APPENDIX 1: ALS Transformer Model Summary

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Layer (type)	Output Shape	Param #	Connected to
non_empty_frame_idxs (InputLayer)	[(None, 64)]	0	[]
tf.math.not_equal (TFOpLambda)	(None, 64)	0	['non_empty_frame_idxs[0][0]']
tf.cast (TFOpLambda)	(None, 64)	0	['tf.math.not_equal[0][0]']
tf.expand_dims (TFOpLambda)	(None, 64, 1)	0	['tf.cast[0][0]']
frames (InputLayer)	[(None, 64, 66, 3)]	0	[]
tf.compat.v1.shape (TFOpLambda)	(3,)	0	['tf.expand_dims[0][0]']
tf.slice (TFOpLambda)	(None, 64, 66, 2)	0	['frames[0][0]']
tf.random.uniform (TFOpLambda)	(None, 64, 1)	0	['tf.compat.v1.shape[0][0]']
tf.slice_1 (TFOpLambda)	(None, 64, 40, 2)	0	['tf.slice[0][0]']
tf.slice_2 (TFOpLambda)	(None, 64, 21, 2)	0	['tf.slice[0][0]']
tf.slice_3 (TFOpLambda)	(None, 64, 5, 2)	0	['tf.slice[0][0]']
tf.math.greater (TFOpLambda)	(None, 64, 1)	0	['tf.random.uniform[0][0]']
tf.math.not_equal_1 (TFOpLambda)	(None, 64, 1)	0	['tf.expand_dims[0][0]']
tf.math.subtract (TFOpLambda)	(None, 64, 40, 2)	0	['tf.slice_1[0][0]']
tf.math.subtract_1 (TFOpLambda)	(None, 64, 21, 2)	0	['tf.slice_2[0][0]']
tf.math.subtract_2 (TFOpLambda)	(None, 64, 5, 2)	0	['tf.slice_3[0][0]']
tf.math.logical_and (TFOpLambda)	(None, 64, 1)	0	['tf.math.greater[0][0]', 'tf.math.not_equal_1[0][0]']
tf.math.equal_1 (TFOpLambda)	(None, 64, 40, 2)	0	['tf.slice_1[0][0]']

a)

tf.math.truediv (TFOpLambd (None, 64, 40, 2)   0   ['tf.math.subtract[0][0]']
a)

tf.math.equal_2 (TFOpLambd (None, 64, 21, 2)   0   ['tf.slice_2[0][0]']
a)

tf.math.truediv_1 (TFOpLam (None, 64, 21, 2)   0   ['tf.math.subtract_1[0][0]']
bda)

tf.math.equal_3 (TFOpLambd (None, 64, 5, 2)   0   ['tf.slice_3[0][0]']
a)

tf.math.truediv_2 (TFOpLam (None, 64, 5, 2)   0   ['tf.math.subtract_2[0][0]']
bda)

tf.where (TFOpLambda)   (None, 64, 1)   0   ['tf.math.logical_and[0][0]']

tf.where_2 (TFOpLambda)   (None, 64, 40, 2)   0   ['tf.math.equal_1[0][0]',
                                                              'tf.math.truediv[0][0]']

tf.where_3 (TFOpLambda)   (None, 64, 21, 2)   0   ['tf.math.equal_2[0][0]',
                                                              'tf.math.truediv_1[0][0]']

tf.where_4 (TFOpLambda)   (None, 64, 5, 2)   0   ['tf.math.equal_3[0][0]',
                                                              'tf.math.truediv_2[0][0]']

tf.math.reduce_sum (TFOpLa (None, 1, 1)   0   ['tf.where[0][0]']
mbda)

tf.reshape (TFOpLambda)   (None, 64, 80)   0   ['tf.where_2[0][0]']

tf.reshape_1 (TFOpLambda)   (None, 64, 42)   0   ['tf.where_3[0][0]']

