Food Classification using VGG16

In [9]:

```
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import VGG16
from tensorflow.keras.layers import Dense, GlobalAveragePooling2D
from tensorflow.keras.models import Model
```

In [10]:

```
train_dir = 'D:\data science\Data scientist\Projects\Project 6 Food class\Fast Food
validation_dir = 'D:\data science\Data scientist\Projects\Project 6 Food class\Fast
```

Data Augmentation

In [11]:

```
train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest'
)

train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical'
)

# Data preprocessing for validation (only rescaling, no augmentation)
validation_datagen = ImageDataGenerator(rescale=1./255)

validation_generator = validation_datagen.flow_from_directory(
    validation_dir,
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical'
)
```

```
Found 15000 images belonging to 10 classes.
Found 3500 images belonging to 10 classes.
```

Building the model

In [12]:

```
base_model = VGG16(weights='imagenet', include_top=False)

# Add new classifier layers
```

```
x = base_model.output
x = GlobalAveragePooling2D()(x)
x = Dense(1024, activation='relu')(x)
predictions = Dense(10, activation='softmax')(x)

# Combine base model and new layers
model = Model(inputs=base_model.input, outputs=predictions)

# Freeze pre-trained layers
for layer in base_model.layers:
    layer.trainable = False
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/v
gg16/vgg16_weights_tf_dim_ordering_tf_kernels_notop.h5
58889256/58889256 [==============================] - 9s 0us/step
```

Training the model

In [24]:

```
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatri
import matplotlib.pyplot as plt
from tensorflow.keras.callbacks import EarlyStopping


model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy


early_stopping = EarlyStopping(monitor='val_loss', patience=3, verbose=1, restore_b

history = model.fit(
    train_generator,
    epochs=20,
    validation_data=validation_generator,
    callbacks=[early_stopping]
)
```

```
Epoch 1/20
109/469 [=====>........................] - ETA: 2:11 - loss: 0.8669 - accuracy: 0.71
76
```

```
C:\Users\deepchanddc2\.conda\envs\py310\lib\site-packages\PIL\Image.py:981: UserWarn
ing: Palette images with Transparency expressed in bytes should be converted to RGBA
images
  warnings.warn(
469/469 [==============================] - 202s 429ms/step - loss: 0.8493 - accurac
y: 0.7234 - val_loss: 1.0489 - val_accuracy: 0.6706
Epoch 2/20
469/469 [==============================] - 214s 455ms/step - loss: 0.8258 - accurac
y: 0.7307 - val_loss: 1.0261 - val_accuracy: 0.6846
Epoch 3/20
469/469 [==============================] - 220s 469ms/step - loss: 0.8169 - accurac
y: 0.7326 - val_loss: 1.0377 - val_accuracy: 0.6797
Epoch 4/20
469/469 [==============================] - 217s 462ms/step - loss: 0.8028 - accurac
y: 0.7325 - val_loss: 1.0549 - val_accuracy: 0.6757
Epoch 5/20
469/469 [==============================] - 221s 472ms/step - loss: 0.7800 - accurac
y: 0.7445 - val_loss: 1.0223 - val_accuracy: 0.6826
Epoch 6/20
469/469 [==============================] - 224s 478ms/step - loss: 0.7698 - accurac
y: 0.7462 - val_loss: 1.0300 - val_accuracy: 0.6929
Epoch 7/20
469/469 [==============================] - 219s 467ms/step - loss: 0.7626 - accurac
y: 0.7477 - val_loss: 1.0125 - val_accuracy: 0.6903
Epoch 8/20
469/469 [==============================] - 222s 473ms/step - loss: 0.7623 - accurac
y: 0.7487 - val_loss: 1.0122 - val_accuracy: 0.6994
Epoch 9/20
469/469 [==============================] - 226s 481ms/step - loss: 0.7318 - accurac
y: 0.7575 - val_loss: 1.0833 - val_accuracy: 0.6823
Epoch 10/20
469/469 [==============================] - 218s 464ms/step - loss: 0.7290 - accurac
y: 0.7559 - val_loss: 1.0314 - val_accuracy: 0.6846
Epoch 11/20
469/469 [==============================] - 223s 476ms/step - loss: 0.7066 - accurac
y: 0.7650 - val_loss: 0.9975 - val_accuracy: 0.6977
Epoch 12/20
469/469 [==============================] - 234s 499ms/step - loss: 0.7027 - accurac
y: 0.7698 - val_loss: 1.0438 - val_accuracy: 0.6906
Epoch 13/20
469/469 [==============================] - 219s 467ms/step - loss: 0.6905 - accurac
y: 0.7691 - val_loss: 0.9668 - val_accuracy: 0.7169
Epoch 14/20
469/469 [==============================] - 221s 471ms/step - loss: 0.6758 - accurac
y: 0.7745 - val_loss: 1.0318 - val_accuracy: 0.7060
Epoch 15/20
469/469 [==============================] - 236s 502ms/step - loss: 0.6710 - accurac
y: 0.7783 - val_loss: 0.9975 - val_accuracy: 0.7006
Epoch 16/20
469/469 [==============================] - ETA: 0s - loss: 0.6623 - accuracy: 0.7833
Restoring model weights from the end of the best epoch: 13.
469/469 [==============================] - 224s 478ms/step - loss: 0.6623 - accurac
y: 0.7833 - val_loss: 1.0177 - val_accuracy: 0.7077
Epoch 16: early stopping
```

