Project Plan Presentation
Trailering Safety Using Computer Vision

The Capstone Experience

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Project Sponsor Overview

•Founded the “Workshop for Precision Mechanics and Electrical Engineering” by Robert Bosch in 1886.

•Began installing telephone systems, electric bells, and magneto ignition.

•Leading and worldwide German supplier in automotive equipment and services.

•Commonly known for appliances from washing machines to power tools.
Project Functional Specifications

• Improve safety for trailer hitching.
• Detect errors that a user makes when hitching a trailer to a vehicle.
• Determine if the hitching process is complete.
  ▪ Evaluate if the hitching process is complete.
Project Design Specifications

• User will submit either a video or image of a trailer being hitched to a vehicle.
• The user input will be displayed with hitching features outlined within a labeled box.
• A checklist will be displayed showing if hitch parts are properly connected.
• A large colored box will indicate if the connection is safe for driving.
Screen Mockup: Video Upload
Screen Mockup: Checklist Menu

Checklist

- Chains Connected
- Hitch Connected
- Tongue Locked
- Cable Connected

Status: Incomplete
Screen Mockup: End of Video
Screen Mockup: Image Mode
Project Technical Specifications

- UI created with wxPython allows users to upload videos/images and receive pass/fail status on the hitching process.
- FFmpeg & OpenCV process videos into images and creates our raw dataset.
- Albumentations will expand the raw dataset since it has limited test cases.
- Training data will be segmented by SAM.
- ML model for object detection will combine Hugging Face and YOLOv8, which are built on PyTorch.
- Pandas will be used to read/create data files.
Project System Architecture

User Interface
- Video Upload
- Feedback

Software Backend
- Data Augmentation
- Scoring Algorithm
- Machine Learning Model

- pandas
- YOLOv8
Project System Components

• Software Platforms / Technologies
  ▪ PyCharm – IDE
  ▪ FFmpeg & OpenCV – video processing
  ▪ Albumentations – expanding dataset
  ▪ SAM – object detection and segmentation
  ▪ wxPython – UI development
  ▪ Pandas – store/access labeled dataset
  ▪ Hugging Face, YOLOv8 & PyTorch – machine learning
Project Risks

• Limited variation in the data set
  ▪ Data has limited variety of environments and part styles.
  ▪ Augment data to add variation or collect more data if necessary.

• Labeling raw data to train models
  ▪ All data is unlabeled.
  ▪ Data will have to be labeled by hand if it cannot be automated.

• Variation in hitching part styles
  ▪ Model needs to recognize various styles of hitching parts.
  ▪ The data set must be well-labeled and varied.

• Recognizing completed hitching steps
  ▪ Model needs to recognize correct ways to complete hitching step.
  ▪ Each method to complete each step should be documented and included in the data set to train the model.
Questions?