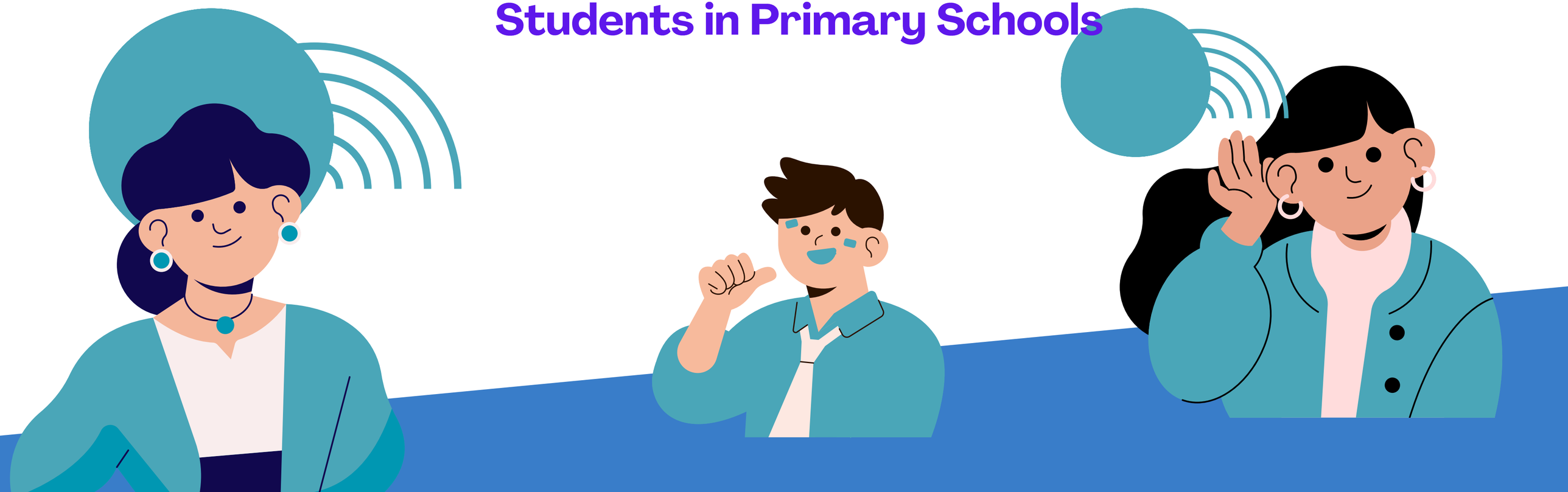
24/25J-338

SIGN MATH

Application to Teach Mathematics for Hearing-Impaired Students in Primary Schools



Presentation Outline

1. Project Overview

2. Front-End Development

- Understanding the Research
- Our Process of UI/UX Design
- Information Architecture
- Wireframing
- User Interface Design
- Color Psychology
- Typography
- Layout Design
- Logo
- User Interface Design

3. Future works

4.Individual Process

Our Team

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SIGN MATH

What is **SignMath ?**

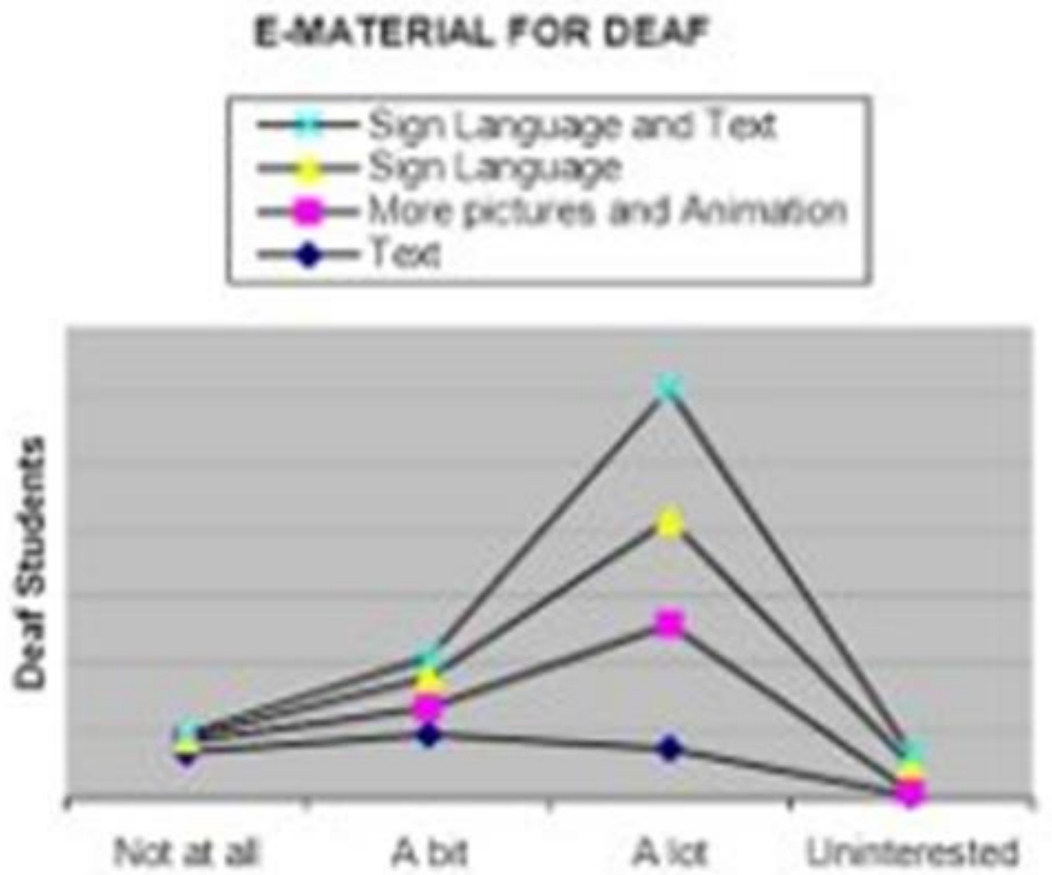
Introduction

- Mathematics education for deaf children in Sri Lanka faces significant challenges due to language barriers and limited literacy.
- The majority of deaf children rely on sign language for communication, making it difficult for them to connect written words and signs with Sinhala language.
- These challenges need to be addressed in primary education to provide equal opportunities for deaf children in mathematics learning.

Research Problem

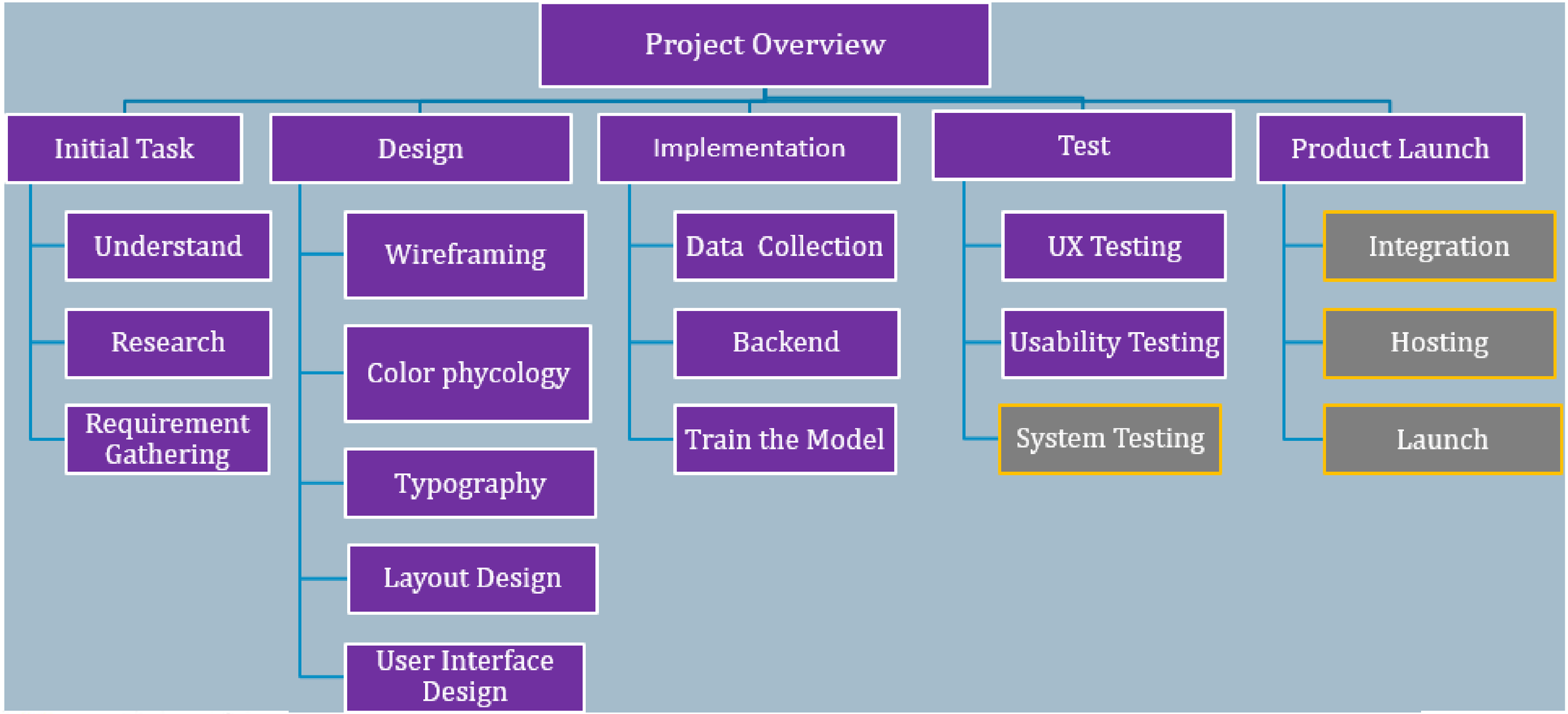
- There were 1.2% deaf students (Age1-14), approximately 5,390 registered deaf students in Sri Lanka as of the end of 2019
- 1/3 of sign language students tend to drop out of school during secondary education because they cannot pass main subjects like mathematics .
- The lack of understanding of the basic of Mathematical concepts
- Inability to express their knowledge and Emotions in the natural languages, especially in Sinhala.
- Teachers may not have the necessary training or resources to support deaf children in their mathematical education.

Research Problem



E-Material for Deaf Children

Project Overview



Research Paper

Congratulations! Your paper was accepted for oral presentation.

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MC Microsoft CMT <email@msr-cmt.org>
To: Praveen Deshan P.A it20184544
Fri 8/25/2023 2:43 AM

[EXTERNAL EMAIL] ***This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.***

Dear Praveen Deshan,

On behalf of the IISEC 2023 Program Committee, it is my pleasure to inform you that your paper "SignMath: Enhancing Mathematical Skills for Hearing-Impaired Students through Interactive Sign Language Learning ," has been accepted for Oral Presentation as a “Full Paper” in the 4TH International Informatics and Software Engineering Conference to be held on December 21-22, 2023. Please note that at least one author needs to be registered in order to publish the paper in the conference proceedings. Also, at least one of the authors is expected to present the paper either remotely or in person.

The reviews of your paper are provided at https://cmt3.research.microsoft.com/IISEC2023/ . Please address all suggestions and recommendations of the reviewers when preparing the final version of your paper.

1) Early-bird registration date is October 15, 2023, and late registration ends on November 15, 2023. The registration form can be located at: https://iisec.tbdakademi.org.tr/register/form.php

After you register, you should see the total amount that needs to be paid for the conference. Please submit that amount via one of the options given at the end of the registration page.

2) Please visit https://iisec.tbdakademi.org.tr/2023/https-iisec-tbdakademi-org-tr-2023-wp-content-uploads-2023-07-iisec-2023-template-of-paper-with-the-catalog-number-docx for the details about the copyright notice that needs to be added to the first page of your paper and the process for the pdf eXpress check. The conference ID for pdf eXpress is 59749X. You can upload the camera-ready versions again from https://cmt3.research.microsoft.com/IISEC2023/. Please use the "Create Camera Ready Submission" link to submit the camera-ready version of the paper. The deadline to upload your paper's final camera-ready version is October 30, 2023.

3) IEEE requires copyright information submitted for every paper published in the proceedings. Once all the camera-ready papers are submitted and registrations are completed, you'll be receiving an individual link from the IEEE containing instructions about how to submit the copyright form. Please watch out for that email coming in the first ten days of November 2023.

We are looking forward to either a virtual or in-person meeting in December. Should you have any questions, please contact to conference chair at conference.iisec@gmail.com .
Thank you again for your interest and contribution to IISEC 2023.

IISEC 2023 Organizing Committee
conference.iisec@gmail.com

4th International Informatics and Software Engineering Conference (IISEC)

Overall Progress

- Data Collection
- Back End
- Model Training
- Front End

UI/UX Design

- Software Quality Testing
- Launch Product

FRONT END DEVELOPMENT

Understanding Research Area

We went to visit Ratmalana deaf school in order to gather onsite information and also went to Pizza Hut New Branch (Thimbirigasyaya) and National Institute of Education (NIE) for gather details about teaching & learning practical's.

Participated in some lessons and got to know about problems ,the hearing impaired students face.

Students hearing disabilities are unique and teachers has to employ different methods to teach them.

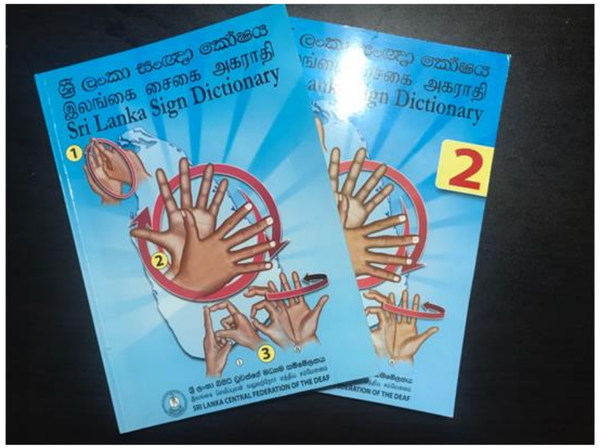
Each student is on their unique learning curve.

