

# Under Vehicle Surveillance System

Bhavay Goyal (24110070) Yash Goyal (24110399)  
Divyansh Sharma (24110113) Chaitanya Bhoite (24110086)  
Advisor Prof. Shanmuganathan Raman  
IIT Gandhinagar



## Introduction

Vehicle security inspections are critical for detecting hidden contraband or unauthorised modifications hidden underneath a vehicle. This has become much more relevant currently following the unfortunate events near the Red Fort. This project presents an Under Vehicle Surveillance System (UVSS) designed to automate and enhance the process of inspection of the undercarriage of cars and trucks. The aim of this project is to create a stitched image from several images of a vehicle's undercarriage, which can be checked for anomalies.

## Pipeline Architecture

**1** The camera (Teledyne Genie Nano) is placed normal to the plane of the road. Multiple images of the undercarriage are taken in quick succession. These images can either be fisheye or planar.

**2** The images taken by the camera are then undistorted using Scaramuzza's *Omnidirectional Camera Model*. The undistorted images are cropped from the sides, perpendicular to the direction of travel of the car, to remove artefacts from undistortion.

**3** Undistorted and cropped images are processed. Histogram Equalization is applied on these images, to make stitching smoother. Images are then stitched and blended together using *OpenPano library*. The result will be used for anomaly detection.

## Image Processing

Parameters for undistortion were found using Scaramuzza's model, which uses projection and transformation.

Images taken by the camera are undistorted using a Python implementation of *OCamCalib*.

Preprocessing of cropped undistorted images. Histogram Equalization for increasing features for smoother stitching.

Multi-band blending is applied to the overlapping (seam) regions of the warped images. This gives the final result.

Homography is calculated to align the images. They are warped to fit on a panoramic plane.

SIFT keypoints and descriptors are extracted from the overlapping regions of the preprocessed images.

