**GESTURE RECOGNITION**

| **Si No.** | **Model Architecture** | **Model Name** | **Best Model Results** | **Model Parameters Details** | **Model Detail** | **Model Description** | **Best Model File** | | **Model Plots** | | **Comments** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Size** | **Accuracy** | **Loss** |
|  | | | | | | | | | | | |
| 1 | CONV3D | Model\_01 | **Accuracy:** 0.9412  **Loss:** 0.1593  **Validation Accuracy:** 0.84  **Validation Loss:** 0.522 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-1: Default CONV3D model | Default model for the experiment with kernel size as 1, epoch equal to 15, batch size equal to 32, "Adam" optimizer and image dimension to be 120x120 with 20 frames considered per video | [model-00012-0.15933-0.94118-0.52198-0.84000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_01/model-00012-0.15933-0.94118-0.52198-0.84000.h5) | 23.3MB | [Model\_01\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_01/model_01_accuracy_plot.png) | [Model\_01\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_01/model_01_loss_plot.png) | Default model for the experiment. Consists of 3 hidden layers with filters including that for the input layer being (16, 32, 64, 128), kernel size as (3,3,3), pooling size as (2,2,2), padding type as "same", default epoch set to 30 and batch size as 32. Also, has 2 dense layers with dropout value set to 0.0. Number of images considered per video is set to 20 |
| 2 | CONV3D | Model\_02 | **Accuracy:** 0.9472  **Loss:** 0.1455  **Validation Accuracy:** 0.81  **Validation Loss:** 0.4262 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-2: Model-1 with frames to be considered increased to 30 | Model\_01 with the number of frames to be considered per video increased to 30 | [model-00012-0.14553-0.94721-0.42624-0.81000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_02/model-00012-0.14553-0.94721-0.42624-0.81000.h5) | 23.3MB | [Model\_02\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_02/model_02_accuracy_plot.png) | [Model\_02\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_02/model_02_loss_plot.png) | Increase in the number of images per video to be considered is to check if the model accuracy improves when more data is presented.  No significant improvement found and hence 20 frames per video seems to be a better value. Model is overfitting |
| 3 | CONV3D | Model\_03 | **Accuracy:** 0.9336  **Loss:** 0.2192  **Validation Accuracy:** 0.81  **Validation Loss:** 0.5126 | **Total Parameters:** 1,507,781  **Trainable Parameters:** 1,506,533  **Non-Trainable Parameters:** 1,248 | Model-3: Model-1 with image height and width adjusted to 100 | Model\_01 with image height and width adjusted to 100 | [model-00013-0.21919-0.93363-0.51265-0.81000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_03/model-00013-0.21919-0.93363-0.51265-0.81000.h5) | 18.2MB | [Model\_03\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_03/model_03_accuracy_plot.png) | [Model\_02\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_03/model_03_loss_plot.png) | Model-1's image dimension is set to 120x120. Changing it to 100x100 to check if that leads to an improvement in the model results.  The accuracy dips and hence we can conclude that a few details are missed when the dimensions for the image is reduced. Model is overfitting. |
| 4 | CONV3D | Model\_04 | **Accuracy:** 0.9532  **Loss:** 0.1501  **Validation Accuracy:** 0.78  **Validation Loss:** 1.1877 | **Total Parameters:** 537,909  **Trainable Parameters:** 536,661  **Non-Trainable Parameters:** 1,248 | Model-4: Model-1 with CONV3D filters in decreasing order | Model\_01 with the CONV3D filters inreverse order i.e., (128, 64, 32, 16) | [model-00014-0.15013-0.95324-1.18771-0.78000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_04/model-00014-0.15013-0.95324-1.18771-0.78000.h5) | 6.6MB | [Model\_04\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_04/model_04_accuracy_plot.png) | [Model\_04\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_04/model_04_loss_plot.png) | Model-1 has the input+hidden layers filter as (16, 32, 64, 128), for experimentation purposes checking for the results when the filters are reversed i.e., (128, 64, 32, 16).  Even though the training accuracy increases by a percent or 2, the validation accuracy along with validation loss is not in acceptable range. This model is overfitting to a large extent. |
