

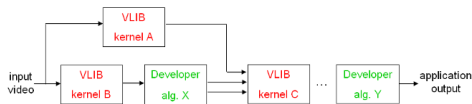
Objective

To combine high compute performance with low power requirements for an ever-growing array of vision applications on embedded processors.

Approach

An optimized vision library that accelerates pixel-intensive tasks while providing sufficient flexibility to developers. Key design considerations include

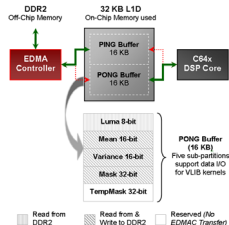
High granularity: small & well-understood operations



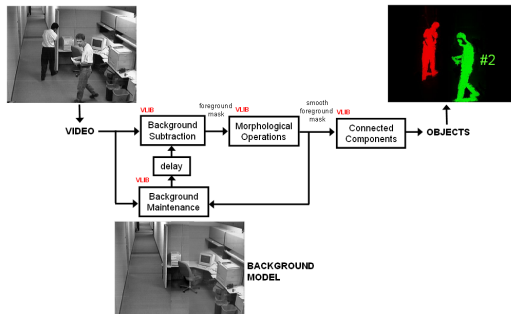
Fixed-point: optimal use of Single-Instruction-Multiple-Data features of embedded DSPs, e.g.,

```
int VLIB_recursiveFilterHoriz1stOrder(
char *out,
char *in,
int width,
int height,
short weight,
char *boundaryLeft,
char *boundaryRight,
char *buffer);
```

Data traffic: Direct Memory Access friendly APIs



Example: Moving Object Segmentation



Overview of functions

Background modeling & subtraction

- Luminance Extraction from YUV:422
- Exponentially-Weighted Running Mean & Variance
- Uniformly-Weighted Running Mean & Variance
- Statistical Background Subtraction
- Mixture of Gaussians Background Modeling & Subtraction
- Morphological Operations (Erosion & Dilatation)
- Connected Components Labeling

Feature extraction

- Harris Corner Score (7x7)
- Hough Transform for Lines
- Histogram Computation for Integer Scalars
- Histogram Computation for Multi-Dimensional Vectors
- Weighted Histogram for Integer Scalars
- Weighted Histogram for Multi-Dimensional Vectors
- Legendre Moments
- Canny Edge Detection
 - +Smoothing
 - +Gradient computation
 - +Non-maximum suppression
 - +Hysteresis thresholding

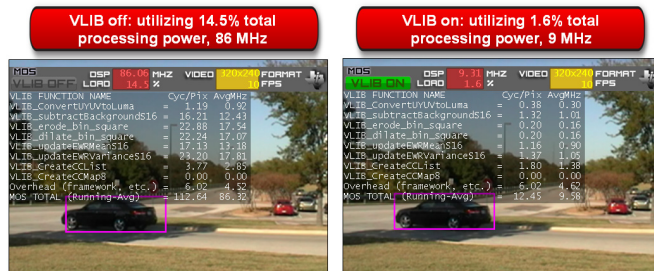
Low-level pixel processing

- Color Conversion YUV:422 interleaved to +YUV planar
- +RGB
- +LAB
- +HIS
- Integral image
- Image Pyramid (2x2 block averaging)
- Non-Maximum Suppression (3x3, 5x5, 7x7)
- Gradient Image Pyramid (5-tap)
- Gaussian Image Pyramid (5-tap)
- First-Order Recursive IIR filters (horiz., vert.)
- SAD-based disparity for stereo

Tracking, recognition, etc.

- Lucas-Kanade Feature Tracking (7x7)
- Kalman Filtering
- Nelder-Mead Simplex optimization
- Bhattacharya distance

Embedded Demonstration on DM6437



In this prototype running on the DM6437 Evaluation Module, VLIB enables ~10x pixel processing improvement over standard C code.

Summary

- VLIB accelerates computer vision applications for high performance embedded systems. Pixel-intensive computations are addressed through
 - + More than 60 functions optimized on the C64x DSP core
 - + Fixed-point implementation
 - + APIs friendly to Direct Memory Access operations
- Provides more headroom for innovative algorithms, and enables processing of more channels at higher resolutions.
- Available for free – to request a copy: www.ti.com/vlibrequest