# A FPGA-Based Low-Cost Real-Time Pipelined System to Extract Robust SIFT Features

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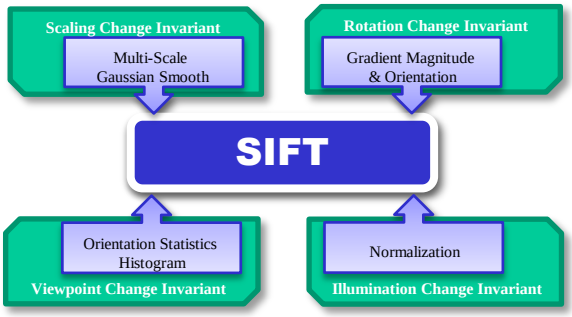
## Research Contents

### Scale Invariant Feature Transform (SIFT)

A robust feature point detection algorithm proposed by David Lowe, being invariant to Scaling, Rotation, Viewpoint, Illumination changes.

- Problem: High Computation Complexity; High Time Consumption; Redundant Computation.
- Aim: Shorten computation time; Keeping similar performance quality.
- Proposal: Full hardware implementation



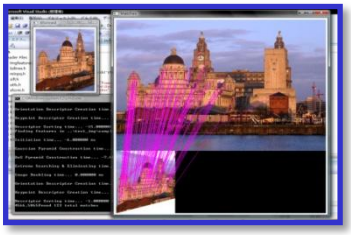

### Wide range of applications

- Object Recognition
- Robot Localization and Mapping
- Panorama Stitching
- 3D Scene Modeling
- Human Action Recognition

Object Tracking

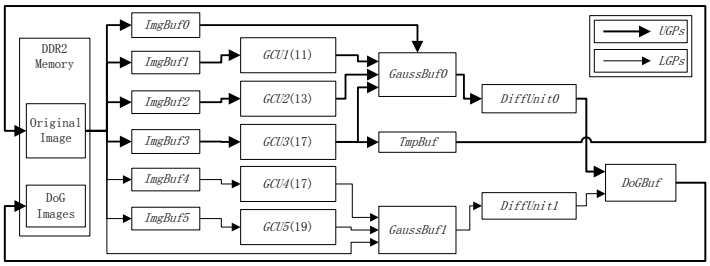
Panorama Stitching

Object Recognition

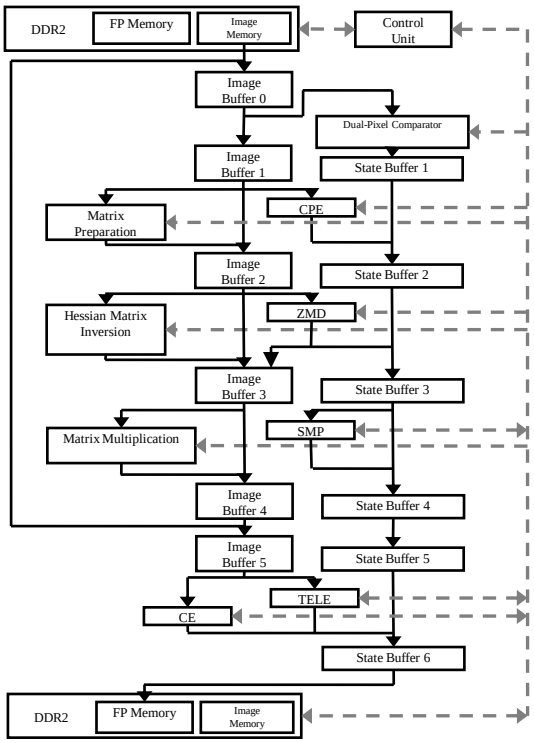


### Proposed Hardware Architecture

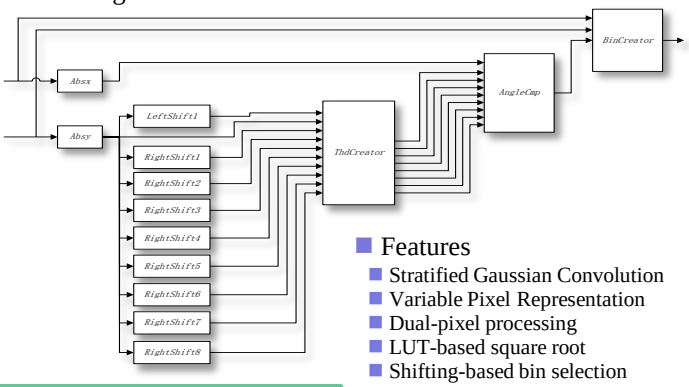
7 Round Parallel GDPC Accelerator




Dual-Pixel Processing FPD Accelerator



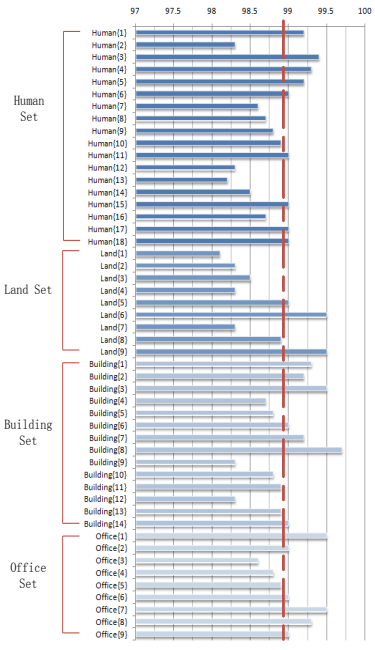

Shifting-Base Low-Cost OC Accelerator




Features

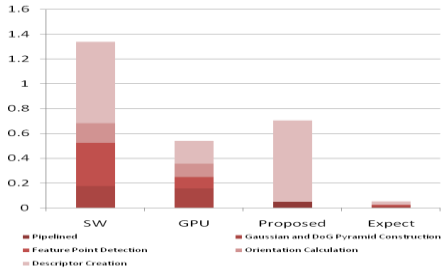
- Stratified Gaussian Convolution
- Variable Pixel Representation
- Dual-pixel processing
- LUT-based square root
- Shifting-based bin selection

## Experimental Results




- Implementable on FPGA
- Reach near time processing
- Affordable by Virtex-V
- Using Dual-Port DDR2 memory
- 98.9% high accuracy for 50 tested images
- Up to 14.5 times acceleration

| Item | GDPC | FPD | OC |
|---|---|---|---|
| Process Speed | 21 fps | 39 fps | 256 fps |
| Slice Registers | 6,120 | 2630 | 1220 |
| Slice LUTs | 6,011 | 6210 | 2548 |

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