# Milestone 1 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 |
|------|--------------|-----------|---------|--------|--------|-------|
| Familiarize OpenCV and TensorFlow | 100% | 25% | 25% | 25% | 25% | None |
| Sprint Planning | 100% | 25% | 25% | 25% | 25% | None |
| Training Dataset | 100% | 20% | 40% | 20% | 20% | None |
| Collaboration Tools | 100% | 20% | 40% | 20% | 20% | None |
| Requirements Doc | 100% | 30% | 20% | 30% | 20% | None |
| Design Doc | 100% | 20% | 20% | 20% | 40% | None |
| Test Plan | 100% | 20% | 30% | 20% | 30% | None |
| Milestone1 Eval | 100% | 20% | 40% | 20% | 20% | None |

# 2 Discussion

## 2.1 Tasks

**Familiarize with OpenCV and TensorFlow:** Our project heavily relies on computer vision and machine learning, for this reason it was important that we all have an understanding of the primary tools that we will be using for this project. We wanted to start with doing some reading and working with OpenCV and TensorFlow before we began doing development. This certainly benefited the group as it is the first time most of us have done any work with machine learning. None of us have created a convolutional neural network before so it better helped us understand what worked needs to be done going forward with the development process.

**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.

**Work on training dataset:** During the proposal process and planning stage of our project we had already chosen a number of datasets that we intended to use to train and test our model with. For this first milestone, we wanted to further look into these datasets to ensure that they fit our criteria for our project. During this time we discovered that our dataset for license plates was no going to be sufficient for what we intended it for. This required us to

find a new license plate dataset that consists of United States license plates and not foreign license plates.

**Determine Collaboration Tools:** For our version control we will be using GitHub, and for communication with each other we plan to use discord. For keeping each other up to date on task completion we plan to use to-do-ist, and google drive to easily share store, and share documents with each other.

**Create Requirements Document:** The goal of the requirements document was to lay out the architecture of the system and any functionalities necessary. We first broke down the entire system into functional subsystems. This allowed us to separate tasks into different subsystems. We also included dependencies such as availability of input data and performance requirements on the processing of that data. Another system which we broke down further was the database, where we outlined the functions and attributes the table must contain. The final major section was the design constraints which outlined any issues we may run into and have to take into consideration when developing our system. Overall this document provides us with a solid plan for the architecture and an an analysis of the requirements for the system.

**Create Design Document:** Following the guidelines provided to us by the IEEE Standard for Information Technology – Systems Design – Software Design Descriptions sections were divided out to each member. We then used a peer review system where once a member completed their section all of us would review, and provide feedback if applicable. This methodology allowed each member to work efficiently without getting bogged down by high frequency meetings, while still requiring each member to be involved in the entire creation process for each part.

**Create Testing Plan:** Alexis worked on setting up the testing plan document and splitting the work among group members. We decided to primarily focus on testing for the three main functionalities: Vehicle Recognition CNNs, video processing, and the user interface. Each of these sections were assigned one of the group members to complete as well as a group member being assigned to the introduction section.

**Milestone 1 Evaluation:** While compiling the Milestone 1 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 1.

## 2.2   Member Contribution

**Remington Greko:** I focused on researching OpenCV and found a breakdown of the steps necessary to extract license plate information from an image. This information was stored in a GitHub repository with a detailed guide on OpenCV and using CNN's on the extracted image. I believe this information will aid us greatly not only in the design phase, but the implementation phase as well. I also found general documentation and guides on OpenCV and TensorFlow which should again prove useful for the implementation phase. After that I worked on the remaining documents for milestone one. We were delegated our tasks for each document which typically included completing a handful of sections in each document.

After each document was complete we reviewed each section to ensure consistency amongst each team member.

**Spencer Hirsch:** Firstly, I did some reading on TensorFlow and OpenCV to better help myself understand the construction of a Convolutional Neural Network and how computer vision can be used to help solve our proposed problem. On the Wednesday, following the submission of our project plan, the group met in the library to layout individual tasks for this milestone, this was our sprint planning, we all participated equally. Next, I validated our training datasets, there was an issue with our license plate dataset which has been resolved. I then laid out and divided up the requirements and design documents. The entire group participated in section one of the requirements document to ensure that we are all on the same page. I worked on my assigned portions of the documents and reviewed my team members sections once they were completed. To ensure accountability I created a shared matrix showing the status of each portion of the document.

**Thomas Johnson:** I focused on a bit on learning about working with OpenCV to gain familiarity for development. I've also begun research on understanding neural networks, and Convolutional Neural Networks, and how they may be implemented using libraries like TensorFlow, and Keras. Like my peers I also found general documentation. During the initial milestone I largely worked on documentation. Documentation was generally split up between all group members as we felt it would be important that everyone had a good understanding of the ground level of our project. Some areas of focus for my documentation entailed: assumptions, and dependencies, software attributes, software architectural design, document change procedures, and our testing methodology.

**Alexis Nagle:** I have primarily focused on researching TensorFlow and Keras for the use of CNNs for image processing and classification. I walked through a demo I found online that had used Keras packages to classify images. This demo was extremely helpful as it showed the basic functionality of Keras. I have also worked on an image classification project using the CIRFA-10 dataset. With this small project I was able familiarize myself with Keras and able to learn about fine tuning hyper-parameters. In addition to this research, I have contributed to all of the documentation needed for this milestone. I did this by completing any portions assigned to me and by peer reviewing other members sections. I had also set up the test document and split the work among all members of the group.

# 3 Milestone 2 Plan

## 3.1 Milestone 2 Task Matrix

| Task | Remington | Spencer | Thomas | Alexis |
|---|---|---|---|---|
| Split Dataset | 20% | 30% | 20% | 30% |
| Create color 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

## 4.1 Milestone 2 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 Color 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 first model that we are training and will serve as a great learning opportunity for us as it is the first CNN that we all would have worked on. For this reason we have evenly divided up the work. It is especially important that we all understand how the model is constructed.

**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 2 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 Feedback

At the beginning of the milestone we met with our client to discuss our plan for this milestone. During this meeting we were able to further break down our project for our client. This was a beneficial experience because our client is involved in many projects similar to ours so we were able to collect valuable feedback from a real-world perspective and not just from an academic perspective. Our client seemed very excited about what we had to offer and expressed that we seemed to have a solid grasp on the tasks at hand. During this meeting we spoke to our client about the technical aspects of our project and how we intended to accomplish specific tasks, this conversation mostly revolved around the contents of the design and requirements documentation. Within the coming weeks we have another meeting planned with our client to discuss the plan for Milestone 2 and collect more feedback regarding what we have already accomplished.

# 6   Faculty Advisor

## 6.1   Meeting Date

Date: September 29, 2023

## 6.2   Advisor Feedback

**Familiarize with OpenCV and TensorFlow:** The team has made sufficient progress and prepared themselves by familiarizing themselves with the tools they will need to use.

**Sprint Planning:** The team has efficiently planned their project into sprints to help organize and manage their progress.

**Work on training dataset:** The team has found sufficient datasets to utilize within their project.

**Determine Collaboration Tools:** The team has found sufficient resources to aid in their collaboration of documents, organization, and communication.

**Create Requirements Document:** Upon review, the team was informed to overall scale down their requirements. This has since been completed after our meeting.

**Create Design Document:** The team has efficiently outlined their overall design of the project.

**Create Testing Plan:** Upon review, the team was informed to expand upon their testing plan. This has since been completed after our meeting.

**Milestone 1 Evaluation:** The team has summarized the progress they have made throughout the first milestone. The team is demonstrating good progress throughout this milestone.

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: _____