On-demand fashion: wardrobe management and trading community

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ABSTRACT – REZUMAT

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The concept of on-demand fashion has been around for some time. Still, its implementation remains challenging due to fast-paced consumer habits that prioritise quick acquisition over thoughtful decision-making. Intelligent wardrobe management and second-hand fashion exchange have emerged to maximise the use of existing clothing and promote more conscious and sustainable consumption behaviours. This study first provides an in-depth analysis of relevant research and the current state of the industry, summarising the technological pain points in existing wardrobe management systems and second-hand trading platforms, as well as the negative user experiences that impact user engagement. It then addresses typical issues faced by consumers in managing their wardrobes and collects 512 valid feedback responses. Finally, based on consumer feedback and a review of the current situation, this study proposes the construction of an on-demand fashion community that integrates both wardrobe management and second-hand trading. The platform consists of four main modules: My Wardrobe, Outfit, Community, and Profile, with a particular focus on the interactive scenarios of the innovative Outfit and Community modules. The platform proposed in this study is expected to promote more sustainable and conscious fashion consumption.

Keywords: *fashion on demand, fashion community, smart wardrobe, second-hand, sustainability*

Moda la cerere: gestionarea garderobei și comunitatea de tranzacționare

Conceptul de modă la cerere există de ceva timp, dar punerea sa în practică rămâne o provocare din cauza obiceiurilor de consum rapide ale consumatorilor, care prioritizează achizițiile rapide în detrimentul luării unor decizii bine gândite. Gestionarea inteligentă a garderobei și schimbul de articole de modă second-hand au apărut pentru a maximiza utilizarea articolelor de îmbrăcăminte existente și pentru a promova comportamente de consum mai conștiente și mai durabile. Acest studiu oferă mai întâi o analiză aprofundată a cercetărilor relevante și a stării actuale a industriei, rezumând punctele slabe tehnologice ale sistemelor existente de gestionare a garderobei și ale platformelor de tranzacționare second-hand, precum și experiențele negative ale utilizatorilor care afectează implicarea acestora. Apoi, abordează problemele tipice cu care se confruntă consumatorii în gestionarea garderobei acestora și colectează 512 răspunsuri valide. În cele din urmă, pe baza feedback-ului consumatorilor și a unei analize a situației actuale, acest studiu propune construirea unei comunități de modă la cerere, care integrează atât gestionarea garderobei, cât și comerțul cu articole second-hand. Platforma este alcătuită din patru module principale: My Wardrobe, Outfit, Community și Profile, cu un accent special pe scenariile interactive ale modulelor inovatoare Outfit și Community. Se preconizează că platforma propusă în acest studiu va promova un consum de modă mai durabil și mai conștient.

Cuvinte-cheie: *modă la cerere, comunitate de modă, garderobă inteligentă, second-hand, sustenabilitate*

INTRODUCTION

Sustainable fashion seeks to reduce environmental impacts in design, production, and consumption by using eco-friendly materials, lowering resource use, preventing pollution, and enhancing product durability [1]. However, rapid consumption and overproduction are significant factors hindering its sustainable development. Thus, promoting sustainable consumption practices and product management is key, and it is the core objective of our proposed approach.

For more sustainable consumption, the on-demand fashion isn't new, but its implementation is challenging. Fast-paced lifestyles favour quick acquisitions over the thoughtful decision-making that on-demand fashion requires. However, growing environmental concerns are shifting consumer priorities – nearly 60% of global consumers value sustainability when purchasing apparel [2]. Almost three-fifths of consumers worldwide said that sustainability was at least slightly important to them when purchasing apparel. This forces industry leaders to rethink their business models. While digital fashion is gaining traction as a way to break old consumption habits, it may merely add to overall consumption without reducing physical clothing purchases and their environmental impact.

