CS 4804
Image Classification in Autonomous Vehicles

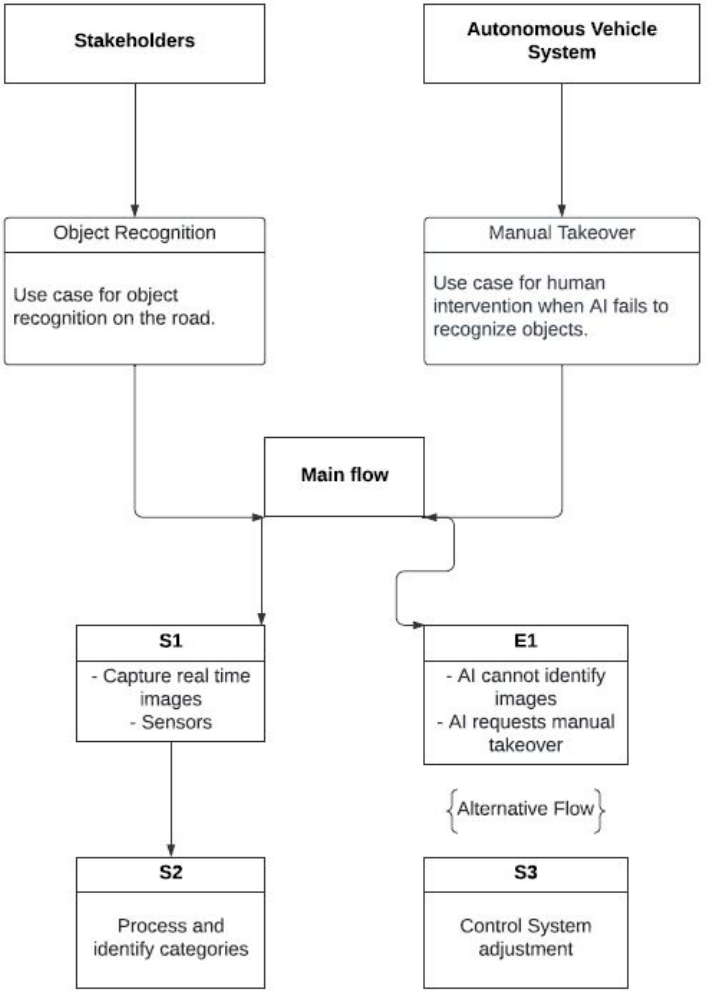
Vatsa Bhatt, Tanisi Tripathi, Fardin Khan, Srikar Iragavarapu

Problem statement and analysis

- Address challenges in image classification for vehicles
- Crucial for ensuring safety
- Precise identification of road signs,pedestrians, and other vehicles


Fig. 1 Autonomous Vehicles [6]

