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Application of K-Means Clustering to Enhance the Quality Control and the Impact of the Productivity in the Apparel Industries

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ABSTRACT

Fabric inspection systems for measuring the quality are an essential part of producing best quality product in an apparel industry. The object of the research work is to analyze the acceptable fabric grade point based on the fabric grade points category using k-means clustering and their impact on the production. By applying the machine learning tools k-means clustering we categorized that hundred unsupervised data in three groups (A, B and C) based on acceptable grade points, of up to 15 (A), 15 to 30 (B), and 30 to 40 (C) respectively. The upper grade fabric can be consumed to produce better products. Thus, we can improve customer satisfaction as well as positive impact on the apparel manufacturing efficiency on both quality and quantity.

Keywords: Machine Learning, Apparels, Textile, Regression, K-Means Clustering,

1. Introduction

In the present situation enhancing product quality and reducing costs are the prime objects of the competitive global market of apparel industries. Fabric inspection systems for measuring the quality are an essential part of producing textile materials since a significant chunk of fabric inspection is done manually by human inspectors(Abou-Taleb et al., 2008). The four-point and ten-point procedures are the most often used fabric inspection systems. For knit fabric, a four-point system is used, and for woven fabric, a ten-point system. Nowadays automatic fabric inspection systems are developed with the help of machine learning algorithms(Banumathi&Nasira, 2012). Fabric inspection has traditionally been done by human visual verification, which has high labour costs and low efficiency. Due to human mistakes brought on by fatigue, their performance is inconsistent, and very slight flaws are difficult to spot. Artificial intelligence applications may provide a practical and affordable method for decision-making in the fashion sector(Tong et al., 2017). The object of the research work is to analyze the acceptable fabric grade point based on the fabric grade points category using k-means clustering and their impact on the production. In the apparel-making sector, consistency can be achieved when the garments are produced based on the material quality, quantities and measurements are dependent on bulk production(Wijayono et al., n.d.).

Few studies have been conducted on garment inspection where the maximum faults show from the fabric defects the majority have focused on fabric inspection. The introduction of automatic garment inspection takes the place of manual clothing inspection. The market is still only somewhat small. Defects must be found in various areas of garment inspection, including sewing, garment sizing, cloth cutting, pressing, dyeing, and other areas. It was suggested to use automatic garment inspection with machine vision to categorize the common problems with shirt collars made of monochromatic fabrics(Yuen et al., 2009). The fabric is typically inspected by the fabric quality control departments either by laying the cloth out on a flat surface or by moving the fabric with a fabric inspection machine. When a quality control employee notices something, the quality control manager is reviewed to determine whether the linked fabric is suitable for manufacturing(Arıkan, 2019).

2. Literature Review

The modern apparel industries always aware about the quality of the products. Because the fabric flaws can significantly affect prices and final product grade, visual surface inspection of fabrics is crucial in the current textile industry for quality control of textile and fashion products. Nearly 85% of second-quality items in the clothing sector are caused by fabric problems, which costs manufacturers less money to produce because second-quality goods only fetch 45%–65% of the cost of first-quality fabric. Fabric inspection is therefore of the utmost importance to avoid producing products of poor quality(Goyal, 2018). Quick defect detection becomes a critical stage in the fabric quality control system as the rate of fabric production increases. Human inspectors have historically been used to find fabric flaws, which slows down the production of high-quality fabrics. The price of fabric is reduced by 45–65% when faults are present, so it is vital to replace human inspectors with intelligent detection systems that use computer vision to boost the effectiveness of fabric defect detection(Zhu et al., 2014a). To solve this problem, we improve previous methods and propose to detect fabric defects via the small scale over-complete basis set. The machine learning algorithms like K-Mean clustering, fuzzy logic etc at the training process only needs defect-free fabric images and the over-complete basis set is trained via sparse coding. To overcome the computation problem posed by Zhou,21,22 the fabric patch's projections in all vectors of the over-complete basis set are taken as the features. The scale of the basis set is proportional with computation cost. In order to reduce the scale of the basis set and decrease more computation, we use Gabor filter to preprocess the fabric image to reduce the complexity of the fabric image signal, which also can reduce the influence of noise(Zhu et al., 2014b). Except the knit fabric inspection system verification of the shipping quantity and random sample are typical inspection elements for the garment inspection procedure. examining the quality of the work, comparing the style and color, measuring the dimensions, identifying the packaging, and checking the labels and markings. The recording of workmanship has the greatest impact on the effectiveness of the entire operation. Flaws found during manufacturing inspection. The requirement to examine all textile components stems from the requirement to prevent the end user from obtaining products that might be structurally flawed(Yuen et al., 2008).