tf.reshape_2 (TFOpLambda)   (None, 64, 10)   0   ['tf.where_4[0][0]']

tf.math.equal (TFOpLambda) (None, 1, 1)   0   ['tf.math.reduce_sum[0][0]']

embedding (Embedding)   (None, 64, 512)   986243 ['tf.reshape[0][0]',
                                                              'tf.reshape_1[0][0]',
                                                              'tf.reshape_2[0][0]',
                                                              'non_empty_frame_idxs[0][0]']

| embedding (Embedding)   multiple   33280   []
| lips_embedding (LandmarkE multiple   178560   []
| mbedding)

|| lips_embedding_dense (Se (None, 64, 384)   178176   []
|| quential)

Layer (type)	Output Shape	Param #	Connected to
lips_embedding_dense_1 (Dense)	(None, 64, 384)	30720	[]
activation_1 (Activation)	(None, 64, 384)	0	[]
lips_embedding_dense_2 (Dense)	(None, 64, 384)	147456	[]
left_hand_embedding (LandmarkEmbedding)	multiple	163968	[]
left_hand_embedding_dense (Sequential)	(None, 64, 384)	163584	[]
left_hand_embedding_dense_1 (Dense)	(None, 64, 384)	16128	[]
activation_2 (Activation)	(None, 64, 384)	0	[]
left_hand_embedding_dense_2 (Dense)	(None, 64, 384)	147456	[]
pose_embedding (LandmarkEmbedding)	multiple	151680	[]
pose_embedding_dense (Sequential)	(None, 64, 384)	151296	[]
pose_embedding_dense_1 (Dense)	(None, 64, 384)	3840	[]
activation_3 (Activation)	(None, 64, 384)	0	[]
pose_embedding_dense_2 (Dense)	(None, 64, 384)	147456	[]

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| fc (Sequential)          (None, 64, 512)           458752    []                          |
|_____||
                  ||
|| fully_connected_1 (Dense  (None, 64, 512)            196608    []                         ||
|| )                                                           ||
||                                                            ||
|| activation (Activation)   (None, 64, 512)        0        []                       ||
||                                                            ||
|| fully_connected_2 (Dense  (None, 64, 512)            262144    []                         ||
|| )                                                          ||
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tf.where_1 (TFOpLambda)   (None, 64, 1)   0   ['tf.math.equal[0][0]',
                                                            'tf.expand_dims[0][0]',
                                                            'tf.where[0][0]']

transformer (Transformer)   (None, 64, 512)   4201472   ['embedding[0][0]',
                                                            'tf.where_1[0][0]']

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|_____|
           _____|
| multi_head_attention (Mul  multiple              1050624   []                     |
| tiHeadAttention)                                          |
|                                                          |
| multi_head_attention_1 (M  multiple              1050624   []                     |
| ultiHeadAttention)                                        |
|                                                          |
| sequential (Sequential)    (None, 64, 512)          1050112   []                    |
|_____||
                  ||
|| dense_25 (Dense)        (None, 64, 1024)           525312    []                    ||
||                                                           ||
|| dropout (Dropout)       (None, 64, 1024)        0        []                  ||
||                                                           ||
|| dense_26 (Dense)        (None, 64, 512)           524800    []                  ||
|                                                  
|_____|
           |
| sequential_1 (Sequential)  (None, 64, 512)          1050112   []                    |
|_____||
                  ||
|| dense_52 (Dense)        (None, 64, 1024)           525312    []                    ||
||                                                           ||
|| dropout_1 (Dropout)     (None, 64, 1024)        0        []                  ||
||                                                           ||
|| dense_53 (Dense)        (None, 64, 512)           524800    []                  ||
|                                                  
|_____|
           _____|
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```

tf.math.multiply (TFOpLamb (None, 64, 512)   0   ['transformer[0][0]',
da)   'tf.where_1[0][0]']

tf.math.reduce_sum_1 (TFOp (None, 512)   0   ['tf.math.multiply[0][0]']

