

ParkSense

Aaron Alden, Spencer Karpati, Zachary Rose

UT-Martin

November 17, 2023

What is ParkSense?

- ① Web Dashboard
- ② Object Detection



Motivation

Background

- ① Address a Campus Issue
- ② Parking Shortage



Technology

① Computer Vision and Deep Learning

- (a) OpenCV
- (b) Ultralytics: YOLOv8



② Hardware

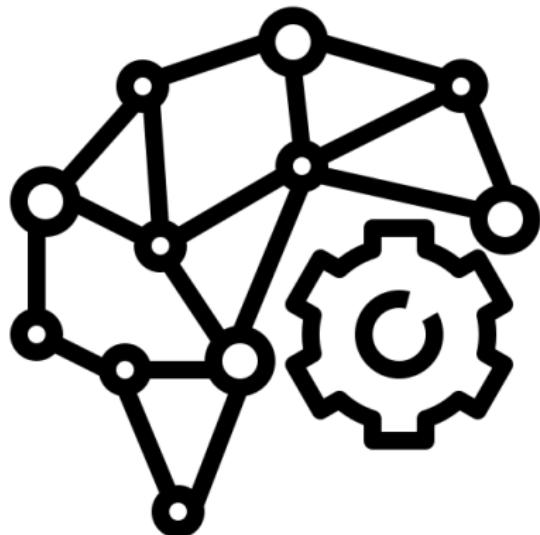
- (a) Raspberry Pi 2 Model B+
- (b) Raspberry Pi Camera Module



What is Deep Learning?

- ① Subset of Machine Learning
 - ⓐ What's the Difference?
 - ⓑ Allows the Ability to Adapt and Learn on Data

- ② Why Do We Need It?
 - ⓐ Receives Labelled Data-set
 - ⓑ Iterates Over Data-set
 - ⓒ Forms a Model for Use



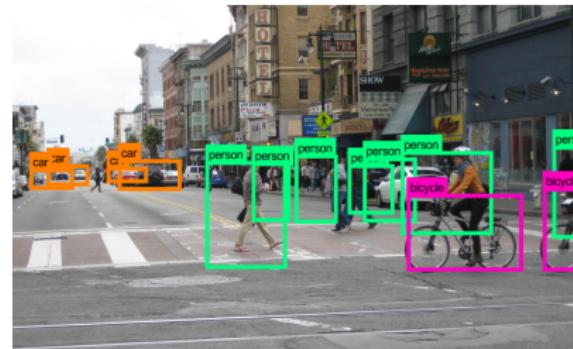
What is Computer Vision?

- ① Subset of Artificial Intelligence (AI)
 - (a) Allows the Computer to “See”

- (b) Necessity for Deep Learning Model

- ② How Does It Work?

- (a) Image Acquisition and Processing
- (b) Refinement and Annotation of Results

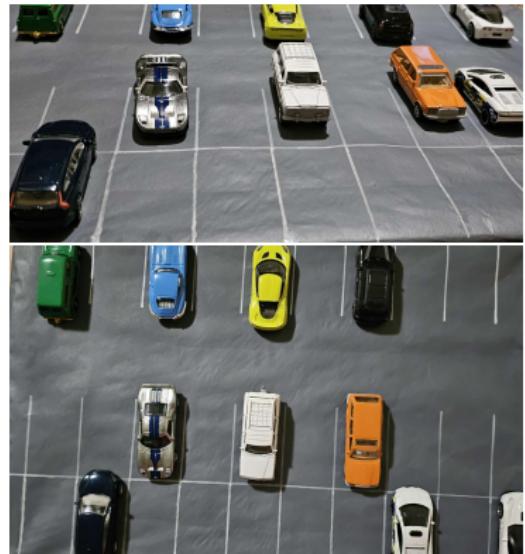


Goals

- ① Provide a Web Dashboard with Lot Information
 - ⓐ Current Spot Availability
 - ⓑ For *Monitoring*
- ② Set Precedent for Similar Projects
 - ⓐ Training Custom Data Sets with Deep Learning
 - ⓑ Portable Computing and Networking

The Parking Lot

- ① Using a Mockup
- ② Easier to Manipulate
 - a) Creating the Dataset
- ③ Looks Fairly Similar to a Real Lot



The Data-set

- ① Contains 20 Images

- (a) Around 18 Empty Instances in Each Image or about 350 in Total
- (b) 10 Taken Instances in Each Image or 200 in Total
- (c) 550 Total Instances