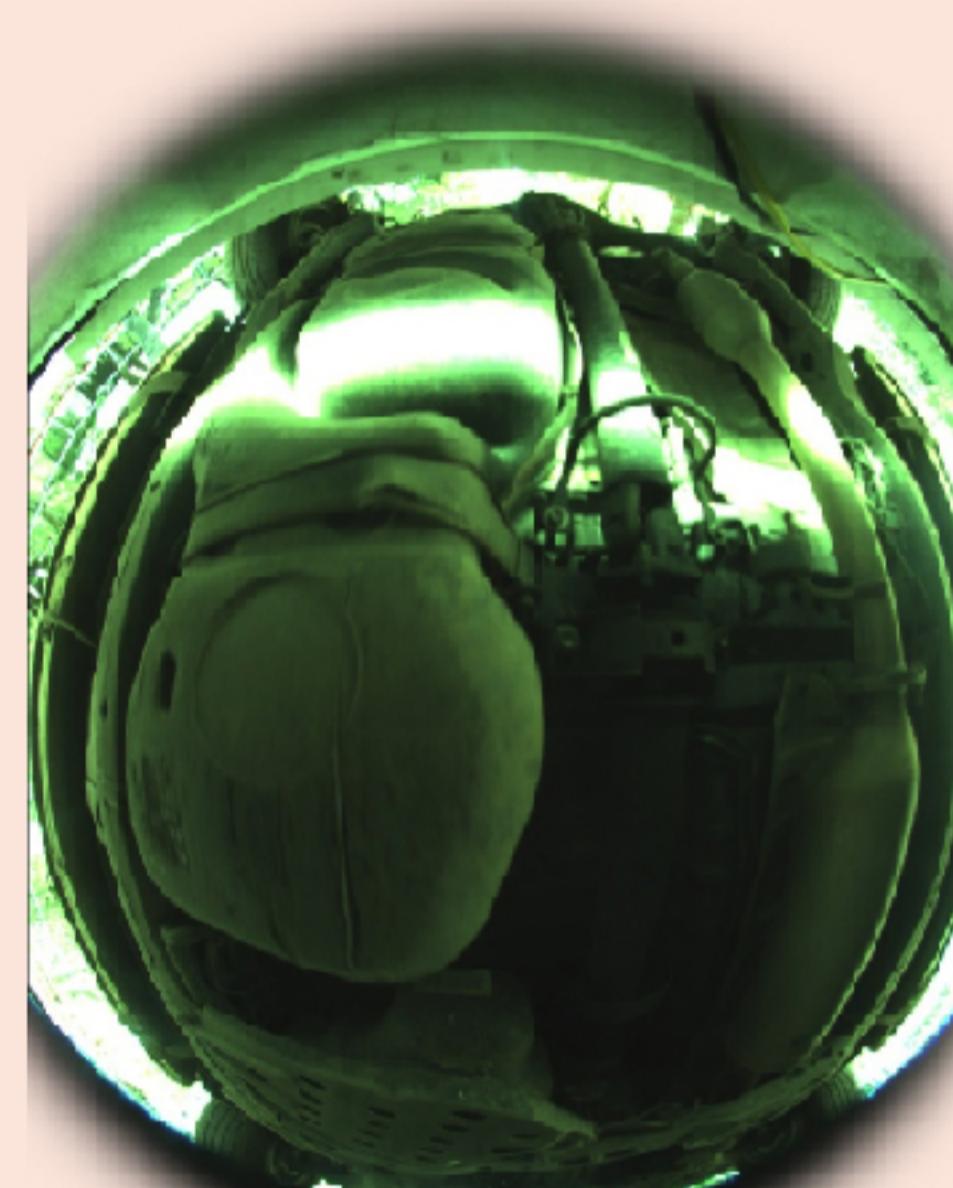
## Results

### Planar images



Example Planar image

### Fisheye images



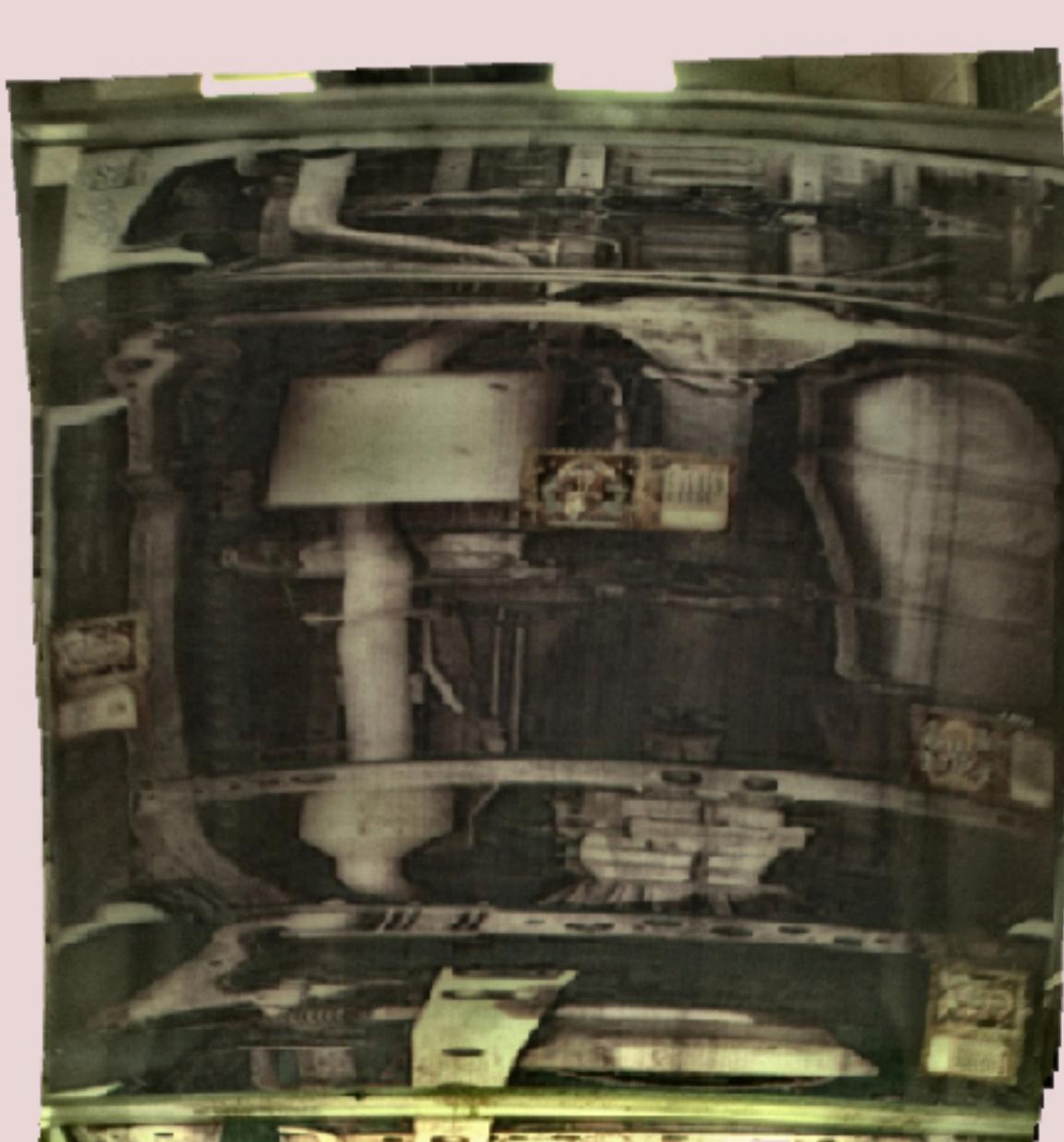
Fisheye image of undercarriage



Undistorted and cropped planar images



Undistorted and cropped fisheye image



Stitched planar result



Stitched fisheye result

## Future Work

We did not have a dataset to train a model for anomaly detection. The logical next step for this project is to incorporate anomaly detection as well, creating an entire Under Vehicle Surveillance System.

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