In this context, maximising the utilisation of consumers' existing clothing is a solution that addresses the root cause of overconsumption and meets the practical needs of ordinary users [3, 4], which is mostly related to the research topic of capsule wardrobe creation [5–7]. By making full use of existing wardrobe items, consumers can not only better

understand and utilize their current clothing (Survey shows that consumers experience on average 36 times "wardrobe panic" annually, when they struggle to pair items together from their wardrobes to compose a nice outfit.), but also optimize their styling choices and effectively reduce the demand for new clothing, providing a practical solution for sustainable fashion. Through intelligent wardrobe management systems, users can easily find the right combinations for themselves in their busy lives, achieving the perfect integration of fashion and sustainability.

And for more sustainable product management, the next question we need to consider is: even after maximising the use of existing clothing, what should be done with items that consumers no longer wish to use? According to statistics, the main disposal methods for clothing include reuse, recycling, incineration, and landfilling [8]. Among these, reuse and recycling are particularly emphasised for their significant advantages in extending garment lifespan, reducing waste, and conserving resources. Indeed, the global secondhand clothing market is showing tremendous growth potential. By 2025, its revenue is projected to reach 77 billion U.S. dollars, almost triple the 27 billion recorded in 2020 [9]. This trend toward circular models is expected to remain robust, with the secondhand market anticipated to expand by an additional 185% by 2029 [10], thus positioning itself as a key driver for sustainable fashion. As a result, researchers boldly assert that the future of fashion is secondhand. The demand for resale is huge, but why are online secondhand clothing platforms struggling? A report from *Marketplace* points out that, for buyers, concerns about product quality and cleanliness are the primary reasons for their reluctance to embrace secondhand clothing [11]. However, this can be alleviated through high-quality images and detailed descriptions of the products. For sellers, the greatest barrier is the time and effort involved (sorting through unwanted clothes, preparing photos, and writing descriptions). The next major challenges are pricing and handling special situations (such as returns and exchanges) [12].

Given these circumstances, we propose an innovative solution that integrates on-demand fashion principles. Our approach targets sustainable consumer behaviour and product management by utilising intelligent management and trading platforms to optimise clothing usage and extend garment lifecycles. The smart wardrobe provides personalised recommendations based on user needs, reducing unnecessary purchases and resource waste. Meanwhile, the trading community offers a channel for secondhand clothing transactions, promoting garment reuse and lowering the demand for new production. In other words, we must consciously model clothing combinations and streamline the steps involved in secondhand fashion transactions.

RELATED WORK

Capsule wardrobe

Research on smart fashion recommendations has increased the sales of fashion products, particularly in the fast fashion sector. Compatibility-based fashion recommendations can help consumers make more conscious purchasing decisions, thus reducing the harmful environmental impact of the fashion industry. A promising topic to explore is the fashionable and sustainable capsule wardrobe building. A capsule wardrobe is a concept of a limited sample of convertible clothing pieces that complement each other. The conception of a capsule wardrobe is not new, but has been very popular recently and discussed on social media [4]. To maximise the utilisation of existing clothing combinations, researchers need to address two main challenges. First, an accurate model of visual compatibility is required. This involves capturing how multiple visual items interact, often based on subtle visual properties. Second, there is the complex problem of combination. Haiso and Grauman [5] proposed an unsupervised generative visual topic model, generalised from Correlated Topic Models, to model the compatibility between fashion items. They developed an EM-like iterative method to solve the combination problem. Dong et al. [13] treated each outfit as a sequence of items, with each item being regarded as a time step input for a bidirectional LSTM to model compatibility. They also proposed a combination optimisation method to adaptively adjust the number of items in an outfit. Furthermore, Chen et al. [7] proposed TensorNet (which consists of two core modules: a Cross-Attention Message Passing module and a Wide&Deep Tensor Interaction module) to simultaneously model the local and global visual compatibility of a set of outfits. Since their research assumes that a capsule wardrobe has already been established, they did not discuss the combination problem. A more comprehensive work is by Patil, Banerjee and Sural [6]. As mentioned in their paper, their work does not focus on the prediction of compatibility between items, but assumes there is a set having all possible compatible outfits. Their research focuses on solving an inherently NP-hard complex combinatorial problem that simultaneously considers compatibility, versatility of individual items, and the overall shopping budget of the outfits. Recently, Tanaka and Ozaki [14] have also explored a more comprehensive investigation of the combination problem.

