A PROPOSED CONCEPTUAL FRAMEWORK FOR CAPTURING ONLINE CUSTOMER REQUIREMENTS IN APPAREL CUSTOMIZATION

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Abstract

The surge in demand for web-based apparel configurators stems from customers seeking customized products with rapid delivery and competitive pricing. Yet, inaccuracies in eliciting customer requirements result in extended product development iterations, consuming time and resources. To empower customers' decision-making during the design phase, a precise product configurator (PC) is essential. This research addresses this challenge by proposing a chatbot-based conceptual model facilitating accurate customer requirement elicitation. The study explores existing PC challenges and applies solutions in the context of online apparel PCs thus enhancing customization efficiency.

Keywords: Apparel, Customization, Product Configurators, Requirement Elicitation,

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INTRODUCTION

The demand for web-based apparel configurators has increased as customers seek customized products with short delivery times and competitive pricing (Lee & Moon, 2015). However, errors in eliciting customer requirements can lead to additional iterations in product development, consuming more time and resources (Heiskala et al., 2010; Kristjansdottir et al., 2018). This is due to the customers not having the ability to make decisions regarding all necessary attributes of a product to their desired level when utilizing a product configurator (PC) during the design phase. (Herrmann et al., 2011). Thus, accurately eliciting customer requirements is a formidable challenge associated with traditional PCs. Hence, it is crucial to develop a conceptual model to ensure precision in the elicitation process for apparel PCs, an area that is currently lacking in the apparel industry context. This research aims to propose a chatbot based conceptual model and enable researchers and PC developers to better develop PCs to elicit accurate customer requirements. The objectives of this study are three fold: (1) to understand the challenges associated with existing PCs; (2) to identify and apply solutions to these challenges in the context of online apparel PCs; and (3) to explore potential solutions to the weaknesses in apparel PCs.

LITERATURE REVIEW

Challenges of existing PCs to meet the right customer needs

However, the implementation of PCs in the apparel industry has been considered less frequently in the literature. Therefore, this paper investigated the challenges encountered by PCs in customizing consumer goods and generally in the product configuration process and it is summarized in Table 1. In general, current PCs require customers to specify the desired level of all the attributes of a product by selecting options and setting parameters predefined in the PC (Cordy & Heymans, 2018).

The lack of professional design and industrial engineering knowledge among online customers often leads to their inexperience in configuring unfamiliar products, resulting in confusion and dissatisfaction with the final product (Kreutler & Jannach, 2006; Leitner et al., 2014; Wang, Zhao, et al., 2020). Moreover, the current "one size fits all" approach used by many online PCs fails to consider the diverse needs of non-professional customer groups (Kreutler & Jannach, 2006; Wang, Zhao, et al., 2020), resulting in a suboptimal product configuration (Wang, Zhao, et al., 2020). The configurator must support products that were not previously defined in the system (Kristjansdottir et al., 2018).

Although PCs have been implemented with more options to meet diversified customer needs, this often leads to decision paralysis and confusion (Chevalier & Servant, 2012; Kreutler & Jannach, 2006; Xie et al., 2015). Additionally, customers may not know their preferences and needs in advance, making the configuration task more challenging (Leitner et al., 2014; Wang, Luo, et al., 2020). The intangible nature of some preferences, such as fit and comfort, also adds complexity to the configuration process (Heiskala et al., 2010). Furthermore, customers may have difficulty in expressing their requirements using the language presented in the PCs (Gerards et al., 2011). As a result, it becomes challenging to develop a product that accurately meets the customer's needs.

Table 1 - Challenges of product configuration approaches to meet customer requirements

	Challenges	**Reference**
C1	Consumers lack domain knowledge about products	(Kreutler & Jannach, 2006; Leitner et al., 2014; Wang, Zhao, et al., 2020)
C2	The complexity of PCs due to many choices in PCs	(Chevalier & Servant, 2012; Kreutler & Jannach, 2006; Xie et al., 2015)
C3	Customers unaware of their actual product requirements	(Leitner et al., 2014; Wang, Zhao, et al., 2020)
C4	Difficult to get the total needs of the customer right	(Heiskala et al., 2010; Wang, Zhao, et al., 2020)
C5	Difficult to define all options in PCs to communicate the requirements of every customer including which are not previously defined	(Ardito et al., 2011; Kristjansdottir et al., 2018; Wang, Zhao, et al., 2020)
C6	"one size fits all" approach	(Kreutler & Jannach, 2006; Wang, Zhao, et al., 2020)
C7	Difficult to express customer requirements using the language presented in the PCs. (customer could not understand the terms used)	(Gerards et al., 2011)

