

```
In [1]: import os
import numpy as np
import nibabel as nib
from sklearn.model_selection import train_test_split
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv3D, MaxPooling3D, Flatten, Dense, Dropout
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint
import matplotlib.pyplot as plt
print(f"TensorFlow version: {tf.__version__}")
print(f"GPU available: {tf.test.is_gpu_available()}")
```

```
2025-07-15 15:40:53.506558: E external/local_xla/xla/stream_executor/cuda/cuda_ff
t.cc:477] Unable to register cuFFT factory: Attempting to register factory for plu
gin cuFFT when one has already been registered
WARNING: All log messages before absl::InitializeLog() is called are written to ST
DERR
E0000 00:00:1752594053.697887    1009 cuda_dnn.cc:8310] Unable to register cuDNN f
actory: Attempting to register factory for plugin cuDNN when one has already been
registered
E0000 00:00:1752594053.751015    1009 cuda_blas.cc:1418] Unable to register cuBLAS
factory: Attempting to register factory for plugin cuBLAS when one has already bee
n registered
TensorFlow version: 2.18.0
GPU available: True
I0000 00:00:1752594060.358922    1009 gpu_device.cc:2022] Created device /device:G
PU:0 with 13942 MB memory: -> device: 0, name: Tesla T4, pci bus id: 0000:00:04.
0, compute capability: 7.5
I0000 00:00:1752594060.359623    1009 gpu_device.cc:2022] Created device /device:G
PU:1 with 13942 MB memory: -> device: 1, name: Tesla T4, pci bus id: 0000:00:05.
0, compute capability: 7.5
```

```
In [2]: import os

# Set Kaggle dataset paths
healthy_dir = "/kaggle/input/fmri-data/Healthy"
schiz_dir = "/kaggle/input/fmri-data/schiz" # Update if you have this too

# Verify directories exist
print(f"Healthy directory exists: {os.path.exists(healthy_dir)}")
print(f"Schizophrenic directory exists: {os.path.exists(schiz_dir)}")

# Get list of NIfTI files
if os.path.exists(healthy_dir):
    healthy_files = [f for f in os.listdir(healthy_dir) if f.endswith('.nii') or f.
    print(f"Found {len(healthy_files)} healthy files")

if os.path.exists(schiz_dir):
    schiz_files = [f for f in os.listdir(schiz_dir) if f.endswith('.nii') or f.ends
    print(f"Found {len(schiz_files)} schizophrenic files")
```

```
Healthy directory exists: True
Schizophrenic directory exists: True
Found 373 healthy files
Found 196 schizophrenic files
```

```
In [4]: def load_nifti(filepath):
    """
    Load and preprocess a NIfTI file
    """
    try:
        nii = nib.load(filepath)
```

```

volume = nii.get_fdata().astype(np.float32)
# Normalize the data to [0, 1] range
volume = (volume - np.min(volume)) / (np.max(volume) - np.min(volume))
# Add channel dimension (for CNN)
volume = np.expand_dims(volume, axis=-1)
return volume
except Exception as e:
    print(f"Error loading {filepath}: {e}")
    return None

```

```

In [6]: import os
import numpy as np
from scipy.ndimage import zoom

def load_nifti(filepath):
    import nibabel as nib
    try:
        img = nib.load(filepath)
        data = img.get_fdata()
        return data
    except Exception as e:
        print(f"Failed to load {filepath}: {e}")
        return None

def resize_volume(volume, target_shape=(128, 128, 128)):
    factors = [t / s for s, t in zip(volume.shape, target_shape)]
    return zoom(volume, zoom=factors, order=1)

def load_data(healthy_dir, schiz_dir, target_shape=(128, 128, 128)):
    X = []
    y = []

    print("Loading healthy brain scans...")
    healthy_files = [f for f in os.listdir(healthy_dir) if f.endswith('.nii') or f.
    print(f"Found {len(healthy_files)} healthy files")

    for i, filename in enumerate(healthy_files):
        filepath = os.path.join(healthy_dir, filename)
        volume = load_nifti(filepath)
        if volume is not None:
            resized = resize_volume(volume, target_shape)
            X.append(resized)
            y.append(0)
            print(f"Loaded healthy file {i+1}/{len(healthy_files)}: {filename}")

    print("\nLoading schizophrenic brain scans...")
    if os.path.exists(schiz_dir):
        schiz_files = [f for f in os.listdir(schiz_dir) if f.endswith('.nii') or f.
        print(f"Found {len(schiz_files)} schizophrenic files")

        for i, filename in enumerate(schiz_files):
            filepath = os.path.join(schiz_dir, filename)
            volume = load_nifti(filepath)
            if volume is not None:
                resized = resize_volume(volume, target_shape)
                X.append(resized)
                y.append(1)
                print(f"Loaded schizophrenic file {i+1}/{len(schiz_files)}: {filename}")
            else:
                print("⚠️ Schizophrenic directory not found. Skipping...")

    X = np.array(X)
    y = np.array(y)

```

```
print(f"\nDataset summary:")
print(f"Total samples: {len(X)}")
print(f"Healthy samples: {np.sum(y == 0)}")
print(f"Schizophrenic samples: {np.sum(y == 1)}")
if len(X) > 0:
    print(f"Input shape: {X[0].shape}")

return X, y
```

```
In [7]: healthy_dir = "/kaggle/input/fmri-data/Healthy"
schiz_dir = "/kaggle/input/fmri-datas/schiz" # ✅ updated path

print("Loading dataset...")
X, y = load_data(healthy_dir, schiz_dir)

if len(X) == 0:
    print("✗ No data loaded. Please check your file paths and file formats.")
else:
    print("✓ Data loaded successfully!")
```

Loading dataset...
Loading healthy brain scans...
Found 373 healthy files
Loaded healthy file 1/373: sub-ON11111_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 2/373: sub-ON42107_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 3/373: sub-ON66452_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 4/373: sub-ON80038_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 5/373: sub-ON88512_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 6/373: sub-ON99633_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 7/373: sub-ON70467_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 8/373: sub-ON95422_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 9/373: sub-ON71932_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 10/373: sub-ON44262_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 11/373: sub-ON33159_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 12/373: sub-ON43585_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 13/373: sub-ON11411_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 14/373: sub-ON95520_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 15/373: sub-ON62200_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 16/373: sub-ON87725_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 17/373: sub-ON97252_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 18/373: sub-ON53213_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 19/373: sub-ON97604_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 20/373: sub-ON88512_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 21/373: sub-ON56250_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 22/373: sub-ON85400_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 23/373: sub-ON96510_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 24/373: sub-ON08155_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 25/373: sub-ON98664_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 26/373: sub-ON96555_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 27/373: sub-ON97427_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 28/373: sub-ON96510_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 29/373: sub-ON96353_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 30/373: sub-ON91906_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 31/373: sub-ON89045_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 32/373: sub-ON83320_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 33/373: sub-ON34754_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 34/373: sub-ON02693_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 35/373: sub-ON85616_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 36/373: sub-ON79309_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 37/373: sub-ON09681_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 38/373: sub-ON65403_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 39/373: sub-ON47254_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 40/373: sub-ON11394_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 41/373: sub-ON93426_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 42/373: sub-ON13545_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 43/373: sub-ON98826_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 44/373: sub-ON03748_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 45/373: sub-ON87743_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 46/373: sub-ON72082_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 47/373: sub-ON18047_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 48/373: sub-ON85301_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 49/373: sub-ON99620_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 50/373: sub-ON98602_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 51/373: sub-ON46717_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 52/373: sub-ON81734_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 53/373: sub-ON99731_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 54/373: sub-ON35773_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 55/373: sub-ON96565_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 56/373: sub-ON96440_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 57/373: sub-ON88614_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 58/373: sub-ON42941_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 59/373: sub-ON39384_ses-02_acq-MPRAGE_T1w.nii
Loaded healthy file 60/373: sub-ON43016_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 61/373: sub-ON34766_ses-01_acq-MPRAGE_T1w.nii

```
Loaded healthy file 62/373: sub-ON26105_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 63/373: sub-ON66199_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 64/373: sub-ON48925_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 65/373: sub-ON77753_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 66/373: sub-ON02811_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 67/373: sub-ON87455_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 68/373: sub-ON85010_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 69/373: sub-ON95214_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 70/373: sub-ON02747_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 71/373: sub-ON47254_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 72/373: sub-ON51111_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 73/373: sub-ON21976_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 74/373: sub-ON84896_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 75/373: sub-ON79309_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 76/373: sub-ON09681_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 77/373: sub-ON99881_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 78/373: sub-ON85981_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 79/373: sub-ON30080_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 80/373: sub-ON23776_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 81/373: sub-ON42107_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 82/373: sub-ON22671_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 83/373: sub-ON93426_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 84/373: sub-ON99547_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 85/373: sub-ON54886_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 86/373: sub-ON76320_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 87/373: sub-ON96602_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 88/373: sub-ON89474_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 89/373: sub-ON94110_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 90/373: sub-ON63704_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 91/373: sub-ON01802_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 92/373: sub-ON95422_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 93/373: sub-ON00400_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 94/373: sub-ON97604_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 95/373: sub-ON43016_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 96/373: sub-ON08571_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 97/373: sub-ON73200_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 98/373: sub-ON61373_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 99/373: sub-ON89045_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 100/373: sub-ON76320_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 101/373: sub-ON98130_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 102/373: sub-ON65412_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 103/373: sub-ON39384_ses-02_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 104/373: sub-ON18047_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 105/373: sub-ON63221_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 106/373: sub-ON52083_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 107/373: sub-ON26105_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 108/373: sub-ON33221_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 109/373: sub-ON72082_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 110/373: sub-ON87362_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 111/373: sub-ON95003_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 112/373: sub-ON89475_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 113/373: sub-ON09540_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 114/373: sub-ON88700_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 115/373: sub-ON43210_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 116/373: sub-ON39099_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 117/373: sub-ON96530_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 118/373: sub-ON97252_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 119/373: sub-ON33159_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 120/373: sub-ON49080_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 121/373: sub-ON41090_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 122/373: sub-ON01802_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 123/373: sub-ON94131_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 124/373: sub-ON44262_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 125/373: sub-ON98642_ses-01_acq-MPRAGE_T1w.nii
```

