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Artificial Intelligence and Machine Learning Lab(18CS62)

Department of CSE

Team Members

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Mentors

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Sign Language Interpretation using Machine Learning Techniques

Problem Domain

- The proposed problem lies in the domain of Machine learning for classification and pattern recognition
- Machine learning is method of data analysis which builds an analytical model . It's based on the principle that systems can learn from previous data and identify patterns and make decisions.
- The proposed problem falls under classification and identification of patterns in a given dataset of sign language gestures
- Methods such as Support Vector Machines can be used for classification problems.
- Neural Networks are also used for classification and pattern matching. They are composed of parallel subunits called neurons which have the ability to change weights with every iteration and adjust to a set of unique weights which give optimal results for the proposed problem

Statement of the problem

To create and develop a machine learning model to recognize and Interpret Sign language using classification algorithms

Objectives

1) To preprocess incoming image/video footage with various feature extraction techniques and pre-processing in order to enhance the efficacy of our implemented models.
2) To work with existing datasets to preprocess and collect them for usage in the creation of models.
3) To source incoming image footage from low-cost and already present camera hardware.
4) To Showcase various models that can recognize a subset of the Indian Sign Language
5) To be able to perform rudimentary sign-language gesture recognition of image/video footage
6) To benchmark few of the various suitable methods, and show their accuracy and precision
7) To Present a model that can (comparatively speaking) reliably recognize ISL so as to be able to convert ISL to text

Methodology

1. The process of sign language interpretation can be divided into three computations :
   a. Skin Segmentation
   b. Feature Recognition
   c. Classification

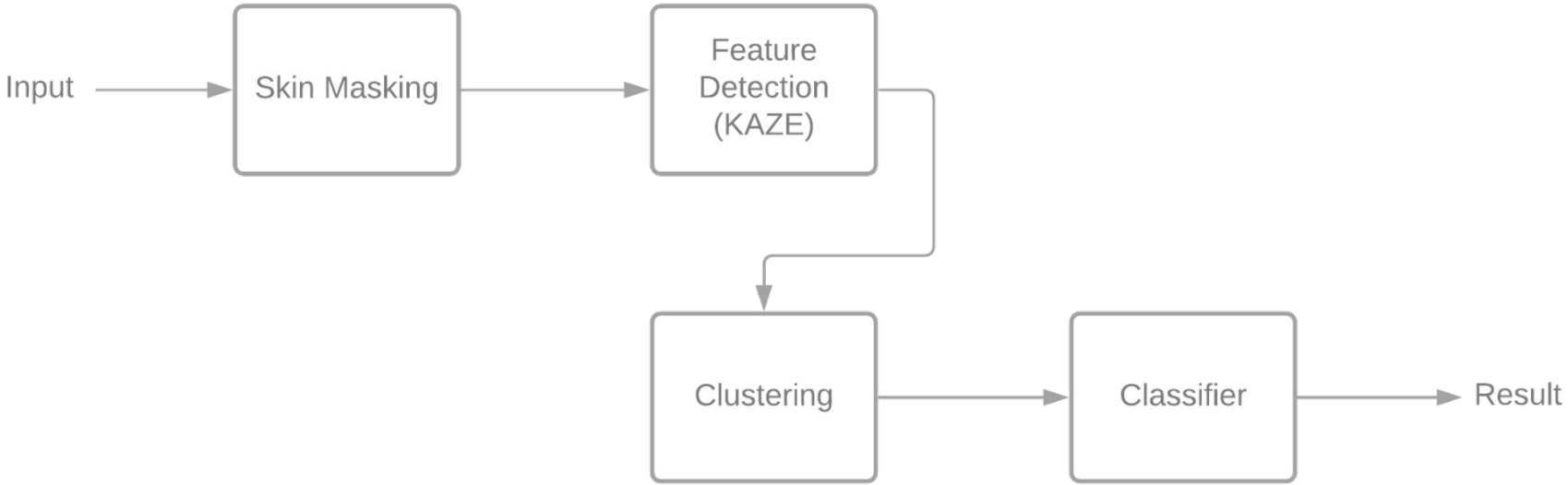
1. Skin segmentation aims at partitioning the skin present in the image based on various features eg. color, shape or texture. This preprocessing step helps remove unnecessary detail in the image to help improve efficacy of our system.

