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Mahim, Mumbai 400016
Department of Information Technology
(Affiliated to University of Mumbai)

# IDENTIFICATION OF INDIAN SIGN LANGUAGE

**Group 9**

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# Academic Year 2022-23

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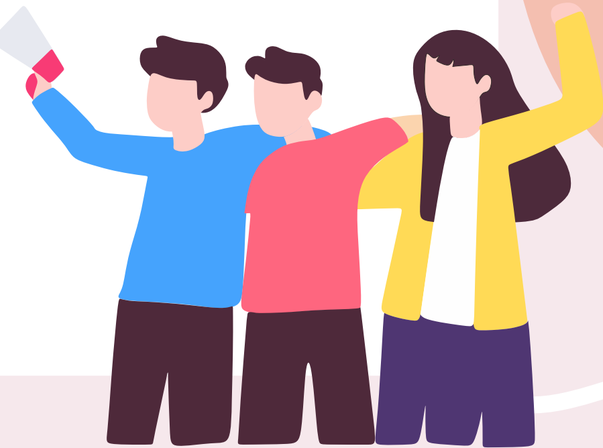

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# Contents:

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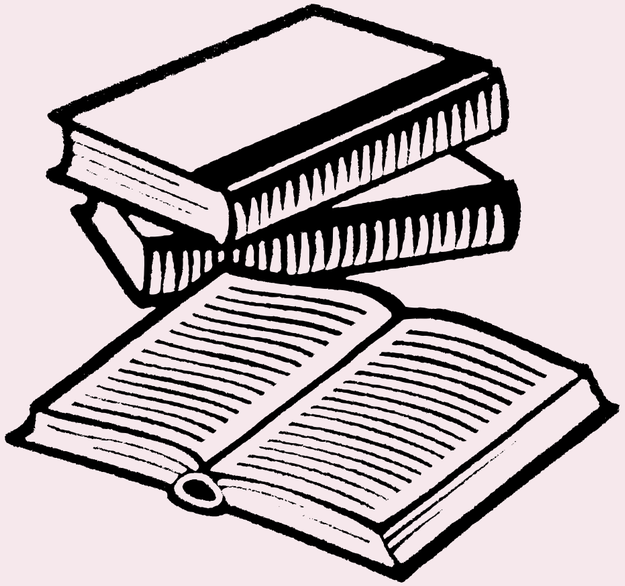
# Introduction

- Deaf and hard-of-hearing persons use sign language, a visual-gestural language, to communicate.
- Hand gestures and other body movements are used to convey meaning. The syntax and vocabulary of this language are wholly different from those of spoken and written languages.
- Similar to how spoken language employs rules to generate comprehensive messages, sign language is structured by complex grammar.
- An AI converting sign language into text or speech providing environment for communication between normal and deaf community.

# LITERATURE SURVEY

| Year | Authors | Title | Algorithm Architecture | Performance Results |
|---|---|---|---|---|
| 2015 | Lionel Pigou, Sander Dieleman, Pieter-Jan Kindermans, Benjamin Schrauwen [2] | Sign Language Recognition using Convolutional Neural Networks. | CNN, ANN | The accuracy on the test set is 95.68% and observe a 4.13% false positive rate, caused by the noise movements |
| 2018 | G.Anantha Rao K.Syamala, P.V.V.Kishore, A.S.C.S.Sastry [3]. | Deep Convolutional Neural Networks for Sign Language Recognition. | CNN | Deep Convolutional Neural Networks for Sign Language Recognition. CNN Comparing the proposed CNN model to existing state-of-the-art classifiers, its average recognition rate was higher at 92.88%. |
| Apr 2018 | Jie Huang, Wengang Zhou, Qilin Zhang, Houqiang Li, Weiping Li [4]. | Video-Based Sign Language Recognition without Temporal Segmentation. | Two-stream 3D CNN | Proposed method LS-HAN achieves 82.7 % accuracy which is more than LSTM-E 76.8%. |
| June 2018 | M.A Hossen, Arun Govindaiah, Sadia Sultana, Alauddin Bhuiyan [5]. | Bengali Sign Language Recognition Using Deep Convolutional Neural Network | Pre-trained VGG16, CNN | Proposed recognition system results - validation loss of 0.3523 (categorical cross-entropy) and validation accuracy of 84.68%. |
| 2018 | Kshitij Bantupalli, Ying Xie [6] | American Sign Language Recognition using Deep Learning and Computer Vision. | CNN, RNN, Machine learning, HMM. | Instead of using Pool Layer, the system was able to attain 93% accuracy with SoftMax Layer. |



