CSC 4120/6120 INTRODUCTION TO ROBOTICS

### MODULE 4

### **Computer Vision**

### All source codes for GoPiGo 3 robot are available in the GitHub page: <https://github.com/DexterInd/GoPiGo3>

Pi Camera needs to be properly configured for these exercises which has been covered in Module 2.

<https://www.dexterindustries.com/GoPiGo/get-started-with-the-gopigo3-raspberry-pi-robot/4-attach-the-camera-and-distance-sensor-to-the-raspberry-pi-robot/>

**Raspbian for Robots**

If you switch to “Raspbian for Robots” OS, you need Jupyter Notebook to work on below exercises. Otherwise just skip to exercises.

Follow below to get “Raspbian for Robots”:

<https://docs.google.com/document/d/1jgToT5YenshgOQhQj6ujSerVt1WlupMrtxTzdRjEIM4/edit?usp=sharing>

TIP: We need few python libraries setup to work on these exercises. The installation may take time and of course drains the Pi’s battery. So you can connect the USB plug into the Raspberry Pi directly either to your laptop or to a power outlet. Since we won’t be moving the robot around for the exercises, this setup could be fine though we need to give a clear view to the camera to do Computer Vision!

Once the Pi is on and ready, go to the link below on your browser:

1. <http://dex.local>
2. Select VNC
3. Open a Terminal
4. **Now install Jupyter notebook and required libraries on the Pi:**

**Update:**

sudo apt update

**Python and pip:**

sudo apt install python3-dev python3-pip

**Install Jupyter notebook:**

sudo pip3 install jupyter

**Download the exercise files:**

git clone <https://github.com/yash-bhat/Module-4.git>

**Other libraries:**

sudo pip3 install matplotlib

sudo pip3 install scikit-learn

Sudo pip3 install opencv-python

sudo apt-get install libjasper-dev

sudo apt-get install libqtgui4

sudo apt-get install libqt4-test

**Open jupyter notebook:**

jupyter notebook

1. This will open the Jupyter notebook in the browser. Navigate to Module 4 you just downloaded. Go through each exercise and run the scripts.

To ssh into the system :

ssh pi@dex.local

(password: robots1234)

**Exercise 1**: **Detecting spots of color**

The task is to detect location on the image captured through the camera of color (target color) chosen by you. Study the algorithm used and set target color (default is white). Change target color and re-run to see if works accordingly.