Loaded healthy file 126/373: sub-ON52733_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 127/373: sub-ON98175_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 128/373: sub-ON00400_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 129/373: sub-ON91906_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 130/373: sub-ON85330_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 131/373: sub-ON87725_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 132/373: sub-ON85514_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 133/373: sub-ON98502_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 134/373: sub-ON87655_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 135/373: sub-ON95214_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 136/373: sub-ON80038_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 137/373: sub-ON12688_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 138/373: sub-ON85305_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 139/373: sub-ON08710_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 140/373: sub-ON58053_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 141/373: sub-ON65412_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 142/373: sub-ON49080_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 143/373: sub-ON63734_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 144/373: sub-ON77753_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 145/373: sub-ON09766_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 146/373: sub-ON96530_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 147/373: sub-ON98175_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 148/373: sub-ON52083_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 149/373: sub-ON23419_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 150/373: sub-ON54886_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 151/373: sub-ON96602_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 152/373: sub-ON85010_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 153/373: sub-ON63221_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 154/373: sub-ON87631_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 155/373: sub-ON76625_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 156/373: sub-ON99731_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 157/373: sub-ON03748_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 158/373: sub-ON09766_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 159/373: sub-ON41090_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 160/373: sub-ON94131_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 161/373: sub-ON84201_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 162/373: sub-ON09760_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 163/373: sub-ON95742_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 164/373: sub-ON98664_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 165/373: sub-ON98642_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 166/373: sub-ON87642_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 167/373: sub-ON76144_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 168/373: sub-ON06421_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 169/373: sub-ON88555_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 170/373: sub-ON25939_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 171/373: sub-ON11111_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 172/373: sub-ON52992_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 173/373: sub-ON70467_ses-01_acq-MPRAGE_T1w (1).nii
Loaded healthy file 174/373: sub-ON34754_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 175/373: sub-ON96353_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 176/373: sub-ON99943_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 177/373: sub-ON73969_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 178/373: sub-ON88753_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 179/373: sub-ON65733_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 180/373: sub-ON02747_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 181/373: sub-ON99943_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 182/373: sub-ON99547_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 183/373: sub-ON97654_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 184/373: sub-ON96252_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 185/373: sub-ON30080_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 186/373: sub-ON58053_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 187/373: sub-ON87304_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 188/373: sub-ON87631_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 189/373: sub-ON61373_ses-01_acq-MPRAGE_T1w.nii

```
Loaded healthy file 190/373: sub-ON08792_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 191/373: sub-ON52220_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 192/373: sub-ON97504_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 193/373: sub-ON98745_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 194/373: sub-ON56250_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 195/373: sub-ON52992_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 196/373: sub-ON88753_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 197/373: sub-ON87092_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 198/373: sub-ON74320_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 199/373: sub-ON97526_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 200/373: sub-ON86202_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 201/373: sub-ON26309_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 202/373: sub-ON52220_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 203/373: sub-ON22299_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 204/373: sub-ON87304_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 205/373: sub-ON85305_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 206/373: sub-ON21976_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 207/373: sub-ON88700_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 208/373: sub-ON09474_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 209/373: sub-ON42941_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 210/373: sub-ON88614_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 211/373: sub-ON88555_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 212/373: sub-ON54268_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 213/373: sub-ON87777_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 214/373: sub-ON66452_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 215/373: sub-ON21959_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 216/373: sub-ON99881_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 217/373: sub-ON66401_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 218/373: sub-ON08571_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 219/373: sub-ON08792_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 220/373: sub-ON51111_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 221/373: sub-ON26309_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 222/373: sub-ON64410_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 223/373: augmented_healthy_output_aug.nii
Loaded healthy file 224/373: sub-ON97515_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 225/373: sub-ON23419_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 226/373: sub-ON89474_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 227/373: sub-ON07392_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 228/373: sub-ON98602_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 229/373: sub-ON93503_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 230/373: sub-ON85400_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 231/373: sub-ON62003_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 232/373: sub-ON46717_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 233/373: sub-ON21834_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 234/373: sub-ON67435_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 235/373: sub-ON97504_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 236/373: sub-ON97427_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 237/373: sub-ON95003_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 238/373: sub-ON23664_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 239/373: sub-ON85301_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 240/373: sub-ON87616_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 241/373: sub-ON76144_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 242/373: sub-ON66243_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 243/373: sub-ON96240_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 244/373: sub-ON22671_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 245/373: sub-ON94110_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 246/373: sub-ON76525_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 247/373: sub-ON08710_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 248/373: sub-ON88753_ses-02_acq-MPRAGE_T1w.nii
Loaded healthy file 249/373: sub-ON65403_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 250/373: sub-ON62200_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 251/373: sub-ON92220_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 252/373: sub-ON51005_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 253/373: sub-ON99633_ses-01_acq-MPRAGE_T1w.nii
```

