

MICHIGAN STATE

U N I V E R S I T Y

Project Plan Presentation

Trailer Safety Using Computer Vision

The Capstone Experience

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Fall 2023



*From Students...
...to Professionals*

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.



Workshop for Precision
Mechanics and Electrical
Engineering



BOSCH



Magneto Ignition



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

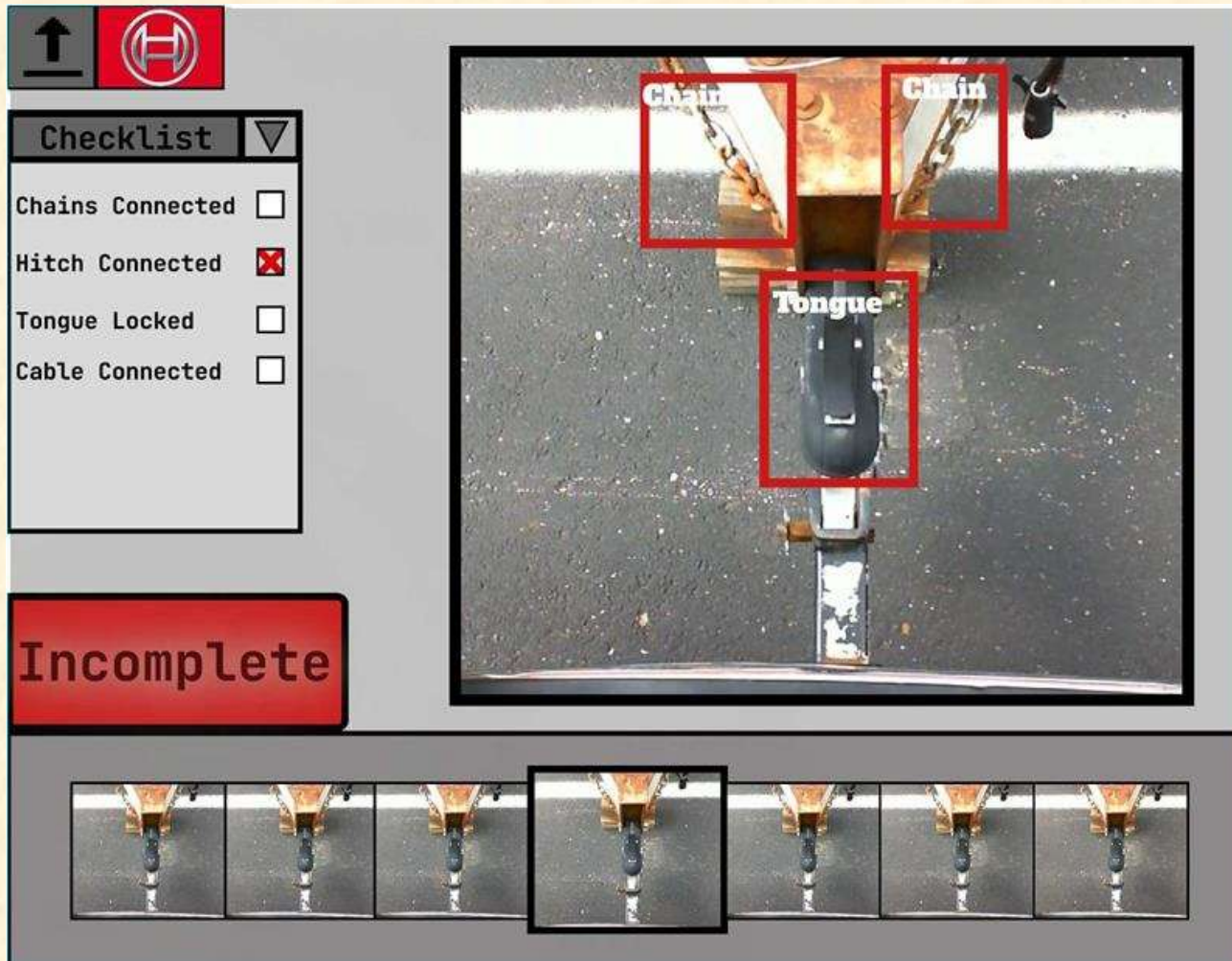
- User will submit either a video or image of a trailer being hitched to a vehicle.
- The user input will be displayed with hitching features outlined within a labeled box.
- A checklist will be displayed showing if hitch parts are properly connected.
- A large colored box will indicate if the connection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



