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A COMPARISON BETWEEN THE NEW ESTABLISHED SIZING SYSTEMS SUD AND SUR MILITARY CLOTHING FACTORY SIZING CHART FOR POSHIRT (U4)-PART 1

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Abstract: The purpose of this paper was to use data mining techniques in establishing standard sizing system for Sudanese army officers garment based on an anthropometric body measurements variables and to compare it with national sizing charts. The data set collected for 841 army officers and for each individual13 anthropometric variables were involved. In this work data mining methods (WEKA and SPSS) were used for clustering and establishing sizing system. The K-means algorithm was implemented to determine the final cluster classification. Cluster analysis using chest and waist as a control anthropometric variables revealed a new established sizing system SUD which consists of eight distinct clusters namely; XS, S, M, L, XL, XXL, XXXL and XXXXL. Size codes and upper and lower size limits are generated. The new proposed sizing system SUD profile was compared with profile of SUR national standards sizing charts. The results revealed that the proposed sizing system SUD follow approximately the same profile as SUR national standard size chart.

Keywords: Data mining, anthropometric survey, garments industry, sizing chart, clustering

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1. INTRODUCTION:

Fayyad et al, (1996) define, data mining as, "the process of extracting valid, previously unknown comprehensible information from large databases in order to improve and optimized business decisions. This definition seems to me more complete definition of data mining. Data mining, uses of algorithms in order to extract the information and patterns derived by the knowledge discovery in database (KDD) process. Fayyad et al, (1996) stated that the term knowledge discovery in databases (KDD) is the nontrivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data. The distinction between the (KDD) process and the data – mining step (within the process) is that, (KDD) refers to the overall process of discovering useful knowledge from data. On the other hand data mining (DM) is the application of specific algorithms for extracting patterns from data.

2. BACKGROUND:

Data mining techniques have been used in many fields, but little research has been done on its application to sizing systems for the manufacturing of garments.Norsaadah et al, (2008) established a sizing system for the manufacture of garment using decision tree based data mining to determine the pants size of army soldier's uniform.Hsu (2008) conducted an empirical study in apparel industry in order to support manufacturing decision for production management as well as marketing with various customers' needs. Hsu (2009) also discussed a two – stage cluster approach, it generates useful patterns and rules for standard size charts. More recently (Bagherzadeh et al, 2010) introduced a study for developing sizing systems by data mining techniques using anthropometric data.A three – stage data mining procedure were employed to develop sizing system for lower body figure type of Iranian male.Hai et al, (2008) studied the application of data mining techniques for developing a sizing system for army soldiers' uniform in Taiwan.In Malaysia; (Norsaadah et al, 2008) used data mining techniques to explore anthropometric data for the development of sizing systemusing the whole data was analyzed using descriptive analysis of average, mean and standard deviation. The data obtained was further explored using the factor analysis method.

3. MATERIAL:

In this work an anthropometric data of 841 army officers were collected from Sur Military Clothing Factory in Sudan. A total of 813 numbers of instances were processed, with 13 different attributes. The attributes for the jacket were, cuff, sleeve, shoulder, length, waist, chest and collar. For the trouser the attributes were length1, foot, knee, thigh, hip, and waist1. For the trouser, the term length1 and waist1 were usedin order to distinct them from those of the Jacket. The measurements of anthropometric data followed the ISO 85591/1989 body measurement standard.

4. METHODS:

The chosen methods for this work were WEKA 3.6.9 and SPSS version 18.0.Because WEKA does not work with numbers, these (813) instances for (jacket + trouser) were categorized in numerical groups. The distribution of the proposed groups was based on waist and length attributes. The database was converted to (size.csv) format to be processed in WEKA. The text file describes a list of instances that sharing a set of attributes. After processing the (size.csv) file in WEKA a list of all attributes, statistics, and other parameters can be utilized as shown in figure: 1.