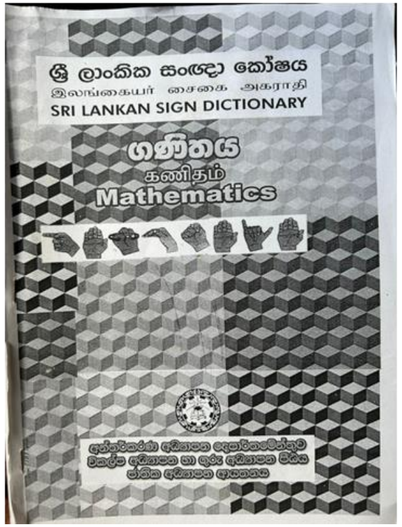
Understanding Research Area

The School for the deaf (Rathmalana)

Understanding Research Area

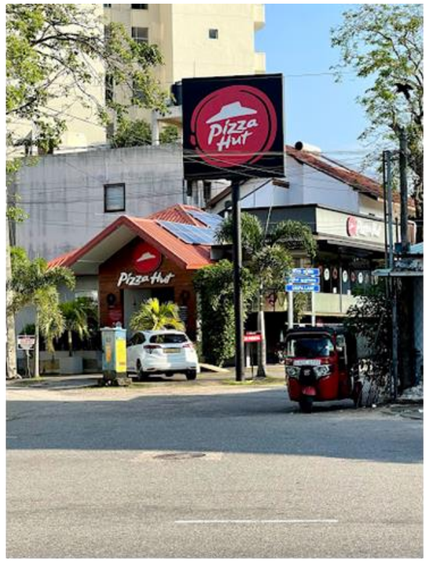
National Institute of Education (NIE – Maharagama)





Understanding Research Area

Pizza Hut New Branch (Thimbirigasyaya)



Our Process of UI/UX Design

UNDERSTAND & RESEARCH

Listen to stakeholders & understand business objectives and requirements and do detailed research on the subject & existing apps

INFORMATION ARCHITECTURE

Construct a point of view based on customers needs and insights. Create a flowchart or a roadmap to broad app functionality

WIREFRAMING

Brainstorming many possible solutions with sketches followed by wireframes

UX TESTING

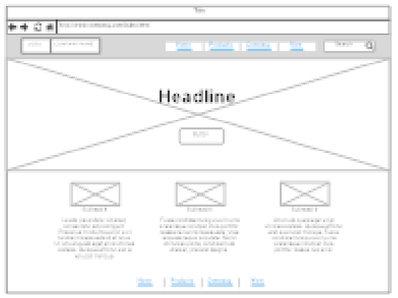
Create an interactive functional prototype of the wireframe to see if the planned functionality works effectively

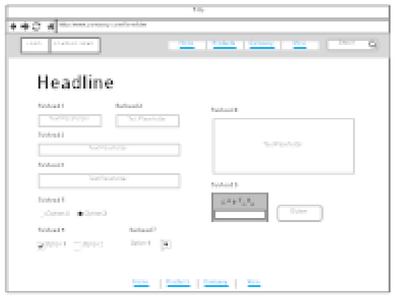
USER INTERFACE DESIGN

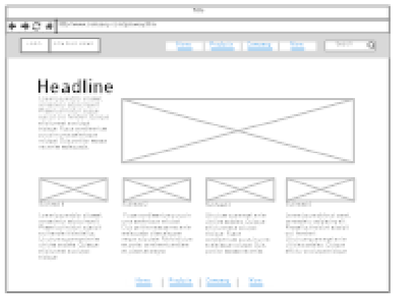
Final layout design, visual asset creation including colors, icons and illustrations

Wireframing

produced wireframes using Sketch before front-end implementation.



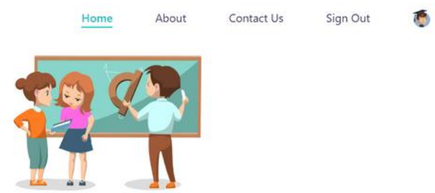




Colour Psychology

Researchers have identified some colors which are effective while l children's learning process(Yellow purple red light blue)

Which greatly enhances students' receptivity and memory improvement

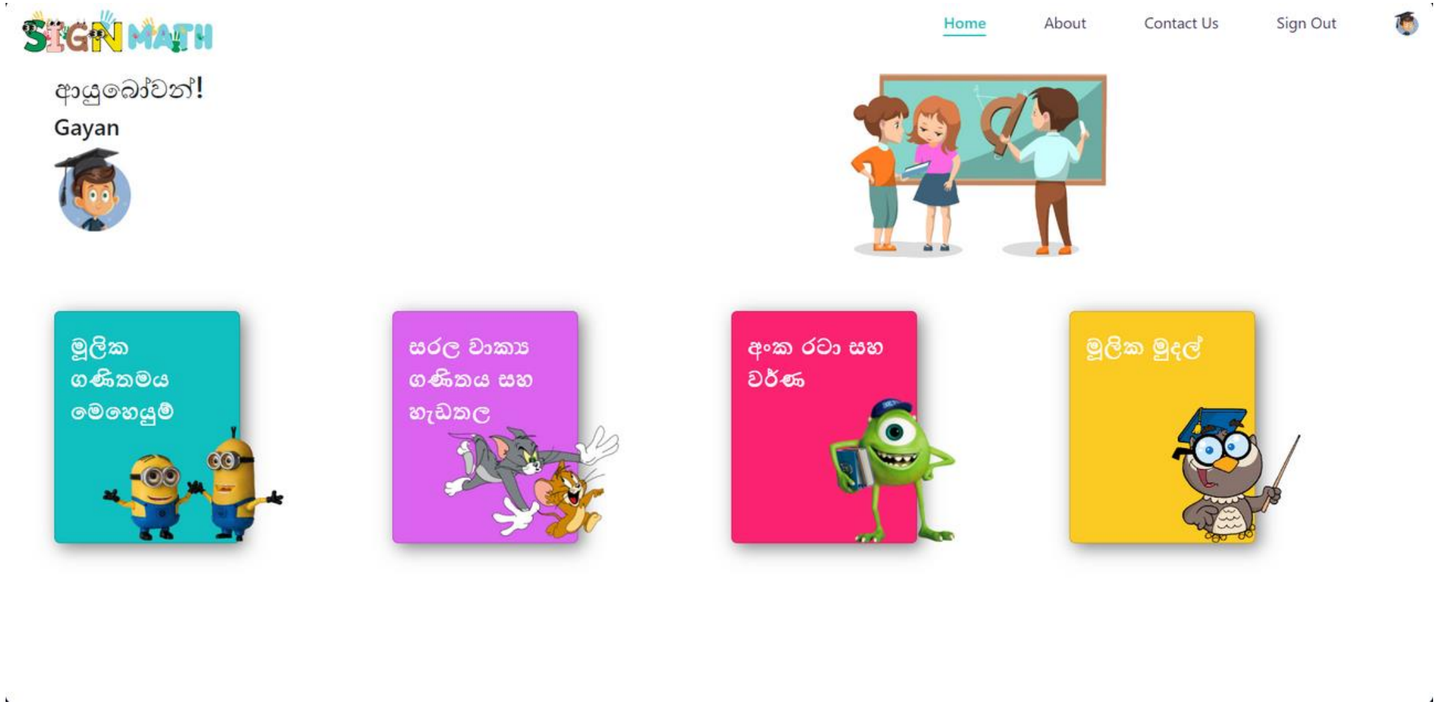


- We have chosen light blue for our Website theme, after getting ideas from the students and teachers.

https://www.sciencedirect.com/science/article/pii/S1057740819302681
https://link.springer.com/article/10.1007/s12144-019-00376-9

Why Light Blue ?

- Calmness and Focus
- Creativity and Imagination
- Stress Reduction
- Cleanliness and Organization



In conclusion, purple is a suitable color for children's e-learning platforms because it stimulates creativity, enhances focus and concentration, is associated with knowledge, and appeals to both genders.

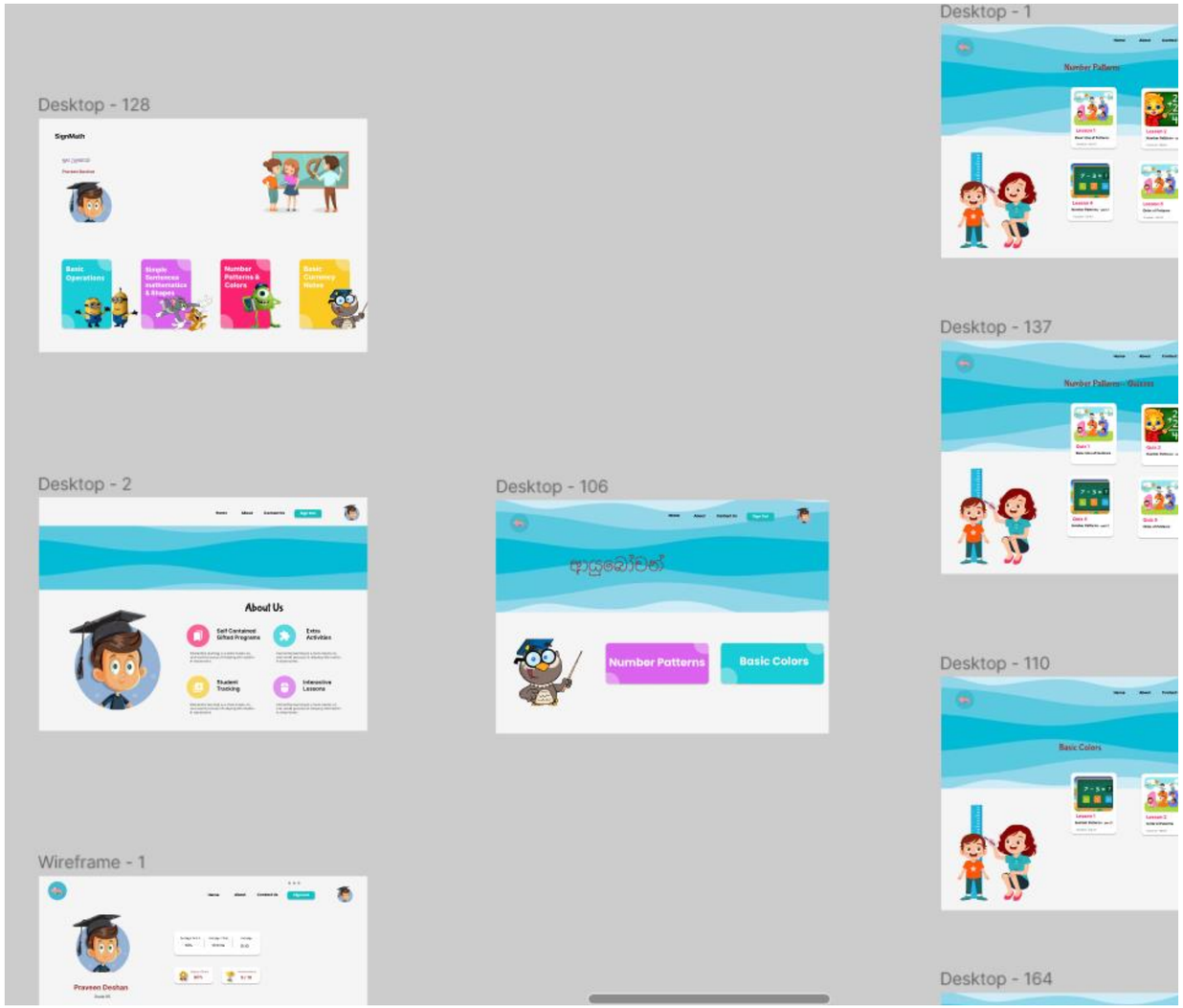
LOGO

29 Students

5 Students

User Interface Design

Figma is used to design user interfaces before bulding the last solution



Implimented Models

We have implemented 4 models in order to identify sign language input

- Model for recognizing Signs of Numbers
- Model for identifying Signs of Basic Shapes
- Model for identifying Signs of Currency Notes
- Model for identifying Signs of Basic Colors

Technologies used

- Keras(implement neural networks)
- Google Colab(Training the model)
- Python(model)
- Open CV(image processing)
- Firebase(online data-base)

- React(responsive)

Future Works

- User Interface Modification
- System Integration
- Usability Testing
- System Testing

Individual Progress

Dissanayaka D. M. S. M
IT22325228

Designing a Novel Interactive Learning Environment for Enhancing Learning Experience through Shapes Comprehension

SLIIT
FACULTY OF COMPUTING

Introduction

- Majority of Sri Lankan's mother language is **Sinhala** and most of Sri Lankan kids struggles with understanding of combination of signs.

- Teaching shapes to Deaf and Mute Students is challenging due to the lack of interaction and inclusive learning tools. This research focuses on designing a novel e-learning environment that combines

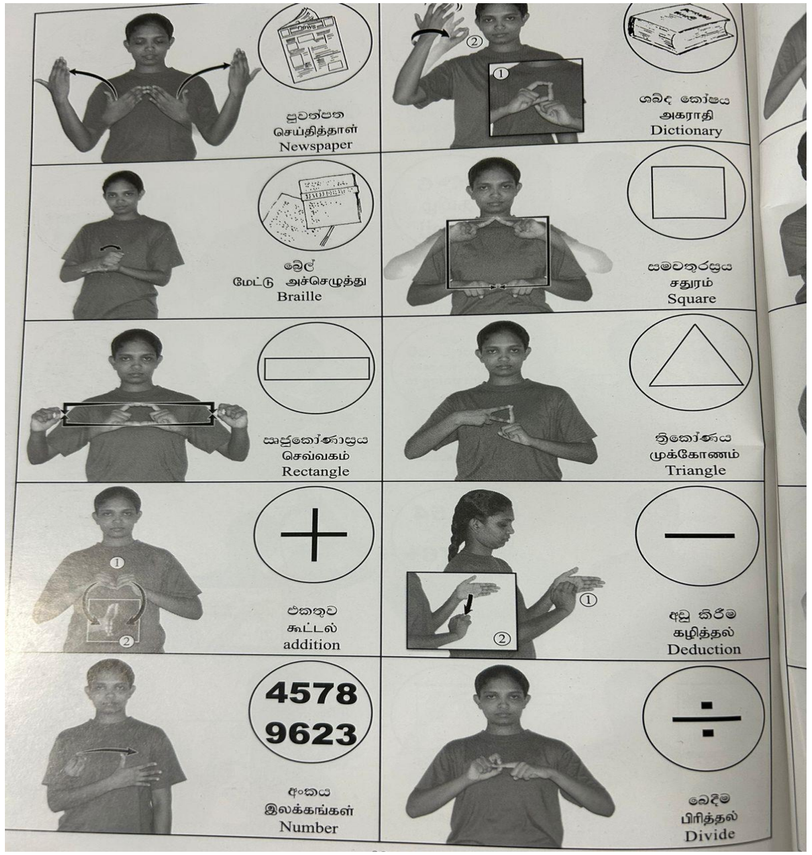
  Sign Language,

  Visual Aids to enhance shape comprehension.

