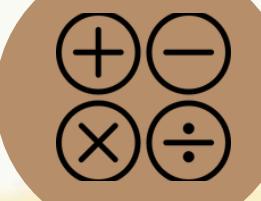




GROSS MOTOR SKILLS



SPEAKING SKILLS



BASIC MATHEMATICS



WRITING SKILLS



**MULTISENSORY LEARNING TOOL FOR  
CHILDREN WITH DOWN SYNDROME**

# INTRODUCTION



- **PURPOSE:**
  - *IMPROVE EDUCATIONAL, SOCIAL, AND HUMAN SKILLS FOR CHILDREN WITH DOWN SYNDROME (AGES 5-10) IN SRI LANKA.*
- **PROBLEM:**
  - *LIMITED ACCESS TO AFFORDABLE, EFFECTIVE EDUCATION TOOLS; CHALLENGES IN WRITING, SPEECH, MATH, AND MOTOR SKILLS.*
- **SOLUTION:**
  - *AFFORDABLE, E-LEARNING PLATFORM FOR HOME USE.*
- **KEY FEATURES:**
  - *FOCUSSES ON 4 AREAS: WRITING, SPEECH, MATH, GROSS MOTOR SKILLS*
  - *USER-FRIENDLY, LOW-COST, AND MODERN.*

# **BACKGROUND & RESEARCH PROBLEM**

- **Background:**
  - In Sri Lanka, children with Down syndrome lack proper education.
  - Many face delays in reading, writing, math, and movement skills.
- **Research Problem:**
  - Schools lack special classes, trained teachers, and enough resources.
  - Parents struggle to teach their children at home without proper guidance.
  - Most learning tools are expensive or complex.
  - Current teaching methods are not effective enough.
  - Expensive medical support.
- **Gap:**
  - No widely available, parent interactive, low-cost solutions.

# RESEARCH GAP

- Challenges Identified:

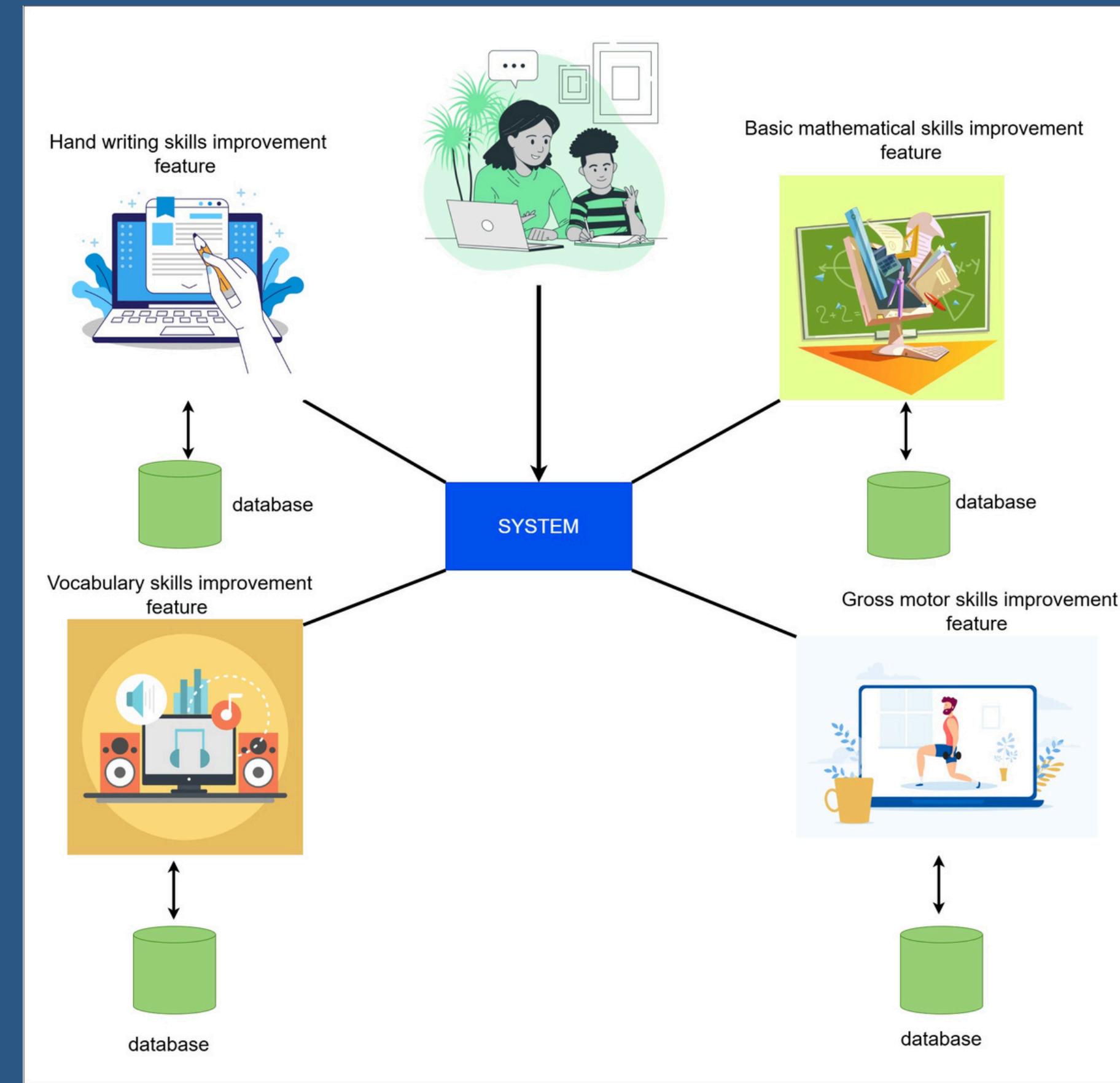
- **Writing:** Limited tools for hand writing skills.
- **Speech:** Pronunciation delays affect communication.
- **Math:** Difficulty with basic concepts; Finger Math helps.
- **Gross Motor:** limits physical activity apps.

ASPECT	TRADITIONAL METHODS	PROPOSED METHOD
Cost	Expensive (e.g., specialized programs)	Low-cost, affordable platform
Accessibility	Limited (school-based, urban-focused)	Home-based, widely accessible
Technology	Minimal (manual tools, games)	Deep learning (CNN, LSTM,RNN )
Parent involvement	Less parent involvement	Parent Involvement activities

# **RESEARCH GOALS**

- **Objective:** Improve quality of life for Down syndrome children in Sri Lanka.
- **Target Audience:** Low-income families with limited resources.
- **Approach:** Multisensory learning (visual, auditory, kinesthetic).
- **Parental involvement for supervision (30 mins/day).**
- **Make it easy for parents and teachers to use.**

# SYSTEM OVERVIEW



# TEACHING BASIC MATHEMATICS USING FINGER MATHS

- Goal:

- Teach children with Down syndrome numbers and basic arithmetic using finger maths.

- Why It Matters:

- Maths is hard for kids to grasp.
- Finger Math uses touch and visuals to make learning concrete.

- Fact:

- All humans learn numbers and math using fingers as kids because moving fingers helps the brain remember numbers with muscle memory.

