

INTERACTIVE LEARNING SYSTEM FOR KIDS

2022-254



TEAM



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INTRODUCTION

- The education field has been revolutionized by introduction of information technology-based tools.
- The effective integration of educational technology and early childhood education requirements are limited.
- The primary aim is to develop an interactive learning platform that provides teaching aids to primary level students without the need of manual supervision.
- Researchers integrated advanced technology and key primary level activities
 - Letter based activities
 - Image based activities
 - Shapes based activities
 - Color based activities



OBJECTIVES



❑ Main Objective

- To create an interactive learning system to enhance knowledge and skills of primary level students .

❑ Sub Objective

- To identify and predict hand-drawn letters, in order to provide suggestions to recorrect the letter in professional manner.
- To recognize shapes and number of shapes by art drawn ,according to the instructions given by system.
- To identify color of drawing object in order to provide corrections and suggestions for the given draw
- Extract features from given image & generate caption depending on that extracted image features



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Introduction - Interactive learning system of English alphabet for kids

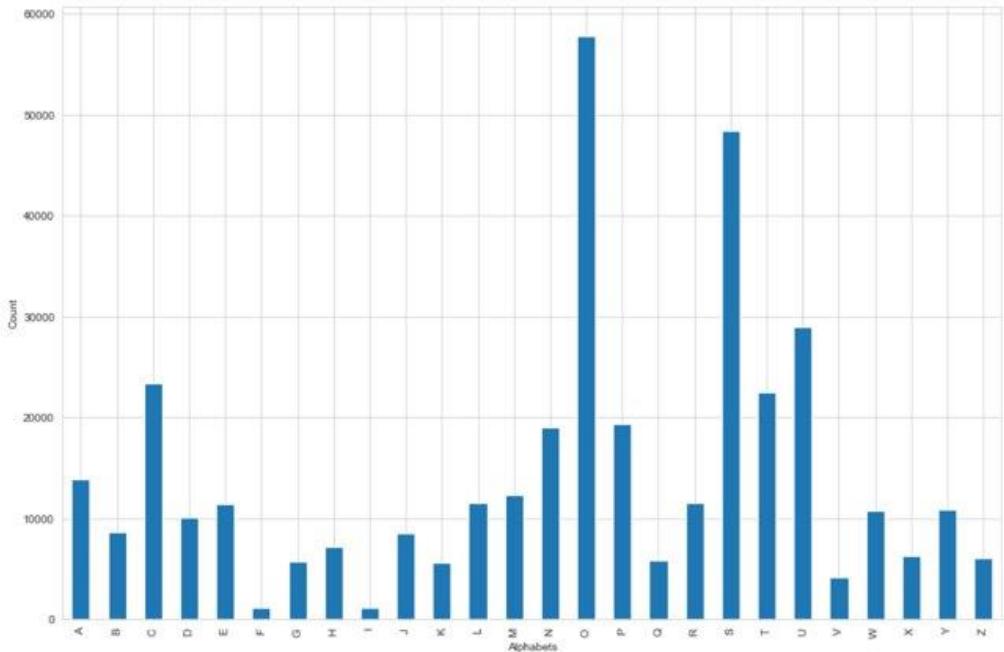


- Focusing on children's handwriting ability of English alphabet.
- Primary aims - To identify and predict hand-drawn letters, in order to provide suggestions to recorrect .
- Existing applications - Allowed children to draw a letter on a provided letter-shaped image (image drawing).
- Present research work
 - Allowing children to write letters on given screen area.
 - predicting the drawing as English letter.
 - identifying mistakes in the basic letter drawing.
 - Demonstrating correct way to draw the letter by the application.
- This system would be act as self-learning platform to children to improve alphabetical knowledge and skills.

Implementation..



❑ Dataset – Old

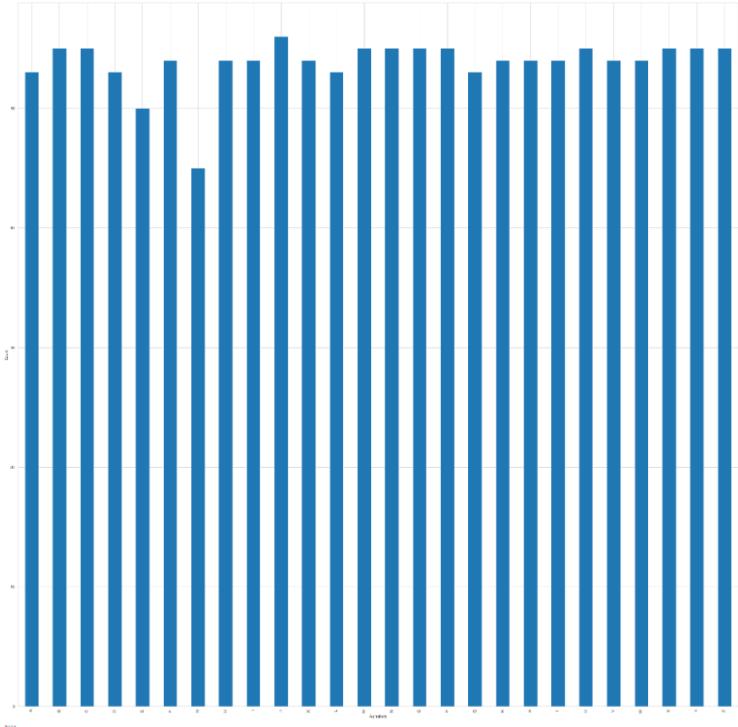


- The dataset contains 26 folders (A-Z) containing handwritten images in size $28*28$ pixels.
- Contain 370000+ images in data set.
- All the images are converted into the CSV format.

Implementation..



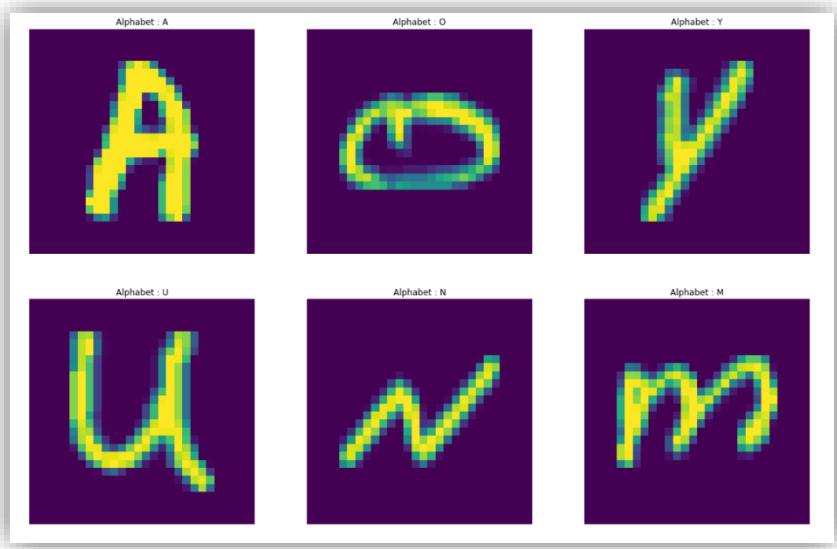
❑ Dataset -New



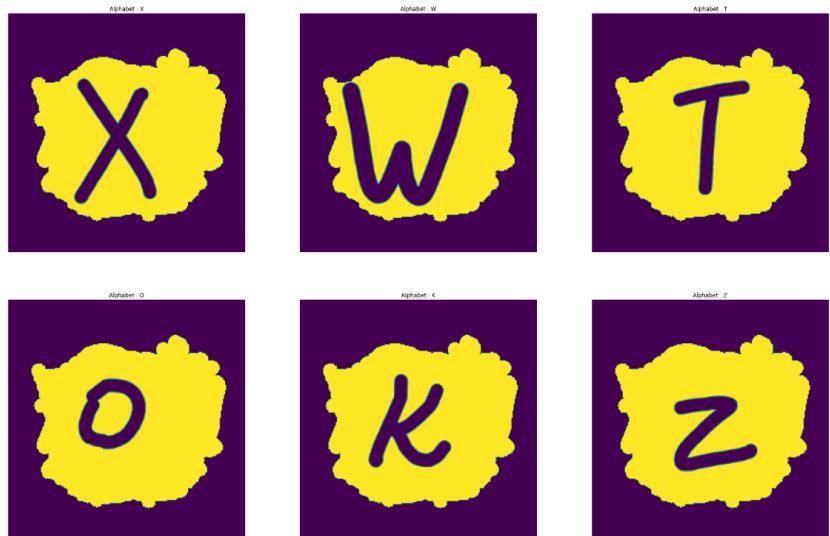
- The dataset contains 26 folders (A-Z) containing handwritten images in size 224*224 pixels.
- Contain 1400+ images in data set.
- All the images are converted into the CSV format.
- To convert the CSV format, create the new python code to convert the image to CSV format

Implementation..

❑ Old & New Training data



Old Training data



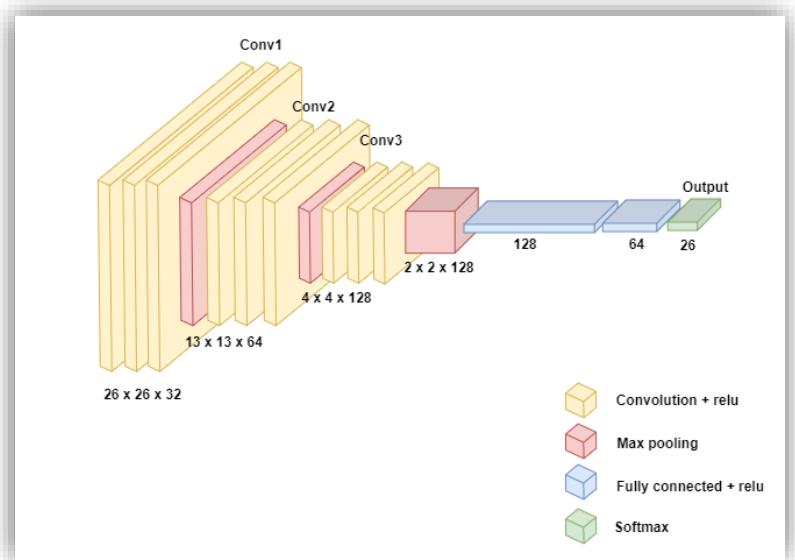
New Training data



Implementation..