Solutions discussed to elicit correct requirements through PCs

The literature proposes approaches for improving requirement elicitation through PCs, emphasizing the two folds of requirement elicitation: requirement capture and requirement validation (Anish & Ghaisas, 2014). Two communication approaches, option-based and natural language (NL)-based, are identified, and corresponding solutions are recommended in accordance with them.

According to several studies, providing a default template to non-professional customers is an effective solution to reduce confusion during the configuration process (Xie et al., 2015). Leitner et al., 2014 recommend providing customizable options for defining the start-up process as a means to help customers visualize the configuration process and make informed choices about their final product (Leitner et al., 2014). Furthermore, providing product options based on customer clusters (Wang & Tseng, 2012) and organizing options based on customizable dimensions like fitting, aesthetics and functions have also been proposed as solutions (Simge, 2013). Chevalier & Servant

(2012) suggest configuring the product step by step while (Kreutler & Jannach, 2006) propose allowing customers to try different options for product features without any support. These solutions aim at helping customers configure products according to their requirements with fewer options and enable customers to make informed choices about their final product.

Table 2 - Summary of the solutions discussed to elicit correct requirements through PCs

Challenges	Requirements Process	Features of configurators
C1 , C2, C3, C4, C5, C6, C7	Requirement elicitation approaches	A. Build an automatic dialogue between customer and configurator using NLP (to provide guidance) B. Degree of freedom in navigation C. Define product configuration step by step D. Provide options according to a cluster of customer E. Provide product template of the customer, the starting point F. Product options should be organized according to customizable dimensions (for an example according to fit, aesthetic, etc.) G. Personalized and domain specific interaction H. Personalized presentation style (for an example personalized layout, options, configuration steps, virtual avatar, etc) I. Provide explanation and reasoning for each configuration J. Provide hints (responses for user inputs)
	Requirement validation approaches	K. Visualize the prototype of the configured product L. Adopt advanced digital technologies (Mixed Reality (MR), Augmented Reality (AR) and Virtual Reality (VR)) M. Provide suggestions/advice on corrective actions automatically (for an example removing and adding components) for increment (incremental refinement)

To achieve effective product configuration and address the challenges of a "one size fits all" approach, personalized dialogue and immediate feedback through hints are necessary to help customers with less domain knowledge (Kreutler & Jannach, 2006). Providing NL based dialogue and customized action steps that cater to the specific domain can help customers express their product demands and obtain optimal configurations, ultimately reducing discrepancies between customer needs and product options available through PCs and making it easier for non-professional customers to find satisfactory product configurations (Colace et al., 2009; Ding, 2008; Leitner et al., 2014; Wang, Zhao, et al., 2020).

To aid in validating the outcome of product configuration, providing visualization of results (Kreutler & Jannach, 2006), recommendations for corrective actions (Yang & Dong, 2012), visualizing the impact of different decision options (Leitner et al., 2014; Simge, 2013) and sensitivity analysis to identify trade-offs between different properties and alternatives to the current configuration are essential (Leitner et al., 2014). Additionally, mixed reality is a promising concept to enhance user interaction with digital tools and provide a better experience with the product (De Silva et al., 2018; Jain, S., Sundström, M., & Peterson, 2018; Maurya et al., 2019). These solutions are proposed to reduce the complexity of PCs and assist customers with less domain knowledge in finding satisfactory product configurations for their requirements and they are depicted in Table 2.

METHODOLOGY

The research paper evaluates the implementation of aforementioned best practices in PCs used in the apparel industry by examining popular brands such as Nike By You, Shirt Tailor, Levi's and Monsieur t-shirt, and Table 3 presents the summary. 'Nike By You' is a popular PC in the footwear market, which uses user-centric design and development (Wang, Zhao, et al., 2020). Additionally, Shirt Tailor is a popular brand related to shirts (Rogoll & Piller, 2004). Levi's was the first industries to go online while Monsieur T-shirt is one of the most popular brands in the apparel industry in the mass customization domain.