Considering the practical establishment of an automatic capsule wardrobe based on the user's existing clothing, the literature review has summarised several points worthy of our consideration and learning: First, in terms of visual compatibility, it is necessary to simultaneously consider both global and local aspects. Second, regarding the combination problem, it is worth contemplating how to address the impact on outfit ensembles of individual items that may be added or removed at any time. Finally, in

terms of data, it is crucial to model using the user's existing clothing (the original wardrobe).

Smart wardrobe management

Smart wardrobe management is a product of contemporary times and evolving user needs. With the aid of continuously updated technologies, the functionalities of wardrobe management systems have been extended in many aspects. Currently, academic research and application design primarily focus on real-time management [15], such as *Closet+* [16], *Stylebook* [17], automatic outfit recommendation [18], like *Cladwell* [19] and *Smart closet* [20]; user preference learning [18, 21], exemplified by *Stylebook*, and lifecycle management [22], such as *Save your wardrobe* [23].

Real-time management primarily enables dynamic updates of clothing statuses to enhance management efficiency and is a fundamental feature of current smart wardrobe systems on the market. The differences among these systems mainly involve factors such as the number of clothing images that can be uploaded at once, the total wardrobe capacity, and data synchronisation capabilities. This study focuses on the function of automatic outfit recommendation. Currently, most smart wardrobe applica-

tions only allow users to manually create outfits. While this offers flexibility, it falls short in helping users efficiently utilise their existing clothing. In contrast, automatic outfit recommendation aims to generate diverse styling options based on the contents of the user's wardrobe. Users simply select suitable outfits from the recommendations, find the corresponding items, and can head out immediately. Although manually creating outfits can spark inspiration, over time, it is not significantly different from the traditional dressing process and may struggle to continuously engage users. User preference learning has great potential for exploration to better serve intelligent outfit matching. Moreover, lifecycle management aligns seamlessly with this research's concept of integrating wardrobe management and trading. By focusing on the usage frequency or lifecycle of clothing to encourage the rational use of resources – such as selling, donating, or recycling – it represents an important step toward sustainable fashion.

Based on the statistical results of global downloads over the past three years for smart wardrobe management applications from the App Intelligence module in *Sensor Tower* [24], this paper summarises and analyses the top 9 applications in table 1. It can be seen that current smart wardrobe management

Table 1

SUMMARY OF SMART WARDROBE MANAGEMENT APPLICATIONS				
Application name		**Main functions**	**Highlights**	**Limitations**
	Cladwell [19]	Real-time management; Automated outfit recommendation	• Ask Cladwell (powered with ChatGPT, get personalised style advice anytime).	• Template-based attribute generation; • Generate outfits based on attribute values.
	Stylebook [17]	Real-time management; User preference learning; Automated outfit recommendation	• Outfit shuffle (generate outfits like shuffling cards).	• Manual attribute editing; • Generate outfits based on attribute values.
	Smart closet [20]	Real-time management; Automated outfit recommendation	• Shop all your favourite brands and keep track of your wishlist in one place.	• Manual attribute editing; • Generate outfits based on attribute values.
	Pureple [26]	Real-time management; Automated outfit recommendation	• Fashion community (discover new styling ideas).	• Manual attribute editing; • Generate outfits based on attribute values.
	Acloset [25]	Real-time management; Automated outfit recommendation; Lifecycle management	• Automatic attribute recognition; • Preloved (sell clothes forgotten in your closet).	• Generate outfits based on attribute values.
	Indyx [27]	Real-time management	• Personal styling services.	• Manual attribute editing.
	MyWardrob [28]	Real-time management	• Fashion community (discover new styling ideas).	• Manual attribute editing.
	Whering [24]	Real-time management; Automated outfit recommendation	• Outfit shuffle (generate outfits like shuffling cards).	• Template-Based attribute generation; • Generate outfits based on attribute values.
	Save your Wardrobe [23]	Real-time management; Lifecycle management	• Provide a range of on-demand local aftercare services.	• Manual attribute editing.

