ENPM673 – Perception for Autonomous Robots

Project 2

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Due date: 8th March 2023, 11:59PM

Submission guidelines:

- This homework 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_proj2.zip & YourDirectoryID_proj2.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(s) you used to compute the 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 sample outputs in your report
- **Disallowed Functions :**
    - Any inbuilt function which calculates the homography.
    - Please see the list of disallowed functions at the end of the document.
    - If you stumble upon any function which is not mentioned, please post the question on the discussion board.
- For each section of the homework, explain briefly what you did, and describe any interesting problems you encountered and/or solutions you implemented.

Problem 1 [70 pts]:

In this problem, you will perform camera pose estimation using homography. Given this video your task is to compute the rotation and translation between the camera and a coordinate frame whose origin is located on any one corner of the sheet of paper.

In order to do so, you must:

- Design an image processing pipeline to extract the paper on the ground and then extract all of its corners using the Hough Transformation technique .
- Once you have all the corner points, you will have to compute homography between real world points and pixel coordinates of the corners. You must write your own function to compute homography.
- Decompose the obtained homography matrix to get the rotation and translation

Note: If you decide to resize the image frames, you need to accordingly modify your intrinsic matrix too. Refer to this discussion.

Data:

The dimensions of the paper is **21.6 cm x 27.9 cm**.
The intrinsic matrix of the camera can be found here.

Problem 2 [30 pts]:

You are given four images which were taken from the same camera position (only rotation no translation) you will need to stitch these images to create a panoramic image.

To solve this problem, you will need to:

- Extract features from each frame (You can use any feature extractor).
- Match the features between each consecutive image and visualize them.
- Compute the homographies between the pairs of images
- Combine these frames together using the computed homographies.

List of Disallowed Functions:

- cv2.findHomography()
- cv2.houghlines() (or any cv2.houghxxx functions)
- cv2.createStitcher()
- cv2.getPerspectiveTransform()
- cv2.findContours()
- cv2.decomposeHomographyMat()
- cv2.recoverPose()
- cv2.affinetransformation()