| 5 | CONV3D | Model\_05 | **Accuracy:** 0.9879  **Loss:** 0.0511  **Validation Accuracy:** 0.89  **Validation Loss:** 0.2539 | **Total Parameters:** 1,900,997  **Trainable Parameters:** 1,900,005  **Non-Trainable Parameters:** 992 | Model-5: Model-1 with single dense layer with filter (256) | Model\_01 has 2 dense layers with size 128 and 256. For Model-05, while retaining the structure, the dense layer is reduced to 1 with size 256 | [model-00014-0.05114-0.98793-0.25387-0.89000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_05/model-00014-0.05114-0.98793-0.25387-0.89000.h5) | 22.9MB | [Model\_05\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_05/model_05_accuracy_plot.png) | [Model\_05-Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_05/model_05_loss_plot.png) | Model-1 makes use of 2 dense layers with filters (256, 128). Changing this to ensure that there is only one dense layer of size (256,)  Good increase in training accuracy but validation accuracy is bad. Overfitting and hence not an optimal model design |
| 6 | CONV3D | Model\_06 | **Accuracy:** 0.9608  **Loss:** 0.1407  **Validation Accuracy:** 0.78  **Validation Loss:** 0.5935 | **Total Parameters:** 1,096,901  **Trainable Parameters:** 1,096,165  **Non-Trainable Parameters:** 736 | Model-6: Model-1 with single dense layer with filter (128) | Model\_01 has 2 dense layers with size 128 and 256. For Model-06, while retaining the structure, the dense layer is reduced to 1 with size 128 | [model-00007-0.14070-0.96078-0.59348-0.78000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_06/model-00007-0.14070-0.96078-0.59348-0.78000.h5) | 13.3MB | [Model\_06\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_06/model_06_accuracy_plot.png) | [Model\_06\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_06/model_06_loss_plot.png) | Model-1 makes use of 2 dense layers with filters (256, 128). Changing this to ensure that there is only one dense layer of size (128,)  Training accuracy at 96% but the loss and validation loss are not at good levels. Overfitting toa big extent and hence not an optimal model design |
| 7 | CONV3D | Model\_07 | **Accuracy:** 0.9321  **Loss:** 0.1972  **Validation Accuracy:** 0.88  **Validation Loss:** 0.3373 | **Total Parameters:** 3,604,933  **Trainable Parameters:** 3,603,685  **Non-Trainable Parameters:** 1,248 | Model-7: Model-1 with image height and width adjusted to 160 | Model-01 with image height and width adjusted to 160x160 | [model-00014-0.19723-0.93213-0.33727-0.88000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_07/model-00014-0.19723-0.93213-0.33727-0.88000.h5) | 43.3MB | [Model\_07\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_07/model_07_accuracy_plot.png) | [Model\_07\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_07/model_07_loss_plot.png) | Model image uses the dimension 120x120 for the experiment. Changing this to 160x160 to verify if that leads to a better model.  The analysis of the accuracy and loss curves suggest a highly volatile model with chances of overfitting |
| 8 | CONV3D | Model\_08 | **Accuracy:** 0.9216  **Loss:** 0.2258  **Validation Accuracy:** 0.68  **Validation Loss:** 1.3454 | **Total Parameters:** 3,604,933  **Trainable Parameters:** 3,603,685  **Non-Trainable Parameters:** 1,248 | Model-8: Model-7 with number of frames increased to 30 | Similar to Model-07 with frames per video to be considered increased to 30 | [model-00012-0.22583-0.92157-1.34545-0.68000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_08/model-00012-0.22583-0.92157-1.34545-0.68000.h5) | 43.4MB | [Model\_08\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_08/model_08_accuracy_plot.png) | [Model\_08\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_08/model_08_loss_plot.png) | Model-7 makes use of 20 images per video. Increasing it to 30 frames per video to verify it leads to a good model.  Model overfits and is not at all optimal |
