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## Big data in fashion industry

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## Big data in fashion industry

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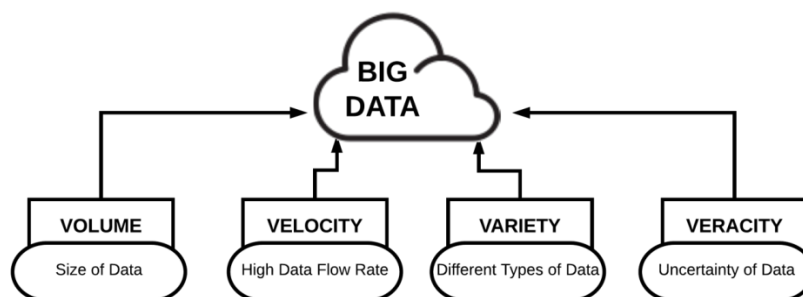
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**Abstract.** Significant work has been done in the field of big data in last decade. The concept of big data includes analysing voluminous data to extract valuable information. In the fashion world, big data is increasingly playing a part in trend forecasting, analysing consumer behaviour, preference and emotions. The purpose of this paper is to introduce the term fashion data and why it can be considered as big data. It also gives a broad classification of the types of fashion data and briefly defines them. Also, the methodology and working of a system that will use this data is briefly described.

### 1. Introduction

The industries are experiencing evolution since ages. The first industrial revolution embarked the use of steam and water to mechanize production. The second used electrification to introduce the world to mass production and division of labour. The third saw the rise of computers and digital technology, which automated the production processes. The third revolution has evolved into the fourth which encompasses the ‘Internet of Things’, and at its core lies the combination of big data, analytics and physical technologies [1] [2].

Big data, as the name suggests, is an enormous amount of data. It can be defined by the 4V’s – Volume, Velocity, Variety, and Veracity (figure 1) [3] [4]. The ability to analyse this huge amount of data is known as big data analytics. The analysis of big data makes valuable conclusions by converting the data into information, that otherwise could not be exposed using less data and traditional methods.



**Figure 1.** The four V's of big data

Big data has gained significant importance in the fashion world in the last decade [5] [6] [7]. It is increasingly being used in trend forecasting, supply chain management, analysing customer behaviour, preferences and emotions. The demands of the customer, nowadays, are constantly changing. They want garments with a personalized style, fit and pattern/color/print. Because of this, the fashion companies lose a lot of money due to excessive stock, which becomes obsolete because of changing trends.

To deal with this, the industry has experienced a shift from mass production to mass customization, which is simply customization at mass production efficiency [8]. There are many technologies that help the industry in creating new ways for satisfying the ever-growing and ever-changing needs of the customer. There are, however, many challenges when it comes to adapting the production process as complexity increases with the level of customization [9] [10].

Another problem with mass customization is that, the customer is unaware of her/his needs and mostly lack professional design knowledge. Due to this, most mass customized products are not as desired, and hence, the customer is rendered dissatisfied. Thus, the requirement of a personal style advisor arises; to help the customer in finding a garment that satisfies her/his needs. Since, everything is going on the web, so there are virtual style advisors available. Most of them are not affordable by every customer. For this, the recommendation systems were introduced. These systems offer the customer recommendations during the process of designing. They can be based on collaborative filtering, wherein the system recommends on the basis of the preferences of a group of users; content based filtering, wherein the system uses user profile to match an item. This requires ratings given to a product directly by the user [11] [12].

But there is one crucial problem with these kinds of systems – the cold start problem [11]. This occurs when the system has to provide recommendation to a new customer. And since there is not enough information about the new customer, the recommended product may not be so relevant. Once the customer starts using the system, a significant amount of information about their preferences is stored, and then the effectiveness of the system starts increasing.

As a result, recommendation system progressed into knowledge base recommender systems [11] [13]. These systems have databases that are linked together with complex relationships. These databases, connected to the system, will give knowledge for giving recommendation to the customer. They don't need user profile for offering recommendations. Hence, they can help in solving the previously stated cold start problem.

For building these knowledge bases, the first requirement is to have data, in this case the data related to fashion industry. In this context, this paper defines the fashion data and how it can be classified. Also, it will introduce a methodology to create a search engine, where the customer can interact with the virtual environment to customize a garment according to his/her needs. The search engine will have integrated knowledge bases of fashion big data, thus helping the customer by giving style recommendations.

The rest of the paper is organized as follows: Section 2 presents an overview of the related works. The fashion data is defined in section 3. The proposed system is presented in section 4. Conclusions and future research direction followed in Section 5.