Saving the trained model

In [25]:

```
model.save(r'D:\data science\Data scientist\Projects\Project 6 Food class\food_clas
```

Model Performance

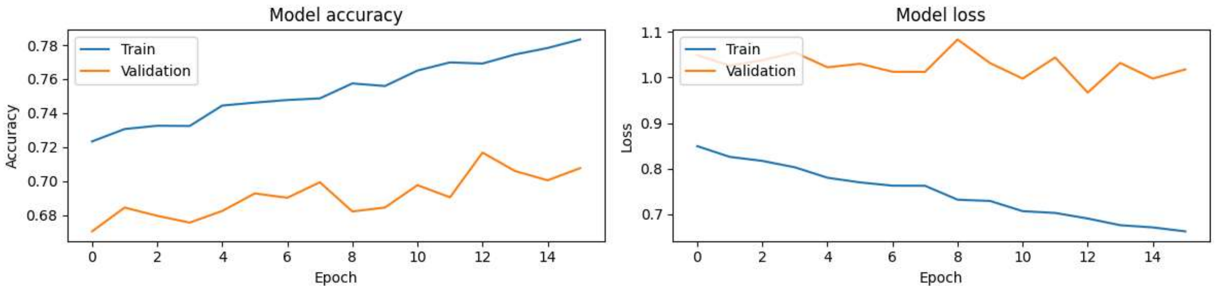
In [31]:

```
plt.figure(figsize=(12, 3))

# Plot training & validation accuracy values
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('Model accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend(['Train', 'Validation'], loc='upper left')

# Plot training & validation loss values
plt.subplot(1, 2, 2)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend(['Train', 'Validation'], loc='upper left')

plt.tight_layout()
plt.show()
```



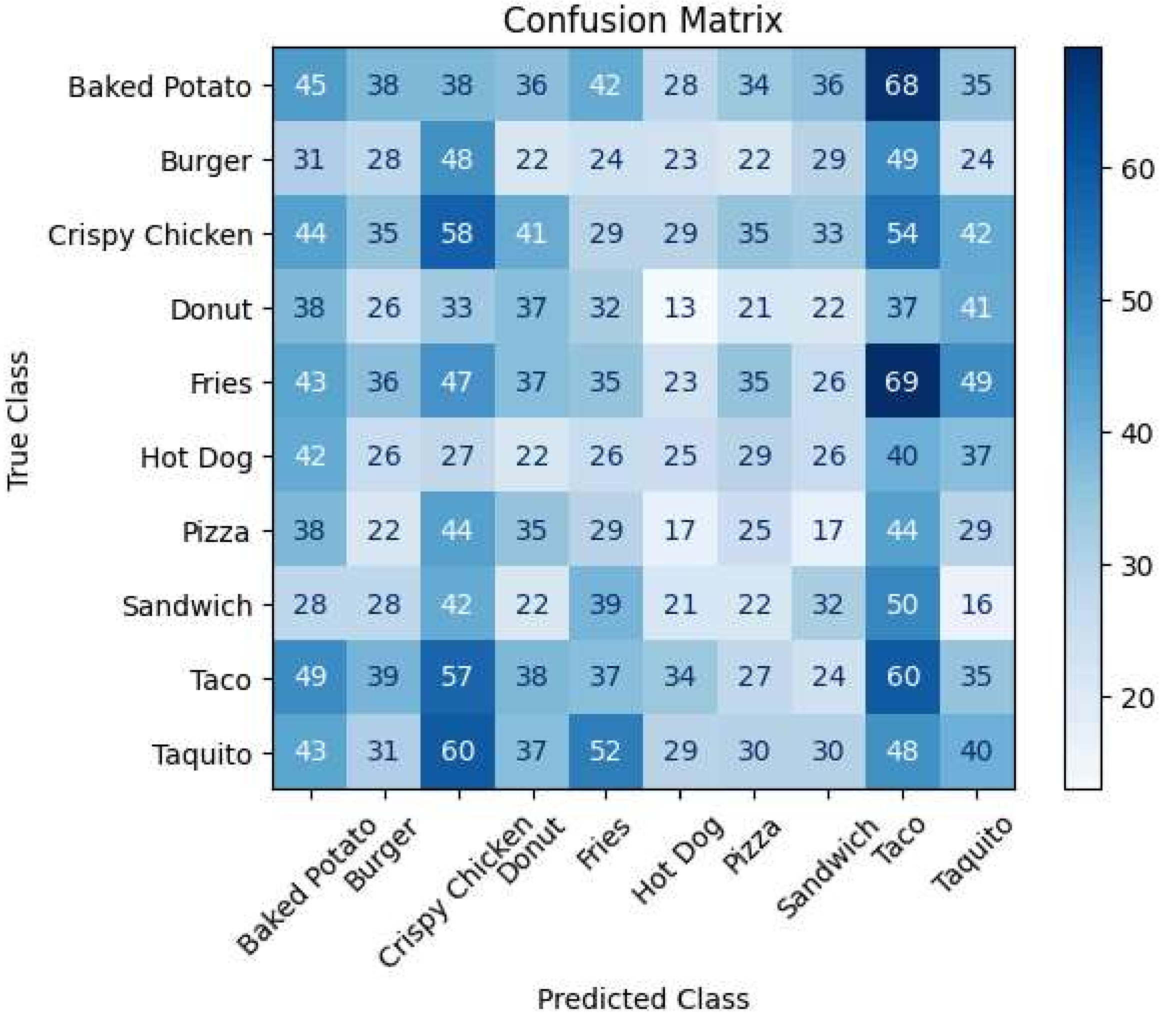
In [27]:

```
Y_pred = model.predict(validation_generator)
y_pred = np.argmax(Y_pred, axis=1)

# Get true labels
true_labels = validation_generator.classes

# Plot confusion matrix
cm = confusion_matrix(true_labels, y_pred)
plt.figure(figsize=(10, 8))
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=validation_genera
disp.plot(cmap=plt.cm.Blues, values_format='d')
plt.title('Confusion Matrix')
plt.xlabel('Predicted Class')
plt.ylabel('True Class')
plt.xticks(rotation=45)
plt.show()

# Print classification report
print(classification_report(true_labels, y_pred, target_names=validation_generator.
110/110 [==============================] - 25s 229ms/step
<Figure size 1000x800 with 0 Axes>
```



