# Darbee Visual Presence™ - Technology for Life-Like Images

## Introduction

Computational image enhancement solutions are revolutionizing the way we enjoy digital content. Today improvements in processors extend digital image quality far beyond the limitations of fidelity. Features like millions of pixels and billions of colors will no longer determine the ultimate quality and realism of the image. High performance computation is now being used with image processing in new and innovative ways to enhance the quality of our digital imaging and more importantly, the experience that we have. This is analogous to the advances made in audio processing, beginning with Dolby.

## Image Enhancement Solutions: Approaches

All digital image processors now incorporate image improvement processing. These processors do things like improve contrast, improve color depth, sharpen images, and filter noise. Computational image enhancement solutions now enable a level of image quality that can surpass what the most perfect camera and display can achieve. It is now possible to use computation to process an image, respectful of the way the brain will process it. By deriving algorithms inspired by the neuro-biologic models of human vision, monoscopic images can now take on new and profound properties of depth and realism. Now we can embed real depth cues in digital images, causing enhanced perception of object shape and ultra clarity. Such approaches move beyond the limitations of fidelity by leveraging principles of how the brain interprets images.

## Image Enhancement Solutions: Limitations

Existing solutions are limited by fidelity or generality. The number of pixels and colors does not determine if an image looks realistic. Common global image enhancements often cause artifacts or enhance noise or unwanted parts of the image. DarbeeVision takes into consideration that human vision perception is based upon stereo vision. Without consideration and respect of this important fact, any enhancement of monoscopic detail or depth cues will be less powerful. In the marketplace, robust chip sets that perform general image enhancements are already part of all image media display systems. Now, all 2D TVs can be upgraded to Ultra HD realism without changing to more expensive display panels.

## The DarbeeVision Advancement: Enhancing images respectful of our brain

DarbeeVision technology is a fundamental breakthrough for image realism. By putting into an image more of what the brain is expecting to take out, Darbee Visual Presence enhanced images help the viewer see them better. More a discovery than an invention, the Darbee approach solves two very tough challenges for monoscopic digital images:

- Problem – What is the right way to enhance monoscopic detail and depth cues?
- Answer – Use parallax disparity as the basis for luminance modulation.

- Problem – How do you avoid artifacts?
- Answer – Selectively apply modulation based upon a fast and accurate saliency mask.

## Darbee Visual Presence™: Technology

At the heart of Darbee Visual Presence there is a discovery. Paul Darbee found that you can actually embed stereo depth information into monoscopic images and achieve gratifying results. A disciplined eight years of exploration into the neuro-biologic basis for human vision has yielded a patented and powerful human-vision-based model for digital image enhancement. It has also yielded a sublime solution for making 2D images look full of depth and realism.

Defying conventional wisdom, Darbee technology creates a seemingly impossible image transformation. The processing happens in real time, with performance surpassing HD 1080p/60. Darbee processing occurs at lightning speed and precision because both the core enhancement method and the selective application parameters have been optimized from the beginning for computational efficiency.

The image processing is done intra-frame so that no large buffer memory or time delays are required. Processing is resolution independent, scaling linearly with the number of pixels in a frame. The algorithms do disparity synthesis, then apply a patented defocus-and-subtract of the resulting images. The algorithm next applies the enhancement only to the areas of interest, via the Perceptor™, a proprietary saliency map. The processing is local, modifying the image luminance on a per-pixel basis.

The resulting improvements go far beyond what fidelity improvements alone can do for image realism. Because the results are embedded in the pixels of an image, the process can be applied any time during the life of the image. The Darbee process can be applied in digital TVs, DVD players, cable or satellite boxes, cameras, video games, mobile devices, PCs, printers, video, or movie post production—indeed, for any digital image at any time.

## Darbee Visual Presence™: Image output example

Example performance is shown below:

Before DarbeeVision

After DarbeeVision

## Applications

The largest application segment for DarbeeVision is digital display devices. Consumer electronics manufacturers put display panels into their products and rely upon consistent quality among their OEM panel makers. Differentiation by the manufacturer comes in waves and is typically driven by advancements in fidelity features. Size, resolution, color gamut, refresh rates, brightness, blackness, up scaling, and de-noising are examples of driving factors. These features for digital image display are virtually the same from one manufacturer to another. Within each class, the main differentiation is the cosmetic appearance of the panel housing. With Darbee Visual Presence, the differentiation will be apparent in the image.

## Patent Summary

DarbeeVision was awarded a patent for the process in 2006, has several others pending and holds numerous additional associated IP assets. Key areas of innovation include embedding disparity depth cues into 2D images, a computationally inexpensive parallax disparity generator, and a very fast, very accurate saliency mask.

## Darbee Products

DarbeeVision Technology is a proven solution that has been tested for digital TVs over the past year. The technology is fully mature and has gone through over 3 years of development with a highly accomplished team, which has a combined domain expertise of over 50 years.

Darbee Visual Presence Software is optimized code with unified APIs that can be implemented into any generic image processor platform.

Darbee Visual Presence Hardware is a logic core that interfaces perfectly with an LCD controller or a media co-processor. Visual Presence Hardware is a technology-independent hardware module that can be integrated in the pixel processing pathway of consumer electronic devices. It is a small form factor and has no impact on existing pin footprints. An FPGA prototype of this logic core is available for customers to conduct side-by-side comparison of video quality performance.

## Conclusion

Driven by the need for image differentiation, demand for real time image enhancement is growing. Current image enhancement solutions do not provide significant differentiation and the most advanced technologies are not optimized for real time or practical application. DarbeeVision has developed a proprietary technology, Darbee Visual Presence, which brings a revolutionary and never-before-seen level of depth and realism to 2D images. By integrating Darbee Visual Presence into existing digital image media devices, pictures can be made better than what even the most perfect camera and display can achieve—much better in fact, by using computation to process an image in the same way the brain does.