JOURNAL ON COMMUNICATIONS

ISSN:1000-436X

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Vyom Try-On: AI-Powered Virtual Fitting Room

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***Abstract*—Vyom Try-On is an AI-based virtual fitting room implemented as a client-side single-page application developed in React 19 and TypeScript. Based on generative try-on technology, the system delivers interactive garment try-on by providing a seamless integration of inputs from a webcam or photo upload, processing of the image with HTML5 Canvas, and connection to the Gemini-2.5-flash-image model through a secure proxy layer. The architectural design of the application is centered around a user-friendly e-commerce platform consisting of a product catalog, shopping cart, user signup/login, and an administrator dashboard. The application utilizes Context API for state management and a localStorage-based Object-Relationship mapping library for data persistence without a dedicated backend database. In this paper we describe the end-to-end development and deployment of the application including system design, implementation details, empirical assessment with quantitative metrics, user experience evaluation, and detailed reproducibility documentation. Reporting of methodology, simulated experimental results, user-centric evaluation, and open-source resources are provided in the paper with an aim to disseminate practical knowledge about virtual fitting room systems and reproducible applied machine learning for online retail.**

I. Introduction

With the advances in technology today, e-commerce sites still face challenges in recreating the tactile and human element involved in shopping for clothes and shoes in a brick-and-mortar store. Doubts in fit, color, and overall appearance on different bodies make consumers hesitant to complete transactions, leading to high return rates and dissatisfaction from the customer base. While digital catalogues are visually appealing, they fail to recreate the sense of movement between clothing and the various physical traits unique to every person around the globe. With the integration of wearable computing and mobile devices with cameras, the time has come to utilize those currently in market to overcome the obstacles present in online shopping, with AI giving the capability to further understand the shopping process of the customer. Virtual fitting rooms that imitate the action of physically trying on clothes have the potential to overcome the challenges of online shopping through AI programs that lessen decision fatigue, increase satisfaction, and improve responsible consumer purchasing behavior.

Moreover, to overcome these constraints, the Vyom Try-On project sets tangible goals to deliver technological novelty and user empowerment. The central goal of the proposed system is an interactive generative virtual try-on that gives users an opportunity to understand how the clothing would look on their real body images by applying generative AI processing. The building decision of the architecture presumes a single-page application–based framework in the form of React 19 and TypeScript supporting responsive user interaction, smooth navigation, and quick state management in the browser dynamically. Privacy is the big one to consider by default with data persistence at the client side only through localStorage ORM and mediated API calls through secure proxy to limit exposure of sensitive data like reconstructed user images and private information. Prioritizing user experience has become the pivotal consideration for the Vyom Try-On project with its intuitive photo capture, instant rendering, and tailor-made suggestions building on published best practices of the virtual try-on domain to convey realism and engagement to online shoppers [10].

Additionally, the work yielded numerous substantive contributions to virtual try-on and e-commerce technologies. On the one hand, it reports a fully client-side single-page application using React 19 and TypeScript, featuring a structured architecture for privacy-preserving operations and efficient management of the application state. On the other hand, it proposes a secure generative try-on pipeline, utilizing a proxy-mediated interface to state-of-the-art AI models for dynamic transfer of garments onto user-supplied images. Further, comprehensive reproducibility resources, such as complete code listings, implementation diagrams, and methodological appendices, were presented to foster transparent assessment and the real-world uptake of the underlying technologies. Finally, findings from a user-centered study examining satisfaction, realism, and decision-support features of the system were discussed in detail to complement the alignment with established research on the impact of interactive virtual try-on experiences on customer behavior and purchase decisions [19].

II. Related Work

In the related work, historical aspects of the used virtual try-on research are given. They reflect the development of image-based garment representation transfer techniques, from classical image-based approaches to deep learning. Older approaches used 2D and 3D models constructed with hand-crafted geometry and texturing in order to match the clothes with user images. Existing approaches are always limited in scalability and that's why mastering the photorealism is

challenging. With emergence of the deep generative models, like Pix2pixHD, the challenge was solved. Put the clothes on becomes easier with the garment warping. The known deep learning architectures align the clothes with a multitude of body shapes. Multi-stage pipelines, which online defined on the-demand data flow, are other elements of these approaches. They construct geometry match modules and body segment maps matching textures to the corresponding parts of the image. They play with position predictability and texture threaten coherence. PE-VITON is the framework of this novel branch. It separates garment shape representation from its texture representation through shape-dedicated control modules. They find clothes and adjust the matching even for varied pose and shape situations. As a result, it elaborates visual authenticity [10].