2. The feature recognition part of the process aims at recognizing the prominent and necessary features of the hand such as palm and finger tips. This would help us in narrowing down the necessary features which are to be worked on during the later stages. It is most popularly implemented using open source modules such as OpenCV.

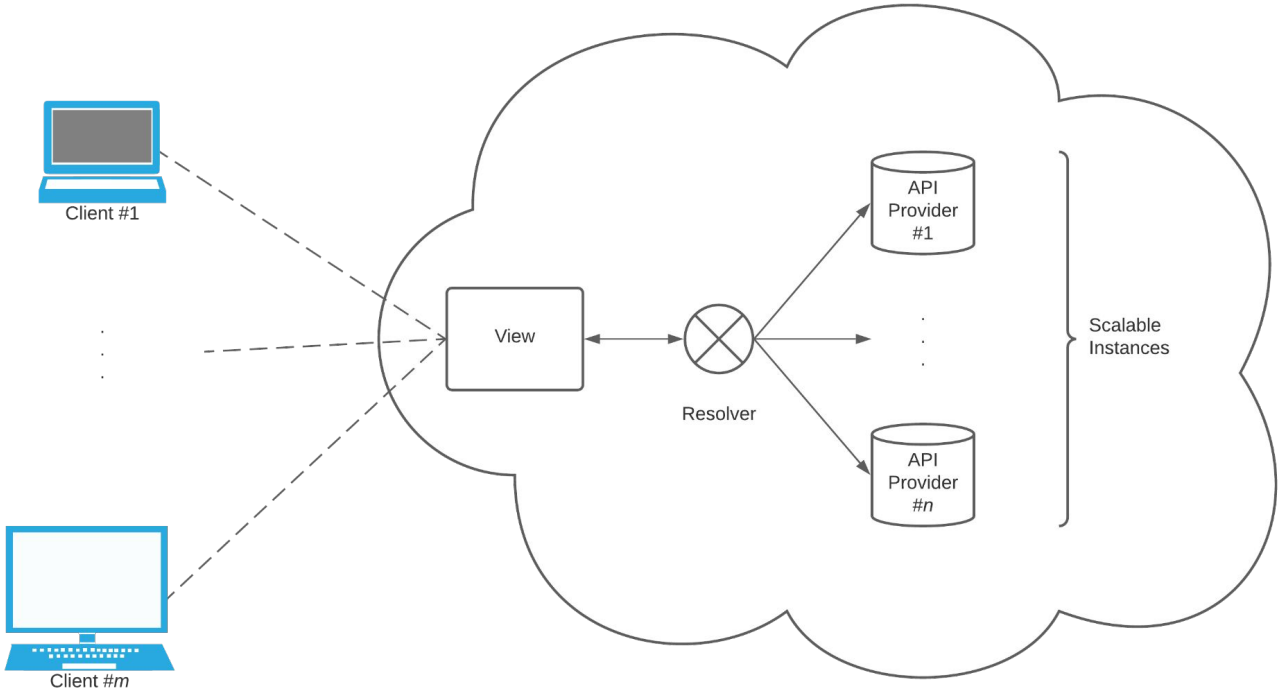
3. Classification is the crux of our project . We propose to test classification algorithms such as Support Vector Machine (SVM) , K Nearest Neighbor (KNN) and Naive Bayes Classifier (NBC) and document their working and efficacy at Sign Language interpretation.

4. The system must be fed with input that has been appropriately pre-processed. The aim is to ensure that the hardware required is minimal. The output is intended to be the text that has been translated/interpreted. The text may be interpreted separately or be embedded as captions.