Table 3 - PCs covered in comparison

Name	Description	URL	Reference
Nike by You	A place that allows the customer to customize the shoes	https://www.nike.com/nike-by-you	NBY
Monsieur T-shirt	A France custom-made cloth maker for men and women with an excellent online t-shirt shop	https://www.monsieurtshirt.com/	MS
The Shirt Tailor	A very compact configuration tool for men shirts	https://www.theshirttailor.com/	TST
Levi's	World's largest maker of pants, noted especially for its blue denim	https://www.levi.com/	LV

ANALYSIS

The study found that all the configurations offer customers the ability to alter the aesthetic characteristics of a product but they do not offer the same level of customization as PCs found in other industries such as Dell computers, which allow for modifications of product modules. Based on the analysis, it was found that the selected PCs elicit customer requirements solely through the options presented within them.

In the selected PCs, customers can experience feature B. The customization of the products through these PCs does not require a specific order to be followed because one can access the customizable parts by clicking on the options available in the menus. Feature D can be experienced in various ways through the selected configurators. NBY's products are categorized, and users can select them according to their preferences. MS's T-shirts are categorized by gender. The selected PCs lack the capability to enable feature C as they focus on modifying the product's aesthetic features rather than specifying its composition through module assemblies. Although selected PCs offer some personalization options categorized by the customer (e.g., size), they only support modifying designs and provide multiple templates for customization, except for TST. TST offers only one template, but the customer can edit the components of the given template by selecting the given module options (e.g., types of collars). Therefore, these PCs can satisfy feature E.

Moreover, the selected PCs do not support features G and H. However, they provide domain-specific options and layout. Additionally, customers can access additional information about the selected product through feature I. In MS, there is an option to get help by contacting via a telephone call, and the customization guide in the PC provides additional information about the product. In TST, the user can read additional information to get an idea of the suitability of the choices. In LV, the user can access further details on the selected product through a customization guide.

Figure 1-Product configuration options available in Nike By You, as per the details provided in Table 2

Figure 2-Product configuration options available in Monsieur T-shirt, as per the details provided in Table 2

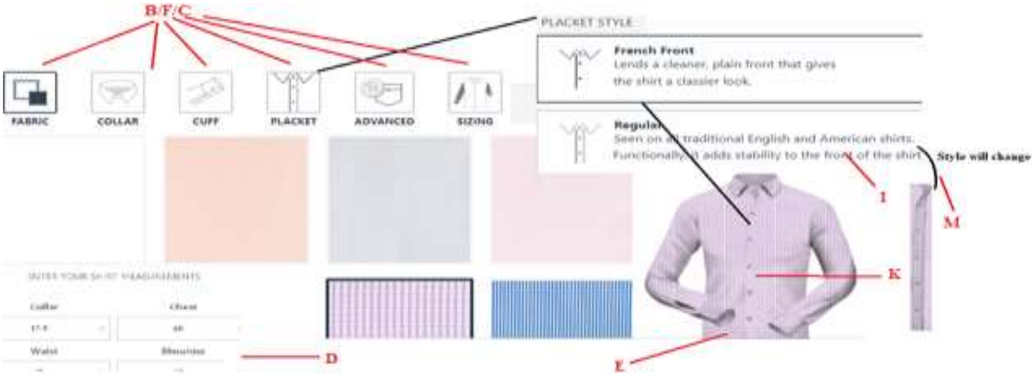

Figure 3-Product configuration options available in Shirt Tailor, as per the details provided in Table 2

Figure 4-Product configuration options available in Levis, as per the details provided in Table 2

However, not all selected PCs facilitate feature J. Yet, they all provide feature K. Two PCs support feature L in different ways. Nike is updating its app with a newer reality tool called 'Nike Fit'. Although AR mirrors are available in the market, MS and TST have not adopted new technologies. Levi's® collaborated with Kohl's to create a unique virtual closet experience on Snapchat that allows consumers to view and create various looks using AR and portal technology (https://www.levistrauss.com/2020/09/03/levis-goes-back-to-school-with-new-approach/). In the chosen PCs, there are options to refine the style options if the selected option does not match the user. However, they do not provide corrective actions to cater to feature M automatically. However, the customer can do the changes as they wish by clicking the given options.