Loaded healthy file 254/373: sub-ON05530_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 255/373: sub-ON48925_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 256/373: sub-ON61087_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 257/373: sub-ON08760_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 258/373: sub-ON88762_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 259/373: sub-ON97765_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 260/373: sub-ON75413_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 261/373: sub-ON97765_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 262/373: sub-ON99703_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 263/373: sub-ON23664_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 264/373: sub-ON96240_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 265/373: sub-ON09540_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 266/373: sub-ON81734_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 267/373: sub-ON96565_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 268/373: sub-ON96555_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 269/373: sub-ON96252_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 270/373: sub-ON87362_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 271/373: sub-ON53213_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 272/373: sub-ON98362_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 273/373: sub-ON11411_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 274/373: sub-ON99703_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 275/373: sub-ON65232_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 276/373: sub-ON83320_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 277/373: sub-ON02693_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 278/373: sub-ON66401_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 279/373: sub-ON65232_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 280/373: sub-ON09474_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 281/373: sub-ON43210_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 282/373: sub-ON08155_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 283/373: sub-ON73200_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 284/373: sub-ON22299_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 285/373: sub-ON97503_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 286/373: sub-ON39384_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 287/373: sub-ON35773_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 288/373: sub-ON93503_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 289/373: sub-ON75413_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 290/373: sub-ON06421_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 291/373: sub-ON95742_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 292/373: sub-ON87777_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 293/373: sub-ON52733_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 294/373: sub-ON13545_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 295/373: sub-ON21959_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 296/373: sub-ON96440_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 297/373: sub-ON99620_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 298/373: sub-ON04111_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 299/373: sub-ON76625_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 300/373: sub-ON75100_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 301/373: sub-ON87092_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 302/373: sub-ON65733_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 303/373: sub-ON94856_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 304/373: sub-ON21834_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 305/373: sub-ON39384_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 306/373: sub-ON02811_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 307/373: sub-ON63704_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 308/373: sub-ON89475_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 309/373: sub-ON98130_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 310/373: sub-ON95259_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 311/373: sub-ON12688_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 312/373: sub-ON88753_ses-02_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 313/373: sub-ON94856_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 314/373: sub-ON93222_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 315/373: sub-ON04111_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 316/373: sub-ON08760_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 317/373: sub-ON23776_ses-01_acq-MPRAGE_T1w.nii

```
Loaded healthy file 318/373: sub-ON87550_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 319/373: sub-ON76525_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 320/373: sub-ON86202_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 321/373: sub-ON11394_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 322/373: sub-ON85514_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 323/373: sub-ON85616_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 324/373: sub-ON87550_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 325/373: sub-ON70467_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 326/373: sub-ON98098_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 327/373: sub-ON52662_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 328/373: sub-ON98826_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 329/373: sub-ON62003_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 330/373: sub-ON98362_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 331/373: sub-ON98502_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 332/373: sub-ON67435_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 333/373: sub-ON07392_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 334/373: sub-ON73969_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 335/373: sub-ON64410_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 336/373: sub-ON87743_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 337/373: sub-ON97515_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 338/373: sub-ON52662_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 339/373: sub-ON33221_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 340/373: sub-ON85330_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 341/373: sub-ON85981_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 342/373: sub-ON70467_ses-01_acq-MPRAGE_T1w (1)_aug.nii
Loaded healthy file 343/373: sub-ON95520_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 344/373: sub-ON43585_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 345/373: sub-ON09760_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 346/373: sub-ON63734_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 347/373: sub-ON66243_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 348/373: sub-ON93222_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 349/373: sub-ON75100_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 350/373: sub-ON87455_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 351/373: sub-ON97503_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 352/373: sub-ON92220_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 353/373: sub-ON71932_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 354/373: sub-ON97654_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 355/373: sub-ON87642_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 356/373: sub-ON74320_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 357/373: sub-ON87655_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 358/373: sub-ON84201_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 359/373: sub-ON05530_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 360/373: sub-ON97526_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 361/373: sub-ON98098_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 362/373: sub-ON66199_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 363/373: sub-ON61087_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 364/373: sub-ON54268_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 365/373: sub-ON34766_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 366/373: sub-ON51005_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 367/373: sub-ON39099_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 368/373: sub-ON88762_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 369/373: sub-ON98745_ses-01_acq-MPRAGE_T1w.nii
Loaded healthy file 370/373: sub-ON84896_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 371/373: sub-ON95259_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 372/373: sub-ON87616_ses-01_acq-MPRAGE_T1w_aug.nii
Loaded healthy file 373/373: sub-ON25939_ses-01_acq-MPRAGE_T1w.nii
```

Loading schizophrenic brain scans...