Methodology



Architecture



Innovative Component

The motivation behind the project was a comparative study on the various models, and gain a deeper understanding of what would work better, and under what circumstances. Even considering this, novelty for the solution expands over the data set formation and usability:

- Inclusion of personal data inputs and establishing a new formed database for ISL.
- A hybrid data set which is an extension of existing sets with the current project inputs.
- Establishing a fresher and newer UI for public use.
- Producing a solution that can be scaled as per user requirements.

Results and Discussion

Data Processing

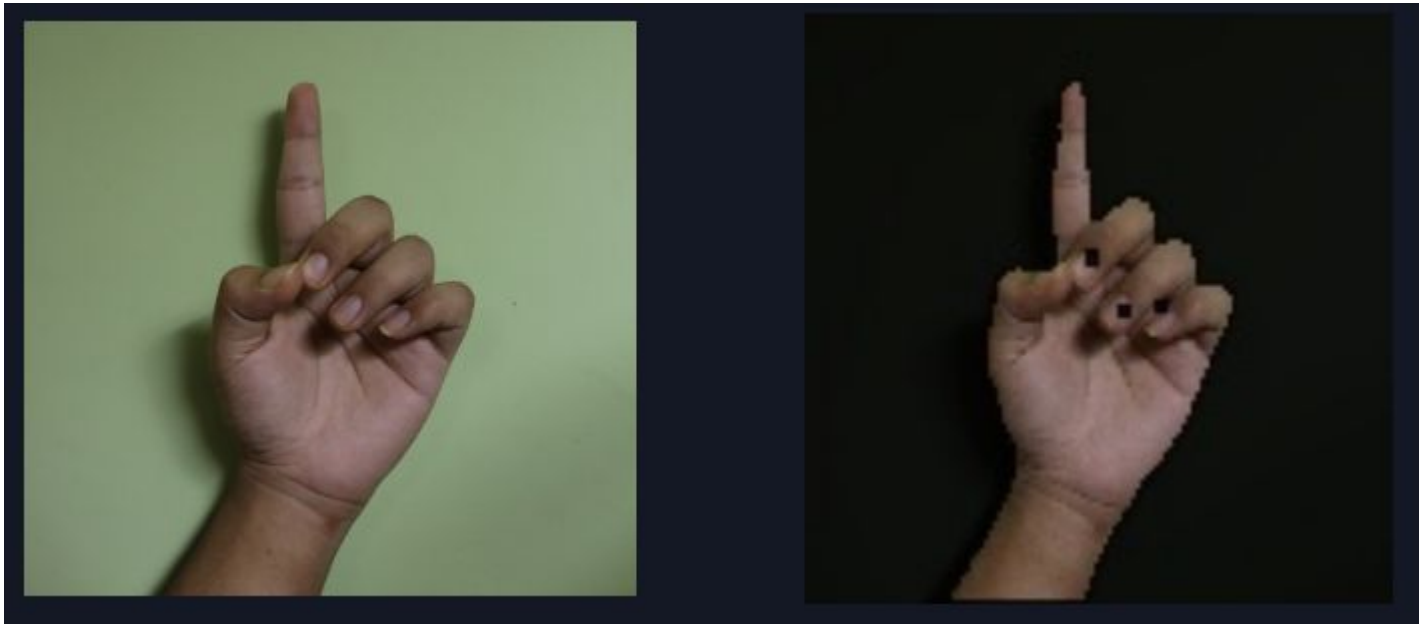
The dataset used for training the models was a combination of a few datasets for Indian Sign Languages, one of them being custom-created. The annotation for the custom dataset was performed manually, and the data set was normalized to a 128x128 size. The whole dataset is then passed through a preprocessing pipeline, which is given as below :

1) **Skin Segmentation:** Skin segmentation is used to retain the skin segment of a picture.Here, HSL thresholding was used to detect and conserve skin, and along with that, a single pass of morphological filtering was used to smooth out the image (Other methods seemed to have used multiple methods, but this was found to yield results that cropped out too much of the skin.)