- The aim is to create an attractive **Sinhala usage platform** that will help these students in more effective and independent learning shapes.

Background

- The two types of signs in teaching shapes for deaf and mute students are:
    - Static Signs
    - Dynamic Signs



Research Problem

Problem:

How can an active learning environment be created through Sinhala Platform (Sinhala Language) to improve shape comprehension for deaf and dumb students through sign language, visual aids and interactive features???

Answer:

To address this problem, an innovative learning platform will be developed that integrates:

1. Sign Language Integration
2. Visual and Interactive Features
3. Personalized Learning
4. Continuous Practice Tools

Objective

Main Objectives:

Implement a system that Enhancing Learning Experience through Assessment and Design Environment to Teaching Simple Sentence mathematics And simple Shapes.

- Create lesson plans and Teaching signs of simple Sentences math's.
- Image Pre-Processing and training the model, Creating a Dataset
- Training the model and Generating quizzes
- Checking students' physical demonstrations and answer evolution

Requirements

FUNCTIONAL REQUIREMENTS

- ✓ Sign Language Integration
- ✓ Word Identifying Quizzes
- ✓ Answer Evaluation & score

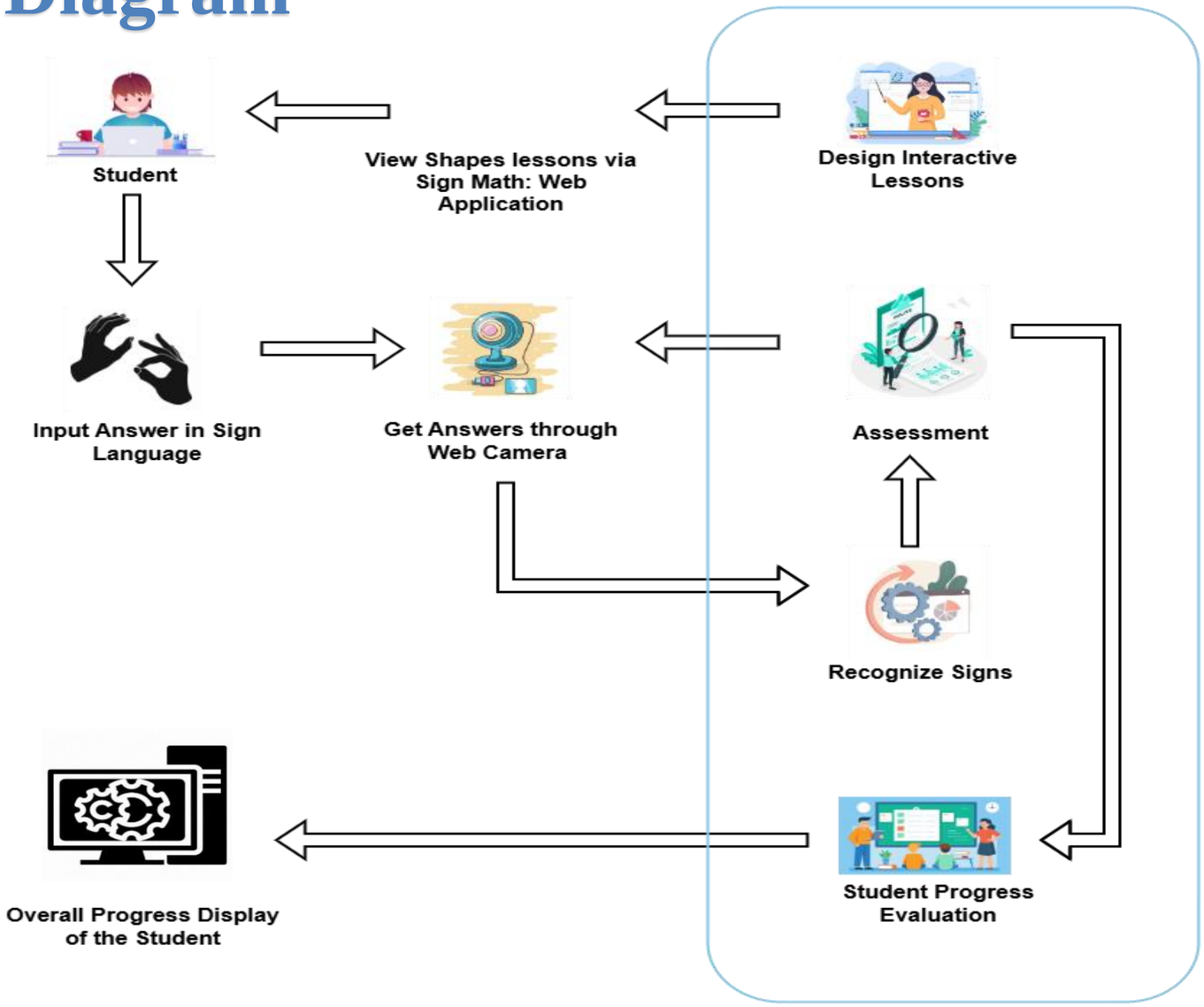
NON-FUNCTIONAL REQUIREMENTS

- ✓ Usability
- ✓ Reliability
- ✓ Portability
- ✓ Speed

USER REQUIREMENTS

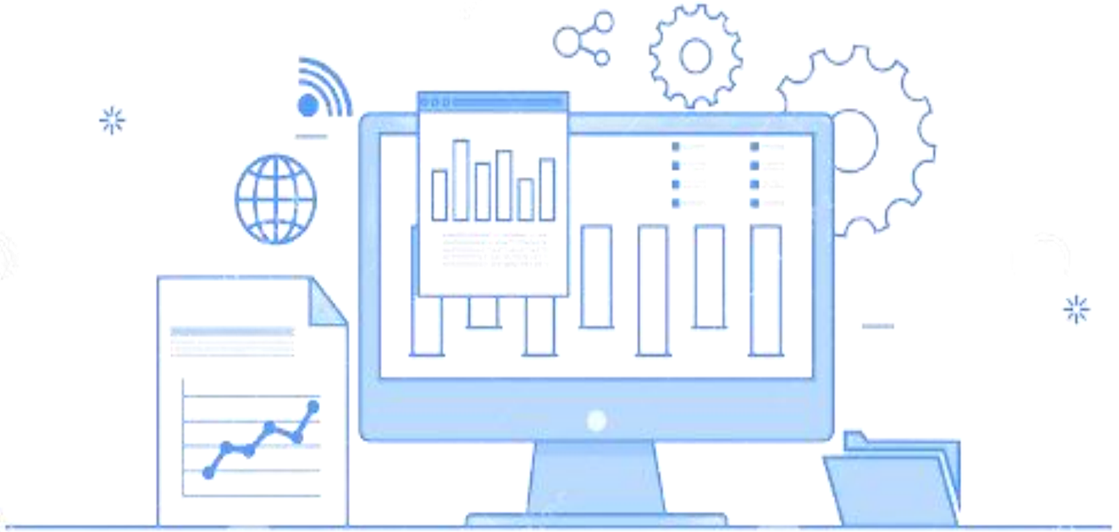
- ✓ Laptop
- ✓ Internet Connection
- ✓ Front Camera

System Overview Diagram



SUB-OBJECTIVIES COMPLETED

Image Pre-Processing and Training The Model



Data Set

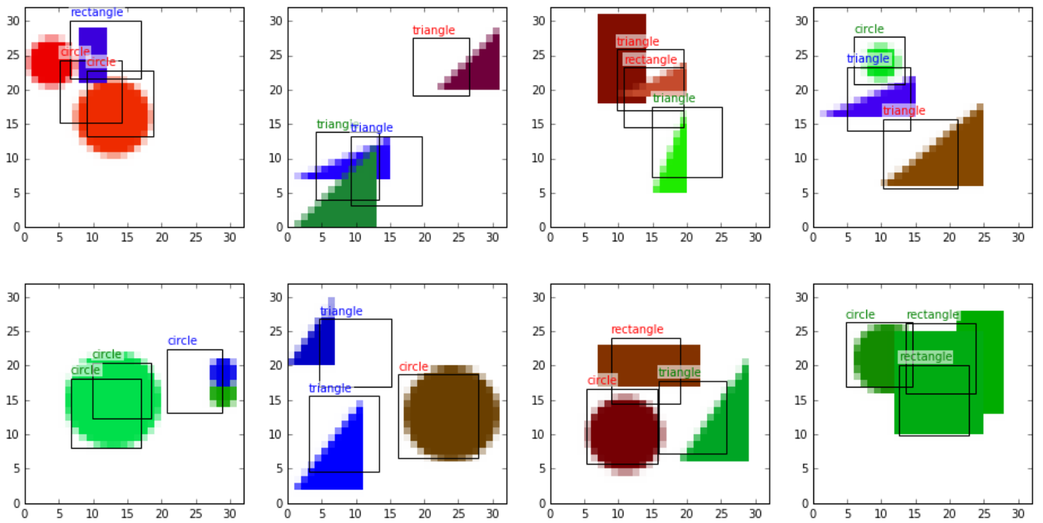
Created a Dataset with,

- Different backgrounds
- Hand signs from two persons
- Slight variations in the hand
- Close to 500 hundred images for one sign

Image Pre Processing

Without Pre Processing

- High fluctuation precision-recall graphs
- Less Map value
- Hight train and validation loss
- Without Gray scale



With Pre Processing

- Less fluctuation precision-recall graphs
- High Map value
- Less train and validation loss
- With Gray scale

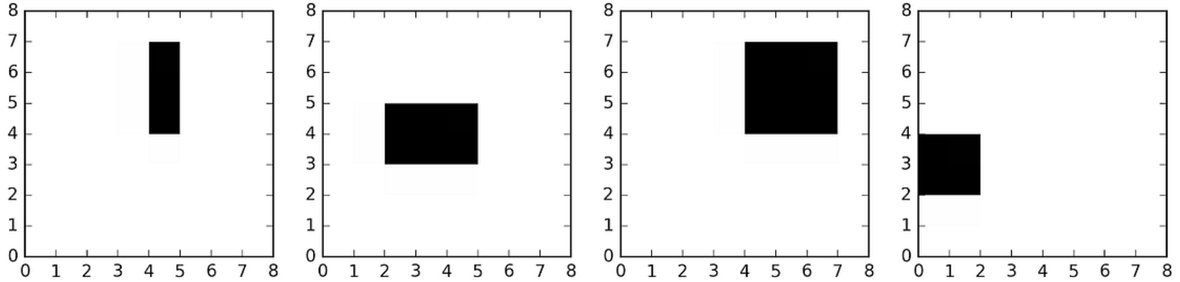
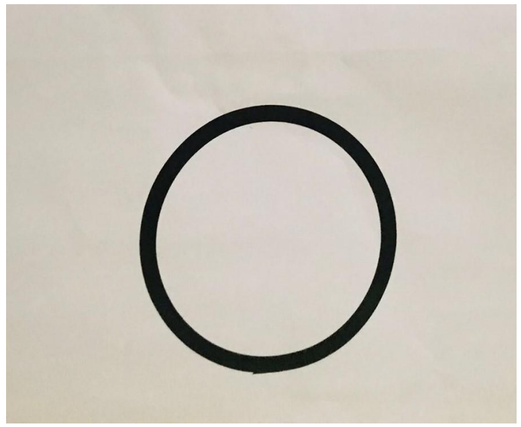
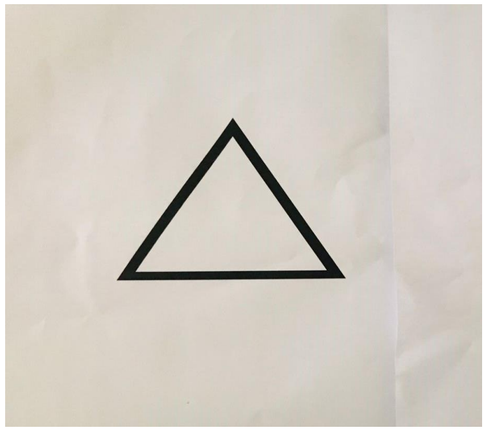
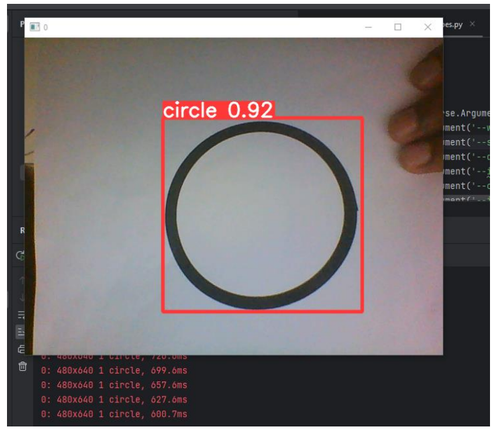


