CS512 Assignment 7 : Sample Report

Karan Bhatiya

Department of Computer Science

Illinois Institute of Technology

Problem Statement:

1. Estimate the optical flow vectors in a sequence of images.

2. The images to the program read from a video file passed in the input parameter.

3. The optical flow vectors should be computed and displayed on one of the images in the sequence as colored straight-line segments.

4. Perform Lucas-Kanade optical flow tracking on input.

5. Pressing 'p' should pause/release the current image.

6. The spatiotemporal derivatives should be computed by extending the spatial gradient estimation technique you used in the previous assignments.

Proposed Solution:

In this section we will discuss about optical flow tracking using block methods using the Lucas-Kanade estimation.

1. First, you must read the video file from input parameter. Now capture the image frame of video using cv2.VideoCapture(videofilepath)
2. Now calculate the velocity vector, these can also be estimated using the least square estimation as the system is over-determined. Then we get new locations which is simply the sum of old locations and the velocity as the time step is one frame.

   The lucas-kanade equation for estimating velocity is given by:

   $$\begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum Iy^2 \end{bmatrix} \cdot \begin{bmatrix} v_x \\ v_y \end{bmatrix} = \begin{bmatrix} -\sum I_x I_t \\ -\sum I_y I_t \end{bmatrix}$$

   And the above equation is obtained by finding the optimum of following equation:

   $$E(v) = \sum_{(x,y)\in Patch} (\nabla I(x,y) \cdot v + I_t)^2$$

   Where, Ix and Iy are the mean gradient of two images with time step of one frame.

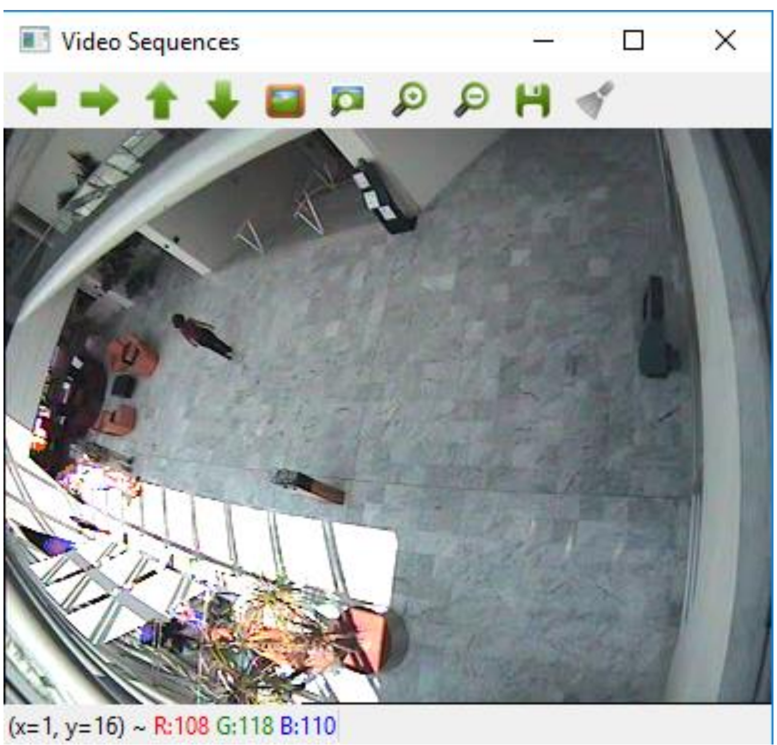
I(t) is the intensity derivative with respect to time in two images.

3. Now we apply the reliability on system matrix we get using velocity estimation. Apply SVD on matrix to get the value of U,D,V^T.
   To get the reliability apply following equation:
   $R \leftarrow \frac{D_{min}}{D_{max}}$
   Where R is the reliability factor.
   R is calculated by taking the ratio of smaller eigenvalue to the larger eigenvalue of the system matrix.
   We use this for tracking as the value is larger good is the tracking.

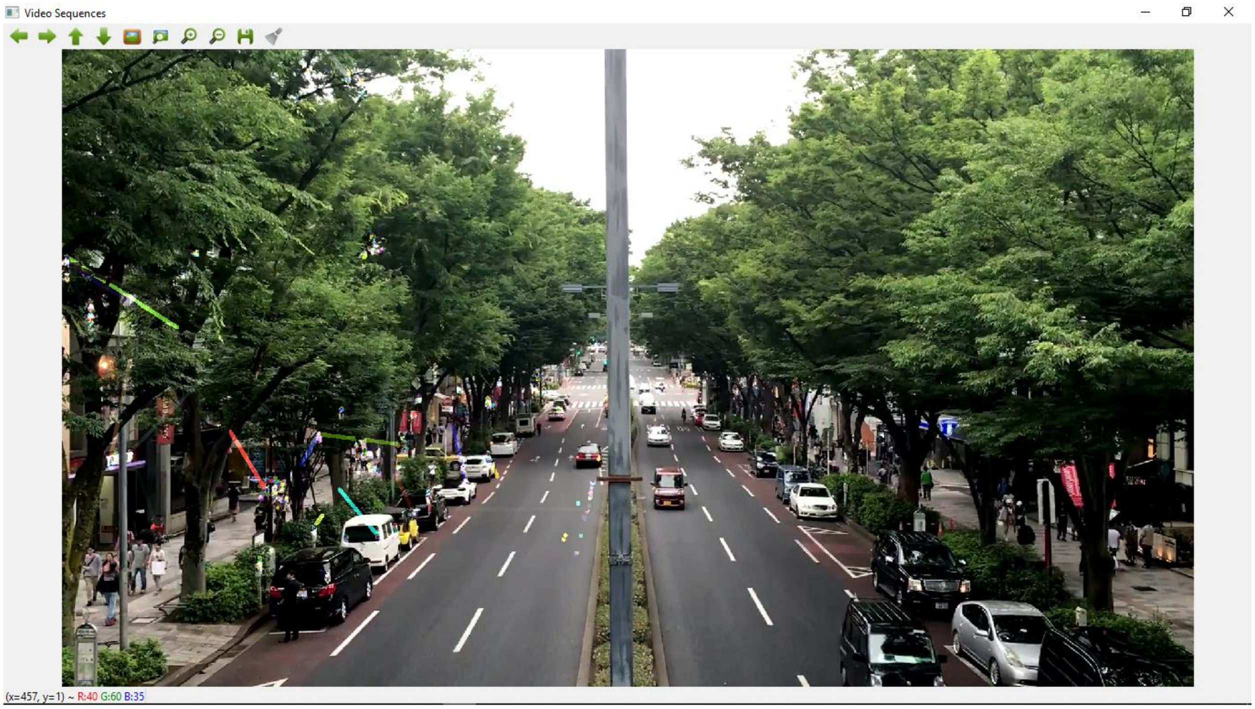
4. Then modify intensity of the points which are used to draw and track the feature points.
   In this we convert the color associated with the points to the HSV color space before modifying the intensity. Because, HSV is orthogonal color space as the v component responsible for the intensity. Now, after modifying the intensity we convert it back to RGB color space.

Solution:

For Walk1.mpg



For test.mp4



References:

1. http://www.inf.fu-berlin.de/inst/ag-ki/rojas_home/documents/tutorials/Lucas-Kanade2.pdf

2. https://docs.opencv.org/3.3.1/d7/d8b/tutorial_py_lucas_kanade. html