	Baked Potato	Burger	Crispy Chicken	Donut	Fries	Hot Dog	Pizza	Sandwich	Taco	Taquito
Baked Potato	45	38	38	36	42	28	34	36	68	35
Burger	31	28	48	22	24	23	22	29	49	24
Crispy Chicken	44	35	58	41	29	29	35	33	54	42
Donut	38	26	33	37	32	13	21	22	37	41
Fries	43	36	47	37	35	23	35	26	69	49
Hot Dog	42	26	27	22	26	25	29	26	40	37
Pizza	38	22	44	35	29	17	25	17	44	29
Sandwich	28	28	42	22	39	21	22	32	50	16
Taco	49	39	57	38	37	34	27	24	60	35
Taquito	43	31	60	37	52	29	30	30	48	40

```
                precision    recall  f1-score   support

  Baked Potato       0.11      0.11      0.11       400
        Burger       0.09      0.09      0.09       300
Crispy Chicken       0.13      0.14      0.14       400
         Donut       0.11      0.12      0.12       300
         Fries       0.10      0.09      0.09       400
       Hot Dog       0.10      0.08      0.09       300
         Pizza       0.09      0.08      0.09       300
      Sandwich       0.12      0.11      0.11       300
          Taco       0.12      0.15      0.13       400
       Taquito       0.11      0.10      0.11       400

      accuracy                           0.11      3500
     macro avg       0.11      0.11      0.11      3500
  weighted avg       0.11      0.11      0.11      3500
```

Prediction from test set

In [30]:
```
import tensorflow as tf
from tensorflow.keras.preprocessing import image
```

```python
import numpy as np
import matplotlib.pyplot as plt

def preprocess_image(image_path):
    img = image.load_img(image_path, target_size=(224, 224))
    img_array = image.img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)
    return img_array / 255.0  # Normalize pixel values to [0, 1]

def predict_class_and_display(image_path, model):
    # Preprocess the image
    processed_image = preprocess_image(image_path)

    # Predict class probabilities
    probabilities = model.predict(processed_image)

    # Get the class label with highest probability
    class_index = np.argmax(probabilities[0])

    # Map class index to class label
    labels = ['Baked potato', 'Burger', 'Crispy Chicken', 'Donut', 'Fries', 'Hot Do
    predicted_class = labels[class_index]

    # Display the image
    img = image.load_img(image_path)
    plt.imshow(img)
    plt.axis('off')
    plt.title('Predicted Class: ' + predicted_class)
    plt.show()

    return predicted_class, probabilities[0]

# Load the saved model
model_path = r'D:\data science\Data scientist\Projects\Project 6 Food class\food_cl
model = tf.keras.models.load_model(model_path)

# Example usage:
image_path = r'D:\data science\Data scientist\Projects\Project 6 Food class\Fast Fo
predicted_class, probabilities = predict_class_and_display(image_path, model)
print("Predicted class:", predicted_class)
print("Probabilities:", probabilities)
```

```
1/1 [==============================] - 0s 118ms/step
```

```
Predicted class: Donut
Probabilities: [0.01528531 0.14946644 0.1648008  0.32641947 0.05095739 0.05446512
 0.04122512 0.0865146  0.08327381 0.0275919 ]
```