Lambda)

tf.math.reduce_sum_2 (TFOp (None, 1)   0   ['tf.where_1[0][0]']
Lambda)

tf.math.truediv_3 (TFOpLam (None, 512)   0   ['tf.math.reduce_sum_1[0][0]',
bda)   'tf.math.reduce_sum_2[0][0]']

 dropout (Dropout)   (None, 512)   0   ['tf.math.truediv_3[0][0]']

 dense (Dense)   (None, 250)   128250   ['dropout[0][0]']

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========================
    Total params: 5315965 (20.28 MB)
    Trainable params: 5315965 (20.28 MB)
    Non-trainable params: 0 (0.00 Byte)
    _____
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APPENDIX 2: ASL Transformer Model Validation Score

	precision	recall	f1-score	support
TV	0.76	0.95	0.84	60
after	0.39	0.37	0.38	59
airplane	0.98	1.00	0.99	57
all	0.78	0.64	0.70	59
alligator	0.56	0.77	0.65	61
animal	0.63	0.54	0.58	48
another	0.61	0.69	0.65	51
any	0.56	0.76	0.65	58
apple	0.94	0.89	0.91	53
arm	0.78	0.39	0.52	54
aunt	0.72	0.65	0.69	55
awake	0.44	0.26	0.33	57
backyard	0.76	0.59	0.67	59
bad	0.80	0.67	0.73	60
balloon	0.70	0.79	0.75	63
bath	0.65	0.96	0.78	54
because	0.88	0.83	0.85	59
bed	0.62	0.96	0.76	55
bedroom	0.71	0.61	0.65	61
bee	0.76	0.63	0.69	60
before	0.73	0.61	0.67	54
beside	0.64	0.49	0.55	47
better	0.90	0.77	0.83	57
bird	0.73	0.97	0.83	58
black	0.93	0.88	0.90	58
blow	0.75	0.88	0.81	59
blue	0.83	0.71	0.76	55
boat	0.68	0.81	0.74	53
book	0.71	0.88	0.78	56
boy	0.92	0.91	0.92	54
brother	0.84	0.88	0.86	60
brown	0.84	0.98	0.90	58
bug	0.67	0.90	0.77	62
bye	0.66	0.75	0.70	60
callonphone	1.00	0.72	0.84	57
can	0.52	0.57	0.54	54
car	0.79	0.63	0.70	54
carrot	0.96	0.45	0.62	55
cat	0.54	0.66	0.59	67
cereal	0.79	0.54	0.64	56
chair	0.68	0.85	0.75	52
cheek	0.90	0.74	0.81	61
child	0.76	0.54	0.63	52
chin	0.75	0.78	0.76	58
chocolate	0.83	0.91	0.87	58
clean	0.43	0.87	0.57	53
close	0.76	0.38	0.51	65
closet	0.88	0.57	0.69	61
cloud	0.74	0.75	0.75	61
clown	0.87	0.87	0.87	61
cow	0.92	0.95	0.93	60
cowboy	0.84	0.83	0.83	58