	20230916_131544.jpg.rf.19da4a13bb7f51...	Type: JPG File Dimensions: 640 x 640	Size: 59.1 KB
	20230916_131630.jpg.rf.e731cb841bf15...	Type: JPG File Dimensions: 640 x 640	Size: 57.8 KB
	20230916_131713.jpg.rf.e6909769f69e35...	Type: JPG File Dimensions: 640 x 640	Size: 61.1 KB
	20230916_131822.jpg.rf.6eda1e53635ea2...	Type: JPG File Dimensions: 640 x 640	Size: 63.1 KB
	20230916_131948.jpg.rf.070d7a3a583af...	Type: JPG File Dimensions: 640 x 640	Size: 58.9 KB
	20230916_132046.jpg.rf.a545dcac882f1...	Type: JPG File Dimensions: 640 x 640	Size: 57.2 KB
	20230916_132155.jpg.rf.0738e6112fc3c6c...	Type: JPG File Dimensions: 640 x 640	Size: 59.2 KB
	20230916_132300.jpg.rf.32135b2df96706...	Type: JPG File Dimensions: 640 x 640	Size: 60.9 KB
	20230916_132349.jpg.rf.242c640063c24a...	Type: JPG File Dimensions: 640 x 640	Size: 62.1 KB
	20230916_132444.jpg.rf.aed0922c995f81...	Type: JPG File Dimensions: 640 x 640	Size: 51.4 KB
	20230917_095346.jpg.rf.f7d3d06fcf77943...	Type: JPG File Dimensions: 640 x 640	Size: 59.6 KB
	20230917_095429.jpg.rf.8f4db55fafef9cf...	Type: JPG File Dimensions: 640 x 640	Size: 58.2 KB
	20230917_095514.jpg.rf.0db89a3cd6db6...	Type: JPG File Dimensions: 640 x 640	Size: 56.0 KB
	20230917_095604.jpg.rf.f44d53488e5380f...	Type: JPG File Dimensions: 640 x 640	Size: 62.2 KB
	20230917_095635.jpg.rf.f97fc2085b537ca...	Type: JPG File Dimensions: 640 x 640	Size: 59.3 KB
	20230917_095750.jpg.rf.e11dc47ef0238d...	Type: JPG File Dimensions: 640 x 640	Size: 62.1 KB
	20230917_095855.jpg.rf.52629f2fd84d0...	Type: JPG File Dimensions: 640 x 640	Size: 59.5 KB
	20230917_095926.jpg.rf.3513b365d90081...	Type: JPG File Dimensions: 640 x 640	Size: 56.8 KB
	20230917_100002.jpg.rf.bb526d0a0c30be...	Type: JPG File Dimensions: 640 x 640	Size: 58.5 KB
	20230917_100048.jpg.rf.91965747bbb2d...	Type: JPG File Dimensions: 640 x 640	Size: 58.3 KB

The Annotation Process

- ① Every Instance Must Have an Annotation
- ② Includes Using Bounding Boxes
 - ⓐ Serves as a Guide
- ③ Annotated Using RoboFlow
 - ⓐ Convenient Annotation Tools
 - ⓑ Export in YOLOv8 Format

