USER GUIDE FOR IPCV TOOLBOX IN MATLAB

Below steps help the user to install and use our IPCV Toolbox.

PRE-REQUISITES:

1. MATLAB with below add-on toolboxes should be installed
    a. Image Processing & Computer Vision Toolbox
    b. MATLAB Support Package for USB WebCams

RUNNING THE PROJECT:

1. Unzip the **project.zip** file and run "**Main_VP.m**" in MATLAB

2. Change the current working directory to the **project** folder and include **functions** and it's subfolders to the path

HOW TO USE THE GUI OF OUR IPCV TOOLBOX:

Part I : Basic Image Processing Tools:
Basic image processing includes 3 tabs namely, **Basics, Edges** and **Lines and Filters**

Step 1: Click on **Load Image** button and the original image will be displayed on the left image axis in the GUI. User can choose the images from folder **data** attached along with the code.

Step 2: Now, top right of GUI, user will find "**Select a Category**" and depending upon the operation user wish to perform, user can navigate to repsective tabs of category, details given below:

Basics--->Colorspace, Histogram and Morphological operations Choose appropriate operation option and the results will be visible on right image axis within GUI

Edges and Lines --->Detect Edges, Lines and Circles : Choose appropriate option from drop down list and the results will be visible on right image axis within GUI

Filters--->Basic and Edge Preserving Filters : Choose appropriate option from drop down list and the results will be visible on right image axis within GUI

Part II : Computer Vision Tools:
This section contains two tabs **Feature Detection** and **Camera Calibration**

Feature Detection--->Detect Features and Match Features : Choose appropriate method for feature detection from drop down and **number of features** you wish to be detected or matched. In order to **match features**, load a second image and click on process, the results will be displayed in an image outside GUI.

Feature Detection--->Object Detection : Browse the original image using **Load Image (*main_card.jpg*)** and the object you wish to detect in that image using **Browse reference object (*card.jpg*)** from **data** folder and click on Detect Object.

Feature Detection--->Panoroma : Load a set of images (***stich*** *folder*) from **data** and click on **Stich Images**

Camera Calibration--->Calibrate Camera: Load a set of checkerboard images from the camera which you wish to calibrate (*select all images from **Calib_images** folder from **data***) and click on **Calibrate Camera** button. You will see the results of detected corner in two first checkerboard images in left and right image axis within GUI.

Camera Calibration --->Show Instrinsics and Extrinsics: Once the camera is calibrated, user can see the instrinsics and extrinsics by using these options.

Camera Calibration --->Structure from motion: Once the camera is calibrated, click on **3D reconstruction** radio button. User can load two images of an object which he/she wishes to find the structure of, from the same camera using **Load Image 1 and Load Image 2** *(use **vamshi1.jpg** & **vamshi2.jpg**)*. Click on **Reconstruct 3D** button to obtain the 3-D structure.

Camera Calibration --->Epipolar Lines: Once the camera is calibrated, click on **Epipolar Lines** radio button. User can load two images of a scene which he/she wishes to draw epipolar lines in, from the same camera using **Load Image 1 and Load Image 2.** Click on **Draw Epipolar Lines** button to see the results.

Part III : Advanced Computer Vision Tools:

This section contains two tabs **Track/Detect** and **SLAM**

Track/Detect --->Track moving object: Browse and Select a Video file (***ball.mp4*** *from* ***data****)* and click on **Track moving object**. Draw an **ROI** on the pop up image around the yellow ball and double click. User can then see the tracking of ball thourhgout the video and later a trajectory path will be displayed on the final image as a result of moving object.

Track/Detect --->Detect faces: Browse a video file (***faces.mp4*** *from* ***data****)* and click on **Detect Faces.** Both original video and face detected video will play side by side within GUI

Track/Detect --->Detect Object: : First browse a video file (***obj_det1.mp4*** *from* ***data****)* and then browse the object image (***card.jpg*** *from* ***data)*** which needs to be detected in the video. Then click on **Detect Object.**

For using SLAM simulator:

1. **Add Landmark:** Click "Add Landmark" and go to the left image axes and choose a location to fix a landmark. Suppose say, you want to add 4 Landmarks. Repeat this step for 4 times on the axes1
2. **Add Waypoint:** Click "Add Waypoint" and go to the axes and choose a location to fix a waypoints. In real-world landmarks are side-ways to the way-paths of a robot
3. **Add Obstacle:** Choose the no. of vertices (*default 3)* and velocities in x and y directions (*default 0)* for adding obstacles To be technically correct, select the obstacles in between way-points and landmarks
4. **Execute SLAM:** You will observe the robot movements from starting way-point and ending way-points Here, while simulation we see:

a. Blue & Red line indicate – expected path and real path resp.
b. Black & Green lines indicate – obstacles and neighboring landmarks resp.
c. Red x marks indicate – the covariance/precision errors of the robot w.r.t the obstacles
d. Blue Circles are the landmarks

5. **Result plots 1:** User can see the pop-ups plot graph
    a. Position Error w.r.t Time
    b. Standard Deviation w.r.t Time
6. **Result plots 2:** There will one more result plots
    a. Scan errors wr.t. to time
    b. Odometry weights errors w.r.t. to time
    c. Robot Turning i.e. Weighted control and Angle w,r,t to Time instances

Part IV: For Accessing Camera Tools:

We have added an option with which user can use the webcam to capture images (let's say for checkerboard) in order to first calibrate it and then use it further for 3D reconstruction etc.

Load Camera and Capture Image: Load Camera will simply start the webcam and user can click on Capture Image button in order to capture a screenshot at a point of time. Later using the Save Image button under right image axis, user can save that image in the local directory.