



UNIVERSITI PUTRA MALAYSIA

**USING IMAGE PROCESSING TECHNIQUE IN PACKAGING
DECORATION**

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PACKAGING DECORATION**

By

ZHIYUAN LI

**This thesis submitted to the Senate of University Putra
Malaysia and has been accepted as fulfilment of the
requirement for the degree of Master of Science**

January 2009



Dedicated to my parents and the family.



Abstract of thesis presented to the Senate of University Putra Malaysia in fulfillment of the requirement for the Degree of Master of Science

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January 2009

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For the past decades, the decoration of packaging plays an important role in promoting the product to the consumer, especially related to the fast moving consumer products. As the product decoration field had attracted much attention, there is a demand to strengthen its effect of decoration to packaging industry. Therefore, one of the active research studies in packaging decoration is to improve the clarity and special effect on the decoration image using image processing techniques. Currently, there has tremendous number of drawing package or computer-aided design software for aiding design in general, but none of them specifically built for packaging decoration purpose.

The aim of this thesis is to develop an application for packaging decoration



purpose that allow user to apply image processing algorithm onto the decoration image and subsequently paste the decoration image on a flat and curve surface in order the decoration image to be viewed at different angles. In order to validate the efficiency of the developed application to achieve the stated aims, two experiments are conducted on the collected 1000 decoration images. The analysis results concludes the developed application is successfully allow user to improve the quality of the appearance clarity of the decoration image by applying selected image processing algorithm and subsequently further verified the effect of the pasted decoration image on the surfaces of the packaging.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENGGUNAAN TEKNIK PEMROSESAN IMEJ DALAM
REKABENTUK PEMBUNGKUSAN**

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Aplikasi pemprosesan imej dalam hiasan pembungkusan

Kebelakang ini, hiasan pembungkusan memainkan peranan penting dalam mempromosikan produk untuk pengguna, khususnya yang berkaitan dengan product pengguna yang laris. Oleh kerana lapangan hiasan pembungkusan dapat menarik perhatian para pengguna, wujud permintaan untuk memperkukuhkan kesan hiasan untuk pembungkusan industri. Oleh itu, salah satu kajian yang aktif dalam lapangan hiasan pembungkusan adalah untuk memperbaiki kejelasan dan kesan pada gambar hiasan dengan menggunakan teknik pemprosesan gambar. Tatkala ini, terdapat banyak perisian perlukisan ataupun perisian perlukisan berpandukan computer untuk membantu rekabentuk, tetapi tiada satu perisian yang khusus untuk tujuan hiasan pembungkusan.

Tesis ini bertujuan untuk membangunkan aplikasi untuk tujuan hiasan pembungkusan yang membenarkan pengguna menggunakan teknik pemprosesan gambar dan seterusnya memaparkan hiasan gambar pada permukaan rata dan melengkung dalam rangka hiasan pembungkusan yang membolehkan hiasan gambar dilihat dari pelbagai sudut. Bagi tujuan untuk menguji kecekapan aplikasi yang telah dibangunkan selaras dengan tujuan yang termaktub, dua ujian percubaan telah dijalankan ke atas 1000 pungutan gambar. Keputusan daripada analisis ini menyimpulkan bahawa aplikasi yang dibangunkan itu telah berjaya membolehkan pengguna dalam meningkatkan kualiti hiasan gambar dari segi penjelasan dengan menggunakan teknik pemprosesan gambar dan seterusnya mengesahkan kesan daripada hiasan gambar yang dipaparkan di atas permukaan dalam pembungkusan.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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CHAPTER 1

INTRODUCTION

The decoration of packaging plays an important role in promoting the product to the consumer, especially related to the fast moving consumer products. All kinds of packaging not only display the appearance model of the product packaging, but even display the rich and colourful images in the surface of the packaging, as illustrated in Figure 1.



Figure 1: (a) Sample of decoration that appears on the packaging, (b) A packaging without any decoration

For a product packaging, an exquisite packaging image can undoubtedly add colours for its appreciation, while the opposite image will merely weaken consumers' desire to buy, debasing the popularity of the brand. Therefore,

packaging decoration field had attracted much attention, especially in this highly competitive market. There is a demand to strengthen its effect of decoration in terms of “beautiful” appearance which creates an actual effect although printed on the packaging. The design of the packaging decoration not only reflected the designer’s thoughts, but also emphasis on the technology level used in bringing out the clarity and special effect on the decoration image. Therefore, one of the active research studies in packaging decoration is to improve the clarity and special effect on the decoration image using image processing techniques. Currently, there has tremendous number of drawing package or computer-aided design software for aiding design in general, but none of them specifically built for packaging decoration purpose.