Found 196 schizophrenic files

```
Loaded schizophrenic file 1/196: sub-99_T1w.nii
Loaded schizophrenic file 2/196: sub-69_T1w_aug.nii
Loaded schizophrenic file 3/196: sub-42_T1w.nii
Loaded schizophrenic file 4/196: sub-20_T1w_aug.nii
Loaded schizophrenic file 5/196: sub-10_T1w.nii
```

```
Loaded schizophrenic file 6/196: sub-04_T1w_aug.nii
Loaded schizophrenic file 7/196: sub-29_T1w_aug.nii
Loaded schizophrenic file 8/196: augmented_output_aug.nii
Loaded schizophrenic file 9/196: sub-58_T1w_aug.nii
Loaded schizophrenic file 10/196: sub-92_T1w_aug.nii
Loaded schizophrenic file 11/196: sub-24_T1w.nii
Loaded schizophrenic file 12/196: sub-17_T1w_aug.nii
Loaded schizophrenic file 13/196: sub-42_T1w_aug.nii
Loaded schizophrenic file 14/196: sub-91_T1w.nii
Loaded schizophrenic file 15/196: sub-102_T1w_aug.nii
Loaded schizophrenic file 16/196: sub-76_T1w_aug.nii
Loaded schizophrenic file 17/196: sub-30_T1w.nii
Loaded schizophrenic file 18/196: sub-81_T1w_aug.nii
Loaded schizophrenic file 19/196: sub-35_T1w.nii
Loaded schizophrenic file 20/196: sub-05_T1w_aug.nii
Loaded schizophrenic file 21/196: sub-07_T1w.nii
Loaded schizophrenic file 22/196: sub-89_T1w.nii
Loaded schizophrenic file 23/196: sub-59_T1w_aug.nii
Loaded schizophrenic file 24/196: sub-77_T1w.nii
Loaded schizophrenic file 25/196: sub-30_T1w_aug.nii
Loaded schizophrenic file 26/196: sub-90_T1w.nii
Loaded schizophrenic file 27/196: sub-63_T1w_aug.nii
Loaded schizophrenic file 28/196: sub-02_T1w.nii
Loaded schizophrenic file 29/196: sub-06_T1w_aug.nii
Loaded schizophrenic file 30/196: sub-84_T1w.nii
Loaded schizophrenic file 31/196: sub-96_T1w_aug.nii
Loaded schizophrenic file 32/196: sub-46_T1w_aug.nii
Loaded schizophrenic file 33/196: sub-36_T1w.nii
Loaded schizophrenic file 34/196: sub-19_T1w_aug.nii
Loaded schizophrenic file 35/196: sub-56_T1w_aug.nii
Loaded schizophrenic file 36/196: sub-57_T1w.nii
Loaded schizophrenic file 37/196: sub-95_T1w.nii
Loaded schizophrenic file 38/196: sub-18_T1w_aug.nii
Loaded schizophrenic file 39/196: sub-12_T1w.nii
Loaded schizophrenic file 40/196: sub-12_T1w_aug.nii
Loaded schizophrenic file 41/196: sub-10_T1w_aug.nii
Loaded schizophrenic file 42/196: sub-92_T1w.nii
Loaded schizophrenic file 43/196: sub-64_T1w.nii
Loaded schizophrenic file 44/196: sub-29_T1w.nii
Loaded schizophrenic file 45/196: sub-80_T1w_aug.nii
Loaded schizophrenic file 46/196: sub-17_T1w.nii
Loaded schizophrenic file 47/196: sub-35_T1w_aug.nii
Loaded schizophrenic file 48/196: sub-50_T1w_aug.nii
Loaded schizophrenic file 49/196: sub-62_T1w.nii
Loaded schizophrenic file 50/196: sub-100_T1w_aug.nii
Loaded schizophrenic file 51/196: sub-51_T1w_aug.nii
Loaded schizophrenic file 52/196: sub-100_T1w.nii
Loaded schizophrenic file 53/196: sub-08_T1w_aug.nii
Loaded schizophrenic file 54/196: sub-53_T1w_aug.nii
Loaded schizophrenic file 55/196: sub-39_T1w_aug.nii
Loaded schizophrenic file 56/196: sub-09_T1w_aug.nii
Loaded schizophrenic file 57/196: sub-58_T1w.nii
Loaded schizophrenic file 58/196: sub-89_T1w_aug.nii
Loaded schizophrenic file 59/196: sub-24_T1w_aug.nii
Loaded schizophrenic file 60/196: sub-101_T1w.nii
Loaded schizophrenic file 61/196: sub-45_T1w_aug.nii
Loaded schizophrenic file 62/196: sub-65_T1w_aug.nii
Loaded schizophrenic file 63/196: sub-59_T1w.nii
Loaded schizophrenic file 64/196: sub-87_T1w_aug.nii
Loaded schizophrenic file 65/196: sub-90_T1w_aug.nii
Loaded schizophrenic file 66/196: sub-27_T1w.nii
Loaded schizophrenic file 67/196: sub-21_T1w_aug.nii
Loaded schizophrenic file 68/196: sub-14_T1w.nii
Loaded schizophrenic file 69/196: sub-34_T1w.nii
```

```
Loaded schizophrenic file 70/196: sub-88_T1w_aug.nii
Loaded schizophrenic file 71/196: sub-79_T1w.nii
Loaded schizophrenic file 72/196: sub-66_T1w.nii
Loaded schizophrenic file 73/196: sub-11_T1w.nii
Loaded schizophrenic file 74/196: sub-16_T1w_aug.nii
Loaded schizophrenic file 75/196: sub-75_T1w_aug.nii
Loaded schizophrenic file 76/196: augmented_schiz_output_aug.nii
Loaded schizophrenic file 77/196: sub-01_T1w_aug.nii
Loaded schizophrenic file 78/196: sub-26_T1w.nii
Loaded schizophrenic file 79/196: sub-93_T1w_aug.nii
Loaded schizophrenic file 80/196: sub-70_T1w.nii
Loaded schizophrenic file 81/196: sub-37_T1w.nii
Loaded schizophrenic file 82/196: sub-95_T1w_aug.nii
Loaded schizophrenic file 83/196: sub-94_T1w.nii
Loaded schizophrenic file 84/196: sub-52_T1w_aug.nii
Loaded schizophrenic file 85/196: sub-18_T1w.nii
Loaded schizophrenic file 86/196: sub-88_T1w.nii
Loaded schizophrenic file 87/196: sub-50_T1w.nii
Loaded schizophrenic file 88/196: sub-49_T1w.nii
Loaded schizophrenic file 89/196: sub-15_T1w_aug.nii
Loaded schizophrenic file 90/196: sub-54_T1w.nii
Loaded schizophrenic file 91/196: sub-06_T1w.nii
Loaded schizophrenic file 92/196: sub-80_T1w.nii
Loaded schizophrenic file 93/196: sub-73_T1w_aug.nii
Loaded schizophrenic file 94/196: sub-78_T1w_aug.nii
Loaded schizophrenic file 95/196: sub-61_T1w_aug.nii
Loaded schizophrenic file 96/196: sub-09_T1w.nii
Loaded schizophrenic file 97/196: sub-71_T1w_aug.nii
Loaded schizophrenic file 98/196: sub-28_T1w.nii
Loaded schizophrenic file 99/196: sub-52_T1w.nii
Loaded schizophrenic file 100/196: sub-46_T1w.nii
Loaded schizophrenic file 101/196: sub-02_T1w_aug.nii
Loaded schizophrenic file 102/196: sub-68_T1w.nii
Loaded schizophrenic file 103/196: sub-32_T1w_aug.nii
Loaded schizophrenic file 104/196: sub-55_T1w_aug.nii
Loaded schizophrenic file 105/196: sub-72_T1w.nii
Loaded schizophrenic file 106/196: sub-41_T1w_aug.nii
Loaded schizophrenic file 107/196: sub-13_T1w.nii
Loaded schizophrenic file 108/196: sub-83_T1w_aug.nii
Loaded schizophrenic file 109/196: sub-32_T1w.nii
Loaded schizophrenic file 110/196: sub-64_T1w_aug.nii
Loaded schizophrenic file 111/196: sub-47_T1w.nii
Loaded schizophrenic file 112/196: sub-03_T1w.nii
Loaded schizophrenic file 113/196: sub-08_T1w.nii
Loaded schizophrenic file 114/196: sub-78_T1w.nii
Loaded schizophrenic file 115/196: sub-55_T1w.nii
Loaded schizophrenic file 116/196: sub-40_T1w_aug.nii
Loaded schizophrenic file 117/196: sub-94_T1w_aug.nii
Loaded schizophrenic file 118/196: sub-56_T1w.nii
Loaded schizophrenic file 119/196: sub-54_T1w_aug.nii
Loaded schizophrenic file 120/196: sub-01_T1w.nii
Loaded schizophrenic file 121/196: sub-36_T1w_aug.nii
Loaded schizophrenic file 122/196: sub-70_T1w_aug.nii
Loaded schizophrenic file 123/196: sub-19_T1w.nii
Loaded schizophrenic file 124/196: sub-47_T1w_aug.nii
Loaded schizophrenic file 125/196: sub-38_T1w.nii
Loaded schizophrenic file 126/196: sub-99_T1w_aug.nii
Loaded schizophrenic file 127/196: sub-28_T1w_aug.nii
Loaded schizophrenic file 128/196: sub-44_T1w_aug.nii
Loaded schizophrenic file 129/196: sub-65_T1w.nii
Loaded schizophrenic file 130/196: sub-61_T1w.nii
Loaded schizophrenic file 131/196: sub-85_T1w.nii
Loaded schizophrenic file 132/196: sub-22_T1w_aug.nii
Loaded schizophrenic file 133/196: sub-31_T1w.nii
```

Loaded schizophrenic file 134/196: sub-86_T1w.nii
Loaded schizophrenic file 135/196: sub-44_T1w.nii
Loaded schizophrenic file 136/196: sub-93_T1w.nii
Loaded schizophrenic file 137/196: sub-73_T1w.nii
Loaded schizophrenic file 138/196: sub-43_T1w.nii
Loaded schizophrenic file 139/196: sub-39_T1w.nii
Loaded schizophrenic file 140/196: sub-15_T1w.nii
Loaded schizophrenic file 141/196: sub-91_T1w_aug.nii
Loaded schizophrenic file 142/196: sub-53_T1w.nii
Loaded schizophrenic file 143/196: sub-43_T1w_aug.nii
Loaded schizophrenic file 144/196: sub-27_T1w_aug.nii
Loaded schizophrenic file 145/196: sub-71_T1w.nii
Loaded schizophrenic file 146/196: sub-33_T1w.nii
Loaded schizophrenic file 147/196: sub-38_T1w_aug.nii
Loaded schizophrenic file 148/196: sub-87_T1w.nii
Loaded schizophrenic file 149/196: sub-04_T1w.nii
Loaded schizophrenic file 150/196: sub-13_T1w_aug.nii
Loaded schizophrenic file 151/196: sub-97_T1w_aug.nii
Loaded schizophrenic file 152/196: sub-101_T1w_aug.nii
Loaded schizophrenic file 153/196: sub-67_T1w_aug.nii
Loaded schizophrenic file 154/196: sub-21_T1w.nii
Loaded schizophrenic file 155/196: sub-60_T1w.nii
Loaded schizophrenic file 156/196: sub-85_T1w_aug.nii
Loaded schizophrenic file 157/196: sub-84_T1w_aug.nii
Loaded schizophrenic file 158/196: sub-03_T1w_aug.nii
Loaded schizophrenic file 159/196: sub-05_T1w.nii
Loaded schizophrenic file 160/196: sub-81_T1w.nii
Loaded schizophrenic file 161/196: sub-63_T1w.nii
Loaded schizophrenic file 162/196: sub-14_T1w_aug.nii
Loaded schizophrenic file 163/196: sub-40_T1w.nii
Loaded schizophrenic file 164/196: sub-86_T1w_aug.nii
Loaded schizophrenic file 165/196: sub-41_T1w.nii
Loaded schizophrenic file 166/196: sub-102_T1w.nii
Loaded schizophrenic file 167/196: sub-77_T1w_aug.nii
Loaded schizophrenic file 168/196: sub-67_T1w.nii
Loaded schizophrenic file 169/196: sub-76_T1w.nii
Loaded schizophrenic file 170/196: sub-37_T1w_aug.nii
Loaded schizophrenic file 171/196: sub-11_T1w_aug.nii
Loaded schizophrenic file 172/196: sub-16_T1w.nii
Loaded schizophrenic file 173/196: sub-57_T1w_aug.nii
Loaded schizophrenic file 174/196: sub-49_T1w_aug.nii
Loaded schizophrenic file 175/196: sub-68_T1w_aug.nii
Loaded schizophrenic file 176/196: sub-51_T1w.nii
Loaded schizophrenic file 177/196: sub-82_T1w_aug.nii
Loaded schizophrenic file 178/196: sub-22_T1w.nii
Loaded schizophrenic file 179/196: sub-96_T1w.nii
Loaded schizophrenic file 180/196: sub-72_T1w_aug.nii
Loaded schizophrenic file 181/196: sub-83_T1w.nii
Loaded schizophrenic file 182/196: sub-69_T1w.nii
Loaded schizophrenic file 183/196: sub-45_T1w.nii
Loaded schizophrenic file 184/196: sub-75_T1w.nii
Loaded schizophrenic file 185/196: sub-66_T1w_aug.nii
Loaded schizophrenic file 186/196: sub-97_T1w.nii
Loaded schizophrenic file 187/196: sub-33_T1w_aug.nii
Loaded schizophrenic file 188/196: sub-20_T1w.nii
Loaded schizophrenic file 189/196: sub-26_T1w_aug.nii
Loaded schizophrenic file 190/196: sub-34_T1w_aug.nii
Loaded schizophrenic file 191/196: sub-60_T1w_aug.nii
Loaded schizophrenic file 192/196: sub-62_T1w_aug.nii
Loaded schizophrenic file 193/196: sub-07_T1w_aug.nii
Loaded schizophrenic file 194/196: sub-31_T1w_aug.nii
Loaded schizophrenic file 195/196: sub-79_T1w_aug.nii
Loaded schizophrenic file 196/196: sub-82_T1w.nii