| Year | Authors | Title | Algorithm Architecture | Performance Results |
|---|---|---|---|---|
| 2020 | Dongxu Li , Chenchen Xu, Xin Yu, Kaihao Zhang, Ben Swift , Hanna Suominen, Hongdong Li [11] | TSPNet: Hierarchical Feature Learning via Temporal Semantic Pyramid for Sign Language Translation | TSPNet, NMT | Conv2d-RNN and TSPNet-Single outperform the state-of-the-art SLT model, Conv2d-RNN, by a large margin. The relative improvement in BLEU-4 score is 39.80% (9.58 → 13.41), and the improvement in ROUGE-L is 9.94% (31.80 → 34.96). |
| 2020 | Necati Cihan Camg,Oscar Koller, SimonHadfifield and Richard Bowden [12]. | Sign Language Transformers: Joint End-to-end Sign Language Recognition and Translation. | RNN-based attention architectures, Connectionist Temporal Classification (CTC). | Compared to earlier approaches, the authors Language Transformers outperform both their recognition and their translation effectiveness with a 2% reduction in word error rate. |
| 2021 | Rachana Patil, Vivek Patil, Abhishek Bahuguna, and Mr. Gaurav Datkhile [13] | Indian Sign Language Recognition using Convolutional Neural Network. | CNN | The model achieved a validation accuracy of approximately 95%. |
| 13 Apr 2022 | Razieh Rastgoo, Kourosh Kiani, Sergio Escalera [14]. | Word separation in Continuous sign language using isolated signs and post-processing | CNN, LSTM | The proposed model obtains an average of recognized Softmax outputs equal to 0.98 and 0.59. |
| 30 Apr 2022 | Abdul Mannan, Ahmed Abbasi, Abdul Rehman Javed, Anam Ahsan, Thippa Reddy Gadekallu, Qin Xin [15]. | Hypertuned Deep Convolutional Neural Network for Sign Language Recognition | CNN | The proposed Deep CNN model can recognize the ASL alphabets with an accuracy rate of 99.67% on unseen test data. |

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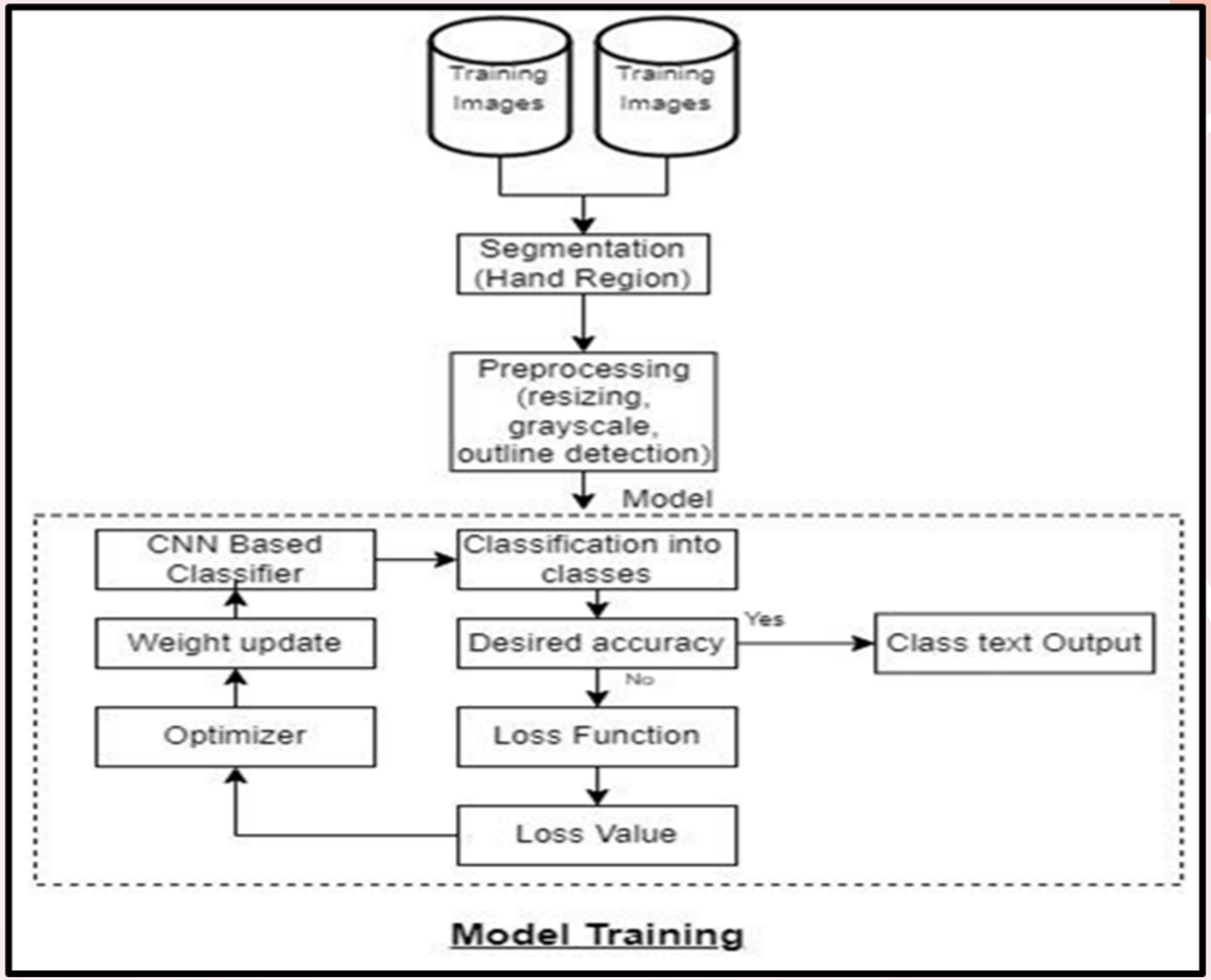
# MODEL TRAINING



