Second Semester Plan

VehID

Version 1.0

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Project Advisor: Dr. Marius Silaghi
Project Client: Clayton Levins, Executive Director of Smart North Florida

January 18, 2024

Contents

1 Project Name

VehID

2 Members

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3 Faculty Advisor

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4 Client

Clayton Levins – Executive Director of Smart North Florida

5 Meeting Date(s) with Client

Wednesday, January 17, 2024

6 Goal and Motivation

We plan on utilizing machine learning to recognize vehicles based upon a variety of characteristics such as color, make, body type, and/or license plate. This technology will be used to aid in public safety in a variety of situations such as AMBER alerts, stolen vehicles, and criminal offenses. This will be an improvement upon the current systems used in these situations which often rely on pure human interaction to spot and report the specified vehicles.

7 Approach (key features of the system)

1. Identify vehicles based upon a given criteria.

   Using machine learning we plan to develop a system to efficiently, and accurately categorize vehicles based on, color, make, body type, and/or license plate information. Institutions such as law enforcement will benefit from our project as it will aid with the process of tracking, and identifying vehicles. Current measures are purely reliant on human perception, which may not be able to accurately log all the necessary details

about targeted vehicles. Alert systems such as AMBER provide information about target vehicles that create a situation that is wholly reliant on civilian due-diligence. Our system will instead be autonomous in its monitoring, and aid civilians, and law enforcement alike. We hope our product will greatly improve the quality of life of law enforcement, and create safer, more lawful communities for all to enjoy

2. Identify numerous vehicles in real-time.

   The system will be able to extract individual images of all vehicles in the frame of the camera. This will allow the system to operate on roads regardless of the volume of cars present. In some locations it may be difficult for an officer to monitor all lanes of traffic alone whereas a few cameras allow for a much broader view of the roadway as a whole. Multiple-vehicle tracking may also allow for prediction of the target vehicles future movement based off traffic patterns. This enables responders to be prepared for a potential confrontation rather than having to react when a situation arises. There is a multitude of further developments which can be made which utilize data from the system, even with the possibility to refine the detection parameters.

3. Report vehicles when full or partial matches are found.

   The system will have a database of current vehicles to continuously look for. As the system looks for these vehicles, it will report any full or partial matches so that correct actions can be taken. If a license plate was given, when the complete match is found the system will report the location spotted as well as the direction of movement. If a license plate was not provided, partial matches will be made when the physical description (color, make, and/or body type) are identified. The system will report both the license plate on the partial matches along with a current location and direction of movement

8 Algorithms and Tools

- Convolutional Neural Networks: We will utilize CNNs to analyze images of cars and extract information about them.
- MERN Stack: We plan on using the MERN stack: MongoDB, ExpressJS, ReactJS, and NodeJS, in order to create the web application for interacting with the data gathered by the system.
- OpenCV: We will be using OpenCV in order to process video feed and extract frames for the CNNs to analyze.
- TensorFlow & Keras: Will be used in the creation and training of our models.

9 Novel Features

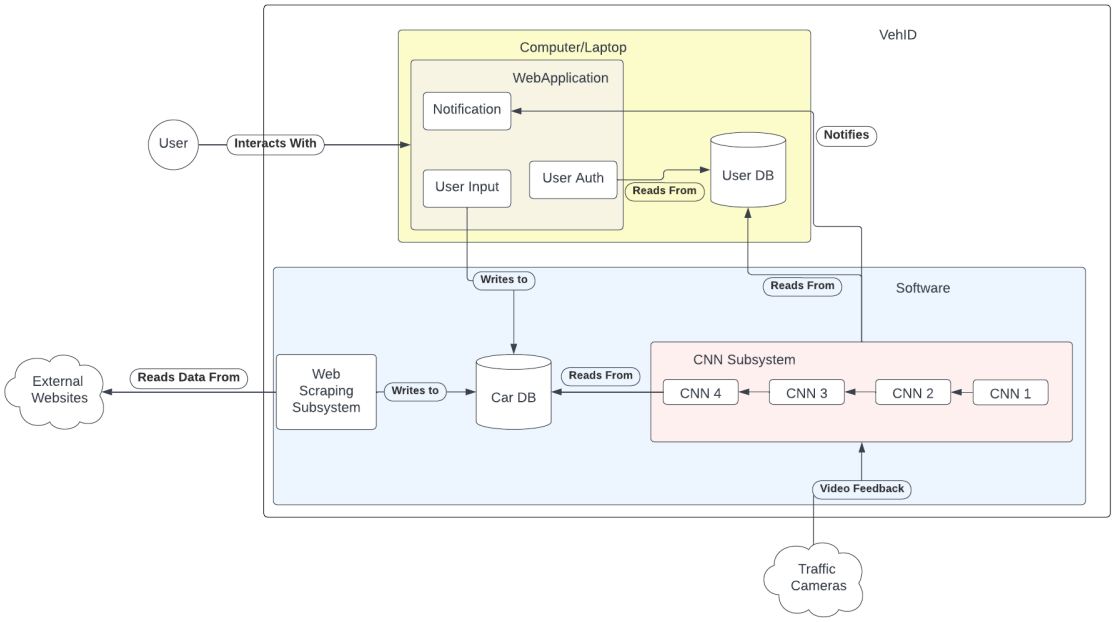
- Convolutional Neural Network (CNN) used to identify a vehicle based on specified criteria. Offering a constant search to aid in law enforcement expeditions and other vehicle safety concerns.

