**Gesture Recognition Case Study**

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The approach we followed was as follows

1. To build a model, that would not take much time to train. If the training took more time, we would make model less complex reducing the number of trainable parameters.
2. Keeping an eye on the loss, the loss computed at the end of every epoch should show a decreasing trend and no rapid fluctuations.
3. Accuracy should show an increasing trend after every epoch.
4. Train and Validation accuracy should be almost similar, if the train accuracy was much larger than the validation accuracy (model over fitting problem) we increased drop out to prevent over fitting and make the model more generic.

Following are the results of the experiments conducted on our models

**Model 1: CNN+RNN**

**Used GRU in RNN layer**

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| **Experiment Number** | **Model** | **Result** | **Decision + Explanation** |
| **1** | **CNN\_GRU**  **Batch Size =10, Epoch = 10**  **Model:**  Trainable params: 1,902,005 | **loss: 0.9069**  **categorical\_accuracy: 0.6119**  **val\_loss: 0.9850**  **val\_categorical\_accuracy: 0.6300** | **Accuracies are similar but low.**  **Increase Batch Size** |
| **2** | **CNN\_GRU**  **Batch Size =20, Epoch = 10**  **Model:**  Trainable params: 1,902,005 | **loss: 0.9174**  **categorical\_accuracy: 0.7353**  **val\_loss: 0.9396**  **val\_categorical\_accuracy: 0.6700** | **Accuracies are similar.**  **Increase Batch Size** |
| **3** | **CNN\_GRU**  **Batch Size =30, Epoch = 10**  **Model:**  Trainable params: 1,902,005 | **loss: 0.7290**  **categorical\_accuracy: 0.7391**  **val\_loss: 1.0953**  **val\_categorical\_accuracy: 0.5750** | **Too much difference between training and validation accuracies.**  **Increase epochs** |
| **4** | **CNN\_GRU**  **Batch Size =30, Epoch = 20**  **Model:**  Trainable params: 1,902,005 | **loss: 0.7787**  **categorical\_accuracy: 0.6522**  **val\_loss: 1.1214**  **val\_categorical\_accuracy: 0.6500** | **Accuracies are similar.**  **Improvement in validation accuracy.**  **Increase Epoch Size** |
| **5** | **CNN\_GRU**  **Batch Size =30, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | **loss: 0.9082**  **categorical\_accuracy: 0.6377**  **val\_loss: 1.0167**  **val\_categorical\_accuracy: 0.6500** | **Accuracies are similar.**  **Not much improvement in accuracies**  **Change batch size and epoch values** |
| **6** | **CNN\_GRU**  **Batch Size =20, Epoch = 20**  **Model:**  Trainable params: 1,902,005 | **loss: 0.9323**  **categorical\_accuracy: 0.5882**  **val\_loss: 0.9121**  **val\_categorical\_accuracy: 0.6600** | **Less training accuracy.**  **Decrease Batch size.** |
| **7** | **CNN\_GRU**  **Batch Size =10, Epoch = 20**  **Model:**  Trainable params: 1,902,005 | **loss: 0.8509**  **categorical\_accuracy: 0.6816**  **val\_loss: 0.9085**  **val\_categorical\_accuracy: 0.6700** | **Accuracies are similar.**  **Not much improvement in accuracies**  **Increase epoch values** |
| **8** | **CNN\_GRU**  **Batch Size =10, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | **loss: 0.8549**  **categorical\_accuracy: 0.6667**  **val\_loss: 0.9035**  **val\_categorical\_accuracy: 0.6800** | **Accuracies are similar.**  **Not much improvement in accuracies**  **Increadse Batch size** |
| **9** | **CNN\_GRU**  **Batch Size =40, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | **loss: 0.5894**  **categorical\_accuracy: 0.8131**  **val\_loss: 0.6884**  **val\_categorical\_accuracy: 0.7667** | **Accuracies are similar.**  **Good improvement in accuracies** |
| **10** | **CNN\_GRU**  **Batch Size =20, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | **loss: 0.9784**  **categorical\_accuracy: 0.6569**  **val\_loss: 0.9091**  **val\_categorical\_accuracy: 0.6700** | **on epoch size=20 and batch size =30**  **Accuracies are similar.**  **Accuracies decreased** |
| **11** | **CNN\_GRU**  **Batch Size =60, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | **loss: 0.7104**  **categorical\_accuracy: 0.6944**  **val\_loss: 1.0876**  **val\_categorical\_accuracy: 0.6500** | **Accuracies are similar.**  **Not much improvement in accuracies** |