| 9 | CONV3D | Model\_09 | **Accuracy:** 0.8673  **Loss:** 0.3902  **Validation Accuracy:** 0.87  **Validation Loss:** 0.4765 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-9: Model-1 with dropout set to 0.25 | Model-01 uses a dropout value of 0.0 as default i.e., no dropout layers. For model-09 the 2 dropout layer is introduced with value 0.25 | [model-00008-0.39023-0.86727-0.47653-0.87000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_09/model-00008-0.39023-0.86727-0.47653-0.87000.h5) | 23.3MB | [Model\_09\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_09/model_09_accuracy_plot.png) | [Model\_09\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_09/model_09_loss_plot.png) | Model-1 has dropout layers with values set to 0.0, basically meaning that it does not have dropout layers at all. Changing this to ensure that the dropout value of 0.25 is used.  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.0004000000189989805.  Reduced accuracy compared to Model-1 with not so good loss values |
| 10 | CONV3D | Model\_10 | **Accuracy:** 0.8763  **Loss:** 0.3136  **Validation Accuracy:** 0.78  **Validation Loss:** 0.7556 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-10: Model-1 with dropout set to 0.50 | Model-01 uses a dropout value of 0.0 as default i.e., no dropout layers. For model-10 the 2 dropout layer is introduced with value 0.50 | [model-00015-0.31362-0.87632-0.75558-0.78000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_10/model-00015-0.31362-0.87632-0.75558-0.78000.h5) | 23.3MB | [Model\_10\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_10/model_10_accuracy_plot.png) | [Model\_10\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_10/model_10_loss_plot.png) | Model-1 has dropout layers with values set to 0.0, basically meaning that it does not have dropout layers at all. Changing this to ensure that the dropout value of 0.50 is used.  Reduced accuracy compared to Model-1 with not so good loss values and also overfitting is observed |
| 11 | CONV3D | Model\_11 | **Accuracy:** 0.9186  **Loss:** 0.2502  **Validation Accuracy:** 0.79  **Validation Loss:** 0.7907 | **Total Parameters:** 1,507,781  **Trainable Parameters:** 1,506,533  **Non-Trainable Parameters:** 1,248 | Model-11: Model-9 with image height and width adjusted to 100 | Similar to model-09 but with image dimension as 100x100 | [model-00015-0.25015-0.91855-0.79069-0.79000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_11/model-00015-0.25015-0.91855-0.79069-0.79000.h5) | 18.2MB | [Model\_11\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_11/model_11_accuracy_plot.png) | [Model\_11\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_11/model_11_loss_plot.png) | Model-1 with dropout value set to 0.25 and image dimension as 100x100.  Overfitting is observed even though the number of parameters count has reduced. |
| 12 | CONV3D | Model\_12 | **Accuracy:** 0.8145  **Loss:** 0.5029  **Validation Accuracy:** 0.47  **Validation Loss:** 2.6316 | **Total Parameters:** 1,507,781  **Trainable Parameters:** 1,506,533  **Non-Trainable Parameters:** 1,248 | Model-12: Model-10 with image height and width adjusted to 100 and frames per video set to 30 | Similar to Model-10 but image dimension changed to 100x100 and frames to be considered per video set to 30 | [model-00010-0.50295-0.81448-2.63156-0.47000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_12/model-00010-0.50295-0.81448-2.63156-0.47000.h5) | 18.2MB | [Model\_12\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_12/model_12_accuracy_plot.png) | [Model\_12\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_12/model_12_loss_plot.png) | Model-1 with dropout layers with value 0.50 and image dimension as 100x100  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.0004000000189989805.  Model overfits and performs worst compared to the other comparable models |