1.1 Image Processing in Packaging Decoration

Packaging decoration has a wide emphasis that details knowledge of the relevant technologies, creative care and consideration of the effects of colours, typefaces and images which must support the brand, position the product and provide the required product to be “stand out” at the point of sale. However in this thesis, packaging decoration is elaborated only in terms of the appearance of the decoration images that are printed on the packaging.

Packaging” is a kind of product, and decoration is an ornament of the product’s shape. The effect of the ornament is decided by the designer based on the product analysis, the understanding level and the designer’s own art completeness, as well

as his/her impregnable unique thought consciousness (Pan, 1999). In the packaging decoration, the image design, the graph, and the wording occupy the leading status; and whether the decoration of the image has the characteristic, it should directly reflect whether the design of the packaging decoration is successful. This fact reflects that the right image plays a vital role in the packing decoration design. The packaging decoration design includes the image, drawing, the ornament, the veins, emboss and so on. These highly contribute to the important art styles in the packaging decoration industry, which is also a crucial method of enhancing the aesthetic art effects. The design of the images must achieve an appropriate ornament and beautification effects (Hu, 2000).

As the clarity and special effects on the images or drawings to be printed on the packaging is highly vital, various image processing technique are applied onto the decoration images. In general, image processing comprising filtering techniques which includes edge enhancement, contrast enhancement, noise removal and smoothing operation for the purpose of improving the clarity and special effect of decoration images. The decoration image covers two dimensional (2D), three dimensional (3D) and embroidery images. The image processing techniques is needed in packaging decoration as the decoration images may appear differently after printed or pasted on the packaging in terms of clarity and appearance of the special effects.

1.2 Problem Statement

Prior to the advancement of computing design, the designer of the packaging decoration represented their designs through manual design plots and then proceed to manufacturing a few models for viewing and testing purpose. According to (Liang, 2000), the design is divided to three steps: (1) designing the packaging image on the plane, (2) imagining the three dimension effect of the packaging image and (3) drawing the packaging image on the packaging model. However, the typical design approach is complicated as the designer has difficulties to imagine the three dimension effect on the packaging body, which resulted actual appearance and texture effect cannot be visualised, effectively. In addition, revision procedure of the design is consuming too high resources and time.

With the enhancement and popularisation of the computer technology, decoration image can be designed and visualised through the computer software. There are various software applications to create fine art images, perform graphic manipulation on the two dimensional image such as Photoshop and Paintshop Pro. The two stated software are highly used and recommended by graphic designer for having highly interactive manipulation tool on image. Although the recommended graphic software has high number of impressive image manipulation functionalities, they are not designed for packaging decoration industry. With the image manipulation functionalities applied on the graphic image, the good and clear resultant image may not be look appropriate for packaging decoration purpose. In packaging decoration, the appearance of the image with the special

effects must be clear under different angle, different location at the surface of the packaging and the shape of the packaging's surface. The current commercial software only allows manipulation on two dimensional image but does not has any functionality to paste the decoration image on the surface of the packaging. Without this pasting functionality, the effect of the decoration image is hardly be visualised in terms of clarity of the graphic elements and special effect in various angle, position and size of the packaging.

Thus, the existing available solution for packaging decoration needs further improvement due to problems discussed above and summarised as follows:

- (1) available image manipulation techniques yet to analyse for packaging decoration effects in terms of maintaining clarity of graphic elements and special effect.
- (2) Non-availability function that applied the manipulated decoration image onto various type of surface of the packaging including flat and curve surfaces in order to analyse the appearance and special effect in various angle, position and size of the packaging.

