VehID

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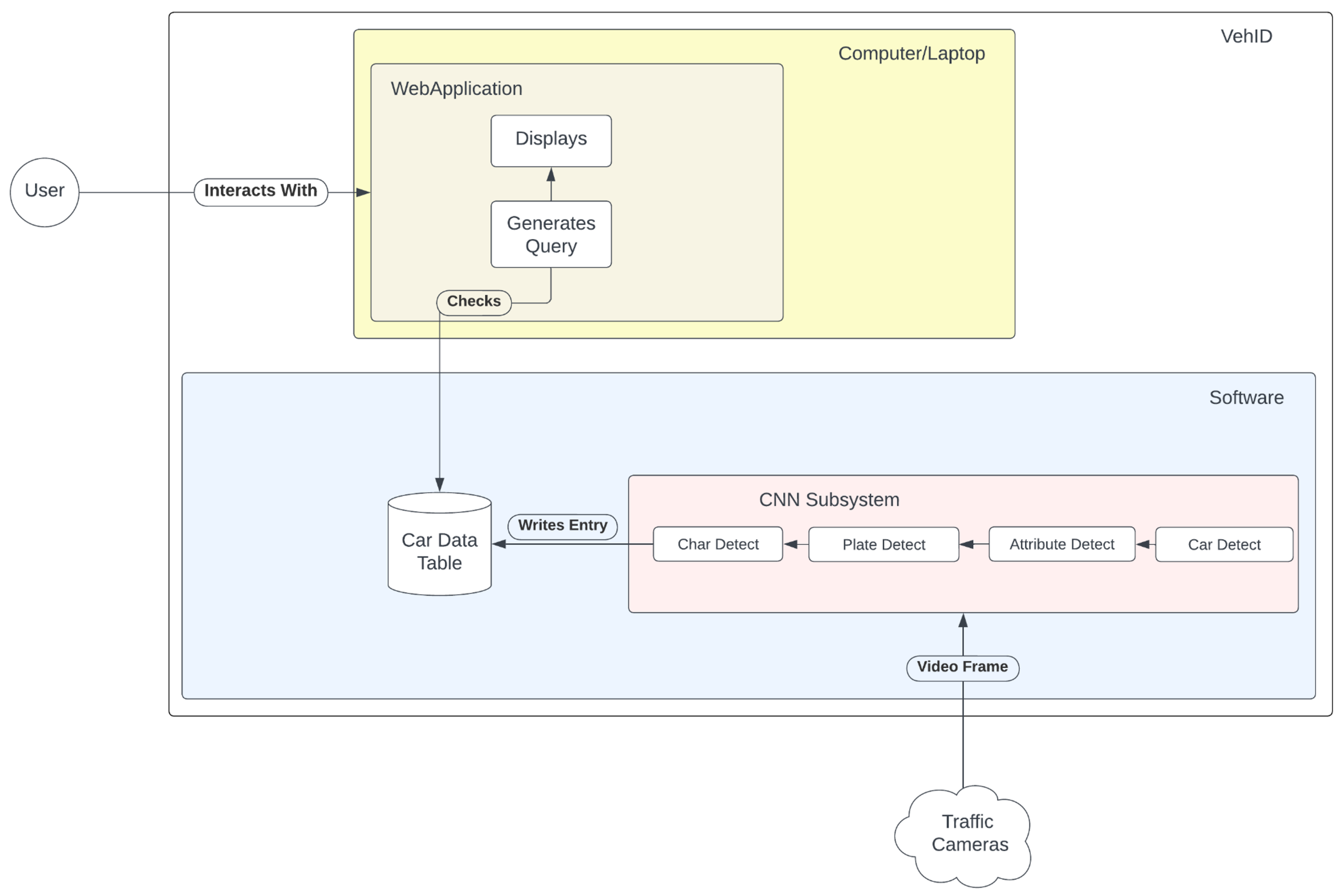
NORTHROP GRUMMAN ENGINEERING & SCIENCE STUDENT DESIGN SHOWCASE FLORIDA TECH