Use-Case Scenario



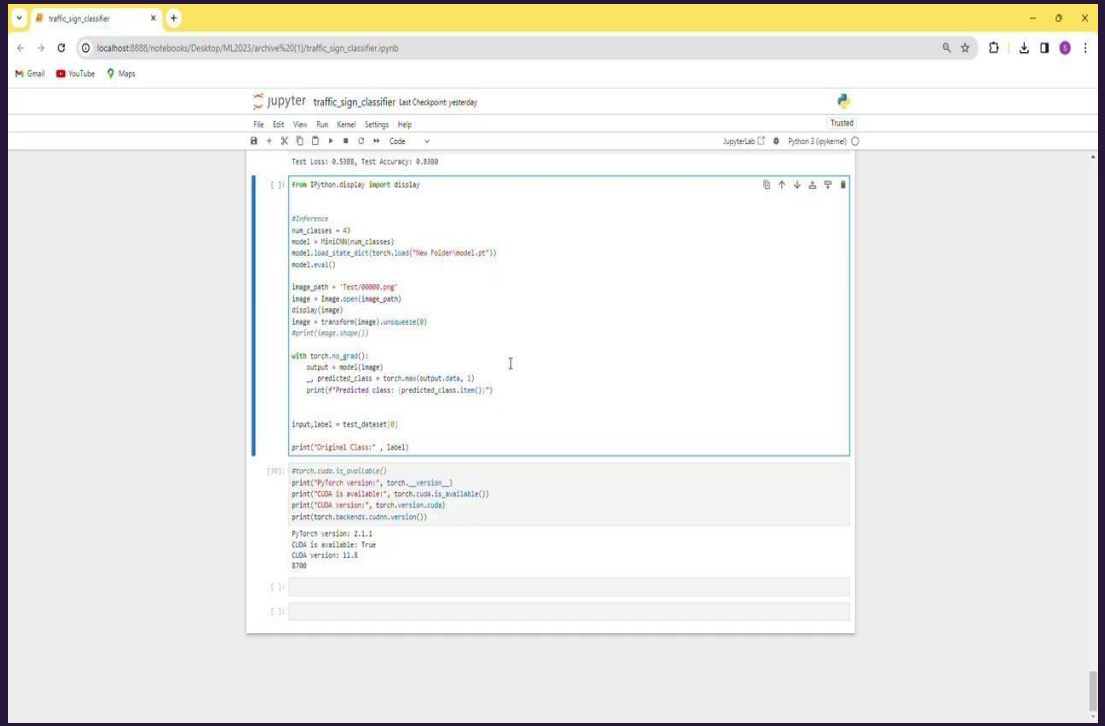
AI algorithm and model

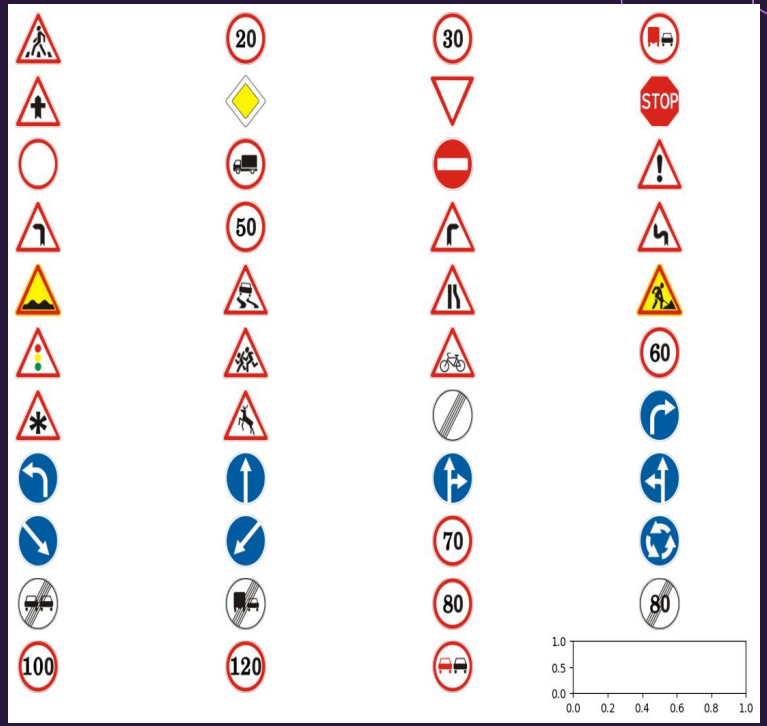
```python
class LargeCNN(nn.Module):
    def __init__(self,input_dim,output_dim):
        super(LargeCNN,self).__init__()
        self.input_dim = input_dim
        self.output_dim = output_dim
        self.metrics = {}
        self.flatten = nn.Flatten()
        self.dropout2 = nn.Dropout(0.2)
        self.dropout3 = nn.Dropout(0.3)
        self.relu = nn.ReLU()
        self.maxpool = nn.MaxPool2d(2)
        self.conv1 = nn.Conv2d(in_channels=3,out_channels=32,kernel_size=3,padding=1)
        self.conv2 = nn.Conv2d(in_channels=32,out_channels=64,kernel_size=3,padding=1)
        self.batchnorm1 = nn.BatchNorm2d(64)
        self.conv3 = nn.Conv2d(in_channels=64,out_channels=128,kernel_size=3,padding=1)
        self.conv4 = nn.Conv2d(in_channels=128,out_channels=256,kernel_size=3,padding=1)
        self.batchnorm2 = nn.BatchNorm2d(256)
        self.conv5 = nn.Conv2d(in_channels=256,out_channels=512,kernel_size=3)
        self.conv6 = nn.Conv2d(in_channels=512,out_channels=1024,kernel_size=3)
        self.batchnorm3 = nn.BatchNorm2d(1024)
        self.l1 = nn.Linear(1024*2*2,512)
        self.l2 = nn.Linear(512,128)
        self.batchnorm4 = nn.LayerNorm(128)
        self.l3 = nn.Linear(128,output_dim)

    def forward(self,input):
        conv = self.conv1(input)
        conv = self.conv2(conv)
        batchnorm = self.relu(self.batchnorm1(conv))
        maxpool = self.maxpool(batchnorm)
        conv = self.conv3(maxpool)
        conv = self.conv4(conv)
        batchnorm = self.relu(self.batchnorm2(conv))
        maxpool = self.maxpool(batchnorm)
        conv = self.conv5(maxpool)
        conv = self.conv6(conv)
        batchnorm = self.relu(self.batchnorm3(conv))
        maxpool = self.maxpool(batchnorm)
        flatten = self.flatten(maxpool)
        dense_l1 = self.l1(flatten)
        dropout = self.dropout3(dense_l1)
        dense_l2 = self.l2(dropout)
        batchnorm = self.batchnorm4(dense_l2)
        dropout = self.dropout2(batchnorm)
        output = self.l3(dropout)
        return output
```