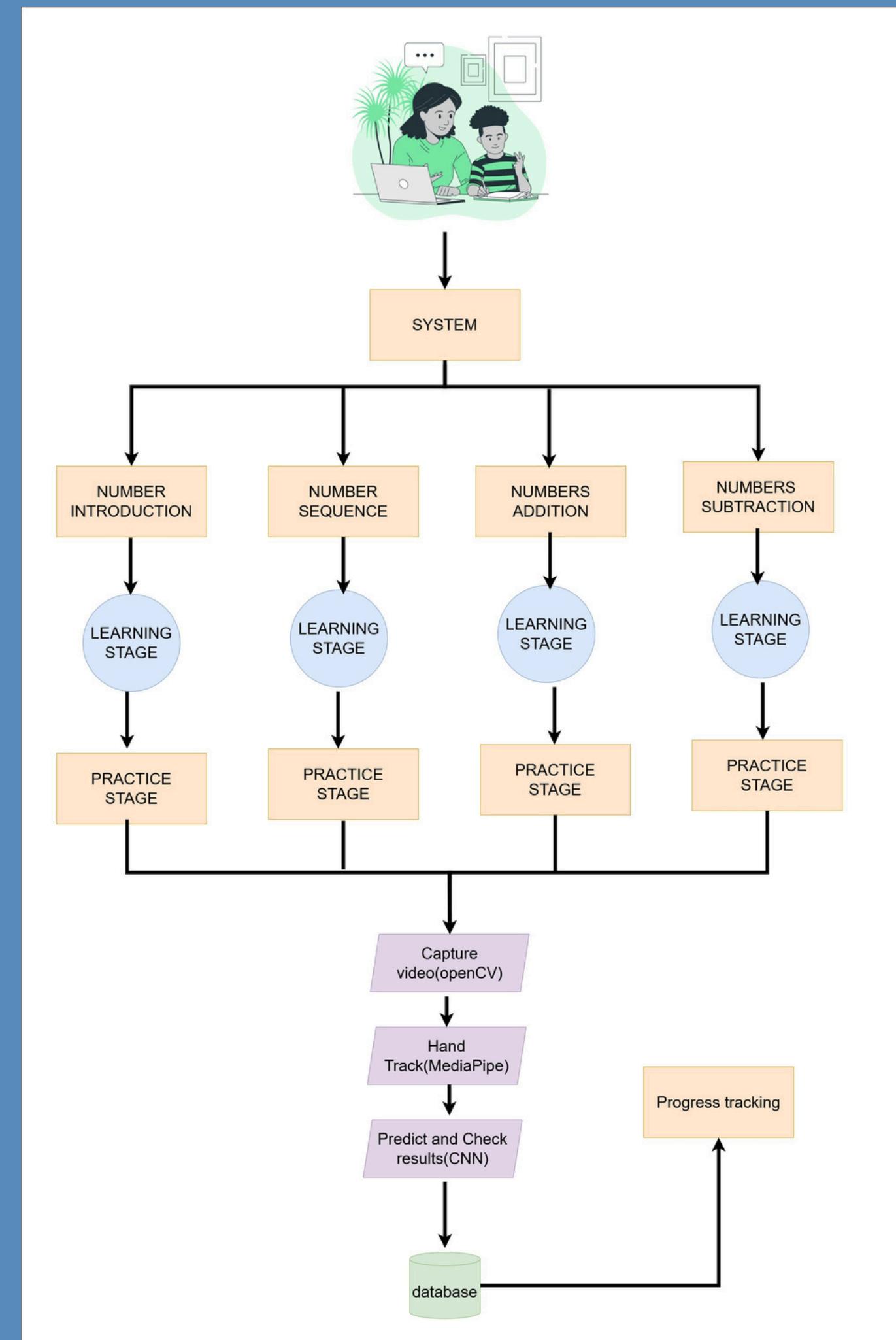
- Target Skills:

- Number recognition, sequences, addition, subtraction



# METHODOLOGY

- Approach:
  - Stage 1: Learn single digits (0-10) with images and Sinhala audio and practice.
  - Stage 2: Learn number sequences (e.g., 1, 2, 3...) and practice.
  - Stage 3: Learn Addition of two numbers and practice
  - Stage 4: Learn Subtraction of two numbers and practice
- Technology:
  - Zustand: State management
  - CNN: Recognizes hand gestures from video input.
  - MediaPipe & OpenCV: Real-time finger tracking (by key points).
- Exercises:
  - Number identification, sequence, addition, subtraction.



# METHODOLOGY

- **Dataset:**
  - Kaggle "Sign Language Hand Gestures" (0-9 + Unknown).
- **CNN Model:**
  - Input: 64x64 RGB images, normalized [0,1].
  - Layers: Convolutional (feature extraction), MaxPooling, Dense, Softmax.
- **Training:**
  - 80% train, 20% test; 15-20 epochs, batch size 32.
- **Enhancements:**
  - Batch normalization for stability.
  - Dropout to prevent overfitting.
- **Real-Time:** MediaPipe extracts 21 finger points; OpenCV

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D,
Flatten, Dense, Dropout
from tensorflow.keras.optimizers import Adam

# Define CNN model architecture
model = Sequential([
    Conv2D(32, (3,3), activation='relu', input_shape=(64, 64, 3)),
    MaxPooling2D(2,2),

    Conv2D(64, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Conv2D(128, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Flatten(),
    Dense(128, activation='relu'),
    Dropout(0.5), # Prevent overfitting
    Dense(10, activation='softmax') # 10 classes (digits 0-9)
])

# Compile the model
model.compile(optimizer=Adam(Learning_rate=0.001),
              loss='categorical_crossentropy',
              metrics=['accuracy'])

