Consistency of Gravure Printers Output for Medicine Packaging

Thesis submitted by

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Title of Thesis

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Abstract

Counterfeiting of pharmaceutical packaging has become amajor challenge to the society which causes severe health hazard. The easiest way of producing fake medicine is counterfeiting the packages of medicine. While counterfeiting the pharmaceutical product, printing and packaging takes very crucial role as the customer buy the product by the attraction and information provided by the package. So the counterfeiters emphasize more on packages and associated printing. Nowadays this issue has spreaded worlwide and it has become a major threat to the society and economy. The counterfeited pharmaceutical products are unauthorized, expired, reused and/or manipulated packages which are similar to the original. The main problem is that it is difficult to identify visual differences between original and fake packaging, and the lack of solutions to identify the authentic packaging. So packaging authentication is a very important need in pharmacetical industry.Through medicine packaging, valuable information such as manufacturing date, expiry date, and chemical composition etc. of product have been conveyed. Advanced technologies have made it easier to replicate the packaging of any products. The simpliest way to produce fake samples of printed packaging is to scan the image of the original package by different devices, such as digital camera, mobile camera, scanner etc.,then to print the scanned image by suitable printers.This work is focused on pharmaceutical package printing not only for its social implication but also for its technological variation. Since most of the medicines are packed in metal foil, the printing technology associated is gravure printing. Hence the work has been based on gravure printing on metal foil. Little work has been done on gravure printing on metal foils. Scanning or taking photographs of the package and re-printing is one of the methods to counterfeit the original package sample. However, the variation of color while reprinting it may be assessed to check whether the printing is done by the original manufacturer or their authenticated printer house. When the image of the original print is taken through different mobiles, camera or scanners, the color values are not the same as the original print even if it is printed on the same printer. However, when the scanned samples are reprinted with different printers, the differences are much higher in comparison to the original print. If it is a single color print, counterfeiters are trying to match the color by applying different color management solutions. Situations become difficult when multicolor printing is applied. Hence, color consistencies of multicolor printing have been studied for checking authenticity of a print. In this study, blister foil has been taken as substrate and a reference color chart (IT8.7/3) are printed with 4-color gravure printing machine. IT8.7/3 is the standard color chart designed by International Color Consortium for printer characterization. The spectral reflectance of the solid colors (Cyan, Magenta, Yellow, Black) and their different combination of color patches of printed color chart (original sample)and its scanned reprinted sample (mentioned as reprint) have been observed. The difference between the samples has been evaluated by color difference CIEΔE2000(ΔE_{00})**.**In this study, the reference image(color chart IT8.7/3) has been printed with three different gravure printers (P1, P2 ,P3 which are mentioned as prints). Then to simulate counterfeiting process, the images of print samples are taken by different input devices. The images are then printed in those three printers again. The scanned and reprinted samples are

referred as reprints. Artificial Neural Network (ANN) model is used to predict the CIELAB color values of a print samples and reprint samples printed in different printers. In this study, 70% of color patches (total 928) have been used to train the network, 15% of the data used as cross-validation and 15% of the data is used to verify the accuracy of the network. Then the predicted color values of one printer (reference Print) are compared with other print and scanned reprint samples to assess the differences. It has been observed that the differences of predicted color values with the print samples are much less when compared with the reference print. The difference becomes much higher for scanned reprint samples in comparison to the same reference prints. Hence it will be possible to identify the reprint sample (if someone tries to reprint it after scanning or taking images of original multicolor artwork and reprints it). Hence the predicted difference may be used to protect medicine packaging from counterfeiting. Yule-Nielsen spectral modified Neugebauer) (YNSN) model has been used to predict the reflectance spectrum for original and reprint sample for different dot areas for different color combinations of color patches. It has been taken to identify the authentic printed sample. It has been observed that the obtained predicted spectrum result is close to the print sample (original) and has wide difference with the scanned reprint samples. The volume of the color gamut has also been studied between print sample (original) and a scanned reprint sample to identify the difference between them. From the color gamut volume it has been analyzed that the gamut volume is lesser for scanned reprintsample than the print samples. The obtained result indicates that the difference could be used to identify whether a sample is original or counterfeited and it will be difficult for counterfeiters to copy the image with these combinations of colors on blister foils packaging and also may help to protect the medicine packaging from counterfeiting.