2) **Feature detection:** Feature detection is used to find the featureset in this image. Since the now skin-segmented image consists of only skin-based data, it should work better to identify features. Some algorithms have used SURF and ORB, however we picked up as a reliable and fast feature detection algorithm

3) **Clustering:** The Visual Bag of Words concept is used here, to obtain a histogram, formed from the key points and descriptors as obtained in the previous steps. This yields key features and the resultant data which is actually used during classification.

Results and Discussion



Resizing and skin segmentation

Results and Discussion

1) kNN algorithm result :

accuracy			0.97	6014
macro avg	0.96	0.93	0.94	6014
weighted avg	0.97	0.97	0.97	6014

2) SVM algorithm result :

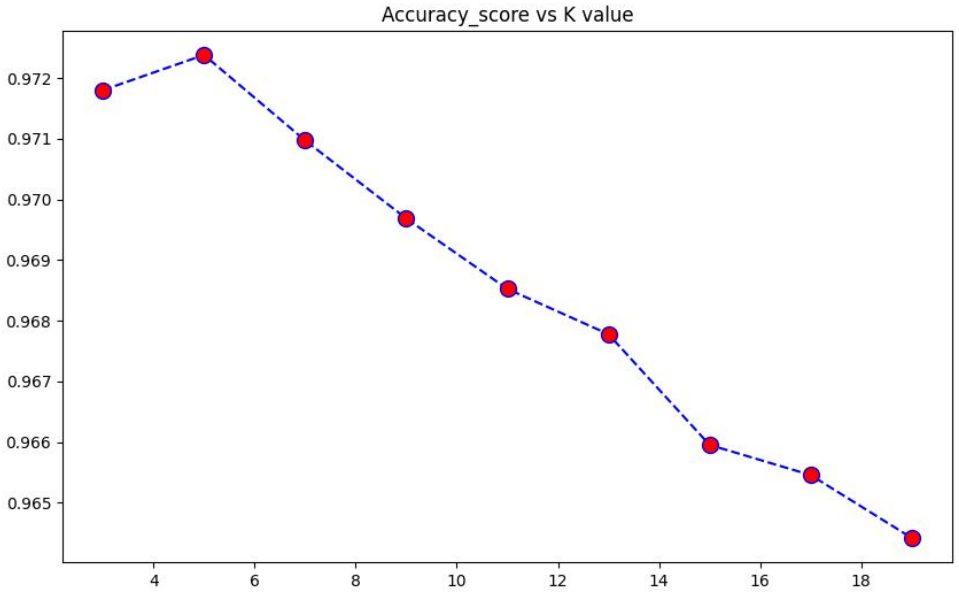
accuracy			0.98	6014
macro avg	0.96	0.96	0.96	6014
weighted avg	0.98	0.98	0.98	6014

3) NBC algorithm result

accuracy			0.93	6014
macro avg	0.91	0.94	0.91	6014
weighted avg	0.93	0.93	0.93	6014

```
GNB
[25 25 25 ... 34 34 34]
0.8875956102427669
MNB
0.9459594280013303
BNB
0.9286664449617559
```

Results and Discussion



K value vs Accuracy score

Results and Discussion

Results

Type	Classification
SVM	None
7-KNN	None
G-NBC	None
Majority(FallBack KNN)	None

Reset

Figure 1: Random Image

Upload file

Choose File capt0001.jpg

Submit

Results

Type	Classification
SVM	L
7-KNN	1
G-NBC	L
Majority(FallBack KNN)	L

Reset

Figure 2: L sign

Results and Discussion

Upload file

Choose File 1173.jpg

Submit

Results

Type	Classification
SVM	2
7-KNN	2
G-NBC	2
Majority(FallBack KNN)	2

Reset

Figure 3: Sign 2

Upload Image

Upload file

Choose File 20210725_231158.jpg

Submit

Results

Type	Classification
SVM	9
7-KNN	1
G-NBC	9
Majority(FallBack KNN)	9

Reset

Figure 4 : Sign 9