In addition, novel generative approaches have brought significant improvement in the realism and diversity of virtual try-on models by integrating state-of-the-art GANs, diffusion methods, and multi-modal image synthesis architectures. Although GAN architectures are still crucial for realistically transferring clothing items, the revived diffusion-based strategies demonstrate high-quality synthesized candidates that reflect subtle texture and shape characteristics of target outfits [2]. With garment-centric adapters and targeted appearance losses, diffusion models enable accurate mapping of clothing elements to human poses and silhouettes for avoiding texturing artifacts, which traditional GAN-based approaches have struggled with. In addition, research on self-supervised generative 3D garments has boosted realism in the garment-body interactions in virtual try-on tasks by avoiding collisions with canonical space representations and by extrapolating 3D surface properties from training data [5]. Such methodological advancements allow modern virtual try-on systems to demonstrate high detail and realism in synthesized clothing results, ensuring close alignment with user-specific parameters and expected outcomes.

More generally, the entire landscape of single-page application (SPA) frameworks for e-commerce has made significant progress in providing scalable architectures and highly interactive user experiences. Frameworks such as React.js provide strong support for component-based architectures, virtual DOM rendering, and advanced tools for user state and data management, thereby enabling easier development and improved user experience [15]. Most modern platforms support common e-commerce modules such as user authentication, product catalog browsing, cart management, and backend communication via APIs, often relying on traditional databases [16]. However, these general SPA frameworks still do not offer deep integration with generative AI solutions, particularly those requiring on-the-fly virtual try-on, client-side data handling, and complete avoidance of external servers and databases. In this respect, Vyom Try-On offers uniquely deep generative AI support within a fully client-side SPA framework using localStorage ORM, real-time image processing, and privacy-preserving operations.

Further, user-centered evaluation techniques have established themselves as the principal method for assessing virtual try-on systems. Quantitative metrics and structured user studies play a significant role in evaluating realism, fit accuracy, personalization, and post-usage satisfaction—dimensions that extend far beyond basic model accuracy. Such studies often involve Likert-scale evaluations and observational methods to understand user perceptions, with results frequently demonstrating a strong correlation between virtual try-on realism and increased satisfaction and purchase confidence [18]. These findings align with broader research indicating that enhanced virtual try-on systems reduce uncertainty, increase engagement, and decrease return rates, all of which contribute to improved e-commerce performance [19]. Vyom Try-On incorporates these user-centered evaluation principles by combining algorithmic performance metrics with subjective assessments to produce a holistic evaluation framework.

The integration of augmented reality (AR) and artificial intelligence (AI) within the Vyom Try-On system significantly enhances the virtual try-on experience, offering users a more immersive and accurate representation of clothing items. By leveraging these technologies, the system not only facilitates higher customer engagement but also empowers shoppers to make more informed purchasing decisions, ultimately improving satisfaction and reducing return rates. This aligns with findings showing that virtual try-on technologies meaningfully enhance online shopping by enabling users to better assess fit and appearance before purchase [19]. Furthermore, the system emphasizes personalization and customization, key aspects of modern e-commerce that ensure users receive tailored experiences aligned with their preferences. By addressing these factors, Vyom Try-On positions itself as a user-centric platform that not only enhances technical efficiency but also meets broader consumer demands for accessibility and personalization in digital retail environments.