cry	0.87	0.84	0.86	57
cut	0.60	0.79	0.68	57
cute	0.95	0.92	0.93	59
dad	0.81	0.98	0.89	57
dance	0.84	0.70	0.76	46
dirty	0.95	0.75	0.84	53
dog	0.71	0.57	0.63	56
doll	0.98	0.90	0.94	61
donkey	0.88	0.97	0.92	59
down	0.74	0.81	0.78	43
drawer	0.66	0.67	0.67	58
drink	0.90	0.98	0.94	57
drop	0.78	0.43	0.55	49
dry	0.79	0.71	0.75	59
dryer	0.84	0.77	0.80	60
duck	0.64	0.84	0.73	57
ear	0.97	0.48	0.64	60
elephant	0.68	0.58	0.62	59
empty	0.69	0.62	0.65	58
every	0.47	0.48	0.48	50
eye	0.82	0.78	0.80	54
face	0.54	0.72	0.61	53
fall	0.86	0.62	0.72	58
farm	0.87	0.67	0.76	58
fast	0.45	0.27	0.34	51
feet	0.88	0.63	0.74	60
find	0.31	0.56	0.40	59
fine	0.52	0.89	0.66	53
finger	0.72	0.57	0.64	60
finish	0.69	0.78	0.73	60
fireman	0.96	0.83	0.89	60
first	0.85	0.78	0.82	60
fish	0.59	0.71	0.65	56
flag	0.75	0.97	0.84	58
flower	0.93	0.88	0.90	57
food	0.90	0.96	0.93	57
for	0.96	0.95	0.96	57
frenchfries	0.56	0.98	0.71	60
frog	0.98	0.91	0.94	54
garbage	0.97	0.58	0.72	50
gift	0.58	0.84	0.69	58
giraffe	0.91	0.59	0.72	54
girl	0.55	0.42	0.48	52
give	0.59	0.25	0.35	53
glasswindow	0.50	0.35	0.41	54
go	0.86	0.23	0.36	53
goose	0.60	0.05	0.09	62
grandma	0.58	0.75	0.66	57
grandpa	0.98	0.83	0.90	60
grass	0.46	0.47	0.46	60
green	0.79	0.91	0.85	55
gum	0.89	0.93	0.91	59
hair	0.83	0.60	0.70	58
happy	0.82	0.90	0.86	60
hat	0.80	0.81	0.80	43
hate	0.49	0.67	0.57	58
have	0.68	0.88	0.77	49

haveto	0.66	0.85	0.75	55
head	0.79	0.91	0.85	58
hear	0.57	0.56	0.56	68
helicopter	0.66	0.47	0.55	57
hello	0.62	0.79	0.69	57
hen	0.52	0.79	0.63	61
hesheit	0.63	0.77	0.69	60
hide	0.48	0.57	0.52	51
high	0.88	0.93	0.90	54
home	0.98	0.81	0.89	59
horse	0.90	1.00	0.94	60
hot	0.76	0.85	0.80	60
hungry	0.87	0.81	0.84	59
icecream	0.91	0.72	0.80	60
if	0.84	0.93	0.88	55
into	0.67	0.69	0.68	54
jacket	0.70	0.72	0.71	58
jeans	0.76	0.55	0.64	56
jump	0.79	0.63	0.70	59
kiss	0.71	0.63	0.67	59
kitty	0.34	0.26	0.30	65
lamp	0.71	0.59	0.64	61
later	0.59	0.78	0.67	58
like	0.66	0.92	0.77	64
lion	0.90	0.84	0.87	55
lips	0.47	0.58	0.52	60
listen	0.76	0.56	0.65	57
look	0.77	0.44	0.56	62
loud	0.77	0.49	0.60	61
mad	0.63	0.83	0.72	58
make	0.60	0.83	0.70	59
man	0.81	0.78	0.79	59
many	0.40	0.64	0.49	50
milk	0.70	0.78	0.74	58
minemy	0.70	0.97	0.81	60
mitten	0.94	0.48	0.64	62
mom	0.58	0.91	0.71	58
moon	0.93	0.95	0.94	59
morning	0.85	0.93	0.89	55
mouse	0.95	0.92	0.93	60
mouth	0.52	0.22	0.31	60
nap	0.59	0.15	0.24	65
napkin	0.73	0.45	0.56	60
night	0.79	0.58	0.67	45
no	0.68	0.85	0.76	61
noisy	0.92	0.41	0.57	56
nose	0.89	0.88	0.89	58
not	0.59	0.90	0.71	61
now	0.69	0.94	0.80	52
nuts	0.60	0.76	0.67	63
old	0.89	0.63	0.74	54
on	0.78	0.73	0.75	59
open	0.66	0.78	0.71	49
orange	0.94	0.79	0.86	58
outside	0.55	0.48	0.51	61
owie	0.63	0.30	0.40	57
owl	0.96	0.95	0.96	57

