

System Design

COMP_195 – Senior Project - Spring 2021

AI Eye

Team Members

Iris Huang

Angela Ayala

Haya Syed

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Project URL

Not currently available

GitHub

<https://github.com/comp195/spring-2021-final-project-ai-eye>

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System Architecture

Software modules

AI Eye is a website that provides a perspective on how autonomous vehicles "see" the world and navigate safely. The website consists of a brief introduction to Google Co-lab that allows us to have access to their virtual machines with applicable hardware we need and introduce the YOLOv4 algorithm, darknet natural network framework and other imaging processing algorithms and steps we take to improve the accuracy of our model.

The user interface

For this project, we will develop a website gathering the algorithm and model implemented. Users may see what output would be shown, for example image. The website will consist of three different sections. The first section would be called "Implementing the Algorithm," which is where we would talk about how our model was trained and what steps were taken. It would walk you through to show you what the output would be for an image. The second section would be "About AI EYE" which give a brief introduction about our ideas and goals for what the interface should accomplish. The third section would be the "Project Developers" listing our names.

Hardware, Software and System Requirements

Hardware requirements

Minimum Requirements	
Processor (CPU)	1 CPU
Memory	2 GB RAM
Storage	10 GiB
Internet Connection	10 Gbps

Software requirements

Internet Browser – Chrome 87.0 or higher

Firefox 85.0 or higher

Microsoft Edge 88 or higher

Internet Explorer 11 or higher

Safari 14 or higher

System requirements

Operating System - Linux 5.10

Chrome OS 88.0

MS-Windows 10

MAC OS 10.12.6

Software Design

Interaction Diagrams

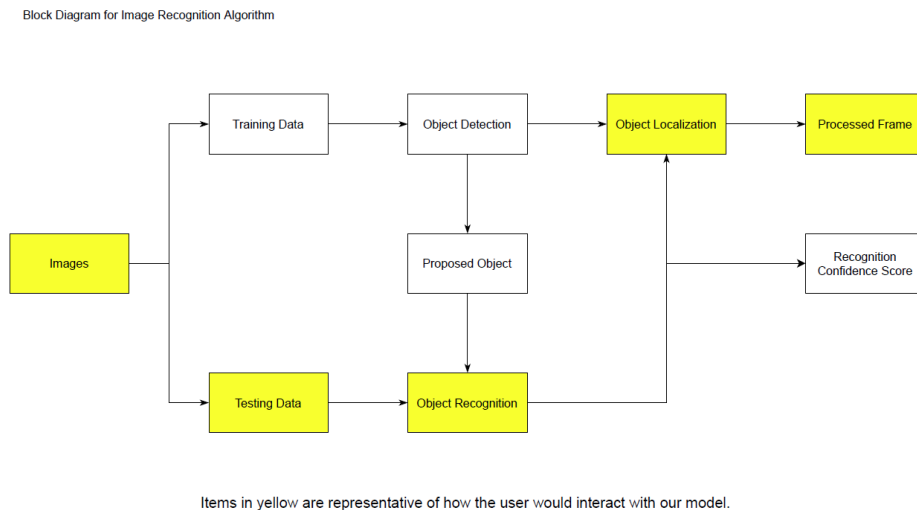


Figure 1 Image Recognition Algorithm

The training process YOLOv4 is taking in a set of properly labeled images or video and perform object detection to detect object if the object is recognized by the model, it would enter object localization stage and proper label the object. If the object is not recognized, it proposes the object, stores its features, and performs object recognition then locates and labels the object.

Similarly, the testing process, as the path highlighted in yellow, takes in an unlabeled dataset to perform recognition, localization then returns the proper labeled result.