| 13 | CONV3D | Model\_13 | **Accuracy:** 0.822  **Loss:** 0.5072  **Validation Accuracy:** 0.73  **Validation Loss:** 0.8323 | **Total Parameters:** 1,941,957  **Trainable Parameters:** 1,940,581  **Non-Trainable Parameters:** 1,376 | Model-13: Specific model with image height and width adjusted to 120, frames per video set to 20, 3 dense layers and 3 layers of dropout layers with 0.25, 0.5 and 0.25 values | Model with 3 dense layer (256,128, 64) and three dropout layers (0.25, 0.5, 0.25) with image dimension set to 120x120 and frames to be considered per video set to 20 images | [model-00010-0.50723-0.82202-0.83225-0.73000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_13/model-00010-0.50723-0.82202-0.83225-0.73000.h5) | 23.4MB | [Model\_13\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_13/model_13_accuracy_plot.png) | [Model\_13\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_13/model_13_loss_plot.png) | Experimenting with additional of more dense and dropout layers with varying values.  Model accuracy is not in acceptable range. |
| 14 | CONV3D | Model\_14 | **Accuracy:** 0.8944  **Loss:** 0.3317  **Validation Accuracy:** 0.7  **Validation Loss:** 0.8369 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-14: Specific model with image height and width adjusted to 120, frames per video set to 20, 2 dense layers and 2 layers of dropout layers with 0.25, 0.5 values | Model with 2 dense layer (256,128) and 2 dropout layers (0.25, 0.5) with image dimension set to 120x120 and frames to be considered per video set to 20 images | [model-00015-0.33171-0.89442-0.83686-0.70000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_14/model-00015-0.33171-0.89442-0.83686-0.70000.h5) | 23.3MB | [Model\_14\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_14/model_14_accuracy_plot.png) | [Model\_14\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_14/model_14_loss_plot.png) | Experimenting with additional of 2 dense and 2 dropout layers with varying values.  Model accuracy is not in acceptable range. and also we get a clue of overfitting. |
| 15 | CONV3D | Model\_15 | **Accuracy:** 0.902  **Loss:** 0.2884  **Validation Accuracy:** 0.75  **Validation Loss:** 0.6958 | **Total Parameters:** 537,909  **Trainable Parameters:** 536,661  **Non-Trainable Parameters:** 1,248 | Model-15: Model-4 with augmentation | Similar to Model-04 but with augmentation enabled | [model-00015-0.28836-0.90196-0.69577-0.75000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_15/model-00015-0.28836-0.90196-0.69577-0.75000.h5) | 6.6MB | [Model\_15\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_15/model_15_accuracy_plot.png) | [Model\_15\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_15/model_15_loss_plot.png) | Model-4 with augmentation enabled.  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.0004000000189989805.  Instead of an improvement, we find that the accuracy decreases and still the model is overfitting |
| 16 | CONV3D | Model\_16 | **Accuracy:** 0.8793  **Loss:** 0.3253  **Validation Accuracy:** 0.79  **Validation Loss:** 0.8268 | **Total Parameters:** 3,604,933  **Trainable Parameters:** 3,603,685  **Non-Trainable Parameters:** 1,248 | Model-16: Model-7 with augmentation | Similar to model-07 with a single change i.e., augmentation is enabled | [model-00014-0.32532-0.87934-0.82684-0.79000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_16/model-00014-0.32532-0.87934-0.82684-0.79000.h5) | 43.4MB | [Model\_16\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_16/model_16_accuracy_plot.png) | [Model\_16\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_16/model_16_loss_plot.png) | Model-7 with augmentation enabled.  Accuracy decreases |
