**Interim Report**

**Name:** Suraj Kothari

**Project Title:** On Neural Radiance Fields (NeRFs) for Analysing Dark Cave Scenes

**Internal Supervisor’s Name:** Simon Julier, Oliver Kingshott

**External Supervisor’s Name:** N/A

# Progress Made to Date

## Project Plan Objectives Completed

These are the objectives I set in my Project Plan which have been completed so far

1. Read and understood the original NeRF paper and found existing code that implements it on a toy dataset
2. Examined the Onboard Illumination Visual-Inertial Odometry (OIVIO) dataset, which comprises of environments with low lighting such as caves, tunnels, and mines. Then downloaded some sample data from this dataset to train a NeRF on later

## Additional Tasks Completed

This is work that has been completed so far which includes prototyping and testing. This work builds the foundation to achieve the main objectives for the project.

1. Downloaded the COLMAP GUI and learned how to use the software to perform pose extraction from a set of images
2. Downloaded a set of images of a building to use with COLMAP for 3D reconstruction and to obtain the pose information
3. Written a script to downsample a set of images to a lower resolution to make it possible to train a NeRF model
4. Written a script to extract the data from text files generated by COLMAP. This includes extracting the images (stored as NumPy arrays), the intrinsic focal length parameter, and the extrinsic (4x4) pose matrices for each viewing direction. All of this data was then collated into a single dataset stored as a NumPy zip
5. Used an implementation of the original NeRF on a Jupyter notebook to train a model on a popular toy dataset, a Lego tractor, using the already provided pose data
6. Used the same notebook to train another model on the custom building dataset, whose pose data was extracted using COLMAP
7. Downloaded a GitHub repository that trains a NeRF using a python script instead of a notebook, which allowed me to train larger models. Applied the script to the building dataset to generate a 360◦ reconstruction video containing novel views of the scene
8. Applied COLMAP to the OIVIO dataset for two sections of the cave, the initial starting scene and a tunnel
9. Trained a larger NeRF model, using higher computing resources, on two parts of the OIVIO dataset – the initial scene with a calibration QR code and a tunnel sequence

# Remaining Work to be Done

**January**:

* Use the model to generate novel views of the underground cave network
* Use keyboard/mouse input to move around the 3D scene generated by the NeRF model

**February**:

* Fix a viewpoint and change the viewing direction to observe the NeRF’s predictions of specular reflection of the cave walls
* Use the NeRF model to analyse the structure of cave walls, such as spikiness, bumpiness, and reflections