❑ Model Creation – Old Data-Set



- Use three 2D Convolution layers.
- Every Con2D layers have max pooling operation to extract maximum value from the Feature map according to filter size.

Implementation..



□ Model Creation - Old Data-Set

```
# creating the model
model = Sequential()

model.add(Conv2D(filters=32, kernel_size=(3, 3),
                 activation='relu', input_shape=(28, 28, 1)))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=64, kernel_size=(3, 3),
                 activation='relu', padding='same'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=128, kernel_size=(3, 3),
                 activation='relu', padding='valid'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Flatten()) # output

model.add(Dense(128, activation="relu"))
model.add(Dense(64, activation="relu"))
# output layer
model.add(Dense(26, activation="softmax"))
# compile
model.compile(optimizer=adam_v2.Adam(learning_rate=0.001),
              loss='categorical_crossentropy', metrics=['accuracy'])
# model summary
model.summary()
```

- Used different filters to get the best accuracy result by increasing each Conv2D layers.
- Used ReLU for activation to get the positive result.
- Used Softmax activation for multi-class classification problems where required on more than two class labels.

Implementation..



□ Model Creation - Old Data-Set

```
# creating the model
model = Sequential()

model.add(Conv2D(filters=32, kernel_size=(3, 3),
                 activation='relu', input_shape=(28, 28, 1)))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=64, kernel_size=(3, 3),
                 activation='relu', padding='same'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=128, kernel_size=(3, 3),
                 activation='relu', padding='valid'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Flatten()) # output

model.add(Dense(128, activation="relu"))
model.add(Dense(64, activation="relu"))
# output layer
model.add(Dense(26, activation="softmax"))
# compile
model.compile(optimizer=adam_v2.Adam(learning_rate=0.001),
              loss='categorical_crossentropy', metrics=['accuracy'])
# model summary
model.summary()
```

- Adam optimizer used for the optimize the model.
- Used Categorical cross entropy for the loss function and that is used in multi-class classification tasks.

Implementation..



❑ Model Creation – New Data-Set

```
# model
model = Sequential()
model.add(Conv2D(filters=32, kernel_size=(3, 3),
                 activation='relu', input_shape=(224, 224, 1)))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=64, kernel_size=(3, 3),
                 activation='relu', padding='same'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Conv2D(filters=128, kernel_size=(3, 3),
                 activation='relu', padding='valid'))
model.add(MaxPool2D(pool_size=(2, 2), strides=2))

model.add(Flatten()) # output

model.add(Dense(128, activation="relu"))
model.add(Dense(64, activation="relu"))
model.add(Dropout(0.35))
# output layer
model.add(Dense(26, activation="softmax"))
# compile
model.compile(optimizer=adam_v2.Adam(learning_rate=0.001),
              loss='categorical_crossentropy', metrics=['accuracy'])
model.summary()
```

- To create this model only changed the input shape size as (224,224,1) cause the image size is 224x224 px.

Implementation..



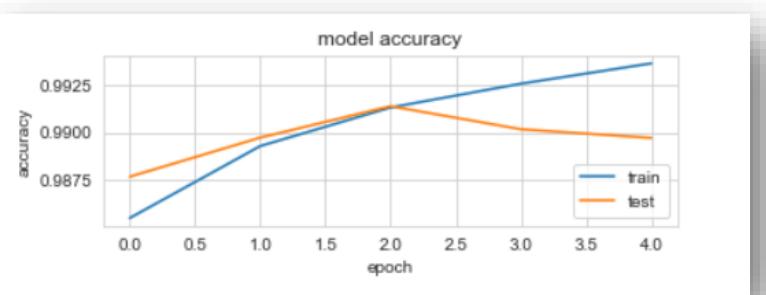
❑ Model Creation – New Data-Set with Transfer Learning (VGG16)

```
# model create
base_model = VGG16(
    weights=None,
    include_top=True,
    input_shape=(224, 224, 1),
    pooling='avg'
)
for layer in base_model.layers:
    layer.trainable = False

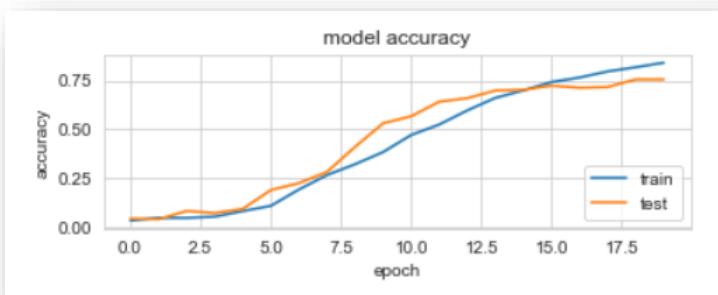
x = layers.Flatten()(base_model.output)
x = layers.Dense(512, activation="relu")(x)
x = layers.Dense(128, activation="relu")(x)
x = layers.Dense(64, activation="relu")(x)
x = layers.Dense(26, activation="softmax")(x)
model = Model(base_model.input,x)

model.compile(loss='categorical_crossentropy', optimizer=adam_v2.Adam(learning_rate=0.001), metrics=['accuracy'])
model.summary()
```