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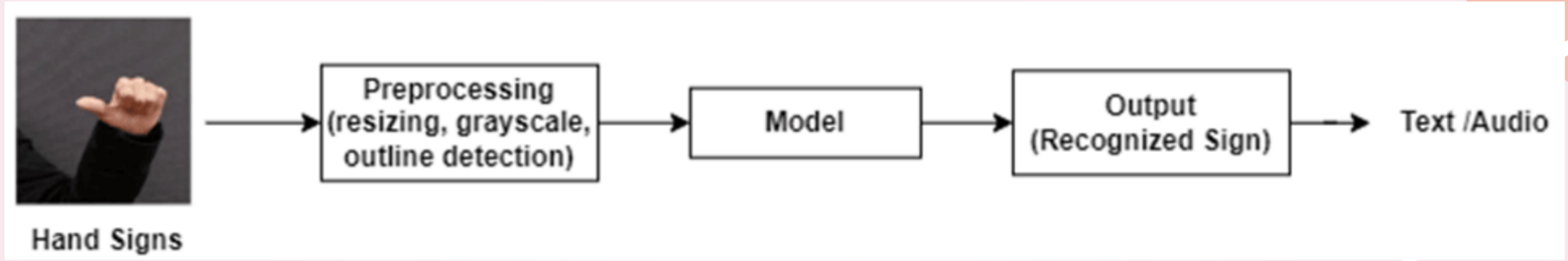


Fig. Block diagram of Hand Sign to Text/Audio conversion

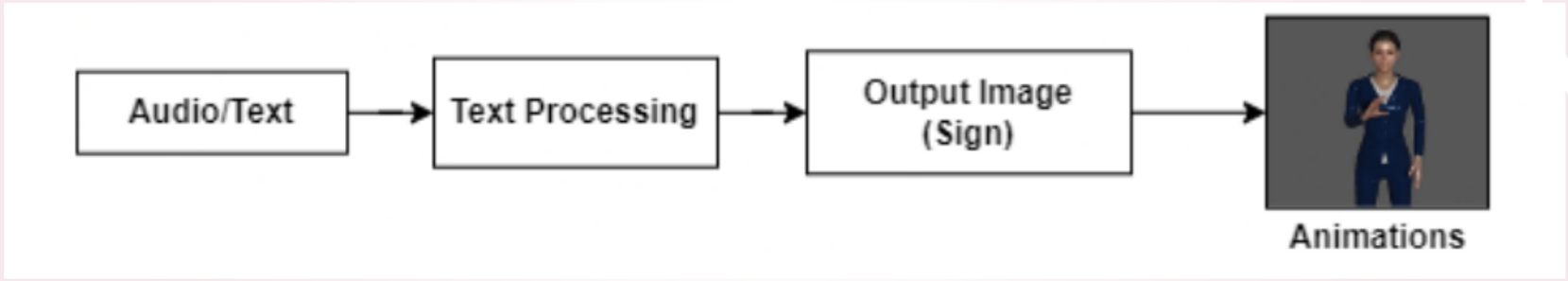


Fig. Block diagram of Audio/Text to Hand Sign conversion

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# REQUIREMENTS

## HARDWARE

COMPUTER/ LAPTOP

- MINIMUM 4GB RAM
- I3 PROCCESSOR 11TH GENERATION
- NVIDIA MX 330

## SOFTWARE

VS CODE

GOOGLE COLAB PLATFORM / GPU

GUI: HTML, CSS, JAVASCRIPT

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# MODERN TOOLS

- Blender
- Tensorflow
- Google Mediapipe
- NLTK
- CNN
- KNN

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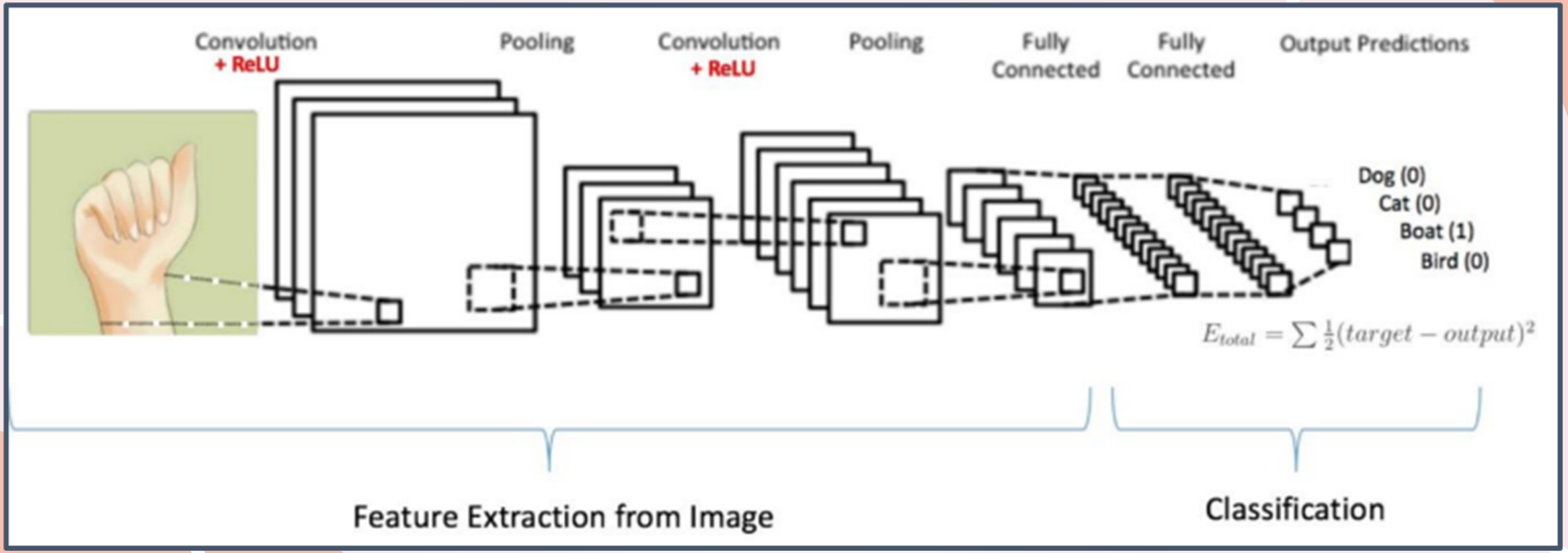
# PROPOSED METHODOLOGY (ALGORITHM / FLOWCHART ETC)



