Multi-Class University Food Classification using Transfer Learning (MobileNetV2) with CNN

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TABLE OF CONTENTS

TABLE OF CONTENTS

OBJECTIVES OF THE PROJECT

MobileNetV2

MobileNetV2: Inverted Residuals and Linear Bottlenecks

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Abstract

In this paper we describe a new mobile architecture, MobileNetV2, that improves the state of the art performance of mobile models on multiple tasks and benchmarks as well as across a spectrum of different model sizes. We also describe efficient ways of applying these mobile models to object detection in a novel framework we call SSDLite. Additionally, we demonstrate how to build mobile semantic segmentation models through a reduced form of DeepLabv3 which we call Mobile DeepLabv3.

applications.

This paper introduces a new neural network architecture that is specifically tailored for mobile and resource constrained environments. Our network pushes the state of the art for mobile tailored computer vision models, by significantly decreasing the number of operations and memory needed while retaining the same accuracy.

Our main contribution is a novel layer module: the inverted residual with linear bottleneck. This module takes as an input a low-dimensional compressed representation which is first expanded to high dimension and filtered with a lightweight depthwise convo-

Technical Model Summery

Model: "sequential"

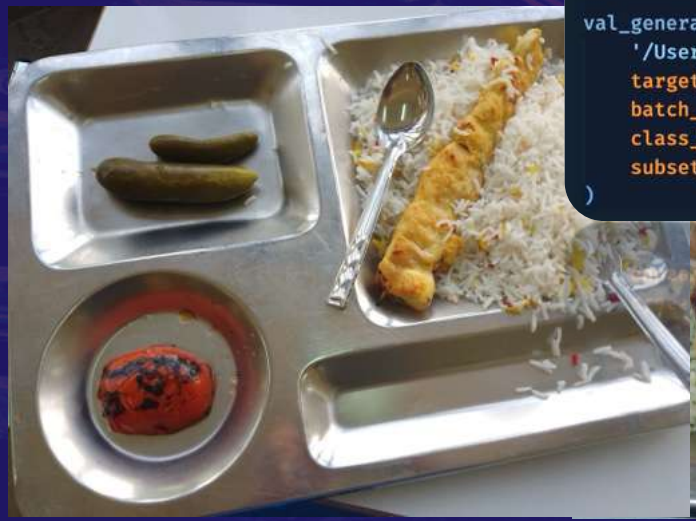
Layer (type)	Output Shape	Param #
mobilenetv2_1.00_224 (Functional)	(None, 7, 7, 1280)	2257984
global_average_pooling2d (GlobalAveragePooling2D)	(None, 1280)	0
dense (Dense)	(None, 256)	327936
dropout (Dropout)	(None, 256)	0
dense_1 (Dense)	(None, 32)	8224
dense_2 (Dense)	(None, 9)	297

Add Markdown Cell

Total params: 2594441 (9.90 MB)
Trainable params: 336457 (1.28 MB)
Non-trainable params: 2257984 (8.61 MB)

Dataset and train/val Generators

```
train_generator = datagen_train.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical',
    subset='training'
)

val_generator = datagen_val.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical',
    subset='validation',
)
```



