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"Pashmina" Purity Determination: Historic Review & Proposed Ideas

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ABSTRACT

This paper analyses the different methods used historically to determine the purity of pashmina, compares, and contrasts their features. To this effect, a meta-analysis of the techniques, methods and results of the papers published since 1981 till date was carried out. Finally, two new methods are proposed which improve on the listed methods in their own little but different ways. The first hypothesis uses a more advanced machine-learning algorithm, and the second posits a way for the customer to personally verify the integrity of a shawl using just their phone.

Keywords : Pashmina quality, Machine learning

I. INTRODUCTION

Pashmina, a prince of speciality hair fibre is one of the finest natural fibre. Encyclopedia of textiles (1980) defines speciality hair fibers as the rare animal fibres which possess special qualities of fineness and luster. Pashmina is the down fibres or undercoat derived from domestic goat known as Capra hircus, which is native to India (Von Bergen, 1963). Pashmina can also be defined as the down (undercoat) fibre derived from Cashmere goats with a diameter of 30 microns or less (ASTM, D-123-59). Pashmina has derived its name from the Persian word 'pashm' meaning soft gold, (Anon, 2005). It is well known for its fineness, warmth, softness, desirable aesthetic value, elegance and timelessness in fashion. Being much softer than superfine merino wool of the same diameter, pashmina is the most luxurious fibre commanding much higher price in the national and international markets. It has a unique position among the fibers of animal origin because of its warmth, lightness, handle and its better ability to absorb dyes and moisture. On equal weight basis, it is has 3 times more insulating capacity as that of wool (Von Bergen, 1963). The term Pashmina is also known as cashmere, kashmir, pashm, tiflit, tiftik, tivit, tibit.[1]

The expensive and rare animal fiber, cashmere, is used to produce soft luxurious apparel and on comparative basis, fetches proportionate value addition much more than other animal fibres. As cashmere processing capacity outstrips available supplies of cashmere, some cashmere processors use superfine merino wool (19 μm and finer) to blend with cashmere. Cashmere wool blends provide the high quality worsted (twisted and spun from long staple fibers) suiting fabric [1] and produces a lower cost product while exploiting the positive market perceptions associated with the luxury cashmere content. Labelling textiles to indicate their composition in such blends is required from both technical and marketing perspectives.

II. KASHMIR AND PASHMINA

Kashmir is known globally for handicrafts. The State has an age old history of rich crafts being practiced at cottage level. These crafts are known for their intricacy and exclusivity. The contribution of these crafts to economy is presently estimated to be Rs. 3, 000 crores. The Pashmina related production from the State of Jammu & Kashmir at a present scale is estimated to an approximate annual turnover of Rs. 1000 crore of which Rs. 700 crore is from exports. Over 1,00,000 workers, including women spinners are directly engaged in the production of Pashmina in the valley and about 10,000 more are benefited by the industry, indirectly. Handicraft industry enjoys the status of being number two in terms of providing employment opportunities to approximately 5 lakh people associated with it directly or indirectly after agriculture. However, the handicraft industry of the state has not been able to reach its deserved heights due to various factors. Globally, there is huge demand for Kashmir handicrafts. However, competition from imitations and look alikes of other countries has marginalized the share of Kashmir handicrafts and is viewed as a threat in absence of brand identity and quality description. Thus, arises the need to safeguard the inherited originality of the regional handicrafts through a mechanism that will ensure protection of the handicrafts of Kashmir as well as help in developing distinct brand identity.

In this paper, we compare various methods, which have been used to determine the purity of pashmina fibres, and propose a new method, which would improve upon the previous models in terms of ease of common man to testify the purity of pashmina goods.

III. TECHNIQUES USED

1. SEM provides detailed high-resolution images of the sample by roistering a focused electron beam across the surface and detecting secondary or backscattered electron signal. An Energy Dispersive X-Ray Analyser (EDX or EDA) is also used to provide elemental identification and quantitative compositional information mainly used in pattern detection and descriptive modelling [2].

