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TOUCH AND GESTURE-BASED INTERFACES IN CREATIVE WORKFLOWS: A REVIEW

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ABSTRACT

The world has now been introduced to touch and gesture-based interfaces as prominent tools in the creative industries, with designers and entertainers engaged with digital media. There are problems or shortcomings, such as ergonomic fatigue and precision in operating these touchscreens. This paper aims to comprehensively examine the effectiveness and ergonomic considerations of these interfaces in facilitating precision, expressiveness and intuitive interaction. A structured literature review was conducted, focusing on peer-reviewed articles published from 2020 to 2025, highlighting empirical studies in creative human-computer interaction (HCI). The study presents that hybrid approaches—combining touch, stylus and gesture input—are increasingly being used in creative software and hardware, offering more adaptable and inclusive designs. The findings support the need for the development of future user-centred interfaces that balance natural interaction with functional control, ensuring accessibility, reducing fatigue and increasing creative output. The limitation of this study focuses on specific interface types and short-term usage contexts.

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1.0 Introduction

The integration of touch and gesture-based interfaces represents a monumental evolution in creative workflows, fundamentally altering how creators interact with their digital tools. This shift away from traditional input devices, such as the mouse and keyboard, towards more intuitive and natural user interfaces (NUIs) is redefining the landscape of digital creativity. Rooted in decades of Human-Computer Interaction (HCI) research, technologies like multi-touch have been in development for over 25 years, paving the way for today's sophisticated systems (Buxton, 2010). These interfaces empower users to manipulate digital content through physical movements that mirror real-world actions, fostering a more direct and engaging user experience that studies have shown leads to higher satisfaction compared to traditional methods (Bailenson et al. 2008; Wang et al., 2023).

The impact of these technologies is felt across a diverse range of creative industries. In the realms of digital art and graphic design, touch interfaces provide a fluid and direct manipulation of the virtual canvas, closing the gap between the artist's hand and the digital medium. For 3D modelling and animation, gesture controls are becoming indispensable, especially within immersive Augmented and Virtual Reality (AR/VR) environments where they allow for natural interaction with three-dimensional objects and spaces (Aleksei, 2024). This paradigm shift not only enhances ergonomics but also improves accessibility, lowering technical barriers and empowering a new generation of creator (Rousselle, 2025).

Despite their clear advantages, the widespread adoption of touch and gesture-based interfaces is not without its hurdles. To create a seamless user experience, designers must overcome significant challenges related to the learnability and discoverability of new gesture vocabularies. Ensuring the accuracy and reliability of motion detection is paramount, as misinterpreted inputs can lead to user frustration and abandonment of the technology (Philippe, 2025).

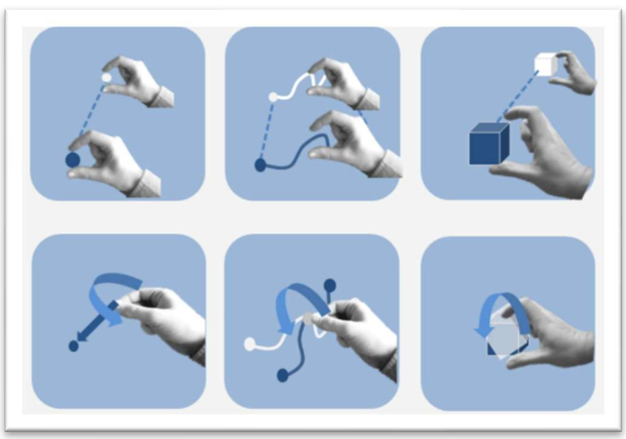


Figure 1: Hand gesture interactions for 3D object manipulation *(Source: Philippe, 2025)*

As shown in Figure 1, gesture-based interaction allows users to manipulate virtual objects intuitively. Gesture-based interaction is a type of Touchless Tech that allows users to control devices using hand movements, finger swipes, or body gestures—without making any physical contact with a screen or surface. These interfaces use advanced motion detection and depth-sensing technologies to interpret human movements as commands (Philippe H., 2025). Furthermore, while touch and gesture controls are highly effective for many tasks, some research indicates that for complex workflows demanding high precision, the traditional mouse may still be the preferred tool for expert users, who value its efficiency and established muscle memory (Jaanhavi bansal, 2023).

This paper aims to comprehensively compare the ergonomic considerations of these interfaces in facilitating precision, expressiveness, and intuitive interaction.

2.0 Literature Review

2.1 Historical Development of Touch and Gesture Interfaces

The concept of direct manipulation and natural interaction is not new; its roots can be traced back to early visionary systems like Ivan Sutherland's Sketchpad in the 1960s, which demonstrated the potential for direct interaction with graphical elements (Sutherland, 2003). However, the widespread adoption of touch and gesture interfaces for general computing, and more specifically for creative tasks, gained significant momentum in the late 20th and early 21st centuries. Pioneering work at institutions like the MIT Media Lab and the University of Toronto's Dynamic Graphics Project, laid the groundwork for multi-touch technology, which became commercially viable with the advent of smartphones and tablets (Greenberg et al., 2012; Buxton, 2020). Companies like Apple and Microsoft further popularized these interaction paradigms, transforming how users engaged with digital content (Rogers & Sharp, 2011).

