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A - INTRODUCTION

This document describes the West Virginia University(WVU) Advanced Driver Assistance Systems (ADAS) team's solution to ADAS Stereo Vision Tool Check. MATLAB Image Processing Toolkit and Image Acquisition Tool kit were extensively used alongside MATLAB apps to achieve desired results. Each activity had its own complexity and challenges. The rest of the document describes in details, the methods used to complete each activity, analyzes the performance and points out the difficulties associated with each of them.

B - Activity 1: Laptop based video capture using stereo camera test setup

One of the important aspects of using stereo vision is that it helps perceive depth of field for overlapping regions. For applications related to automotive and driver safety it can be used to estimate distance of vehicles in front.

B.1 - Stereo Camera Calibration

To simulate a stereo vision setup two Logitech webcams were mounted on a frame. The frame also has suction cups for a stable attachment on the dashboard or roof of vehicle.

IMAGE 1 . STEREO CAMERA SETUP

Camera calibration helps relate pixels on the image to a point cloud from the position of vision. The checkerboard method was used to calibrate the cameras. A checkerboard was held at a certain distance from the two cameras. A snapshot from each camera was simultaneously taken and stored on the hard disk. This process was repeated for different position and orientations of the checkerboard. It should be kept in mind that each frame should have the full view of checkerboard. A total of 30 calibration images were taken. MATLAB's stereo vision calibration app was used to obtain calibration parameters with help of calibration images.

Image 2 . CALIBRATION IMAGES collage

B.2 - Footage Capture

The stereo camera setup was used for completing this activity. It was mounted on the roof of the car near the windshield. Later the videos were split into individual components for activities related to a particular scenario. Safety was ensured while footage capture. A designated passenger was given the responsibility of handling hardware and software.

Table 1 summarizes the events and occurrence time.

Event	Video File Name	Occurrence Time
Approaching and stopping at stop signs		
Passing by multiple speed limit signs		
Driving by intersection with traffic lights		
Walking on sidewalks		
Crossing in front of vehicles		
Following vehicles on freeway / highway		

Following vehicles on freeway / highway while roads curve		
Following through changing lighting conditions		
Following on city streets		
Changing lanes behind vehicle		

TABLE 1 : Summary of event occurrence

C - Activity 2: Development of ground truth labeling and algorithm performance metrics

C.1 - Ground Truth Labelling

The 'Ground Truth Labeler' app provided by MathWorks was used to develop the ground truth database. The bounding rectangles were drawn and appropriate names were given to identify different objects in the image. The objects in the image could be vehicles, pedestrians, signs etc.

C.2 - Algorithm performance metrics

True Positive	**False Negative**	**Total Positive**	**False Positive**	**Tue Negative**	**Total Negative**	**True Positive Rate**	**True Negative Rate**	**False Detection Rate**

D - Activity 3: Refinement of CV algorithms

D.1 - Vehicle, Sign and Pedestrian Detection

D.2 - Lane marking identification

D.3 - Stereo camera-based depth estimation