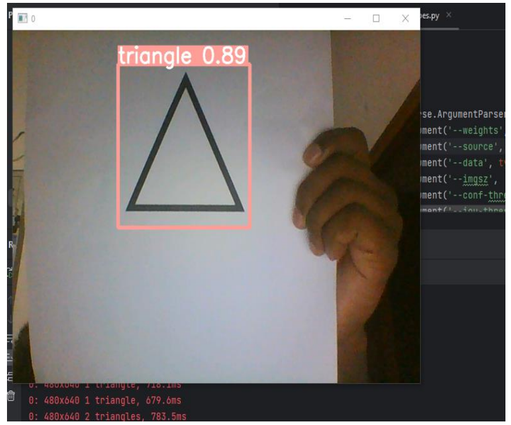
Image Pre Processing

+



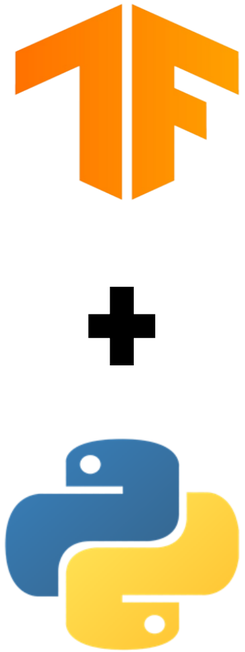






Model Training

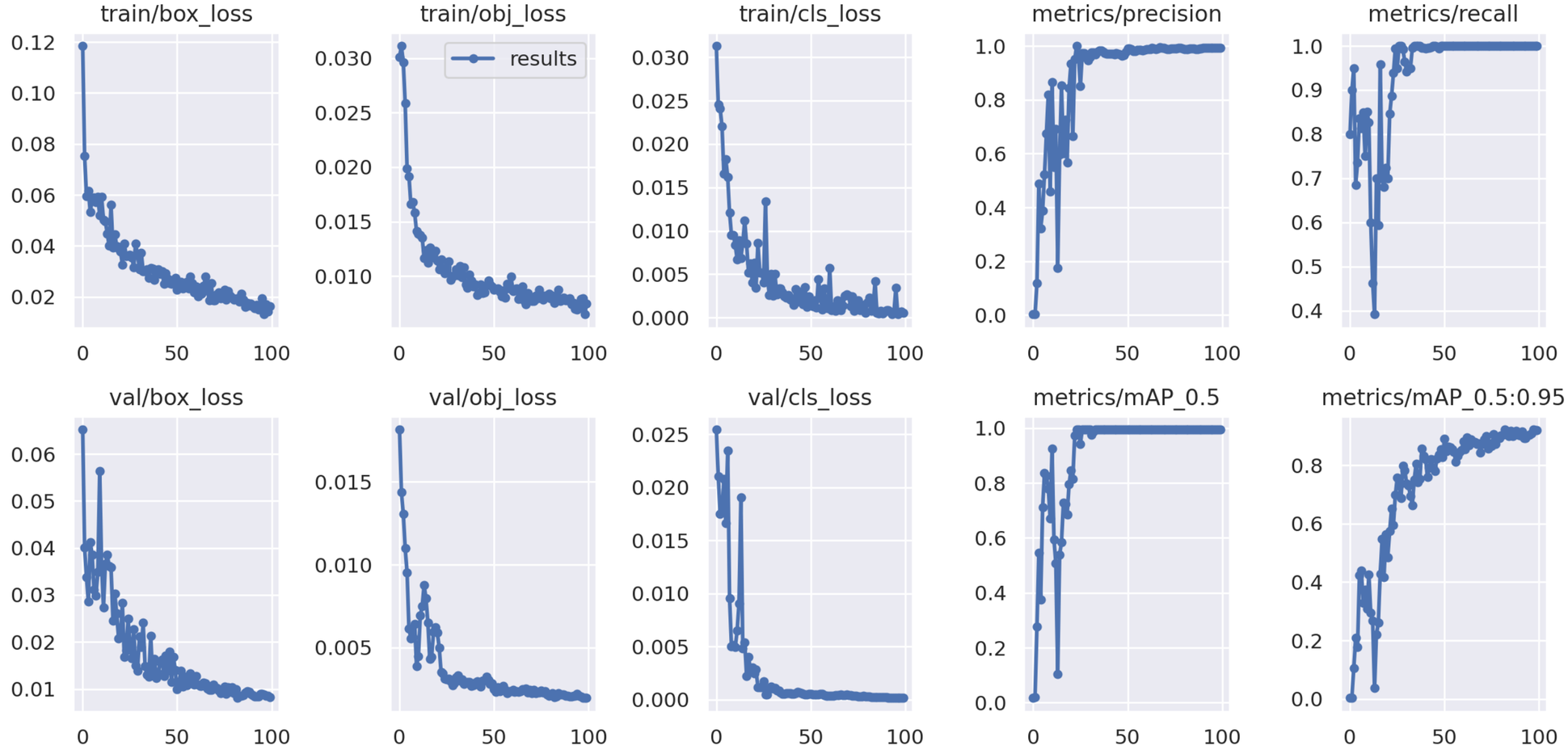
Model trained using Google Colab online tool



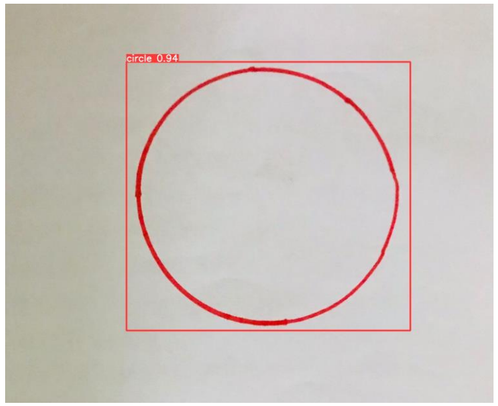
```
100 epochs completed in 0.096 hours.
Optimizer stripped from runs/train/exp/weights/last.pt, 14.4MB
Optimizer stripped from runs/train/exp/weights/best.pt, 14.4MB

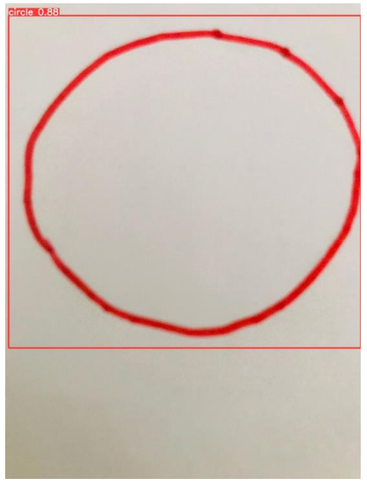
Validating runs/train/exp/weights/best.pt...
Fusing layers...
Model summary: 157 layers, 7015519 parameters, 0 gradients, 15.8 GFLOPs
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 1/1
                   all         20         20      0.988          1      0.995      0.922
                circle         20         10      0.981          1      0.995       0.96
              triangle         20         10      0.995          1      0.995      0.885
Results saved to runs/train/exp
```

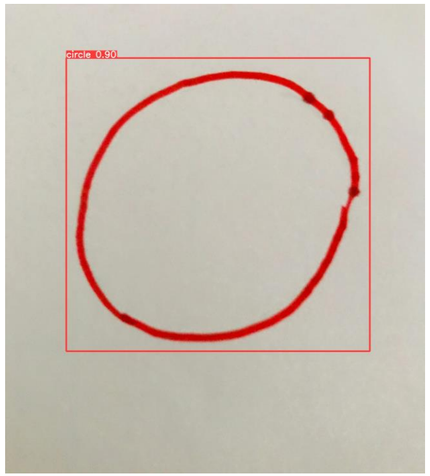
Model Training

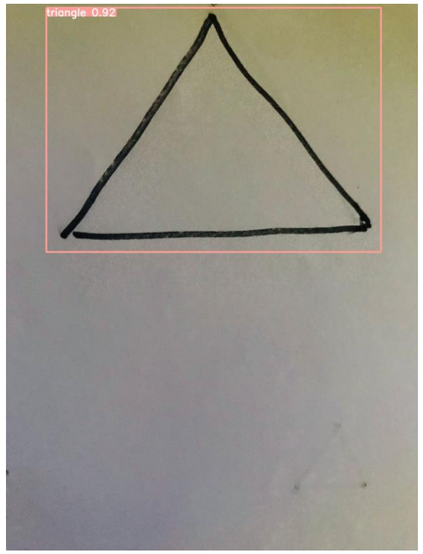


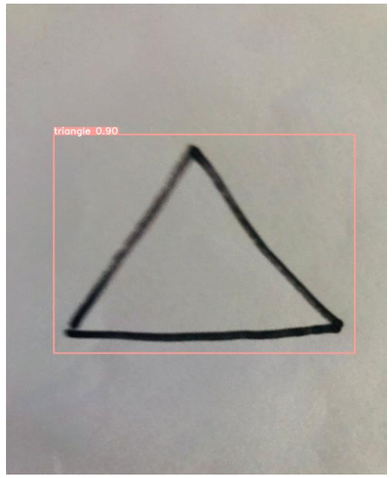
Test Data Accuracy











Progress up to now

- A New dataset was created for Shapes.
- Data were preprocessed
- Built and trained a model to identify signs.
- Implemented individual lessons for Shapes.
- Implemented Sign input Detection through the c
- Implemented responsive interfaces.

Future Works

- Improving the Accuracy for the model..
- Add more quizzes.

Demo

Weerarathne H.K.D.P.P
IT19203072

Teaching and Evaluating Numbers & Basic Mathematical Operations of Mathematic

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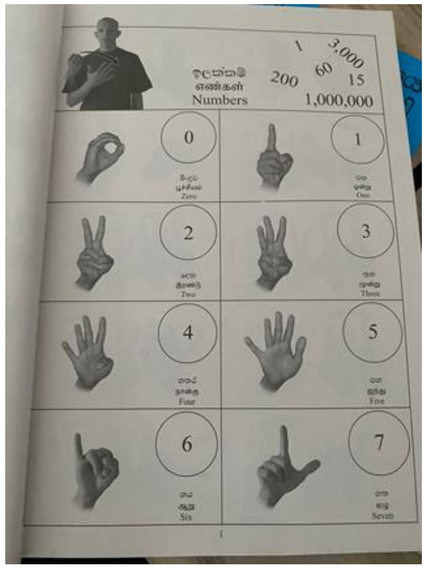
Background

Why Mathematical Basic Concepts Important to Deaf Children?

When teachers are teaching mathematics in a sign language classroom in the primary section they have to use several methods to teach .



- Draw the letter on the board.
- Show how to sign the letter using the hand.
- Show lip movement when the letter is pronounced.

Reserch Problem

Sign language Students in primary schools tend to forget the Mathematical Signs and concepts ,because they don't get a chance to revise their knowledge out side the classroom.

How can an interactive learning environment incorporating sign language, visual aids, and machine learning technologies be designed?

Can this novel approach improve the numeracy skills of deaf and mute children through a application?

Main Objective- Teach and Evaluate the Understanding of Numbers and Basic Mathematic Operations .

Sub Objectives-

- Creating interactive lessons to teach the Sinhala alphabet (images, animations, videos).
- Grading Student's knowledge using quizzes.
- Evaluating students' overall progress.
- Identify finger spelling through the camera,
  - Creating a Dataset
  - Building a separate model to Identify signed letters
  - Image pre-processing
  - Training the model
  - Hands segmentation and tracking
  - Feature extraction and classification

Requirements

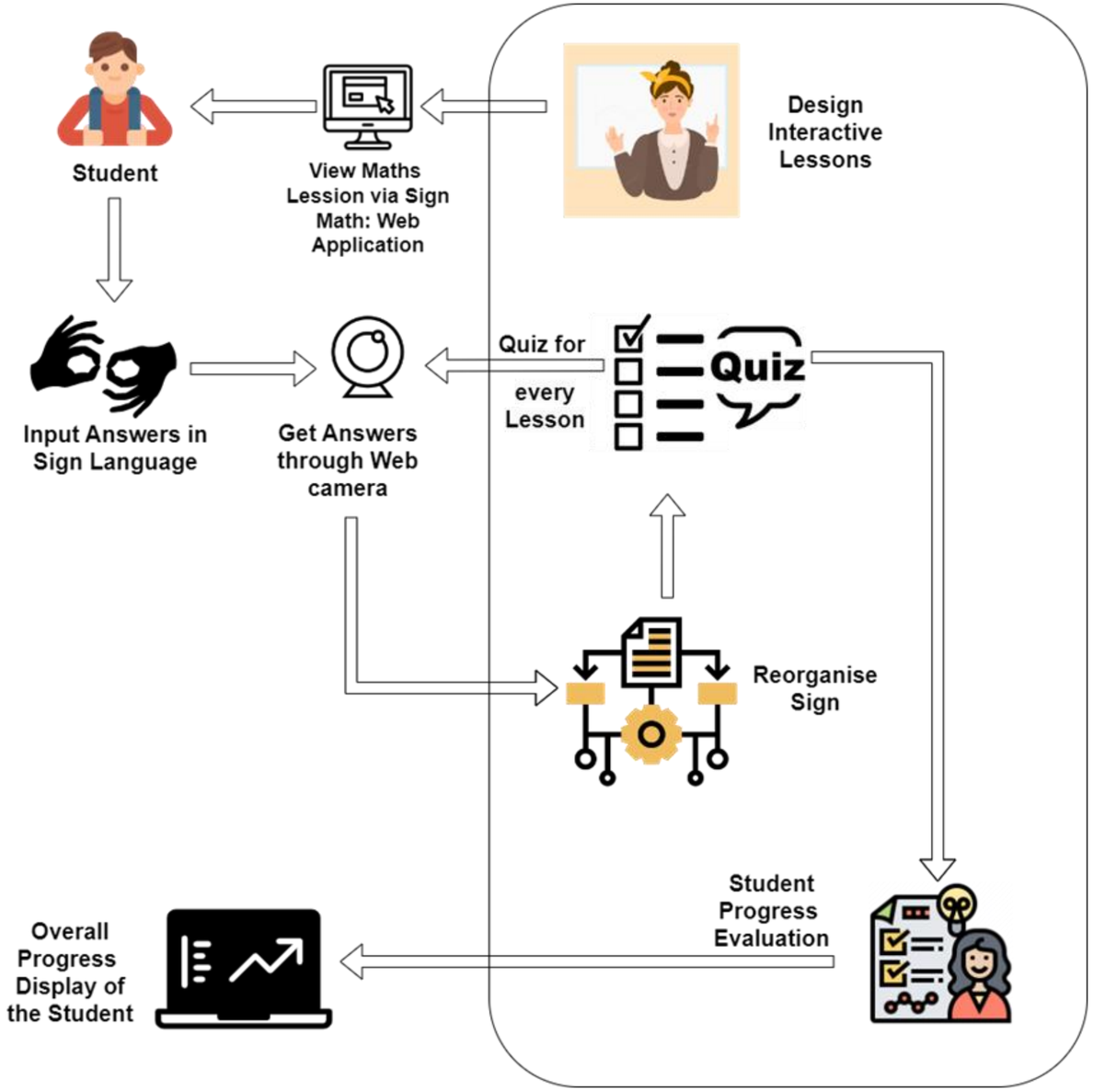
Functional

- View individual lessons
- Attempt a quiz and measure their knowledge
- Identify sign language input through the camera
- Quizzes should be graded
- Individual students' progress should be evaluated by quiz marks.