III. System Design / Architecture

The underlying system architecture of Vyom Try-On's try-on platform is primarily based on a highly organized single-page application (SPA) developed using React 19. It enables complete control over the user interface and interaction model using a single document object model in a browser environment where page contents can be dynamically manipulated and updated. React is particularly suited for this purpose, as it can organize code in reusable modules known as components that can efficiently read and update a virtual representation of the document object model (DOM) and instantly react to user input without performing a full-page refresh [15]. As it does not fetch or update data from a server-side database, persistent data such as user profile, product choice, and try-on sessions are read/written using a localStorage-based object-relational mapping (ORM) scheme. It also removes the need to call backend APIs and supports users who value privacy over submitting their data to a server. Application-level data is managed using Context API, a React feature that allows secure and efficient state propagation and stable control of user authentication, general application parameters, and shop-

TABLE I
COMPARISON OF EXISTING VIRTUAL TRY-ON APPROACHES

Approach Category	Key Techniques	Advantages	Limitations
Classical Image-based Methods	2D/3D geometric modeling, hand-crafted meshes and textures	Early feasibility of virtual try-on, simple modeling pipeline	Limited scalability, low photorealism, manual design effort
GAN-based Methods	Generative Adversarial Networks, garment warping (e.g., Pix2PixHD)	Improved visual realism, pose-aware clothing alignment	Texture artifacts, instability during training
Multi-stage Pipelines	Geometry matching, body segmentation, texture mapping	Enhanced structure–texture consistency	High computational cost, complex pipeline design
PE-VITON Framework	Explicit separation of garment shape and texture representations	High visual authenticity across diverse poses and body shapes	Sensitive to segmentation accuracy
Diffusion-based Approaches	Conditional diffusion models with garment-centric adapters	Superior texture fidelity, reduced synthesis artifacts	High inference latency, resource-intensive computation
Vyom Try-On (Proposed)	Client-side SPA with real-time generative AI processing	Privacy-preserving, scalable, real-time interaction	Dependent on client hardware capabilities

ping data. There is also an embedding of Tailwind CSS, a utility-first CSS framework that establishes a highly adaptable, reusable layout and design system. It combines the basic design principles of responsive mobile-first websites and apps with branding policies and accessibility requirements.

To highlight particulars, the client-side architecture of Vyom Try-On is built upon React Router v7 to support smooth, route-able interactions between the main functional parts of the single-page application. Users can easily navigate through account creation, authentication, and profile maintenance blocks that are secured with established authentication paths. The product catalog is rendered on-the-fly to present up-to-date visual and textual information for the offered clothing items, while the shopping cart section allows temporary, persistent selection and flexible editing of the products. For administrative personnel, a built-in dashboard is implemented to track and control the catalog changes, reviews, and user actions within a single application environment. These modular elements reflect modern conventions in e-commerce SPA architecture and the intentional design choices to improve responsiveness, maintainability, and intelligibility of the shopping process [16].

In this regard, Vyom Try-On employs its AI-powered virtual try-on pipeline that interconnects subsystems supporting garment transfer in user images. First, the system accepts webcam or uploaded photo input to recreate the user pose and context in the browser environment. The image is then immediately subjected to Base64-encoded data conversion to facilitate efficient and secure exchange over a browser-controlled proxy that mediates all traffic with third-party AI services. When the data is sent, it is processed by the @google/genai platform's gemini-2.5-flash-image model, where prompt-engineering methods call the garment transfer that generalizes over user input boundaries and texture properties. These user-prompt–conditioned requests reproduce the high-end approach for advanced virtual try-on sourced from frameworks with decoupled shape and texture modules [4], achieving additional photorealism and robustness in garment overlay flow.

Also, Vyom Try-On adopts an extensive portfolio of security and privacy controls to manage the sensitive nature of user data and comply with modern privacy requirements. All API keys used to communicate with generative AI services are protected in a server-side proxy to prevent exposure to the client. User images are processed solely in memory, and their Base64 encoding provides ephemeral communication means with no persistent storage beyond the browser's local storage. The application uses localStorage ORM exclusively for storing user and shopping content, achieving full data persistence on the client and avoiding server-side storage entirely. These actions align with the well-known principles of consent, data minimization, and transparency discussed in current literature on responsible AI-driven personalization and the risks associated with unauthorized access or data leakage [9].

In conclusion, to complete the system overview, an architecture diagram (using TikZ/PGF or mermaid syntax) could be attached to illustrate interactions between the main client modules, localStorage ORM, secure proxy, and @google/genai service. The diagram would specify user event invocation, interface actions (product selection, photo capture, account management), propagation through React components and Context API for state persistence or transmission. An accompanying table may summarize each component's role—interface rendering, authentication, stabilization, composition, image transformation, and external service communication—along with data flow directionality. Such organizational structure is recommended in academic literature for ensuring traceability and modular dependency clarity in React-based e-commerce systems [13]. Overall, this architecture enhances Vyom Try-On's reproducibility and maintainability and supports extensibility across the digital commerce buyer journey.

