CS348K: Visual Computing Systems
Class/Reading Response Template

Reminder: please make sure the PDF you submit to Gradescope DOES NOT have your name on it. We will concatenate all responses and give everyone in the class a PDF of all responses.

Part 1: Top N takeaways from discussions in the last class. Note: this part of the response is unrelated to the current reading, but should pertain to the discussion of the prior reading in class (or just discussion in the class in general, if there was no reading):

- What was the most surprising/interesting thing you learned?
    - An counter-intuitive fact for me: bigger pixels == better camera. It is intuitive that smaller pixels can capture more details. Actually, larger pixels can capture more light and potron than smaller pixels, which leads to better image quality.
- Is there anything you feel passionate about (agreed with, disagreed with?) that you want to react to?
    - I think image compression is interesting, and I read something about this. There are two types of image compression techniques: lossless and lossy compression. JPEG and MPEG are lossy compression methods while PNG and ZIP are lossless compression methods. One popular machine learning-based compression algorithm is the Neural Image Compression (NIC) method using auto-encoder and attention optimization. I think attention mechanism can be really effective in these question because it allows the model to focus on specific parts of the image. Thus it can easily identify the most important regions, where pixels are very different and less important regions where all pixels are same.
- Did class cause you to do any additional reading on your own? If so, what did you learn?
    - Answered in the question above.
- Major takeaways in general?
    - Principles about photography, e.g., pixels, sensors, lens, and some basic physics.
    - Noises that affect digital image. Main types of noise are: photon noise, sensor noise, compression noise, read noise, which may cause artifacts and color fringing.
    - Image processing filters and their functions. Gaussian filter and Median filter for smoothing and noise reduction. Bilateral filter for preserving edges and fine details.

Part 2: Answers/reactions to instructor's specific prompts for this reading. (Please see course website for prompts).

What are the major constraints of the system? For example are there performance constraints? Usability constraints?

Performance constraints: The system must produce a photograph within a few seconds without a computer or the cloud. The process must be done on the device itself with limited power and computational resources.

Usability constraints: The system must be parameter-free so photographers can get better pictures without knowing the strategy or algorithm.

Conservative constraints: The system should be reliable enough to be used as the default picture-taking mode. It should not contain artifacts, and at least generate conventional photographs. The photographs should be faithful to the scene even in HDR situations. The system shouldn't generate cartoony or surrealistic images or change the brighteness and illumination too much.

The main technical idea of this paper is to combine a sequence of similarly underexposed photos, rather than attempt to combine a sequence of photos with different exposures (the latter is called "bracketing"). What are the arguments in favor of the chosen approach? Appeal to the main system design principles.

1. By using similarly underexposed photos, the system helps to reduce camera shake blur because the exposure time is shorter.

2. By using similarly underexposed photos, the system can avoid clipping the highlights, which allows for a wider dynamic range.

3. By using similarly underexposed photos, the system can align and merge in a more efficient and robust way, thus reduce noise and avoid ghosting.

Why is the motivation for the weighted merging process described in Section 5? Why did the authors not use the simpler approach of just adding up all the aligned images? (Can you justify the designer's decision by appealing to one of the stated design principles?)

The motivation is to address the issue of misalignment between the reference frame and the alternate frames.

Because it would result in motion blur. It gives equal importance to all the frames, so those with significant motion blur will blur the resulting image. A weighted merging only allow shapest features so it can produce a sharper and less blurry output.

It should be 3, align and merge in a more efficient and robust way. By assigning higher weights to the better aligned frames, the merging process can combine information from multiple frames while avoiding the negative effects like blurring. This helps to reduce noise and avoid ghosting, so it aligns with principle 3.

Part 3: [Optional] Questions I'd like to have specifically addressed via in class. (We also encourage you to just post these questions on Ed immediately so anyone can answer!)