Robotic Computer Vision
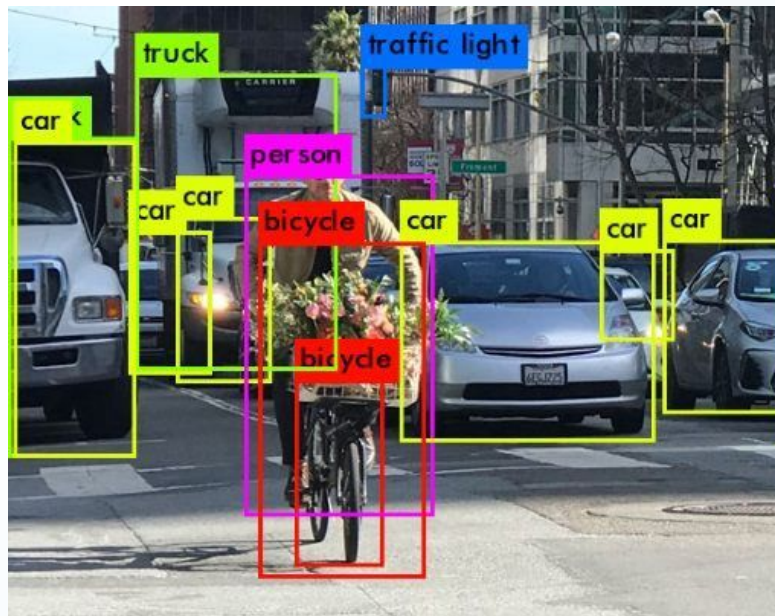*Midterm Progress Update*

Sean Morton

Project Purpose

Guiding questions:

- How does a robot interact with its environment?
- How do we, as engineers, get a robot to act more human?
- How do we make robots easier to interact with for ordinary people?

Our goal is to make a robot that can see and interact with its environment using computer vision.

SCARA Robot Overview

Acronym: **S**elective **C**ompliance **A**rticulated **R**obot **A**rm.
Used in assembly lines; 3 joints + z-axis + gripper

Goals of project: to create a robot for low cost that can move over a table, survey the objects above table, and grab them.

As of Oct 2021: New J2 coupler designed to reduce droop; new E-box designed

Next steps: consult Nick Marchuk @MechLab for stepper motor debug

Object Detection Overview

What is Object Detection (and why is it data science)?

A subset of computer vision: <u>what</u> objects can a neural network can find in an image, and <u>where</u> they are.

How do you run it?

Most O.D. neural networks are designed to work with OpenCV.

```
net = cv2.dnn_DetectionModel(pathA, pathB)
```

The fastest Object Detection model yet is MobileNet SSD – the one used in this project.

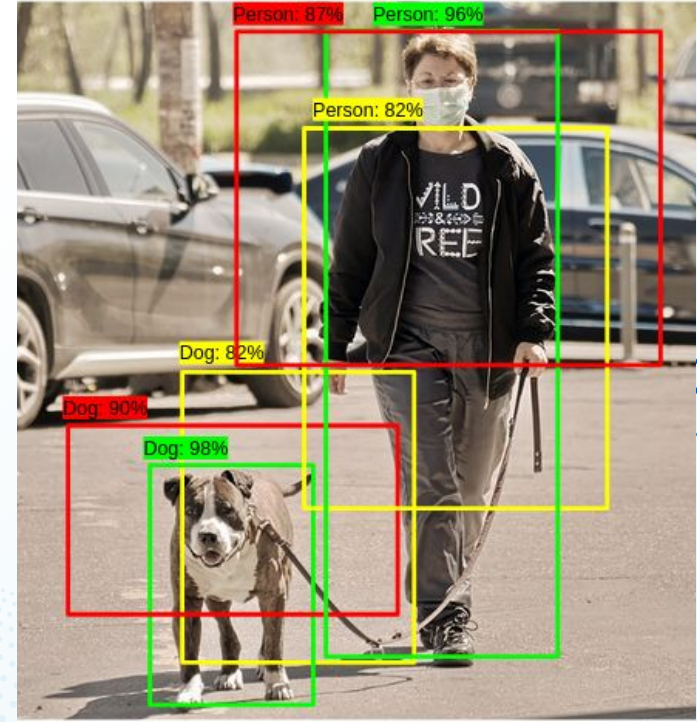# MDS Principles and Framework

Data generation/collection:
Data comes in the form of photo input collected from 1-3 cameras