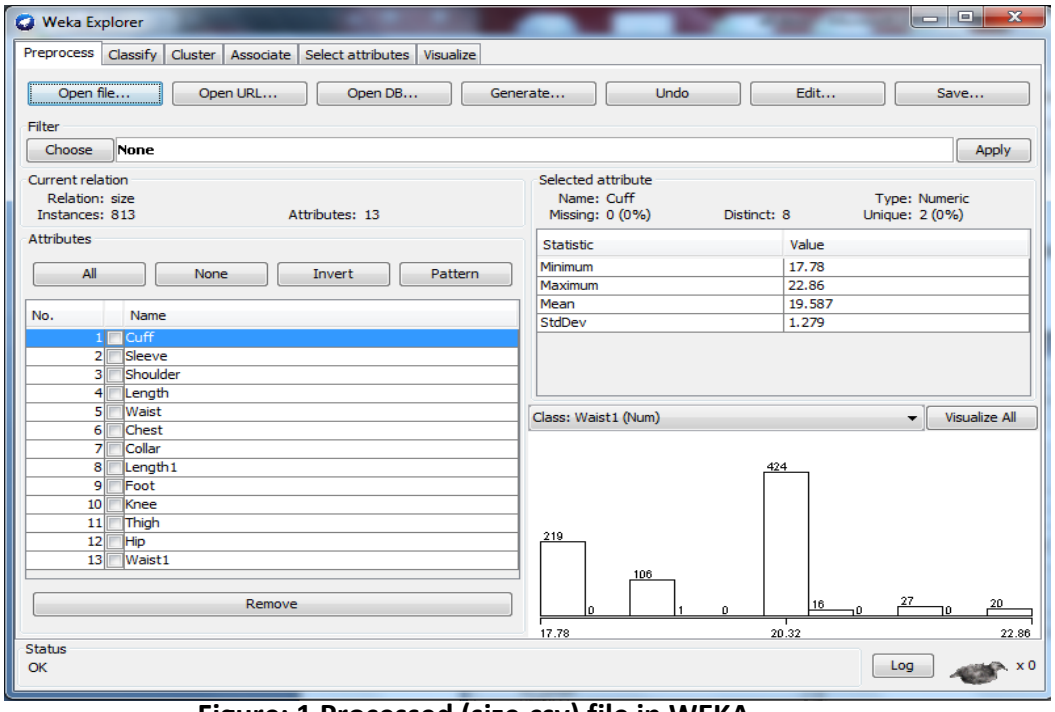

Figure: 1 Processed (size.csv) file in WEKA

5. RESULTS AND DISCUSSION:

Elawad (2015) stated that the new clusters generated using the WEKA werecluster (7, 8 and 9).In cluster 7 the percentage covered by the proposed sizing systems was 97%. However, the size figures 4XL and 5XL were not selected by the WEKA. This may be due to the fewer number of persons in these size figures. On the other hand, in cluster 8 the percentage covered by the proposed sizing system was 96.7 and there was only one size figure (5XL) with no classes that was not represented. This may be due to the fewer number of persons in this size figure. In cluster 9 the percentage covered by the proposed sizing system was 76.7, but there were four sizing figures XL, 3XL, 4XL and 5XL were not represented. This may be due to the fewer number of persons in these size figures.

As can be seen from the results, in the three clusters (7, 8, and 9) the size 5XL was omitted in all clusters. This may be attributed to the nature of the Sudanese male body shape. Therefore cluster 8 seems to be the best sizing system that represents the data collected from Sur factory. This is because it covered nearly 96.7% of the data and it includes 8 figure types. After the eleven figure sizes were classified by the WEKA, the new established size system of the eight figures size were determined following step by step SPSS (1999) and the results are given in Table1.

Table 1: The Proposed New Established Size System

	XS **M-2STD**	**S** **M-1STD**	**M** **Mean**	**L** **Mean+1STD**	**XL** **M+2STD**	**XXL** **M+3STD**	**XXXL** **M+4STD**	**XXXXL** **M+5STD**
Cuff	17	18.3	19.6	20.9	22.2	23.5	24.8	26.1
Sleeve	56.6	60.1	63.6	67.1	70.6	74.1	77.6	81.1
Shoulder	40.6	43.6	46.6	49.6	52.6	55.6	58.6	61.6
Length	68.6	73.4	78.2	83	87.8	92.6	97.4	102.2
Waist	73.5	85.1	96.7	108.3	119.9	131.5	143.1	154.7
Chest	92	100.5	109	117.5	126	134.5	143	151.5
Collar	36.1	39	41.9	44.8	47.7	50.6	53.5	64.9
Length 1	97.1	101.7	106.3	110.9	115.5	120.1	125	129.3
Foot	40	42.9	45.8	48.7	51.6	54.5	57.4	60.3
Knee	46.1	50	53.9	57.8	61.7	65.6	69.5	73.4
Thigh	63.8	69.5	75.2	80.9	86.6	92.2	97.8	103.7
Hip	93.2	99.2	105.2	111.2	117.2	123.2	129.2	135.2
Waist 1	72.6	83.3	94	104.7	115.4	126.1	136.8	147.5

