Title of Project

English: Deep Comic Screening via Tone-aware Semantic Layer Analysis

Chinese: 基於灰色調語義圖層分析的漫畫網點填充深度學習網絡

Abstract of Research Comprehensible to a non-specialist

Comic is a world-wide popular art form enjoyed by people of all ages. However, creating a comic book is time-consuming. It generally takes a professional comic artist one or several days to finish a single comic page. Usually, creating a comic page takes three steps: sketching, inking, and screening. The artist will first convey the idea and concept by quickly sketching a rough drawing using freehand strokes and then trace a clean inked line drawing. Finally, screentones will be applied to the inked line drawing to enrich the visual content (Figure 1). While the screening process is highly tedious and repetitive, there still lacks automatic tools to release the artist from this tedious process. So, comic companies and famous comic artists generally hire several assistants to help with the tedious and repetitive screening task. An automatic comic screening system is highly desired in the comic industry for saving time and labor.

However, automatic screening a comic line drawing is extremely challenging. There are many different screentones of various shapes and tones. Finding the proper screentones to fill the white areas in a line drawing in non-trivial. Firstly, not necessarily all areas need to be filled with screentones, e.g., human faces and hands are usually screentone-free. Secondly, the tone of the screentone should correctly express the object's color and shades, e.g., a dark object should be filled with a low-tone screentone, and vice versa. Thirdly, screentones might be affected by semantic usage, e.g., stripes are commonly used to express the shades. Lastly, areas belonging to the same object should be filled with the same screentone, e.g., the two sleeves of a shirt should be filled with the same screentone. But all the above characteristics of screentones are highly related with the high-level semantics, which is extremely difficult to be analyzed, especially for line drawings where most of the pixels are either black or white and exhibit similar local charactertistics.

Recently, the deep learning technologies have greatly advanced the development of various image analysis and image synthesis applications. Nevertheless, the existing deep learning solutions face significant problems when dealing with line drawings and screentones. Firstly, the input line drawing is relatively simple and uninformative, which only contains a solid white background and some sparse black lines. In the meantime, the target comic image is much more complex that contains color, material, and lighting information presented by screentones of different appearances and densities. The existing methods generally fail to resolve this large information gap. Secondly, screentones are composed of high-frequency elements such as lines and dots. However, the generation of the output image is interpolative with deep neural networks, so the existing methods generally generate blurry outputs (Figure 2 and 3).

Despite the difficulties of generating screentones with intensive strokes from simple line drawings, we propose a novel learning-based solution to automatic generate the screentones for an inked line drawing. The key idea of our design is to split the difficult line-to-screentone process into two easier-to-solve problems by taking the tones as an intermediate representation between line drawings and screened comics. So, the line-to-screentone task now consists of two

processes, a line-to-tone process and a tone-to-screentone process. While the information gap between line drawing and screened comic is large, the information gap between line and tone or tone and screetone is much smaller, which could be potentially learned and predicted by the deep convolutional neural networks.

With the proposed system, we believe the tangible outcomes, e.g., publications and algorithms, should directly benefit the comic industry, the research society, and comic customers. Moreover, the research project would also provide invaluable chance in developing the skills of the teachers and the students related to digital entertainment and artificial intelligence technologies, which is also part of the curriculums and programmes offered by the school and the institute.