pajamas	0.87	0.74	0.80	54
pen	0.69	0.34	0.46	64
pencil	0.61	0.58	0.60	60
penny	0.61	0.46	0.53	54
person	0.36	0.40	0.38	35
pig	0.89	0.92	0.91	53
pizza	0.58	0.38	0.46	66
please	0.90	0.78	0.84	60
police	0.98	0.87	0.92	60
pool	0.90	0.48	0.63	56
potty	0.81	0.94	0.87	53
pretend	0.82	0.84	0.83	61
pretty	0.56	0.52	0.54	58
puppy	0.80	0.52	0.63	62
puzzle	0.68	0.78	0.73	50
quiet	0.70	0.66	0.68	61
radio	0.89	0.65	0.75	60
rain	0.87	0.65	0.74	60
read	0.82	0.75	0.78	53
red	0.90	0.74	0.81	58
refrigerator	0.88	0.53	0.66	55
ride	0.90	0.34	0.49	53
room	0.44	0.67	0.53	60
sad	0.77	0.92	0.84	60
same	0.81	0.80	0.80	59
say	0.38	0.64	0.48	55
scissors	0.60	0.73	0.66	60
see	0.62	0.98	0.76	60
shhh	0.84	0.95	0.89	60
shirt	0.88	0.93	0.90	54
shoe	0.92	0.90	0.91	60
shower	0.72	0.62	0.67	55
sick	0.87	0.70	0.77	56
sleep	0.37	0.67	0.48	57
sleepy	0.54	0.71	0.61	63
smile	0.73	0.73	0.73	56
snack	0.81	0.60	0.69	58
snow	0.94	0.84	0.89	58
stairs	0.83	0.63	0.72	60
stay	0.69	0.75	0.72	56
sticky	0.40	0.79	0.53	53
store	0.82	0.93	0.87	55
story	0.94	0.56	0.70	59
stuck	0.90	0.95	0.92	56
sun	0.62	0.50	0.55	58
table	0.71	0.92	0.80	51
talk	0.97	0.50	0.66	58
taste	0.73	0.91	0.81	57
thankyou	0.38	0.90	0.53	52
that	0.58	0.60	0.59	55
there	0.52	0.46	0.49	50
think	0.58	0.76	0.66	55
thirsty	0.93	0.86	0.89	49
tiger	0.89	0.91	0.90	56
time	0.82	0.84	0.83	50
tomorrow	0.87	0.49	0.63	55
tongue	0.49	0.81	0.61	58

tooth	0.51	0.62	0.56	53
toothbrush	0.67	0.67	0.67	57
touch	0.68	0.60	0.64	57
toy	0.98	0.80	0.88	55
tree	0.81	0.84	0.82	56
uncle	0.93	0.87	0.90	60
underwear	0.86	0.62	0.72	61
up	0.55	0.87	0.68	60
vacuum	0.45	0.48	0.47	52
wait	0.51	0.69	0.59	51
wake	0.41	0.64	0.50	58
water	0.81	0.95	0.87	62
wet	0.46	0.45	0.46	66
weus	0.69	0.88	0.78	57
where	0.80	0.93	0.86	56
white	0.88	0.73	0.80	60
who	0.86	0.80	0.83	60
why	0.82	0.71	0.76	59
will	0.87	0.59	0.70	56
wolf	0.71	0.61	0.66	57
yellow	0.80	0.83	0.81	58
yes	0.63	0.74	0.68	62
yesterday	0.78	0.65	0.71	60
yourself	0.88	0.75	0.81	57
yucky	0.44	0.34	0.38	56
zebra	0.73	0.87	0.79	61
zipper	0.75	0.66	0.70	32
accuracy			0.71	14248
macro avg	0.74	0.71	0.71	14248
weighted avg	0.74	0.71	0.71	14248