2. DNA profiling (alsocalled DNA fingerprinting, DNA testing, or DNA typing) is the process of determining an individual's DNA characteristics, called DNA profile, that is very likely to be different in unrelated individuals, thereby being as unique to individuals as are fingerprints (hence the alternative name for the technique). DNA profiling with the aim of identifying not an individual but a species is called DNA barcoding.[3]

3. Differentialscanning calorimetry, or DSC, is a thermo-analytical technique in which the difference for heat required to increase the temperature of a sample and reference is measured as a function of temperature. Both the sample and reference are maintained at nearly the same temperature throughout the experiment. Generally, the temperature program for a DSC analysis is designed such that the sample holder temperature increases linearly as a function of time.[4]

4. Machine learning is a sub field of computer science that empowers computers to act, learn and make decisions like humans, by feeding them data and information in the form of observations and or real-world interactions without the need of explicit programming them. Machine learning systems automatically learn from the inputs that are fed to them. This is a better alternative to manually constructing them because it saves us a lot of time and resources.[5]

5. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful

information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/ features associated with that image.[6]

6. Artificial neural networks (ANNs) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. Such systems "learn" (i.e. progressively improve performance on) tasks by considering examples, generally without task-specific programming.[7]

7. The Learning Vector Quantization algorithm (or LVQ for short) is an artificial neural network algorithm that lets you choose how many training instances to hang onto and learns exactly what those instances should look like[8]

TABLE I. Comparison of Various Models of Pashmina Purity Determination

Paper	Technique	Equipment Used	Result
Langley Kennedy (1981)[9]	SEM investigation of Fibre scale general nature	SEM	Wool – Longest, most even scales. Pashmina – Broader, thicker, shorter, uneven scales.
Wortmann and Arns (1986)[10]	SEM investigation of cuticle scale height	Hand microtome, SEM	Wool – Higher cuticle scale height Pashmina – Lower height
Robson (1989)[11]	SEM investigation followed by basic image processing	SEM, image processing functions	Parameters extracted by image processing for clearer distinction of parameters.
Nelson (1992)[12]	DNA Analysis	Human Identification System	DNA contrasting used to differentiate fibres.
Claudia (2002)[13]	DSC tracing and thermal denaturation	Stereo scan 240 SEM, DSC tracer	Enthalpy difference used to distinguish fibres.
Varley(2006)[14]	Vertical Sequential Cuticle Scale height measurement	SEM	Vertical Cuticle Height measurement
Shi and Yu(2009)[15]	Machine Learning	CCD Camera	Bayes classification model used to incorporate parameter differences.
Qian.(2010)[16]	Image Processing	Camera. Image and data processing software	Staining followed by image processing and calculating blend ratio and its difference.
Zhang(2010)[17]	Wavelet Transform Analysis	SEM	Features extracted using brightness variations caused by the cuticular scale height, shape and interval used for classification.
Shi and Yu (2011)[18]	Neural Network Model	Camera, Image processing software.	Features extracted using image processing and a neural network used for classification with 93% efficiency.
Xian-Jun Shi (2011)[8]	LVQ Neural Network Model	CCD Camera	Inexpensive and cost-effective neural network-based variant with 91% efficiency.
Tonetti (2012)	Immunological method using monoclonal antibody production.	Chemicals including meta bi-sulphides, urea, dithiothreitol.	Different protein yields to separate wool and pashmina.
Kim (2013)	Protein Fingerprint Analysis	Mass spectrometer.	Ion peaks ratios used to distinguish fibres.
Vineis (2014)	Peptide Analysis	Mass spectrometer.	Extraction yield of keratin proteins used as differentiating parameter.

IV.CONCLUSION

Method 1

1. To develop a model which would upload the image of the fabric onto a server.

2. Server would magnify the image and use LVQ neural network model to determine its purity.

- The image would divided into a small number of pixels (iteratively until each small block contains a small line), slope and other information about the line would be stored in the data base.[17]
- Using the information extracted from each block the image could be easily magnified and the desired parameters for LVQ model would be determined .

3. Percentage purity would be returned to the user, using a user friendly application.

Method 2

The data-set consisting of the independent variables i.e. the extracted parameters and the dependent variable i.e. the percentage purity is divided into training and test sets. Since the result requires the prediction of a dependent variable i.e percentage purity, a regression algorithm such as "Random Forest Regression" is applied. Following the creation of decision trees, prediction for an observation is taken from each of these trees and an average of these gives the final prediction i.e the percentage purity.

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