Data Augmentation

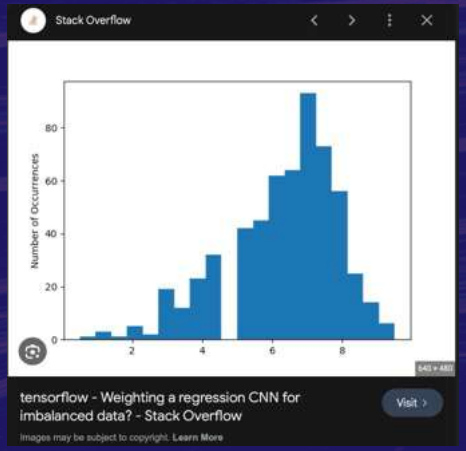


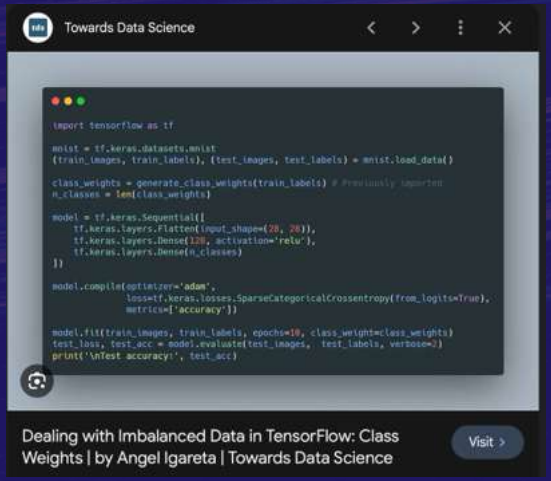
```
datagen_train = ImageDataGenerator(
    rescale=1./255,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    rotation_range=40,
    width_shift_range=0.2,
    height_shift_range=0.2,
    brightness_range=[0.5, 1.5],
    channel_shift_range=0.2,
    vertical_flip=True,
    fill_mode='nearest',
)
datagen_val = ImageDataGenerator(rescale=1./255, validation_split=0.15)
```





Weight Balancing





Balancing Class Weights (*inorder to improve perrformace on minority classes*)

+ Code + Markdown

```
labels = train_generator.classes

class_counts = np.bincount(labels)
total_samples = np.sum(class_counts)
class_weights = total_samples / (len(class_counts) * class_counts)

class_weight_dict = dict(zip(range(len(class_counts)), class_weights))
```

Start Training the Model

- Fine-tuing the model on my small Dataset

```
his=model.fit(train_generator, epochs=30, validation_data=val_generator, class_weight=class_weight_dict)
```

Training Steps

Start Training the Model

- Fine-tuing the model on my small Dataset

```
his=model.fit(train_generator, epochs=30, validation_data=val_generator, class_weight=class_weight_dict)
```

```
Epoch 1/30
6/6 [==============================] - 29s 5s/step - loss: 10.8897 - accuracy: 0.1304 - val_loss: 9.7474 - val_accuracy: 0.3000
Epoch 2/30
6/6 [==============================] - 25s 4s/step - loss: 9.6405 - accuracy: 0.2174 - val_loss: 9.0709 - val_accuracy: 0.1500
Epoch 3/30
6/6 [==============================] - 25s 4s/step - loss: 8.5484 - accuracy: 0.2298 - val_loss: 8.2256 - val_accuracy: 0.0500
Epoch 4/30
6/6 [==============================] - 25s 5s/step - loss: 8.0764 - accuracy: 0.1988 - val_loss: 7.5761 - val_accuracy: 0.2500
Epoch 5/30
6/6 [==============================] - 25s 4s/step - loss: 7.3981 - accuracy: 0.2174 - val_loss: 6.9731 - val_accuracy: 0.3500
Epoch 6/30
6/6 [==============================] - 25s 5s/step - loss: 6.7613 - accuracy: 0.2236 - val_loss: 6.4106 - val_accuracy: 0.2500
```

```
his=model.fit(train_generator, epochs=30, validation_data=val_generator, class_weight=class_weight_dict, callbacks = [callback])
```

```
Epoch 1/30
3/3 [==============================] - 24s 10s/step - loss: 1.3040 - accuracy: 0.7888 - val_loss: 0.8583 - val_accuracy: 1.0000
Epoch 2/30
3/3 [==============================] - 21s 7s/step - loss: 1.1557 - accuracy: 0.8447 - val_loss: 0.8613 - val_accuracy: 1.0000
Epoch 3/30
3/3 [==============================] - 21s 7s/step - loss: 1.2200 - accuracy: 0.8075 - val_loss: 0.8619 - val_accuracy: 0.9655
Epoch 4/30
3/3 [==============================] - 21s 9s/step - loss: 1.2884 - accuracy: 0.7391 - val_loss: 0.8473 - val_accuracy: 0.9655
```

```
datagen_train = ImageDataGenerator(
    rescale=1./255,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    rotation_range=40,
    width_shift_range=0.2,
    height_shift_range=0.2,
    brightness_range=[0.5, 1.5],
    channel_shift_range=0.2,
    vertical_flip=True,
    fill_mode='nearest',
)
datagen_val = ImageDataGenerator(rescale=1./255, validation_split=0.15)

train_generator = datagen_train.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical',
    subset='training'
)

val_generator = datagen_val.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical',
    subset='validation',
)
```

