CS512 Assignment 5: Report
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❖ Problem statement:

1. Estimate the optical flow vectors in a sequence of images.
2. The input to the program reads from a video file.
3. The optical flow vectors should be computed and displayed on one of the images in the sequence as coloured straight-line segments.
4. Pressing 'p' should pause/release the current image.
5. Implement one of Lucas-Kanade, affine-flow, or Horn-Schunk algorithm.
6. The spatiotemporal derivatives should be computed by extending the spatial gradient estimation technique you used in the previous assignments.

❖ Proposed Solution:

The Horn-Schunck algorithm assumes smoothness in the flow over the whole image. Thus, it tries to minimize distortions in flow and prefers solutions which show more smoothness.

The flow is formulated as a global energy functional which is then sought to be minimized. This function is given for two-dimensional image streams as:

$$E = \iint \left[(I_x u + I_y v + I_t)^2 + \alpha^2 (\|\nabla u\|^2 + \|\nabla v\|^2) \right] \mathrm{d}x\mathrm{d}y$$

According to the contents we learned in the class, we know the detailed approach of Horn–Schunck method solution should be:

- Start with initial guess for u and v, we use L-K or affine flow iteratively refine them

$$u^{n+1} = u^n - \frac{(I_x \bar{u}^n + I_y \bar{v}^n + I_t) I_x}{I_{x^2} + I_{y^2} + \alpha}$$

$$v^{n+1} = \bar{v}^n - \frac{(I_x \bar{u}^n + I_y \bar{v}^n + I_t) I_y}{I_{x^2} + I_{y^2} + \alpha}$$

- When max of (un+1−un||vn+1−vn)<τ, where τ is the threshold, it stops.

❖ Implementation details:

- Every time use read () function, it takes one frame of the videos, we can use this to implement the pause function by calling while loop when process the frame, and use cv2.waitkey() to continue the video.
- When process numpy array as matrix reshape () function may cause more bucket in following data processing.
- When take parameter into some function, we need to know the type and change it into right type to compute.
- Used cv2.waitkey() to slow down the frame playing.

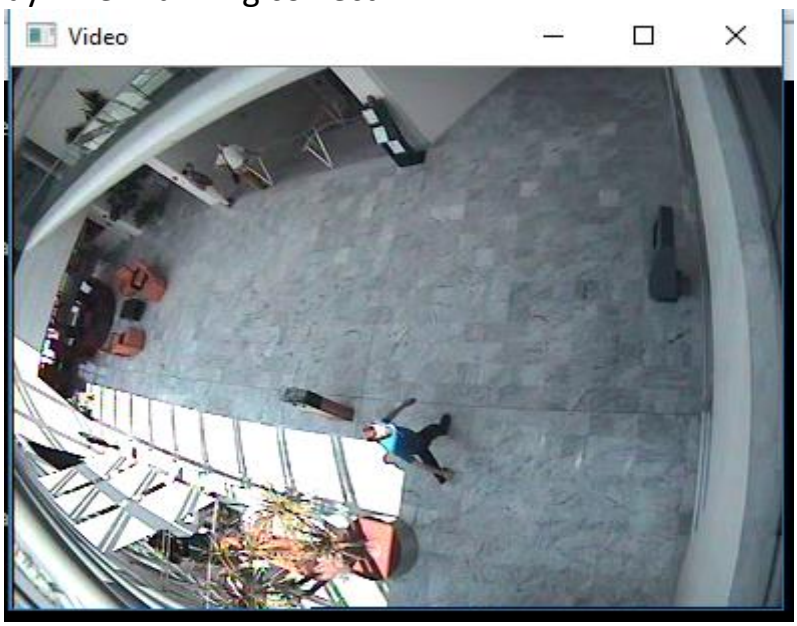
❖ Results

- When running the program it will display the help doc

```
C:\Users\parth\Desktop\AS7\src>python AS7.py ..\data\Walk2.mpg

Optical Flow Estimation
Help:
    e.g. .\AS6.py ..\data\Walk2.mpg
    Press p :  pause or release current image
    Press ESC : to exit
```

- Video will play when running correct



- Press ‘p’ or ‘P’ to pause the video. The Horn-Schunk algorithm implement result will display.