

Neural Networks Project - Gesture Recognition

Objectives:

The main objective is to build a gesture recognition feature in the smart-TV using deep learning techniques that can recognize five different gestures performed by the user which will help users control the TV without using a remote .

The following table consists of the experiments conducted to develop a Model for predicting gestures from the provided datasets.

Experiment Number	Model	Result	Decision + Explanation
	Conv3D	OOM Error	Reduce both the batch size and the number of neurons in the dense layer.
Model- 1	Conv3D	Training Accuracy : 0.97 Validation Accuracy : 0.25	The Model is learning too much from the training data and not generalizing well to new data. Let's some dropout layers Total Parameters:1117061
Model- 2	Conv3D	Early stopping at: epoch:11/25 Training Accuracy : 0.83 Validation Accuracy : 0.32	The epoch is automatically stopped early by early stopping since the validation loss did not show any improvement. Let's lower the learning rate to 0.0002. Total Parameters:3638981
Model- 3	Conv3D	Early stopping at: epoch:11/25 Training Accuracy : 0.73 Validation Accuracy : 0.29	The Model achieved a slight improvement. We've successfully reduced the parameter size by half compared to the earlier Model. Let's experiment with adding more layers to further enhance the Model's performance. Total Parameters:1,762,613

Model- 4	Conv3D	Training Accuracy : 0.92 Validation Accuracy : 0.89	With the addition of more layers, we haven't observed significant performance improvement. Let's introduce dropout layers at the convolution layers and observe the effects. Total Parameters:2,556,533
Model- 5	Conv3D	Training Accuracy : 0.90 Validation Accuracy : 0.25	It seems that adding dropouts at the convolution layers has led to over fitting again, as indicated by the reduction in validation accuracy. The Model is struggling to generalize well to unseen data. Let's try to reduce the parameters Total Parameters:2,556,533
Model- 6	Conv3D	Training Accuracy : 0.80 Validation Accuracy : 0.21	Validation accuracy low. Let's try to reduce the parameters. Total Parameters: 696,645
Model- 7	Conv3D	Training Accuracy : 0.80 Validation Accuracy : 0.27	It seems there hasn't been a noticeable improvement in the validation accuracy. Let's switch to CNN+LSTM. Total Parameters: 504,709
Model- 8 (Final Model)	CNN+LSTM	Training Accuracy : 0.98 Validation Accuracy : 0.89	We achieved the highest validation accuracy of 86% with the CNN-LSTM Model. Total Parameters:1,657,445
Let's employ some data augmentation and check the model's performance:			
Model- 9	Conv3D	Training Accuracy : 0.78 Validation Accuracy : 0.81	(3,3,3) Filter & 160x160 Image resolution, similar to Model 2 Total Parameters: 3,638,981
Model- 10	Conv3D	Training Accuracy : 0.71	(2,2,2) Filter & 120x120 Image resolution, similar to Model 3. Network is generalizing well.

		Validation Accuracy : 0.73	Total Parameters: 1,762,613
Model- 11	Conv3D	Training Accuracy : 0.78 Validation Accuracy : 0.73	Adding more layers, Similar to Model 4: Total Parameters: 2,556,533
Model- 12	Conv3D	Training Accuracy : 0.71 Validation Accuracy : 0.26	Adding dropouts, Similar to Model 5: Very low performance. Let's reduce the network parameters. The Model is experiencing significant over fitting. Total Parameters: 2,556,533
Model- 13	Conv3D	Training Accuracy : 0.82 Validation Accuracy : 0.78	Reducing network parameters, Similar to Model 6: After reducing network parameters, Model's performance is quite good. Total Parameters: 696,645
Model- 14	Conv3D	Training Accuracy : 0.80 Validation Accuracy : 0.85	Reducing network parameters again, Similar to Model 7: Total Parameters: 504,709
Model- 15	CNN LSTM with GRU	Training Accuracy : 0.99 Validation Accuracy : 0.85	Over fitting is considerably high, not much improvement. Total Parameters: 2,573,925
Model- 16	Transfer Learning (Optional)	Training Accuracy : 0.97 Validation Accuracy : 0.82	Since we're not training the MobileNet weights, we're encountering poor validation accuracy. Let's include training them and assess if it enhances performance. Total Parameters: 3228864

Model- 17	Transfer Learning with GRU &(Optional)	Training Accuracy : 0.99 Validation Accuracy : 0.99	Achieving a training accuracy of 99% and a validation accuracy of 99% is truly remarkable!
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Final Model: Model -8, CNN+LSTM

Conclusion: After conducting extensive experiments, we can conclude that Model 8, utilizing a combination of CNN and LSTM, exhibited strong performance. So we can select it as our final selection.

- Model 8 achieves a commendable Training Accuracy of 98% and Validation Accuracy of 89%, indicating its capability to generalize well to unseen data.

- Model 8 has fewer parameters compared to other models, while maintaining strong performance.

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