systems have basically not implemented automatic recognition of individual item attributes or the generation of outfits based on fashion compatibility. The Preloved module in *Acloset* [25] is similar to the concept of this plan; the difference is that users need to sort out clothing they no longer use, photograph it, and upload it to the Preloved community for sale.

Second-hand fashion market and community transactions

As indicated by the data in the introduction, the second-hand clothing market is gradually becoming a significant branch of the fashion industry, with its sales far surpassing those of other categories of second-hand products. Not only does second-hand fashion hold substantial economic and ecological importance, but it also prompts changes in consumer behaviour patterns. Brands such as *Nike, H&M,* and *Lululemon*, along with online platforms like *The RealReal* [29], *Sellpy* [30], are actively developing second-hand trading platforms. By providing services for buying and selling second-hand clothing, these platforms help consumers extend the lifecycle of their garments. Another notable feature of the second-hand fashion market is the rise of community trading models, where consumers engage in direct exchange and purchase of items through online community platforms. This model not only increases user engagement but also strengthens interaction and trust among consumers. Platforms like *Depop* [31] and *Poshmark* [32] combine second-hand trading

with social media elements, forming a social fashion community that enhances user participation and transaction frequency through interactions such as likes and comments. The promotion of second-hand fashion directly responds to consumers' demand for sustainable and green fashion. Consumer motivations in the second-hand fashion market differ from those in the traditional fashion market; primary motivations often include concern for sustainable development, affordable prices, and a preference for uniqueness and vintage styles. Research indicates that these consumer psychologies and preferences are enabling the second-hand market to gradually shed labels like "cheap" or "substandard products," leading to its widespread acceptance and integration into mainstream fashion [33].

However, the sustainable fashion industry, particularly second-hand clothing, is still in its infancy, especially in the emerging economies. The primary reason is that consumers lack awareness of the environmental advantages and economic value of second-hand clothing, followed by the complexity of product uploading and management [34] . For example, some studies have pointed out that users face cumbersome steps when uploading second-hand items – such as organising items, taking photographs, adding detailed descriptions, and setting prices – which leads to significant time and energy consumption. This becomes a barrier to participation in the second-hand market [35]. These obstacles make users feel that the entire process is lengthy and not worth the effort, resulting in resistance toward the

Table 2

SUMMARY OF MAINSTREAM SECONDHAND FASHION TRADING PLATFORMS			
Platform name	**Main functions**	**Highlights**	**Ease of getting started**
The RealReal [29]	• Professional authentication; • Luxury focus.	Specialises in luxury items with authentication services.	★ ★ More complex start-up requires professional review and item submission, but the platform assists with uploads and pricing.
Poshmark [32]	• One community, thousands of brands, and a whole lot of second-hand style.	Strong social integration resembles social media.	★ ★ ★ Relatively easy, user-friendly process for uploading items, but requires manual descriptions and pricing.
Thredup [37]	• Full-service consignment; • Automated pricing.	Full-service model, minimal user effort.	★ ★ ★ ★ Simple start-up, users only need to send items, and the platform handles the rest.
Depop [31]	• One community, thousands of brands, and a whole lot of second-hand style.	Social media-like interface, user-run shops.	★ Requires users to manually take photos, add descriptions, and set prices, a more involved process.
Vinted [38]	• One community, thousands of brands, and a whole lot of second-hand style.	No seller fees, promotes a community atmosphere.	★ Requires users to manually take photos, add descriptions, and set prices, a more involved process.
ReGAIN [39]	• Shopping, sharing, second-hand trading, and social interaction are integrated into one.	Send unwanted items and get access to discount coupons.	★ ★ ★ ★ Simple start-up, users only need to send items, and the platform handles the rest.

