Homework #4 - Machine Learning for Robotics (RBE 577) Self-Supervised Depth Estimation

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RBE577: Machine Learning For Robotics

Introduction:

Depth estimation from single images have many applications in robotics, autonomous navigation, augmented reality, and 3D scene understanding, but need lots of labeled data to train in a supervised manner. Getting labeled, real world, depth maps is very challenging and costly, making the supervised approach unappealing. MonoDepth2 implements a different approach to the problem with an architecture capable of self-supervised training on unlabeled, real world, image sequences. Here we implement the MonoDepth2 library on the syndrome dataset and compare the ground truth depth maps to the MonoDepth2 depth prediction network.

Model:

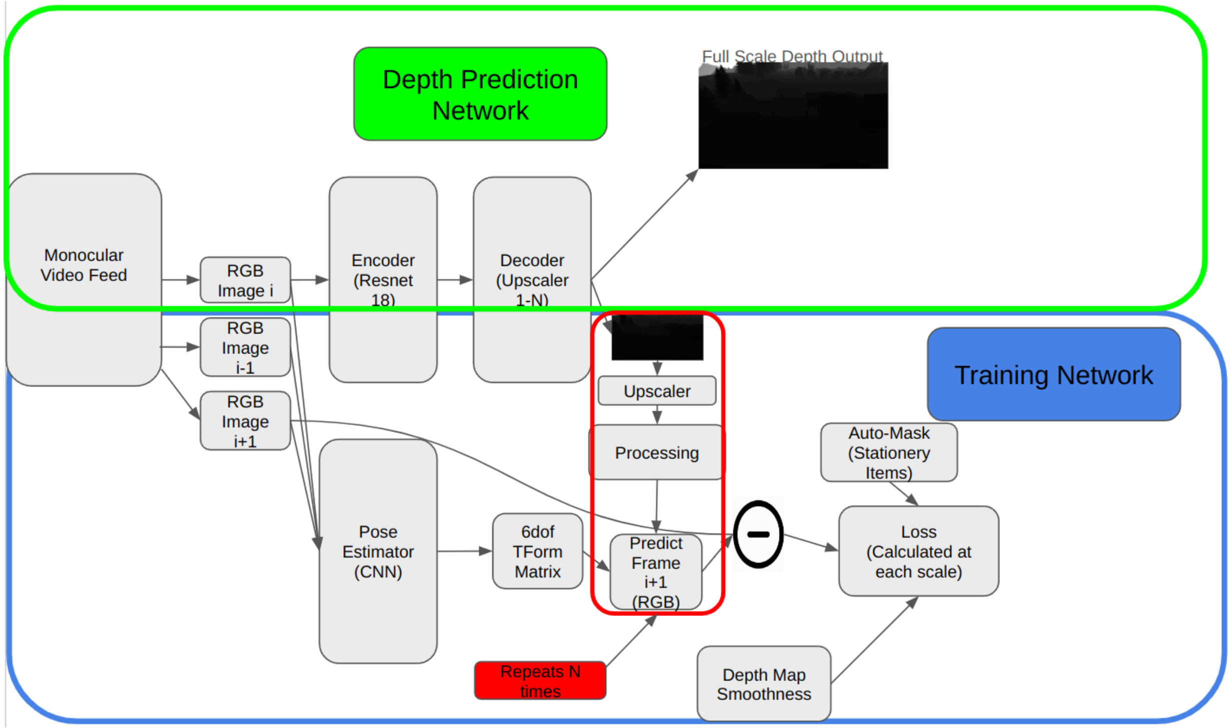
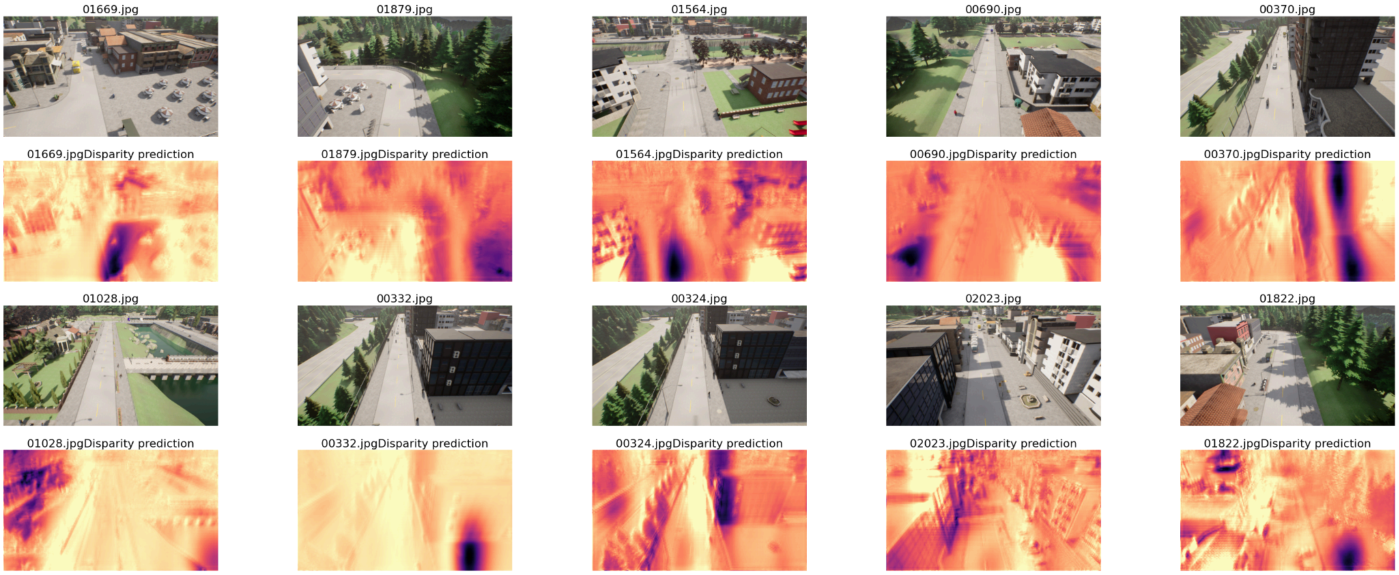