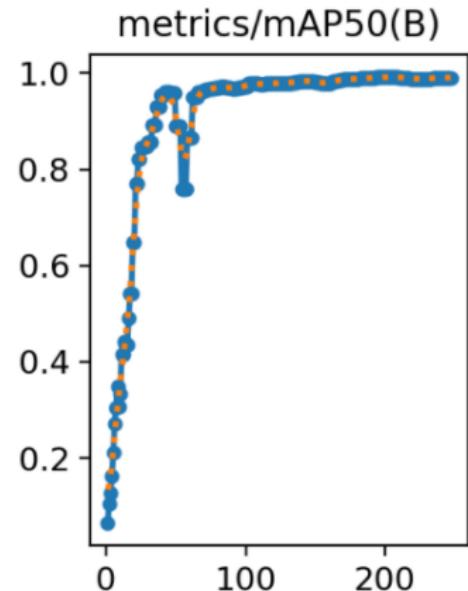


1. -0.29514100000000000 .54888888713975 -0.371498523175 0.4674700927100000 -0.48688707231249
1. 0.1975405546875 -0.39906215878125 0.26195100000000003 0.3232529450625 0.11643118906250001
1. 0.43956043906250003 0.39906215878125 0.514128728125 0.3232529450625 0.35060177812500004 0.2
1. 0.9249084249999999 0.4999999999999999 0.479431374375 0.712977494374375 0.4196078437500000 0.650183124999
1. 0.2053898843175 0.4460784315000000 0.5130821546875 0.55119607843750000 0.6753294125 0.
1. 0.4235898843175 0.4460784315000000 0.50119607843750000 0.6501831249999999 0.6753294125 0.
1. 0.514128728125 0.13529411713875 0.580847234375 0.087254803125 0.42778448487843750000 0.042
1. 0.7548403968749999 0.3413172546875 0.960230244875 0.415686217343750003 0.9903192046875 0
1. 0.782312925 0.27352941249999996 0.9824699109375 0.35 0.282352940625 0.8215693921875 0
1. 0.242264635312500003 0.1911764703125 0.58176847375 0.2589669375 0.22843137347375 -0.154901960975
1. 0.8849717343750000 0.2505882353125 0.558803921875 0.15882353125 0.2505882353125 0.15882353125 0.565
1. 0.83202051171875 0.650570381875 0.558803921875 0.516745158575 0.66960784373
1. 0.770538984375 0.7764705875 0.52459453125 0.6647058826125 0.4330193609375 0.78725495031
1. 0.9589220298875000 0.40490196093749997 0.76397979078125 0.340196093749997 0.303106171875 0
1. 0.4225490203125 0.102040815625 0.4725490203125 0.0523284249999999 0.4225490203125 0.54019607843750000
1. 0.3021978015625 0.5588235296875 0.10446572483749999 0.715686265625 0.0091578093750000
1. 0.11512297187500001 0.4725490203125 0.102040815625 0.4749117640625 0.20146520156249999 0.398039215625 0.0
1. 0.4225490203125 0.102040815625 0.4749117640625 0.20146520156249999 0.398039215625 0.02232205125 0.474998
1. 0.281264635312500003 0.332380490625 0.15882353125 0.2505882353125 0.15882353125 0.15882353125 0.1
1. 0.4238618151125 0.25058823539375 0.26235133437439996 0.15882353125 0.25058823539375 0.15882353125 0.21
1. 0.418628990625 0.2196079437000003 0.26235133437439996 0.476190475 0.1725490203125 0.476190475 0.1725490203125 0.05252998
1. 0.529827315625 0.1333333321249999 0.48199895125 0.0833333321250001 0.3218210359375 0.11
1. 0.66449816875 0.175694156875 0.52365860625 0.4644165239375 0.176470375 0.60
1. 0.709052853125 0.13431372815625 0.5737994296875 0.0931372815625 0.514128728125 0.1372549
1. 0.6972789125000001 0.1392156659375 0.74056265625 0.0931372815625 0.6109366828125 0.052
1. 0.409462848439 0.4793845196 0.4793845196 0.0174874475411 0.438039215625 0.048039215625 0.052



The Model

- ① Custom Model: “testmodel250”
- ② Why is the Model Important?
 - ⓐ Contains Needed Weights
- ③ How Weights are Determined



Data Pipeline

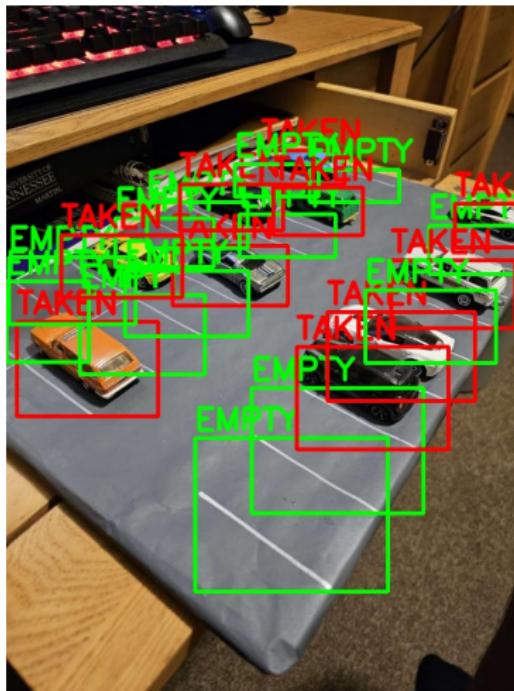
- ① Data Collection
- ② Server Event Handler
- ③ Client Updated



```
Project/Program$ cat data.txt  
17 Emptys, 6 Takens
```