Notes: The ratings range from 1 to 5 stars, with 5 stars indicating the easiest platform to start using, based on the overall user experience and simplicity of listing items.

platform. Further research indicates that the lack of automation and intelligent technologies – such as technical tools to simplify the product upload process – makes platform usage seem burdensome and difficult to maintain attractiveness [36]. Therefore, how to simplify these steps through technological means (e.g., automatic image analysis and recommended descriptions) is a challenge and a potential improvement direction faced by many second-hand platforms. This work summarises the current mainstream second-hand trading platforms, particularly focusing on ease of use (table 2).

METHODOLOGY

User survey

This study previously conducted an online questionnaire survey with 512 valid responses on the current status of consumers' wardrobes. Firstly, figure 1, *a* presents the distribution of participants' gender, age, and occupation.

Secondly, regarding the current state of wardrobes, we set up two questions to collect feedback, and the results are shown in figure 1, *b*. It is evident that this data reveals the common phenomenon of most people

Fig. 1. Graphical representation of: *a* – distribution of participants' gender, age, and occupation; *b* – wardrobe status; *c* – daily dressing situations
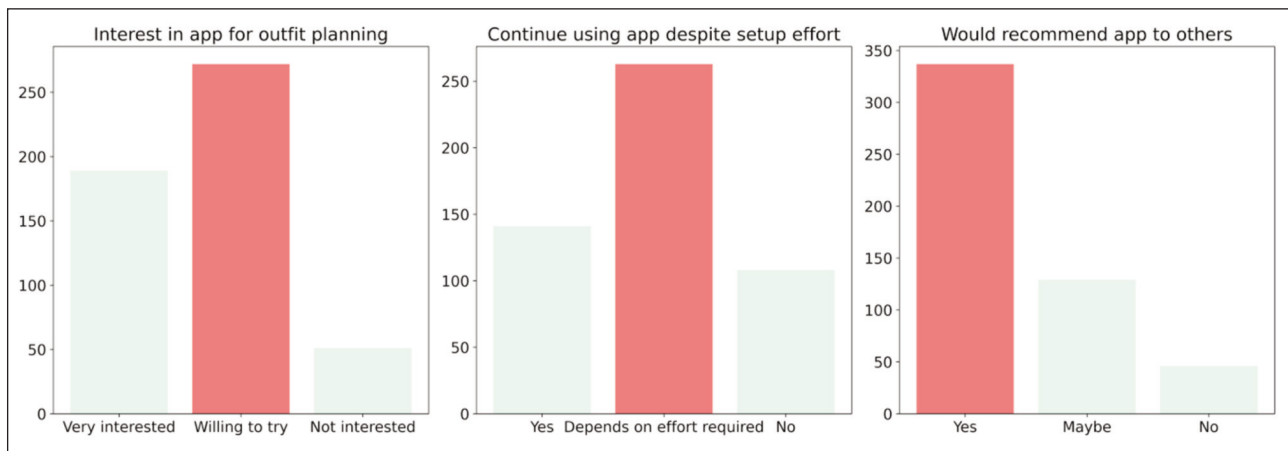
Fig. 2. Feedback on wardrobe management platform needss

having unworn clothing items tucked away at the bottom of their wardrobes. The vast majority of respondents admitted that their wardrobes contain many unused garments. The main reason is that new clothes are difficult to match with old ones, leading to new items, worn only a few times, gradually being forgotten. Other common reasons include frequent purchases of new clothes, the rapid obsolescence of new garments, and changes in personal dressing style. Overall, with the rapid turnover of fashion trends and changes in consumption habits, many people tend to frequently buy new clothes but seldom consider how they coordinate with existing items, resulting in many garments being left unused. This phenomenon reflects the impact of modern consumerism and suggests that placing more emphasis on matching actual needs when purchasing clothing might help reduce such waste.