Appendix 3A: LSTM(Model2) results

```
Epoch 1/50
25/25 [==============================] - 0s 18ms/step - loss:
3.2265 - accuracy: 0.3363 - val_loss: 5.3778 - val_accuracy: 0.0625
Epoch 2/50
25/25 [==============================] - 0s 16ms/step - loss:
2.7695 - accuracy: 0.4094 - val_loss: 5.4829 - val_accuracy: 0.0875
Epoch 3/50
25/25 [==============================] - 0s 16ms/step - loss:
2.3840 - accuracy: 0.4963 - val_loss: 5.7282 - val_accuracy: 0.0700
Epoch 4/50
25/25 [==============================] - 0s 15ms/step - loss:
2.0180 - accuracy: 0.5838 - val_loss: 5.7450 - val_accuracy: 0.0900
Epoch 5/50
25/25 [==============================] - 0s 14ms/step - loss:
1.6819 - accuracy: 0.6475 - val_loss: 5.9343 - val_accuracy: 0.0825
Epoch 6/50
25/25 [==============================] - 0s 14ms/step - loss:
1.3888 - accuracy: 0.7194 - val_loss: 6.1780 - val_accuracy: 0.0950
Epoch 7/50
25/25 [==============================] - 0s 14ms/step - loss:
1.0648 - accuracy: 0.7925 - val_loss: 6.5686 - val_accuracy: 0.0725
Epoch 8/50
25/25 [==============================] - 0s 14ms/step - loss:
0.8979 - accuracy: 0.8275 - val_loss: 6.7814 - val_accuracy: 0.1000
Epoch 9/50
25/25 [==============================] - 0s 14ms/step - loss:
0.7429 - accuracy: 0.8706 - val_loss: 6.8937 - val_accuracy: 0.0850
Epoch 10/50
25/25 [==============================] - 0s 14ms/step - loss:
0.6046 - accuracy: 0.8850 - val_loss: 7.0825 - val_accuracy: 0.0950
Epoch 11/50
25/25 [==============================] - 0s 13ms/step - loss:
0.4546 - accuracy: 0.9344 - val_loss: 7.2407 - val_accuracy: 0.0775
Epoch 12/50
25/25 [==============================] - 0s 14ms/step - loss:
0.3682 - accuracy: 0.9550 - val_loss: 7.4183 - val_accuracy: 0.0875
Epoch 13/50
25/25 [==============================] - 0s 14ms/step - loss:
0.3064 - accuracy: 0.9669 - val_loss: 7.5476 - val_accuracy: 0.0950
Epoch 14/50
25/25 [==============================] - 0s 14ms/step - loss:
0.2407 - accuracy: 0.9725 - val_loss: 7.8010 - val_accuracy: 0.0825
```

```
        Epoch 15/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.1962 - accuracy: 0.9812 - val_loss: 7.7526 - val_accuracy: 0.0850
        Epoch 16/50
        25/25 [==============================] - 0s 15ms/step - loss:
0.1550 - accuracy: 0.9894 - val_loss: 7.8876 - val_accuracy: 0.0650
        Epoch 17/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.1368 - accuracy: 0.9900 - val_loss: 7.9243 - val_accuracy: 0.0725
        Epoch 18/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.1099 - accuracy: 0.9944 - val_loss: 8.0856 - val_accuracy: 0.0900
        Epoch 19/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0964 - accuracy: 0.9944 - val_loss: 8.1380 - val_accuracy: 0.0725
        Epoch 20/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0900 - accuracy: 0.9969 - val_loss: 8.3452 - val_accuracy: 0.0900
        Epoch 21/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0814 - accuracy: 0.9950 - val_loss: 8.3696 - val_accuracy: 0.0925
        Epoch 22/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0833 - accuracy: 0.9919 - val_loss: 8.5537 - val_accuracy: 0.0825
        Epoch 23/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0813 - accuracy: 0.9956 - val_loss: 8.5786 - val_accuracy: 0.0925
        Epoch 24/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0601 - accuracy: 0.9981 - val_loss: 8.5922 - val_accuracy: 0.0800
        Epoch 25/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0520 - accuracy: 0.9981 - val_loss: 8.5101 - val_accuracy: 0.0950