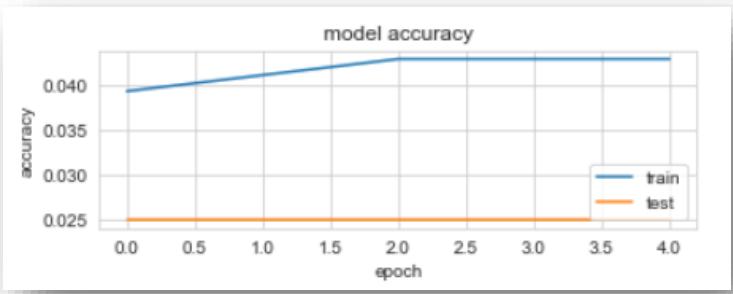
Results



Old model accuracy – 98%+

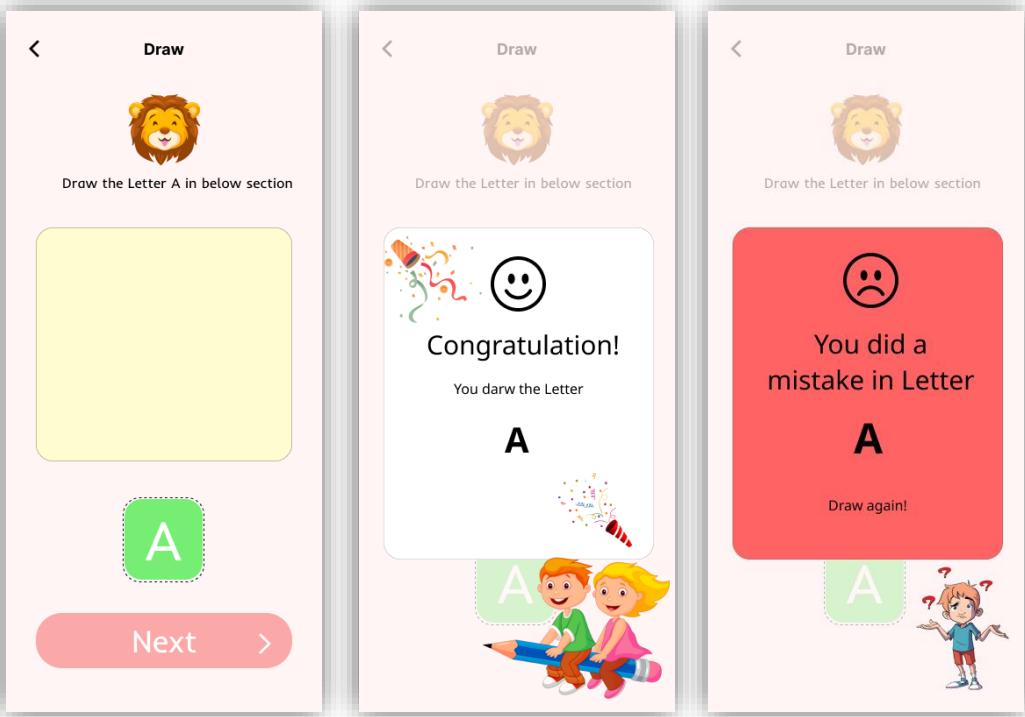


New model accuracy – 75%+



VGG16 model accuracy – 45%+

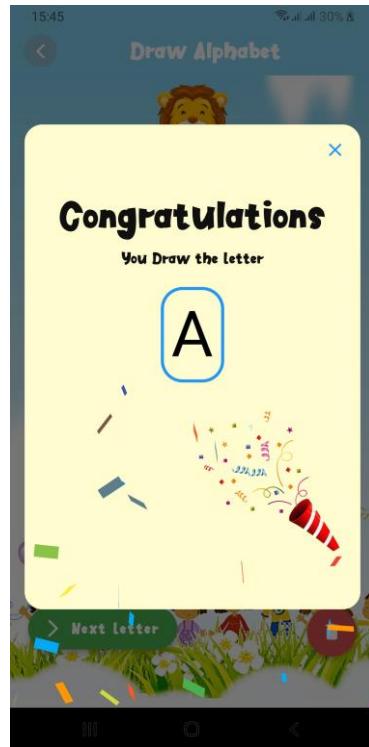
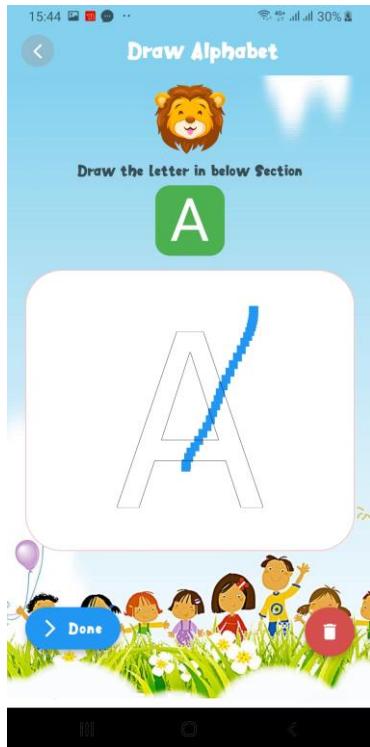
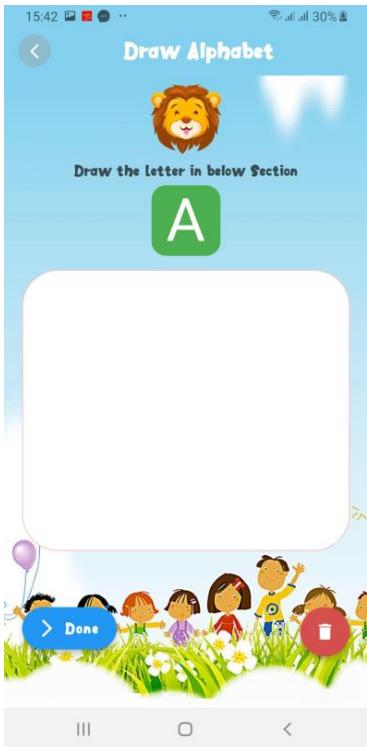
Designing



- Use Figma tool to design the Mobile Interface.
- Here shows pre-design interfaces.



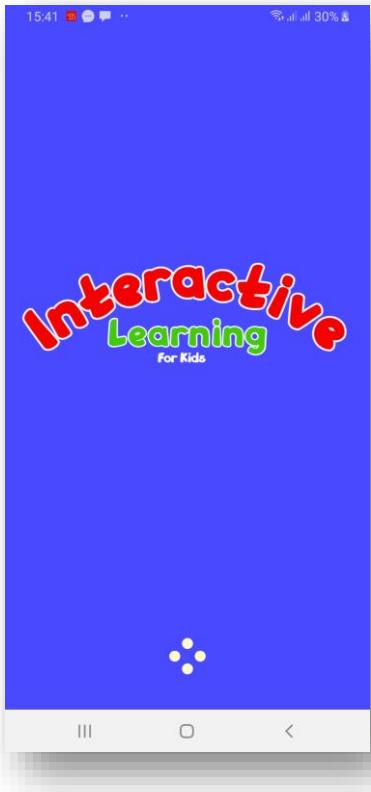
Designing..



- This images shows the actual UI output of the application.



Designing..



- This is the Splash Screen in the Mobile application for our research.



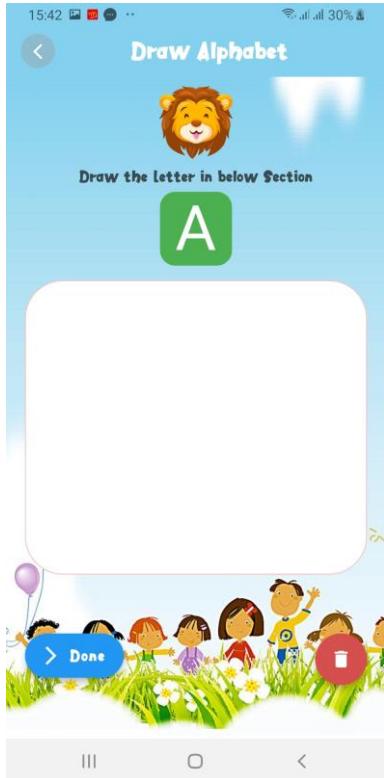
Designing..



- This is the Actual Home Screen in the Mobile application for our research.



Designing...



- Kids can draw the letters given section with the given alphabet.
- When clicking the done button then it checks whether the drawn alphabet letter and given alphabet letter are correct or wrong.

Key Pillars & Relevant Technologies



- Use Convolution Neural Network (CNN) in Deep Learning to recognize and prediction the drawing letters.
- Also, Used the Transfer Learning Method (VGG16)
- Use the `image_compare` library to check mistakes for the hand-drawn letters.
- Pixel Comparison Algorithm - (IMED – IMage Euclidean Distance)

Key Pillars & Relevant Technologies



Hardware Requisites

- Our basic plan is to implement the application operating on an Android device with a drawing platform
 - Mobile Phone



Technologies to be used

- Flutter
- Python
- TensorFlow



User Requirement & Functional Requirement



Functional Requirements

- Recognize hand-drawn letters.
- Predict the letter if the student draws the letter incompletely.
- Identify mistakes done by the student when drawing the letter and correct the mistake letter.

User Requirements

- User friendliness.
- Provide solutions to improve knowledge of writing letters.
- Facilitate quick response.

Challengers & Overcomes



❑ Challengers

- Lack of existing literature and works related to the outcome of study.
- Difficult to find most suitable data set for model.
- Difficult to use some parameters when creating a model for the study (optimizes, activations).
- Difficult to intergrade models and mobile applications.
- Difficult to obtain the model outcome in mobile applications.

❑ Overcomes

- Follow the guidance of supervisors and experts.
- Refer to the references and previously published works.
- Utilize the theoretical knowledge of the machine learning module.
- Self-studied and used analytical thinking to resolve the problems.

Overall...



Completed

- Developed the 3 models.
- Completed the frontend of mobile application.
- Prediction of the alphabet.
- Connected with the model & android using the tflite library in TensorFlow.
- Identify the mistakes of the drawn alphabet letter.
- Recorrect the mistaken letter in a standard way.



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Introduction

- In current education system normally all the modules and syllabus are made for physical environment.
- And primary level education based on teach under proper supervision.
- A situation like pandemic (Corona) or if mentor would not be able to supervise that children's it will not good for them
- And sometimes current Sri Lankan education system teacher is not able to manage all class room students at once
 - Those facts are bring this idea



Background/Research Gap



- **Image content identification.**
- That's why those activities are familiarizing in basic **childhood syllabus**.
- Until today that supervision is **fully manual process**
- If child will have to use method like **distance learning** it will be not effective on their knowledge



Research Problem

- In primary level student has **developing brain** and most of the time the primary education **base on give to proper understanding** to children about some **basic in our knowledge system**,
- Most of our learning base on some **image understanding** and **context writing**
- In childhood that stage must follow by under any proper **supervision**, If not children will be learning some wrong staff.
- There is **no any automated** way to track or monitor mentioned problem
- So that is the reason world needs some **automated monitoring system** to teach primary students.



Specific and Sub-Objectives

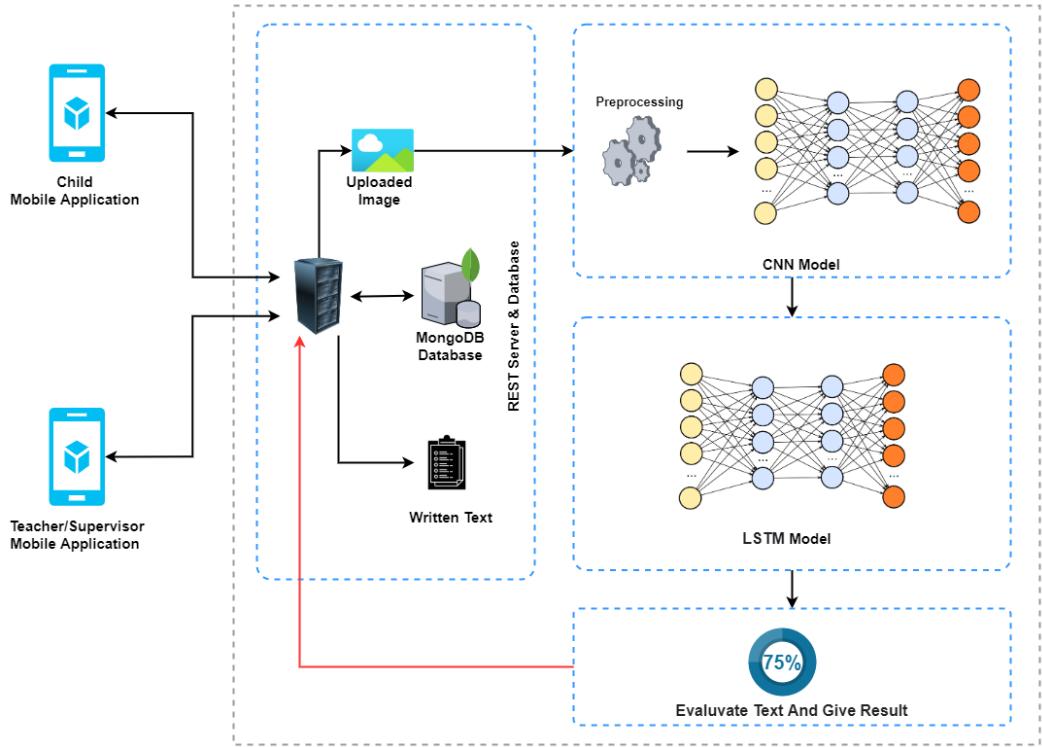


- Identify uploaded image and generate caption on image compare with student given answers
 - Identify the image details and generate caption
 - Identify the student answer on writing board.
 - Evaluate those two text and give the result

Research Methodology



System Diagram



Methodology



- Image Feature Extraction
 - Use VGG16 model

```
#Extract Image Features
model = VGG16()
model = Model(inputs=model.inputs, outputs=model.layers[-2].output)
```