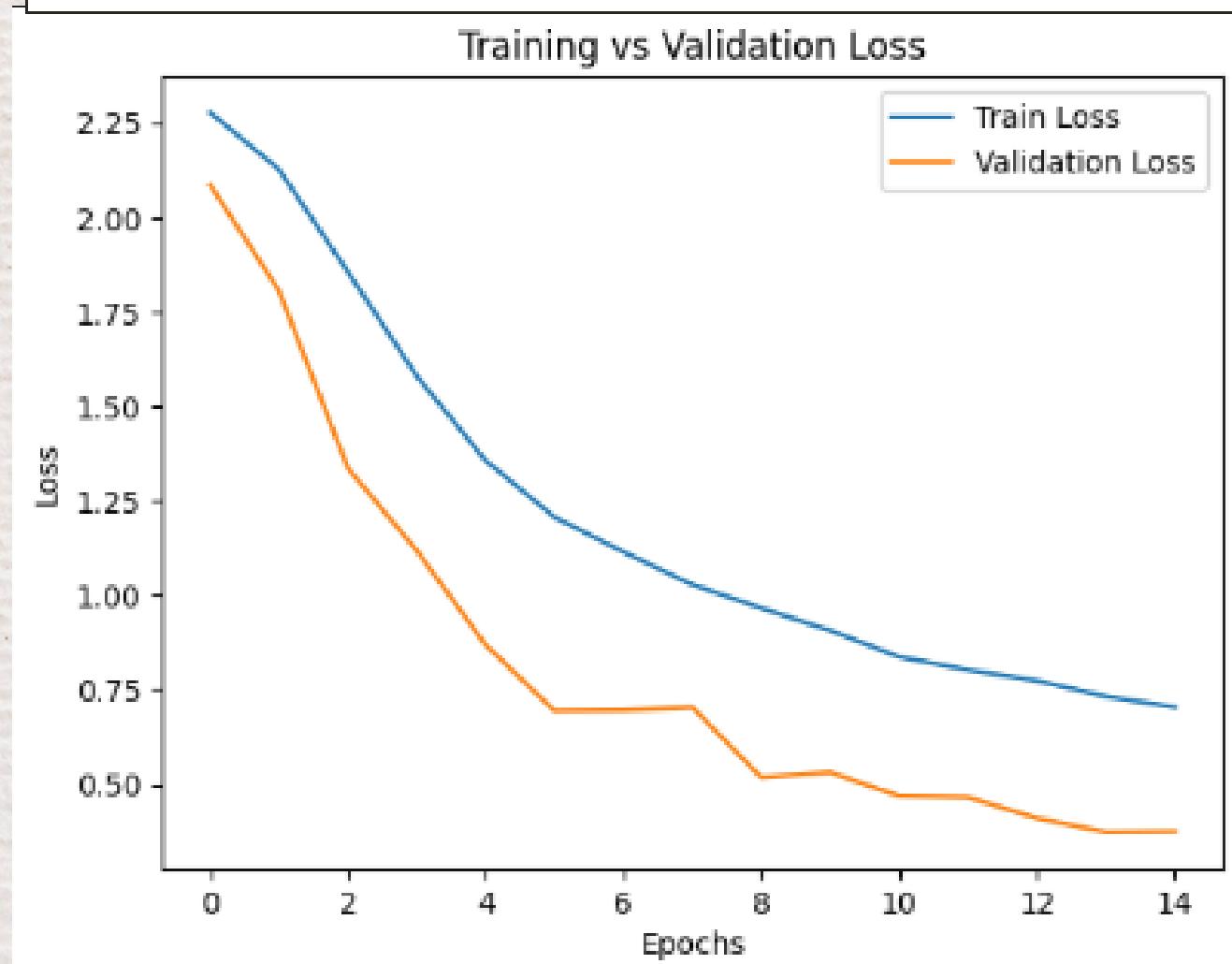
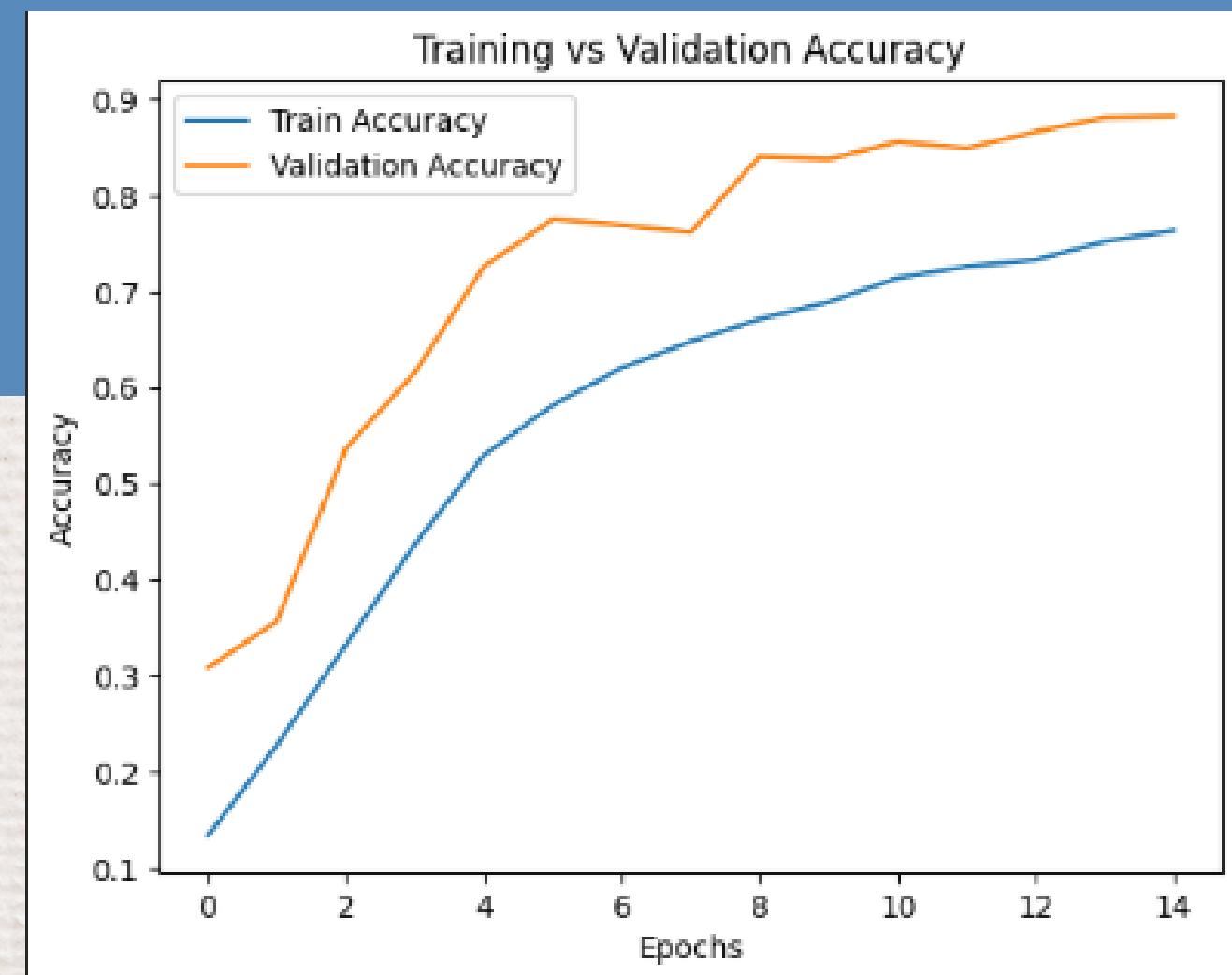
# Train the model
history = model.fit(
    train_generator,
    epochs=15,
    validation_data=test_generator
)

