Digital Production of Personalized 3D Displays or Simple Folding Cartons

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Abstract

Personalization is not a common practice in packaging industry. In publishing industry, personalization is highly valued and business is rapidly growing. We have worked extensively on leveraging state-of-the-art of personalization for packaging. As packaging industry deploys digital technologies, we believe personalization will yield high value packages. However the state-of-the-art techniques of publishing workflow inadequately address the issues and complexities of packaging workflow. The packaging prototyping industry uses highly labor intensive ad-hoc methods that are difficult scale up to profitable production of packages. While this problem in general is very hard, we have developed an initial scalable solution for 3D pop-up greeting cards, whose workflow is very similar to production of personalized folding cartons, point of purchase display, or a structure with cutouts.

In our method we auto generate a plotter/cutter cut-path from an image asset that pops-out against a background. The system uses the image asset, the generated path, a variable background image, and a selected base structure template, to generate a combined raster image of the template for printing. It also generates a vector image that contains both the generated path and the cutting and creasing instructions of the base template. This vector image enables us to drive a programmable plotter/cutter to extract a personalized structural piece. To enable scalable production, we automatically coordinate the printing of the composed graphics and the extraction of the 'graphics specific' cut, creased and perforated structure without human intervention. Such a system enables rapid production of personalized dimensional mail piece flats, POP displays and simple folding cartons.

Background and Motivation

Personalization of documents, collaterals, promotional material and direct mail is rapidly growing and technology and services are available in the market [1]. Variable data publishing tools enable manipulation of document content and layout at any desired instance, even very late in the process. Digital printing machines enable such printing to be cost effective and timely.

In packaging industry job run lengths are rapidly declining and customization, regionalization of packages is rapidly increasing. A few of the customization are driven by regulatory needs, but many are driven by brand owners to influence their customers. Although these needs are similar to personalization needs in publishing, personalization in packaging is not very prevalent.

Through the use of variable data publishing technology, digital printing and finishing systems, it is possible to produce cost-effective, short-run, customized and personalized packages. Within packaging, our initial focus has been on folding cartons structure and graphics. We believe our work described here is easily extensible to direct mail and 'point-of-purchase' (POP) displays and other promotional artifacts that paper boards.

This work will help in rapid low cost customization, versioning and regionalization of packages. While we have not come across strong demand for personalization in a classic sense, we believe this technology will enable Brand Owners to establish more effective interaction and intimacy with their customers. Further this technology will also enable improving customer support services that provide more targeted instructions for consumption or use of the packaged product. Similarly, in direct mail or promotional communication, this technology will enable more attractive personalization.

In conventional personalization print media is generally fixed, but the content is changeable. Hence for every document instance the content layout is dynamically adjusted to make the changed content fit and even look aesthetically pleasing [2-3]. In the work described here we propose to change both the content and the media. i.e. not only the content needs to go through the layout on the fly, but the layout itself need to be decided for each personalized artifact. In addition, in the case of 3D artifacts, finishing sequence may also need to be changed for every instance.

While the ultimate goal of our work is yet to be achieved, we have developed good understanding of problem by solving some specific applications that do not need on-demand change to finishing steps. We use pop-up greeting card as an example here and we describe the steps needed to personalize the structure and content of the card automatically.

Approach to structural variation

Variation of structural design within the context of a promotional campaign presents a challenge in the layout of graphics, images and messages when the structural shape and size vary. It is also challenging to find suitable automation for folding, gluing and other finishing operations.

Our approach to overcome the issues of structural variation involve variation of design where the size and shape are allowed to vary without requiring variable fields containing assets such as images, graphic and messages to be automatically re-sized or re-positioned.

Consistent size and folding sequence

It is also important to select a structural design that varies without impacting the setup and production of finishing equipment. Today's finishing equipments are unable to adapt to changing size and folding sequence variations. In our approach the size and folding sequence of the pop-up greeting card remains constant. This general design rule allows for the production of the pop-up greeting card on existing finishing equipments.

Structural Design

The structural design of the pop-up greeting card in our experiment has both a fixed template and variable facet. The fixed template is constant while the variable facet changes based on the image. Figure 1 below shows a sample structural design.

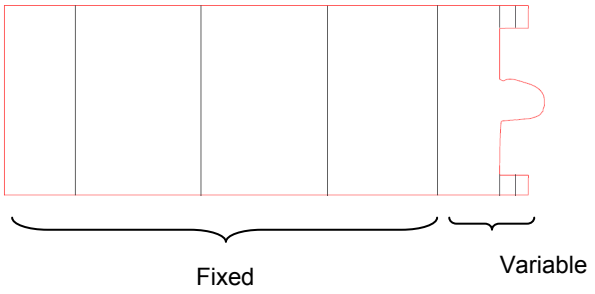

Figure 1 - Variable Structural Design

The variable facet is constructed from a photograph such as the one shown in figure 2.