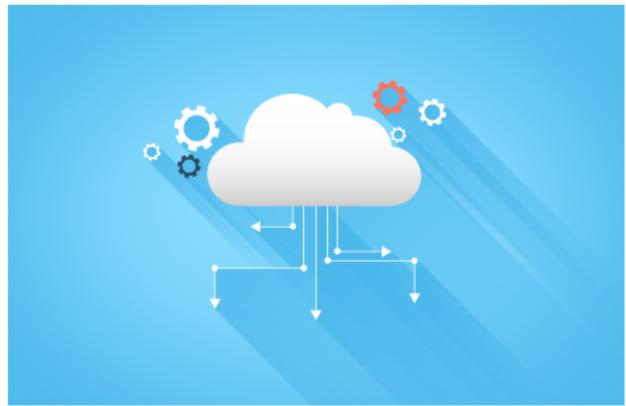
Demonstration



Video

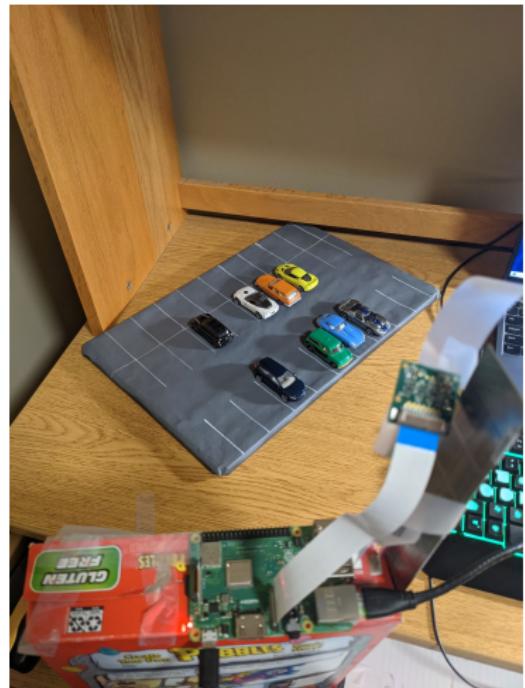
Server and Cloud Computing

- ① Websockets
 - ⓐ Security Concerns
- ② Server Event Handler
- ③ Issues with speed of computation
 - ⓐ Cloud Computing

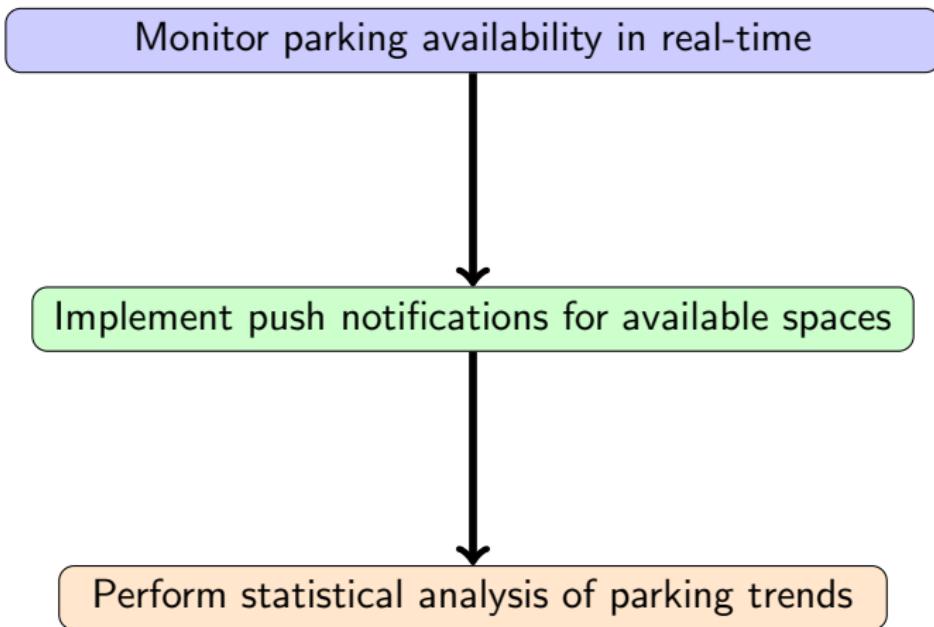


Challenges

- ① New Territory
 - (a) No Prior Experience with Used Technologies
- ② Processing data on low power devices
- ③ Building a stable model under varied conditions



Future Work



Any Questions?

Questions? Comments?

Further project/author information:

Please visit our GitHub repository for more details:

github.com/Spencek7746/Senior-Design-Project

