Quality Assessment for Natural and Screen Content Images

Woei-Tan Loh
Faculty of Engineering
Universiti Malaysia Sarawak
Kota Samarahan, Malaysia
lohwt91@yahoo.com

Annie anak Joseph
Faculty of Engineering
Universiti Malaysia Sarawak
Kota Samarahan, Malaysia
jannie@unimas.my

David B.L. Bong
Faculty of Engineering
Universiti Malaysia Sarawak
Kota Samarahan, Malaysia
bbldavid@unimas.my

***Abstract*— Quality assessment (QA) of screen content images (SCIs) has gained more and more popularity. SCIs are very different from natural images (NIs) which have been dealing with by most researchers in the literature. QA methods specifically designed for NIs also can be used to evaluate the quality of SCIs. Yet, their performances are unsatisfactory. This may due to the statistical differences of SCIs and NIs. In this paper, SCIs and NIs QA methods in the literature are being compared and studied for both SCIs and NIs benchmarked databases. It is found out that methods that incorporate gradient features work well for both SCIs and NIs. This points out a possible way to utilize gradient features to come out with a QA method that works for both SCIs and NIs simultaneously. Hence, application related to SCIs and NIs such as deep learning and multitasking for person tracking system can be improved with the QA method.**

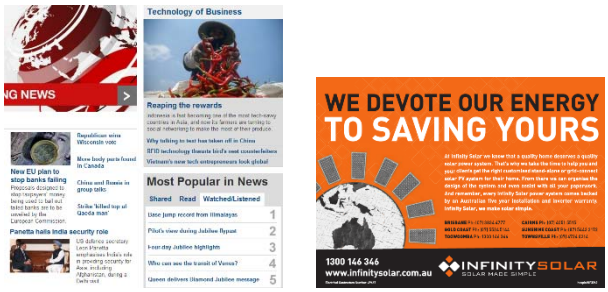
Keywords*— *image quality, screen content images, natural images, gradient

I. INTRODUCTION

Screen content images (SCIs) gained more and more attention recently. Many daily lives activities and applications involved SCIs. Some of them are remote computing [1], screen sharing [2], and cloud computing and gaming [2-4]. In order to maintain and improve the visual experience in these activities, qualities of SCIs play an important role. Quality assessment (QA) of SCIs is statistically more complex than natural images (NIs). This is due to the fact that SCIs are a mixture of text, graphics contents, and NIs. Some examples of SCIs and NIs are shown in Figure 1.

In this paper, the performance of the natural and SCIs quality assessment methods are being compared for the natural and SCIs databases. This aims to find QA features that are applicable to both SCIs and NIs. Most of the QA methods proposed in the literature are specifically designed for NIs. Recently, there were also some QA methods proposed for SCIs. Yet, an important question comes to mind is that if it is possible to design a QA method that can assess the quality of both SCIs and NIs. If such methods exist, their applications can be more useful and wider than the existing methods.

The organization of the rest of the paper is as follows. Section 2 briefly reviews some existing SCIs and NIs QA methods. Comparisons of the QA methods are briefly elaborated in Section 3. Performances of selected SCIs and NIs QA methods on five image databases are shown in Section 4. The results are also being discussed and analyzed. Section 5 concludes this paper



(a)

(b)

Fig. 1. Examples of SCIs and NIs. (a) SCIs [15] (b) NIs [27].

II. LITERATURE REVIEW

Most of the existing QA methods are tested on NIs or SCIs only. In this section, the state of the art QA methods for NIs and SCIs are discussed briefly.

Some of the popular NIs QA methods are Structural Similarity (SSIM) [5], Multiscale SSIM (MSSIM) [6] information weighted SSIM (IW-SSIM) [7], feature similarity (FSIM) [8], gradient magnitude similarity deviation (GMSD) [9], visual saliency-based index (VSI) [10], and visual information fidelity (VIF) [11]. SSIM is the most popular QA methods to date. It has been widely used and modified to suit specific conditions. Some works even extend it for video quality assessment [12-13]. It involves the similarity of luminance, contrast, and structure of the images while assessing the quality of NIs. MSSIM is the extension of SSIM. MSSIM further incorporates information into SSIM. IW-SSIM is also an extension of SSIM by incorporating a new weighting method. This weighting method is based on the information content of every pixel in an image. On the other hand, FSIM considers the similarities of phase congruency and gradient magnitude as the QA features. There is also an extension of FSIM for color images. GMSD is one of the best performance NIs QA methods. It only considers the gradient magnitude of each pixel in an image. Standard deviation is used to replace average while computing the final index for GMSD. It is also well known for its low computational complexity. VSI focuses on visual saliency maps. These maps