Dataset summary:
 Total samples: 569
 Healthy samples: 373
 Schizophrenic samples: 196
 Input shape: (128, 128, 128)
 Data loaded successfully!

```
In [8]: # Split the data into train and test sets
if len(X) > 0:
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.2, stratify=y, random_state=42
    )
    print(f"Data split:")
    print(f"Training samples: {len(X_train)}")
    print(f"Testing samples: {len(X_test)}")
    print(f"Training healthy: {np.sum(y_train == 0)}")
    print(f"Training schizophrenic: {np.sum(y_train == 1)}")
    print(f"Testing healthy: {np.sum(y_test == 0)}")
    print(f"Testing schizophrenic: {np.sum(y_test == 1)}")
```

Data split:
 Training samples: 455
 Testing samples: 114
 Training healthy: 298
 Training schizophrenic: 157
 Testing healthy: 75
 Testing schizophrenic: 39

```
In [9]: import numpy as np
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv3D, MaxPooling3D, Flatten, Dense, Dropout,
#  1. Remove extra dimensions if added more than once
def fix_shape(X):
    while X.ndim > 5:
        X = np.squeeze(X, axis=-1)
    if X.ndim == 4:
        X = np.expand_dims(X, axis=-1) # Add channel axis
    return X

#  2. Fix shapes
X_train = fix_shape(X_train)
X_test = fix_shape(X_test)

#  3. Define model
def create_model(input_shape):
    model = Sequential([
        Input(shape=input_shape),
        Conv3D(16, kernel_size=3, activation='relu'),
        MaxPooling3D(pool_size=2),
        Conv3D(32, kernel_size=3, activation='relu'),
        MaxPooling3D(pool_size=2),
        Conv3D(64, kernel_size=3, activation='relu'),
        MaxPooling3D(pool_size=2),
        Flatten(),
        Dense(128, activation='relu'),
        Dropout(0.3),
        Dense(64, activation='relu'),
        Dropout(0.3),
        Dense(1, activation='sigmoid')
    ])
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
    return model
```

```
# ✅ 4. Build and check model
if len(X_train) > 0:
    input_shape = X_train[0].shape # (128, 128, 128, 1)
    print(f" ✅ Input shape for model: {input_shape}")
    model = create_model(input_shape)
    model.summary()
else:
    print(" ❌ X_train is empty. Cannot build model.")

✅ Input shape for model: (128, 128, 128, 1)
```

```
I0000 00:00:1752594398.121614 1009 gpu_device.cc:2022] Created device /job:localhost/replica:0/task:0/device:GPU:0 with 13942 MB memory: -> device: 0, name: Tesla T4, pci bus id: 0000:00:04.0, compute capability: 7.5
I0000 00:00:1752594398.121870 1009 gpu_device.cc:2022] Created device /job:localhost/replica:0/task:0/device:GPU:1 with 13942 MB memory: -> device: 1, name: Tesla T4, pci bus id: 0000:00:05.0, compute capability: 7.5
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv3d (Conv3D)	(None, 126, 126, 126, 16)	448
max_pooling3d (MaxPooling3D)	(None, 63, 63, 63, 16)	0
conv3d_1 (Conv3D)	(None, 61, 61, 61, 32)	13,856
max_pooling3d_1 (MaxPooling3D)	(None, 30, 30, 30, 32)	0
conv3d_2 (Conv3D)	(None, 28, 28, 28, 64)	55,360
max_pooling3d_2 (MaxPooling3D)	(None, 14, 14, 14, 64)	0
flatten (Flatten)	(None, 175616)	0
dense (Dense)	(None, 128)	22,478,976
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 64)	8,256
dropout_1 (Dropout)	(None, 64)	0
dense_2 (Dense)	(None, 1)	65

Total params: 22,556,961 (86.05 MB)

Trainable params: 22,556,961 (86.05 MB)

Non-trainable params: 0 (0.00 B)

```
In [10]: # Define callbacks for training
early_stopping = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True,
    verbose=1
)
model_checkpoint = ModelCheckpoint(
    'best_model.h5',
    monitor='val_accuracy',
```

```
    save_best_only=True,  
    verbose=1  
)  
callbacks = [early_stopping, model_checkpoint]
```

```
In [31]: # Train the model  
if len(X) > 0:  
    print("Starting training...")  
    history = model.fit(  
        X_train, y_train,  
        epochs=20,  
        batch_size=2, # Small batch size due to memory constraints  
        validation_split=0.2,  
        callbacks=callbacks,  
        verbose=1  
)  
    print("Training completed!")
```

Starting training...
Epoch 1/20

WARNING: All log messages before absl::InitializeLog() is called are written to ST DERR

```
I0000 00:00:1752592902.280734    163 service.cc:148] XLA service 0x7c16e400cea0 is initialized for platform CUDA (this does not guarantee that XLA will be used). Devices:
I0000 00:00:1752592902.281507    163 service.cc:156] StreamExecutor device (0): Tesla T4, Compute Capability 7.5
I0000 00:00:1752592902.281546    163 service.cc:156] StreamExecutor device (1): Tesla T4, Compute Capability 7.5
I0000 00:00:1752592902.808397    163 cuda_dnn.cc:529] Loaded cuDNN version 90300
E0000 00:00:1752592903.942086    163 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.
E0000 00:00:1752592904.087838    163 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.
2025-07-15 15:21:47.477251: E external/local_xla/xla/service/slow_operation_alarm.cc:65] Trying algorithm eng20{k2=5,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}) is taking a while...
2025-07-15 15:21:47.496049: E external/local_xla/xla/service/slow_operation_alarm.cc:133] The operation took 1.018884935s
Trying algorithm eng20{k2=5,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}) is taking a while...
2025-07-15 15:21:48.496259: E external/local_xla/xla/service/slow_operation_alarm.cc:65] Trying algorithm eng20{k2=8,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}) is taking a while...
2025-07-15 15:21:48.571790: E external/local_xla/xla/service/slow_operation_alarm.cc:133] The operation took 1.075622206s
Trying algorithm eng20{k2=8,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}) is taking a while...
2/182 ————— 14s 81ms/step - accuracy: 0.1250 - loss: 1375.5414
I0000 00:00:1752592911.972849    163 device_compiler.h:188] Compiled cluster using XLA! This line is logged at most once for the lifetime of the process.
182/182 ————— 0s 77ms/step - accuracy: 0.7388 - loss: 212.0439
```