## **2. Related Work**

Significant work has been done in the field of big data. The term big data has been used since many years as a business buzz-word. Its significance and value has been proved in various sectors like

engineering, healthcare, education, manufacturing, entertainment, retail. Many companies use big data technologies to its maximum advantage on a daily basis to extract value from them. In research, many authors have been pointing out the potential benefits of using big data as a new tool to understand everything from traffic jams to customer preferences. However, big data is still at a nascent stage in the fashion industry. Several fashion retailers are now making use of big data to understand their customers' behavior and to cater to their needs in a better way.

In this context, a lot of research has been done, to develop recommender systems [13] [14] [15], which make use of the big data technologies to predict customer behavior. The key function of a recommendation system, in general, is to predict what a customer would like to buy, on the basis of their analyzed behavior, shopping preferences and the behavior of the people with similar choices or demographics. Most systems require sufficient information about the customer to be able to offer them products that will meet their needs. Martinez et al [16] proposed a recommender system that caters to the unavailability of enough information about customer preferences. Their system collects information from the user by using numerical preference relation structure which only requires to be filled with a small number of values. McAuley et al [17] proposed an image based recommendation system which modeled the human sense of the relationships between objects based on their appearance. All these systems, however, require prior knowledge about the preferences of the customer. For this reason, many knowledge base recommender systems have been developed. Wang et al [18] proposed a fashion recommender system that considers perception of both the fashion experts and the consumers. Their system integrates fashion themes and human perception on personalized body shape and fashion designer's knowledge.

So, it can be incurred from the literature that most of the developed systems focus on a particular knowledge – fashion design, fit, color, and material. Hence, there is an urgent need to develop a system that has all the knowledge bases related to garment design integrated.

### 3. Fashion big data

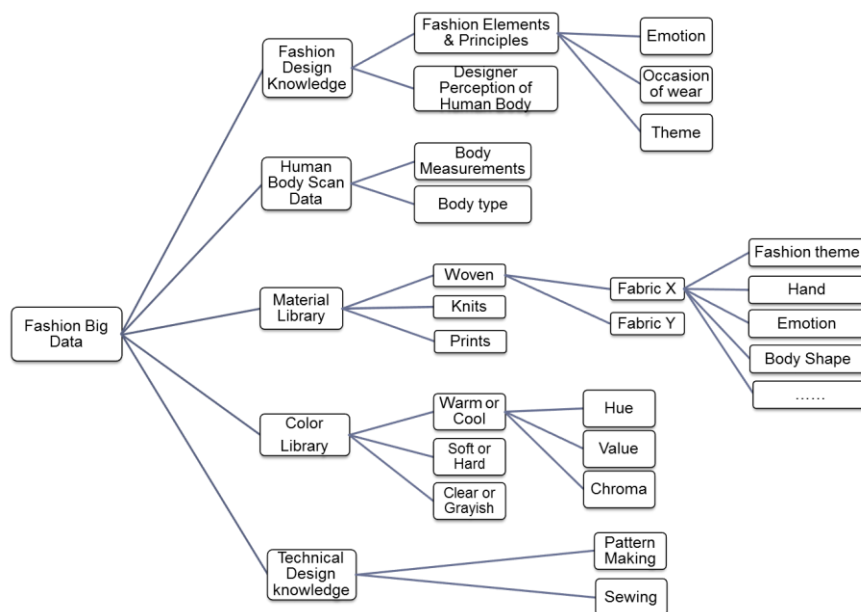
The Oxford dictionary defines data as *“The quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media”*

All the data associated with a fashion product is hence called as fashion data. This data can be used for trend analysis, customer behavior analysis, forecasting etc. Fashion industry generates and creates various sources of data. All these data come in various forms like words, images etc. Since it is the era of fast fashion, the data is rapidly growing and changing. Hence, this data can be termed as fashion big data as it portrays all the features of big data. Following is a broad classification of the fashion data (figure 2).

- i. **Material:** This includes the fabric that is used to make a fashion product. The fabric has various characteristics like yarn type, yarn count, yarn twist, weft & warp density, weave structure etc. To achieve different types of fabric, one or more of these are changed. This enormously changes the appearance and feel of the fabric, which correlate to emotions, fashion themes, colors etc.
- ii. **Fashion Design:** It is the knowledge about the elements & principles of design, which combined together, gives the design of a fashion product. The design of a product is mostly influenced by human emotions, fashion themes, occasion of wear etc.

- iii. **Body Data:** The body data can be in the form 2D or 3D data. For 2D, it is collected using the conventional method of body measurement. For 3D, it is collected 3D body scanners. These data can provide information like body measurement & body type.
- iv. **Color:** Color preference is an important aspect that influences a gamut of human behavior. Kobayashi's color image scale [19] states that color can have three attributes – warm or cool, soft or hard, clear or grayish, which associate with hue, chroma & value. These attributes can be linked with the emotion
- v. **Technical/Production design:** The technical design allows the producer to understand that how the product will be made. This makes the design of a product production friendly. It includes knowledge of pattern making, sewing etc.