**Model 2: Conv3D**

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| **Experiment Number** | **Model** | **Result** | **Decision + Explanation** |
| **0** | **Conv3D**  **Model\_a**  Trainable params: 3,667,509 | loss: 1.7014  categorical\_accuracy: 0.2500  val\_loss: 1.0500 - val\_categorical\_accuracy: 0.6000  **H5 files generated was large due to large number of trainable paramameters** | **Low accuracy.**  **Need to make the model less complex.**  **Need to reduce the dense layer neurons.**  **Build new model with less trainable parameters,** |
| **1** | **Conv3D**  **Batch Size =20, Epoch = 10**  **Model\_b**  Trainable params: 1,120,133 | **loss: 1.7627**  **categorical\_accuracy: 0.3431**  **val\_loss: 2.4863**  **val\_categorical\_accuracy: 0.1600** | **Very less accuracies**  **Change batch size** |
| **2** | **Conv3D**  **Batch Size =30, Epoch = 10**  **Model\_b**  Trainable params: 1,120,133 | **loss: 1.7355**  **categorical\_accuracy: 0.3188**  **val\_loss: 1.6884**  **val\_categorical\_accuracy: 0.3750** | **Less Accuracies, need to build new model** |
| **3** | **Conv3D**  **Batch Size =40, Epoch = 10**  **Model\_c**  Trainable params: 863,989 | **loss: 1.1334**  **categorical\_accuracy: 0.5329**  **val\_loss: 1.2390**  **val\_categorical\_accuracy: 0.4333** | **Accuracies are similar.**  **Good improvement in accuracies**  **Let us continue changing the batch size and epochs** |
| **4** | **Conv3D**  **Batch Size =40, Epoch = 15**  **Model\_c**  Trainable params: 863,989 | **loss: 0.6567**  **categorical\_accuracy: 0.7578**  **val\_loss: 0.8244**  **val\_categorical\_accuracy: 0.7500** | **Accuracies are similar.**  **Good improvement in accuracies**  **Let us increase number of epochs** |
| **5** | **Conv3D**  **Batch Size =40, Epoch = 20**  **Model\_c**  Trainable params: 863,989 | **loss: 0.5407**  **categorical\_accuracy: 0.8062**  **val\_loss: 0.7622**  **val\_categorical\_accuracy: 0.7167** | **Accuracies are similar.**  **Good improvement in accuracies**  **But the difference between the training and validation accuracies increased.**  **Let us increase number of epochs** |
| **6** | **Conv3D**  **Batch Size =40, Epoch = 30**  **Model\_c**  Trainable params: 863,989 | **loss: 0.5679 –**  **categorical\_accuracy: 0.7647 –**  **val\_loss: 0.7589**  **val\_categorical\_accuracy: 0.6833** | **Accuracies reduced.**  **Let us decrease the batch size and number of epochs.** |
| **7** | **Conv3D**  **Batch Size =30, Epoch = 10**  **Model\_c**  Trainable params: 863,989 | **loss: 0.6244**  **categorical\_accuracy: 0.7971**  **val\_loss: 0.6635**  **val\_categorical\_accuracy: 0.7250** | **Improvement in accuracies.**  **Try different batch size and epoch combination** |
| **8** | **Conv3D**  **Batch Size =10, Epoch = 40**  **Model\_c**  Trainable params: 863,989 | **loss: 0.7909**  **categorical\_accuracy: 0.6522**  **val\_loss: 0.7220**  **val\_categorical\_accuracy: 0.7000** | **Accuracies reduced.** |
| **9** | **Conv3D**  **Batch Size =10, Epoch = 25**  **Model\_c**  Trainable params: 863,989 | **loss: 0.7981**  **categorical\_accuracy: 0.6667**  **val\_loss: 0.8166**  **val\_categorical\_accuracy: 0.6000** | **Reduced accuracies**  **Increase batch size by 10.** |
| **10** | **Conv3D**  **Batch Size =20, Epoch = 25**  **Model\_c**  Trainable params: 863,989 | **loss: 0.7638**  **categorical\_accuracy: 0.6812**  **val\_loss: 0.8124**  **val\_categorical\_accuracy: 0.6750** | **Improved accuracies.**  **But not as much as before.**  **Let us try for a small batch size** |
| **11** | **Conv3D**  **Batch Size =5, Epoch = 30**  **Model\_c**  Trainable params: 863,989 | **loss: 0.7979**  **categorical\_accuracy: 0.6957**  **val\_loss: 0.7131**  **val\_categorical\_accuracy: 0.8500** | **Too much difference between validation and training accuracies.** |

**Conclusion:**

**For model 1 (CNN+RNN) , Experiment 9 gave the best result**

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| **CNN\_GRU**  **Batch Size =40, Epoch = 30**  **Model:**  Trainable params: 1,902,005 | loss: 0.5894  **categorical\_accuracy: 0.8131**  val\_loss: 0.6884  **val\_categorical\_accuracy: 0.7667** |

**For model 2 (CONV3D), Experiment 4 gave the best result**

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| **Conv3D**  **Batch Size =40, Epoch = 15**  **Model\_c**  Trainable params: 863,989 | **loss: 0.6567**  **categorical\_accuracy: 0.7578**  **val\_loss: 0.8244**  **val\_categorical\_accuracy: 0.7500** |

**Submitting the model 1’s (CNN+RNN) H5 file for evaluation**

**model-00007-0.58941-0.81315-0.68838-0.76667.h5**