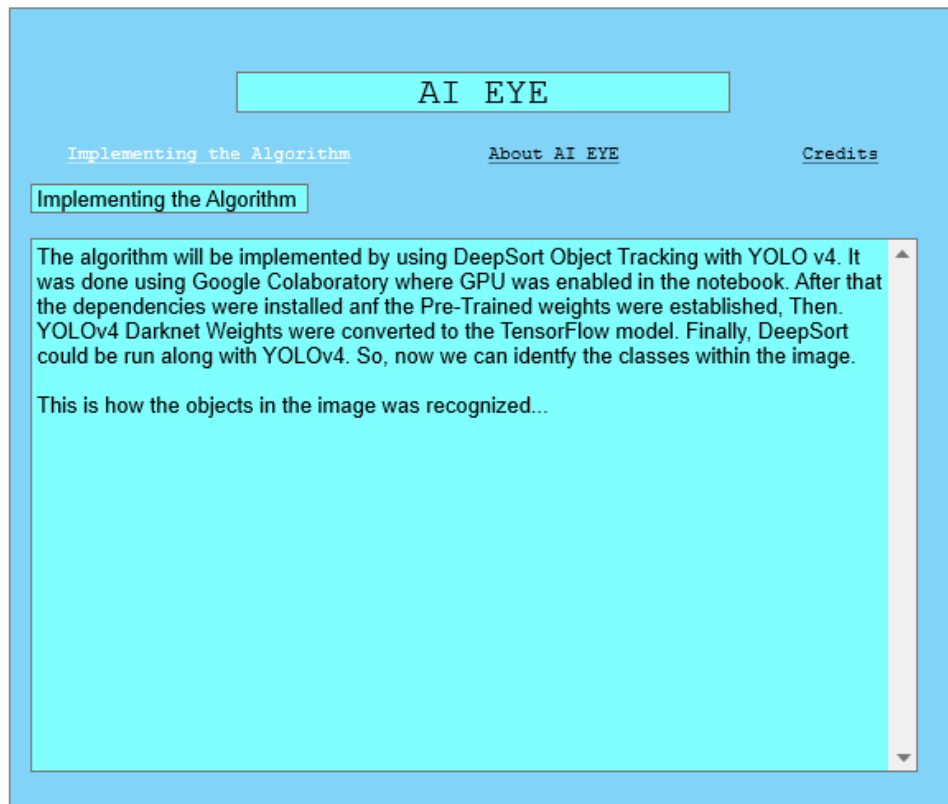
Design Considerations

For this project, we are going to adapt the YOLOv4 algorithm and Darknet neural network framework. YOLO stands for You Only Look Once, presented by Redmon's team from the University of Washington [1]. YOLO is one of the most effective object detection algorithms that unlike other object detection algorithms, YOLO utilizes a single neural network to predict in one evaluation. Redmon's paper indicates that it could obtain 45 FPS on a Titan X GPU. With the speed of YOLO, we can train our model with more samples to achieve a higher accuracy rate for the model with the limited time we have for this project. Within all the versions that are published, YOLOv4 outperforms the previous versions [2].

While YOLOv4 is an object detection algorithm we utilize for AI Eye. The darknet framework is going to be used as well. Darknet is an open-source neural network framework and YOLO is based on darknet architecture. Darknet also has plenty of documentation explaining how we could utilize its interface in their GitHub repository to help us to start training our custom model for AI Eye.

User Interface Design

The model would be trained using YOLOv4 and we would all collaborate using Google Co-laboratory. This platform is ideal to add code along with text. The language we will be using is Python in the notebook. We will then gather our model and create a website where users can walk through and see how we implement the algorithm. It will be a step-by-step tutorial showing what was done and how objects in the image could be recognized. All code that will be implemented and all research gathered will be pushed to GitHub.