n = 813all values are in centimeters ___ jacket ___ trouser

Figure (2) shows the relevant scatter plots of chest on the X-axis verse the waist on the Y-axis and the interval was 4 cm to demonstrate the distribution of all figures type. It has been reported that, Cooklin, (1992) the chest is the most important anthropometric variable in establishing sizing systems in the field of garment making. The waist is also an important variable for sizing male garments in many countries. Figure (3) illustrates the differences between the eight types for the new established sizing systems. The figure was plotted as a line graph to yield a better insight into the differences between the new established sizing systems.

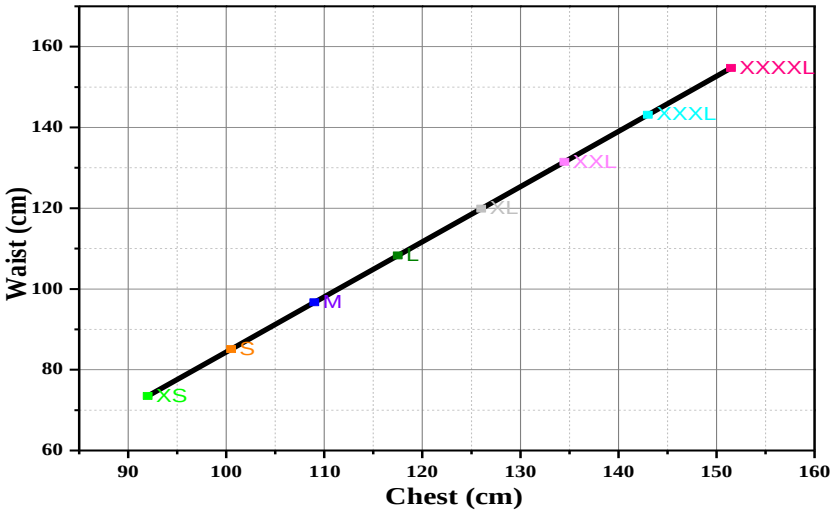

Figure 2: Scatter plot of chest verse waist for the proposed new established size system

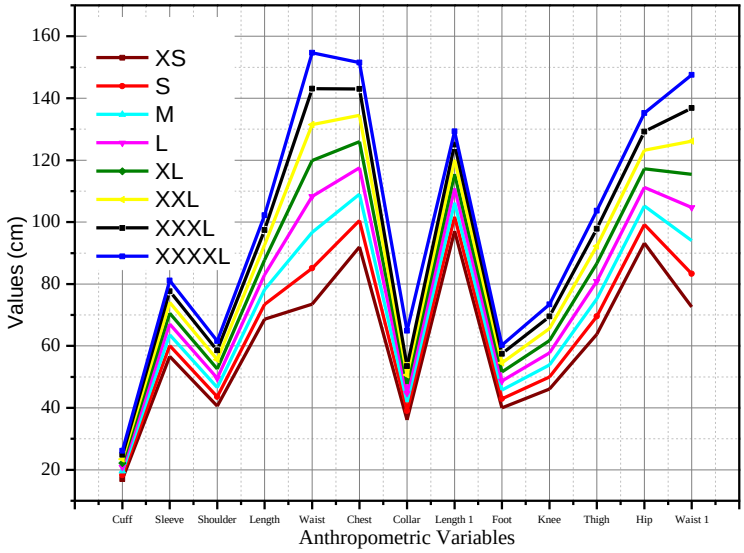

Figure3: The distinct anthropometric variables between the proposed new established size systems

The new size code was termed (SUD) abbreviated for Sudan, and then the code was added to establish the 8 size figures for Sudanese army officers (poshirt uniform). Therefore, the new size codes are, SUD XS, SUD S, SUD M, SUD L, SUD XL, SUD XXL, SUD XXXL and SUD XXXXL.In order to know what percentages of the populations are covered by each size we need to establish lower and upper limits. The value obtained for each size code is used as a midpoint and the lower and upper limit are determined from it. The half value of the standard deviation of each body dimension added or subtracted to the midpoint value. A value of 0.01 is subtracted from the figure obtained below the midpoint to create limits between the lower value of the next size and the upper value of the previous one. To avoid overlapping of figures with the next size value of 0.01 is subtracted from the upper limit making it less than the next value. Beazley, (1998) and other researchers used this procedure.