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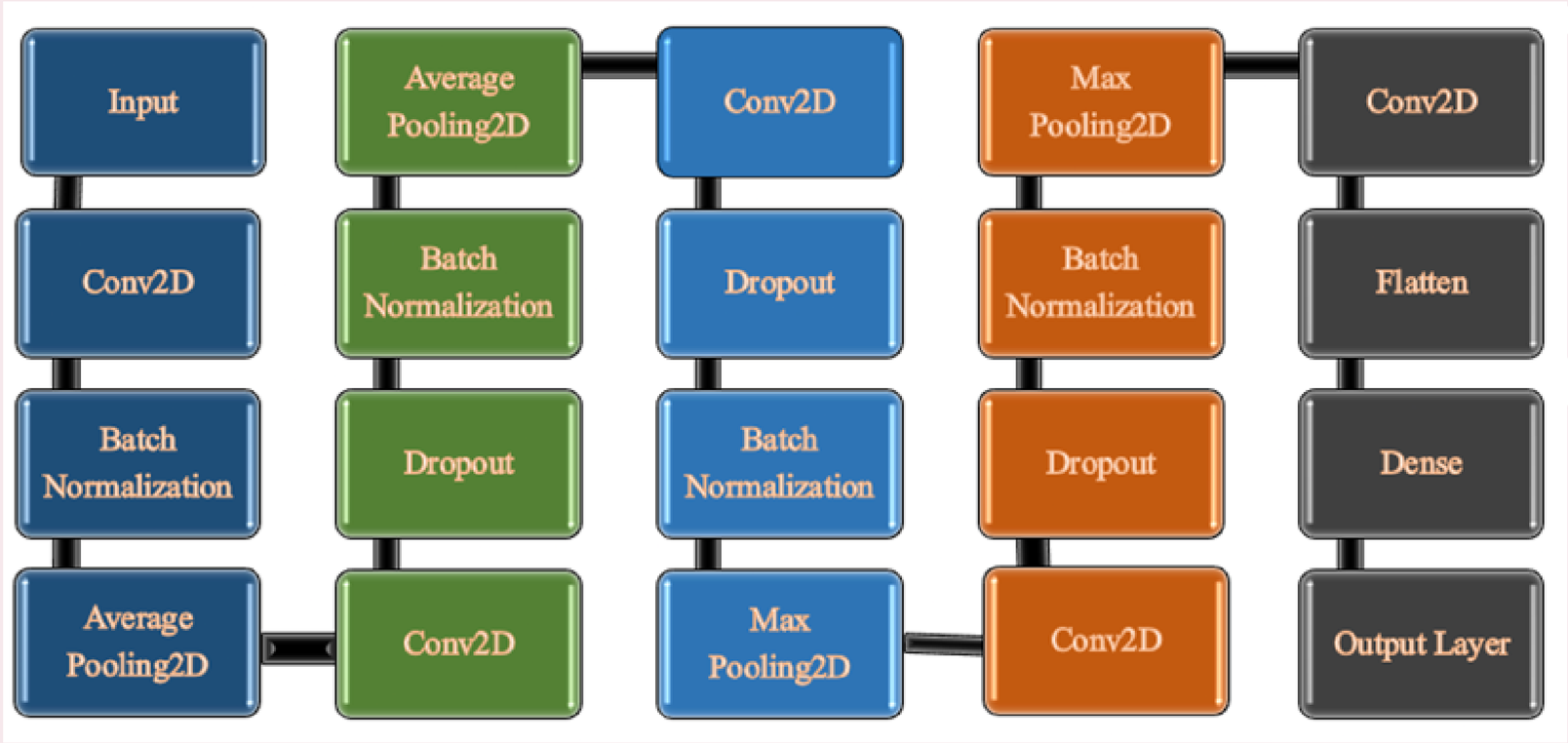
# PROPOSED CNN MODEL ARCHITETCURE



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| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Pre-processing Approach | Gaussian Blur and Gray Scaling | Gaussian Blur, Gray scaling, Thresholding and Edge detection | Gaussian Blur, Gray scaling, Edge detection , Varying Augmentation parameters and 30% Dataset 2 mixture. | Gaussian Blur, Gray scaling, Edge detection and 70% of Dataset 1 + 70% of Dataset 2 | Mediapipe hand detection, Drawing finger joints, Gaussian Blur,Gray scaling and Edge detection |

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| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| CNN Layers | 6 | 6 | 6 | 6 | 6 |
| Activation, Optimizer | ReLU,Adam | ReLU,Adam | ReLU,Adam | ReLU,Adam | ReLU,Adam |

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| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Result: | Accurate classification of test classes<br>Low recognition rate of 0.8% on unseen data<br>Inability to recognize in real-time video frames<br>Model needs improvement for practical use | Accurate classification of all test set classes<br>Improved recognition rate from 0.8% to 15% on unseen data<br>Indicates enhanced generalization capabilities<br>Still struggles to recognize hand signs in real-time video frames. | 30% of Dataset 2 included in training set<br>Recognition rate improved on unseen set<br>Improvement observed<br>Dataset 2 incorporation helped | Model achieved 77% accuracy on unseen test dataset<br>Poor performance in real-time classification<br>Unable to identify classes in real-time<br>Further improvements required for real-time usage. | Model achieved 99.50% accuracy.<br>Real-time sign language recognition.<br>K-Nearest Neighbor classifier used.<br>Effective communication for deaf individuals. |

