ENPM673 – Perception for Autonomous Robots

Mid-Term Exam

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Due date: 16th March 2023, 11:59 PM

Submission guidelines:

- This mid-term exam is to be done and submitted individually.
- Your submission on ELMS/Canvas must be a **zip file & a pdf file**, following the naming convention.
- **YourDirectoryID_midterm.zip** & **YourDirectoryID_midterm.pdf**. If your email ID is abc@umd.edu or abc@terpmail.umd.edu, then your Directory ID is abc. Remember, this is your directory ID and NOT your UID.
- Please submit only the **python script** (**one py file for all the problems**) you used to compute the intermediate and final results, the **PDF report** you generate for the project and a **detailed README.md file which includes the steps to run your code and any non-standard libraries used**. The zip file should contain only the source code and related files.
- **The report should not be inside the zip file**.
- Include results in your report. **Handwritten reports** are **not accepted.**
- For each problem, explain your solution clearly as a computer vision pipeline or a flow chart, why you chose this pipeline, and describe any interesting problems you encountered and/or solutions you implemented.
- **You can use any built-in function to solve the problems (no restrictions on OpenCV packages).**
- Note that **usage of ChatGPT is NOT allowed.**
- **Questions (2, 3 and 4) below required coding and the rest do not.**

Problem 1:

A. Let's say we want to design a robot to perform indoor wall painting tasks. List all the **perception sensors** that would be needed for this task and why they would be needed.

B. Similarly, assume that we want to design a robot that will fix an underwater broken pipe. This robot should be able to work in any type of underwater water environment. What type of perception sensors can be used in this case, and why?

Problem 2:

- Using the video from the first homework, assuming that the width of the ball is around 11 pixels, use Hough transform to detect the ball.

Problem 3:

- Given the photo of a train track, transform the image so that you get a top view of the train tracks, find the distance between the train tracks for every row of the warped image, and then find the average distance. Show the intermediate results.

Problem 4:

- Detect each hot balloon in a given image of hot air balloons. Find the number of hot air balloons automatically. The final results should show each hot air balloon labeled with different colors.

  Note: Do not worry about resolving occlusion, occluded balloons can be combined as one.

Problem 5:

- Given these numbers below:

  25 13 2 11 4 6 15 22

  Apply k-means to get 3 clusters. Show detailed work. **No coding**.