# Save the trained model
model.save("../models/hand_gesture_model.h5")

# Evaluate model on test data
test_loss, test_acc = model.evaluate(test_generator)
print(f"Test Accuracy: {test_acc:.2f}")
```

# RESULTS

- Performance:
  - Accuracy: 88%.
  - Loss: 0.35%.
- Outcomes:
  - Correct gestures recognition(>0.6) predict the number.
  - Low-confidence gestures (<0.6) prompt "Unclear Gesture! Try Again."
- Progress Tracking:
  - History logged for parents to identify weak areas.



# BENEFITS & IMPACT

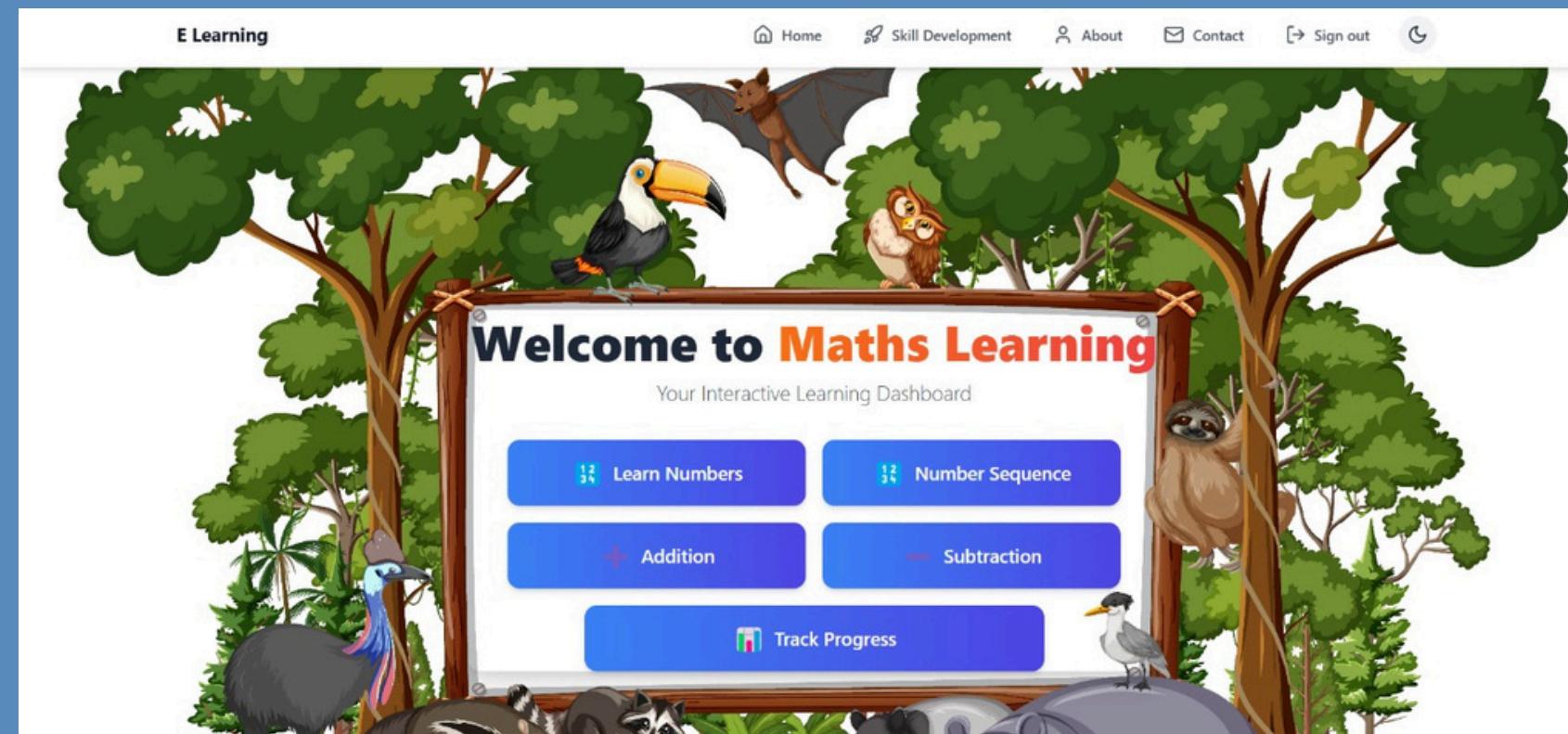
- Benefits:

- Engaging: Audio, visuals, and rewards boost memory.
- Effective: Finger Math simplifies number comprehension.
- Accessible: Real-time feedback at home.

- Impact:

- Improves math skills for daily life.
- Empowers children and parents with an interactive tool.

