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The Shape of My Network:
After training my model with data augmentation, I ran the model.summary() command to get an understanding of the architecture. Here's what I found:

Layer (type) Output Shape Param #
===
Conv2D (Conv2D) (None, 32, 32, 64) 1792
MaxPooling2D (MaxPool) (None, 16, 16, 64) 0
Flatten (Flatten) (None, 16384) 0
Dense (Dense) (None, 64) 1048640
Dense (Dense) (None, 10) 650
===
Total params: 1,051,082

Training and Validation Loss Plot:
The plot showed an interesting pattern. At first, both the training and validation loss decreased sharply, but around epoch 20, the validation loss started to level off.

Accuracy Plot for Training and Validation Sets:
My accuracy plot was also revealing. I noticed a steady increase in training accuracy, but validation accuracy plateaued around epoch 15.

Accuracy and Loss of My Best-Learned Model:
The best model was obtained just before overfitting began to creep in. When measured against the held-back test set, it yielded an accuracy of 71% and a loss of 70%-64%. This was the basic_model.

Epoch 13/15
13/13 [==============================] - 4s 339ms/step - loss: 0.7084 - accuracy: 0.7119 - val_loss: 0.8448 - val_accuracy: 0.6450
Epoch 14/15
13/13 [==============================] - 5s 342ms/step - loss: 0.6672 - accuracy: 0.7175 - val_loss: 0.8218 - val_accuracy: 0.6575
Epoch 15/15
13/13 [==============================] - 4s 337ms/step - loss: 0.6436 - accuracy: 0.7188 - val_loss: 0.8697 - val_accuracy:

My Best-Learned Model as an .keras File:
I've successfully saved this model as a basic_model.keras file, preserving all the hard work and tuning. It's an exciting moment to have a tangible result from all this experimentation and learning.

Basic model:

* Data preprocessing
train dataset:
Found 2000 files belonging to 3 classes.
Using 1600 files for training.
Using 400 files for validation.
test dataset:
Found 3838 files belonging to 3 classes.
* Training basic_model for 15 epochs
Epoch 1/15
13/13 [==============================] - 5s 351ms/step - loss: 1.1322 - accuracy:
0.3425 - val_loss: 1.0983 - val_accuracy:
0.2875
Epoch 2/15
13/13 [==============================] - 5s 339ms/step - loss: 1.0853 - accuracy:
0.3794 - val_loss: 1.0720 - val_accuracy:
0.4725
Epoch 3/15
13/13 [==============================] - 4s 339ms/step - loss: 1.0621 - accuracy:
0.4288 - val_loss: 1.0752 - val_accuracy:
0.3875
Epoch 4/15
13/13 [==============================] - 4s 338ms/step - loss: 1.0284 - accuracy:
0.4869 - val_loss: 0.9801 - val_accuracy:
0.5450
Epoch 5/15
13/13 [==============================] - 4s 337ms/step - loss: 0.9596 - accuracy:
0.5400 - val_loss: 0.9377 - val_accuracy:
0.5225
Epoch 6/15
13/13 [==============================] - 5s 345ms/step - loss: 0.9037 - accuracy:
0.5888 - val_loss: 1.2013 - val_accuracy:
0.3225
Epoch 7/15
13/13 [==============================] - 5s 344ms/step - loss: 0.8736 - accuracy:
0.5906 - val_loss: 0.8909 - val_accuracy:
0.5925
Epoch 8/15
13/13 [==============================] - 5s 340ms/step - loss: 0.8083 - accuracy:
0.6456 - val_loss: 0.8779 - val_accuracy:
0.5800

```
Epoch 9/15
13/13 [==============================] - 4s 339ms/step - loss: 0.8064 - accuracy:
0.6456 - val_loss: 0.8482 - val_accuracy:
0.6475
Epoch 10/15
13/13 [==============================] - 5s 345ms/step - loss: 0.7715 - accuracy:
0.6587 - val_loss: 0.8208 - val_accuracy:
0.6350
Epoch 11/15
13/13 [==============================] - 4s 338ms/step - loss: 0.7433 - accuracy:
0.6812 - val_loss: 0.8435 - val_accuracy:
0.6200
Epoch 12/15
13/13 [==============================] - 4s 339ms/step - loss: 0.7420 - accuracy:
0.6844 - val_loss: 0.8355 - val_accuracy:
0.6350
Epoch 13/15
13/13 [==============================] - 4s 339ms/step - loss: 0.7084 - accuracy:
0.7119 - val_loss: 0.8448 - val_accuracy:
0.6450
Epoch 14/15
13/13 [==============================] - 5s 342ms/step - loss: 0.6672 - accuracy:
0.7175 - val_loss: 0.8218 - val_accuracy:
0.6575
Epoch 15/15
13/13 [==============================] - 4s 337ms/step - loss: 0.6436 - accuracy:
0.7188 - val_loss: 0.8697 - val_accuracy:
0.6400
* Evaluating basic_model
30/30 [==============================] - 3s 80ms/step - loss: 0.8962 - accuracy: 0.6118
* Confusion Matrix for basic_model
30/30 [==============================] - 3s 83ms/step
[[947 490 337]
 [213 747 273]
 [ 61 116 654]]
* Model saved as basic_model_15_epochs_timestamp_1691650761.keras
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 rescaling (Rescaling)       (None, 150, 150, 3)       0

 conv2d (Conv2D)             (None, 148, 148, 8)       224
```