| 17 | CONV3D | Model\_17 | **Accuracy:** 0.9095  **Loss:** 0.2495  **Validation Accuracy:** 0.5  **Validation Loss:** 1.8163 | **Total Parameters:** 1,933,765  **Trainable Parameters:** 1,932,517  **Non-Trainable Parameters:** 1,248 | Model-17: Default CONV3D model with Augmentation | Default CONV3D model used for the experimentation i.e., same as Model-01 with augmentation enabled | [model-00015-0.24947-0.90950-1.81628-0.50000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model_17/model-00015-0.24947-0.90950-1.81628-0.50000.h5) | 23.3MB | [Model\_17\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_17/model_17_accuracy_plot.png) | [Model\_17\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model_17/model_17_loss_plot.png) | Default model used for this experimentation with augmentation enabled.  Reduction in accuracy numbers and also the model overfits to the worst possible extent. |
| 18 | CONV3D | Model-18 | **Accuracy:** 0.8371  **Loss:** 0.42  **Validation Accuracy:** 0.58  **Validation Loss:** 1.3598 | **Total Parameters:** 712,453  **Trainable Parameters:** 710,533  **Non-Trainable Parameters:** 1,920 | Model-18: Conv3D with 2 hidden layers(Different kernel sizes and dropout value as 0.2), learning rate equal to 0.001 and usage of GlobalAveragePooling3D | Model with hidden layers having different kernel sizes. the learning rate applied is 0.001 with usage of GlobalAveragePooling3D. MaxPooling3D layers also have differing pool sizes unlike other models which had the same pool size for all maxpool layers | [model-00014-0.41999-0.83710-1.35979-0.58000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-18/model-00014-0.41999-0.83710-1.35979-0.58000.h5) | 8.6MB | [Model\_18\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-18/model_18_accuracy_plot.png) | [Model\_18\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-18/model_18_loss_plot.png) | Conv3D model with learning rate of 0.001 and making use of globalAveragePooling. Expecting a drop in number of parameters and a possible increase in accuracy with reduction or no overfitting  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.00020000000949949026.  Number of parameters reduce but the model overfits |
| 19 | CONV2D + RNN | Model-19 | **Accuracy:** 0.8009  **Loss:** 0.515  **Validation Accuracy:** 0.47  **Validation Loss:** 1.7403 | **Total Parameters:** 99845  **Trainable Parameters:** 99,269  **Non-Trainable Parameters:** 576 | Model-19: TimeDistributed Conv2D + GRU(128 neurons) without dropout layer | CONV2D and GRU with no dropout layers | [model-00018-0.51495-0.80090-1.74029-0.47000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-19/model-00018-0.51495-0.80090-1.74029-0.47000.h5) | 1.3MB | [Model\_19\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-19/model_19_accuracy_plot.png) | [Model\_19\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-19/model_19_loss_plot.png) | Conv2D with GRu having no dropout layers to be used as base model for Conv2d+RNN models  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.00020000000949949026.  Huge reduction in the number of trainable parameters but the overfitting is to the extreme |
| 20 | CONV2D + RNN | Model-20 | **Accuracy:** 0.7044  **Loss:** 0.7316  **Validation Accuracy:** 0.21  **Validation Loss:** 2.8104 | **Total Parameters:** 99845  **Trainable Parameters:** 99,269  **Non-Trainable Parameters:** 576 | Model-20: TimeDistributed Conv2D + GRU(128 neurons) with dropout layer and batch size as 20 | Similar to model-19 but with dropout layer and learning rate as 0.001.Batch size set to 20 | [model-00009-0.73157-0.70437-2.81035-0.21000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-20/model-00009-0.73157-0.70437-2.81035-0.21000.h5) | 1.3MB | [Model\_20\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-20/model_20_accuracy_plot.png) | [Model\_20\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-20/model_20_loss_plot.png) | Conv2D+RNN base model with inclusion of a dropout layer and batch size set to 20.  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.00020000000949949026.  Model performs worse than the base model with no dropout layer |