- Utilizing the existing network of traffic cameras to monitor roads and highways.
- Using vehicles themselves as identifiers rather than purely license plate recognition as similar existing technologies currently utilize.

10 Technical Challenges

1. Training neural network(s) to identify color, body type, make, and license plate of a vehicle. This may prove difficult to combine the different classifications with our limited knowledge of neural networks.
2. The ability to recognize and identify multiple vehicles within a single frame from the camera. This may prove difficult as it will require some computer vision concepts to be able to detect the individual objects from a video feed.
3. Designing a web application in order to store data gathered by the CNNs. The application will also web scrape data from traffic/AMBER alert websites so that we can search for matches. This will require learning new technologies such as database hosting and full-stack web development.

11 Design



12 Evaluation

1. Accuracy: Ensure the accuracy of model predictions based on preset vehicle criteria. Level of correctness necessary to deploy software in real-world situations, i.e. greater

than 90% accuracy.

2. Reliability: Ensure the correctness of model performance in accurately capturing video feed and the various models abilities to capture and report that data.

3. Speed: Ensure the swiftness of data transfer between all neural networks as well as the database and web applications. Quick and clean transactions between all components is essential for the overall effectiveness of our system.

4. Intuitive UI Design: Ensure we adhere to web app design principles to create an application that feels comfortable, and natural to use.

5. User Survey: Deploy user survey to first time users of our web application in order to determine the ease of use and intuitiveness of our design. Smooth and easy user interface is essential for ensuring the accuracy and reliability of results.

13 Progress Summary

Model/feature	**Completion %**	**To do**
Vehicle Color Recognition	100%	
Vehicle Body Type Recognition	100%	
Vehicle Make Recognition	0%	Construct, train, and test the model.
Vehicle License Plate Recognition	0%	Construct, train, and test the model.
Video Processing to Extract Images	0%	
Database to hold Searches	0%	
Web Application to Manage Searches	0%	

14 Milestone 4 Itemized Tasks

- Begin implementation of backend database for queries
- Begin implementation of web application for database entries
- Implement vehicle make recognition model

15 Milestone 5 Itemized Tasks

- Implement license plate recognition model
- Implement video processing to extract images to categorize

- Create poster and ebook page for Senior Design Showcase

16 Milestone 6 Itemized Tasks

- Test/demo of the entire system
- Conduct evaluation and analyze results
- Create user/developer manual
- Create demo video

17 Milestone 4 Task Matrix

Task	**Remington**	**Spencer**	**Thomas**	**Alexis**
Create database	50%	0%	50%	0%
Create web application	50%	0%	50%	0%
Split Dataset	0%	50%	0%	50%
Create vehicle make recognition Model	0%	50%	0%	50%
Hyper-parameter tuning	0%	50%	0%	50%
Data preprocessing	0%	50%	0%	50%
Sprint Planning	25%	25%	25%	25%
Milestone Evaluation	25%	25%	25%	25%

18 Milestone 4 Description

Create Database: To support the web application, we will create a backend database to hold search requirements for any vehicles actively being looked for. This database will be utilized by the series of models to identify matching vehicles to those being searched for.

Begin Creating Web Application: The web application will act as the sole user interface for the project. The web application will allow for two types of users: ordinary users and admin. Both types of users will be able to view and query the current database of vehicles being searched for. Admin users will be able to add to the database of vehicles being searched for.

Split Dataset: In order to use the dataset we have selected to train a Neural network we must split the data into training, testing, and validation subsets so that we can accurately analyze how our model is performing and ensure that the model is not simply recognizing the training images.

Create Vehicle Make Recognition Model: As one of our primary goals of this project, we hope to recognize the logos within vehicle images to correctly identify the make of the vehicle. The model for this portion will consist of object detection to locate the logo within the image and classification to determine what brand the logo corresponds with.

Hyper-parameter Tuning: Upon creating and testing the model, we will evaluate the models performance based upon a variety of metrics and determine the best parameters to alter to improve the performance of the model and decrease the overfitting of the model.

Data Prepossessing: Prior to training our models we need to ensure our data is properly labeled, uniform, and ready to be used by a CNN. To ensure this we must scale the all the images to a uniform size and normalize the data so that it will not cause an overflow in the model. If we choose so this portion will also include data augmentation to create images from different angles in order to better train the model and avoid overfitting that may happen if all the data looks too much alike.

Sprint Planning: Due to the fact that we are following the Agile Software Development process, each milestone marks the start of a new sprint. When we lay out the tasks for the milestone we all meet and decide what work needs to get done and the importance of each item we have decided on for the milestone. Every group member participates equally during this task.

Milestone 4 Evaluation: All work done during a milestone is followed by a milestone evaluation. All members reflect on the work they did during the milestone and write summaries about their work. All members are expected to participate equally as they know best what work they completed during each milestone.

19 Faculty Advisor Approval

Faculty Advisor Signature: _____ Date: _____