Go To Home: Examples

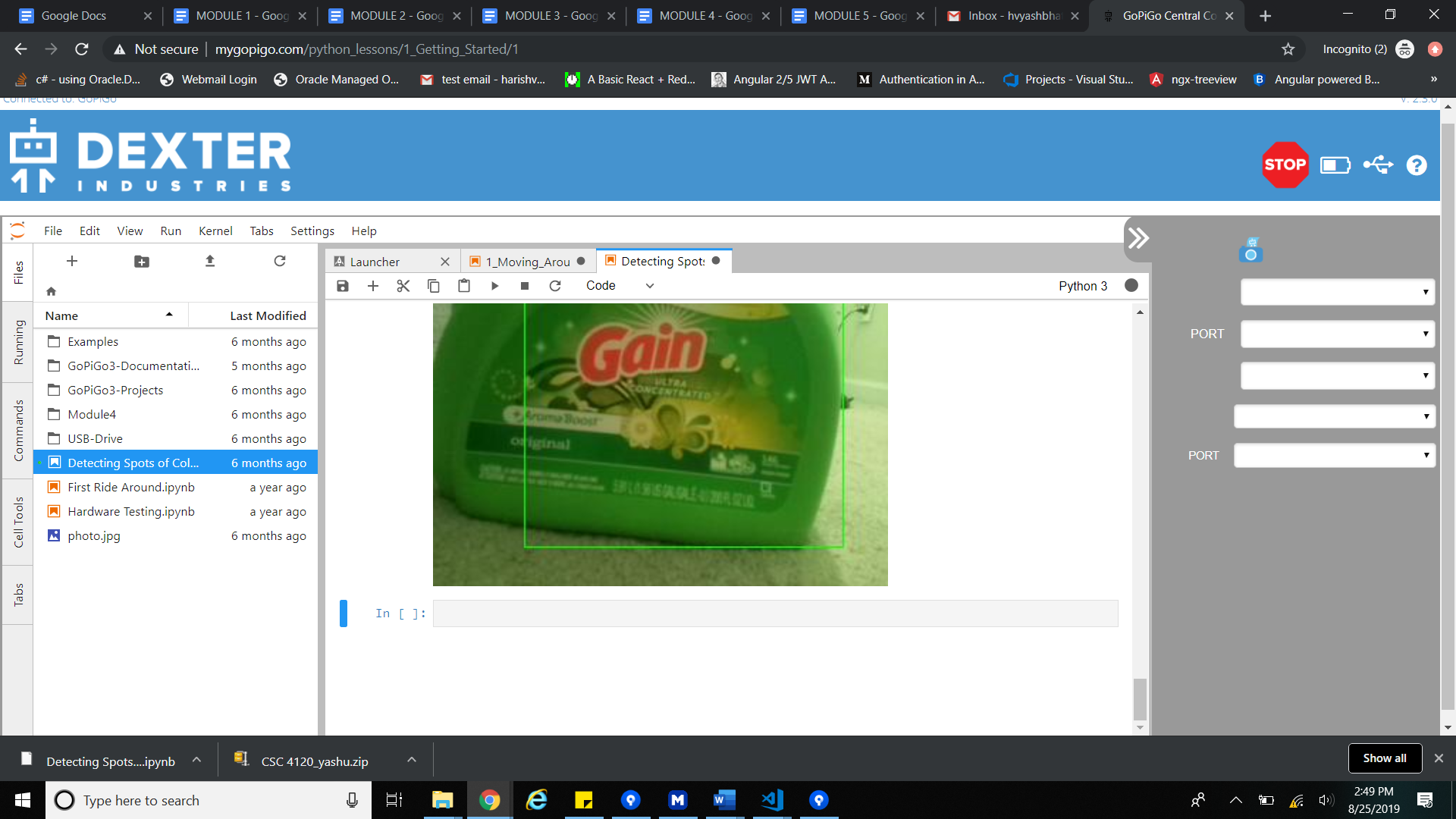
Run the Jupyter notebook **Detecting Spots of Color.ipynb**

**For Raspbian:**

Go to Module 4 Exercise 1 folder from the jupyter Dashboard and run **Detecting Spots of Color.ipynb**

Result:

Location is the detected area of target color. Below you can see green color is spotted.



**Exercise 2: Face detection**

In this exercise we will be detecting human face and eye by utilising pre-trained Haar-Cascade classifiers for human faces and eyes.

Go to Home: Examples: Face Detection

Run the Jupyter notebook **Face Detection.ipynb**

**For Raspbian:**

Go to Module 4 Exercise 2 folder from the jupyter Dashboard and run **Face Detection.ipynb**

Result:

Should be able to detect face and eyes (when eyes are open)

**Exercise 3: Upper body combined with face and eyes detection.**

Create a new folder “Module 4” in the Home directory and upload all the files under Module 4 exercise 3 in support files.

Now run the Jupyter notebook **Body Detection.ipynb**

**For Raspbian:**

Go to Module 4 Exercise 3 folder from the jupyter Dashboard and run **Body Detection.ipynb**

Observe how haar cascades masks for upper body detection (haarcascade\_upperbody.xml) is used to detect the upper portion of a human body. Once the upper body is detected we proceed to check for face and subsequently detect the eyes.

Result:

Should be able to detect upper body if a person is in the frame and subsequently detect face and eyes (when eyes are open).

**Assignment Problems for Demonstration**

**1. Combine codes from Exercise 1 and Exercise 2 to create an application that can identify colors along with detecting faces in the scene. Test your application on a mock setup. You can set up the mock setup anywhere you like. Capture a camera view video and show the video on the demo day. Live demonstration is not mandatory.**

**Hints:** Print RED, GREEN and BLUE on paper or make color sheets. Also print a passport size or facial-level photograph --printing your own face is preferable. Place these in the scene on the walls or perhaps attach to some obstacles. The robot must be able to identify colors and face. The robot need not be moving, BUT the robot must NOT be handheld.

**Expected output:** The robot must be able to identify Red, Green and Blue colors and a face.

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