

Heterogeneous Multi-Sensor Camera

Imagine a camera which can capture color images using visible light at noon, grayscale images based on both visible and near-infrared light at midnight and hybrid images in between those extremes. Focused on the needs of security cameras, we have built a camera which can do just this.

Today's surveillance cameras typically have one day-mode and one night-mode. In day-mode, the camera captures images from the visible light just like a conventional camera does (see image 1). In night-mode, on the other hand, both visible and near-infrared light is captured which leads to a brighter but colorless image (see image 2).

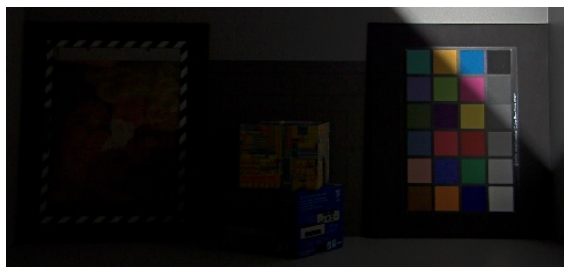


Image 1. Day-mode image. Too dark to the left.

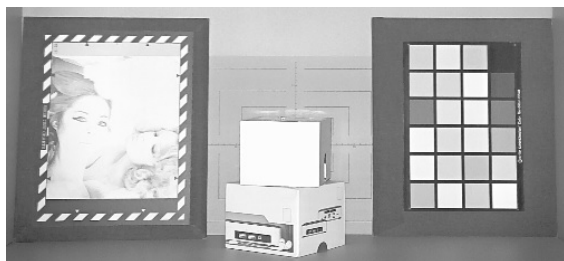


Image 2. Night-mode image. Great contrast.

In situations where it is unclear which mode today's cameras should be in, we believe our camera will be superior. At dusk, for example, the day-mode may not capture enough light to get good-quality images while the night-mode will not capture any color information at all. Another interesting situation is when a street-lamp only illuminates half of the scene which means that an ideal camera would have half of the image in day-mode and the other half in night-mode. None of these situations are covered well by today's camera design which led

us to instead look into a fundamentally different design.

From the outside, our camera looks like any other camera with a lens letting the light in and a connection which can transfer the images to computers, TV screens, hard drives or whatever that may be feasible. But when taken apart, our camera has two new elements that a conventional camera lacks. First, it has a second image sensor and second, it has a special thin bit of glass called beam-splitter. The beam-splitter splits the visible light and the infrared light onto the two separate image sensors. This way, the camera produces two sets of images at the same time and thus obtains both day- and night-mode images simultaneously.

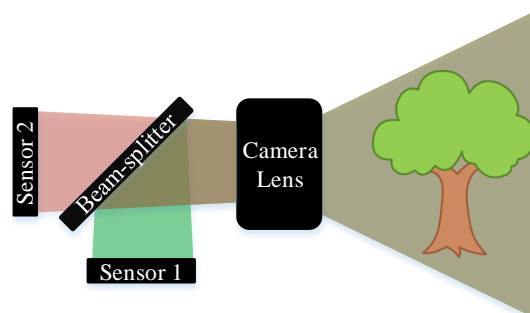


Image 3. The camera setup used.

While this solution of taking two different images from the same camera already is a very interesting idea, we decided to push it all even further and merge the two images into one superior image (see image 4). The merge algorithm first senses how good the two input images are and then essentially extracts the contrast from the night-mode image, the colors from the day-mode image and combines them into a new, merged image.



Image 4. Merged image; the best of image 1 and 2.