Figure 2 - Photograph

All photographs are taken against a blue screen to enable automated processing. The variable facet is constructed by combining the alpha layer of the image with a mask image shown in figure 3. The alpha layer of the image is created via a background removal algorithm that automatically detects the background color to produce the alpha layer.

Figure 3 – Mask Image

The combined alpha layer is depicted in figure 4.

The cut path for the facet is then created by following the boundary of the combined masked image.

Figure 4 – Alpha Layer

Automation of design

The XMPie Personal Effects system [5] supplies a means for streamlining the process of producing personalized printed material. Our system is implemented within the XMPie's variable data print production solution. We believe there are other commercially available personalization tools that could be used to achieve this task.

An Adobe InDesign or a similar creation tool can be leveraged to define the base graphical and structural elements for the piece. The contents of variable objects in the design, such as images and text, are dynamic. These objects provide a designer with placeholders for dynamic content, and are used to insert personalized information during the production stage.

Figure 5 – Graphic Design Layer

Separate layers are specified in the design, one to define the graphical elements for printing (figure 5), and the other to describe the corresponding structural design (figure 6).

Production Automation

Efficient production of the described personalized piece is necessary for this to be a viable application. The overall production workflow is depicted in Figure 7 where the processes start with a setup (step 1), an individual's photo taken against a chromakey screen (step 2) and is electronically stored in the personalization software such as XMPie. The software

automatically selects a card image, background image, and a personalized message (steps 3 - 6).

Once the selections have been made, our software automatically creates two documents: a graphics for printing and a die line for driving the plotter/cutter.

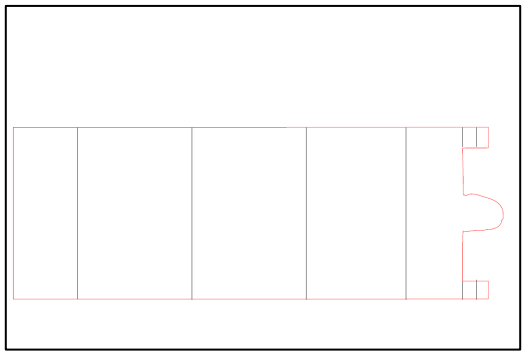

Figure 6 – Structural Design Layer

Use of barcodes to synchronize the die lines with printing enables better automation. Once the die line information has been created and stored, location reference is encoded into the barcode. After the printing process is complete (step 7) the graphical flat is finished using a plotter/cutter (step 8). The finishing system obtains the appropriate die line for finishing the piece by decoding the barcode reference.

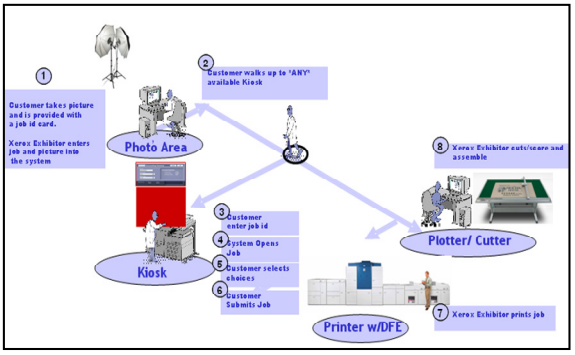

Figure 7 –Personalized greeting card workflow

Figure 8: Personalized Pop-up greeting card

The overall workflow interaction points are simple and direct and little effort is required to drive the formation of a completed pop-up greeting card is shown in Figure 8.

Conclusion

We have presented an effective approach to creating and producing personalized pop-up greeting cards and folding cartons. By using existing system and standards, we were able to create new dimensional print of high value. We believe as digital printing spreads into packaging or high value direct mailing applications, ability to manipulate both structure and content will be a big advantage. There are still a lot of unsolved problems in this space. Effective automation of finishing sequence that deals with varying structure is going to be the most challenging of these problems.

References

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Biography

Barry Gombert received his B.S. degree in Electrical Engineering from Valparaiso University. He worked in the, aerospace, and commercial printing industries prior to joining Xerox in 1987. Currently he works at the Xerox Research Centers in Webster, NY USA. His research interests include distributed systems, document management, and print.

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