6. A COMPARISON BETWEEN THE NEW ESTABLISHED SIZING SYSTEMS SUD AND SUR MILITARY CLOTHING FACTORY POSHIRT (U4)

In order to compare the new established sizing systems with SURnational sizing systems charts, five figure types; SX, S, M, L and XL, and five variables; chest, waist, hip, collar and sleeves were chosen from the eight figure types, see table (1). As can be seen from tables (2 and 3) and figures (4), the new size system (SUD) follows the size chart for the sizing systems (SUR). Therefore, the scatter plot of chest verse waist for the new size system SUDfollows the same trend that was plotted in figure (2). For the new established size figure (SUD) figure (2) plots a distribution graph of chest on the X-axis verse waist on the Y-axis to demonstrate the distribution of all five figure types. It can be seen that in figures (2 and 3) for both the new established sizing systems (SUD and SUR) the plot of chest verse waist fall in straight lineand follow the same profile.

Table (2): Five Steps Size Ranges Obtained from the New Established Sizing Systems SUD

Size Body Dimensions	**XS** **Mean** **-2STD**	**S** **Mean** **-1STD**	**M** **Mean**	**L** **Mean** **+1STD**	**XL** **Mean** **+2STD**
Chest	92	100.5	109	117.5	126
Waist	73.5	85.1	96.7	108.3	119.9
Hip	93.2	99.2	105.2	111.2	117.2
Collar	36.1	39	41.9	44.8	47.7
Sleeve	56.6	60.1	63.6	67.1	70.6

n = 813all values are in centimeters

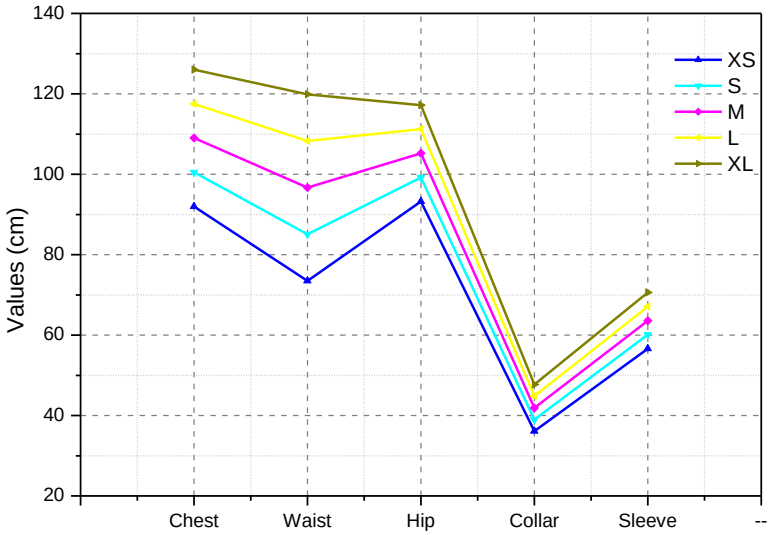

Figure4: New established sizing system 5 figure types and corresponding anthropometric variables

Table3: SUR Military Clothing Factory Poshirt (U4) Size Specification

Size	XS (cm)	S (cm)	M (cm)	L (cm)	XL (cm)
Chest	104.1	106.7	109.2	111.8	114.3
Waist	84	89	94	99	104
Hip	99.8	104.8	109.8	114.8	119.8
Collar	36.8	38.1	39.4	40.6	41.9
Sleeve	61	62.2	63.5	64.8	66

