ABSTRACT

The originality of products is of serious concern nowadays and packaging has a major role in it. package printing becomes critical as fake medicines, expired/ counterfeited food products can be easily packed and sold if printed with proper color combination. Secure packaging is one of the essential techniques to avoid counterfeiting. Often the out-of-date medicines or packaged food products or cosmetics are sold by changing the expiry date of the product which can cause severe health hazard. In recent years, printing technology has helped to fight against counterfeiting, a plea threatening citizen safety and impacting the financial health of food and pharmaceutical packaging industries. The authentication of the packaging is considered as an important step in the investigation of suspected counterfeits of packaged products. Due to the advancement of printing technologies, the emergence of counterfeits with a better appearance may be observed. In the recent years, due to the easy access of the high-quality printing technologies, the importance of package printing security has been increased to prevent the counterfeiting of packages. Hence it is important to identify whether a printed package is printed by original food or medicine manufacturers or their authorized printers or it is printed by counterfeiters. Scanning or photographing the package and reprinting is one approach for forging an authentic package sample. To simulate it, the original sample is being scanned/photographed and then reprinted using a variety of digital cameras, mobile cameras, scanners, and other devices.

This study will help to identify the authenticity of a printed package. Undoubtedly it will have a great impact on the packaging industry to check the authenticity and validity of the packaged product. This study has proposed four potential methods to distinguish an original print document from a reprint document (which may be simulated as counterfeited). Firstly, this research has suggested a method by creating a variable image watermark in order to protect batch number and expiry date of different packaged products. The idea of image watermarking is to hide some important information in the form of data bits inside the host image which will ascertain the authenticity of the product and which cannot be easily copied or printed. In this proposed work, a non-blind watermarking technique has been developed so that it cannot be easily copied or printed. The idea of this watermarking is to imperceptibly embed a small amount of secret information in an image, which is called a watermark, so that when any test print is studied properly, it can be identified whether it is printed in original printer by the manufacturer or it is counterfeited. More particularly this non-blind dynamic watermark is designed on the basis of product batch number and expiry date and is embedded into an image and stored in a 16-bit buffer wherein each of the said 16-bits are embedded into specific intensity values in the host image. The application of the watermark is in food and medicine industry as well as in many other industries.

In the experimental process, the reference target chart IT 8.7/3 has been printed using three different gravure printers (P1, P2, P3). Gravure printing process is widely acceptable for flexible package printing, specially on films and foil. In this study, blister foil is used as the substrate as it is mostly used in pharmaceutical industries and food packaging for its light weight, chemical inertness and impermeability to air and water. The images of print samples

are then captured using camera. The images are printed again in the same three printers and then the samples are named as reprint samples (R1, R2, R3). The second study has demonstrated another method to identify an original print document from a reprint document (which may be simulated as counterfeited product) using microscopic dot parameter analysis of color patches from standard color chart IT8.7/3. The samples printed in the gravure process are analysed using the Lays & Mayo microscope with 4x zoom and ScopeImage 9.0 microscope software. The analysis at microscopic scale of original print documents shows some specific dot shapes which depend on the printing parameters as well as the printing device used. We can, therefore, draw the assumption that the dot shapes can be used as a fingerprint to differentiate a print from a reprint. In the third study, the reference target chart IT 8.7/3 has been printed using three different gravure printers (P1, P2, P3). The images of print samples are then captured using camera. The images are printed again in the same three printers and then the samples are named as reprint samples (R1, R2, R3). The parameters like dot area, major axis, minor axis and eccentricity of cyan, magenta, yellow and black tints for print and reprint samples are measured using MATLAB R2018a. Canny edge detection algorithm has been applied on the microscopic images. Then the boundaries of the objects are being calculated by detecting the contours of the detected edge dots in the samples. From the results, it has been observed that the dot shape parameters may be used to distinguish the print sample from reprint sample. Fourthly, a multi-classification-based method Support Vector Machine (SVM) have been utilized using shape descriptor index features for print and reprint source identification.

The experimental results show that the proposed methods can successfully differentiate original print from its scanned/photographed (simulated counterfeits) reprints which can be effectively used to prevent counterfeiting in medicine, food processing or other industries and have the scope of commercialisation in order to prevent the great challenge of counterfeiting of medicines and other products. The suggested method successfully classified the print and reprint sample at different dot percentages with a high rate of accuracy.