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A colorful activity titled "Learn Number Sequences". It shows a sequence of numbers from 4 to 8, each paired with a hand icon showing the corresponding number of fingers. The first three numbers (4, 5, 7) have a yellow circle around them, while 6 and 8 have a pink circle. A question mark is placed over the fourth position. To the right, the correct answer "6 six" is shown with its hand icon. A "Guide for Parents: Helping Your Child Learn" section is visible at the bottom.

An activity titled "Number" where users are asked to show the number 2 with their hands. A camera view shows a person's hands. A green checkmark icon and a "Correct Answer!" message with a confetti emoji are displayed. A "Well Done!" checkbox is checked. The status bar at the bottom shows "Captured 5/5 Images" and "Prediction: 2".

An activity titled "Number Adventure!". It shows a large number 1 and a hand pointing to it. A "Tap the picture to hear the number!" instruction is present. A large number 1 is also displayed at the bottom center.

# ENHANCING GROSS MOTOR SKILLS

Improve gross motor skills in children with Down Syndrome using an interactive system

## Goal:

- To help children with Down syndrome improve their gross motor skills through interactive, child-friendly activities

## Target Skills:

- Balance
- Strength
- Mobility
- Coordination

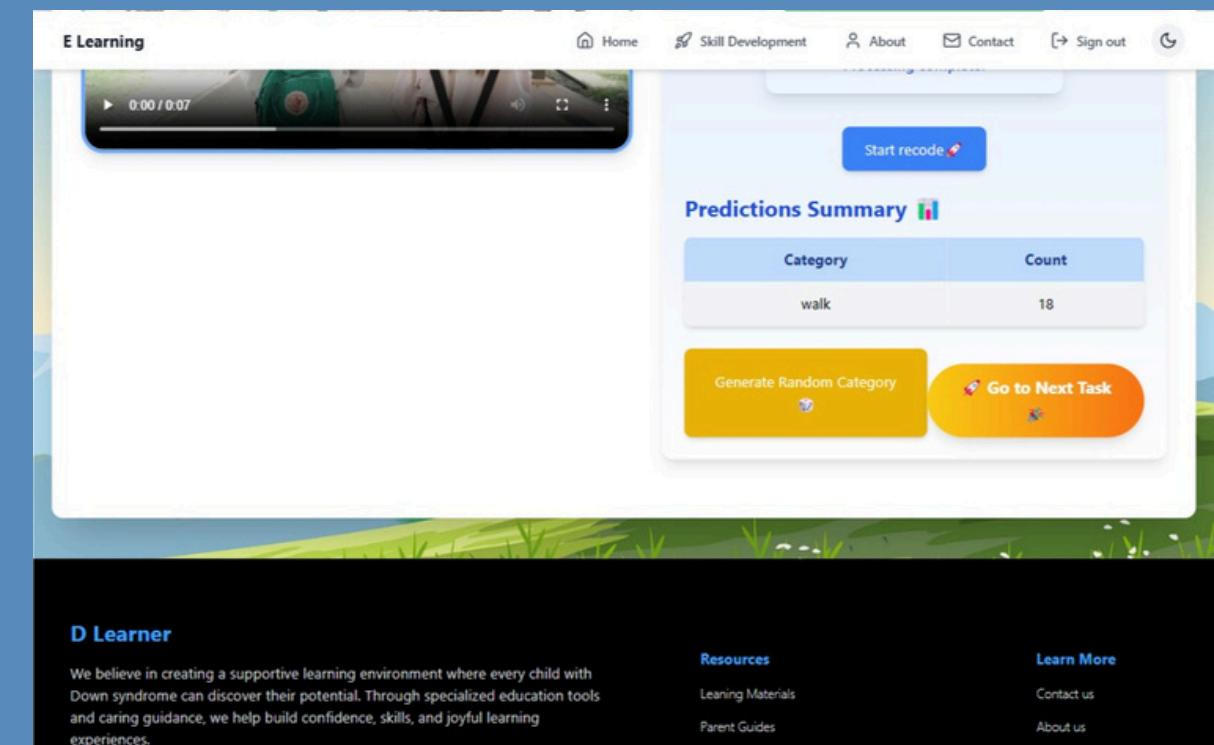
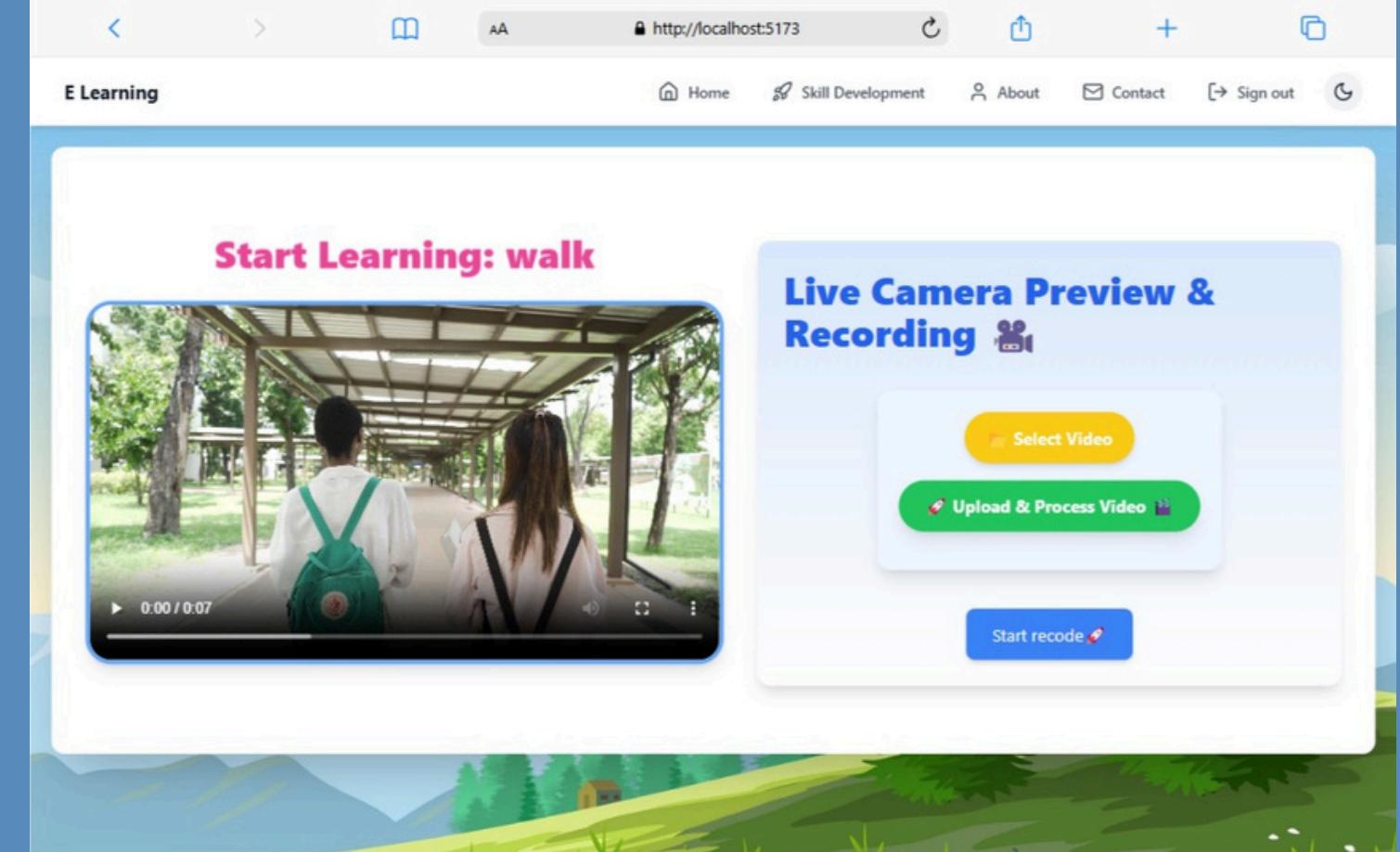
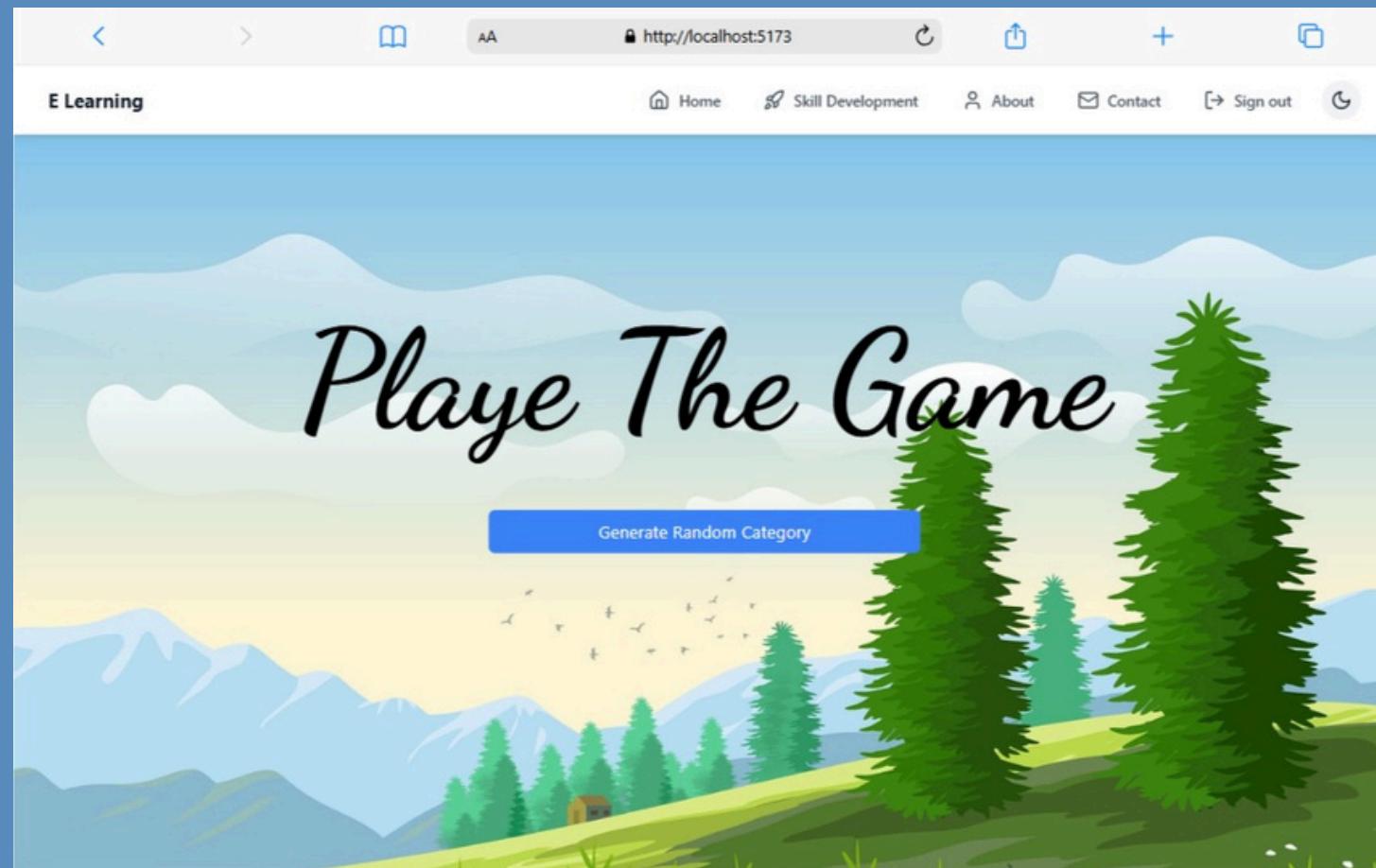


# METHODOLOGY

## How IT Works

- Identifies the child's skill level
- Provides a random gross motor skill activity.
- Captures or uploads a video for analysis.
- Predicts the action and classifies skill level (easy, medium, hard).
