PROJECT PROPOSAL DOCUMENT

Team Name : cut-copy-paste

1. **Problem Title** :
   Artifact-free High Dynamic Range Imaging for Dynamic Scenes using Robust Patch-Based HDR Reconstruction
   [Reference Link]
   https://www.ece.ucsb.edu/~psen/Papers/SIGASIA12_HDR_PatchBasedReconstruction_LoRes.pdf
2. **Github link** :
   https://github.com/firesans/HDR-DIP-Project.git
3. **Team Members** :
   Sai Praneeth Chokkarapu - Roll No: 20161009
   Sanjana Gunna - Roll No: 20161110
4. **Main goal(s) of the project** :
   HDR imaging from a set of sequential exposures is a traditional way to capture high-quality images of static scenes, but suffers from artifacts for scenes with significant motion. The main goal of this project is to implement a new approach to HDR reconstruction that draws information from all the exposures and is robust to camera/scene motion.
5. **Problem definition** :

- **What is the problem**?
  The problem of removing motion artifacts for sequential HDR imaging has been the subject of extensive research. For pixels with motion, many algorithms use only a subset of exposures (in many cases only one) to produce a de-ghosted HDR. The fundamental problem with these techniques is that they cannot handle scenes with large motion if the changing portions of the scene have HDR content. So, the input sources are aligned to a reference exposure before merging them into an HDR image. The most successful algorithms use optical flow (OF) to register the images, but even these methods are still brittle in cases of large motion or complex occlusion/disocclusion. Since the “aligned” images produced by these algorithms often do not align to the reference very well, standard HDR merges of their results still have ghosting artifacts. Aligning the images to each other is a difficult problem that would be easier with information from the final HDR result which can be done using patch-based algorithms but the direct application of standard patch-based methods have not addressed the problem of HDR image reconstruction.

- **How things will be done ?**

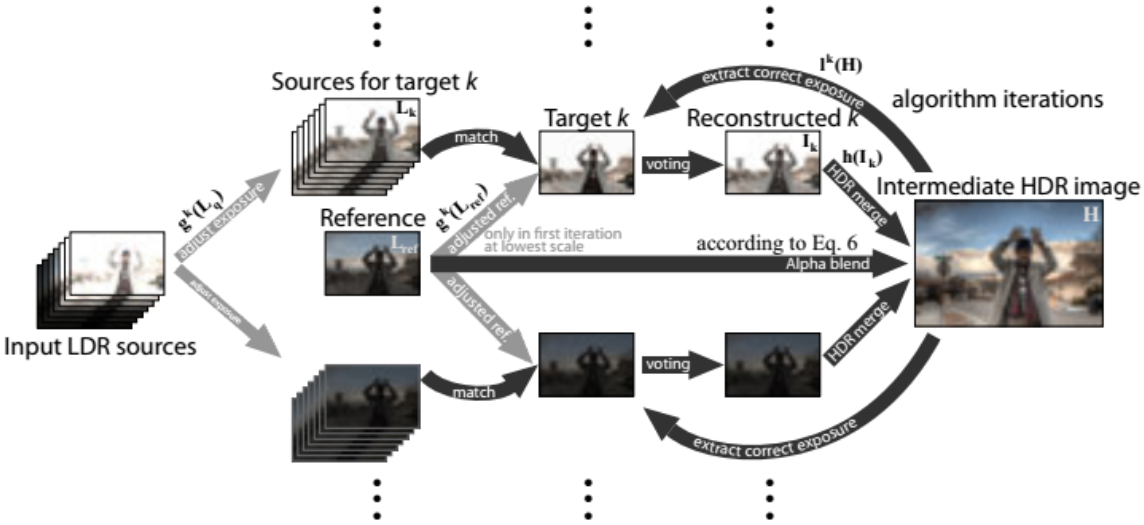
  We use a **patch-based algorithm**, which is based on a new **HDR image synthesis equation,**

  HDR image synthesis equation does:

  - ❏ Creating an HDR image containing information from all the exposures that is aligned to **one** of them, as if taken by an HDR camera at the same moment in time.
  - ❏ And this turns into an **optimisation problem**, in which the optimal solution should match a reference image in the regions where it is well exposed, and in its poorly exposed regions is locally similar to the other LDR sources, containing as much information from them as possible.
  - ❏ After optimising using the patch based approach, we integrate the **alignment and merging** processes, instead of the conventional alignment and merging pipeline.

