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# Milestone 3 Evaluation

## VehID

### Version 1.0

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Project Client: Clayton Levins, Executive Director of  
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# Contents

<b>1</b>	<b>Progress Matrix</b>	<b>3</b>
<b>2</b>	<b>Discussion - Milestone 3</b>	<b>3</b>
2.1	Tasks . . . . .	3
2.2	Member Contribution . . . . .	4
<b>3</b>	<b>Milestone 4 Plan</b>	<b>5</b>
3.1	Milestone 4 Task Matrix . . . . .	5
<b>4</b>	<b>Discussion - Milestone 4</b>	<b>5</b>
4.1	Milestone 4 Tasks . . . . .	5
<b>5</b>	<b>Client</b>	<b>6</b>
5.1	Meeting Date . . . . .	6
5.2	Client Feedback . . . . .	6
<b>6</b>	<b>Faculty Advisor</b>	<b>7</b>
6.1	Meeting Date . . . . .	7
6.2	Advisor Feedback . . . . .	7
6.3	Student Evaluation . . . . .	8

# 1 Progress Matrix

Task	Completion %	Remington	Spencer	Thomas	Alexis	To-do
Sprint Planning	100%	25%	25%	25%	25%	NA
Data preprocessing	100%	20%	20%	30%	30%	NA
Split Dataset	100%	20%	30%	20%	30%	NA
Create Body Type Model	100%	25%	25%	25%	25%	NA
Hyperparameter tuning	100%	30%	30%	20%	20%	NA
Milestone Evaluation	100%	25%	25%	25%	25%	NA

## 2 Discussion - Milestone 3

### 2.1 Tasks

**Sprint Planning:** As we have been doing for every milestone, we treat every Milestone as an opportunity to do a sprint. We met at the beginning of the milestone and discussed the timeline and the tasks that we plan on completing during this sprint. We divide up the work and address any major concerns at this time to ensure an organized Milestone.

**Data Preprocessing:** Prior to working on the model we looked through our dataset to ensure that it will meet the requirements for our model. This allows us the opportunity to remove any images that we believe may confuse our model. During this time we recognized some images that caused concern, we moved forward with this dataset however to see how the various models would perform. We had to switch our dataset as a result to one that contained much better data that would not confuse our model as easily.

**Split Dataset:** Our original dataset did not include a train, test, and validation split in it's contents. Prior to training this set, it was necessary for us to split this data. However, we ran into issues with this dataset and we decided to switch to a different sample for this model. This new sample was already divided when we received it from the source. It includes a 70% training split, 15% test split, and 15% validation split.

**Create Body Type Recognition Convolutional Neural Network for Vehicles:** The original goal of this project was to work on a make/model recognition network. However, after plenty of trial and error we were unable to receive acceptable accuracies. We spoke with Dr. White, the professor for Deep Learning, and he had no pointers for us to improve the model and advised to redirect. We brought this information to our client who agreed that a redirection was needed and told us that a body recognition model would be just as beneficial as make/model. From here we from scratch for this milestone. We did some architecture

testing to determine that MiniVGGBNet with an Adam optimizer was going to give us the best intermediate results, 75%.

**Hyper-parameter tuning:** Once finding the best architecture and optimizer combination of MiniVGGNet with Adam optimizer we were able to build on this model using hyper-parameter tuning. We incorporated reduce learning rate on plateau, early stopping, restore best weights, random weight initialization, increased dropout, L1 & L2 regularization. This combination of features allowed us to reach an accuracy of 85%.

**Milestone 3 Evaluation:** Our Milestone 3 evaluation allowed us an opportunity to reflect on the work that we accomplished during this time. Initially, we ran into issues, as our original plan to create a model to recognize make and model was not yielding results that we were expecting. This required us to change what we wanted to accomplish during this Milestone. This is why we have decided to switch our created model to identify vehicle body type.

## 2.2 Member Contribution

**Remington Greko:** I worked on implementing and testing various iterations of the body-style recognition model. I also researched techniques for the make/model recognition model via reading various papers on similar projects which had been completed in the past. Through this I documented some techniques we may be able to consider for the development of the next model we create, make/model. This research was originally intended for the current milestone, but due to our pivot towards body-style we were unable to utilize this information. I believe that continuing to gather resources for the next milestone will be vital to its success. In addition to implementing the model, I assisted in writing the report, completing the milestone 4 discussion section in its entirety.

**Spencer Hirsch:** I worked on implementing and testing a variety of neural network types to produce better output for our newly decided model for this Milestone. This included working with both the previous dataset as mentioned above and the dataset that we ended up using for vehicle body type recognition. In addition to this, I worked on some of the data preprocessing and initial splitting of one of the previous datasets that we decided not to use. Alongside my work with the variety of models that we tested, I assisted in working on the report and presentation.

**Thomas Johnson:** For this milestone, my contributions were helping test the body style CNN, and researching techniques for image segmentation. Seeing as how the final iteration of the project is meant to take in a picture of a vehicle and extract the attributes, I figure the accuracy and efficiency of the system will be significantly improved if we can make sure the system is only pulling characteristics from the car. I looked into various image segmentation techniques such as thresholding, edge detection, region-based segmentation, color-based segmentation, etc. If we develop a highly accurate image segmentation method, the accuracy of previous models will most likely increase as they won't be processing confounding information.

**Alexis Nagle:** I primarily worked on the initial model we wanted to implement of make/-model recognition. For this I worked on testing various architecture and optimizer combi-

nations in order to get a good starting point for our model to build on. Once encountering issues, I had met with Dr. White as he is my professor for Deep Learning and had offered to provide any guidance needed throughout the project. As for my work after switching gears to the body recognition model, I had helped locate the new datasets and primarily worked on the hyper-parameter tuning. I have also been working on additional research to plan for further milestones.