All values are in centimeters

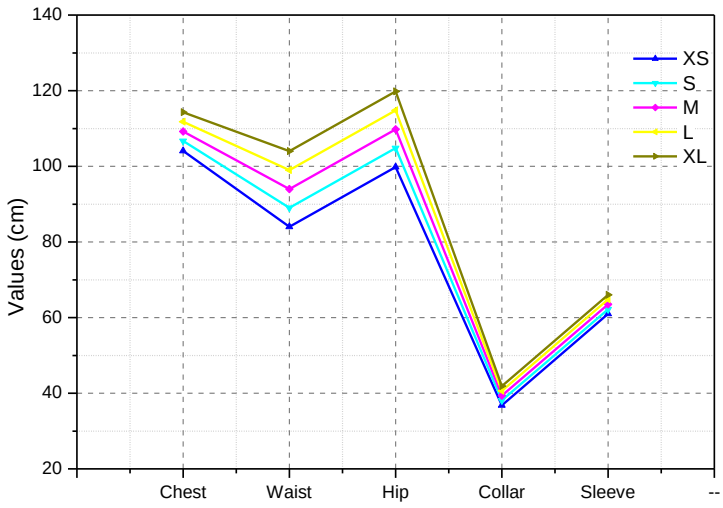

Figure (4): SUR 5 figure types and corresponding anthropometric variables

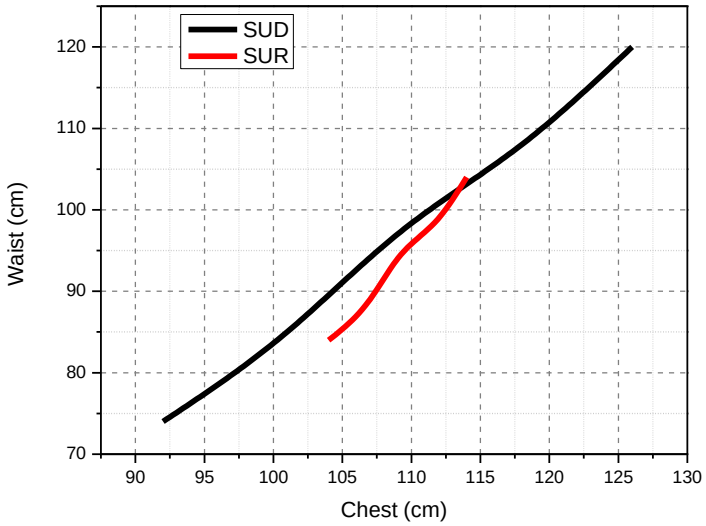

Figure5: The New SUD and SUR scatter plot of chest verse waist for 5 figures Types

Figure 5 shows that the new established sizing systems SUD and SUR the plot of chest verse waist approximately fall in straight line this may be due to:

a) The national standards (SUR) deal essentially with the size designation of clothing and are not directly concerned with the sizing systems as such. In other words, the establishment of a size designation system that indicates the body size of a person that a garment is intended to fit. Therefore, the size designation system is based on body and not garment measurements. Choice of garments measurements is normally left to the garment designer and manufacture, who are concerned with style, cut and other fashion elements, and he must make due allowance for garments normally worn beneath a specific garment.

b) The new established sizing systems deals with clothing designer and manufactures where the measurements are taken manually and for every individual. Therefore, the measurements may not be accurate. The accuracy of measurements depends on the skill of the person who takes the measurements. Also this difference may be due to the nature of the Sudanese body size compared with other nationalities.

CONCLUSION:

In this paper, data mining methods (WEKA and SPSS) were applied in order to establish sizing systems for Sudanese army officers' uniform (poshirt). The new established sizing systems SUD were compared with SUR standard national sizing charts. The results revealed

that the new established sizing systems follow approximately the same profile. With clustering technique it was possible to discover the differences in body shapes that exited among army officers poshirt uniform in Sudan. Therefore it is important to consider their body shapes differences in garments production.

From the reviewed literature it was clear that the rule of classification of the whole body types (upper and lower) has been investigated in a few works before. Therefore this work looked into this topic. This was done because it helps the garment manufacturer to better understand the customer's body shape characteristics and therefore planning for production accordingly.

The percentage of army officers who fall in a certain figure type and sizes can serve as a good reference to indicate the quantity of garments to be produced for specific market. Thus a realistic plan for producing male army officer's uniforms can be established.

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