(just Original Images)

```
datagen_train2 = ImageDataGenerator(rescale=1./255)
datagen_val2 = ImageDataGenerator(rescale=1./255, validation_split=0.20)


train_generator2 = datagen_train2.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=target_size,
    batch_size=batch_size,
    class_mode='categorical',
    subset='training'
)

val_generator2 = datagen_val2.flow_from_directory(
    '/Users/parsa/Desktop/Food',
    target_size=target_size,
    batch_size=batch_size,
    class_mode='categorical',
    subset='validation'
)
```

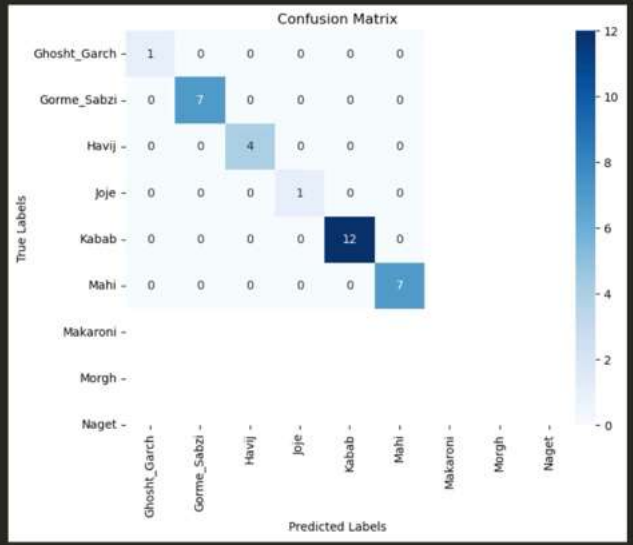
Final Results

==========] - 0s 191ms/step

Model Evaluation

```
2/2 [==============================] - 1s 234ms/step
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         6
           1       0.83      1.00      0.91        10
           2       1.00      0.89      0.94         9
           3       1.00      1.00      1.00         2
           4       0.92      0.85      0.88        13
           5       0.75      1.00      0.86         3
           6       1.00      1.00      1.00         4
           7       0.93      0.88      0.90        16
           8       1.00      1.00      1.00         1

    accuracy                           0.92        64
   macro avg       0.94      0.96      0.94        64
weighted avg       0.93      0.92      0.92        64

[[ 6  0  0  0  0  0  0  0  0]
 [ 0 10  0  0  0  0  0  0  0]
 [ 0  0  8  0  0  0  0  1  0]
 [ 0  0  0  2  0  0  0  0  0]
 [ 0  2  0  0 11  0  0  0  0]
 [ 0  0  0  0  0  3  0  0  0]
 [ 0  0  0  0  0  0  4  0  0]
 [ 0  0  0  0  1  1  0 14  0]
 [ 0  0  0  0  0  0  0  0  1]]
```

```
1/1 [==============================] - 0s 250ms/step
Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         1
           1       1.00      1.00      1.00         7
           2       1.00      1.00      1.00         4
           3       1.00      1.00      1.00         1
           4       1.00      1.00      1.00        12
           7       1.00      1.00      1.00         7

    accuracy                           1.00        32
   macro avg       1.00      1.00      1.00        32
weighted avg       1.00      1.00      1.00        32
```



Model in Action

```
28    predictions = model.predict(img_array)
29    # ************
```

PROBLEMS 2 PORTS TERMINAL

```
~
python3 -u "/Users/parsa/Downloads/Food Classification Project CNN/mai
Enter Image Path: /Users/parsa/Desktop/140.jpg
1/1 [==============================] - 0s 395ms/step
Predicted Class: Joje
Confidence: 98.56%
**********

Enter Image Path: /Users/parsa/Desktop/Screenshots/Screenshot 176.jpg
1/1 [==============================] - 0s 26ms/step
Predicted Class: Gorme_Sabzi
Confidence: 75.10%
**********

Enter Image Path: /Users/parsa/Desktop/Screenshots/Screenshot 179.jpg
1/1 [==============================] - 0s 26ms/step
Predicted Class: Havij
Confidence: 72.56%
**********
```

THANKS!

References:

Slidesgo
Andrew Deep
Jose Deep
StackOverflow
Tensorflow
ChatGPT 3.5

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