- Provides feedback and personalized activity recommendations.

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# DEVELOPING WORD PRONUNCIATION



## Goal:

- To enhance the pronunciation and vocabulary skills of children with Down syndrome, enabling them to communicate more clearly and confidently.

## Target Skills:

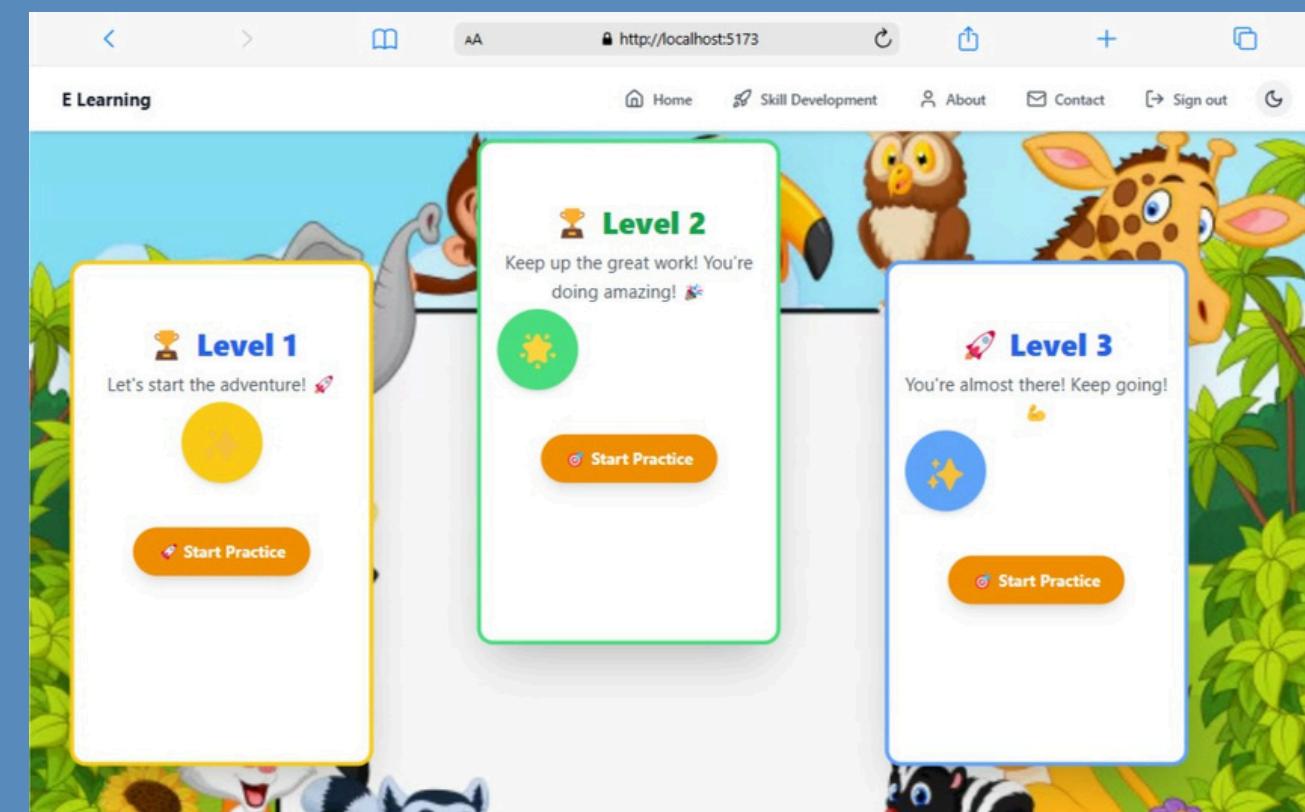
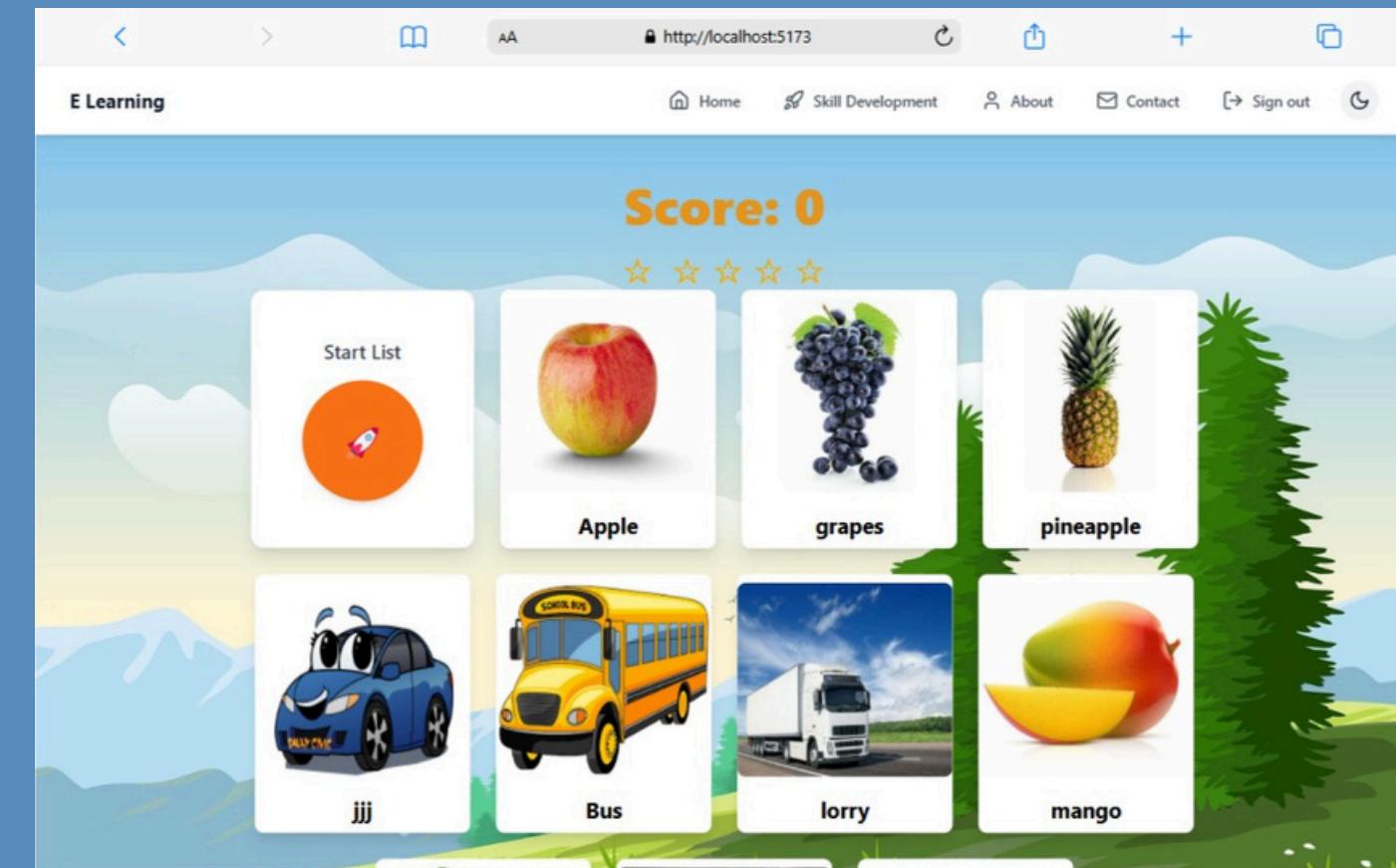
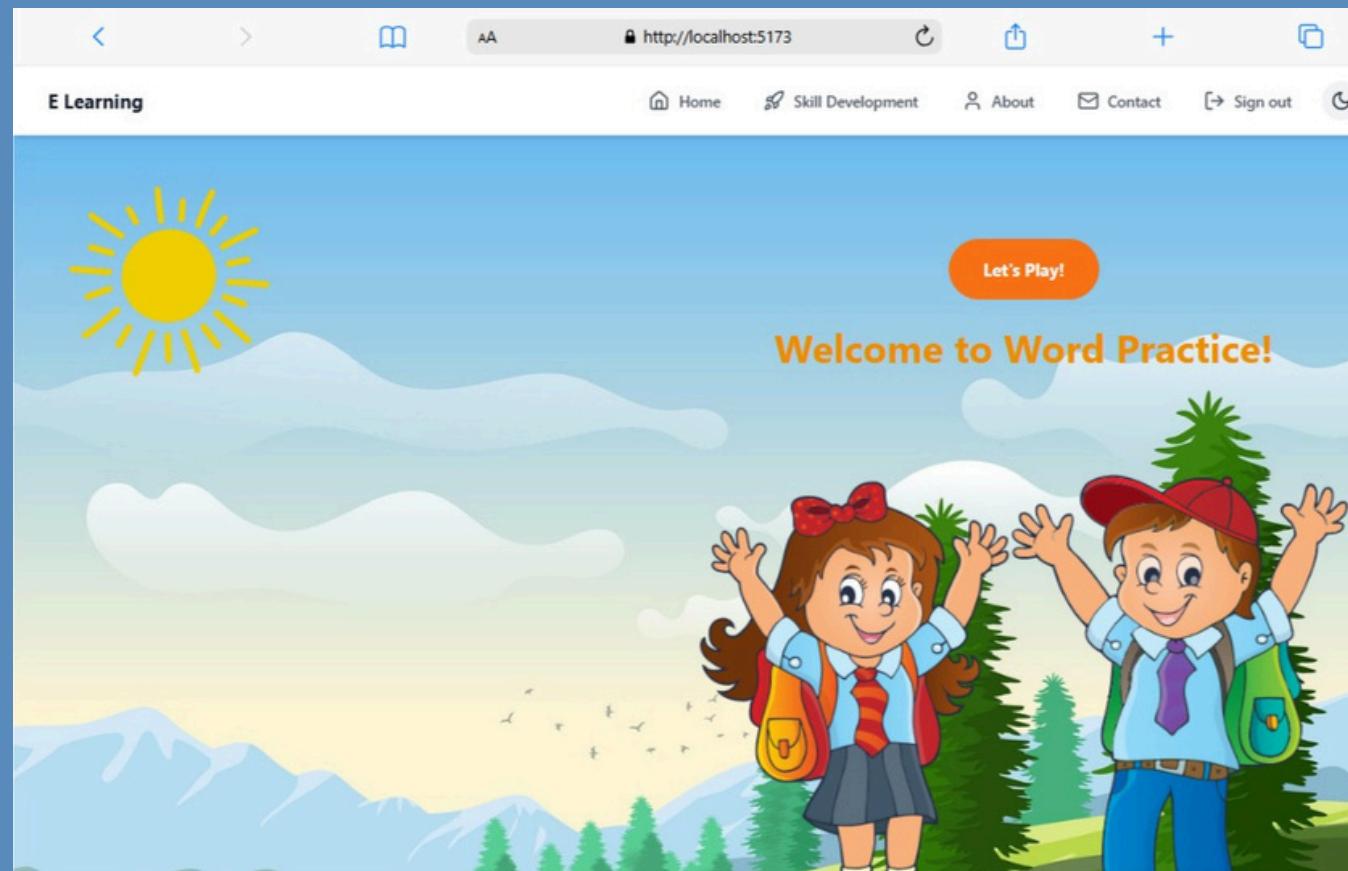
- Pronunciation Accuracy
- Mouth Coordination
- Breathing Control
- Vocabulary Expansion

# METHODOLOGY

## How IT Works

- Learn mouth movements and breathing for clear speech.
- Pronounce words accurately with guided practice.
- Expand vocabulary by linking words to real-life objects.
- Improve through feedback and progress tracking.