3. Material and Methodology

The project work is done at Narayangonj, Dhaka, in the knit composite industries. The research data was collected by observing the inspection results, and quantitative qualitative data was sourced from the fabric inspection department of the factory. We have studied the types of fabric faults and penalty points of cloth faults and found out the fabric acceptable grade points per hundred yards from the equation number 1. In the process flow diagram of the research work image number 1, we collected sufficient information about the cloth weight per unit length called gram per square meter (GSM), Fabrics types, compositions, width, length and required quantity from the merchandising department. The data set was prepared from the booking information and received quantity. There were seven types of knit fabric. Single Jersey and Pique cloth construction was 100% cotton, Lycra Pique and Yarn Dyed Lycra Pique, 63% cotton, 33% modal and 4% Lycra, Interlock, 68% cotton, 14% Polyester and 8% Lycra and Yarn Dyed single Jersey. The total quantity of knitting fabric booked was 69520 kg and the received quantity was 68421.5 kg. among them 10% of fabric was inspected by the four points system. The length of the inspected fabric was 15694.5 yards and the average width of the cloth was 65 inches. The total number of different defects was 4514 during fabric inspection. We classified the permissible grade points per hundred yards after inspecting the fabric. Grades A, B, and C were regarded as acceptable grade points of 15, 30, and 40, respectively. K-Mean Clustering was used to group the fabric grades and compare them to the garment section's cutting effectiveness.

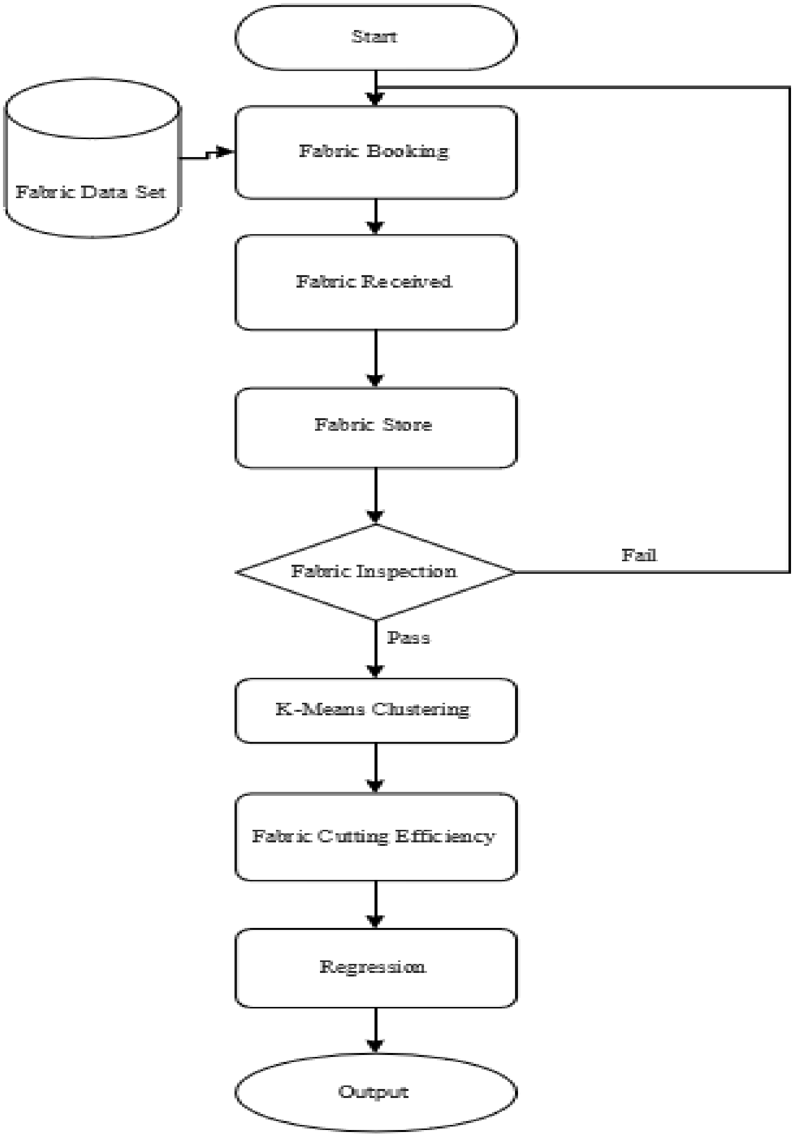

Figure 1 The process flow diagram of research work

3.1 Equation

$$Fabric\ grade\ Points\ Per\ 100\ Square\ yards = \frac{Total\ \ Penalty\ \ Points\ \ X\ 100X36(inch)}{Inspected\ \ Fabric\ \ Length(yds)X\ Fabric\ \ width(inch)} \quad (1)$$

4. Result and Discussion

The characteristics of the allowable grade points for fabric are displayed in Table 1. We determined the grade points of the fabric using equation 1. The fabric structure, gram per square meter, fabric breadth, inspection length, and the amount of flaws to compute acceptable grade points are the factors that determine grade points for clothing inspection.