Next, we designed four questions regarding daily dressing situations, and the feedback is presented in figure 1, *c*. This set of data reveals some key issues that modern individuals face concerning the time spent on dressing and making choices. The majority of people usually spend less than half an hour on dressing, reflecting a demand for efficient outfit selection in daily life. However, when confronted with different occasions and changes in weather, many still need to weigh and consider their options, making dressing time-consuming and a source of concern. At the same time, many respondents indicated that difficulties in choosing outfits often lead to repeatedly trying on and taking off clothes, becoming the main reason for the time consumed. When people encounter confusion in dressing, they primarily seek advice from friends and family or obtain inspiration through online resources, highlighting the importance of social circles and the internet in dressing decisions. Furthermore, despite investing a significant amount of time and effort into dressing, many do not always achieve the desired effect, potentially leading to uncertainty and feelings of dissatisfaction. Overall, the data reflect modern individuals' need for quick and satisfactory dressing solutions, while also

revealing the dilemmas and matching challenges faced during the dressing process.

Finally, we also conducted a simple survey regarding user needs for wardrobe management platforms, and the results are shown in figure 2. These charts indicate that most respondents exhibit high interest and potential acceptance of outfit assistant applications. Despite the possibility that recording clothing items may be time-consuming, the majority expressed willingness to continue using the app, depending on circumstances. If the application indeed improves dressing efficiency, the vast majority are willing to recommend it to others, suggesting positive potential for promotion.

Prototyping

By transforming the concept of "On-Demand Fashion: Wardrobe Management and Trading Community" into practical application scenarios (figure 3), the platform involves four main modules: **My wardrobe:** Used to store the user's existing clothing; **Outfit:** User-created outfits and system-generated outfits; **Community:** Users sell and purchase second-hand clothing; **Profile:** User personal information, order details, and outfit sharing space.

In this study, we provide a more detailed interactive explanation of the highlight modules of the on-demand fashion community, particularly focusing on functions that have not been fully implemented in existing platforms but hold significant value.

First, as shown in figure 4, *a*, we have added a 'Quick Pricing' option in Module a2 to support instant intelligent pricing (based on the brand and quality of the clothing). Upon user confirmation, clothing items selected for 'QuickSell' will automatically appear in Module c1, enabling rapid posting and display of items. The trading function endowed by the platform aims to reduce users' decision-making costs in second-hand transactions, optimise the resale process, improve user experience, and enhance platform stickiness.

Second, as illustrated in figure 4, *b*, we provide an interactive demonstration of the outfit matching scenario. In Module b1, users can manually create
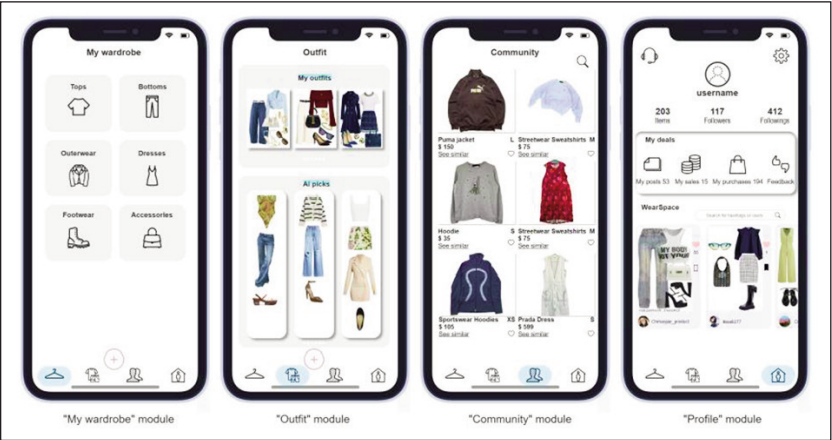
Fig. 3. Illustration of the main application scenario modules

outfits by selecting clothing from different categories and dragging them into the outfit box, facilitating users to assemble outfits on their own. Meanwhile, Module b2 offers a hybrid model-based outfit recommendation. Specifically, we directly generate the outfit recommendation list through the fashion compatibility model and item combination algorithms, while the preference learning model in the user-created outfits module indirectly guides the fashion compatibility model, thereby influencing the final recommendation outcomes. Users can browse the recommended outfits and mark their favourite options. We aim to make full use of wardrobe items, reduce users' decision-making pressure in daily outfit choices, and encourage more conscious consumption.

