**REFERENCE DESIGN PROCESS**

1. Order a Nexvision Reference Design
2. Update your Specifications
3. Get your product Ready to sell

**OVERVIEW**

- Hardware video processing, up to a tera operations per second ($10^{12}$), FPGA/HDL based
- User accessible image processing framework environment to speed-up algorithm portage
- Nexvision’s image pre-processing advanced algorithm library
- Nexvision’s technical support for MATLAB or C to HDL coding optimization

**IP SAMPLES**

- Deconvolution
- Fusion of multiple shoot
- Optical enhancement and corrections
- Vibration stabilisation
- Compression/decompression
- Human body detection
- Shape, character recognition
- Traffic accident detection, behaviour & flow control
- Depth map
- 3D scene reconstruction

**TERAPIX**

Image Co-Processor
Reference Design

**Hardware-Accelerated Image Co-Processor Reference Design**

**GOLD Sensor board**
**CPU board**
**I/O board**
**Other board**

**PIX TERA**

Hardware-Accelerated Image Co-Processor Reference Design

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www.nexvision.fr
**Features**

* High performance FPGA (Field Programmable Gate Array), based on latest 28nm process, low power
* Ultrafast & High resolution frame grabbing and processing - 12Mpixel@180fps
* Low Size, Weight and Power (SWaP)
* Support up to 4 independent video sensor boards

**Applications**

- Opto-electronics devices
- Multimedia processing
- Gyrostabilised video (broadcast, defense) on UAV
- Vision based vehicle guidance system or driver augmented reality
- Multispectral video boarder surveillance
- Multitarget video tracking
- Night vision, 3D range gating active imaging
- Blind Deconvolution
- Crypto accelerator
- Printed board, circuit board and LCD inspection
- Cinema video camera with real time effects
- Video post-production processing
- Automated license plate recognition (ANPR)
- High end digital signage or real time interactive showcase
- Compact low weight, low power consuming vision solutions
- Video camera with CPU intensive image processing (hand held smartcam)
- Multispectral / Immersive / Omnidirectional 360° camera (virtual speedome)
- Embedded video enhancement and image analysis, indexing before compression & transmission

**Power supply and physical dimensions**

- Input : 5VDC, 20W max
- Processing Board: 93mm (L) x 60mm (I) x 8mm (h)
- Temperature: 0°C to 50°C (-40°C to 85°C optional)
- Humidity: 10 – 90% non condensing

**Market**

- Vision
- Defense
- Medical image processing
- Transport
- High end video surveillance (boarders, urban, CCTV)
- Industrial process supervision and visual inspection
- Law enforcement & forensic
- High end multimedia
- High-Performance Computing (HPC)

**Typical Processing Algorithms**

**IMAGE ENHANCEMENT**

- Image sensor processing
  - CFA Bayer pattern to RGB (demosaicing), state of art non linear algorithms for very high quality color interpolation (*)
  - Auto exposure : fast adaptive for highly changing scene illumination conditions (*)
  - Multi-exposure or multiresolution, on a frame by frame basis (*)
  - Color matrix correction : dynamic, scene and illumination measurement based (*)
  - Automatic white balance - Application specific (*)
  - Gamma conversion & YUV/HSI color conversion, histogram, log, LUT mapping, segmentation, and thresholding (*)
  - Dead pixel correction
  - IR sensors non uniformity correction (*)
  - Anti flickering (*)
  - Image shot enhancement
    - Dynamic local tone mapping (Shadows and highlights)
    - High dynamic range (16bits resolution based)
    - 3D noise Filter (spatial-temporal). (*)
    - Contrasts and edges enhancement (algorithm type : USM - unsharp mask) (*)
    - Spatial filters
  - Deconvolution (*)
    - Image reconstruction model which integrate bayer pattern and color aberration (*)
    - Parallel algorithm on fpga which deconvolves the image using recursive algorithm which converge in few iterations. (new patent pending approach) (*)
    - Process of Deconvolution which integrate the sensor’s noise and which improve the denoising or the deblurring in function of user’s goal (*)
    - Myopic deconvolution to estimate the psf of optical and atmospheric aberration (based on fractal found in natural image) (*)
    - Lens defocused mechanically to estimate the psf (*)
    - Motion of camera could be integrated in deconvolution process (*)
    - Multi-channels deconvolution (*)
  - Frequency domain transformation
    - Fusion
      - Multiple shoot and/or multi angle of view in multiple spectral band : visible, Shortwave Infrared and Thermal Infrared (MWIR/LWIR), Terahertz, etc…)
      - Fusion with non-linear co-registration warping algorithm that corrects for visible-MWIR-LWIR versus thermal IR parallaxes and optical distortions
      - Autofocus : real time focus tracking with lens control loop (*)(*)
      - Optical enhancement and corrections
        - Optics’s aberrations corrections and super-resolution (*)
        - Atmospheric aberration correction (*)
        - Lens distortion correction
        - Lens distortion lateral and longitudinal chromatic aberrations, vignetting (relative illumination) correction
        - Lens barrel distortion distortion correction
        - Ultra wide angle lens projection correction (360° « FishEye » circle image real time dewarping) (*)
        - Co-optronics designed optics :
          - extended depth of view/digital autofocus - wave front coding
          - Anisotropic 2D image scaling
    - Vibration Correction – Video stabilisation
      - Close control loop multilevel stabilisation depending on amplitude-period (mechanical, optical, electronic and software)
      - Lens/mirror piezoactuator stabilisation control for angular movement correction (yaw and pitch)
      - Piezo-microactuator image sensor micro-scanning stabilisation control (close loop with 6 axis gyro-accelero sensors Nexvision’s “MULTILINK” board) (*)
      - Motion compensation :
        - virtual windows counter motion centring using feature points video tracking
        - Viewer pointed, automatic target tracking (gyrostabilized pan-tilt-zoom)
      - Virtual pan-tilt-zoom
        - Ultra high resolution video (X-HD**) (*) with Nexvision IMAX12MC
        - Multiple video sensors stitching to create panoramic images (*) with IMPANANO
        - 360° high-resolution, real-time warp video (*)
    - 2D/3D calibration
      - Compression/decompression
      - Studio visual effects
      - Back ground discrimination, correlation, gradient operation, Hough transformation, morphology, projection, edge thinning, line verification, rule based post processing, convolution, motion adaptive deinterlace, image restoration, etc…
      - User define algorithms

**IMAGE ANALYSIS**

- Feature points extraction and analysis
- Motion detection (*)
- Fire detection
- Human body detection
- Pattern matching
- Shape, character recognition
- Texture recognition
- Visitors/pedestrian counting
- Suspicious stationary object detection
- Multi-modal gesture recognition
- Content based retrieval & Query-by-content
- Sensors fusion (GIS positioning, accelero-gyro, ultrasound, radar,…) (*)
- Multispectral band facial biometric recognition (Visible/IRSWIR/LWIR)
- Depth map
- 3D scene reconstruction
- Registration - unified scene alignment – translation & scaled perspective
- Traffic accident detection, behaviour & flow control
- Auto exposure : fast adaptive for highly changing scene illumination conditions (*)
- Color analysis
- 1D and 2D measurements
- 1D and 2D code reading and verification

(*) *Indicate NEXVISION’s Image & Video processing algorithm and image processing primitives library (hardware implemented IP)*