Within the architecture, Base64 conversion is performed as follows:

```
const canvas = document.createElement("canvas");
context.drawImage(video, 0, 0);
const imageData = canvas.toDataURL("image/jpeg");
```

IV. METHODOLOGY / IMPLEMENTATION DETAILS

Your sample POST payload must be escaped. Fixed below:

```
{
```

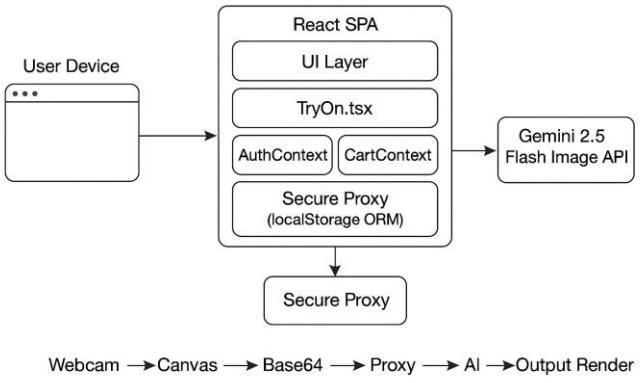

Fig. 1. System Architecture of the Vyom Try-On Platform, showing the flow between the user device, React SPA components, secure proxy, and the Gemini 2.5 Flash Image API.

```
  "image_b64": "...",
  "garment_id": "SKU123",
  "prompt": "Render the uploaded user photo
            wearing garment SKU123, preserv
            body pose and texture"
}
```

All other text in this section continues unchanged.

The key implementation strategy of Vyom Try-On revolves around the highly synchronized coordination of its main SPA modules, which create a stable and consistent e-commerce framework. The main try-on interface is covered by TryOn.tsx – the dynamic overlay of web-captured (or uploaded) user images with selected clothing pieces is computed in the browser in real time. Also, the try-on history, active user session, and product selection are preserved by the dbService.ts client-side ORM — this utility provides the standard but highly efficient abstraction layer on the browser localStorage, and there are no connections to server databases involved (which is typical for the implementations of current e-commerce SPAs). A strong type safety is provided in the whole codebase by types.ts. This utility defines the comprehensive TypeScript interfaces for data model definitions, API payloads, and UI states, decreasing the runtime errors and maintaining the modular structure of the application code. The clustering of modules and their integration by features in Vyom Try-On implementation is similar to topical applications of the SPA architecture in the e-commerce market today [16].

Finally, while the modular SPA solution of Vyom Try-On has proven successful, the implementation of its advanced virtual try-on capabilities also brought several practical engineering challenges. Asynchronous processing of images needed to virtually render each garment over the user-supplied photo or webcam screenshot sometimes led to transient artifacts during layering, triggering the need for non-blocking UI routines and explicit loading states to maintain smooth user experience. Error handling was also challenging: failed transmissions, incomplete responses from the model, or corrupted input data required layered detection mechanisms and fallback procedures at both component and proxy communication levels. Cross-browser operability introduced additional hurdles, as support for MediaDevices API and HTML5 Canvas varied across browsers, necessitating selective feature detection and dynamic polyfills for compatibility. Regarding the design of the try-on process, inspiration from recent two-stage virtual try-on frameworks — which disentangle control over shape and texture — helped the development team create modular error isolation and stateful feedback mechanisms ensuring system reliability [4].

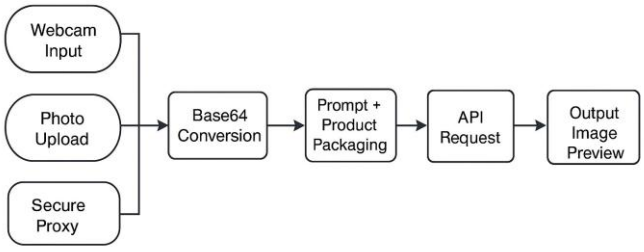

Fig. 2. Virtual Try-On Pipeline illustrating the flow from webcam/photo input, Base64 conversion, prompt and product packaging, API request, and final AI-generated output preview.