Table 4 - Analysis of the application of solution discussed in the apparel industry

	NBY	MS	TST	LV
A	×	×	×	×
B	✓	✓	✓	✓
F	✓	✓	✓	✓
C	x	x	x	x
D	✓	✓	✓	✓
E	✓	✓	✓	✓
G	×	×	×	×

	NBY	MS	TST	LV
H	×	×	×	×
I	✓	✓	✓	✓
J	×	×	×	×
K	✓	✓	✓	✓
L	✓	×	×	✓
M	×	×	×	×

RESULT

Based on the analysis, the selected PCs primarily rely on a set of options for eliciting customer requirements with no application of NL-based approach to elicit requirements. This limitation demonstrates that the co-design process is confined to the options presented on the website with no means for customers to express their specific needs. While many best practices from the literature have been implemented, several key features are still missing as depicted in Table 4. Without these features, customers may end up with an unsatisfactory end-product if they make a wrong selection.

By enabling NLP, customers would be able to communicate their needs in NL, and the configurator could offer personalized guidance and corrective options similar to a physical store experience. This approach would facilitate proper customer needs assessment and co-design, leading to greater customer satisfaction. Therefore, the apparel industry should prioritize implementing apparel PCs with these functional requirements.

Natural language based solutions used in the industries for requirement elicitation

Chatbots are a form of artificial intelligence technology that is being increasingly utilized in a range of industries and businesses to communicate with customers in NL and assist with their needs (Um et al., 2020). The use of chatbots for requirement elicitation has been explored in various industries including software (Rajender Kumar Surana et al., 2019), medicine (Ganapathy et al., 2021), construction (Li, 2018), manufacturing (T.-Y. Chen et al., 2021) and retail (J. S. Chen et al., 2021) with benefits including the ability to simulate human interviews, provide tailored advice and reduce customer service costs. While many chatbots are currently used in e-commerce web applications to assist customers with product selection and answer questions (Galitsky & Ilvovsky, 2017), their use in product co-design through product configuration is less common. Although frameworks for integrating chatbots into virtual reality environments for product customization exist, they have not been extensively tested in the apparel customization (Finch C.T. Wu, Oscar N.J. Hong, Amy J.C. Trappey, 2020). When comparing the advantages/strengths of Zumstein & Hundertmark, 2018, it is worthwhile to use chatbots to configure online products on e-commerce apparel websites (Zumstein & Hundertmark, 2018). As per the conceptual model presented, chatbots have the potential to create customized conversations, offer suggestions and details and provide justification and rationale for each configuration.

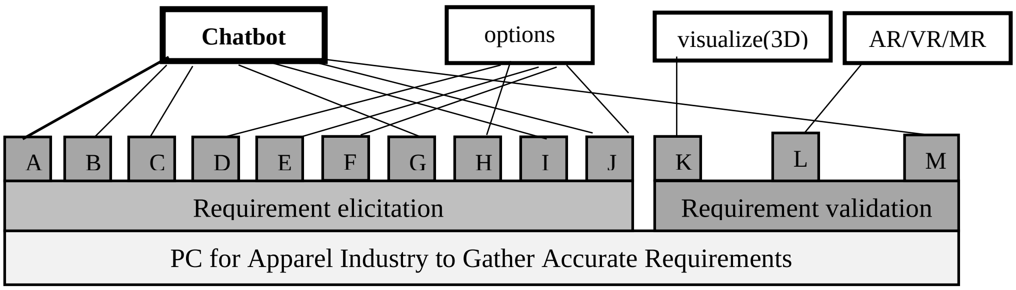

Figure 5-PC for the apparel industry

CONCLUSION

With the demand of online PCs, eliciting customer requirements accurately is a difficult challenge associated with traditional PCs. Therefore, a conceptual model to ensure precision in the elicitation process for apparel PCs is crucial. This study proposes a chatbot-based conceptual model that enables researchers and PC developers to better develop PCs to elicit accurate customer requirements. This study examines the effectiveness of implementing best practices in PCs utilized in the apparel industry. The PCs that were analyzed in this study relied solely on the options presented within them to capture customer requirements. However, as depicted in Figure 5, an NL-based approach is the optimal solution for addressing the limitations identified.

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