CODE(7 QUBITS 16 LAYERS):

import torch

import torchreid

from torchvision import transforms

import pennylane as qml

# Define the quantum circuit using PennyLane

n\_qubits = 7

n\_layers = 16

dev = qml.device("default.qubit", wires=n\_qubits)

@qml.qnode(dev)

def qnode(inputs, weights):

    qml.AmplitudeEmbedding(inputs, wires=range(n\_qubits), pad\_with=0.0, normalize=True)

    qml.BasicEntanglerLayers(weights, wires=range(n\_qubits))

    return [qml.expval(qml.PauliZ(wires=i)) for i in range(n\_qubits)]

# Define the number of quantum layers dynamically

weight\_shapes = {"weights": (n\_layers, n\_qubits)}

class HybridReIDModel(torch.nn.Module):

    def \_\_init\_\_(self, num\_classes):

        super(HybridReIDModel, self).\_\_init\_\_()

        # Pre-trained ResNet50 for feature extraction

        self.backbone = torchreid.models.build\_model(

            name='resnet50',

            num\_classes=num\_classes,

            loss='softmax',

            pretrained=True,  # Using pre-trained weights

        ).cuda()

        # Freeze all layers except the final few (fine-tune deeper layers)

        for param in self.backbone.parameters():

            param.requires\_grad = False  # Freeze all layers initially

        # Unfreeze the last few layers (for example, the last block of ResNet50)

        for param in self.backbone.layer4.parameters():

            param.requires\_grad = True  # Unfreeze the deeper layers

        # Quantum layers

        self.qlayers = torch.nn.ModuleList([

            qml.qnn.TorchLayer(qnode, weight\_shapes) for \_ in range(n\_layers)

        ])

        # Fully connected layer for final classification

        self.fc = torch.nn.Linear(n\_layers \* n\_qubits, num\_classes)

    def forward(self, x):

        # Extract features

        features = self.backbone(x)  # Now, this will fine-tune based on the "requires\_grad"

        # Quantum layers and fully connected output

        quantum\_outputs = []

        part\_size = features.size(1) // n\_layers

        for i in range(n\_layers):

            start\_idx = i \* part\_size

            end\_idx = (i + 1) \* part\_size if i < n\_layers - 1 else None

            x\_part = features[:, start\_idx:end\_idx]

            quantum\_outputs.append(self.qlayers[i](x\_part))

        x = torch.cat(quantum\_outputs, dim=1)

        x = self.fc(x)

        return x

# Wrap execution code in main guard

if \_\_name\_\_ == '\_\_main\_\_':

    # Define transformations

    transform\_pipeline = [

        'random\_flip',       # Random horizontal flip

        'random\_rotate',     # Random rotation

        'random\_crop',       # Random resized crop

        'color\_jitter',      # Color jitter

        'normalize'          # Normalize (mean, std)

    ]

    # Create data manager for PRID2011

    datamanager = torchreid.data.VideoDataManager(

        root='',

        sources='prid2011',

        height=256,

        width=128,

        batch\_size\_train=8,

        batch\_size\_test=64,

        seq\_len=6,

        sample\_method='random',

        transforms=transform\_pipeline ,

        num\_instances=4,

        workers=8

    )

    # Access train and test loaders

    datamanager.train\_loader.num\_workers = 0  # Ensure compatibility with Windows

    train\_loader = datamanager.train\_loader

    test\_loader = datamanager.test\_loader

    query\_loader = test\_loader['prid2011']['query']

    gallery\_loader = test\_loader['prid2011']['gallery']

    # Get number of unique identities (classes)

    num\_classes = datamanager.num\_train\_pids

    # Instantiate hybrid model

    model = HybridReIDModel(num\_classes).cuda()

    # Build optimizer and scheduler

# Build optimizer and scheduler

    optimizer = torch.optim.Adam(

        model.parameters(),

        lr=0.0001,  # Smaller learning rate for fine-tuning

        weight\_decay=5e-4  # L2 regularization to prevent overfitting

    )

    # Scheduler for adjusting the learning rate

    scheduler = torch.optim.lr\_scheduler.CosineAnnealingLR(optimizer, T\_max=20)  # Gradual learning rate reduction

    # Create training engine

    engine = torchreid.engine.VideoSoftmaxEngine(

        datamanager,

        model,

        optimizer,

        scheduler=scheduler,

        pooling\_method='avg',

        use\_gpu=True

    )

    engine.run(

        max\_epoch=30,

        save\_dir='log/hybrid\_resnet50\_dynamic\_layers7-16(3)',

        print\_freq=1,

        test\_only=False,

        eval\_freq=5

    )

RESULTS:  
EPOCH 1:

Speed: 2.2156 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 18.5%

CMC curve

Rank-1 : 10.1%

Rank-5 : 24.7%

Rank-10 : 31.5%

Rank-20 : 41.6%

EPOCH 2:

Speed: 2.2574 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 36.4%

CMC curve

Rank-1 : 22.5%

Rank-5 : 55.1%

Rank-10 : 64.0%

Rank-20 : 78.7%

EPOCH 3:

Speed: 1.1569 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 43.0%

CMC curve

Rank-1 : 28.1%

Rank-5 : 56.2%

Rank-10 : 73.0%

Rank-20 : 87.6%

EPOCH 4:

Speed: 1.0895 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 45.4%

CMC curve

Rank-1 : 29.2%

Rank-5 : 61.8%

Rank-10 : 74.2%

Rank-20 : 88.8%

EPOCH 5:

Speed: 1.1060 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 52.0%

CMC curve

Rank-1 : 38.2%

Rank-5 : 69.7%

Rank-10 : 78.7%

Rank-20 : 89.9%

EPOCH 6:

Speed: 1.1530 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 48.8%

CMC curve

Rank-1 : 34.8%

Rank-5 : 62.9%

Rank-10 : 79.8%

Rank-20 : 92.1%

EPOCH 7:

Speed: 1.0724 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 54.9%

CMC curve

Rank-1 : 42.7%

Rank-5 : 68.5%

Rank-10 : 80.9%

Rank-20 : 91.0%

EPOCH 8:

Speed: 1.1446 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 52.9%

CMC curve

Rank-1 : 39.3%

Rank-5 : 69.7%

Rank-10 : 79.8%

Rank-20 : 91.0%

EPOCH 9:

Speed: 1.1393 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 59.5%

CMC curve

Rank-1 : 44.9%

Rank-5 : 76.4%

Rank-10 : 87.6%

Rank-20 : 95.5%

EPOCH 10:

Speed: 1.1046 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 59.9%

CMC curve

Rank-1 : 46.1%

Rank-5 : 77.5%

Rank-10 : 83.1%

Rank-20 : 94.4%

EPOCH 11:

Speed: 1.1753 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 57.4%

CMC curve

Rank-1 : 44.9%

Rank-5 : 73.0%

Rank-10 : 86.5%

Rank-20 : 96.6%

EPOCH 12:

Speed: 1.1327 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 61.9%

CMC curve

Rank-1 : 48.3%

Rank-5 : 79.8%

Rank-10 : 92.1%

Rank-20 : 97.8%

EPOCH 13:

Speed: 1.0427 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 57.0%

CMC curve

Rank-1 : 41.6%

Rank-5 : 76.4%

Rank-10 : 86.5%

Rank-20 : 97.8%

EPOCH 14:

Speed: 2.3165 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 62.4%

CMC curve

Rank-1 : 50.6%

Rank-5 : 76.4%

Rank-10 : 89.9%

Rank-20 : 94.4%

EPOCH 15:

Speed: 1.1072 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 60.6%

CMC curve

Rank-1 : 44.9%

Rank-5 : 80.9%

Rank-10 : 89.9%

Rank-20 : 95.5%

EPOCH 16:

Speed: 1.0769 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 61.6%

CMC curve

Rank-1 : 48.3%

Rank-5 : 77.5%

Rank-10 : 91.0%

Rank-20 : 94.4%

EPOCH 17:

Speed: 1.0809 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 60.8%

CMC curve

Rank-1 : 46.1%

Rank-5 : 78.7%

Rank-10 : 89.9%

Rank-20 : 96.6%

EPOCH 18:

Speed: 1.0776 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 62.8%

CMC curve

Rank-1 : 49.4%

Rank-5 : 78.7%

Rank-10 : 85.4%

Rank-20 : 97.8%

EPOCH 19:

Speed: 1.1074 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 57.4%

CMC curve

Rank-1 : 43.8%

Rank-5 : 74.2%

Rank-10 : 87.6%

Rank-20 : 96.6%

EPOCH 20:

Speed: 1.1101 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 58.2%

CMC curve

Rank-1 : 43.8%

Rank-5 : 74.2%

Rank-10 : 86.5%

Rank-20 : 96.6%

EPOCH 21:

Speed: 1.0891 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 60.4%

CMC curve

Rank-1 : 46.1%

Rank-5 : 76.4%

Rank-10 : 91.0%

Rank-20 : 95.5%

EPOCH 22:

Speed: 1.0801 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 63.0%

CMC curve

Rank-1 : 50.6%

Rank-5 : 76.4%

Rank-10 : 86.5%

Rank-20 : 97.8%

EPOCH 23:

Speed: 1.1007 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 58.2%

CMC curve

Rank-1 : 42.7%

Rank-5 : 79.8%

Rank-10 : 86.5%

Rank-20 : 96.6%

EPOCH 24:

Speed: 1.0724 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 63.2%

CMC curve

Rank-1 : 49.4%

Rank-5 : 75.3%

Rank-10 : 86.5%

Rank-20 : 94.4%

EPOCH 25:

Speed: 1.0592 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 58.3%

CMC curve

Rank-1 : 42.7%

Rank-5 : 74.2%

Rank-10 : 86.5%

Rank-20 : 93.3%

EPOCH 26:

Speed: 1.9328 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 59.9%

CMC curve

Rank-1 : 46.1%

Rank-5 : 74.2%

Rank-10 : 86.5%

Rank-20 : 95.5%

EPOCH 27:

Speed: 1.5600 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 63.0%

CMC curve

Rank-1 : 50.6%

Rank-5 : 77.5%

Rank-10 : 91.0%

Rank-20 : 96.6%

EPOCH 28:

Speed: 1.0931 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 66.0%

CMC curve

Rank-1 : 55.1%

Rank-5 : 77.5%

Rank-10 : 88.8%

Rank-20 : 96.6%

EPOCH 29:

Speed: 1.1301 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 58.8%

CMC curve

Rank-1 : 42.7%

Rank-5 : 79.8%

Rank-10 : 89.9%

Rank-20 : 97.8%

EPOCH 30:

Speed: 1.1122 sec/batch

Computing distance matrix with metric=euclidean ...

Computing CMC and mAP ...

\*\* Results \*\*

mAP: 67.2%

CMC curve

Rank-1 : 56.2%

Rank-5 : 80.9%

Rank-10 : 87.6%

Rank-20 : 92.1%

Checkpoint saved to "log/hybrid\_resnet50\_dynamic\_layers7-16(3)\model\model.pth.tar-30"

Elapsed 1:04:15