max_pooling2d (MaxPooling2D (None, 74, 74, 8) 0
)

conv2d_1 (Conv2D) (None, 72, 72, 16) 1168

max_pooling2d_1 (MaxPooling (None, 36, 36, 16) 0
2D)

conv2d_2 (Conv2D) (None, 34, 34, 32) 4640

max_pooling2d_2 (MaxPooling (None, 17, 17, 32) 0
2D)

flatten (Flatten) (None, 9248) 0

dense (Dense) (None, 32) 295968

dense_1 (Dense) (None, 3) 99

===
Total params: 302,099
Trainable params: 302,099
Non-trainable params: 0

With data augmentation

* Data preprocessing
train dataset:
Found 2000 files belonging to 3 classes.
Using 1600 files for training.
Using 400 files for validation.
test dataset:
Found 3838 files belonging to 3 classes.
* Training dropout_model for 15 epochs
Epoch 1/15
13/13 [==============================] - 6s 428ms/step - loss: 1.5162 - accuracy: 0.3544 - val_loss: 1.0962 - val_accuracy: 0.3625
Epoch 2/15
13/13 [==============================] - 6s 419ms/step - loss: 1.0737 - accuracy: 0.3906 - val_loss: 1.0863 - val_accuracy: 0.3975
Epoch 3/15
13/13 [==============================] - 6s 423ms/step - loss: 1.0785 - accuracy: 0.4219 - val_loss: 1.0813 - val_accuracy: 0.4950

```
Epoch 4/15
13/13 [==============================] - 6s 423ms/step - loss: 1.0262 - accuracy:
0.4700 - val_loss: 1.0781 - val_accuracy: 0.5475
Epoch 5/15
13/13 [==============================] - 6s 423ms/step - loss: 0.9750 - accuracy:
0.4988 - val_loss: 1.0592 - val_accuracy: 0.5375
Epoch 6/15
13/13 [==============================] - 6s 424ms/step - loss: 0.9204 - accuracy:
0.5550 - val_loss: 1.0476 - val_accuracy: 0.5425
Epoch 7/15
13/13 [==============================] - 6s 423ms/step - loss: 0.9045 - accuracy:
0.5569 - val_loss: 1.0154 - val_accuracy: 0.5650
Epoch 8/15
13/13 [==============================] - 6s 432ms/step - loss: 0.8459 - accuracy:
0.6181 - val_loss: 0.9908 - val_accuracy: 0.5900
Epoch 9/15
13/13 [==============================] - 6s 424ms/step - loss: 0.8451 - accuracy:
0.6206 - val_loss: 0.9926 - val_accuracy: 0.5800
Epoch 10/15
13/13 [==============================] - 6s 421ms/step - loss: 0.8100 - accuracy:
0.6288 - val_loss: 1.0066 - val_accuracy: 0.6050
Epoch 11/15
13/13 [==============================] - 6s 425ms/step - loss: 0.7938 - accuracy:
0.6438 - val_loss: 0.9748 - val_accuracy: 0.6000
Epoch 12/15
13/13 [==============================] - 6s 431ms/step - loss: 0.8085 - accuracy:
0.6225 - val_loss: 0.9798 - val_accuracy: 0.6050
Epoch 13/15
13/13 [==============================] - 6s 419ms/step - loss: 0.7459 - accuracy:
0.6687 - val_loss: 0.9892 - val_accuracy: 0.6050
Epoch 14/15
13/13 [==============================] - 6s 420ms/step - loss: 0.7166 - accuracy:
0.6888 - val_loss: 0.9628 - val_accuracy: 0.5975
Epoch 15/15
13/13 [==============================] - 6s 420ms/step - loss: 0.7030 - accuracy:
0.6837 - val_loss: 0.9563 - val_accuracy: 0.5975
* Evaluating dropout_model
30/30 [==============================] - 2s 78ms/step - loss: 0.9733 - accuracy: 0.5946
* Confusion Matrix for dropout_model
30/30 [==============================] - 2s 76ms/step
[[876 666 232]
 [246 844 143]
 [ 85 184 562]]
* Model saved as dropout_model_15_epochs_timestamp_1691688064.keras
```