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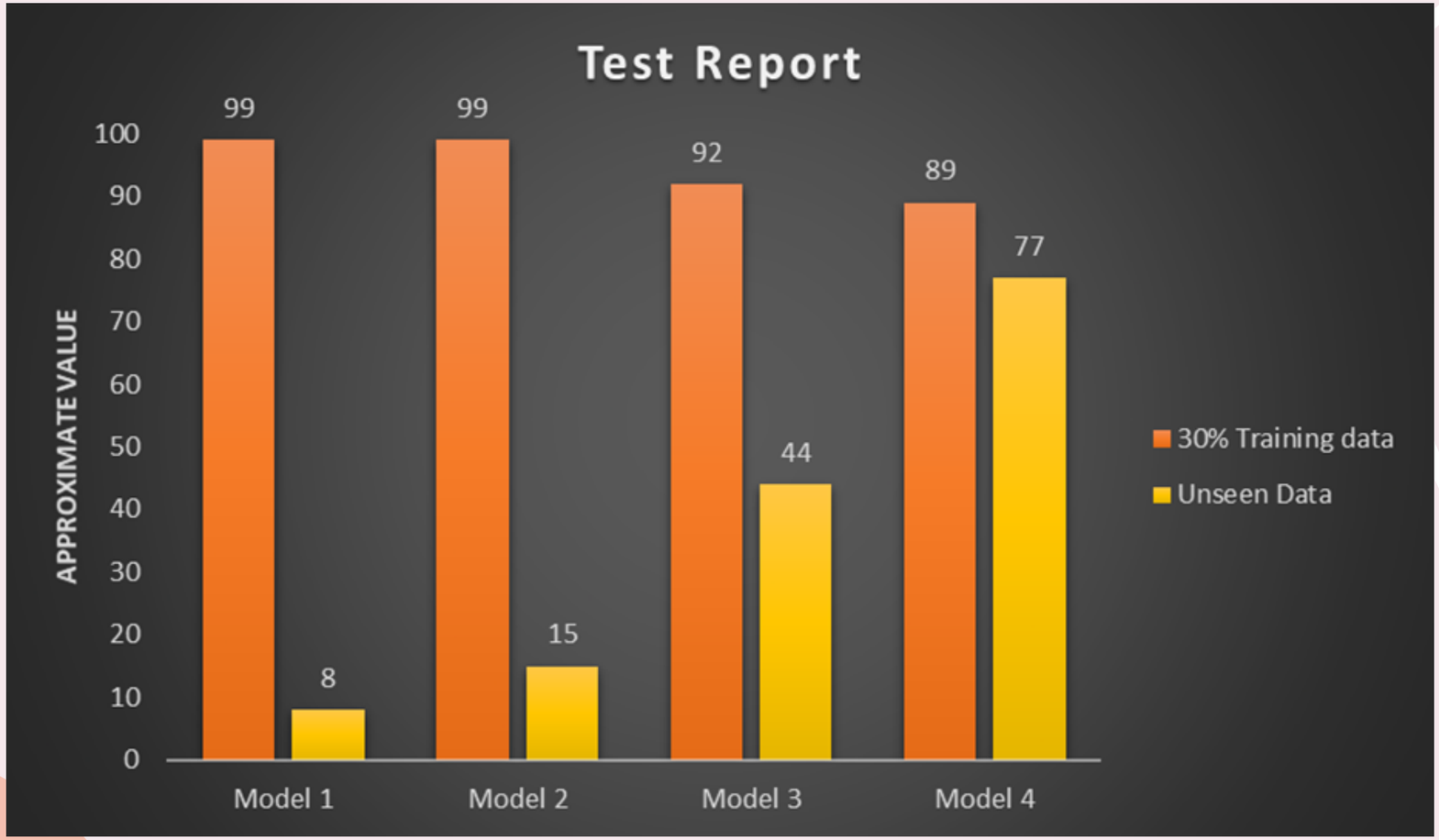
# SUMMARIZED TEST RESULT OF MODELS 1–4



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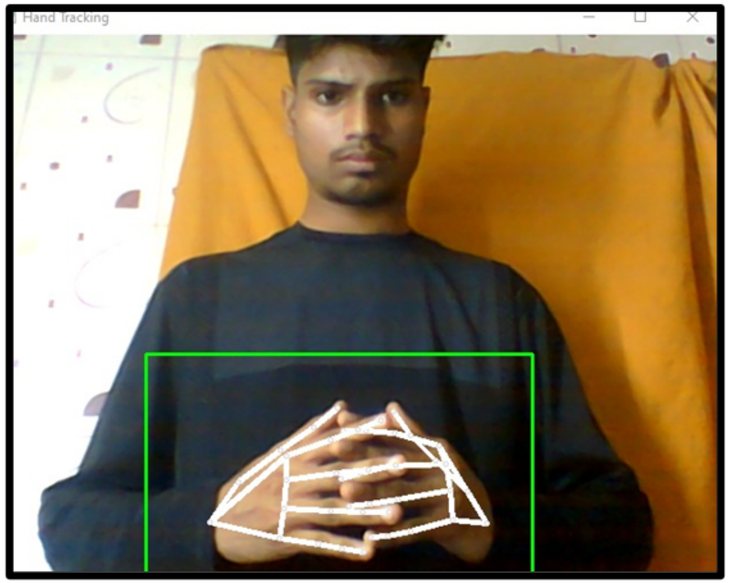