```

E0000 00:00:1752592928.986570      164 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
E0000 00:00:1752592929.134123      164 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
E0000 00:00:1752592931.188867      161 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
E0000 00:00:1752592931.330683      161 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
Epoch 1: val_accuracy improved from -inf to 0.93407, saving model to best_model.h5
182/182 34s 117ms/step - accuracy: 0.7395 - loss: 211.1484 -
val_accuracy: 0.9341 - val_loss: 0.4480
Epoch 2/20
182/182 0s 79ms/step - accuracy: 0.9187 - loss: 0.6077
Epoch 2: val_accuracy improved from 0.93407 to 0.97802, saving model to best_mode
1.h5
182/182 17s 91ms/step - accuracy: 0.9188 - loss: 0.6067 - val
_accuracy: 0.9780 - val_loss: 0.2540
Epoch 3/20
182/182 0s 81ms/step - accuracy: 0.9365 - loss: 0.8507
Epoch 3: val_accuracy did not improve from 0.97802
182/182 16s 87ms/step - accuracy: 0.9365 - loss: 0.8494 - val
_accuracy: 0.9670 - val_loss: 0.2060
Epoch 4/20
182/182 0s 81ms/step - accuracy: 0.9700 - loss: 0.1229
Epoch 4: val_accuracy did not improve from 0.97802
182/182 16s 87ms/step - accuracy: 0.9700 - loss: 0.1228 - val
_accuracy: 0.9780 - val_loss: 0.0466
Epoch 5/20
182/182 0s 81ms/step - accuracy: 0.9551 - loss: 0.3470
Epoch 5: val_accuracy improved from 0.97802 to 0.98901, saving model to best_mode
1.h5
182/182 17s 92ms/step - accuracy: 0.9550 - loss: 0.3466 - val
_accuracy: 0.9890 - val_loss: 0.0663
Epoch 6/20
182/182 0s 81ms/step - accuracy: 0.9662 - loss: 0.1164
Epoch 6: val_accuracy did not improve from 0.98901
182/182 16s 86ms/step - accuracy: 0.9662 - loss: 0.1163 - val
_accuracy: 0.9560 - val_loss: 0.0793
Epoch 7/20
182/182 0s 81ms/step - accuracy: 0.9625 - loss: 0.0991
Epoch 7: val_accuracy did not improve from 0.98901
182/182 16s 86ms/step - accuracy: 0.9625 - loss: 0.0991 - val
_accuracy: 0.9560 - val_loss: 0.1637
Epoch 8/20
182/182 0s 81ms/step - accuracy: 0.9543 - loss: 0.1170
Epoch 8: val_accuracy did not improve from 0.98901
182/182 16s 86ms/step - accuracy: 0.9544 - loss: 0.1169 - val
_accuracy: 0.9780 - val_loss: 0.0618
Epoch 9/20
182/182 0s 81ms/step - accuracy: 0.9731 - loss: 0.0725
Epoch 9: val_accuracy did not improve from 0.98901
182/182 16s 86ms/step - accuracy: 0.9731 - loss: 0.0726 - val
_accuracy: 0.9560 - val_loss: 0.0652
Epoch 9: early stopping
Restoring model weights from the end of the best epoch: 4.
Training completed!

```

In [11]:

```
# Train the model without early stopping
if len(X) > 0:
    print("Starting training...")
```

```

        history = model.fit(
            X_train, y_train,
            epochs=20,
            batch_size=2, # You can adjust this based on memory
            validation_split=0.2,
            verbose=1
        )

        print("✓ Training completed!")
    
```

Starting training...

Epoch 1/20

```

WARNING: All log messages before absl::InitializeLog() is called are written to ST
DERR
I0000 00:00:1752594428.365099    1043 service.cc:148] XLA service 0x7f370800d3f0 i
nitialized for platform CUDA (this does not guarantee that XLA will be used). Devi
ces:
I0000 00:00:1752594428.367736    1043 service.cc:156] StreamExecutor device (0):
Tesla T4, Compute Capability 7.5
I0000 00:00:1752594428.367757    1043 service.cc:156] StreamExecutor device (1):
Tesla T4, Compute Capability 7.5
I0000 00:00:1752594428.832691    1043 cuda_dnn.cc:529] Loaded cuDNN version 90300
E0000 00:00:1752594429.818835    1043 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
E0000 00:00:1752594429.966428    1043 gpu_timer.cc:82] Delay kernel timed out: mea
sured time has sub-optimal accuracy. There may be a missing warmup execution, plea
se investigate in Nsight Systems.
2025-07-15 15:47:13.366237: E external/local_xla/xla/service/slow_operation_alarm.
cc:65] Trying algorithm eng20{k2=5,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8
[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,
1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__c
udnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_
_mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"fo
rce_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]
} is taking a while...
2025-07-15 15:47:13.392792: E external/local_xla/xla/service/slow_operation_alarm.
cc:133] The operation took 1.026687946s
Trying algorithm eng20{k2=5,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0})
custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}),
wi
ndow={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$conv
BackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"k
None","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earli
est_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}
is tak
ing a while...
2025-07-15 15:47:14.393089: E external/local_xla/xla/service/slow_operation_alarm.
cc:65] Trying algorithm eng20{k2=8,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8
[0]{0}) custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,
1,0}), window={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__c
udnn$convBackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_
mode":"kNone","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"fo
rce_earliest_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]
} is taking a while...
2025-07-15 15:47:14.476073: E external/local_xla/xla/service/slow_operation_alarm.
cc:133] The operation took 1.083174739s
Trying algorithm eng20{k2=8,k3=0} for conv (f32[16,1,3,3,3]{4,3,2,1,0}, u8[0]{0})
custom-call(f32[2,1,128,128,128]{4,3,2,1,0}, f32[2,16,126,126,126]{4,3,2,1,0}),
wi
ndow={size=3x3x3}, dim_labels=bf012_oi012->bf012, custom_call_target="__cudnn$conv
BackwardFilter", backend_config={"cudnn_conv_backend_config":{"activation_mode":"k
None","conv_result_scale":1,"leakyrelu_alpha":0,"side_input_scale":0},"force_earli
est_schedule":false,"operation_queue_id":"0","wait_on_operation_queues":[]}
is tak
ing a while...

```

2/182 ————— 14s 82ms/step - accuracy: 0.5000 - loss: 670.6835