Non-Functional

- The interfaces should be user friendly for the primary students

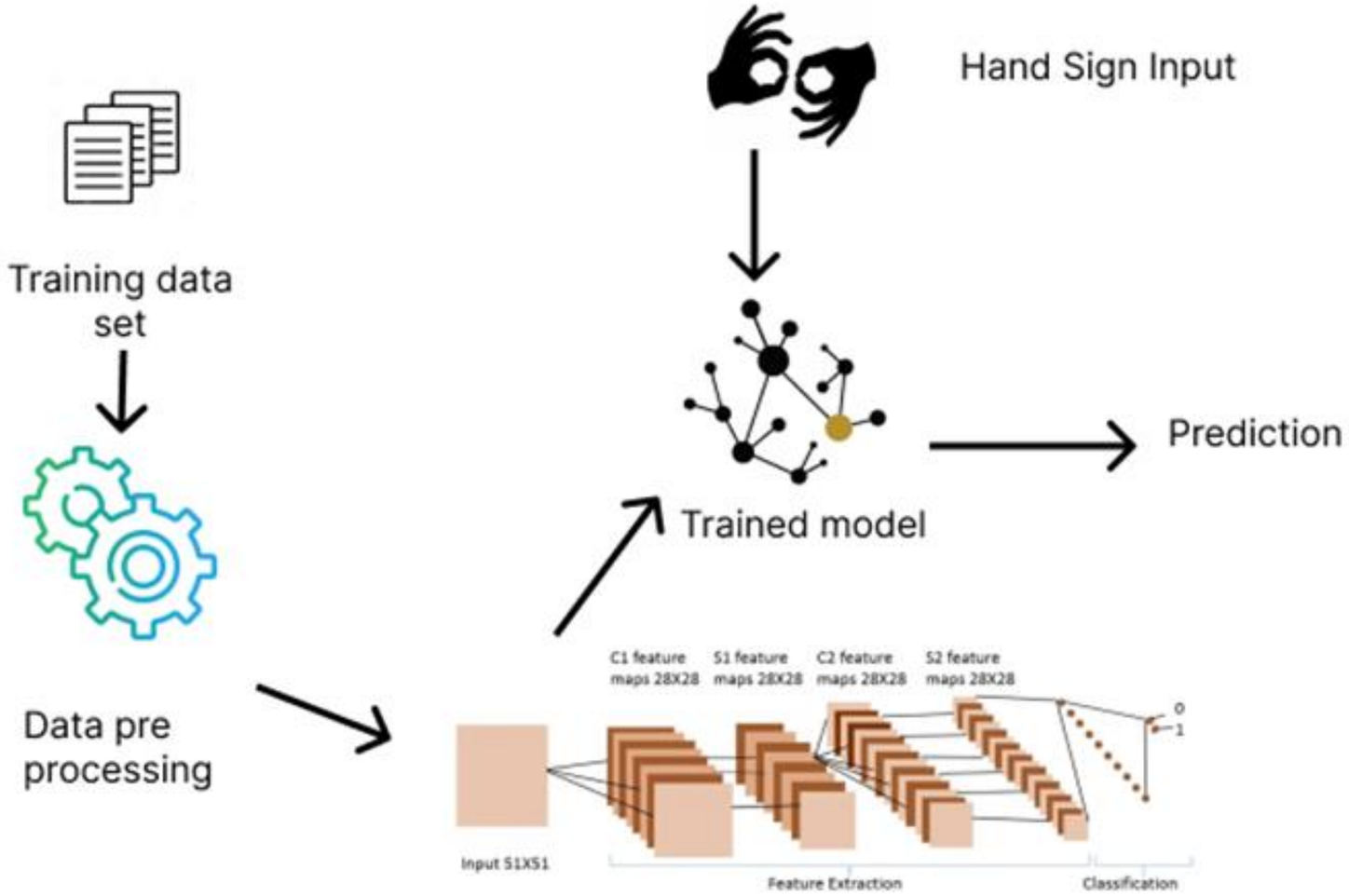
System Overview Diagram



Lesson interface

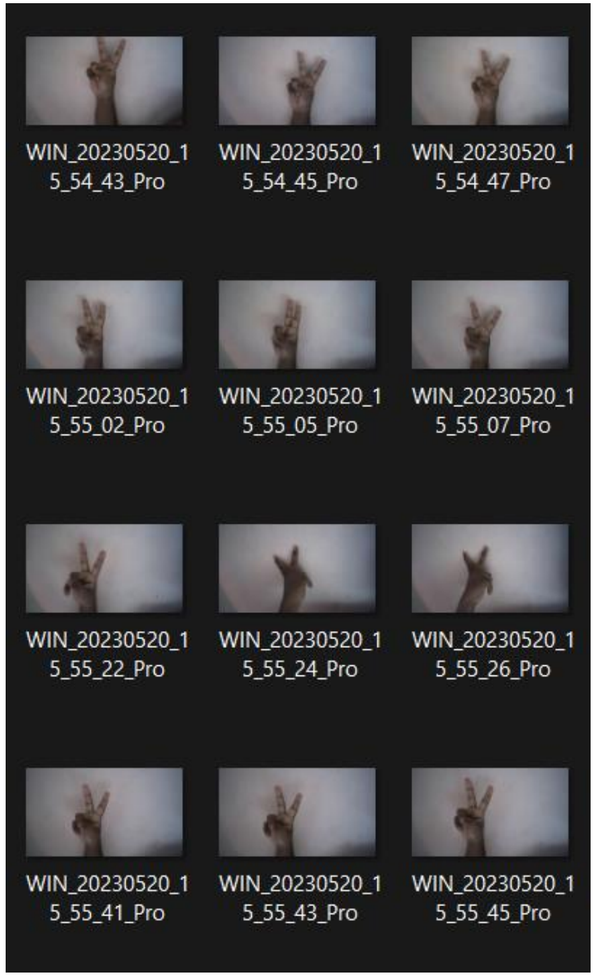
Quiz interface

How finger Spelling is identified



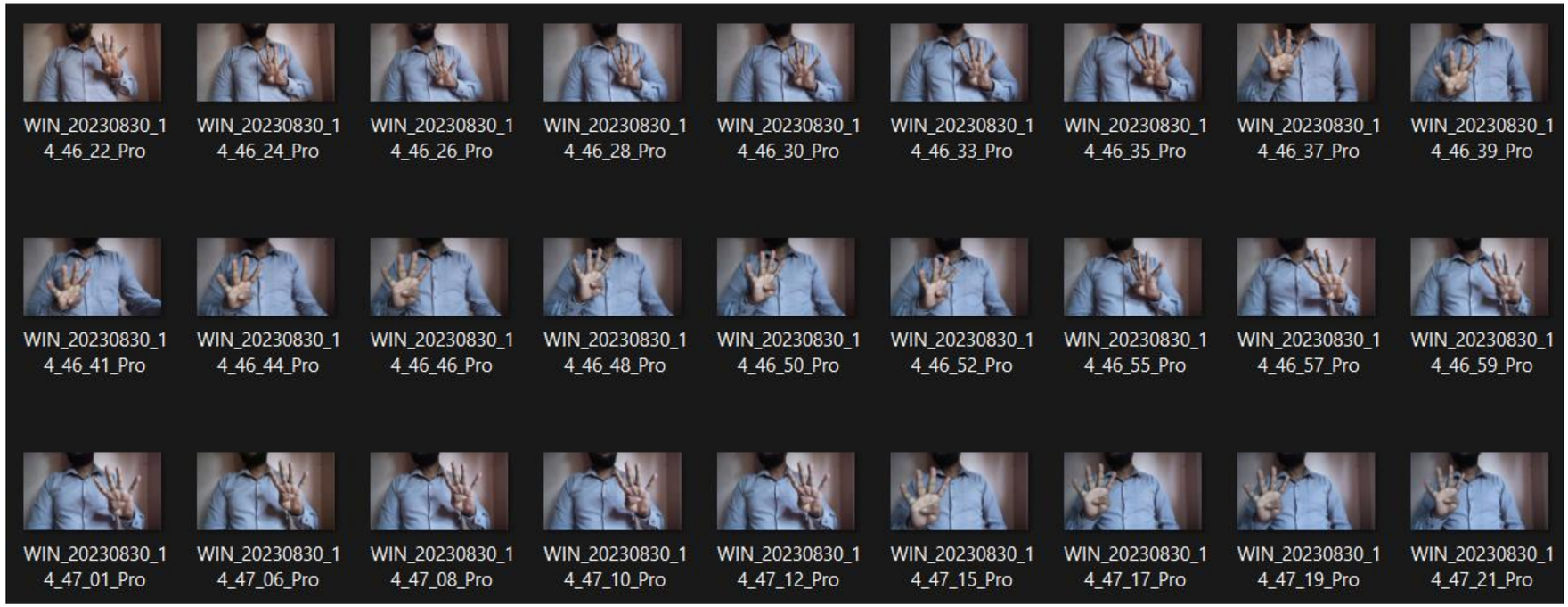
feature extraciton & Classification

Dataset



Created a Dataset for 9 Numbers with,

- Different backgrounds
- Hand signs from two persons
- Slight variations in the hand
- Close to 400 hundred images for one sign



Model training

- Google Co-Lab was used to train the model

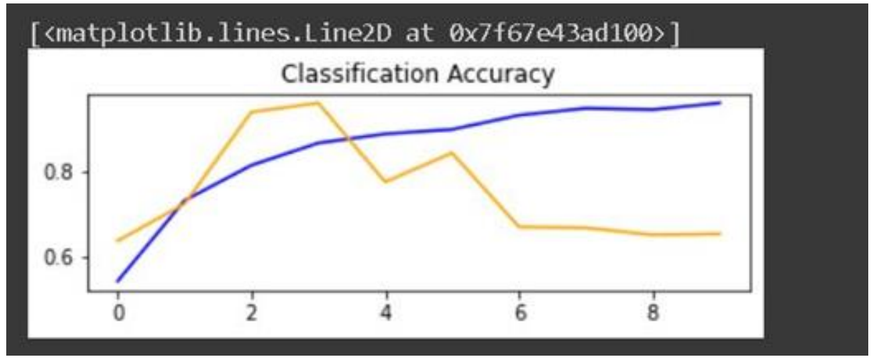
```
Found 180 images belonging to 3 classes.

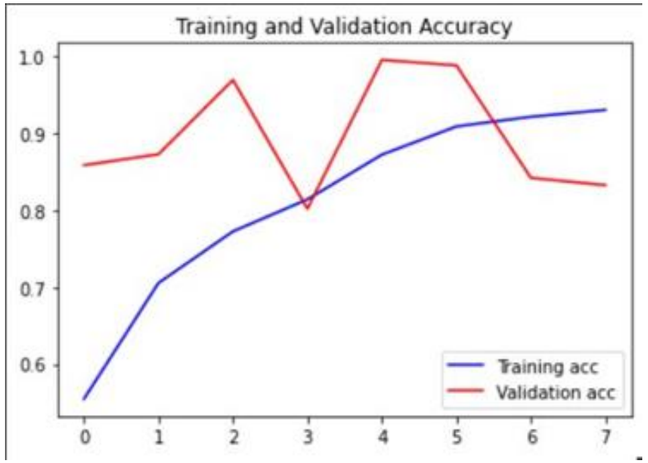
#with early_stoping
from tensorflow.keras.callbacks import EarlyStopping

early_stopping = EarlyStopping(monitor='val_loss', mode='min', patience=3, restore_best_weights=True)
history = model.fit(train_generator, epochs=10, steps_per_epoch=50,
                    validation_data=validation_generator, validation_steps=7, workers=4, callbacks=[early_stopping])

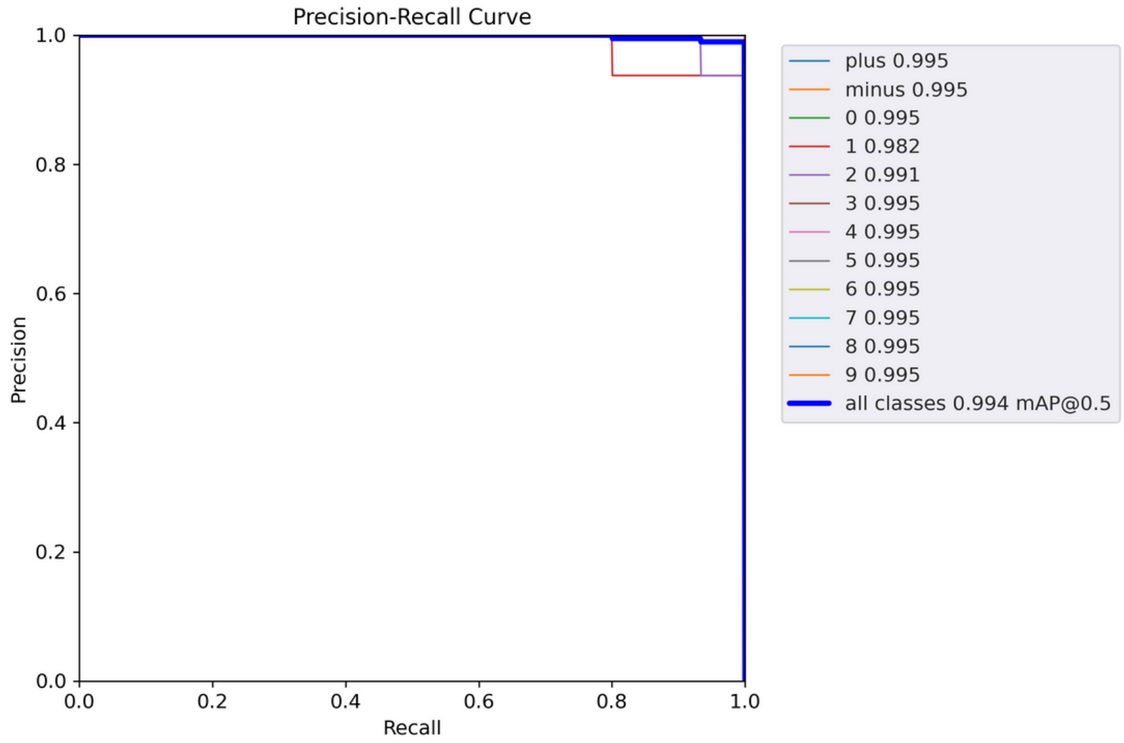
Epoch 1/10
50/50 [==============================] - 590s 12s/step - loss: 0.8782 - accuracy: 0.5548 - val_loss: 25.8435 - val_accuracy: 0.8585
Epoch 2/10
50/50 [==============================] - 498s 10s/step - loss: 0.6318 - accuracy: 0.7054 - val_loss: 14.1079 - val_accuracy: 0.8726
Epoch 3/10
50/50 [==============================] - 495s 9s/step - loss: 0.5090 - accuracy: 0.7725 - val_loss: 1.3641 - val_accuracy: 0.9693
Epoch 4/10
50/50 [==============================] - 494s 9s/step - loss: 0.4392 - accuracy: 0.8141 - val_loss: 19.0424 - val_accuracy: 0.8019
Epoch 5/10
50/50 [==============================] - 496s 9s/step - loss: 0.3233 - accuracy: 0.8722 - val_loss: 0.1368 - val_accuracy: 0.9953
Epoch 6/10
50/50 [==============================] - 495s 9s/step - loss: 0.2657 - accuracy: 0.9089 - val_loss: 1.7473 - val_accuracy: 0.9882
Epoch 7/10
50/50 [==============================] - 494s 9s/step - loss: 0.2229 - accuracy: 0.9214 - val_loss: 37.5841 - val_accuracy: 0.8420
Epoch 8/10
50/50 [==============================] - 493s 9s/step - loss: 0.2042 - accuracy: 0.9303 - val_loss: 54.5065 - val_accuracy: 0.8325

model.save_weights('signlangmodel_weights.h5')
model.save('signlangmodelacc.h5')
```