        Epoch 26/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0428 - accuracy: 0.9981 - val_loss: 8.6848 - val_accuracy: 0.0800
        Epoch 27/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0426 - accuracy: 0.9969 - val_loss: 8.7928 - val_accuracy: 0.0750
        Epoch 28/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0426 - accuracy: 0.9975 - val_loss: 8.9056 - val_accuracy: 0.0775
        Epoch 29/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0372 - accuracy: 0.9987 - val_loss: 8.8903 - val_accuracy: 0.0875
        Epoch 30/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0308 - accuracy: 1.0000 - val_loss: 8.9169 - val_accuracy: 0.0900
        Epoch 31/50
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        25/25 [==============================] - 0s 14ms/step - loss:
0.0287 - accuracy: 0.9994 - val_loss: 9.0420 - val_accuracy: 0.0825
        Epoch 32/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0253 - accuracy: 1.0000 - val_loss: 9.0827 - val_accuracy: 0.0825
        Epoch 33/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0249 - accuracy: 0.9987 - val_loss: 9.0530 - val_accuracy: 0.0750
        Epoch 34/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0246 - accuracy: 0.9994 - val_loss: 9.1160 - val_accuracy: 0.0900
        Epoch 35/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0238 - accuracy: 0.9994 - val_loss: 9.1337 - val_accuracy: 0.0850
        Epoch 36/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0242 - accuracy: 1.0000 - val_loss: 9.1707 - val_accuracy: 0.0900
        Epoch 37/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0262 - accuracy: 0.9981 - val_loss: 9.2305 - val_accuracy: 0.0950
        Epoch 38/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0220 - accuracy: 1.0000 - val_loss: 9.3240 - val_accuracy: 0.1025
        Epoch 39/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0192 - accuracy: 1.0000 - val_loss: 9.3831 - val_accuracy: 0.0825
        Epoch 40/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0186 - accuracy: 1.0000 - val_loss: 9.3772 - val_accuracy: 0.0900
        Epoch 41/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0200 - accuracy: 1.0000 - val_loss: 9.3343 - val_accuracy: 0.0850
        Epoch 42/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0176 - accuracy: 1.0000 - val_loss: 9.4875 - val_accuracy: 0.0750
        Epoch 43/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0178 - accuracy: 0.9987 - val_loss: 9.4551 - val_accuracy: 0.0750
        Epoch 44/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0170 - accuracy: 1.0000 - val_loss: 9.4896 - val_accuracy: 0.0750
        Epoch 45/50
        25/25 [==============================] - 0s 14ms/step - loss:
0.0187 - accuracy: 0.9994 - val_loss: 9.7413 - val_accuracy: 0.0825
        Epoch 46/50
        25/25 [==============================] - 0s 13ms/step - loss:
0.0339 - accuracy: 0.9981 - val_loss: 9.4402 - val_accuracy: 0.0825
        Epoch 47/50
        25/25 [==============================] - 0s 14ms/step - loss:
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0.0413 - accuracy: 0.9937 - val_loss: 9.3658 - val_accuracy: 0.0925
Epoch 48/50
25/25 [==============================] - 0s 14ms/step - loss:
0.0672 - accuracy: 0.9869 - val_loss: 9.3700 - val_accuracy: 0.0825
Epoch 49/50
25/25 [==============================] - 0s 14ms/step - loss:
0.1009 - accuracy: 0.9862 - val_loss: 9.5789 - val_accuracy: 0.0900
Epoch 50/50
25/25 [==============================] - 0s 14ms/step - loss:
0.3018 - accuracy: 0.9262 - val_loss: 8.9880 - val_accuracy: 0.0825