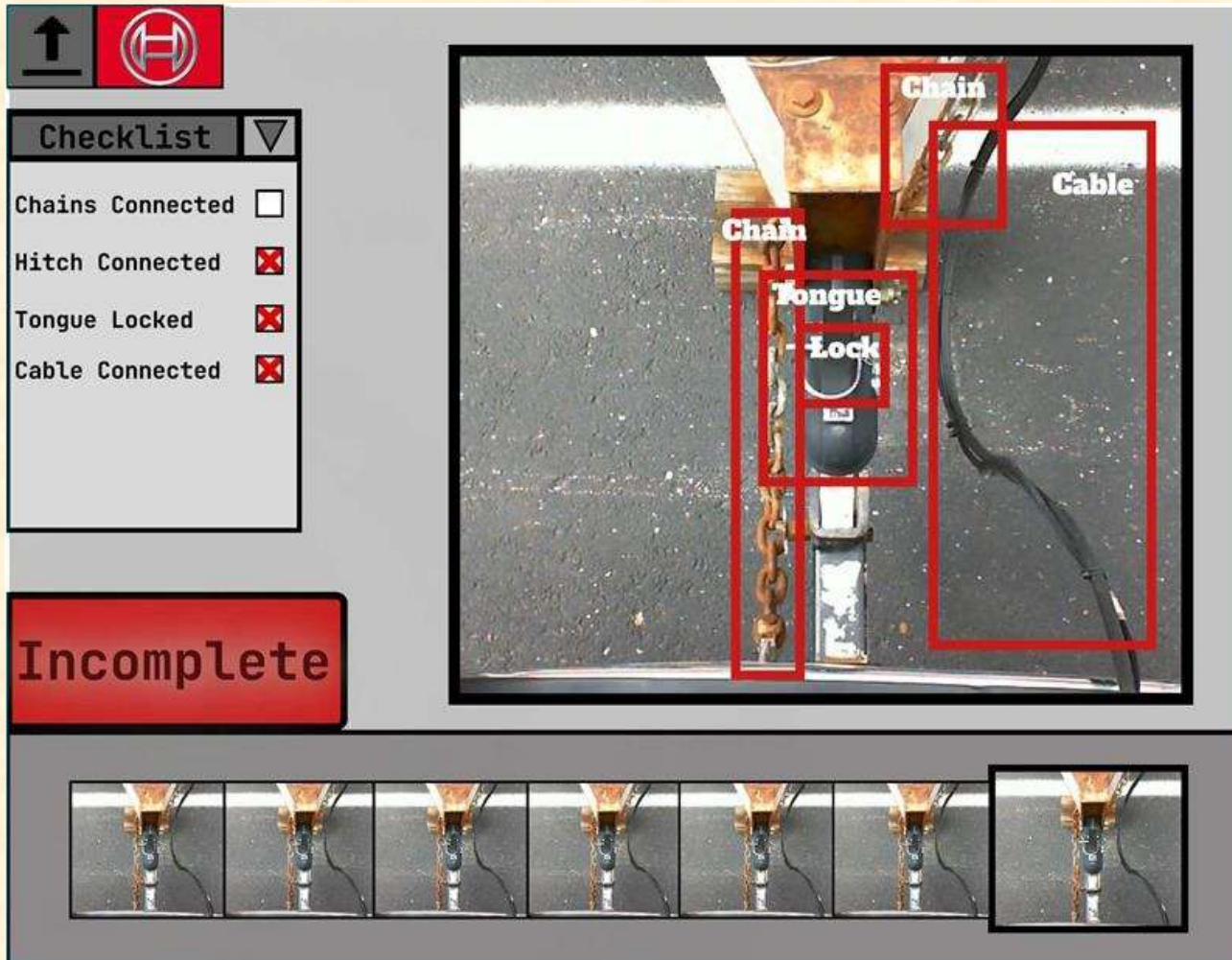
Screen Mockup: Video Upload




Screen Mockup: Checklist Menu



Screen Mockup: End of Video



Screen Mockup: Image Mode


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Checklist ▾

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

Complete

Chain, Tongue Lock, Cable, Chain

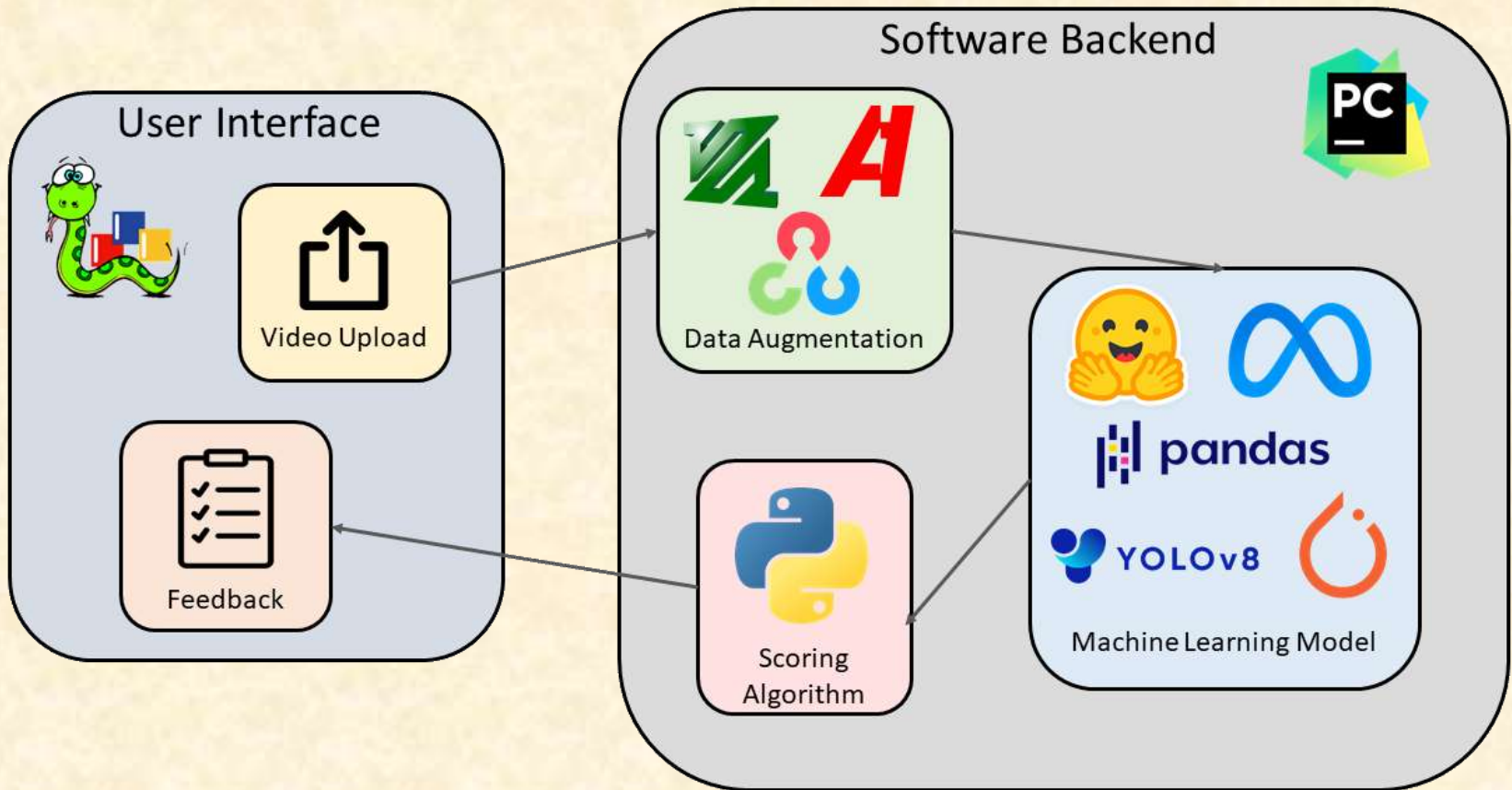


Project Technical Specifications

- 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.
- Alumentations 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



Project System Components

- Software Platforms / Technologies
 - PyCharm – IDE
 - FFmpeg & OpenCV – video processing
 - Alumentations – 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?

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