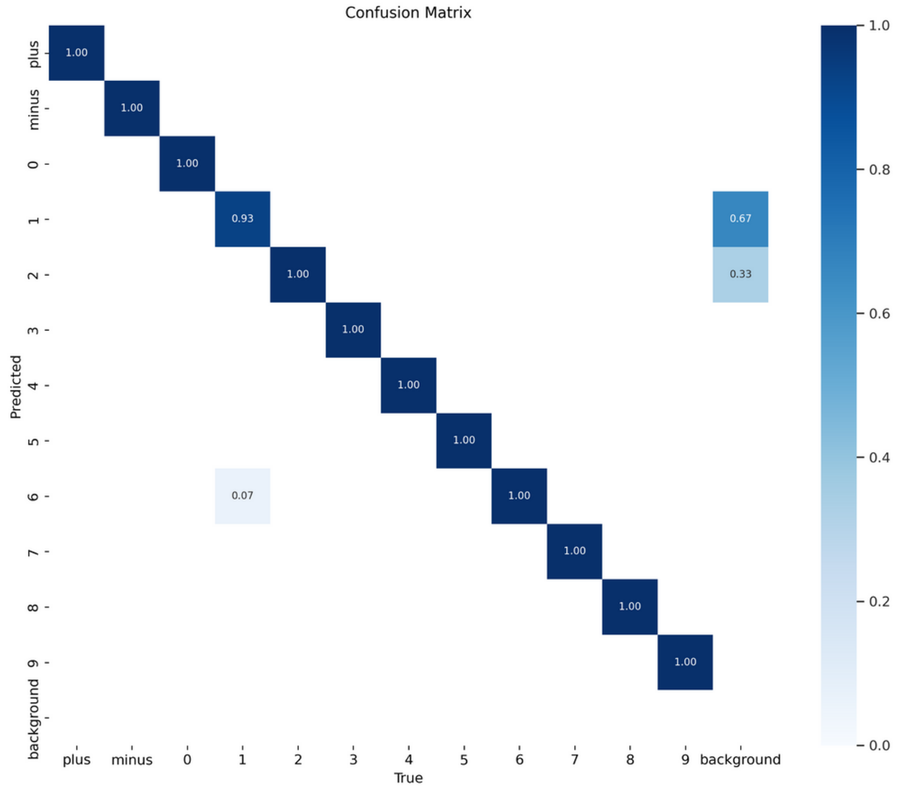




Test Data Accuracy

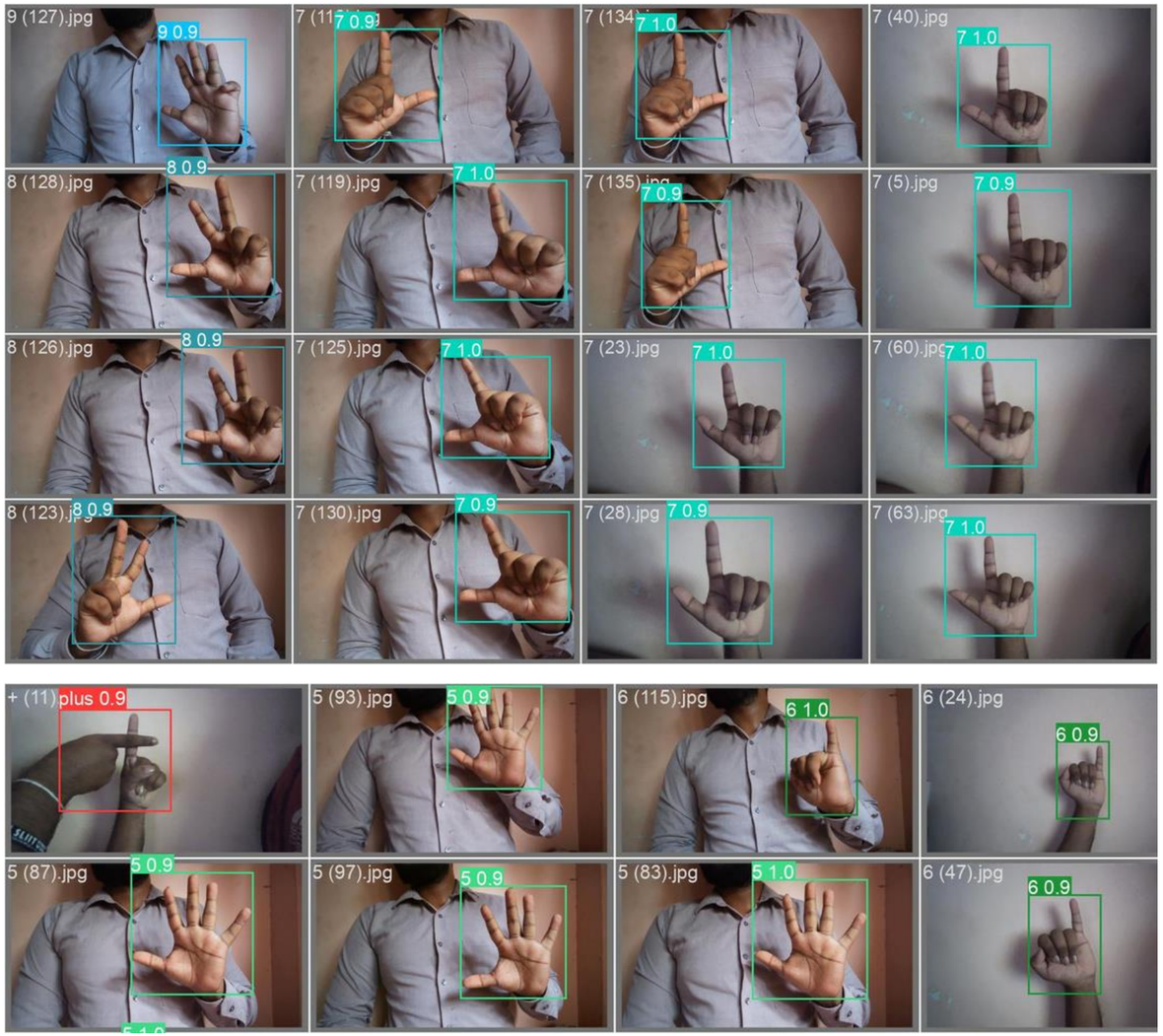


P-R Curve of Accuracy



Confusion Metrix

Test Data Accuracy



- Test data set has accuracy more than 90%
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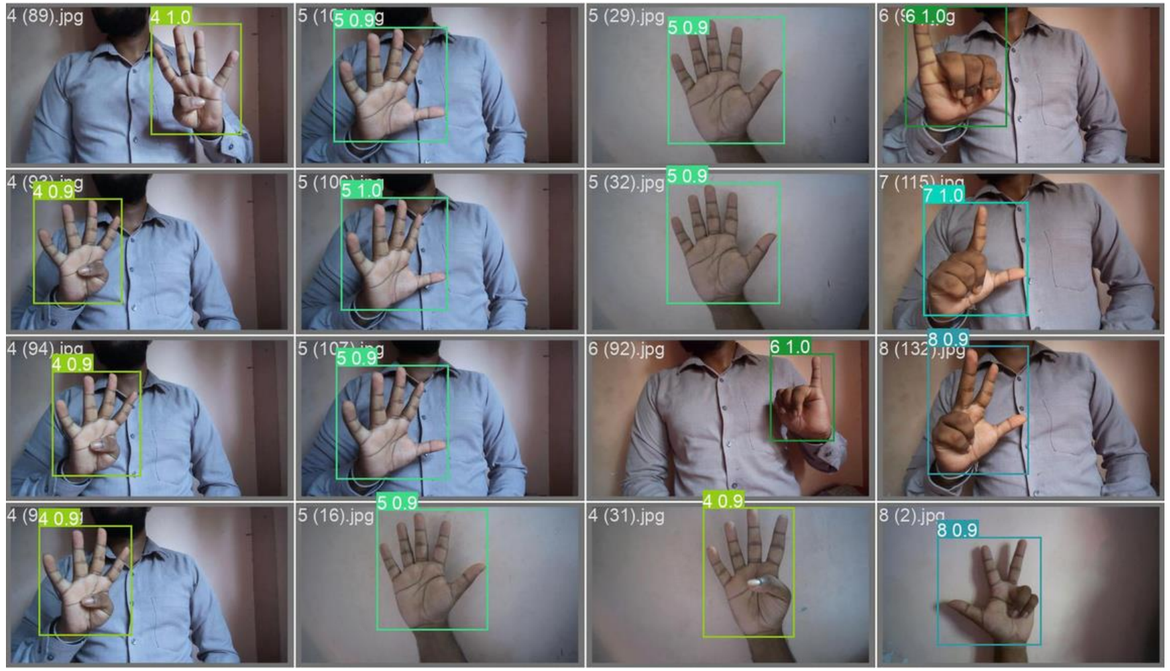
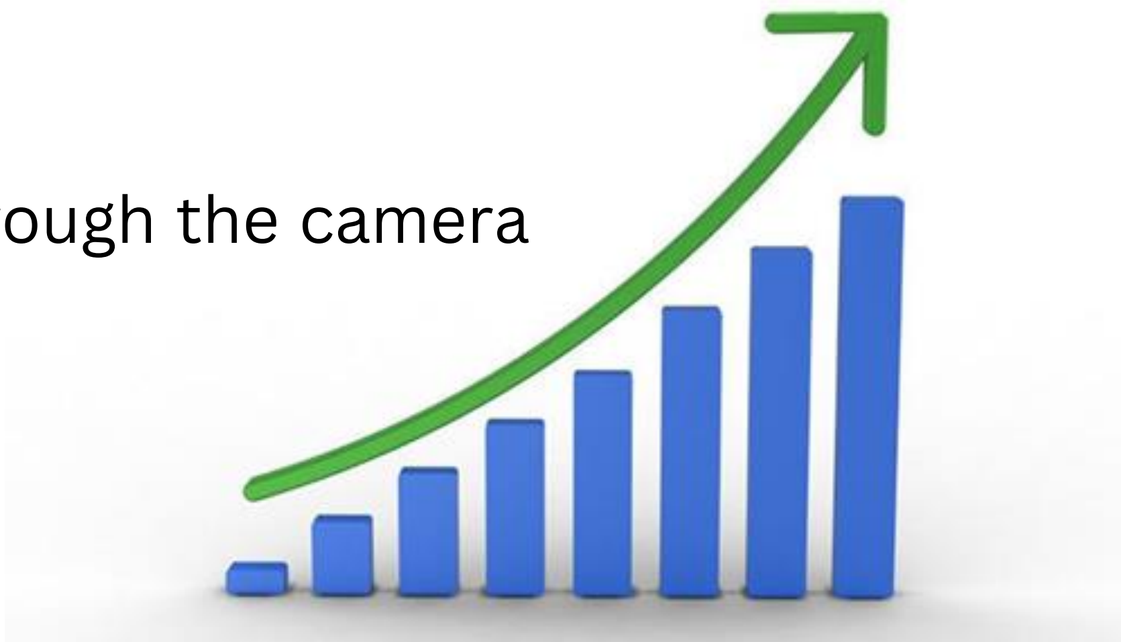


Progress up to now

- A New dataset was created for 10 Numbers in Sinhala Sign Language.
- Data were preprocessed
- Built and trained a model to identify signs.
- Implemeted individual lessons for Numbers and Operations.
- Created quizzes for each lesson
- Implemented Sign input Detection through the camera input.
- Implemented responsive interfaces.



Future Works

- Improving the accuracy of the model
- Add more quizzes and teaching lessons
- Develop the functionality for evaluating and storing the students progress

Demo

K R M KELANIYAGE
IT16057784

Designing an Interactive Learning Environment for Teaching Basic Currency Identification

SLIIT
FACULTY OF COMPUTING

Background

Why we need to teach currency notes and coins?

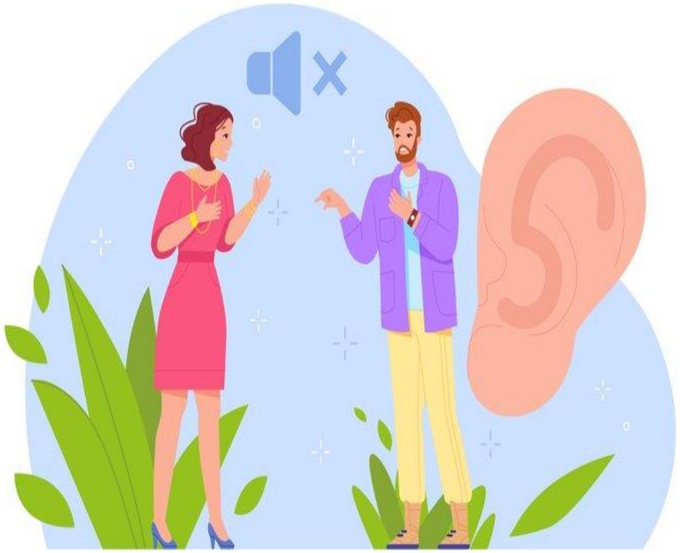
- Helps them to prepare for the real world
- Majority of children struggled with understanding the combinations of signs
- Teachers also struggled to teach them in school
- That it is good to give them an understanding of currencies at an early age.