Goal

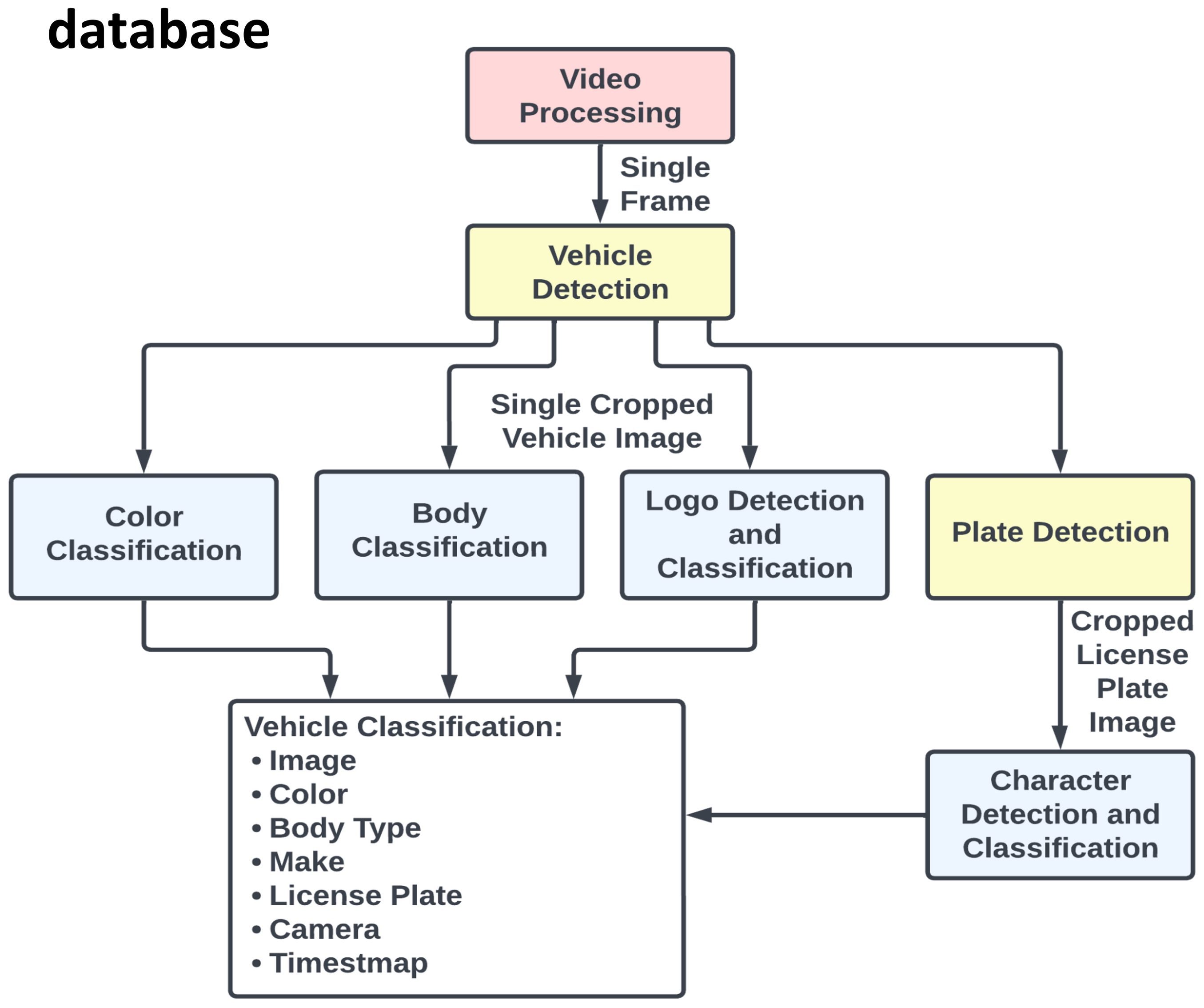
To improve public safety by utilizing machine learning to recognize vehicles based upon a variety of characteristics such as color, body type, make, and/or license plate.

Design



Neural Network (NN) Subsystem

- ➢ Utilized pre-existing NN architectures
  - Mini VGGNet (Body and Color Classifications)
  - YoloV8 (Vehicle, Logo, Plate, and Character Detection)
- ➢ Exports results to a JSON file for use in the database



Motivation

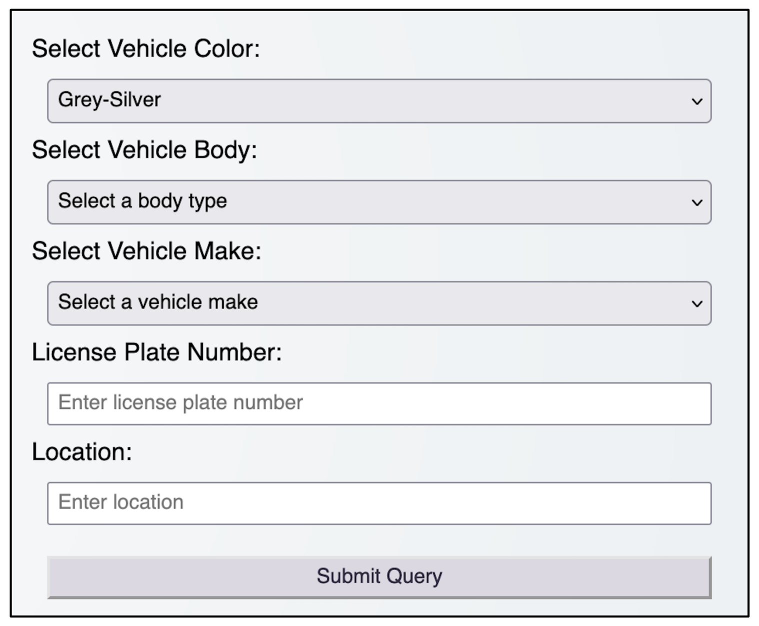
- ➢ Aid in AMBER alerts, stolen vehicles, and criminal offenses, which tend to rely on pure human interaction to spot and report the specified vehicles.
- ➢ Existing automation only identifies license plate numbers and is not beneficial when only other characteristics are available.