To extract knowledge from these data, they have to be linked together. The next section describes the proposed system that will use this data.



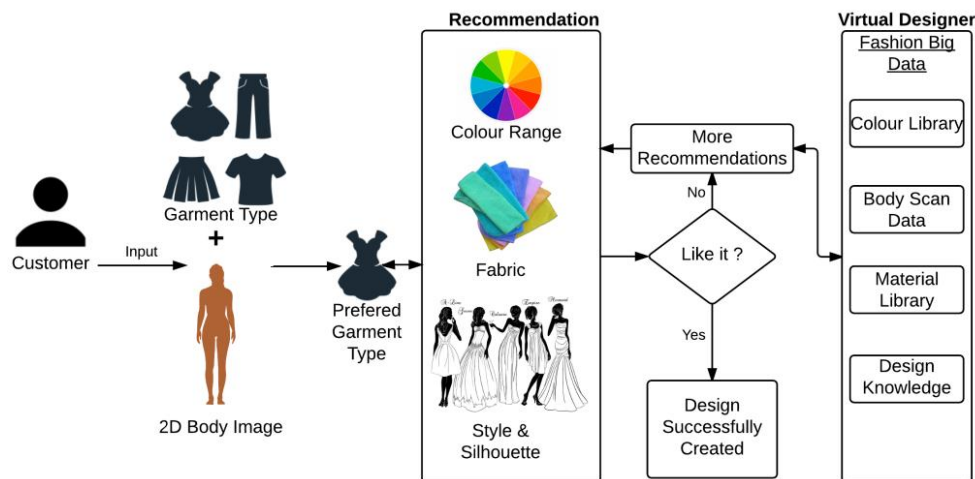
**Figure 2.** Data in Fashion

#### 4. Proposed System

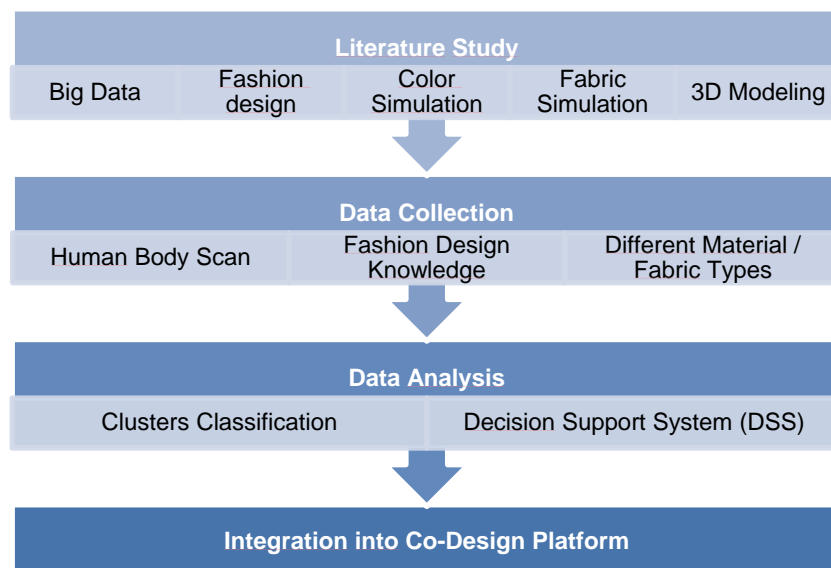
The proposed system (figure 3) is a combination of the knowledge based recommender system and a search engine. It takes from engine the ability to provide the customer with an option to write her/his query and with the help of the recommender system, offer a product to the customer.

The system will have the knowledge bases mentioned in section 3. These bases will help in removing the cold start problem. The working of the system will be such that the customer can select a garment silhouette and provide his measurements, now the system will recommend a material, colour,

design which matches best the garment type selected as well as that looks best on the body type ( to be identified using the measurements provided by the customer). If the customer likes the recommendations she/he can choose to order the garment, or else the system will improve its suggestions. The methodology to be followed to build the system is also presented in figure 4.



**Figure 3.** An overview of the proposed system



**Figure 4.** Methodology followed

## 5. Conclusion

The study introduces the term fashion data and why it can be termed as big data. It also presents the classification of the data and briefly defines each one of them. In addition to this, a system is proposed that will use this data to provide the customer with a mass customization service. The methodology and working of the proposed system is briefly described. The future work involves the collection of the fashion data, creating knowledge bases, establishing a link between those knowledge bases and connection it to the search engine.



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