| 21 | CONV2D | Model-21 | **Accuracy:** 0.7707  **Loss:** 0.5506  **Validation Accuracy:** 0.46  **Validation Loss:** 2.5074 | **Total Parameters:** 129,477  **Trainable Parameters:** 128,517  **Non-Trainable Parameters:** 960 | Model-21: TimeDistributed Conv2D with Dense layers, without dropouts using GlobalAveragePooling3D | CONV2D with no dropout layers and no RNN | [model-00015-0.55065-0.77074-2.50738-0.46000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-21/model-00015-0.55065-0.77074-2.50738-0.46000.h5) | 1.6MB | [Model\_21\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-21/model_21_accuracy_plot.png) | [Model\_21\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-21/model_21_loss_plot.png) | Pure CONV2D model with no RNN, no dropout layers and using globalAveragePooling3d !!!  Comparable accuracy with that of the base model for CONV3D+RNN. However, overfitting still exists |
| 22 | CONVLSTM2D | Model-22 | **Accuracy:** 0.8311  **Loss:** 0.437  **Validation Accuracy:** 0.84  **Validation Loss:** 0.4161 | **Total Parameters:** 13,781  **Trainable Parameters:** 13,589  **Non-Trainable Parameters:** 192 | Model-22: TimeDistributed ConvLSTM2D with no dropout layer using GlobalAveragePooling3D | ConvLSTM2D model with no dropout layers with learning rate set to 0.001 and epoch to 12 | [model-00012-0.43697-0.83107-0.41611-0.84000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-22/model-00012-0.43697-0.83107-0.41611-0.84000.h5) | 260KB | [Model\_22\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-22/model_22_accuracy_plot.png) | [Model\_22\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-22/model_22_loss_plot.png) | CONVLSTM2D model with no dropout layers  Big drop in number of parameters and also the final model file size but the loss values are to an acceptable level. Also, the accuracies though good and not overfitting are not convincing enough |
| 23 | Transfer learning with MobileNet | Model-23 | **Accuracy:** 0.994  **Loss:** 0.0189  **Validation Accuracy:** 0.98  **Validation Loss:** 0.0734 | **Total Parameters:** 3,693,253  **Trainable Parameters:** 3,669,317  **Non-Trainable Parameters:** 23,936 | Model-23: Transfer Learning Using MobileNet for GRU type and training all weights | MobileNet Transfer learning by training all weights and using GRU RNN type | [model-00019-0.01890-0.99397-0.07341-0.98000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-23/model-00019-0.01890-0.99397-0.07341-0.98000.h5) | 44.5MB | [Model\_23\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-23/model_23_accuracy_plot.png) | [Model\_23\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-23/model_23_loss_plot.png) | Transfer learning using MobileNet and RNN type as GRU  Best model so far. But the accuracy and loss curves are not linear |
| 24 | Transfer learning with MobileNet | Model-24 | **Accuracy:** 0.9955  **Loss:** 0.0257  **Validation Accuracy:** 0.97  **Validation Loss:** 0.0748 | **Total Parameters:** 3,840,453  **Trainable Parameters:** 3,816,517  **Non-Trainable Parameters:** 23,936 | Model-24: Transfer Learning Using MobileNet for LSTM type and training all weights | MobileNet Transfer learning by training all weights and using LSTM RNN type | [model-00008-0.02565-0.99548-0.07479-0.97000.h5](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/Best_Models/Model-24/model-00008-0.02565-0.99548-0.07479-0.97000.h5) | 46.3MB | [Model\_24\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-24/model_24_accuracy_plot.png) | [Model\_24\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-24/model_24_loss_plot.png) | Transfer learning using MobileNet and RNN type as LSTM  Good model with MobileNet again however the accuracy and loss curves are not linear |
| 25 | Transfer learning with MobileNet | Model-25 | **Accuracy:** 0.9955  **Loss:** 0.0294  **Validation Accuracy:** 0.94  **Validation Loss:** 0.2462 | **Total Parameters:** 3,446,725  **Trainable Parameters:** 3,422,789  **Non-Trainable Parameters:** 23,936 | Model-25: Model-23 with GRU cell size as 64 and drop-out value 0.5 | MobileNet Transfer learning by training all weights and using GRU RNN type with cell size set to 64 and making use of a dropout layer with value 0.5 |  | 41.6MB | [Model\_25\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-25/model_25_accuracy_plot.png) | [Model\_25\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-25/model_25_loss_plot.png) | Transfer learning with MobileNet and GRU by training all the weights.  Leads to a very good model with excellent accuracy values and a good loss and accuracy curve values across the epochs |