```
I0000 00:00:1752594437.910383    1043 device_compiler.h:188] Compiled cluster using XLA! This line is logged at most once for the lifetime of the process.  
182/182 ━━━━━━ 0s 80ms/step - accuracy: 0.7777 - loss: 112.1193  
E0000 00:00:1752594455.127276    1045 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.  
E0000 00:00:1752594455.275454    1045 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.  
E0000 00:00:1752594457.372604    1045 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.  
E0000 00:00:1752594457.514243    1045 gpu_timer.cc:82] Delay kernel timed out: measured time has sub-optimal accuracy. There may be a missing warmup execution, please investigate in Nsight Systems.
```

182/182 33s 113ms/step - accuracy: 0.7782 - loss: 111.6674 - val_accuracy: 1.0000 - val_loss: 0.0621
 Epoch 2/20
 182/182 16s 86ms/step - accuracy: 0.9473 - loss: 0.7034 - val_accuracy: 0.9560 - val_loss: 0.6415
 Epoch 3/20
 182/182 16s 86ms/step - accuracy: 0.9253 - loss: 0.4440 - val_accuracy: 0.9780 - val_loss: 0.0829
 Epoch 4/20
 182/182 16s 86ms/step - accuracy: 0.9599 - loss: 0.3078 - val_accuracy: 0.9121 - val_loss: 0.1213
 Epoch 5/20
 182/182 16s 86ms/step - accuracy: 0.9257 - loss: 0.6718 - val_accuracy: 0.9670 - val_loss: 0.1113
 Epoch 6/20
 182/182 16s 86ms/step - accuracy: 0.9762 - loss: 0.5737 - val_accuracy: 0.9560 - val_loss: 0.1339
 Epoch 7/20
 182/182 16s 86ms/step - accuracy: 0.9280 - loss: 0.2909 - val_accuracy: 0.9560 - val_loss: 0.0923
 Epoch 8/20
 182/182 16s 86ms/step - accuracy: 0.9608 - loss: 0.1211 - val_accuracy: 0.9670 - val_loss: 0.0864
 Epoch 9/20
 182/182 16s 86ms/step - accuracy: 0.9590 - loss: 0.1041 - val_accuracy: 0.9780 - val_loss: 0.1139
 Epoch 10/20
 182/182 16s 86ms/step - accuracy: 0.9877 - loss: 0.0681 - val_accuracy: 0.8791 - val_loss: 0.2273
 Epoch 11/20
 182/182 16s 86ms/step - accuracy: 0.8966 - loss: 0.1999 - val_accuracy: 0.8791 - val_loss: 0.1930
 Epoch 12/20
 182/182 16s 86ms/step - accuracy: 0.8828 - loss: 0.2067 - val_accuracy: 0.9231 - val_loss: 0.1555
 Epoch 13/20
 182/182 16s 86ms/step - accuracy: 0.9103 - loss: 0.6739 - val_accuracy: 0.9341 - val_loss: 0.1493
 Epoch 14/20
 182/182 16s 86ms/step - accuracy: 0.9747 - loss: 0.2050 - val_accuracy: 0.9451 - val_loss: 1.0805
 Epoch 15/20
 182/182 16s 86ms/step - accuracy: 0.9264 - loss: 2.2324 - val_accuracy: 0.9780 - val_loss: 0.0530
 Epoch 16/20
 182/182 16s 86ms/step - accuracy: 0.9153 - loss: 0.2424 - val_accuracy: 0.8791 - val_loss: 0.1910
 Epoch 17/20
 182/182 16s 86ms/step - accuracy: 0.9199 - loss: 0.1608 - val_accuracy: 0.8681 - val_loss: 0.2051
 Epoch 18/20
 182/182 16s 87ms/step - accuracy: 0.9249 - loss: 0.4637 - val_accuracy: 0.9451 - val_loss: 0.1493
 Epoch 19/20
 182/182 16s 86ms/step - accuracy: 0.9675 - loss: 0.1270 - val_accuracy: 0.9560 - val_loss: 3.3046
 Epoch 20/20
 182/182 16s 86ms/step - accuracy: 0.9475 - loss: 34.1134 - val_accuracy: 0.9121 - val_loss: 10.8058
 Training completed!

In [13]: # Memory-optimized evaluation block for Kaggle
`import gc
import numpy as np`

```

if 'X_test' in locals() and len(X_test) > 0:
    print("⌚ Evaluating model on test set...")

    test_losses = []
    correct_predictions = 0
    total_predictions = len(X_test)

    # Evaluate one sample at a time
    for i in range(total_predictions):
        # Evaluate single sample
        single_loss, single_acc = model.evaluate(
            X_test[i:i+1], y_test[i:i+1],
            verbose=0, batch_size=1
        )
        test_losses.append(single_loss)

        # Predict single sample
        pred = model.predict(X_test[i:i+1], verbose=0)
        predicted_class = 1 if pred[0][0] > 0.5 else 0
        if predicted_class == y_test[i]:
            correct_predictions += 1

        # Show progress
        if (i + 1) % 5 == 0 or i == total_predictions - 1:
            current_acc = correct_predictions / (i + 1)
            print(f"Progress: {i+1}/{total_predictions}, Accuracy so far: {current_"

        # Memory cleanup
        if i % 3 == 0:
            gc.collect()

    # Final metrics
    final_accuracy = correct_predictions / total_predictions
    average_loss = np.mean(test_losses)

    print("\n📊 Final Results:")
    print(f"Average Test Loss: {average_loss:.4f}")
    print(f"Test Accuracy: {final_accuracy:.4f}")
    print(f"Correct Predictions: {correct_predictions}/{total_predictions}")

    # 📑 Optional: Try batch evaluation if memory allows
    try:
        print("\n⌚ Trying full batch evaluation...")
        test_loss_batch, test_accuracy_batch = model.evaluate(
            X_test, y_test, verbose=1, batch_size=1
        )
        print(f"Batch Evaluation - Loss: {test_loss_batch:.4f}, Accuracy: {test_accur"
    except Exception as e:
        print(f"⚠️ Batch evaluation failed due to memory error: {e}")
        print("Used sample-by-sample evaluation instead.")

    gc.collect()

else:
    print("❌ No test data found. Please make sure data is loaded and split correc

```

```
 Evaluating model on test set...
Progress: 5/114, Accuracy so far: 1.0000
Progress: 10/114, Accuracy so far: 1.0000
Progress: 15/114, Accuracy so far: 1.0000
Progress: 20/114, Accuracy so far: 1.0000
Progress: 25/114, Accuracy so far: 1.0000
Progress: 30/114, Accuracy so far: 1.0000
Progress: 35/114, Accuracy so far: 1.0000
Progress: 40/114, Accuracy so far: 1.0000
Progress: 45/114, Accuracy so far: 1.0000
Progress: 50/114, Accuracy so far: 0.9800
Progress: 55/114, Accuracy so far: 0.9818
Progress: 60/114, Accuracy so far: 0.9833
Progress: 65/114, Accuracy so far: 0.9846
Progress: 70/114, Accuracy so far: 0.9857
Progress: 75/114, Accuracy so far: 0.9867
Progress: 80/114, Accuracy so far: 0.9750
Progress: 85/114, Accuracy so far: 0.9765
Progress: 90/114, Accuracy so far: 0.9778
Progress: 95/114, Accuracy so far: 0.9684
Progress: 100/114, Accuracy so far: 0.9700
Progress: 105/114, Accuracy so far: 0.9714
Progress: 110/114, Accuracy so far: 0.9727
Progress: 114/114, Accuracy so far: 0.9737
```

Final Results:

Average Test Loss: 0.1036
 Test Accuracy: 0.9737
 Correct Predictions: 111/114

Trying full batch evaluation...

```
114/114  1s 12ms/step - accuracy: 0.9861 - loss: 0.0976
Batch Evaluation - Loss: 0.1036, Accuracy: 0.9737
```

```
In [14]: # Quick check - run this cell to see what variables exist
print("Available variables:")
for var in ['X_train', 'X_test', 'y_train', 'y_test', 'model']:
    if var in locals():
        if var.startswith('X') or var.startswith('y'):
            print(f"

```

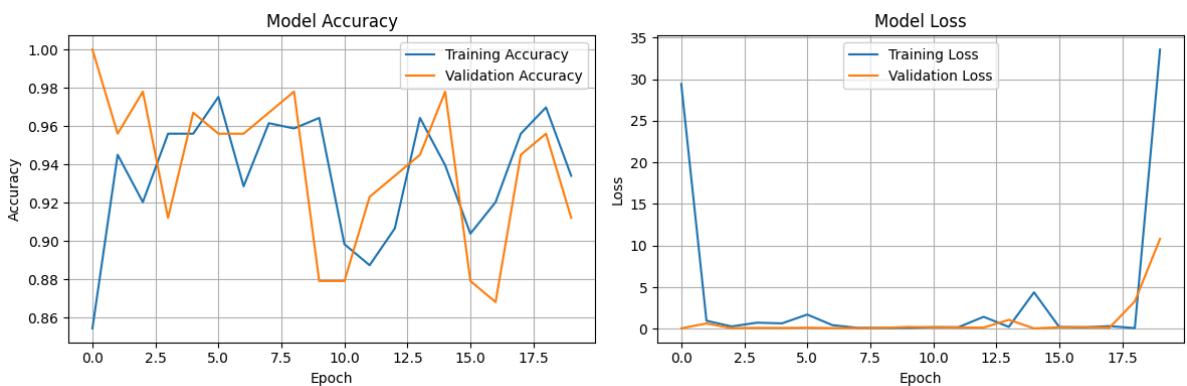
```

    ax1.grid(True)