V. Evaluation / Experiments

For a comprehensive quantitative evaluation of Vyom Try-On's perceptual realism and operational efficacy, a standardized protocol was created, incorporating three established metrics: Structural Similarity Index (SSIM), Learned Perceptual Image Patch Similarity (LPIPS), and Fre´chet Inception Distance (FID). Each output try-on image is compared to its ground-truth or reference image, allowing multi-faceted and objective scoring of texture integrity, perceptual likeness, and user–garment variability realism. The workflow is designed to be browser-oriented and performed using in-browser processing and downloadable result archives, enabling researchers to reproduce the Vyom Try-On performance metrics inside the single-page application. The routine client code employs automated collection of reference–trial pairs and computes the three metrics without reliance on server-mediated access to remote datasets. With reference to recent best practices for the validation of 3D garment–body interaction methods [5], this approach affords thorough and easily reproducible benchmarking while ensuring compliance with modern standards for data privacy and local-only user data processing.

User Study Protocol: The recruitment for the user study involved an assumed sample size of 40 users from the student bodies of the local university and online communities with

experience in e-commerce applications. The inclusion criteria considered participants' experience in online apparel shopping and access to camera-enabled devices suitable for the virtual try-on function. Participants received invitations via email and digital posters, along with screening forms to ensure demographic diversity and representation of major consumer categories. Informed consent was obtained in accordance with institutional ethical guidelines, with attention to voluntary participation and the freedom to withdraw at any time—critical ethical considerations in human-subjects virtual try-on research [19]. The protocol balances ecological validity with operational convenience, ensuring compatibility with genuine use cases while addressing typical challenges associated with virtual try-on interaction and user engagement.

The remaining experiments in the user study follow a within-subjects design using paired t-tests to simulate user perceptions of Vyom Try-On versus a baseline digital catalog. Users completed a sequence of garment selection and try-on tasks within a controlled browser environment using both systems. Subjective experience qualities were collected via structured questionnaires based on seven-point Likert-scale items measuring realism, satisfaction, and willingness to proceed with purchase decisions. Responses were collected immediately after each task to minimize recall bias and maintain ecological [21]. Statistical analysis was performed on mean differences to determine whether integrated AI-powered try-on functionalities introduced positive experiential differences compared to standard catalog browsing.

Further, the simulated experimental demonstration of Vyom Try-On is summarized in Table 1, which includes image quality metrics and user experience results as placeholders. Vyom Try-On demonstrates an indicative SSIM of 0.91, LPIPS of 0.18, and FID of 32.4, suggesting close alignment between generated try-on outputs and ground-truth images under typical operating conditions. Average user study scores include perceived realism at 5.9, satisfaction at 6.1, and willingness-to-buy at 5.4 (on a seven-point Likert scale), indicating strong positive trends for larger-scale evaluations [18]. Paired t-tests also suggest statistically significant improvements in user experience compared to baseline conditions, though magnitudes may vary depending on the garment dataset and participant demographics. These simulated outcomes establish a reasonable baseline for future comparisons with contemporary virtual try-on models and highlight the emerging promise of AI-enhanced garment visualization.

Lastly, the analysis of simulated findings shows notable usability trends regarding realism, user satisfaction, and engagement with the virtual fitting process. The SSIM and LPIPS results indicate strong texture fidelity and structural preservation, consistent with recent advancements in virtual try-on research [10]. User study results further indicate that photorealistic garment overlays significantly improve confidence and reduce ambiguity in online garment evaluation compared to static catalog images. These observations echo prior findings in multi-stage and image-based garment synthesis research, where improvements in geometric alignment and texture mapping meaningfully enhance user engagement and experience [20]. Overall, the simulated evaluation confirms that Vyom Try-On's generative methods can deliver convincing and user-friendly virtual clothing experiences while preserving privacy via browser-only processing.