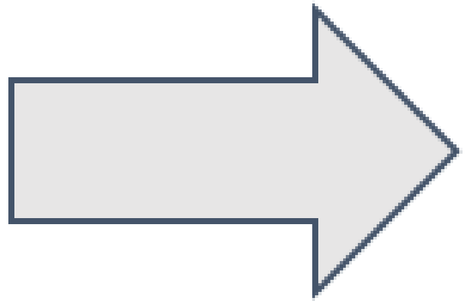

- Mediapipe's hand segmentation technique, which finds hands in the picture.
- Extracts the hand pose from given frame
- This extracted frame is the input to our Model

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Taking input from camera in grayscale

Applying preprocessing

Inverting pixel's

Transformed Image given to Model

Model

Sign

Corresponding sign

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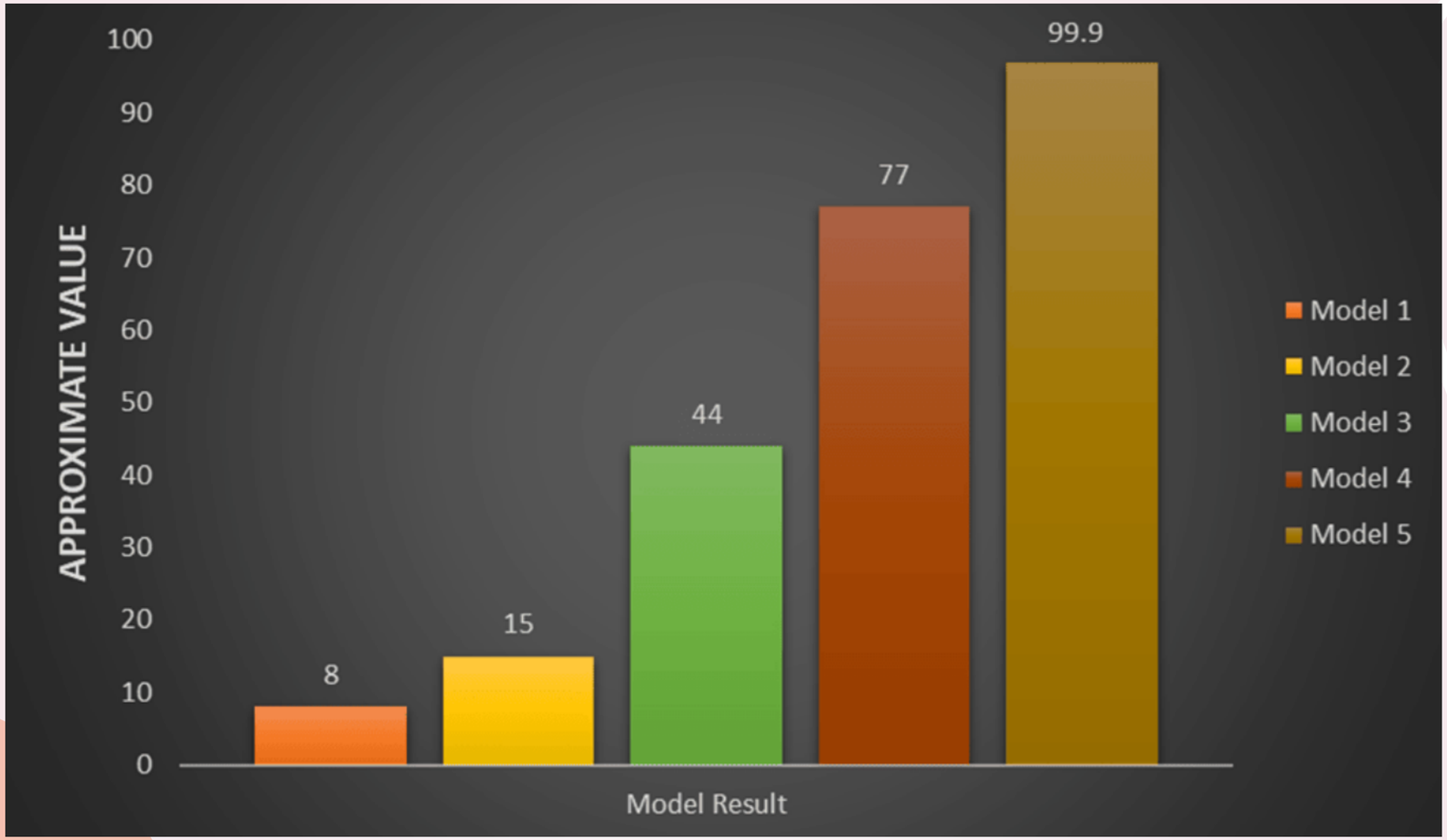
# SUMMARIZED TEST RESULT OF MODELS 1-5



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# TEXT TO SIGN LANGUAGE ANIMATION