The algorithm using a convolutional neural network (CNN) in PyTorch. This algorithm is designed for the German Traffic Sign Recognition Benchmark (GTSRB) dataset.

```python
class MiniCNN(nn.Module):
    def __init__(self, num_classes):
        super(MiniCNN, self).__init__()
        self.conv1 = nn.Conv2d(3, 32, 3, padding=1)
        self.conv2 = nn.Conv2d(32, 64, 3, padding=1)
        self.conv3 = nn.Conv2d(64, 128, 3, padding=1)
        self.pool = nn.MaxPool2d(2, 2)
        self.fc1 = nn.Linear(128 * 4 * 4, 256)
        self.fc2 = nn.Linear(256, num_classes)
        self.dropout = nn.Dropout(0.5)

    def forward(self, x):
        x = self.pool(F.relu(self.conv1(x)))
        x = self.pool(F.relu(self.conv2(x)))
        x = self.pool(F.relu(self.conv3(x)))
        x = x.view(-1, 128 * 4 * 4)
        x = F.relu(self.fc1(x))
        x = self.dropout(x)
        x = self.fc2(x)
        return x
```

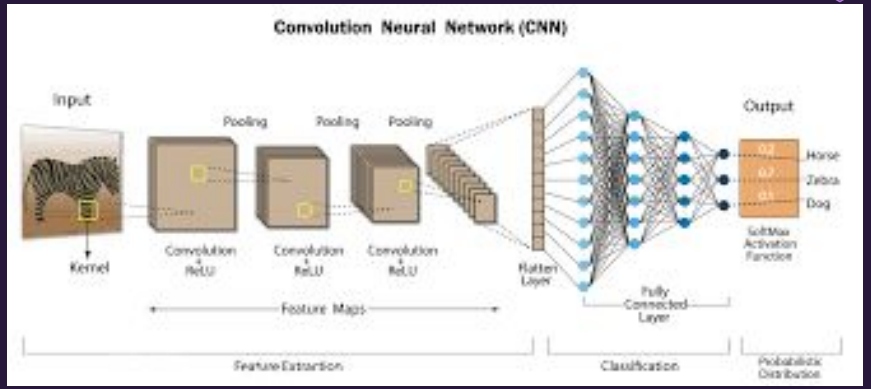
Results and demonstration





Lessons learned

- Balancing CNN architecture for efficiency
- Overcame intricacies in real-world traffic scenarios
- PyTorch for the flexibility and community support



Thank you!

Questions?