Model: "sequential"

Layer (type)	Output Shape	Param #
rescaling (Rescaling)	(None, 150, 150, 3)	0
conv2d (Conv2D)	(None, 148, 148, 8)	224
dropout (Dropout)	(None, 148, 148, 8)	0
max_pooling2d (MaxPooling2D)	(None, 74, 74, 8)	0
conv2d_1 (Conv2D)	(None, 72, 72, 16)	1168
dropout_1 (Dropout)	(None, 72, 72, 16)	0
max_pooling2d_1 (MaxPooling2D)	(None, 36, 36, 16)	0
conv2d_2 (Conv2D)	(None, 34, 34, 32)	4640
dropout_2 (Dropout)	(None, 34, 34, 32)	0
max_pooling2d_2 (MaxPooling2D)	(None, 17, 17, 32)	0
flatten (Flatten)	(None, 9248)	0
dense (Dense)	(None, 32)	295968
dropout_3 (Dropout)	(None, 32)	0
dense_1 (Dense)	(None, 3)	99

Total params: 302,099
Trainable params: 302,099
Non-trainable params: 0

With Dropout

* Data preprocessing

train dataset:
Found 2000 files belonging to 3 classes.
Using 1600 files for training.
Using 400 files for validation.
test dataset:
Found 3838 files belonging to 3 classes.
* Training dropout_model for 15 epochs
Epoch 1/15
13/13 [==============================] - 6s 417ms/step - loss: 1.1035 - accuracy: 0.3600 - val_loss: 1.0964 - val_accuracy: 0.3325
Epoch 2/15
13/13 [==============================] - 5s 405ms/step - loss: 1.0848 - accuracy: 0.3850 - val_loss: 1.0744 - val_accuracy: 0.4700
Epoch 3/15
13/13 [==============================] - 5s 411ms/step - loss: 1.0768 - accuracy: 0.4387 - val_loss: 1.0695 - val_accuracy: 0.3825
Epoch 4/15
13/13 [==============================] - 5s 404ms/step - loss: 1.0299 - accuracy: 0.4650 - val_loss: 1.0085 - val_accuracy: 0.4600
Epoch 5/15
13/13 [==============================] - 6s 413ms/step - loss: 0.9851 - accuracy: 0.5119 - val_loss: 0.9753 - val_accuracy: 0.5750
Epoch 6/15
13/13 [==============================] - 6s 411ms/step - loss: 0.9147 - accuracy: 0.5769 - val_loss: 0.9388 - val_accuracy: 0.5025
Epoch 7/15
13/13 [==============================] - 6s 419ms/step - loss: 0.8980 - accuracy: 0.5562 - val_loss: 0.9024 - val_accuracy: 0.5650
Epoch 8/15
13/13 [==============================] - 6s 424ms/step - loss: 0.8832 - accuracy: 0.5756 - val_loss: 0.8709 - val_accuracy: 0.5825
Epoch 9/15
13/13 [==============================] - 6s 417ms/step - loss: 0.8517 - accuracy: 0.6044 - val_loss: 0.8710 - val_accuracy: 0.5725
Epoch 10/15
13/13 [==============================] - 6s 412ms/step - loss: 0.8150 - accuracy: 0.6194 - val_loss: 0.8944 - val_accuracy: 0.5875
Epoch 11/15
13/13 [==============================] - 6s 416ms/step - loss: 0.8003 - accuracy: 0.6481 - val_loss: 0.8982 - val_accuracy: 0.5850
Epoch 12/15
13/13 [==============================] - 6s 424ms/step - loss: 0.7852 - accuracy: 0.6550 - val_loss: 0.8984 - val_accuracy: 0.5775
Epoch 13/15

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13/13 [==============================] - 6s 426ms/step - loss: 0.7356 - accuracy:
0.6831 - val_loss: 0.8575 - val_accuracy: 0.6275
Epoch 14/15
13/13 [==============================] - 5s 411ms/step - loss: 0.7154 - accuracy:
0.6938 - val_loss: 0.8500 - val_accuracy: 0.6325
Epoch 15/15
13/13 [==============================] - 6s 428ms/step - loss: 0.6978 - accuracy:
0.6988 - val_loss: 0.8618 - val_accuracy: 0.6025
* Evaluating dropout_model
30/30 [==============================] - 3s 83ms/step - loss: 0.9017 - accuracy: 0.6040
* Confusion Matrix for dropout_model
30/30 [==============================] - 3s 80ms/step
[[844 632 298]
 [166 850 217]
 [ 59 148 624]]
* Model saved as dropout_model_15_epochs_timestamp_1691651091.keras
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 rescaling (Rescaling)       (None, 150, 150, 3)       0