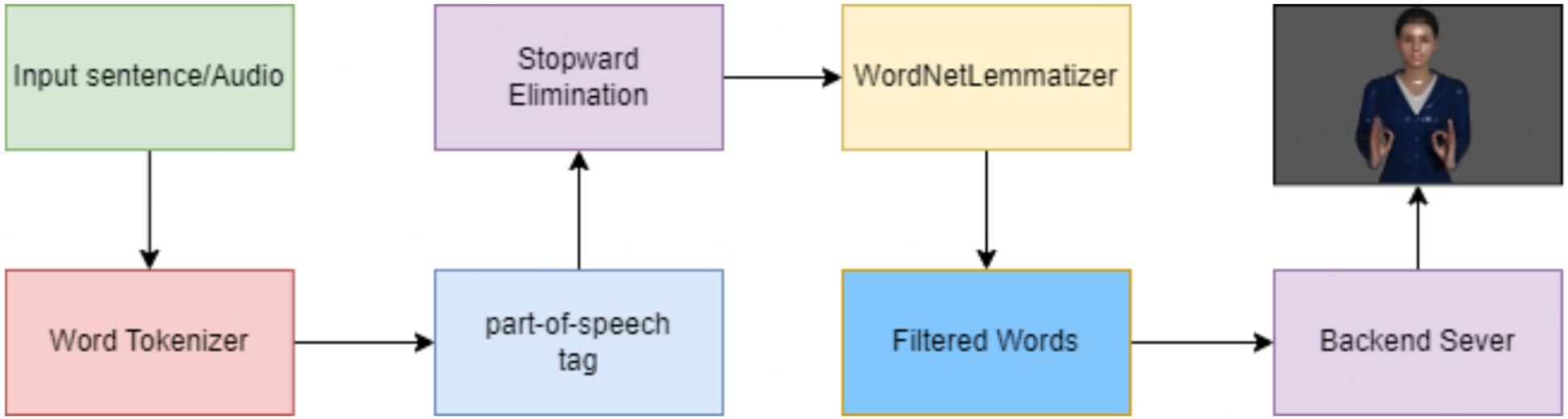


*Fig*. Text to ISL Animation

To create animations for Indian Sign Language hand motions, the team utilized Blender, a 3D modeling software.

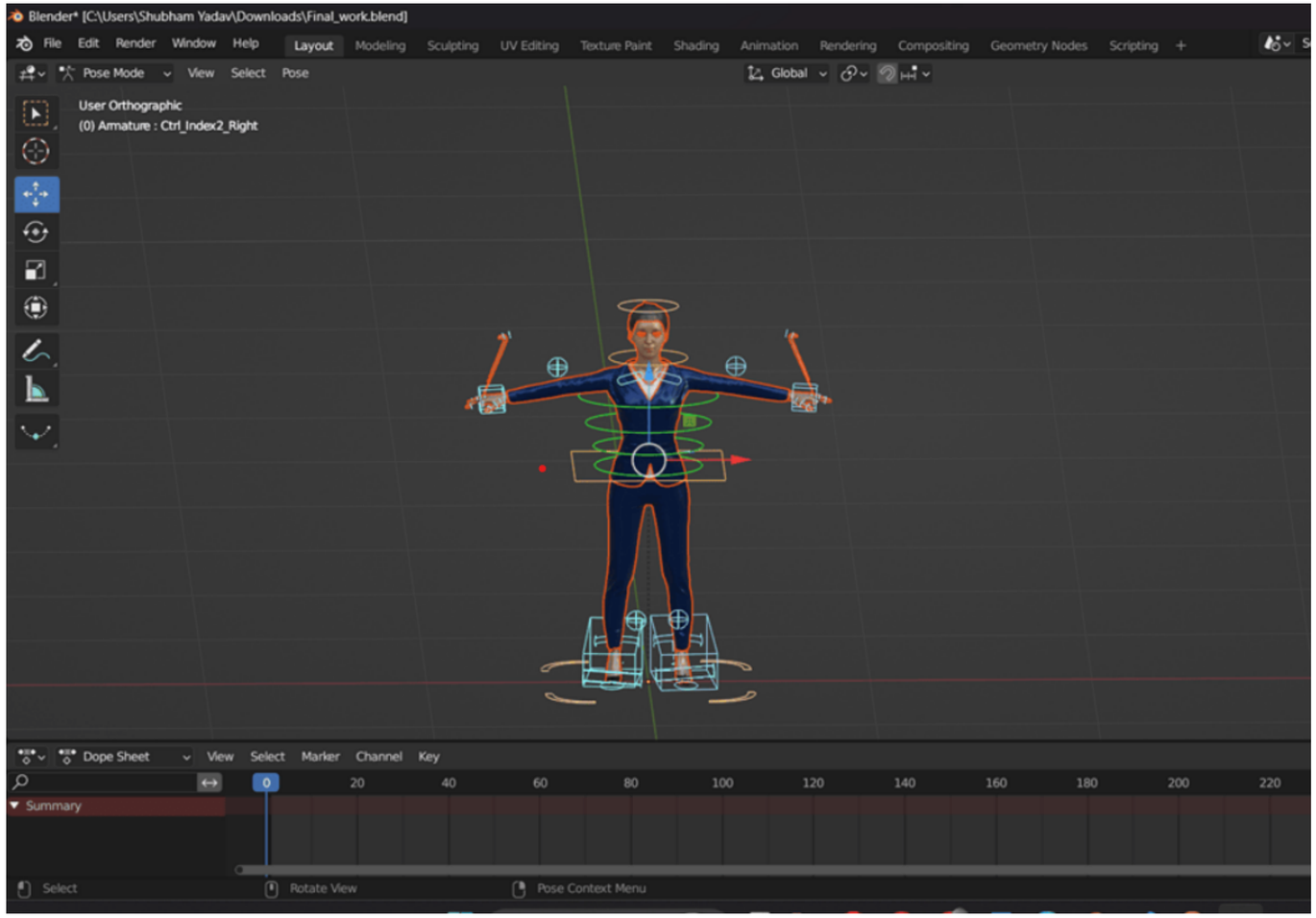


*Fig*. Blender 3D character used for animation

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# APPLICATION'S USER INTERFACE