Methodology



Image Feature Extraction

Extract Model Image Data

```
features = []
directory = os.path.join(BASE_DIR, 'Images')

for img_name in tqdm(os.listdir(directory)):
    img_path = directory + '/' + img_name
    image = load_img(img_path, target_size=(224, 224))
    # convert image pixels to numpy array
    image = img_to_array(image)
    # reshape data for model
    image = image.reshape((1, image.shape[0], image.shape[1], image.shape[2]))
    # preprocess image for vgg
    image = preprocess_input(image)

    # extract features
    feature = model.predict(image, verbose=0)
    image_id = img_name.split('.')[0]
    features[image_id] = feature
```

Methodology



- Create Word Mapping

```
# create mapping of image to captions
mapping = {}
# process lines
for line in tqdm(captions_doc.split('\n')):
    # split the line by comma(,)
    tokens = line.split(',')
    if len(line) < 2:
        continue
    image_id, caption = tokens[0], tokens[1:]
    # remove extension from image ID
    image_id = image_id.split('.')[0]
    # convert caption list to string
    caption = " ".join(caption)
    # create list if needed
    if image_id not in mapping:
        mapping[image_id] = []
    # store the caption
    mapping[image_id].append(caption)
```

Methodology

Data Generator

```
def data_generator(data_keys, mapping, features, tokenizer, max_length, vocab_size, batch_size):
    # loop over images
    X1, X2, y = list(), list(), list()
    n = 0
    while 1:
        for key in data_keys:
            n += 1
            captions = mapping[key]
            # process each caption
            for caption in captions:
                # encode the sequence
                seq = tokenizer.texts_to_sequences([caption])[0]
                # split the sequence into X, y pairs
                for i in range(1, len(seq)):
                    # split into input and output pairs
                    in_seq, out_seq = seq[:i], seq[i]
                    # pad input sequence
                    in_seq = pad_sequences([in_seq], maxlen=max_length)[0]
                    # encode output sequence
                    out_seq = to_categorical([out_seq], num_classes=vocab_size)[0]

                    # store the sequences
                    X1.append(features[key][0])
                    X2.append(in_seq)
                    y.append(out_seq)
            if n == batch_size:
                X1, X2, y = np.array(X1), np.array(X2), np.array(y)
                yield [X1, X2], y
                X1, X2, y = list(), list(), list()
                n = 0
```



Methodology



Model Creation

```
# encoder model
# image feature layers
inputs1 = Input(shape=(4096,))
fe1 = Dropout(0.4)(inputs1)
fe2 = Dense(256, activation='relu')(fe1)
# sequence feature layers
inputs2 = Input(shape=(max_length,))
se1 = Embedding(vocab_size, 256, mask_zero=True)(inputs2)
se2 = Dropout(0.4)(se1)
se3 = LSTM(256)(se2)

# decoder model
decoder1 = add([fe2, se3])
decoder2 = Dense(256, activation='relu')(decoder1)
outputs = Dense(vocab_size, activation='softmax')(decoder2)

model = Model(inputs=[inputs1, inputs2], outputs=outputs)
model.compile(loss='categorical_crossentropy', optimizer='adam')
```

Methodology



Caption Generation

```
# generate caption for an image
def predict_caption(model, image, tokenizer, max_length):
    # add start tag for generation process
    in_text = 'startseq'
    # iterate over the max length of sequence
    for i in range(max_length):
        # encode input sequence
        sequence = tokenizer.texts_to_sequences([in_text])[0]
        # pad the sequence
        sequence = pad_sequences([sequence], max_length)
        # predict next word
        yhat = model.predict([image, sequence], verbose=0)
        # get index with high probability
        yhat = np.argmax(yhat)
        # convert index to word
        word = idx_to_word(yhat, tokenizer)
        # stop if word not found
        if word is None:
            break
        # append word as input for generating next word
        in_text += " " + word
        # stop if we reach end tag
        if word == 'endseq':
            break
    return in_text
```

Technologies

- Android
- Node JS
- Python
- AWS or Google Storage
- Jupyter Notebook

android 



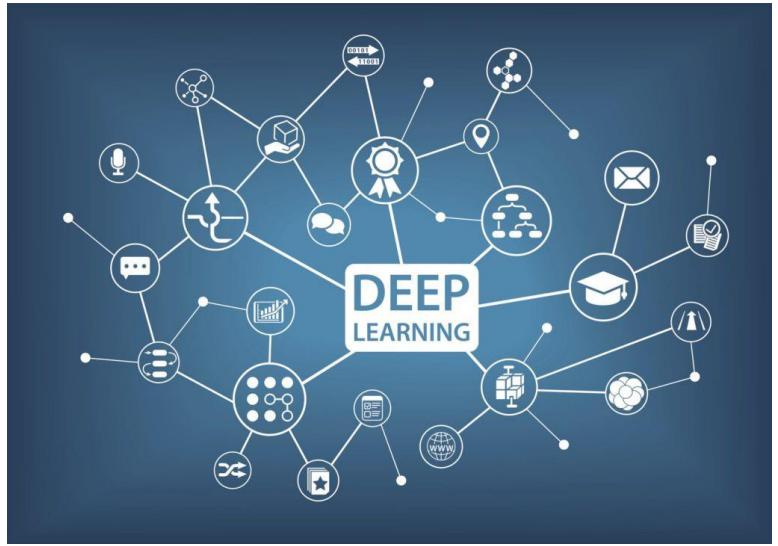
node 

aws 

Key Pillars

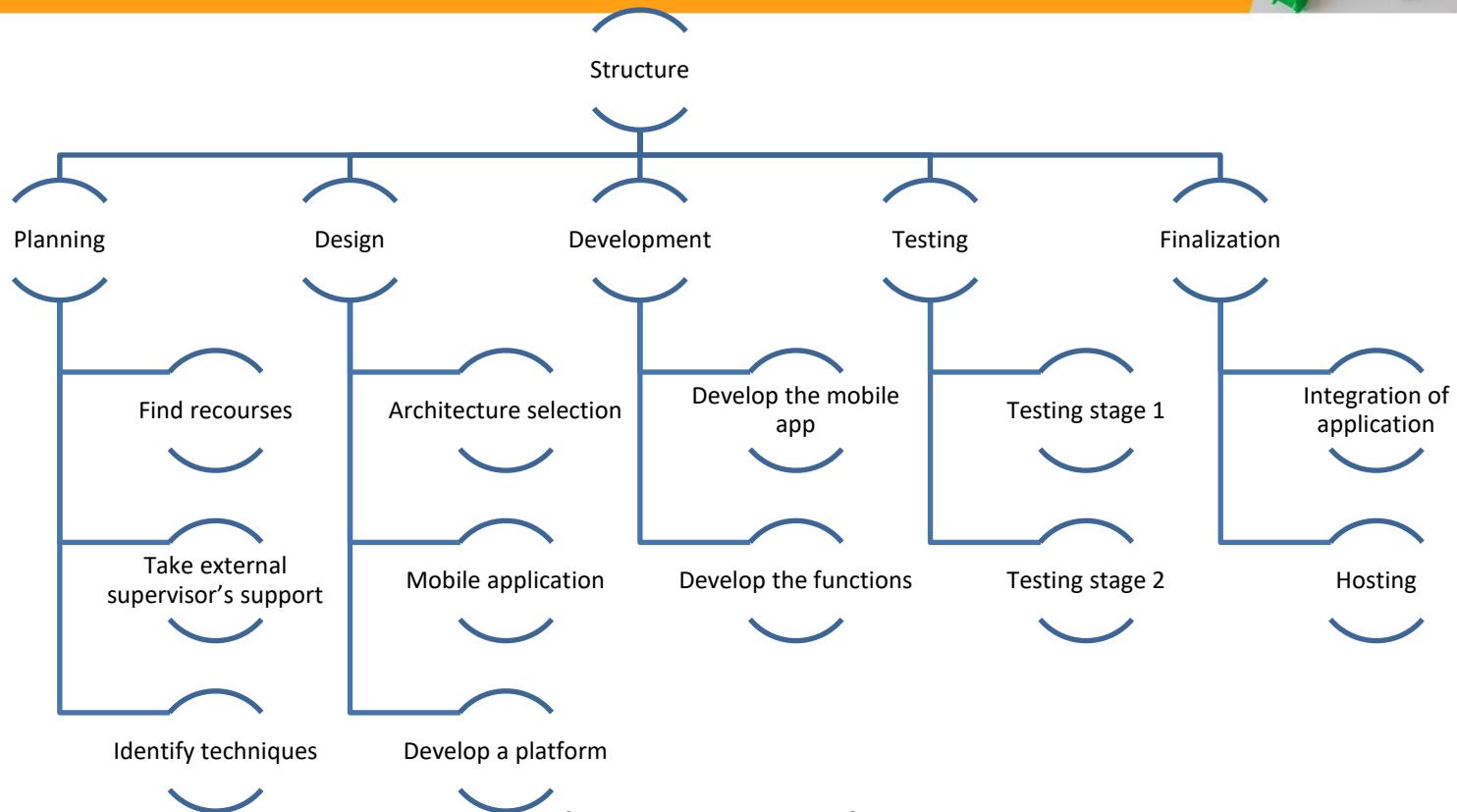


Techniques of Key Pillars



- Deep Learning
 - Neural Network
 - CNN
 - LTSM

Work Breakdown Structure



Results



- Depending on the previous research this one gained conspicuous success and, in this model, identify the object and characters in 90% accuracy and identify the action and behaviors on the image in 80% accuracy and this model is capable for make caption more than 70% accurate.