| 26 | Transfer learning with MobileNet | Model-26 | **Accuracy:** 0.9608  **Loss:** 0.1671  **Validation Accuracy:** 0.93  **Validation Loss:** 0.2821 | **Total Parameters:** 3,516,229  **Trainable Parameters:** 3,492,293  **Non-Trainable Parameters:** 23,936 | Model-26: Model-24 with GRU cell size as 64 and drop-out value 0.5 | MobileNet Transfer learning by training all weights and using GRU RNN type with cell size set to 64 and making use of a dropout layer with value 0.25 |  | 42.4MB | [Model\_26\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-26/model_26_accuracy_plot.png) | [Model\_26\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-26/model_26_loss_plot.png) | Model-24 with GRU cell size set to 64 and using a single droput layer with value 0.25  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.00020000000949949026.  Good model but we already have models with values far better than this |
| 27 | Transfer learning with MobileNet | Model-27 | **Accuracy:** 0.9427  **Loss:** 0.222  **Validation Accuracy:** 0.93  **Validation Loss:** 0.2485 | **Total Parameters:** 3,446,725  **Trainable Parameters:** 3,422,789  **Non-Trainable Parameters:** 23,936 | Model-27: Model-25 with learning rate changed to 0.0001 | MobileNet Transfer Learning with GRU, cell size as 64 and dropout layer with value 0.5 and learning rate reduced to 0.0001 |  | 41.6MB | [Model\_27\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-27/model_27_accuracy_plot.png) | [Model\_27\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-27/model_27_loss_plot.png) | Model-25 uses a learning rate of 0.01. changing it to 0.001 to verify if that leads to an even better model.  Even though the model is good, this is not an improvement to the best model we already have |
| 28 | Transfer learning with MobileNet | Model-28 | **Accuracy:** 0.9774  **Loss:** 0.0839  **Validation Accuracy:** 0.98  **Validation Loss:** 0.1287 | **Total Parameters:** 3,446,725  **Trainable Parameters:** 3,422,789  **Non-Trainable Parameters:** 23,936 | Model-28: Model-25 with SGD optimizer | Model-25 has been the optimum model till now. Experimenting with optimizer "SGD" on the same |  | 14MB | [Model\_28\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-28/model_28_accuracy_plot.png) | [Model\_28\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-28/model_28_loss_plot.png) | Till now model-25 is the one with excellent values and is our best model. Model-25 makes use of "Adam" Optimizer. Changing it to "SGD" to check if that gives us an even better model.  Model is good again but no match to the best model we already have. But a great reduction in model file size. |
| 29 | Transfer learning with MobileNet | Model-29 | **Accuracy:** 0.9638  **Loss:** 0.1624  **Validation Accuracy:** 0.91  **Validation Loss:** 0.4041 | **Total Parameters:** 3,446,725  **Trainable Parameters:** 3,422,789  **Non-Trainable Parameters:** 23,936 | Model-29: Model-25 with RmsProp optimizer | Model-25 has been the optimum model till now. Experimenting with optimizer "RMSProp" on the same |  | 27.8MB | [Model\_29\_Accuracy](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-29/model_29_accuracy_plot.png) | [Model\_29\_Loss](https://github.com/techexorcist/gesture-recognition-deep-learning/blob/master/All_Models/Model-29/model_29_loss_plot.png) | Till now model-25 is the one with excellent values and is our best model. Model-25 makes use of "Adam" Optimizer. Changing it to "RMSProp" to check if that gives us an even better model.  Early Stopped due to ReduceLROnPlateau reducing learning rate to 0.00020000000949949026.  Model is good again but no match to the best model we already have. But a good reduction in model file size in comparison with Model-25 |

**CONCLUSION:** Even though the model from model-24 experiment gives closest to Model-25 results, Model-25 was chosen at my end after checking the loss and accuracy curves