 conv2d (Conv2D)             (None, 148, 148, 8)       224

 dropout (Dropout)           (None, 148, 148, 8)       0

 max_pooling2d (MaxPooling2D  (None, 74, 74, 8)        0
 )

 conv2d_1 (Conv2D)           (None, 72, 72, 16)        1168

 max_pooling2d_1 (MaxPooling  (None, 36, 36, 16)       0
 2D)

 conv2d_2 (Conv2D)           (None, 34, 34, 32)        4640

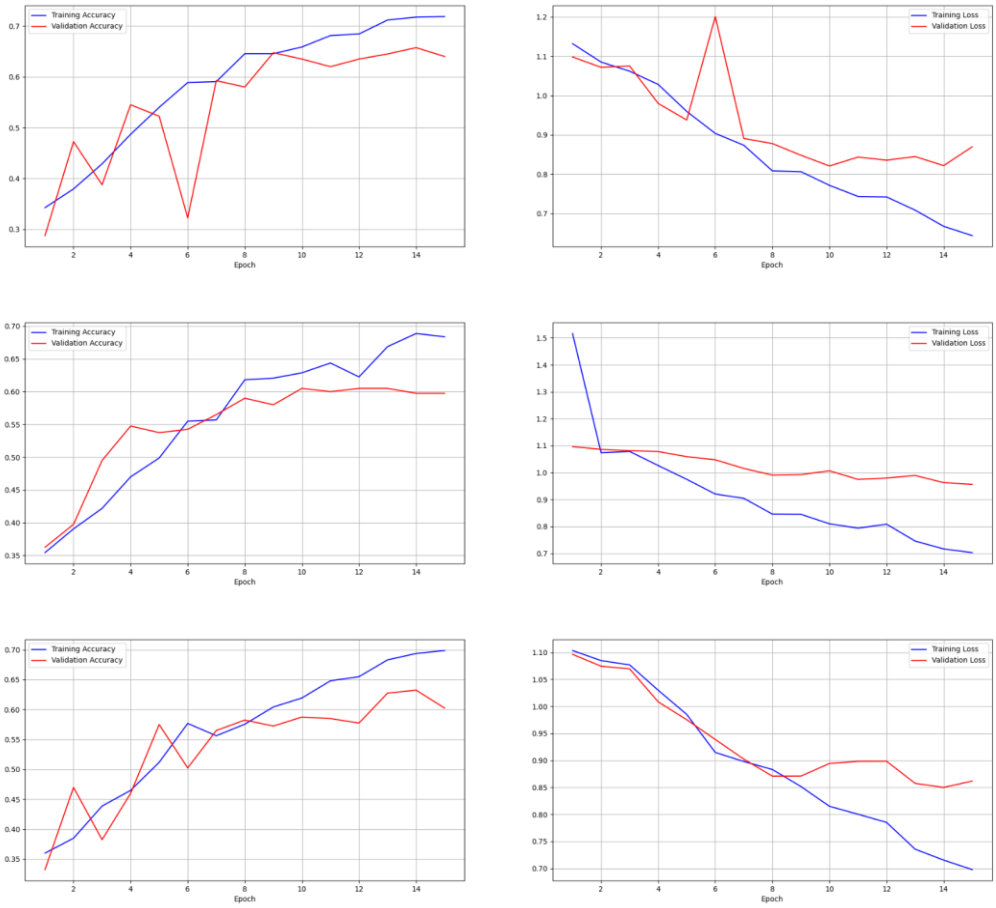
 max_pooling2d_2 (MaxPooling  (None, 17, 17, 32)       0
 2D)

 flatten (Flatten)           (None, 9248)              0

 dense (Dense)               (None, 32)                295968

 dense_1 (Dense)             (None, 3)                 99
```

==========



Trace of Moves in the Game:

Me (X): Center
Computer (O): Top-left
Me (X): Bottom-center
Computer (O): Top-center
Me (X): Top-right
Computer (O): Bottom-right
Me (X): Middle-right
Computer (O): Middle-left
Me (X): Bottom-left (Game ended in a draw!)

Answers to the Questions:

- How well did your interface work?

  The interface worked fairly well. There were a few times when it didn't quite catch my expression, but it was mostly smooth.

- Did it recognize your facial expressions with the same accuracy as it achieved against the test set?

  It seemed to be slightly less accurate than the test set. It was close, but there were moments when it seemed to misinterpret my expressions.

- If not, why not?

  I suspect the lighting in the room might have affected the recognition. Also, I might not have been as consistent with my expressions as the samples in the test set.

This game was an enjoyable and unconventional experience. The interface's responsiveness was mostly satisfying, and it provided a new and engaging way to play a classic game. The minor discrepancies in facial recognition didn't significantly impact the gameplay, and I could see myself using this interface again in the future.