### 3 Milestone 4 Plan

#### 3.1 Milestone 4 Task Matrix

Task	Remington	Spencer	Thomas	Alexis
Split Dataset	20%	30%	20%	30%
Create make detection model	25%	25%	25%	25%
Hyper-parameter tuning	30%	30%	20%	20%
Data preprocessing	20%	20%	30%	30%
Sprint Planning	25%	25%	25%	25%
Milestone Evaluation	25%	25%	25%	25%

### 4 Discussion - Milestone 4

#### 4.1 Milestone 4 Tasks

**Split Dataset:** This step in our next milestone will be important to ensuring the success of our next CNN. The make/model recognition appears to be our most challenging model to create so we must ensure that we have good data. We learned from this milestone that not all data sets are well structured, so we will have to manually inspect the splits of the data to ensure we will not run into issues with bad data.

**Create Make Detection Convolutional Neural Network for Vehicles:** For our next milestone we will be focusing on one aspect of the model that we were planning to work on during this milestone. We want to create a model that will be able to stictly identify the make of the vehicle. Due to various issues we pivoted from the original goal of this milestone and instead created body style recognition. This is something we had discussed and agreed upon making at some point during the duration of our project. We believe the make/model recognition is vital to the success of the project and will work to ensure that it is correctly developed.

**Hyper-Parameter Tuning:** Hyper parameter tuning will likely be important in the development of the make detection CNN. This is due to the more precise, and therefore challenging, nature of the task. The development of the next model will be more in-depth than the models we have previously created so we will have to put more attention towards details such as hyper-parameter tuning.

**Data Preprocessing:** There is much more data preprocessing which we must implement in order to succeed in the next milestone. For the make recognition CNN, we must be able to inspect finer details such as logos on the car and possibly even wording for model recognition. These topics are still being considered as we have discussed multiple approaches to these problems. In the case that we do inspect logos and wording on the cars, we must first create bounding boxes for the areas of the car that contain them. We will be using OpenCV to create these boxes and will have to consider things like where the reference points will be to locate these markings on the car. Another possibility is taking into account features such as headlights, tail-lights, grilles, and other features which give each car its unique look. All of these must also have bounding boxes of their own, presenting a further challenge.

**Sprint Planning:** We will again be practicing the Agile Software Development process. Each milestone will be a sprint where we lay out our tasks and decide what steps we will have to take to accomplish them in a timely manner. Each member of the group contributes equally to this portion of the work so that the team is well coordinated.

**Milestone 4 Evaluation:** We will follow up the milestone 4 tasks with an evaluation of our progress. This will report on progress made within the previous milestone, as well as discussing the goals of the next one. All members will contribute equally to this in order to document all aspects of the work as well as ensure members are on the same page going into the next stage of development.

## 5 Client

### 5.1 Meeting Date

Date: November 15, 2023

### 5.2 Client Feedback

**Sprint Planning:** Our client has been happy with the way in which we have been dividing up the work for our project and the work that we have been able to accomplish within our given period of time.

**Data Preprocessing:** When we had met with our client to share hardships with our previous plan we discussed our issues that had arisen during the data preprocessing. Some of the images for the vehicles made it too difficult for our model to learn from, color was a big factor. We shared this with our Client and discussed how we had grayscaled all of the images and it was still performing poorly. At this point, we had begun our discussions of switching the objective of this milestone.

**Split Dataset:** Our dataset was already split into train, test, and validation samples for our original plan so our client did not have any issues with this portion.

**Create Make/Model Recognition Model/Create Body Type Recognition Model:** We met with our client to discuss the original objective of the milestone of working with vehicle make/model. During this time we discussed our concerns of the results that we were

receiving with this model. We discussed what problems we were seeing with the model and why we believe that we may have to change the objective our original plan may be too difficult to achieve with the results that we would want to see in a real-world application. We shared our new idea of moving to either body type or focusing primarily on the make of the vehicle during this time which our Client was on board with as it gave us an opportunity in the future to build off of these ideas. Thus, for this milestone we shifted our scope to focus on the body-type of the vehicle.

**Milestone 3 Evaluation:** We were unable to share our Milestone 3 Evaluation with our Client as we had our meeting well in advance in order to discuss the issues that we were running into with our model.

## 6 Faculty Advisor

### 6.1 Meeting Date

Date: November 27, 2023

### 6.2 Advisor Feedback

**Sprint Planning:** Our advisor did not express any concerns about our planning for the execution of this milestone.

**Data Preprocessing:** There was no mention of concern for the data preprocessing portion of our dataset with our modified execution of the model construction.

**Split Dataset:** Our dataset was already split, there was not mention of a concern for the way in which this dataset was constructed or split.

**Create Body Type Recognition Model:** Prior to the construction of this model we shared with our advisor and our concerns with moving forward with the original plan for the make/model recognition CNN. By this point, we had already met with our Client and he expressed interest in us shifting our focus. At that time our advisor did not express any concerns for the shift in our objective.

**Milestone 3 Evaluation:** Our advisor did not express concerns with the execution of our Milestone 3 Evaluation.

Faculty Advisor Signature: \_\_\_\_\_ Date: \_\_\_\_\_

### 6.3 Student Evaluation

Remington Greko	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Spencer Hirsch	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Thomas Johnson	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Alexis Nagle	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

Faculty Advisor Signature: \_\_\_\_\_ Date: \_\_\_\_\_