In 90% Progress



- Completed backend APIs
- Frontend UIs
- Combined Application
- UI testing
- API testing

Next 10%



- Intergrade With main application
- Hosting APIs in Cloud and Making them Global



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Identify hand-drawn shapes and recognize art drawn using shapes

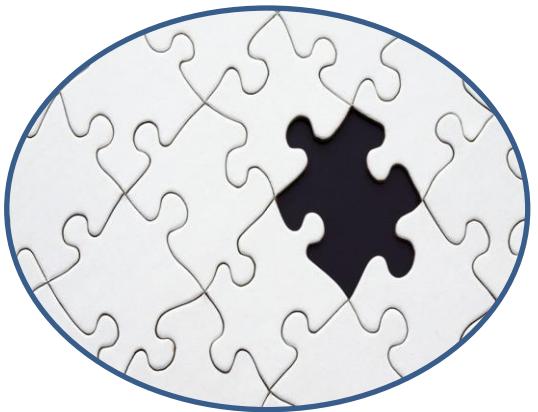


Research Gap



Platform	Identify hand-drawn shape	Identify an art drawn using shapes
Nursery App	✗	✗
Early Learn	✗	✗
Using Fuzzy Logic to Recognize Geometric Shapes Interactively	✓	✗
Sketch Recognition with Natural Correction and Editing	✓	✗

Background/Research Gap



A smart shape-learning method has been invented. The specialty and novelty of this method are students can draw the shape of their t and then the system will identify the drawn shape and suggest corrections if needed. Below functionality also will include in this method.

- Identify an art drawn using shapes by the student.

Research Problem

- Students' mind in primary education is very sensitive. If they think that some learning is hard to do and I cannot do this, that learning will never be easy for the students.
- Mental problems can be affected for students because of hard teaching methods.
- There are very short amount of application in the world that can identify hand drawn shapes.
- Primary age children's mindsets are willing to study with the drawing and pictures. But there is no better method to do that.



Objectives

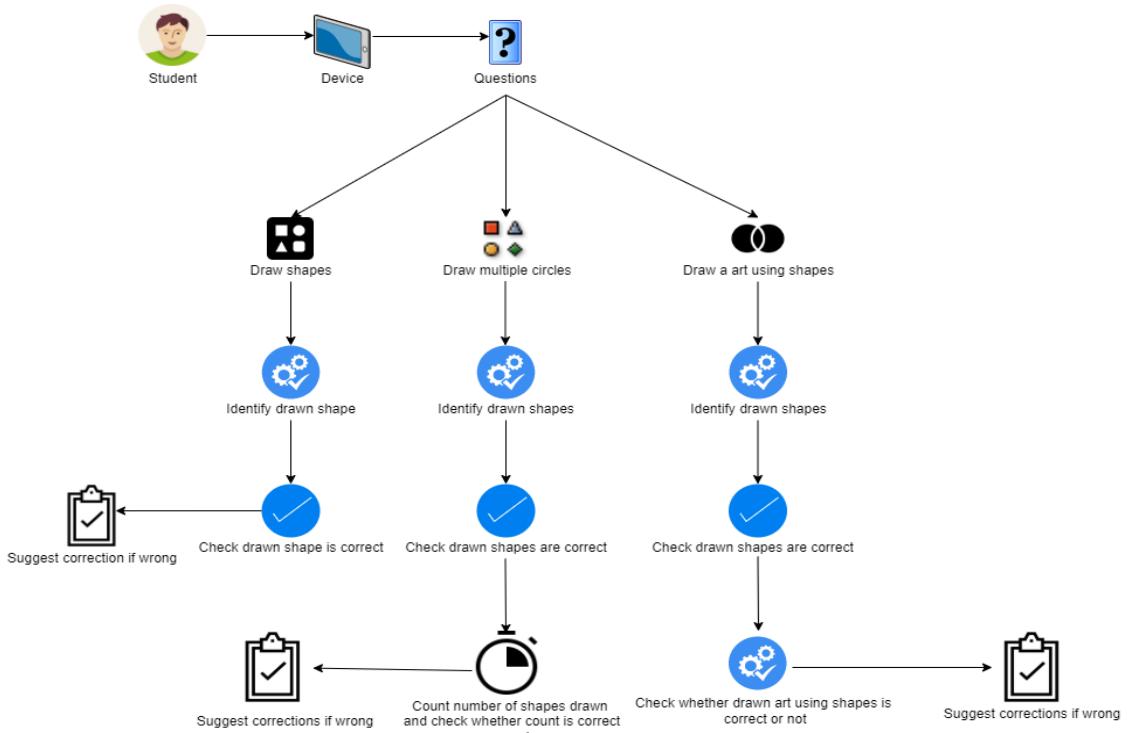
- Identify hand-drawn shapes by primary ages kids.
- Identify hand-drawn arts that can draw using shapes by primary ages kids.
- Provide correct incorrect status of shapes and arts for kids



Research Methodology



System Diagram

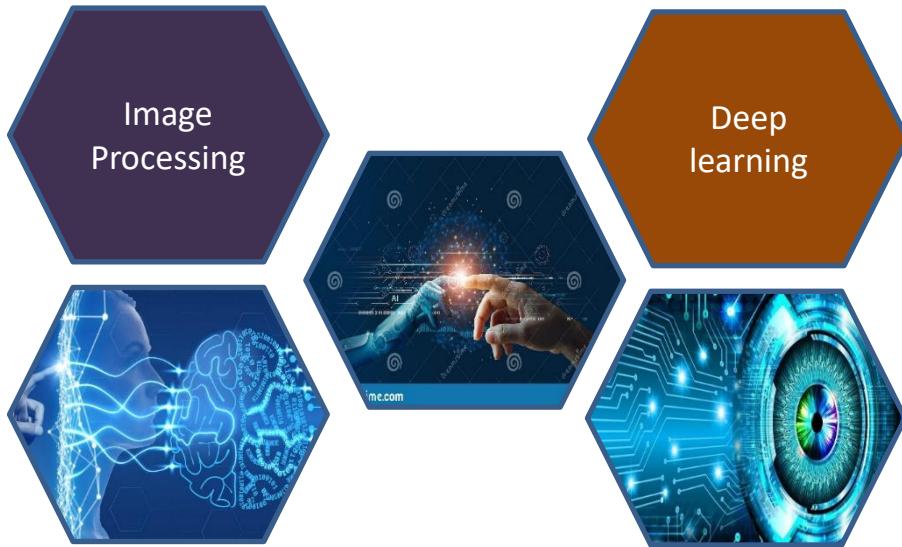


Technologies

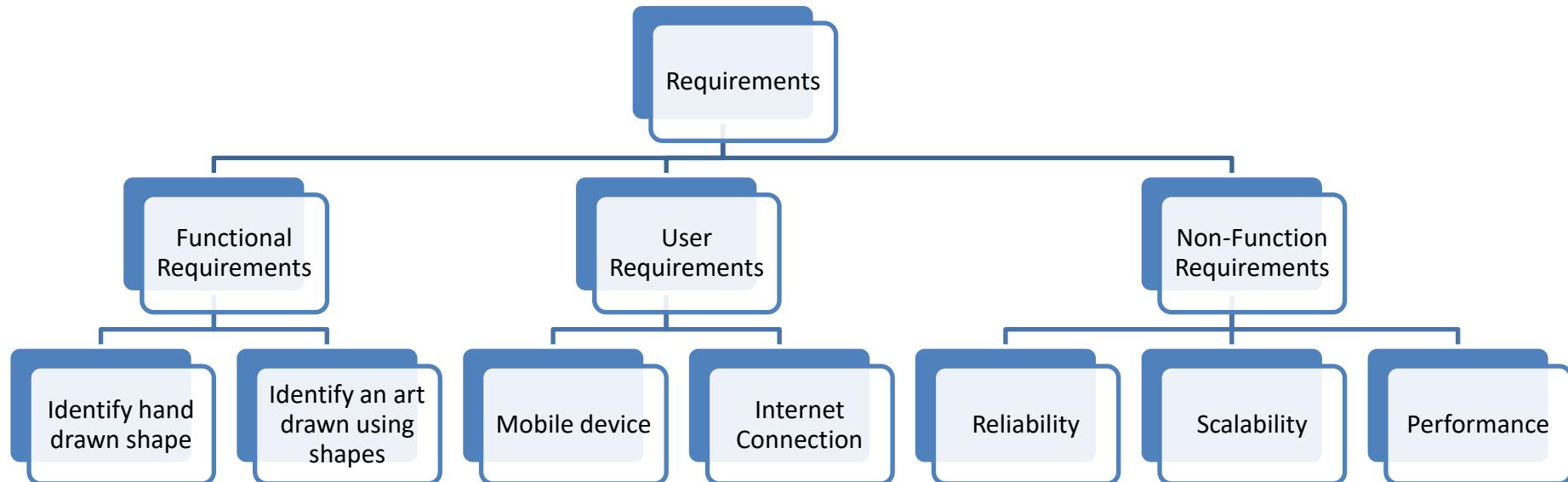
- Python
- Flutter
- Dart



Key Pillars



Requirements

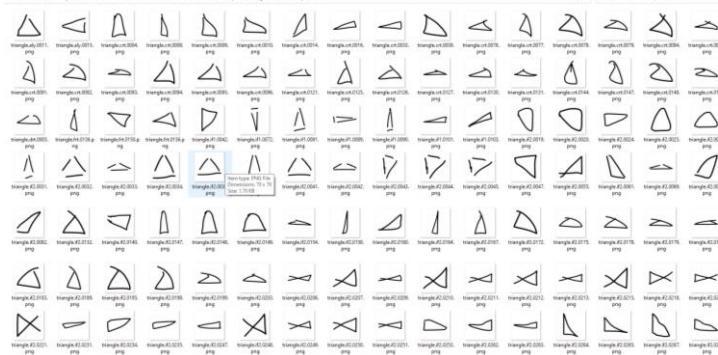


Implementation..



❑ Dataset

- The dataset was created by primary ages kids
- *Contain 5033 hand drawn images in dataset.*



Implementation..



□ Steps to create the model

- ❖ Data preparation
 - Load data
 - Reshape
 - Split data into train & test
- ❖ Create CNN based model
 - Define the model
 - Set the activation & optimizer
- ❖ Evaluate the model
 - Train for identify correct and incorrect shapes

Implementation..



