consistent quality, potentially limiting the effectiveness of learning.



SignMaster addresses these gaps by offering interactive and engaging learning experiences, providing personalized feedback to enhance understanding and execution of signs, ultimately boosting motivation and retention. Through its focus on HKSL and advanced AI technology, SignMaster ensures a consistent quality of content, offering a comprehensive solution that surpasses traditional resources like HKSL dictionaries and YouTube tutorial videos.

FUTURE DEVELOPMENTS

1. VR/ AR Enhancement

Future incorporation of Apple Vision Pro to create a more immersive and engaging 3D learning experience, improving sign language accuracy.

2. Partnership with deaf organizations

Establish partnerships with Hong Kong deaf organizations to rigorously test the accuracy and reliability of our app, coupled with a blockchain-based system to convert in-app rewards into real-world donations.

香港聾人福利促進會 The Hong Kong Society for the Deaf

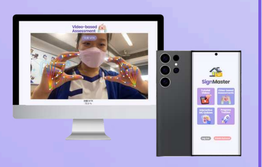
Silence

香港聾人協會 The Hong Kong Association of the Deaf

香港聾人協會 CODA Hong Kong

3. Expanded Platform Support

Development of Android and web versions alongside the existing iOS app to increase accessibility and remove device restrictions, maximizing the app's impact and reaching a wider audience.



BACKGROUND

Hong Kong has a substantial hard-of-hearing and speaking population (approximately 3.3% or 246,200 individuals). They often face communication barriers, resulting in isolation and limited opportunities. These challenges stem from inadequate sign language learning materials for those around them, a shortage of sign language interpreters and societal discrimination. Hong Kong Sign Language (HKSL) is unique, therefore, specialized resources are essential for fostering inclusivity and effective communication.

OUR MISSION

We aim to develop an accessible and affordable interactive platform for learning Hong Kong Sign Language (HKSL). Our innovative approach will utilize real-time feedback and visual demonstrations to overcome the limitations of traditional learning methods, building user confidence and fluency. By connecting those with and without hearing or speaking difficulties, we hope to promote inclusivity and contribute to United Nations' Sustainable Development Goal 10: reducing inequalities, ultimately breaking down communication barriers and fostering a more equitable society.

SOCIAL IMPACT

SignMaster's potential for social impact is substantial, targeting a service available market of 729,000 individuals, comprising 243,000 deaf and mute individuals and 486,000 of their family members and friends who would benefit from learning Hong Kong Sign Language. With a projected service obtainable market of $583,000 (10% penetration), SignMaster could facilitate access to valuable learning resources, equivalent to providing 7,288 individuals with sign language dictionaries or funding 4,485 hours of tutorial classes. By offering a more accessible and engaging learning method, SignMaster aims to empower this population to bridge communication gaps. This can lead to increased opportunities in education and employment, stronger social integration, and improved quality of life for deaf and mute individuals and their families.

TARGET USERS

1. Individuals with Hearing Impairments

Enhanced communication fosters independence, better social interactions, and more education and job opportunities, bridging communication gaps for confident self-expression.

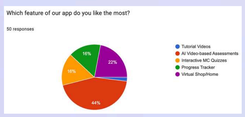
2. Family Members and Friends

Better communication and improved connections create inclusive homes, strengthening bonds and enhancing understanding of challenges faced by those with hearing impairments.

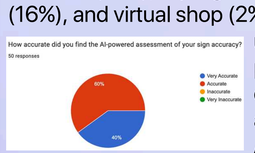
3. Caregivers:

Caregivers enhance support through better communication, improving quality of life for individuals with hearing impairments and easing their own emotional and practical burdens.

USER FEEDBACK



User feedback from 50 individuals aged 11 to 65 revealed positive responses towards our app. The AI-powered video assessments were the most popular feature (44% preference), followed by the interactive quizzes (22%), tutorial videos (16%), progress tracker (16%), and virtual shop (2%). Overall user experience was largely positive, with 60% rating their experience as "Excellent" and 36% as "Good." Importantly, the core AI-powered sign accuracy assessment received strong validation, with 60% of users finding it "Very Accurate" and another 40% finding it "Accurate." This suggests the app effectively delivers on its promise of providing real-time, accurate feedback.

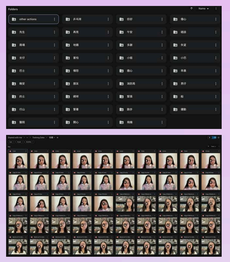


CONCLUSION

SignMaster revolutionizes HKSL learning with AI-driven tailored feedback and rewards, promoting inclusivity through empowered signers in a more cohesive society.

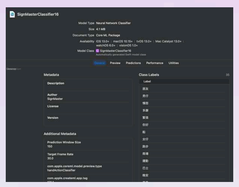
MEGAN LAM, GINNIE CHAN - DIOCESAN GIRLS' SCHOOL

TRAINING DATA



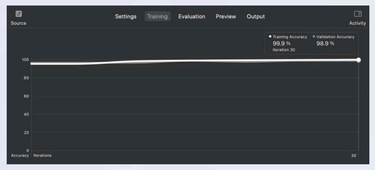
Since we realized there was no existing training dataset available online, we created one ourselves. We reviewed numerous HKSL tutorial videos on platforms like YouTube to ensure our signing accuracy, as well as consistency before recording a total of 1,750 videos and capturing 35 distinct signs for training our AI model.

MODEL TRAINING



To train our AI model, we utilized CoreML to develop a hand action classifier specifically designed for Hong Kong Sign Language (HKSL). We conducted numerous iterations during the training process, continually refining the model to enhance its performance.

After extensive training and validation, we achieved an impressive accuracy rate exceeding 90%. This high level of accuracy demonstrates the model's effectiveness in accurately recognizing and evaluating hand movements, ensuring that users receive reliable feedback on their signing proficiency. The rigorous training process not only validated the robustness of our model but also confirmed its potential to significantly enhance the learning experience for users of SignMaster.



MODEL INTEGRATION

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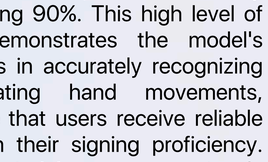

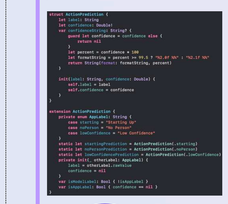

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CYBERSECURITY

1. Secure Password Management

SignMaster employs Firebase Authentication's robust hashing and salting mechanism as a primary security measure.

Passwords are irreversibly transformed using one-way hashing functions, and the addition of unique random salts further strengthens security by preventing rainbow table attacks. This ensures password protection even if the database is compromised.

2. Firestore Security and Data Encryption

SignMaster's data protection goes beyond password security. We utilize Firestore security rules to control data access, granting permission only to authenticated users. Furthermore, both encryption in transit and at rest protect data, minimizing the risk of exposure even in a database compromise.

3. Comprehensive error handling

SignMaster's code includes robust error handling for authentication failures (incorrect passwords, network issues, server errors, invalid input), preventing sensitive information disclosure.