Milestone 2 Evaluation

VehID

Version 1.0

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Project Client: Clayton Levins, Executive Director of Smart North Florida

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Contents

1 Progress Matrix

Task	Completion %	Remington	Spencer	Thomas	Alexis	To-do
Split Dataset	100%	20%	30%	20%	30%	NA
Create color recognition Model	100%	25%	25%	25%	25%	NA
Hyper-parameter tuning	100%	30%	30%	20%	20%	NA
Data preprocessing	100%	20%	20%	30%	30%	NA
Sprint Planning	100%	25%	25%	25%	25%	NA
Milestone Evaluation	100%	25%	25%	25%	25%	NA

2 Discussion - Milestone 2

2.1 Tasks

Sprint Planning: Following class on the Wednesday after the Plan was submitted, we met as a group to plan out this milestone. We intend to use the Agile Software Development process. This allows us to treat each milestone as a sprint. Allowing us to layout our project a handful of weeks in advance and revisit anything that needs to be revisited. This meeting allowed us to talk about all of the challenges we had ahead and allowed us to discuss the workload of the assignments. This is reflected in the matrix listed above as well as the one we had submitted with our plan.

Split Dataset: The data set we used for the color recognition model was already split into training, testing, and validation sections. We did not have to perform this task.

Data Preprocessing: We modified the data set due to colors assigned the color "gold" being incorrectly labeled. We lumped colors which were closely related to each other i.e. silver and grey, tan and beige. This step streamlined the colors we were searching for, it brought the number of classes down from 15 to 13. In addition to this, we scaled the images down to 64x64 pixel resolution to allow the model to operate more quickly. This is possible because the performance of color recognition is not tied to the resolution of the input image.

Create Color Recognition Model: We utilized a Convolutional Neural Network for the color recognition model. Throughout the development of this model we tested multiple architectures and optimizers to see which ones performed the best. These architectures included single layer benchmark and small convolutional which resulted in 67 and 69 percent accuracy respectively. After this we moved on to the Mini VGGNet architecture. When coupled with the Adam Optimizer and SGD Optimizer, we were able to achieve 77 and 80

percent accuracy respectively. The final architecture we tested was AlexNet with the same optimizers as before. These models had lower accuracies (77 and 76) so we reverted and selected Mini VGGNet with the SGD Optimizer for our model.

Hyper-Parameter Tuning: After we selected the model we began hyper-parameter tuning to further increase the model's performance. The main parameters we modified were: L1 regularization, L2 regularization, random weight initialization, early stopping, and reduction of learning rate on plateau. Through adjustments to these parameters we were able to achieve a higher accuracy of 84 percent. The most recent variant of our model performs at 90 percent accuracy, where the extra 6 percent increase over the hyper-tuned variant came from the reduction of the possible colors (i.e. silver and grey were combined etc) and L1 & L2 regularization values.

Milestone 2 Evaluation: While compiling the Milestone 2 evaluation, we as a team reflected upon the work we have done throughout the milestone and broke it down into the documentation. Each member has listed their individual contributions to the the progress in Milestone 2.

2.2 Member Contribution

Remington Greko: I primarily focused on researching, learning, and testing different approaches to the neural network. I had no experience with neural networks/machine learning prior to this milestone so I decided familiarizing myself with TensorFlow would be a solid first step. I played around with various versions of the model to experiment and see what parameters affected which results. In addition to this I gathered some resources for the next milestones involving license plate and make/model detection. I hope to be in a more comfortable position to contribute more to our next CNN model.

Spencer Hirsch: For this milestone I worked on some of the preprocessing of the dataset, manually revising colors of the dataset. Another portion of the Milestone that I worked on was the hyper-parameter tuning.By changing some of the hyper-parameters that were given to the model we can influence the accuracy and other metrics of the model. I attempted to run a grid search for the hyper-parameter tuning but ran into some computational issues as the processing of this is computationally expensive. I was able to do a partial grid search, with this we found a slightly better accuracy with modified L1 and L2 hyper-parameters. We all collectively worked on the Milestone Evaulation, Presentation, and we all participated in the sprint planning.

Thomas Johnson: Through this milestone I focused on data preprocessing. I designed a basic CNN layer to independently test the effects of preprocessing data on our CNN. Instead of incorporating augmentation layers, I chose to preprocess the data before feeding it into the network. I used TensorFlow's ImageDataGenerator for this preprocessing. After testing, I observed that the results with preprocessed data were comparable to those with unaugmented data. I believe this similarity in results is due to the nature of our task, which is identifying the color of a car. Given the simplicity of this task, it might not be significantly affected by data augmentations.