# UI



# IMPROVING WRITING SKILLS



## How IT Works

### Goal:

- To create an AI-driven educational tool that enhances Sinhala letter recognition and writing for children with Down syndrome through real-time feedback and adaptive learning

### Target Skills:

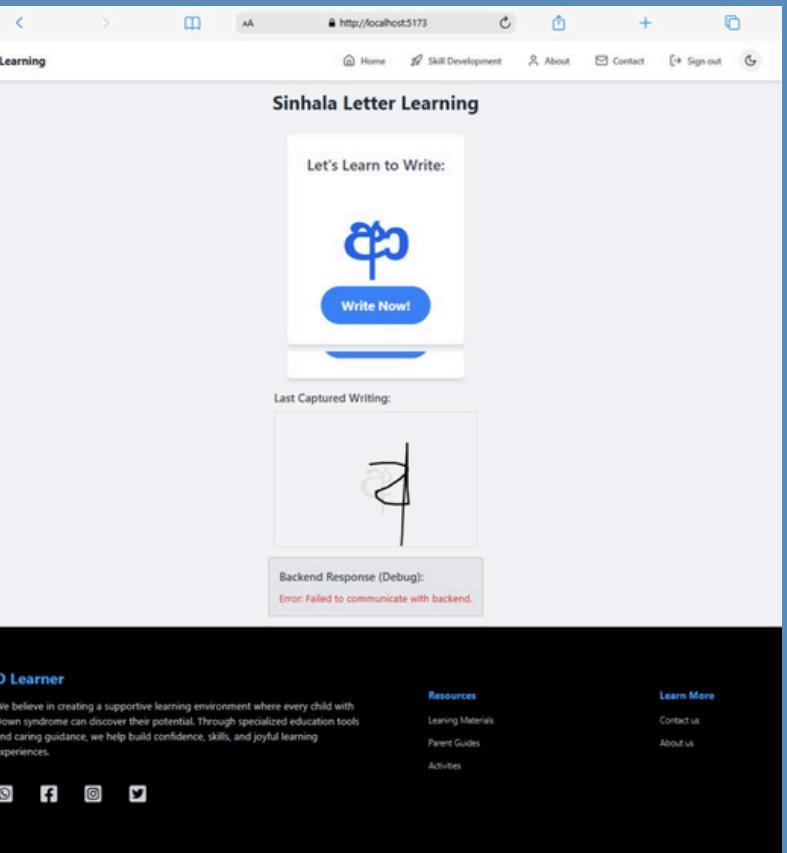
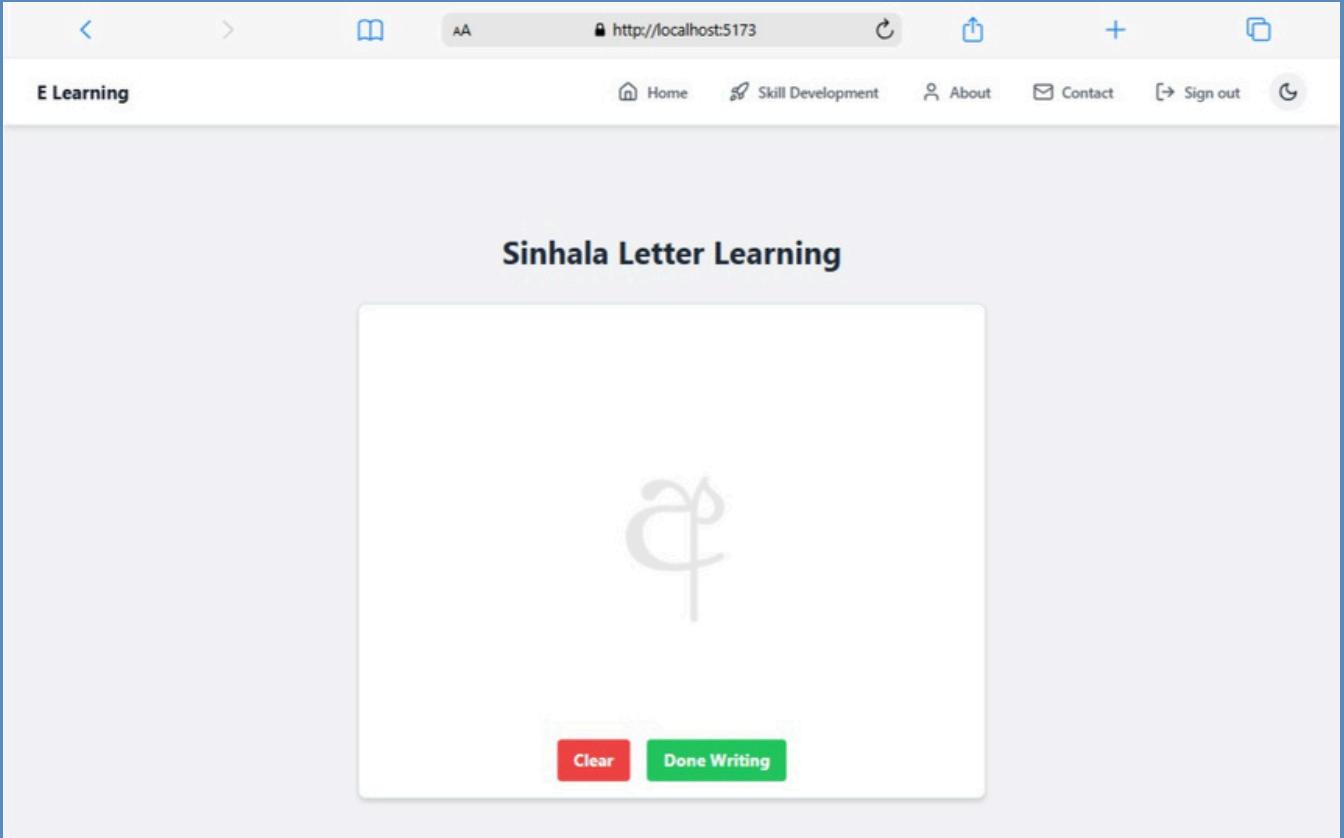
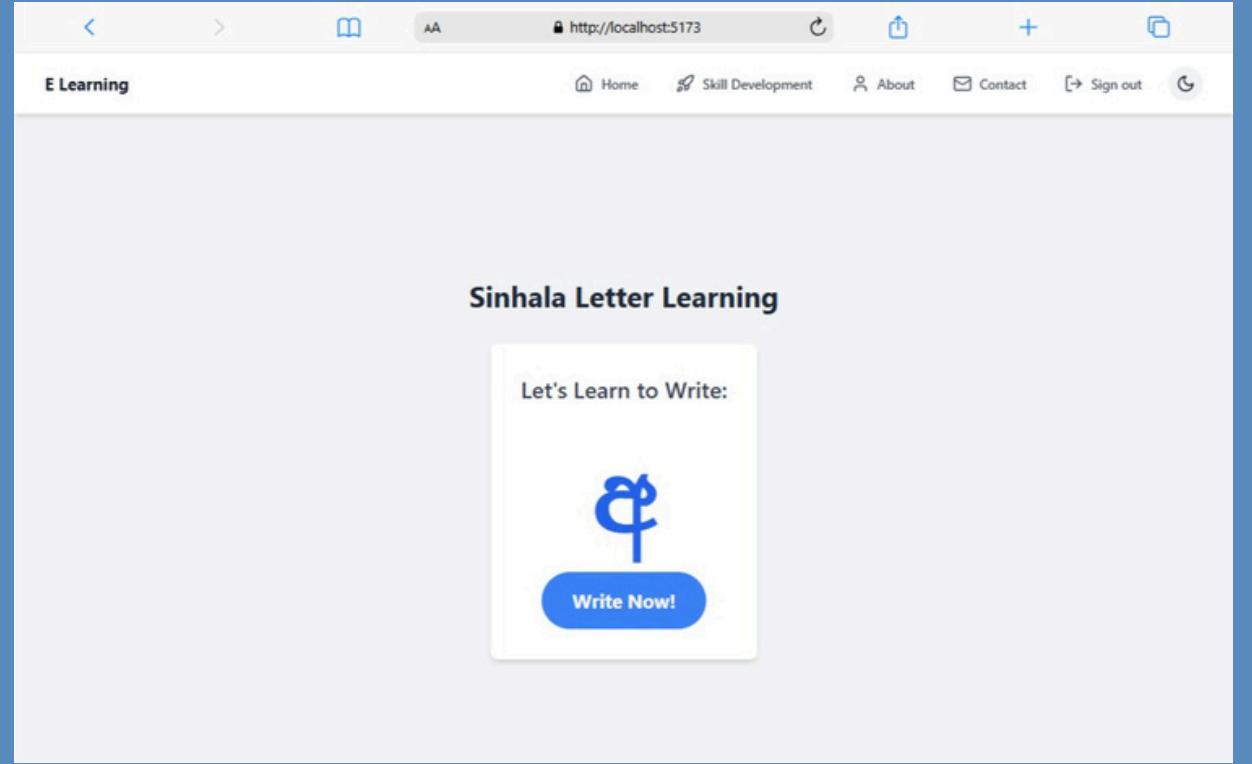
- Letter Recognition
- Handwriting Accuracy
- Fine Motor Skills
- Cognitive Processing
- Confidence in Writing

# METHODOLOGY

## How IT Works

- Use a diverse dataset with rotations, distortions, and viewpoint changes to improve generalization
- Display a Sinhala character and let the child draw on a touchscreen interface.
- Capture, normalize, and evaluate the drawing using CNN confidence scoring.
- Adjust learning dynamically, reinforcing weak areas and guiding mastery

UI



THANK  
YOU