Table 1 Inspection Results of Fabric Points

Sl #	Fabric Structure	GSM	Fabric Width (Inches)	Inspected Fabric Length (yds)	Total Number of Deffects	Total Penalty Points	Acceptable Grade Points
1	Pique	222	76	169	51	105	29
2	Lycra Pique	187	81	205	52	108	23
3	Yarn Dyed Lycra Pique	188	82	207	40	98	21
4	Single Jersey	180	78	120	35	85	33
5	Inter Lock	210	56	245	42	103	27
6	Yarn Dyed Single Jersey	220	65	155	60	110	39
7	Lycra Single Jersey	185	62	160	62	115	38
8	Pique	225	75	210	56	120	27
9	Single Jersey	185	75	180	71	109	29
10	Inter Lock	220	58	140	65	90	40
--	Yarn Dyed Lycra Pique	190	65	225	59	95	23
---	Yarn Dyed Single Jersey	185	75	220	118	110	24
---	Lycra Single Jersey	175	72	310	126	115	19
99	Pique	210	72	315	128	122	19
100	Single Jersey	180	75	240	120	125	25

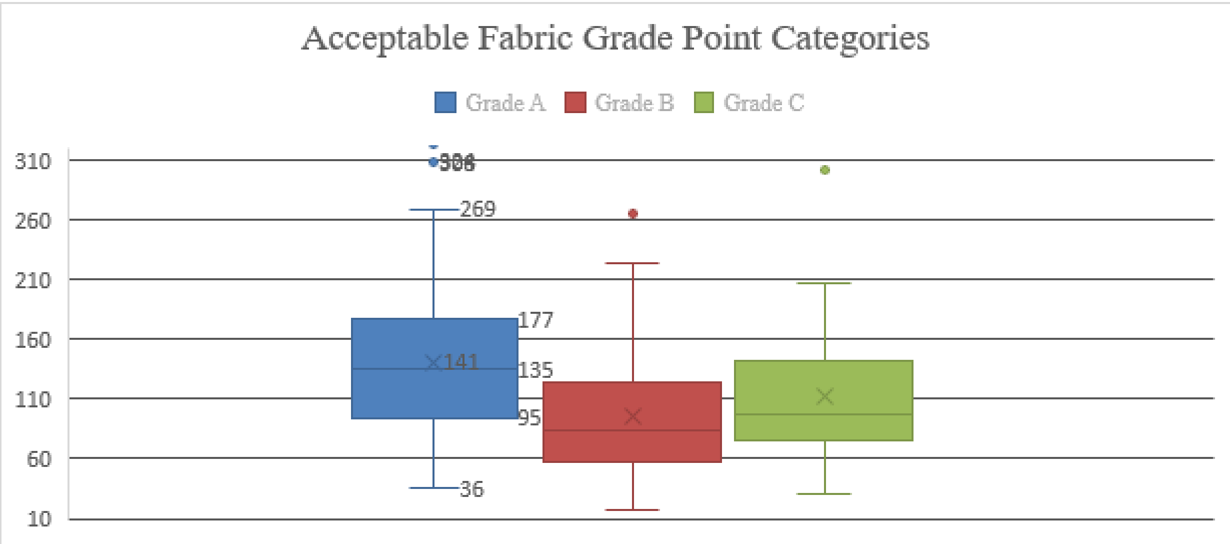

Figure 2 K-Means Clustering Categorised the fabric grade

Figure 2 shows the allowable grade points for grade A fabric, with the maximum outliers being 324, the maximum without outliers being 269, the third quartile value being 177, the mean being 141, the first quartile value being 25, and the minimum outliers being 36. Similar to this, fabric grade points of B and C values are 96 and 113 respectively, with maximum outliers of 266 and 302, without maximum outliers of 223 and 207, 3rd quartile values of 124 and 142, mean values of 57 and 75, and minimum without outliers of 18 and 31, respectively.

Table 2 Regression Results of Fabric Grade A, B and C

Regression Statistics, Grade A		*Regression Statistics, Grade B*		*Regression Statistics, Grade C*	
Multiple R	0.367610788	Multiple R	0.572948683	Multiple R	0.506570063
R Square	0.135137691	R Square	0.328270194	R Square	0.256613229
Adjusted R Square	0.056513845	Adjusted R Square	0.317435842	Adjusted R Square	0.221213859
Standard Error	39.34517827	Standard Error	30.38384464	Standard Error	30.13512105
Observations	13	Observations	64	Observations	23

The fabric grade points A, B, and C regression results are shown in Table 2. The R-square values are gradually 0.135, 0.328, and 0.256, which suggests that our independent variable, i.e. Cloth grades on the factors that gradually influence the dependent variable, i.e., by 13.5%, 32.8%, and 25.6%. efficiency in cutting fabric.

