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Megapixel Mythology and Photospace:
Estimating Photospace for Camera Phones from Large Image Sets

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Abstract:
It is a myth that more pixels result in better images. The performance of image capture devices varies considerably according to the conditions of image capture. Although almost every camera will take a reasonably good image of a brightly lit outdoor scene, use under challenging scene conditions (such as low indoor lighting) will separate the wheat from the chaff. Cell phone cameras are often used in low-light situations where the lack of a flash and limited exposure time will produce underexposed images. Handheld picture-taking at close distances can introduce motion blur. Unless test exposure conditions in the lab properly represent usage conditions, the customer experience of quality cannot be adequately predicted from objective image quality measurements. Camera utilization can be quantitatively described by photospace distributions, a statistical description of the frequency of pictures taken at varying light levels and camera-subject distances. If the photospace distribution is known, the distribution of quality as experienced by the typical user can be determined either through direct measurement of subjective quality or through laboratory measurements of objective quality. In both cases, determination of the user experience is based on a sampling process that is consistent with the photospace distribution.

ImagePhi was developed as a software tool to interactively examine individual images with the aim of estimating the primary photospace variables: subject illumination and subject distance. In order to populate a photospace distribution, large numbers of images have to be examined. This is facilitated by ImagePhi's user-friendly interface. Also, subjective evaluations of failure modes for low quality images can be entered into ImagePhi. Possible modes of failure include blur (optical and motion), noise, plus errors of white balance, exposure (too bright or dark), and contrast.

We have collected sets of images acquired by typical users from a small population of popular camera phones ranging from VGA to 3 Megapixel resolution and examined their image quality data. ImagePhi has been applied to these images so as to estimate representative photospace distributions of cell phone camera usage. The correlation of the failure modes with the two-dimensional photospace distribution has been investigated. Measurements of objective camera performance under representative photospace conditions will illuminate the non-global assignment of an image quality measure.

The ‘megapixel myth’ is thus seen to be less a myth than an ill framed conditional assertion, whose conditions are to a large extent specified by the camera’s operational state in photospace.