JPEG compressed domain image retrieval by colour and texture

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In this paper we introduce a new approach for image retrieval in the compressed domain of JPEG encoded images. Our algorithm allows for retrieval based on both colour and texture properties of images. Furthermore, the operations involved are of low complexity which means that they can be implemented very efficiently and so enables fast retrieval. Even more importantly, in contrast to previous techniques, our novel algorithm uses the DC coefficients only and hence takes advantage of the fact that they are coded separately from the AC coefficients. We start with the observation that the DC coefficients hold the means of the image blocks, and so essentially describe a low resolution version of the image. We then utilize that in JPEG compression the original RGB images usually first undergo a colour space conversion into the YCbCr space which consists of one achromatic (intensity) channel (Y) and two chromatic channels (Cb and Cr). Similar to previous work we ignore the intensity channel for our colour based matching part. This also has the advantage that by doing so we can discard any dependence on the imaging geometry and any shading effects in the scene. Hence, we build a $(16 \times 16)$ chromaticity histogram from the DC coefficients of the Cb and Cr channels. The Y channel on the other hand is used for the texture part of our retrieval method, as it is usually intensity changes that account for texture aspects. Ojala et al. have recently introduced a simple yet effective texture algorithm called LBP. In this method each pixel is assigned a certain index according to the structure of its surrounding pixels. In a second stage a $(256 \times 1)$ histogram of these indices is built which describes the texture information of the image. In this paper we use the LBP algorithm on the DC data of the Y channel. Clearly this is not the same as the original technique, rather it operates on a different resolution of the image. We argue however that operating on pixel resolution as in the original LBP might not be ideal either as many textures are only defined at lower resolutions (e.g., buildings). To verify this we compare image retrieval results based on LBP on both the original resolution and a subsampled image as coming from a JPEG stream. We further demonstrate the validity of our other assumptions namely that indexing performs roughly the same in chromaticity space as in RGB space, and that colour indexing based on subsampled images does not degrade the retrieval performance significantly. Finally we test our novel algorithm on a subset of the MIT VisTex image database. While we obtain good results for retrieval on either our colour and texture operators, by combining them retrieval performance turns out to be excellent.