Figure 1: Model Architecture Diagram

Model Architecture:

The model uses two main networks to train, a depth prediction network, and a training pose estimator network. The depth prediction network features a U-Net style encoder-decoder. The encoder uses a pretrained ResNet18, and the decoder utilizes upsampling layers along with skip connections from the encoder to produce a full scale depth map. The pose estimation network uses a modified ResNet18 model to intake sets of images [t-1, t, t+1] and predict 6-DoF relative poses between frames. This network is only utilized during training. Using the pose estimator network during training allows the depth prediction network to be trained on unlabeled datasets by computing the loss using the predicted depth images.

Results: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Loss Vs Epoch

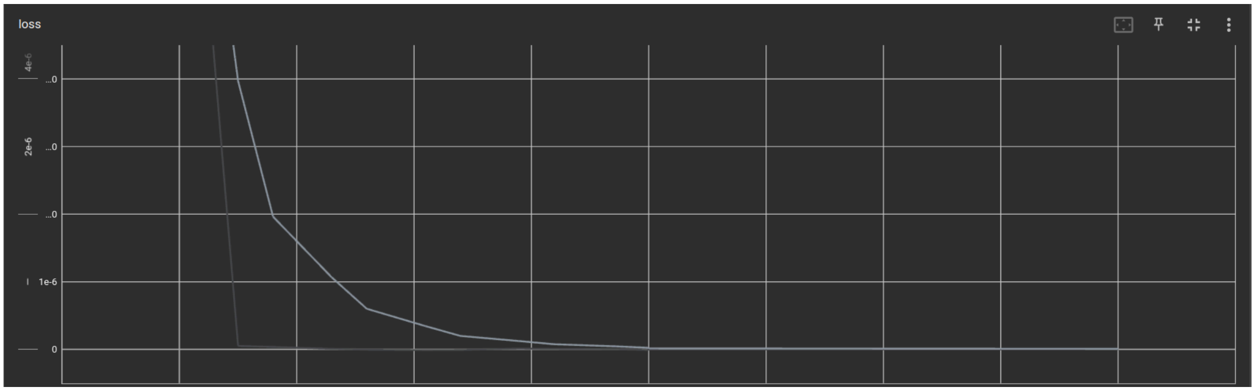

Figure 2: Loss Vs Epoch