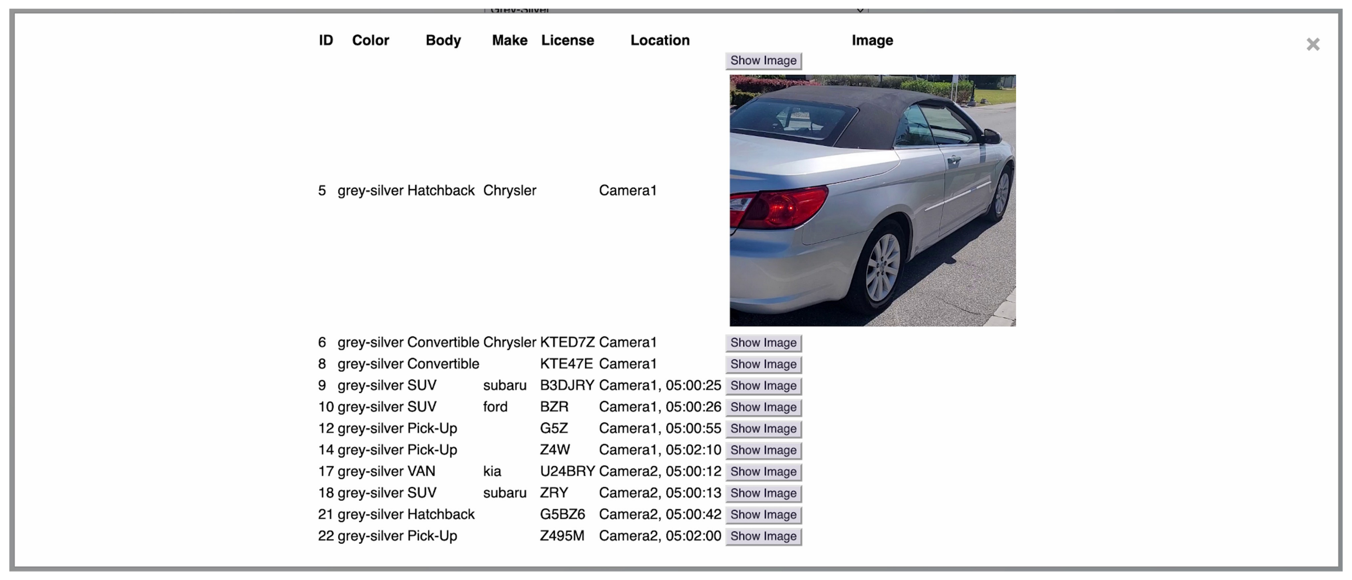
Database

- ➢ Stores vehicle entries detected by the NN subsystem into a JSON format hosted on JBIN.
  - Includes image path, color, body type, make, plate, camera ID, and timestamp.

Web Application

- ➢ Allows for users to interact with the data in a tabulated display serving as the user interface
- ➢ User functionalities:
  - Perform queries to search for vehicles with desired characteristics
  - Filter detected vehicle entries to be displayed in the user interface
  - Edit and delete detected vehicle car entries
  - View saved images for each car entry for manual verification
- ➢ Example Query for any detected Grey-Silver vehicles and corresponding results displayed in the modal.





Implementation

- ➢ Neural Network Subsystem Tools:
  - Utilized various Python libraries
    - OpenCV
    - Tensorflow: Keras, Mini VGGNet Model
    - Ultralytics: YoloV8 models
- ➢ Web Application Tools:
  - HTML/CSS, JavaScript, Node

Evaluation Results

- ➢ Neural Network Subsystem Evaluation:
  - 95% positive vehicle predictions
  - 45% positive color predictions
  - 32% positive body type predictions
  - 47% positive make predictions (out of the ones that had predictions)
  - 71% had 1 or more attributes correctly predicted
  - 28% had 2 or more attributes correctly predicted
- ➢ Web Application Evaluation:
  - Accurate and timely query results
  - Accurate and timely filter results
  - Timely table population

Limitations

- ➢ Image/Video Quality - Lack of access to higher quality images, and quality discrepancy
- ➢ Weather/Environmental Factors - Lack of testing in unideal weather conditions / lack of diverse data
- ➢ Website speed - Response time may be slow due JBIN restrictions

Improvements

- ➢ Further training and tuning on select models with broader datasets to improve performance.
- ➢ Implement web scraping to automatically populate the database with queries from sources such as AMBER alerts.
- ➢ In web application implement timed queries to be rechecked against the database automatically.
- ➢ Incorporate into a network of existing cameras.