□ Model Creation

```
def cn_model():
    no_of_filters = 60
    size_of_filter_1 = (5, 5)
    size_of_filter_2 = (3, 3)
    size_of_pool = (2, 2)
    no_of_node = 500

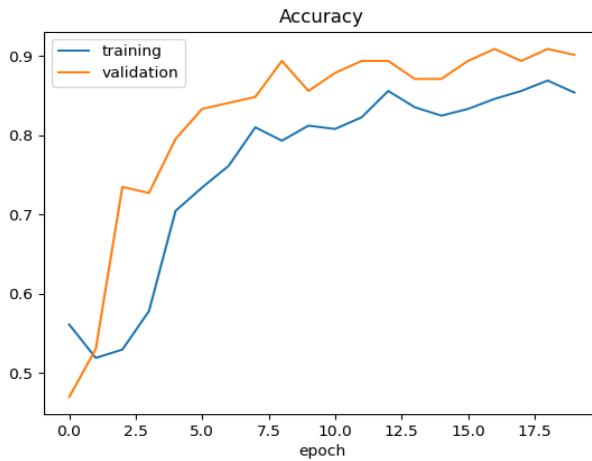
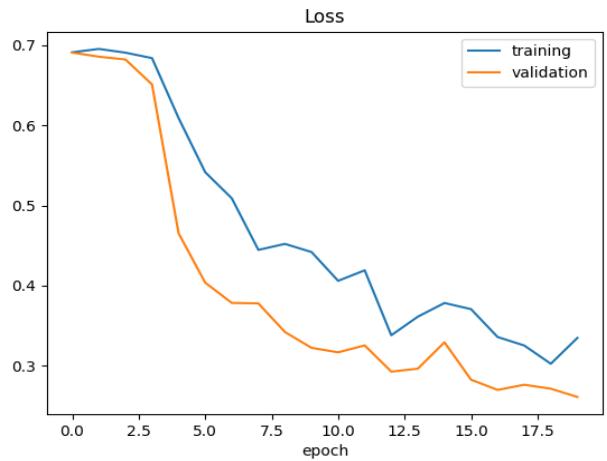
    model = Sequential()
    model.add((Conv2D(no_of_filters, size_of_filter_1, input_shape=(image_dimension[0],
                                                                image_dimension[1], 1), activation='relu')))
    model.add((Conv2D(no_of_filters, size_of_filter_1, activation='relu')))
    model.add(MaxPooling2D(pool_size=size_of_pool))
    model.add((Conv2D(no_of_filters // 2, size_of_filter_2, activation='relu')))
    model.add((Conv2D(no_of_filters // 2, size_of_filter_2, activation='relu')))
    model.add(MaxPooling2D(pool_size=size_of_pool))
    model.add(Dropout(0.5))

    model.add(Flatten())
    model.add(Dense(no_of_node, activation='relu'))
    model.add(Dropout(0.5))
    model.add(Dense(no_of_data_category, activation='softmax'))

    model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
    return model
```

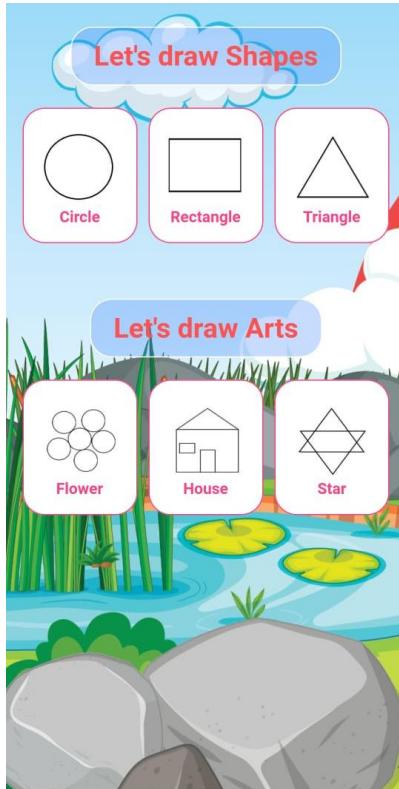
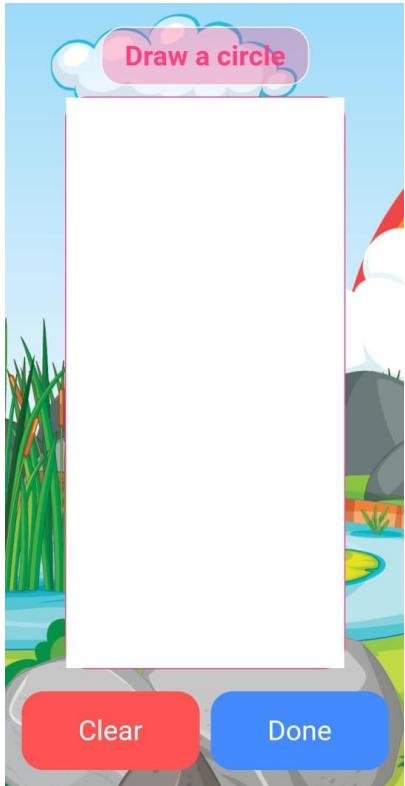
- 11 layers have used for this model.
- Used ReLU for activation to get the positive result.
- Used Softmax activation for multi-class classification problems where required on more than two class labels.

Result

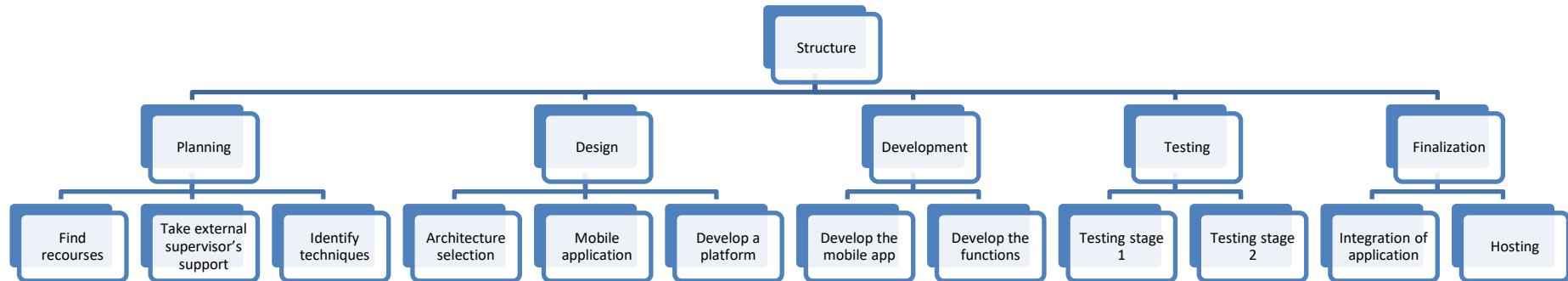


- This model has more than 87% accuracy

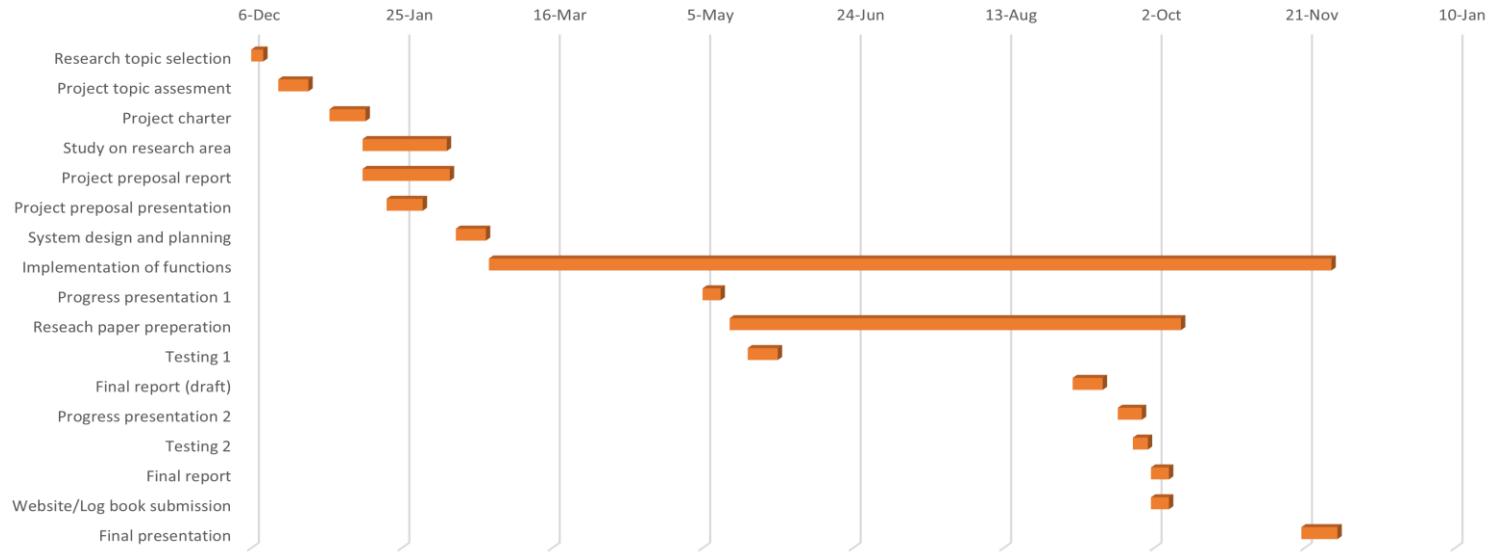
Design



Work Breakdown Structure



Grant Chart





IT19197838 | L.H.G.N.Ravindu

B.Sc. (Hons) Degree in Information Technology Specialized in Information Technology

Introduction



- The preschool years are a critical period for children to receive high-quality personal care and learning experiences.
- Many primary schools still use the **traditional learning process** since it is very common.
- In a typical classroom, basic materials such as a **blackboard, whiteboard, chalk, and marker** are used.
- Our program allows students to recognize **objects and colors**.