Table 3 Analysis of Variation Results

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2660.757189	2660.757189	1.718787591	0.216557849
Residual	11	17028.47358	1548.043053		
Total	12	19689.23077			
Regression	1	27971.38528	27971.38528	30.29901582	7.51559E-07
Residual	62	57237.03694	923.1780152		
Total	63	85208.42222			
Regression	1	6583.083876	6583.083876	7.249090271	0.01363725
Residual	21	19070.63593	908.1255205		
Total	22	25653.71981			

The results of the analysis of variance (ANOVA) for the fabric grade points A, B, and C are shown in Table 3. The F-values are gradually 1.718, 30.299, and 7.249, indicating that our independent variable, i.e. Grades for fabric go higher than the F-values of sigma=0.05 The hypothesis not significant.

Table 4 Coefficients Results of Fabric Grade Point and Cutting Efficiency

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	76.33441866	24.5313768	3.111705442	0.009895316
Grade A	0.272864697	0.208130749	1.311025397	0.216557849
Intercept	53.8627498	9.783424532	5.505510839	7.48539E-07
Grade B	0.345600668	0.062785638	5.50445418	7.51559E-07
Intercept	47.34734319	17.34310349	2.730038671	0.012544408
Grade C	0.281430724	0.104527305	2.692413466	0.01363725

Table 4 displays the findings of the coefficient p-values for the fabric grade points A, B, and C. The p-values are 0.216 to 7.515 to 0.013, show that the fabric grades A and B have p values higher than the sigma=0.05 so it non-significant While the grade C result is smaller than the p-value, it is significant.

5. Conclusions

This methodology can be used in apparel industry to grade their existing fabric. The upper grade fabric can be consumed to produce better products. Thus, we can improve customer satisfaction as well as positive impact on the apparel manufacturing efficiency on both quality and quantity. To the get more precise effects we can use automation instead of manual system.

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References

Abou-Taleb, H. A., Tallah, A., &Sallam, M. (2008). ON-LINE FABRIC DEFECT DETECTION AND FULL CONTROL IN A CIRCULAR KNITTING MACHINE. In *AUTEX Research Journal* (Vol. 8). http://www.autexrj.org/No1-2008/

Arıkan, C. O. (2019). Developing an intelligent automation and reporting system for fabric inspection machines. *TekstilveKonfeksiyon*, *29*(4), 86–93. https://doi.org/10.32710/tekstilvekonfeksiyon.491362

Banumathi, P., &Nasira, G. M. (2012). Fabric Inspection System using Artificial Neural Networks. *International Journal of Computer Engineering Science (IJCES)*, *2*(5). https://sites.google.com/site/ijcesjournalhttp://www.ijces.com/

Goyal, A. (2018). Automation in fabric inspection. In *Automation in Garment Manufacturing* (pp. 75–107). Elsevier Inc. https://doi.org/10.1016/B978-0-08-101211-6.00004-5

Tong, L., Wong, W. K., &Kwong, C. K. (2017). Fabric Defect Detection for Apparel Industry: A Nonlocal Sparse Representation Approach. *IEEE Access*, *5*, 5947–5964. https://doi.org/10.1109/ACCESS.2017.2667890

Wijayono, A., Mahure, J., & Kulkarni, Y. C. (n.d.). *Related papers FABRIC FAULTS PROCESSING: PERFECTIONS AND IMPERFECTIONS*. www.tjprc.org

Yuen, C. W. M., Fung, E. H. K., Wong, W. K., Hau, L. C., & Chan, L. K. (2008). Application of smart system to textile industry: Preliminary design of a smart hanger for garment inspection. *Journal of the Textile Institute*, *99*(6), 569–580. https://doi.org/10.1080/00405000701660160

Yuen, C. W. M., Wong, W. K., Qian, S. Q., Chan, L. K., & Fung, E. H. K. (2009). A hybrid model using genetic algorithm and neural network for classifying garment defects. *Expert Systems with Applications*, *36*(2 PART 1), 2037–2047. https://doi.org/10.1016/j.eswa.2007.12.009

Zhu, Q., wu, M., li, J., & Deng, D. (2014a). Fabric defect detection via small scale over-complete basis set. *Textile Research Journal*, *84*(15), 1634–1649. https://doi.org/10.1177/0040517514525880

Zhu, Q., wu, M., li, J., & Deng, D. (2014b). Fabric defect detection via small scale over-complete basis set. *Textile Research Journal*, *84*(15), 1634–1649. https://doi.org/10.1177/0040517514525880