Alexis Nagle: Throughout this milestone I primarily focused on creating the base model of the CNN. This consisted of determining the loss function, the activation function, the optimizer, and the architecture. For the loss and activation functions I did some research to determine the best fits from our project which ended up being categorical cross entropy and ReLU, respectively. For the architecture and optimizer, I proceeded with some trial and error since these vary from problem to problem; this resulted in learning that the best suit combination is using a MiniVGGNet architecture with an SGD optimizer.

3 Milestone 3 Plan

3.1 Milestone 3 Task Matrix

Task	**Remington**	**Spencer**	**Thomas**	**Alexis**
Split Dataset	20%	30%	20%	30%
Create make/model recognition 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 3

4.1 Milestone 3 Tasks

Split Dataset: This portion of the next milestone will focus taking our existing datasets and splitting them up into training and test data. This is will be an important step for all of our Convolutional Neural Networks going forward. We need to ensure that we have datasets for the model to learn from and also datasets that our model can be tested on. We need to pay close attention during this portion to avoid over-training our model. To have an effective model we want to ensure that our model is not too familiar with a specific set of data, this portion of our milestone will help mitigate this issue.

Create Make/Model Recognition Convolutional Neural Network for Vehicles: This is our primary goal for this milestone. We have three Convolutional Neural Networks to train, we are constructing them in their respective order of important in our model. This will be our second model that we are training and will allow us to apply what we have learned throughout the previous milestone.

Hyper-Parameter Tuning: After our model is trained, we will test our model. After testing, we will have numerical values that are attributed to the effectiveness of our model. Hyper-parameter tuning will allow us an opportunity to make our model better by specifically focusing on the parameters fed to the model in order to increase the effectiveness.

Data Preprocessing: Prior to training our models we need to ensure our data is 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 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 decided 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 3 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.

5 Client

5.1 Meeting Date

Date: October 25, 2023

5.2 Client Feedback

Split Dataset: Our client was pleased with the way in which our dataset was split, we discussed the contents of the dataset that we had decided to train the model on. He had no concerns with our chosen dataset as he saw that it accurately fits our requirements for this assignment.

Create Color Recognition Model: We showed our client the raw data that our model produced. He mentioned that if we wanted to bring this to market there would be requirements for the accuracy of our model. He seemed very pleased with the way in which our model performed. With our current model for color recognition performing at 90% accuracy, he was very pleased to see the amount of progress that we were able to make in such short time.

Hyper-Parameter Tuning: Our client was very pleased with the results of the hyper-parameter tuning, our model showed drastic improvement with the changing of the L1 and L2 regularization values.

Data Preprocessing: We had to a due a fair amount of data preprocessing for the construction of this model, with this being the case, we shared the process that we went through and the changes we made to the model with our client. He believes that the changes we made to the dataset were necessary as it offered such a great change in the performance of the model, both increasing precision and accuracy of the model.

Sprint Planning: Our client mentioned that he has complete faith in us as we seem very organized in the way we are accomplishing tasks.

Milestone 2 Evaluation: Our client was extremely pleased with the progress that we have made and with our plans moving forward. He is very excited for the future of the project and is looking forward to seeing what we will be able to accomplish. He mentioned that he has worked with our Computer Vision and Machine Learning products in the past but nothing that is like ours.

6 Faculty Advisor

6.1 Meeting Date

Date: October 26, 2023

6.2 Advisor Feedback

Split Dataset: The way in which our dataset was split was not a major concern. The 70-15-15 split seems to be effective in training model.

Create Color Recognition Model: Expressed concerns with decision making of the model. Would like to see a visualization of the model to ensure decision making is accurate. Model appears to be perfomring well so far.

Hyper-Parameter Tuning: The team has found sufficient parameters to train the model with to increase metrics of the model.

Data Preprocessing: The preprocessing of the data appears to be sufficient, discussed the revision of a number of classes.

Sprint Planning: The team efficiently planned out their workload for the milestone, sufficient progress has been made for the milestone.

Milestone 2 Evaluation: The team summarized their accomplishments throughout the milestone. Good progress has been demonstrated so far in project. Requested that we include a visualization of our model to display decision making.

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: _____