Research Problem

- Traditional education places a greater emphasis on teaching than on learning. There has been a lot of work put into developing a basic improvement that will ensure successful learning. Students used traditional methods such as color pencils, watercolors, papers, and other learning materials in this scenario. This is a massive waste. Also, most students are uninterested in this material, but they really interact with mobile phones, so we provide mobile solution for interactive learning for primary students.



Objectives

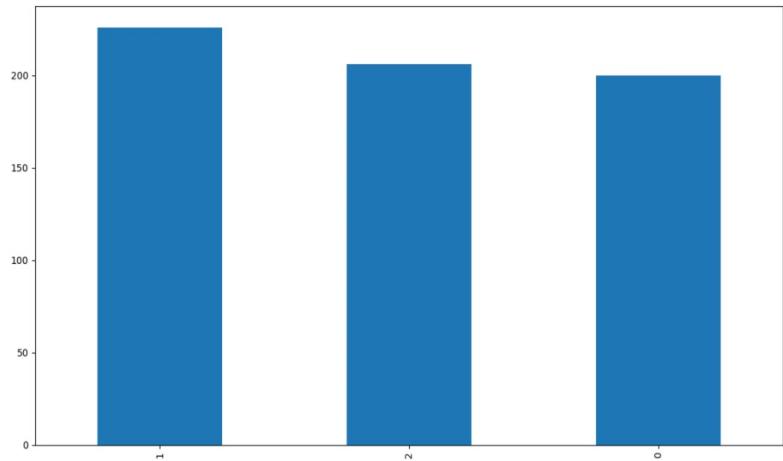


- Determine what pictures students drew on the surface.
- Identify mistakes done by student
- The algorithm will recognize the color of the student's sketched picture.
- Make a color suggestion that is appropriate.
- Testing and checking the accuracy.
- Finally, recommend a student's drawn object corrections.

Implementation



- Dataset



- More than 600 images drawn by pre-school students.
- All these pictures were drawn by children of two preschools.

Implementation

- Data collection



Little Kids Pre-School

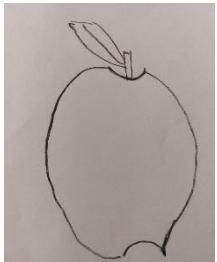
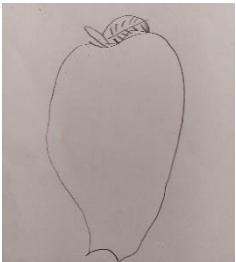
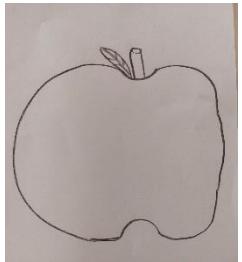


Brilliants Way Pre-School

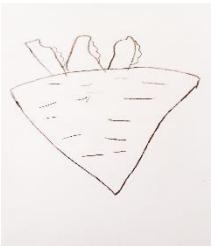


Implementation

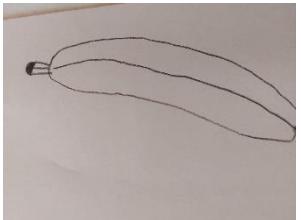
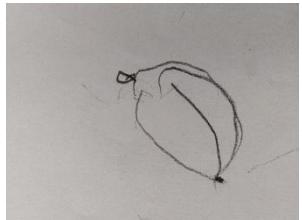
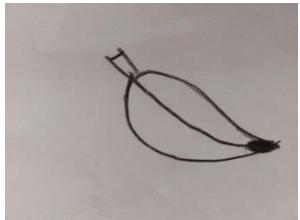
Apple



Carrot



Banana



Implementation



- Model Creation

```
24  
25  
26 model = Sequential()  
27  
28 model.add(Conv2D(256, (3, 3), input_shape=data.shape[1:]))  
29 model.add(Activation('relu'))  
30 model.add(MaxPooling2D(pool_size=(2, 2)))  
31  
32 model.add(Conv2D(128, (3, 3)))  
33 model.add(Activation('relu'))  
34 model.add(MaxPooling2D(pool_size=(2, 2)))  
35  
36 model.add(Flatten())  
37  
38 model.add(Dropout(0.5))  
39 model.add(Dense(64, activation='relu'))  
40  
41 model.add(Dense(4, activation='softmax'))  
42  
43 model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])  
44  
45 model.load_weights('model.h5')  
46  
47
```

- Use MaxPooling 2d , Conv2D, Dropout, Relu Function and Dense Layers

Technologies



Keras



Tensorflow



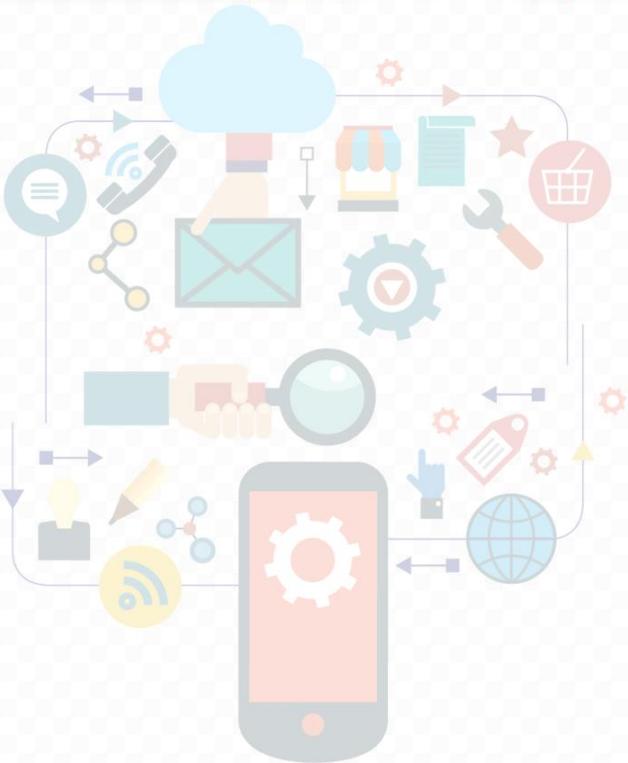
Flask



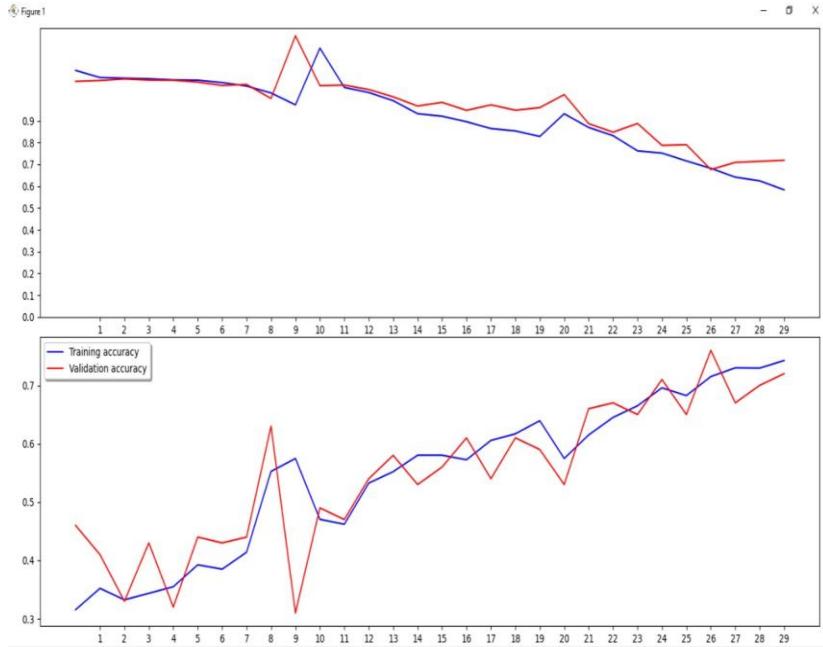
OpenCV



Flutter



Result

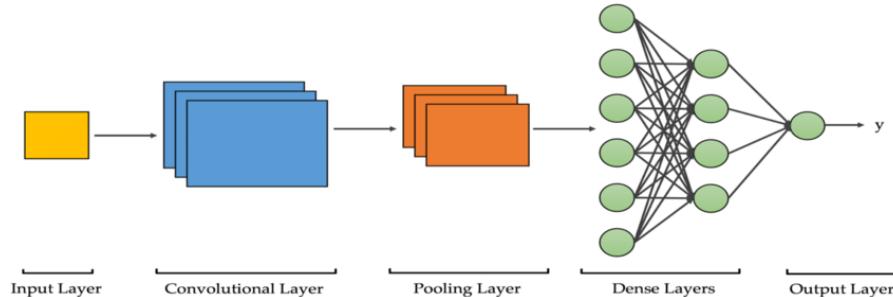


- More than 89% accuracy.

