Image Fusion Using Laplacian Pyramid Transform
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Capstone Design Project under the guidance of Prof. Dario Pompili

Goal
- Fuse two images in order to make their blurred parts clearer. This could use in the application of augmented reality.

Motivations and Objectives
- Clear pictures are needed in use of recognition applications. Imagine one day we do not use the AR code, instead, we could scan the object itself to get relevant information.
- Pictures we take usually do not have whole clear performance, especially when it comes to pictures with extended depth of field.
- Our goal is to make two same pictures with different blurred parts clearer using mobile computing.

Research (Methodology)
- LP (Laplacian Pyramid)
  - A pyramid structure can be described as a collection of images at different scales which together represent the original image. Each level of the Laplacian pyramid is recursively constructed from its lower level by the following four basic procedures: blurring; subsampling (reduce size); interpolation (expand in size); and differencing (to subtract two images pixel by pixel).[1]
- DWT (Discrete Wavelet Transform)
  - Two-dimensional (2-D) DWT.
- Performance Evaluation:
  - Fusion Root Mean Square Error: the difference between fused image and reference image.
  - Average Gradient: reflect the resolution of image, the information in the details.

User Interface for Android Application
- Where you choose first image
- Where you choose second image
- Tap the “fuse” button to fuse these two images
- fused image we get, notice the blurred part has become clearer

EXCEPTION 1:
- When you choose two same images of different sizes:

EXCEPTION 2:
- When you choose two different images of same sizes:

EXCEPTION 3:
- When you choose same image of different sizes:

Note: EXCEPTION 3 could be solved if image matching technology is used. We could then match these two images based on their same parts.

Results
- We blurred images in different ways (left-right, diagonal, center-around) to show performance under different input conditions.

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References
[1] A Categorization of Multiscale-Decomposition-Based Image Fusion Schemes with a Performance Study for a Digital Camera Application