1.3 Objectives of Research

The aim of this thesis is to develop user-friendly and easy-to-use application for packaging decoration purpose, which has the following objectives:

- 1) To apply several image processing algorithm onto the decoration image

- 2) To apply the processed decoration image on a flat and curve surface in order the decoration image to be viewed at different angle

1.4 Scope of Research

A set of measured data that composed of 10 images of 2 types of different images which are texture and graphic for each image is used to validate the objectives of this thesis. The measured data that is used as decoration image is collected in the Laboratory of Multimedia System at the Faculty of Engineering, in University Putra Malaysia.

A prototype application is developed to perform several image processing algorithm onto the decoration image in order to improve the clarity and special effect of the original image. The application is extended to apply the processed decoration image on the surface of the packaging. The packaging with the decorated image is viewed with different angle in order to analyse the appearance and special effects of the decorated image. The tested surface of the packaging consists of two types: flat and curve.

1.5 Thesis Organization

Chapter 1 described the background and problems of packaging decoration and the

usage of image processing algorithm in order to enhance the clarity of the decorated image to be pasted on the packaging. This chapter furthers details the objective and scope of the research.

Chapter 2 highlights the literature review of the usage of various image processing algorithm in the packaging decoration and also describes the specific image processing algorithm in order to obtain decorated packaging in terms of clarity of the appearance and special effects.

Chapter 3 is devoted to detail implementation of the prototype application that is capable to apply various images processing algorithm onto the decoration image as well as applying the processed image at the surface of the packaging.

Chapter 4 discusses the result of the processed image onto the flat and curve surface of the packaging in terms of clarity of the appearance and special effects. Finally, the conclusion for this research is presented in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Due to the high demand of consumers in expecting the packaging of the product to be rich in terms of colour and clarity, various research techniques are explored to improve the clarity and special effect on the decoration image. One of the most convincing techniques to be practically used for this purpose is image processing operations. Generally, image processing operations are utilised in manipulating the original decoration image which may be affected by noises introduced by image capturing means, unclear graphic elements includes text, logo and product image, as well as low richness in terms of colour properties. Although the quality of the original decoration image is improved with image processing operations, it may not reflect the similar appearance when printed on the surface of the packaging that appears in flat or curve surfaces.

This chapter describes the background of image printing in the packaging industry. In this chapter, the theoretical information on the image processing operations used in enhancing the quality of the decoration image of the packaging is discussed.



2.2 Previous Work in the Packaging Decoration

This section relates generally to the background of generating and printing decoration image on packaging product. The packaging manufacturers have provided their product with images before history was recorded. However, the process of creating and transferring imagery to packaging product has been labour-intensive, time-consuming, and wasteful of materials. This weakness is remains true despite many changes that have taken place in the printing industry over the past decade.

Nowadays, consumer has desire to view information through graphs and images. This desire is extremely dependent to individual work, study, life and idea. Prior to computing technology, the designer of the packaging decoration industry represented their designs through manual design plots and manufactured a few models based on the designs. The involved steps are too time-consuming and the accuracy of the manufactured model is not guarantee.

The generating and printing of decoration image involves a series of steps where the digital version of the decoration image is generated electronically at the computer site and stored in a storable medium. The retrievable digital copy of the decoration image is transfer to the printing site where a printer such as inkjet printer is used for jetting an ink through an inkjet print head directly onto a surface of the packaging to print the digital decoration image onto the surface of the packaging product.

Throughout the processes in obtaining the final packaging product with decoration image, generation of decoration image plays an important role in determining the success of the final output of the packaging product. For the generation of decoration image, it is commonly been digitized using graphic design application. Over the past decade, graphic design application has added its image manipulation functionality due to the advancement of computer-aided design (CAD) technology.

Computer-aided design is the use of computer technology to aid in design of a part or product, which the design may represented in two dimensional and three dimensional digital images. Thus, computer-aided design technology is used in the domain of packaging design (Wang and Qian, 1996). In the field of product development there are often immense costs associated with the testing of new products. Every new product must undergo at a small measure of physical testing. The physical testing is needed not only to ensure that it meets minimum safety standards but also to ensure that it will successfully operate under the range of conditions to which it can expect to be exposed. Fortunately, there is no need to physically test all of these designs. Instead, designers can view the design using computer-aided design

Since the early development of computer-aided design, there is a trend towards increasing accessibility. When computer-aided design applications became available for packaging development in the 1960s, it was only the largest of enterprises that could afford to make use of the technology such as the aerospace and automobile industries, for instance.