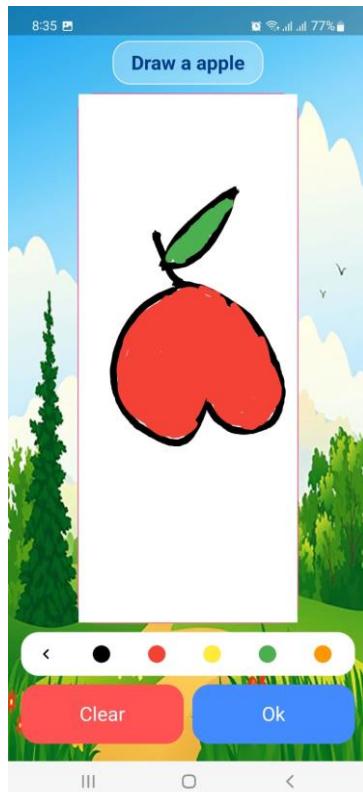
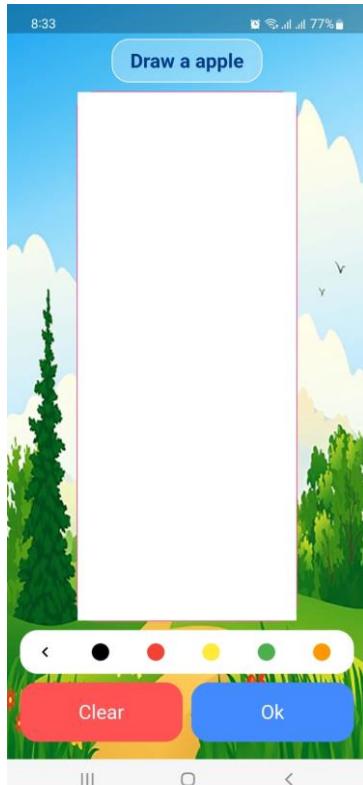
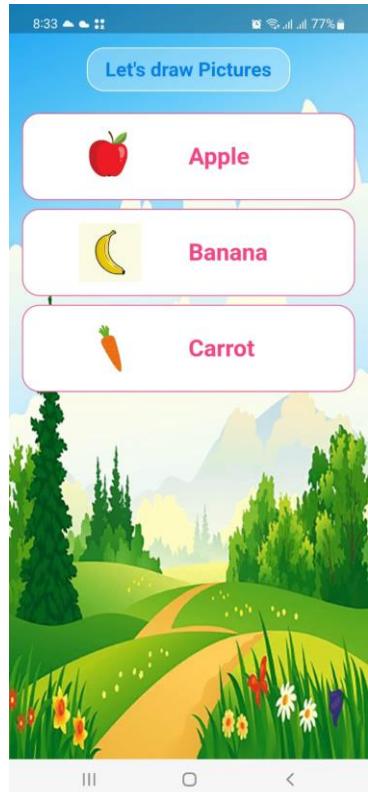
Key Pillars & Relevant Technologies



- Use Convolution Neural Network (CNN) to detect drawing objects.
- A subclass of deep neural networks is CNN.
- In terms of recognizing and segmenting certain objects, CNN has shown better results.



Design





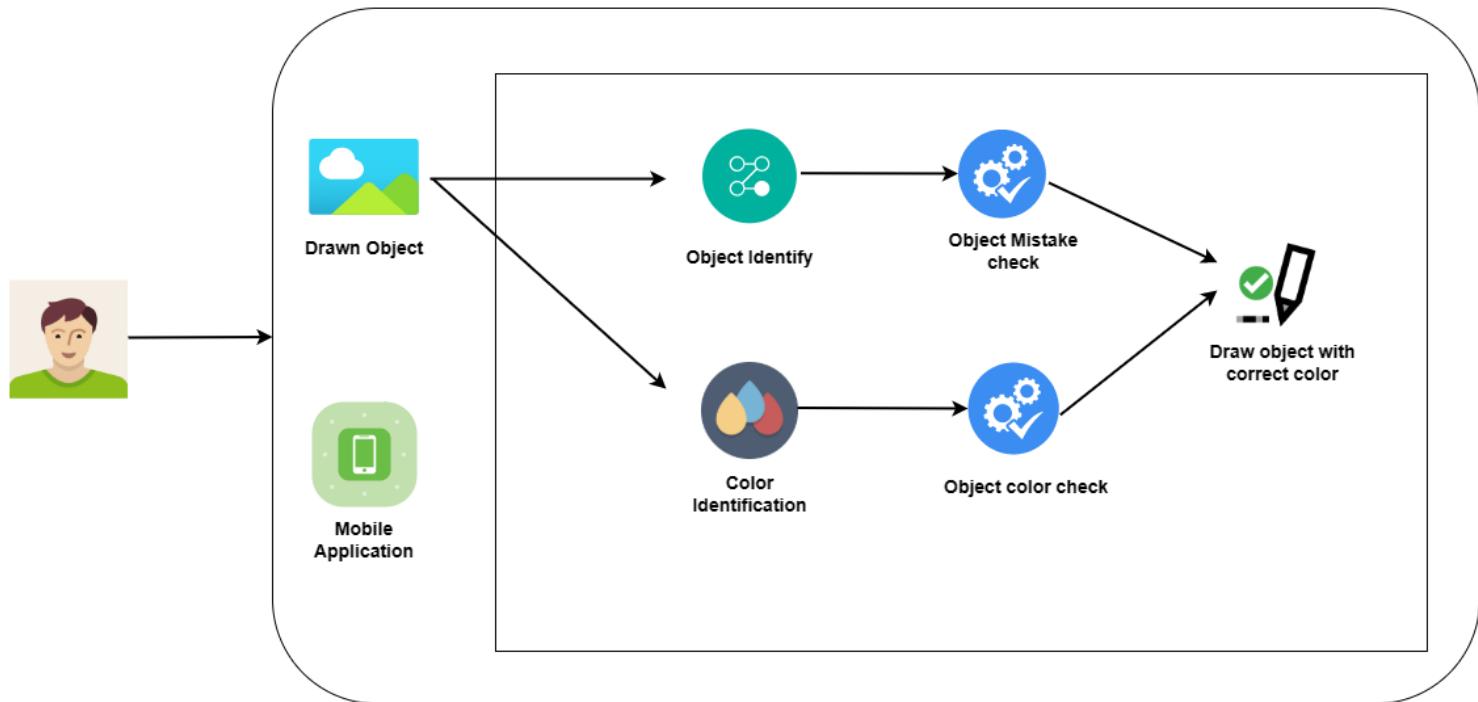
Demo

In Final Presentation

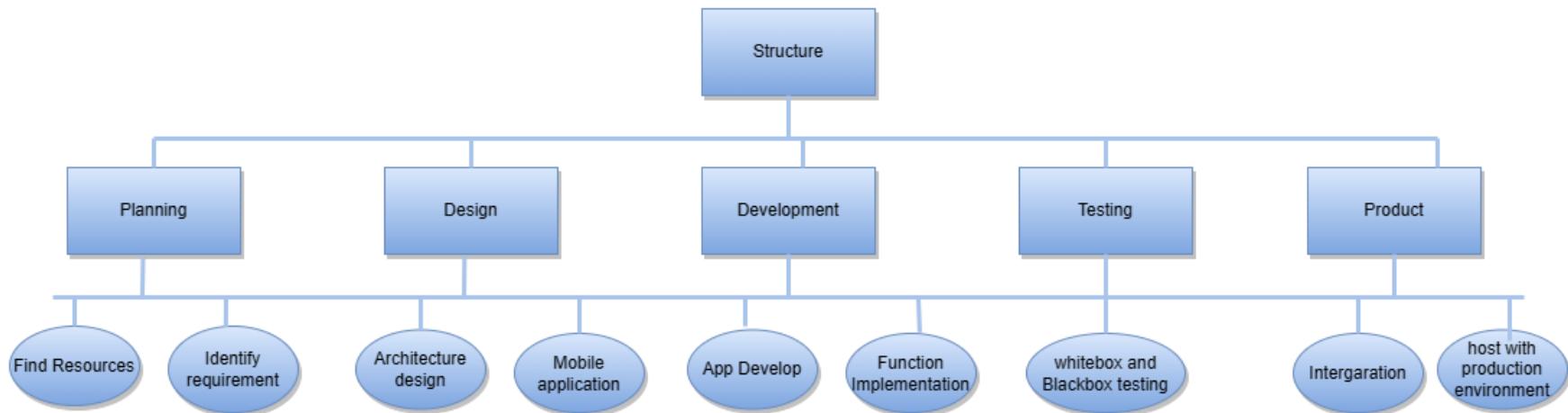
- Improve with the primary application
- API hosting in the cloud and globalization



System Architecture



Work Breakdown Structure



Grant Chart



Dec 6 - Jan 25 100% Research topic selection

Dec 19 - Dec 28 100% Project charter

Dec 31 - Jan 12 100% Project topic assesment

Dec 12 - Dec 24 100% Project Proporsal Report

Feb 1 - Feb 3 100% Proposal Presentation

Feb 11 - May 13 100% Implementation

May 11 - May 13 PP1

May 13 - Jun 30 100% Research Paper

Oct 2 - Oct 28 PP2

Nov 16 - Nov 18 Final Presentation

2021 2022



COMMERCIALIZATION



Our App



- The First Computerized Commercialized & Automated Primary Education Application in Sri Lanka
- First App Introduce For Primary School Students Distance Learning
- 75% Automated Flow For Teachers

Main Features

- Teach students letters efficiently.
- Improve the ability to draw images.
- Increasing Knowledge of shapes.
- Improve the ability to identify features in images.

MARKET



How many children are in school in Sri Lanka?



According to the Ministry of Statistics, today there are approximately **10,012 public** schools serving close to 4,037,157 students, all around the island.

- Mean there will be around 1.5 Million primary students
- Approx. Customer Base 0.5 Million

Flyer

Teach Your Kids
With Our App

Interactive Learning System For
Kids
Coming Soon....



The app interface features a colorful, cartoonish design with a blue sky background, white clouds, and floating confetti. It includes four main activity cards: "Draw Alphabet" (yellow), "Draw Shape" (purple), "Identify Object" (green), and "Write Sentences" (pink). Each card has a small icon and a circular arrow button.





How We Can Promote This App ?

- Facebook Advertisement
- Referral Program
- Notice
- TV Commercial
- Flyers



How Make Money This App ?

- User Subscriptions
- Partnerships





Free Plan

What You'll Get

- Unlimited Access
- Ads Free
- Notify the child errors
- Gold Member Card

Free

Try Premium For 1 Month Free

Selected

Premium Plan

What You'll Get

- Unlimited Access
- Ads Free
- Notify the child errors
- Gold Member Card

RS 299.00/month

Choose

Enterprise Plan

What You'll Get

- Unlimited Access
- Ads Free
- Notify the child errors
- Gold Member Card

Negotiable

Choose