Mathematical Formulation of the problem :

Given a set of N LDR sources taken with different exposures and at different times (L1,....,LN - taking motion aspects into picture), our primary goal is to reconstruction HDR image ***H*** that is aligned to one of them (the reference, called Lref), but contains HDR information from all N exposures.



6. **Results of the project**:
   - What will be done?

     We implement the patch-based HDR image reconstruction algorithm proposed in the paper in MATLAB and test it on real images. To judge the quality of our reconstructed images, we compare against some of the standard approaches for HDR image alignment and deghosting.
     [Standard Approaches: *Gallo et al. 2009*, *Pece and Kautz [2010]*]
   - What is the expected final result ?
     - The expectation is that the HDR reconstructed is robust to camera/scene motion.
     - An effective integration of LDR image alignment and HDR merging process which is robust to complex motion and can successfully handle a wide range of natural scenes.

7. **What are the project milestones and expected timeline** ?

   The project can be divided into 6 phases:
   - Pre-Processing of the LDR stack with respect to the exposure time.
   - Optimisation Algorithm Implementation
   - HDR Alignment
   - HDR Merging
   - Result analysis
   - Documentation

TIMELINE OF THE PROJECT		
Task No.	**Milestones**	**Expected Deadline**
1.	Pre-Processing of the input LDR images	OCTOBER 5th
2.	Optimisation Algorithm Implementation	OCTOBER 25th
3.	HDR Alignment	NOVEMBER 2nd
4.	HDR Merge	NOVEMBER 13th
5.	Result Analysis	NOVEMBER 15th

6.	Documentation	NOVEMBER 29th (tentative)

8. **Team members and tasks for each member**:

Task	Member who does that task
Pre-Processing of the input LDR images, building framework	Praneeth and Sanjana
Optimisation Algorithm Implementation	Praneeth and Sanjana
HDR Alignment	Praneeth
HDR Merge	Sanjana
Result Analysis	Sanjana and Praneeth
Documentation	Sanjana and Praneeth

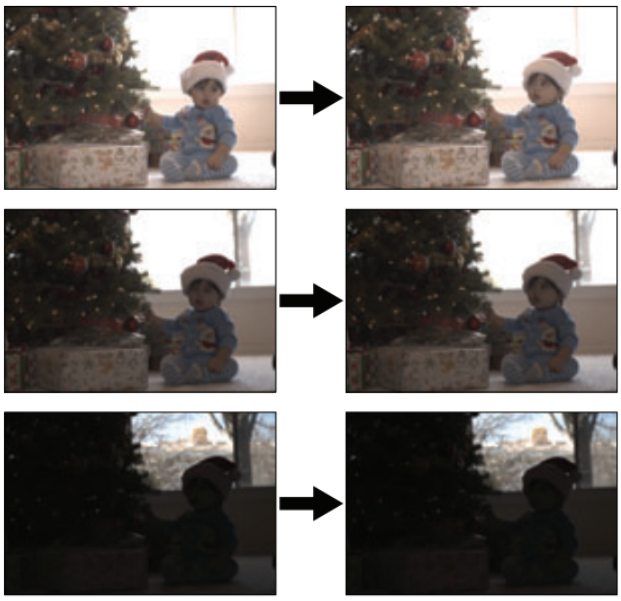
****Results are attached in the following page**

EXPECTED RESULTS:

INPUT STACK OF LDR IMAGES:

Standard HDR

Our result



Input LDR sources

Reconstructed LDR images

Final tonemapped HDR result

EXPECTED ANALYSIS :

Gallo et al. [2009]

Pece and Kautz [2010]

Our approach