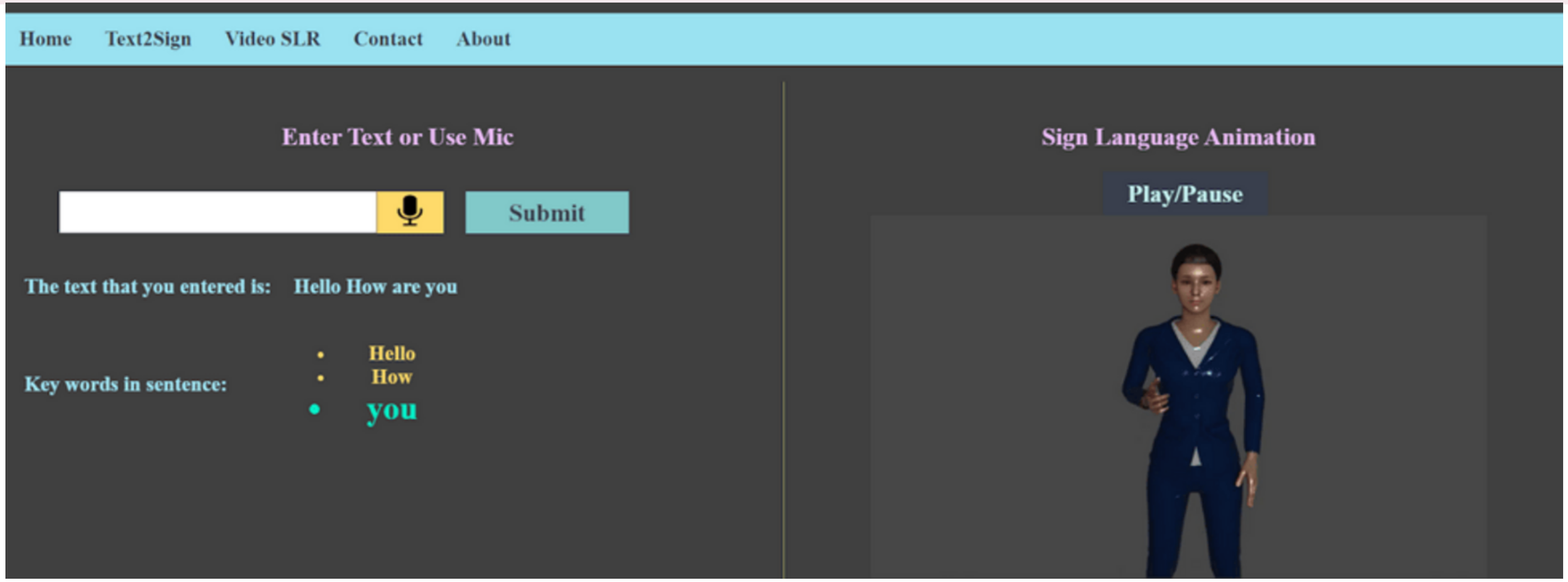


*Fig*. Animation playing on frontend

- The use of Blender and rigging systems allowed for the creation of realistic and accurate animations of Indian Sign Language hand motions, which are integrated into the application's user interface.
- This feature enables users to communicate with Sign Language in a more natural and intuitive way, without requiring prior knowledge of the language

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# CONCLUSION

To build a model for real-time applications, careful attention should be given to preprocessing and feature extraction. Our experiments demonstrated that Model 5 outperformed previous models in real-time applications. It is observed that modifying the preprocessing steps improved the results on static data but resulted in poor performance in real-time applications. Thus, we recommend extracting features from video frames using model 5 approach or other techniques like optical flow and training the model using more complex neural network structures such as CNN-RNN to obtain better results.

# REFERENCES


**[1]** K.Shenoy,Tejas Dastane,Varun Rao,Devendra Vyavaharkar,“RealtimeIndianSignLanguage(ISL)Recognition” ,1 July 2021.
**[2]** Lionel Pigou, Sander Dieleman, Pieter-Jan Kindermans, Benjamin Schrauwen. ”Sign Language Recognition using Convolutional Neural Networks”, 2015.
**[3]** G.Anantha Rao, K.Syamala, P.V.V.Kishore, A.S.C.S.Sastry, “Deep Convolutional Neural Networks for Sign Language Recognition.” , 2018.
**[4]** Jie Huang, Wengang Zhou, Qilin Zhang, Houqiang Li, Weiping Li, “Video-Based Sign Language Recognition without Temporal Segmentation”, AAAI-18, April 2018.
**[5]** M.A Hossen, Arun Govindaiah, Sadia Sultana, Alauddin Bhuiyan “Bengali Sign Language Recognition UsingDeep Convolutional Neural Network” June 2018.
**[6]** Kshitij Bantupalli, Ying Xie, “American Sign language identification using Deep Learning and Computer Vision.”, IEEE,2018.
**[7]** Sruthi C. J and Lijiya A. Member, “Signet: A Deep Learning based Indian Sign Language Recognition System.”,IEEE, April 2019.
**[8]** Lean Karlo S. Tolentino, Ronnie O. Serfa Juan, August C. Thio-ac, Maria Abigail B. Pamahoy, Joni Rose R. Fortezaz and Xavier Jet O. Garcia. “Sign language identification using Deep Learning.”, IJMLC, December 2019.
**[9]** Ankita Wadhawan, Parteek Kumar, “Deep learning-based sign language recognition system for static signs” , Jan 2021.
**[10]** Prof. Radha S. Shirbhate, Mr. Vedant D. Shinde, Ms. Sanam A. Metkari, Ms. Pooja U. Borkar, Ms. Mayuri A. Khandge. ”Sign language Recognition Using Machine Learning Algorithm” March 2020.


# THANK YOU!