**Gesture Recognition Project**

**Problem Statement:**

Imagine you are working as a data scientist at a home electronics company which manufactures state of the art smart televisions. You want to develop a cool feature in the smart-TV that can recognise five different gestures performed by the user which will help users control the TV without using a remote.

The gestures are continuously monitored by the webcam mounted on the TV. Each gesture corresponds to a specific command:

* Thumbs up: Increase the volume
* Thumbs down: Decrease the volume
* Left swipe: 'Jump' backwards 10 seconds
* Right swipe: 'Jump' forward 10 seconds
* Stop: Pause the movie

An CNN + RNN model needs to be developed.

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| **Experiment Number** | **Model** | **Result** | **Decision + Explanation** |
| **1** | **Conv3D**  **(only CNN)** | Categorical Accuracy: **>0.8**  Categorical AUC: **>0.8**  Validation Categorical Accuracy**: >0.35**  Validation AUC**: >0.65** | **5 Epochs**  **The model is clearly overfitting.** |
| **2** | **CNN + SimpleRNN** | Categorical Accuracy: **~0.25-0.3**  Categorical AUC: **~0.55-0.6**  Validation Categorical Accuracy**: ~0.25**  Validation AUC**: ~0.55-0.6** | **5 Epochs**  **The model is not learning well in training. Even after 5 Epochs, the model is doing slightly well than a random guess.** |
| **3** | **CNN + GRU** | Categorical Accuracy: **~0.20**  Categorical AUC: **~0.45-0.5**  Validation Categorical Accuracy**: ~0.2**  Validation AUC**: ~0.45-0.5** | **5 Epochs**  **The model is not learning well in training. Even after 5 Epochs, the model is doing slightly well than a random guess.** |
| **4** | **CNN + LSTM** | Categorical Accuracy: **~0.8**  Categorical AUC: **~0.95**  Validation Categorical Accuracy**: ~0.5-0.6**  Validation AUC**: ~0.75-0.8** | **5 Epochs**  **The model is clearly overfitting. But still, it is better than all earlier models. The validation accuracy is steadily rising.** |
| **5** | **CNN + LSTM (include Dropouts)** | Categorical Accuracy: **~0.65-0.7**  Categorical AUC: **~0.85-0.9**  Validation Categorical Accuracy**: ~0.3-0.35**  Validation AUC**: ~0.55-0.6** | **5 Epochs**  **The model is overfitting more than the above model.** |
| **6** | **CNN + LSTM (include Dropouts and BatchNormalization)** | Categorical Accuracy: **~0.3-0.35**  Categorical AUC: **~0.65-0.7**  Validation Categorical Accuracy**: ~0.2**  Validation AUC**: ~0.55-0.6** | **5 Epochs**  **The model is overfitting. The validation accuracy is not steadily rising and the validation AUC of 0.6 is not good either.** |
| **7** | **CNN + LSTM (different dropouts)** | Categorical Accuracy: **~0.65-0.7**  Categorical AUC: **~0.85-0.9**  Validation Categorical Accuracy**: ~0.2-0.25**  Validation AUC**: ~0.55** | **5 Epochs**  **The model overfitting. In term of validation, eEven after 5 Epochs, the model is doing slightly well than a random guess.** |
| **8** | **LSTM with Batch Normalization and extra convolution layers** | Categorical Accuracy: **~0.55-0.6**  Categorical AUC: **~0.85-0.9**  Validation Categorical Accuracy**: ~0.25-0.3**  Validation AUC**: ~0.65** | **5 Epochs**  **The model is overfitting. The validation accuracy is not steadily rising and the validation AUC of 0.65 is not good either. But the validation accuracy is steadily rising.** |
| **9** | **Model 9: CNN + LSTM (with 25 Epochs)** | Categorical Accuracy: **~0.55-0.6**  Categorical AUC: **~0.85-0.9**  Validation Categorical Accuracy**: ~0.25-0.3**  Validation AUC**: ~0.65** | **25 Epochs**  **This model is same as Model #4 but with more Epochs. This was tried because Model #4 seemed the most promising with 5 Epochs. However, we can see that the validation categorical accuracy is stuck at 0.52-0.54 for more than 10 Epochs.** |
| **Final Model** | **Model 10: Model 8 + 25 Epochs** | Categorical Accuracy: **~0.9**  Categorical AUC: **~0.99**  Validation Categorical Accuracy**: ~0.75-0.8**  Validation AUC**: ~0.9-0.95** | **25 Epochs**  **This model is same as Model #8 but with 25 Epochs. Even now the model is overfitting but not by a very big margin. This is the final model.** |