    # Plot Loss
    ax2.plot(history.history['loss'], label='Training Loss')
    ax2.plot(history.history['val_loss'], label='Validation Loss')
    ax2.set_title('Model Loss')
    ax2.set_xlabel('Epoch')
    ax2.set_ylabel('Loss')
    ax2.legend()
    ax2.grid(True)

    plt.tight_layout()
    plt.show()
# Plot training history if training was completed
if len(X) > 0 and 'history' in locals():
    plot_training_history(history)

```



In [17]:

```

# Make predictions and show results
if 'X_test' in locals() and len(X_test) > 0:
    print("🔍 Making predictions on test data...")

# Make predictions
predictions = model.predict(X_test, batch_size=1, verbose=1)
predicted_classes = (predictions > 0.5).astype(int).flatten()

# Manual accuracy calculation
accuracy = np.mean(predicted_classes == y_test)
print(f"\n✅ Manual accuracy calculation: {accuracy:.4f}")

# Print sample predictions
print("\n🔍 Sample predictions:")
for i in range(min(10, len(X_test))):
    actual = "Schizophrenic" if y_test[i] == 1 else "Healthy"
    predicted = "Schizophrenic" if predicted_classes[i] == 1 else "Healthy"
    confidence = predictions[i][0]
    correct = "✓" if predicted_classes[i] == y_test[i] else "✗"
    print(f"Sample {i+1}: Actual = {actual}, Predicted = {predicted}, Confidence = {confidence}, Correct = {correct}")
else:
    print("✗ No test data available for prediction.")

```

🔍 Making predictions on test data...
114/114 ━━━━━━━━ 1s 12ms/step

✓ Manual accuracy calculation: 0.9737

🔍 Sample predictions:

Sample 1: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 2: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 3: Actual = Schizophrenic, Predicted = Schizophrenic, Confidence = 0.76 ✓
Sample 4: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 5: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 6: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 7: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 8: Actual = Healthy, Predicted = Healthy, Confidence = 0.00 ✓
Sample 9: Actual = Schizophrenic, Predicted = Schizophrenic, Confidence = 0.76 ✓
Sample 10: Actual = Schizophrenic, Predicted = Schizophrenic, Confidence = 1.00 ✓

In [18]:

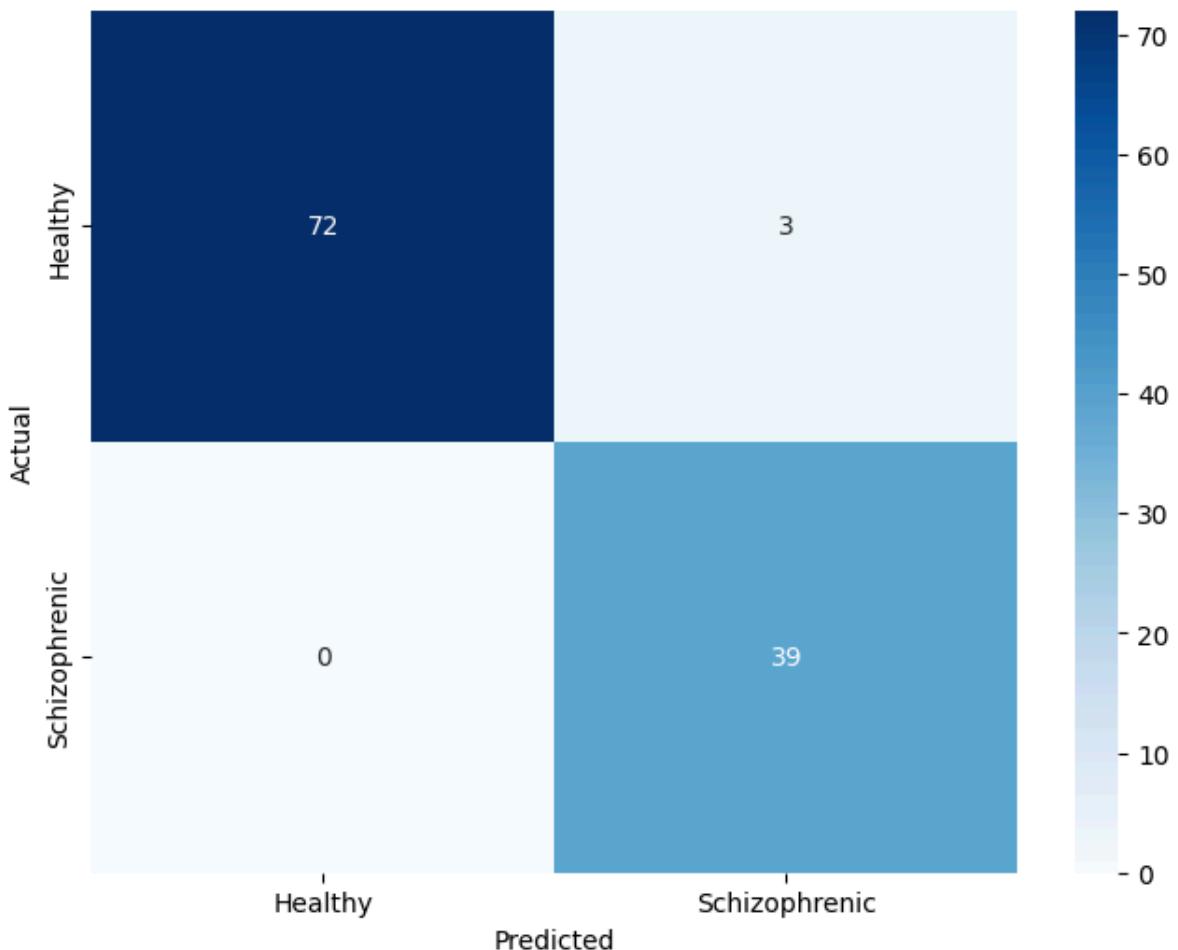
```
# Display confusion matrix and classification report
if len(X) > 0:
    from sklearn.metrics import confusion_matrix, classification_report
    import seaborn as sns

    # Confusion Matrix
    cm = confusion_matrix(y_test, predicted_classes)

    plt.figure(figsize=(8, 6))
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
                xticklabels=['Healthy', 'Schizophrenic'],
                yticklabels=['Healthy', 'Schizophrenic'])
    plt.title('Confusion Matrix')
    plt.xlabel('Predicted')
    plt.ylabel('Actual')
    plt.show()

    # Classification Report
    print("\nClassification Report:")
    print(classification_report(y_test, predicted_classes,
                                target_names=['Healthy', 'Schizophrenic']))
```

Confusion Matrix



Classification Report:

	precision	recall	f1-score	support
Healthy	1.00	0.96	0.98	75
Schizophrenic	0.93	1.00	0.96	39
accuracy			0.97	114
macro avg	0.96	0.98	0.97	114
weighted avg	0.98	0.97	0.97	114

In [19]:

```
# Save the final model
if len(X) > 0:
    model.save('final_schizophrenia_model.h5')
    print("Model saved as 'final_schizophrenia_model.h5'")

    # Also save model architecture as JSON
    model_json = model.to_json()
    with open("model_architecture.json", "w") as json_file:
        json_file.write(model_json)
    print("Model architecture saved as 'model_architecture.json'")
```

Model saved as 'final_schizophrenia_model.h5'
 Model architecture saved as 'model_architecture.json'