Mechanistic features:
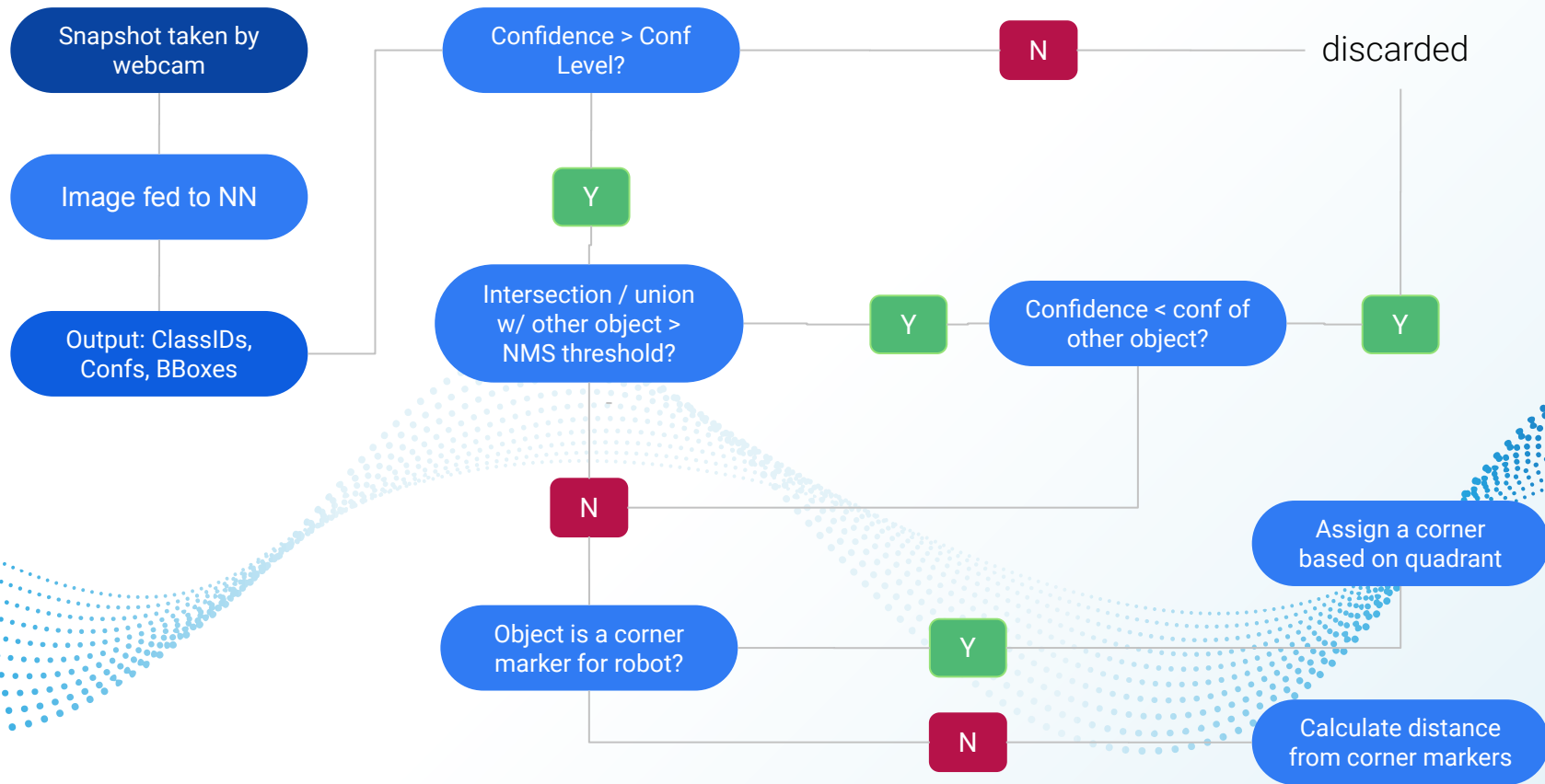Classifications, confidence levels, and bounding boxes of objects

Dimensional reduction:
# of classifications reduced by Non-Max Suppression (NMS)

Pre-NMS overlap of detection

Flowchart of Detection

Snapshot taken by webcam

Image fed to NN

Output: ClassIDs, Confs, BBoxes

Confidence > Conf Level?

N → discarded

Y

Intersection / union w/ other object > NMS threshold?

Y

Confidence < conf of other object?

Y

N

Assign a corner based on quadrant

Object is a corner marker for robot?

Y

N

Calculate distance from corner markers

Streamlit App Functionality

Detection Threshold

0.45

0.01   0.99

NMS Threshold

0.50

0.01   0.99

Real-Time Object Detection

Hello! Here's a brief tutorial on how to turn your phone camera into a smart computer vision camera.

Webcam choice

● My phone
○ Demo Computer

You will need to download an app called "IP Webcam" (Android) or "ipCam" (Apple) onto your phone in order to run this demo.

Find the option that says 'start server' and press the button.

Enter the IP address of your webcam (ex. 12.345.67.890:8080):

Enter IP address

Using variable ip_url = http:///shot.jpg

Streamlit Demo

1. Start the server on SPM Laptop
2. Presenter can navigate to http://10.105.177.187:8501
3. Users can use their phones to carry out object detection!