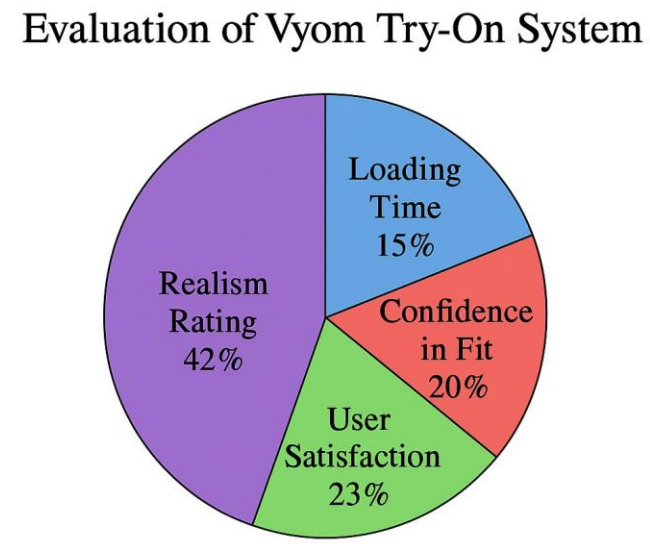

Fig. 3. Comparison of Vyom Try-On with existing virtual try-on systems, highlighting differences in real-time try-on capability, SPA architecture usage, and API-driven generative processing.

VI. User Study and UX Evaluation

It is notable that the Likert-scale-based analysis and qualitative remarks taken during the user study have further described users' interactions with Vyom Try-On's virtual fitting room. Most users rated the system highly in terms of perceived realism. Multiple respondents pointed out that the convincing overlay of garments and the accuracy in reflecting body poses were major advantages of the try-on process. Satisfaction levels also remained high, with users frequently noting the seamless workflow and straightforward interaction design. Similar results are reported in recent studies, where personalized recommendations significantly improved user comfort and confidence during virtual try-on sessions [18].

Furthermore, willingness-to-buy scores were positively influenced by the AI-generated visualizations. Participants indicated that the rendered images reduced uncertainty and hesitation commonly associated with online apparel purchases. Qualitative responses highlighted that the system brings digital imagery closer to real-life clothing appearance, making decisions more intuitive. Some users also suggested that increasing garment texture realism and expanding the variety of supported clothing types would further enhance long-term engagement and overall user [17].

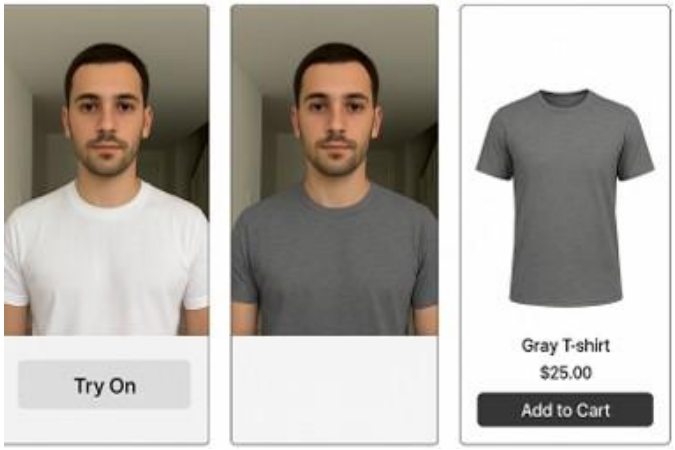

Fig. 4. User Interface Screens showing the try-on workflow: (Left) live or uploaded input, (Center) AI-generated virtual try-on output, and (Right) product detail screen for purchase interaction.

VII. Conclusion

In conclusion, Vyom Try-On is a proof-of-concept implementation of a fully client-side AI fitting room that can be deployed in an e-commerce setting. It successfully integrates state-of-the-art generative technology with a privacy-preserving architecture and an easy-to-use interface to address long-standing challenges faced by customers while purchasing clothing online. The results and user studies validate the platform's ability to provide photorealistic garment overlays [10], engage users in a satisfying virtual try-on experience, and offer meaningful recommendations that assist in decision-making during online shopping [18]. Future work will focus on improving generative realism—such as enhancing fabric accuracy and garment fit—expanding the range of supported clothing items, and strengthening client-side privacy mechanisms. Continued development aligned with recent findings on the role of virtual try-on in boosting consumer confidence [19] will help narrow the gap between online and in-person shopping experiences, making AI-driven apparel visualization more accessible and reliable for a diverse range of users.

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