Reserch Problem

- Teach combined signs with user-friendly interface

- Create Sign Videos with Sentences

Teachers can demonstrate create their difficult part with sign videos-so they don’t need to teach again and again



- Currency identifying Quizzes for related sign videos

- Currency identifying quizzes using Sinhala medium

Main Objective

Designing an Interactive Learning Environment for Teaching Basic Currency Identification.

Sub-Objective

- Teaching Sri Lanka Basic Currency notes and coins.
- Generate Quizzes, Showing Answers to the camera.
- Answer Evaluation & Correction.

Requirements

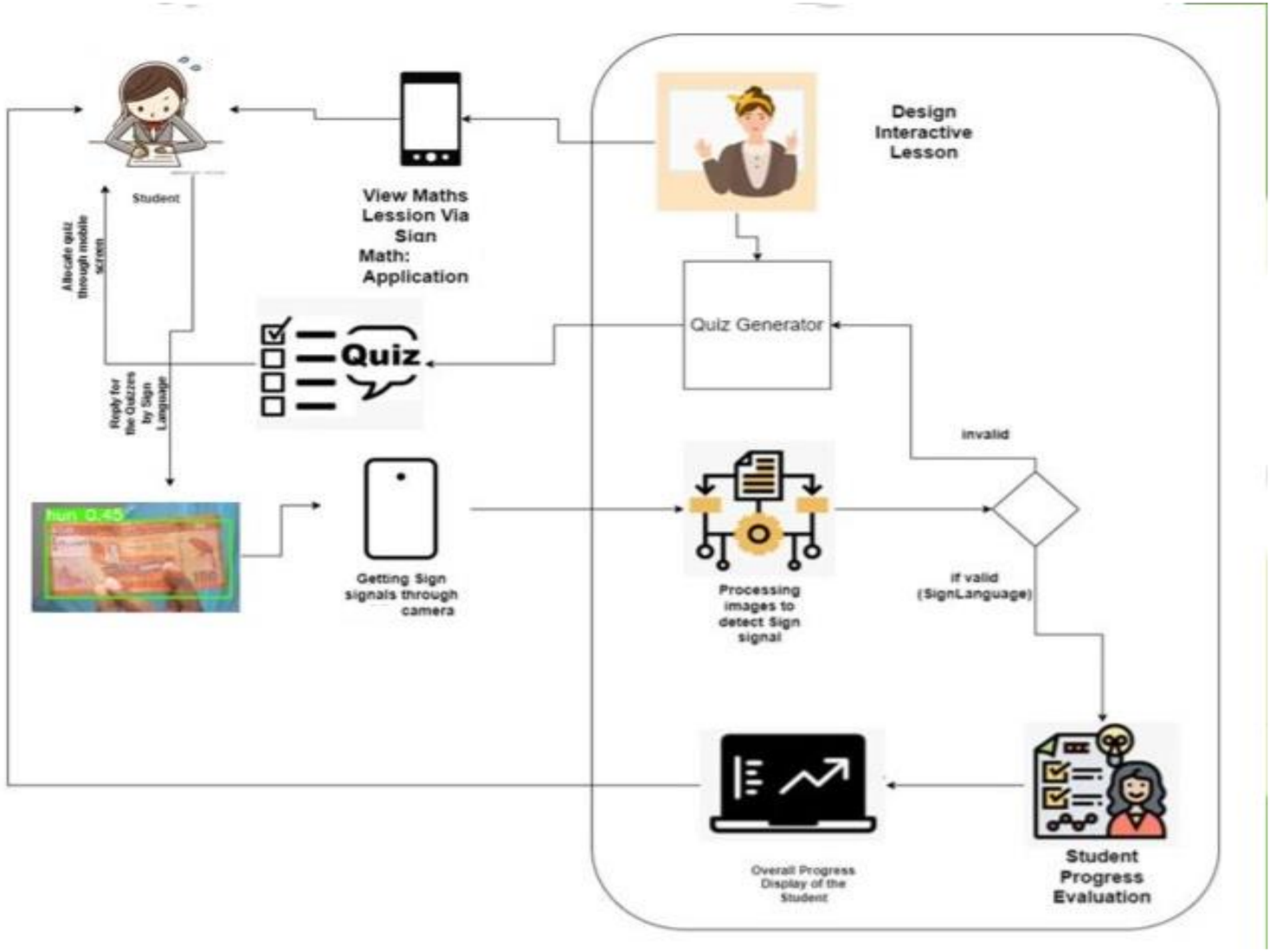
Functional

- Currency notes and coins teaching lessons
- Sentences Identifying Quizzes
- Show the correct answers
- Answer evaluation & score

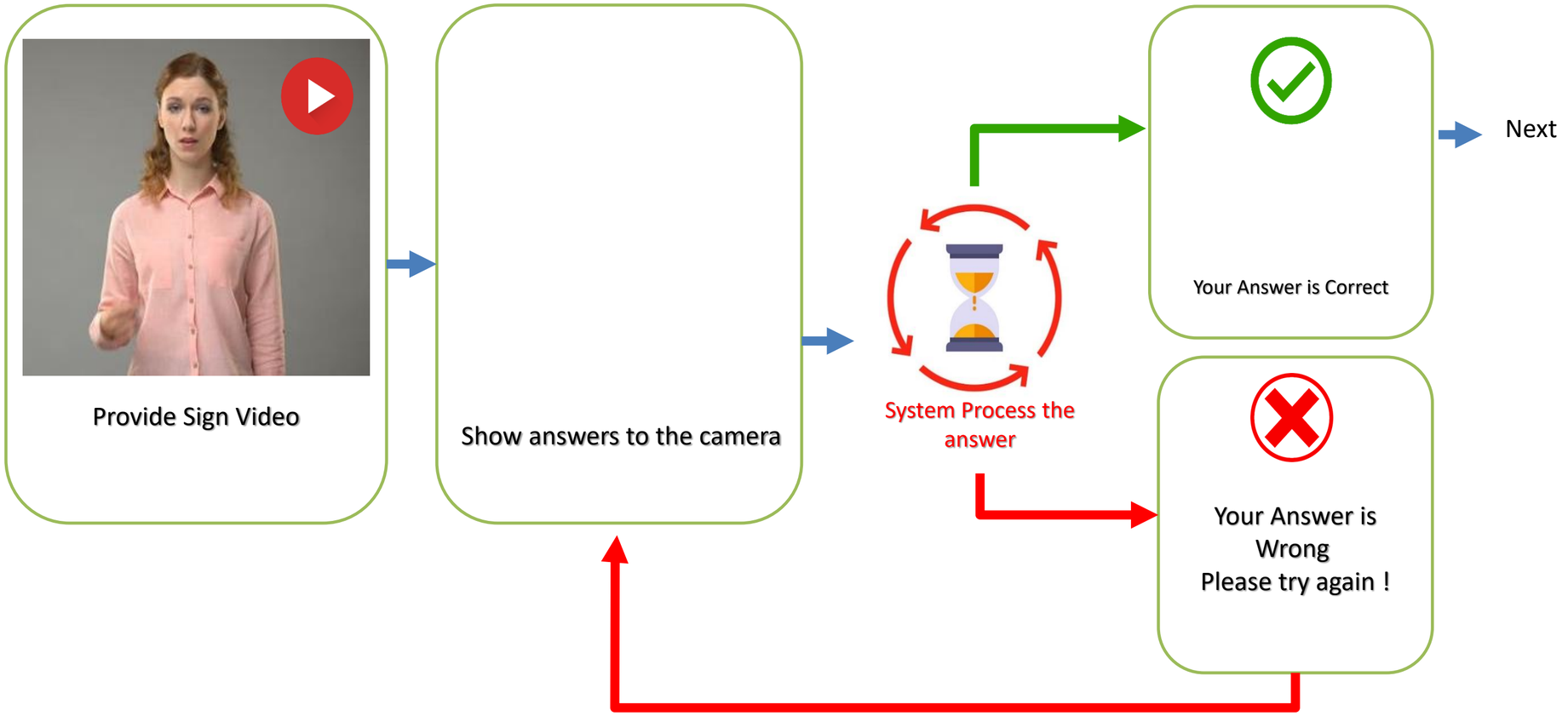
Non-Functional

- Usability

System Overview Diagram



Lesson interface



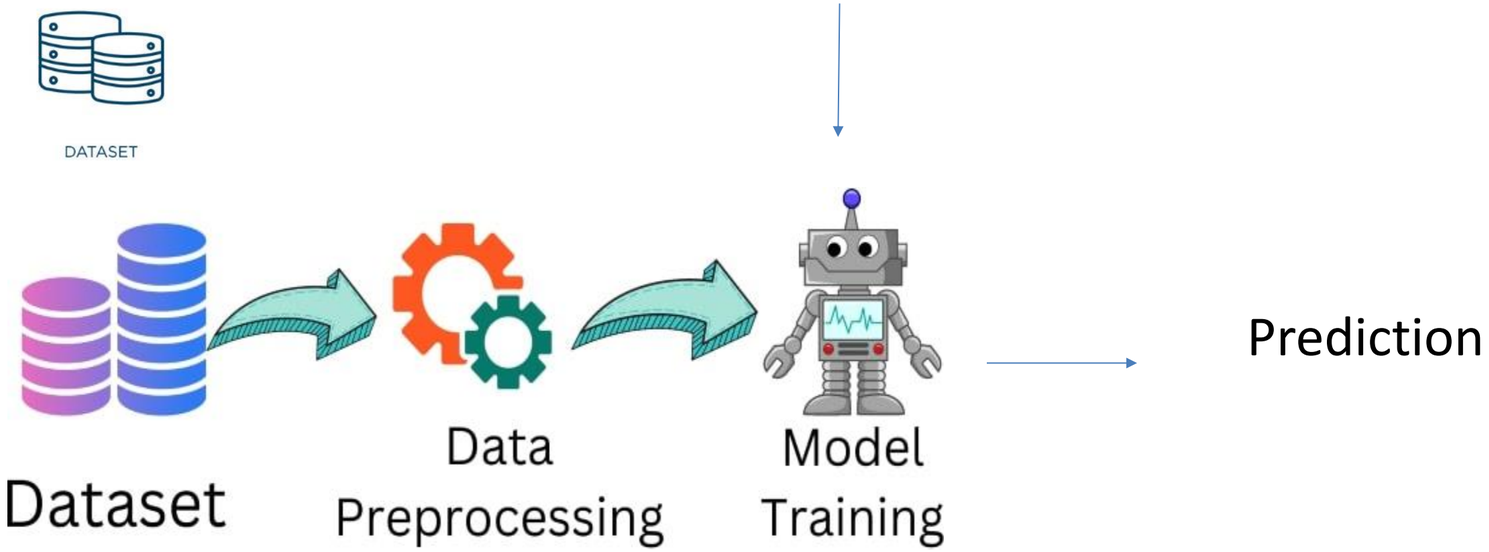
Quiz interface

රුපියල් 100 යි

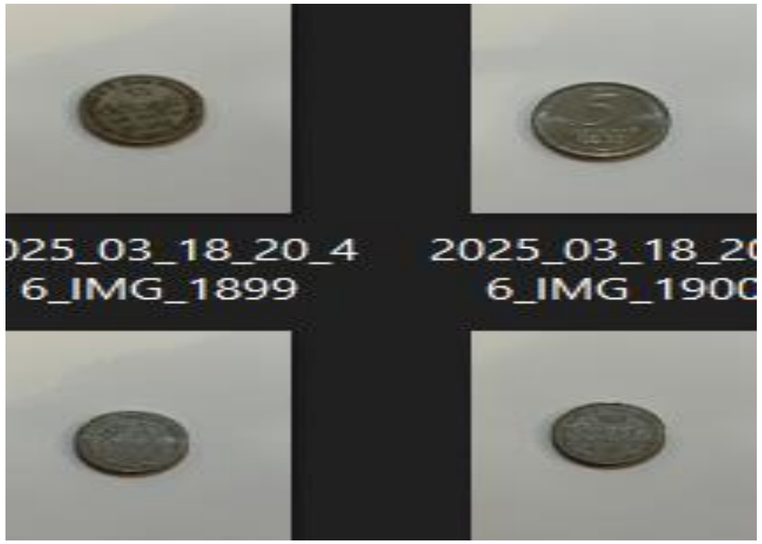
රුපියල් 1000 යි

රුපියල් 500යි

How currency is identified

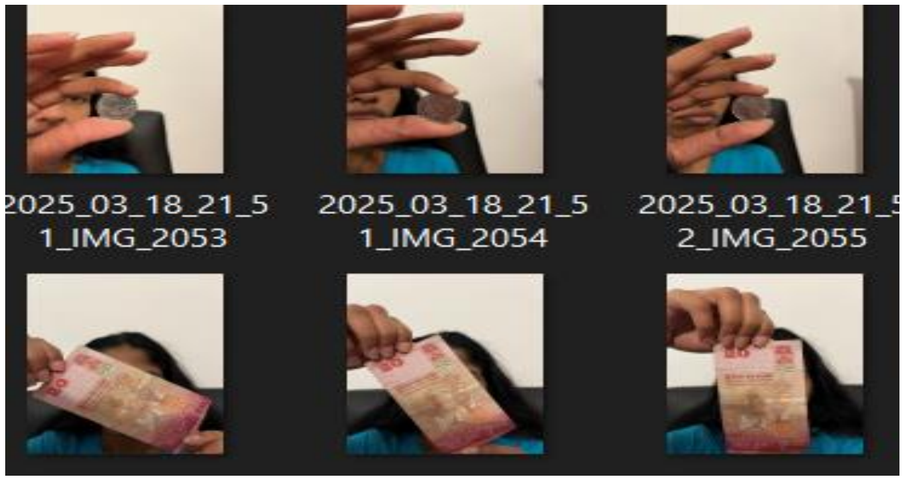


Dataset



Created a Dataset for Currency with,

- Different backgrounds
- Slight variations in the currency
- Close to 500 hundred images for currency