CONCLUSIONS

The innovation of this work lies in integrating on-demand fashion, capsule wardrobe management, and a second-hand trading community into a single platform. By utilising intelligent matching algorithms, the platform assists users in discovering more outfit possibilities within a limited selection of clothing, thereby maximising the utilisation of existing garments. Simultaneously, the platform provides users with a convenient space for second-hand trading, promoting the sharing and circulation of idle clothing items. This not only meets users' needs for efficient outfit coordination but also advocates for sustainable fashion consumption, reducing resource waste.

However, these innovations also bring new challenges. First, we need to establish an accurate visual compatibility model to precisely capture the matching potential between clothing items under a limited dataset. Traditional visual compatibility models typically require large amounts of training data to learn the matching patterns between garments, but the user's wardrobe size is limited and cannot provide sufficient data support. Therefore, we need to explore methods based on small-sample learning or transfer learning to enable the algorithm to work effectively in a small-data environment. Second, even within a limited wardrobe, the possible combinations of outfits are still vast. How to efficiently process these combinations and provide practical outfit suggestions is a difficulty in algorithm design. Moreover, the effective personal preferences conveyed when users create their own outfits should not be wasted, which means the algorithm needs to be capable of learning and updating the model in real time to adapt to the user's changing needs. Finally, the quality assessment and pricing strategy of second-hand clothing are also key issues that need to be addressed. How to balance intelligent outfit matching and second-hand trading functions on the platform to ensure a smooth and valuable user experience is the comprehensive challenge we face.
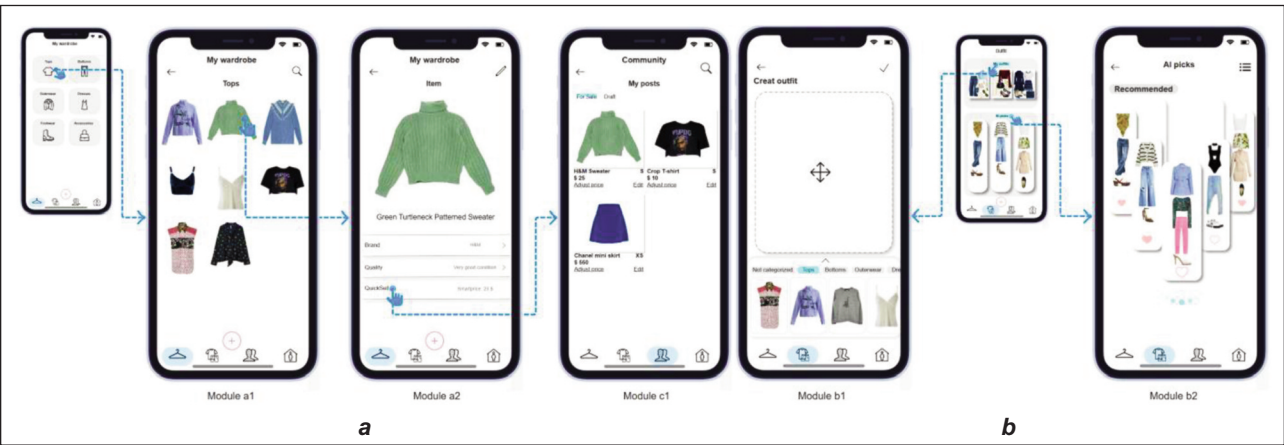
Fig. 4. Scheme of: *a* – Transaction scenario: One-click resale of unused clothing from your wardrobe;
b – Outfit matching scenario: User-created outfits and system-generated outfitss

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