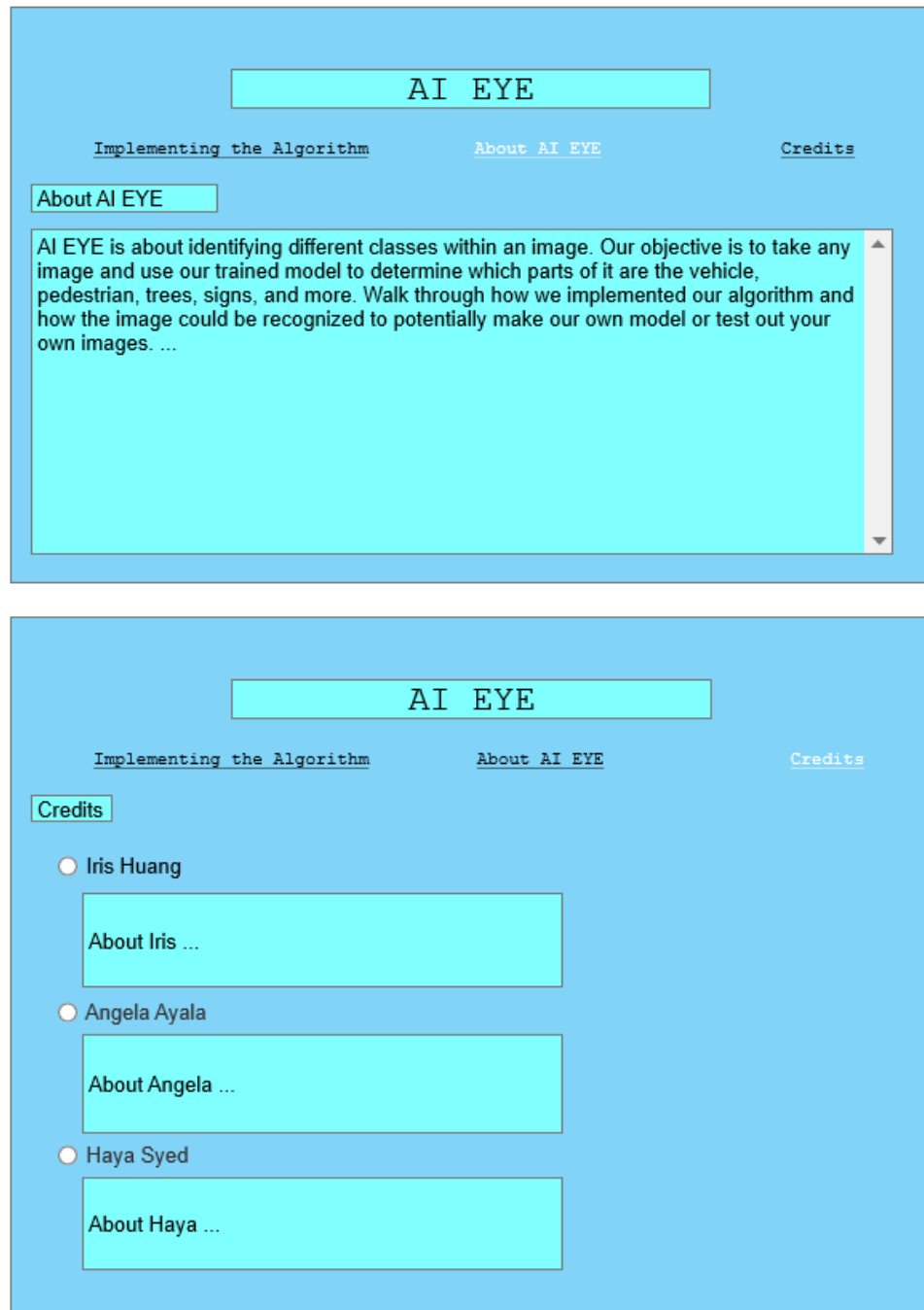


Figure 2 Interface Prototype

Glossary of Terms

Algorithm – a sequence of steps given to the computer for the computer to complete a task.

You Only Look Once (YOLO) – An artificial neural network that uses deep learning algorithms for object detection.

Artificial Neural Network (ANN) - a series of algorithms that attempt to recognize underlying relationships in a set of data through a process that imitates how the human brain operates.

Deep Learning – An artificial intelligence approach to imitate how the human brain processes data and creates patterns used in decision making.

Machine Learning - The use of statistical algorithms to find patterns in data that provides systems with the ability of unsupervised learning.

Unsupervised Learning – Technique in which a created model artifact can work on its own to discover patterns and information that was not been previously recognized.

Model Artifact – The output that results from the process of training a data set.

Dataset - Collection of related sets of information composed of individual elements that can be processed either separately, in a combination or as a unit.

Training Set - Samples of data used when teaching an algorithm to recognize patterns.

Testing Set - Dataset used to assess the performance of a model artifact.

Object Detection - Process of locating instances of objects or features in images or video. (ie. Where is this object in the image?)

Object Recognition – Process of identifying an object or feature in images or video. (ie. What is the object in the image?)

Confidence Interval – A way of measuring the degree of uncertainty is a sampling method.

Clustering - Process of discovering natural grouping in data.

Classification – Process of categorizing a given dataset into classes, labels, or targets.

Pattern recognition - Process of recognizing regularities in each dataset.

Cloud Computing – Delivery of computing services over the internet.

References

- [1] J. Redmon, S. Divvala, R. Girshick, and A. Farhadi, “You Only Look Once: Unified, Real-Time Object Detection,” *Arxiv*, 09-May-2016. [Online]. Available: <https://arxiv.org/pdf/1506.02640v5.pdf>. [Accessed: 07-Feb-2021].
- [2] AlexeyAB, “AlexeyAB/darknet,” *GitHub*. [Online]. Available: <https://github.com/AlexeyAB/darknet>. [Accessed: 07-Feb-2021].
- [3] Manishgupta, “YOLO-You Only Look Once,” *Medium*, 30-May-2020. [Online]. Available: <https://towardsdatascience.com/yolo-you-only-look-once-3dbdbb608ec4#:~:text=YOLO%20algorithm%20is%20an%20algorithm,what%20is%20actually%20being%20predicted>. [Accessed: 07-Feb-2021].