Model training

- Google Co-Lab was used to train the model

```
Found 180 images belonging to 3 classes.

#with early_stoping
from tensorflow.keras.callbacks import EarlyStopping

early_stopping = EarlyStopping(monitor='val_loss', mode='min', patience=3, restore_best_weights=True)
history = model.fit(train_generator, epochs=10, steps_per_epoch=50,
                    validation_data=validation_generator, validation_steps=7, workers=4, callbacks=[early_stopping])

Epoch 1/10
50/50 [==============================] - 590s 12s/step - loss: 0.8782 - accuracy: 0.5548 - val_loss: 25.8435 - val_accuracy: 0.8585
Epoch 2/10
50/50 [==============================] - 498s 10s/step - loss: 0.6318 - accuracy: 0.7054 - val_loss: 14.1079 - val_accuracy: 0.8726
Epoch 3/10
50/50 [==============================] - 495s 9s/step - loss: 0.5090 - accuracy: 0.7725 - val_loss: 1.3641 - val_accuracy: 0.9693
Epoch 4/10
50/50 [==============================] - 494s 9s/step - loss: 0.4392 - accuracy: 0.8141 - val_loss: 19.0424 - val_accuracy: 0.8019
Epoch 5/10
50/50 [==============================] - 496s 9s/step - loss: 0.3233 - accuracy: 0.8722 - val_loss: 0.1368 - val_accuracy: 0.9953
Epoch 6/10
50/50 [==============================] - 495s 9s/step - loss: 0.2657 - accuracy: 0.9089 - val_loss: 1.7473 - val_accuracy: 0.9882
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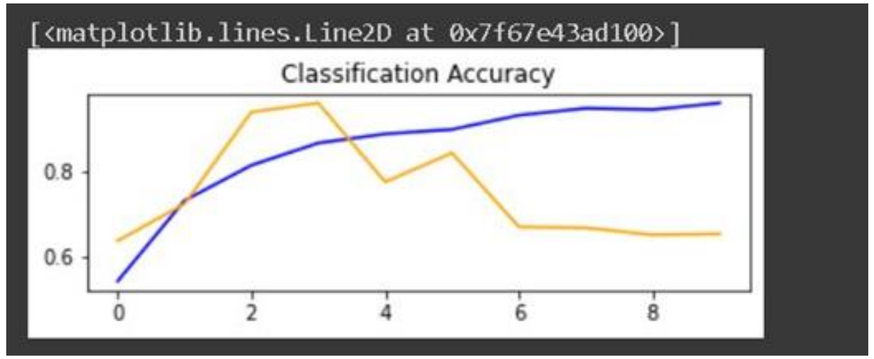

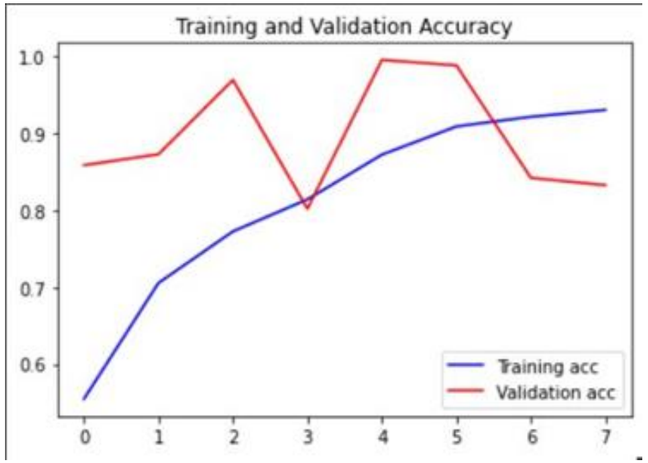

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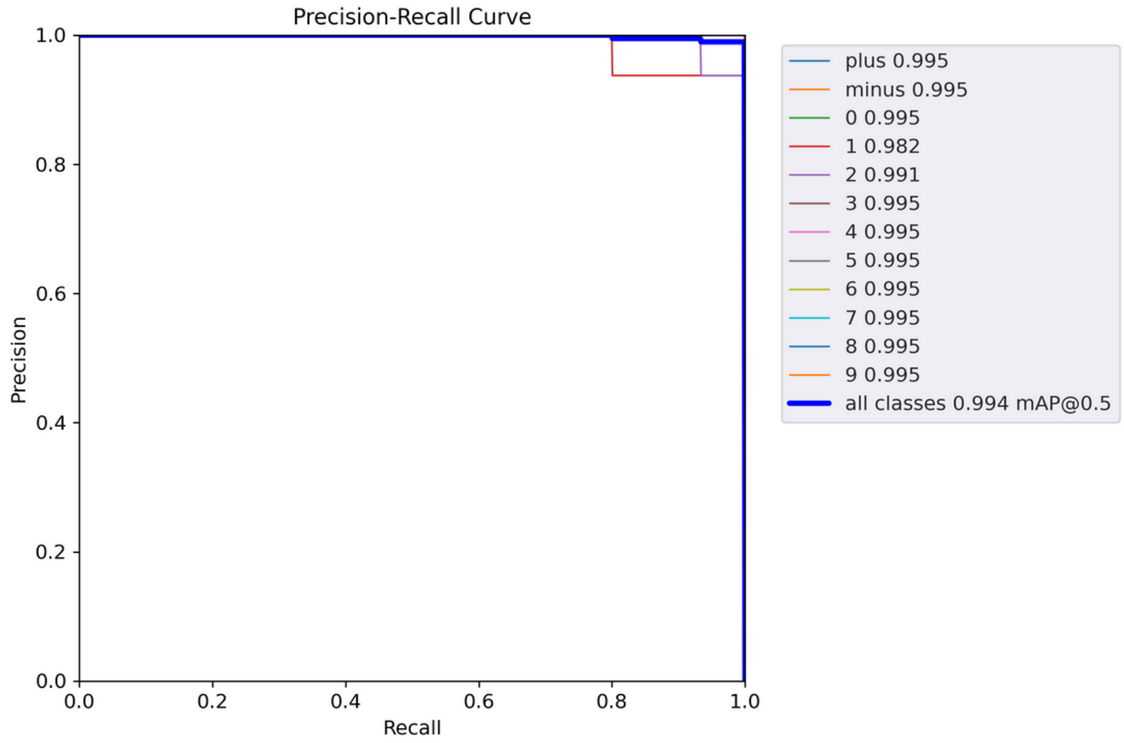

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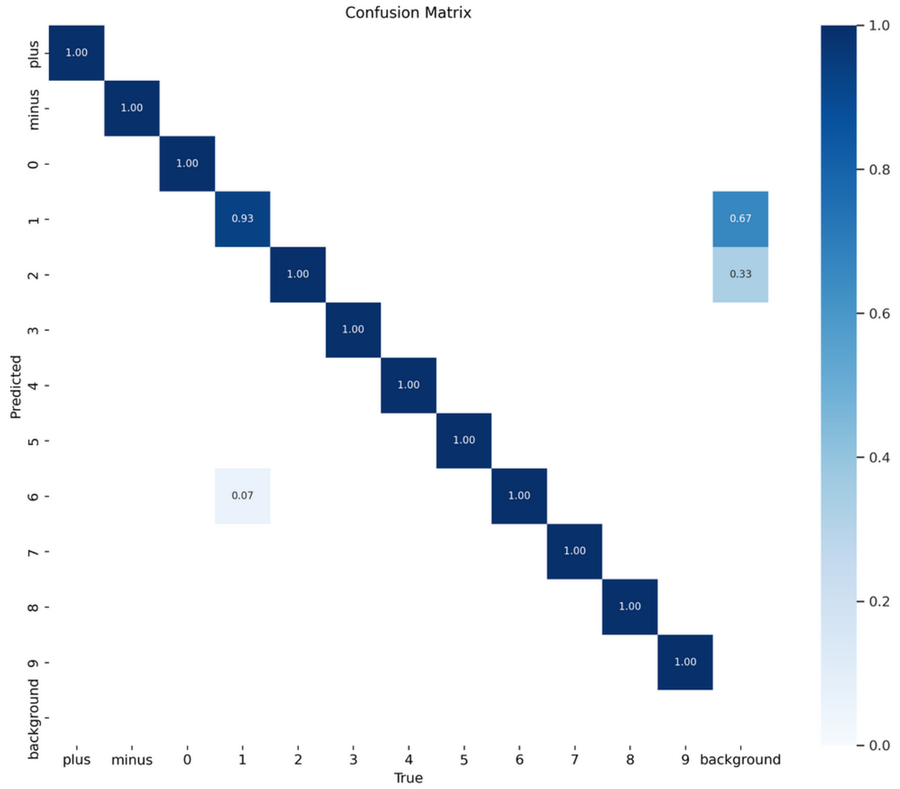

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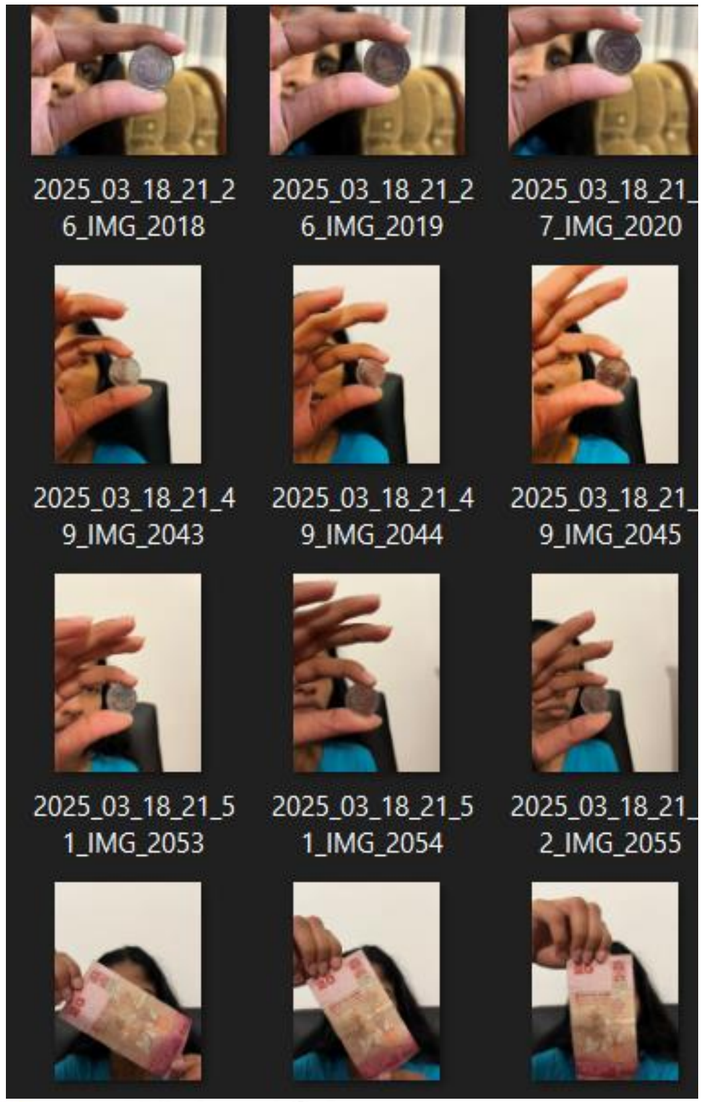

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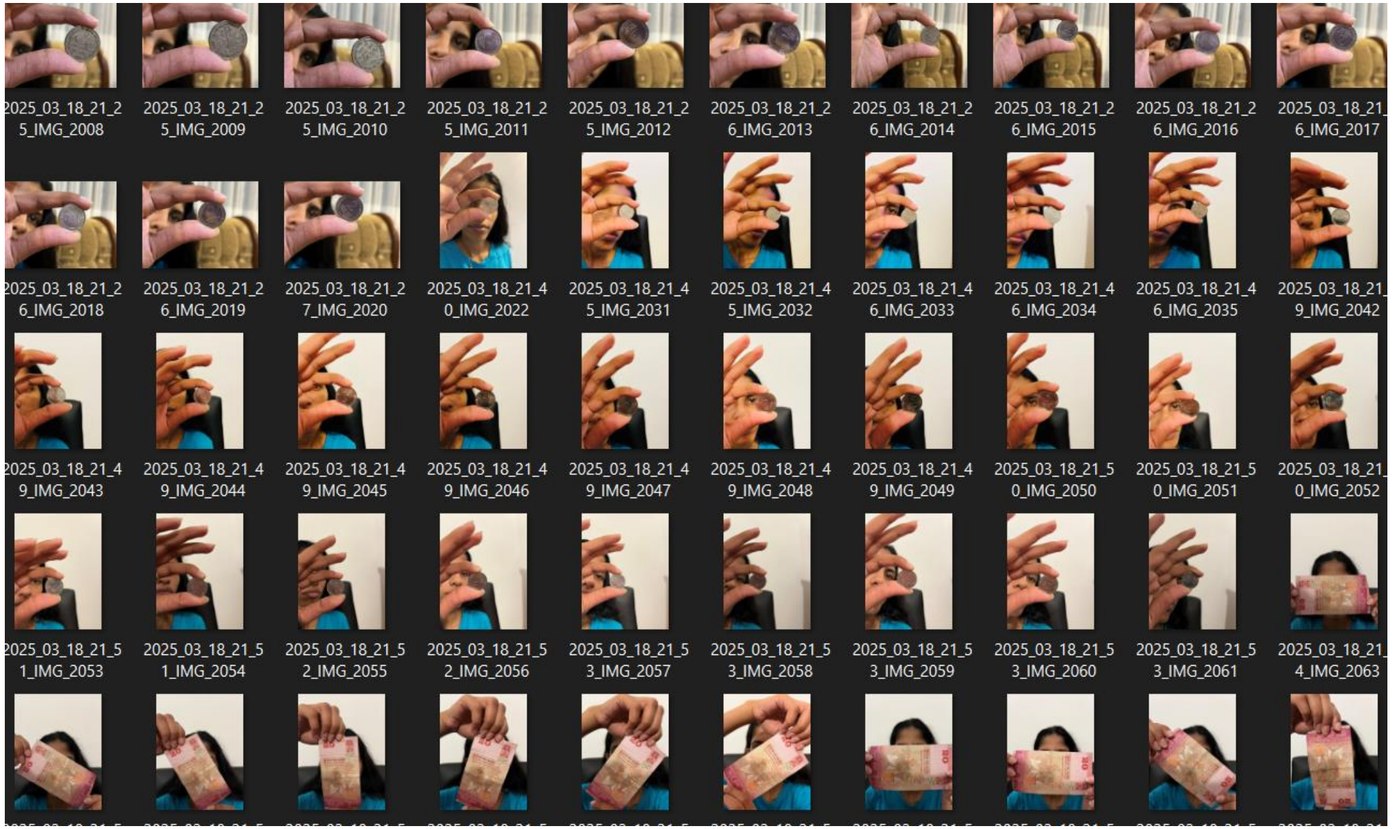

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THANK YOU