Touch and gesture interfaces trace their roots to early touchscreen experiments in the 1960s–1980s, but the conceptual and design foundations for modern multi-touch and gesture work were solidified by decades of HCI research that followed (Buxton, 2010). Early systems moved from resistive and infrared sensing to capacitive and optical approaches, enabling the responsiveness and fidelity required for direct-manipulation interactions. The multi-touch renaissance popularized in consumer devices in the late 2000s recast the human hand as a primary input device and seeded a wave of research into bimanual interaction, gesture vocabularies, and direct-manipulation affordances. Recent scient to metric studies trace this evolution in the literature and show how research emphases shifted from hardware and sensing to interaction techniques, usability, and application domains (touchscreens in vehicles, kiosks, and creative tools), highlighting persistent themes such as occlusion, precision limits, and discoverability of gesture sets.

From 2020 through 2025 the field intensified efforts to make gesture recognition robust, real-time, and applicable beyond lab settings by leveraging machine learning, sensor fusion, and new sensing modalities. Reviews and empirical studies in this period document advance in deep temporal models for continuous gesture recognition, the rise of RF/mm Wave radar as a privacy-friendly, lighting-robust sensing alternative, and the proliferation of benchmark datasets and evaluation frameworks aimed at reproducibility and real-world performance assessment. Recent work also emphasizes evaluation rigor proposing concrete methods to quantify gesture-UI effectiveness and points to gaps that remain, such as long-term in-situ studies of gesture adoption, unified benchmarks for creative gesture corpora, and practical haptic integration to close the sensory gap between physical and digital tools. These trends suggest the discipline is moving from isolated prototypes toward standardized, deployable systems suitable for creative workflows and public installations.

2.2 Theoretical Frameworks and HCI Principles

The design and effectiveness of touch and gesture-based interfaces are deeply rooted in established HCI principles and cognitive theories. The concept of Natural User Interfaces (NUIs) posits that interaction should be intuitive and mimic real-world actions, reducing the cognitive load on the user (Wigdor & Wixon, 2011). Similarly, Fitts' Law, which predicts the time required to move rapidly to a target area, has been central in optimizing touch target sizes and gesture trajectories to enhance both speed and accuracy (MacKenzie, 1992). These theoretical foundations remain relevant in contemporary systems, where precision and efficiency are critical to ensuring user satisfaction, particularly in creative workflows. Furthermore, considerations of cognitive load and ergonomics are paramount; interfaces should minimize mental effort and physical strain during prolonged use, a challenge often associated with gestures that require sustained arm movements (often termed "gorilla arm" effect)(Myers et al., 2000).

In addition to performance optimization, cognitive load and ergonomics are paramount considerations in interface design. Prior research highlighted the risks of physical fatigue, such as the so-called "gorilla arm" effect, when gestures require sustained mid-air movements (Myers et al., 2000). Recent studies confirm that prolonged gesture use can negatively impact usability and emphasize the importance of balancing interaction richness with ergonomic sustainability (Stefanidi, 2023; Hashi et al., 2024). Emerging frameworks in gesture-based interaction therefore advocate for multimodal input strategies—such as combining touch, pen, and speech input—to mitigate fatigue while maintaining expressive power.

Collectively, these principles illustrate that while NUIs offer the promise of intuitive, embodied engagement, their design must be grounded in empirical models of human performance, cognitive processing, and ergonomic well-being. Modern HCI research increasingly integrates these theories with machine learning–driven recognition pipelines, enabling adaptive systems that personalize interaction techniques based on user behavior and context (Tang et al., 2023). This synthesis of classic HCI theory with emerging computational methods underscores a shift toward more user-centered, adaptive, and sustainable gesture-based interfaces for creative domains.

Human–computer interaction (HCI) theory offers multiple complementary lenses for understanding touch and gesture interfaces. Classic principles—direct manipulation, affordances, and mental models—remain central because they explain why direct touch produces more transparent mappings between action and effect (users "see" the result of their action) and why discoverability matters for gesture vocabularies. Recent meta-reviews reaffirm that designers should ground gesture mappings in clear affordances and predictable feedback loops so users can form accurate mental models and learn gestures quickly (Stefanidi, 2023). These foundational ideas help explain both successes (intuitive multi-touch editing) and recurring usability problems (hidden gestures, mode errors) in contemporary creative tools.

Embodied cognition and embodied interaction extend those principles by foregrounding the body as a locus of cognition: movements, posture, and spatial relations are not merely inputs but part of how people think while creating (e.g., sketching, shaping, composing). Systematic reviews in embodied interaction and embodied-cognition research highlight empirical evidence that body-based interactions can amplify spatial reasoning and creativity when interface design leverages sensorimotor coupling, tangible proxies, or bimanual coordination (Lee-Cultura & Giannakos, 2020; Ale et al., 2022). For gesture-driven creative workflows this implies design choices that respect the natural kinematics of tasks (e.g., using a stylus for fine stroke control while reserving gross mid-air gestures for spatial transforms) and intentionally map bodily affordances to meaningful computational outcomes.

Finally, as sensing and machine learning matured between 2020–2025, theoretical focus expanded to include socio-technical and methodological frameworks that treat recognition pipelines, datasets, and evaluation as integral parts of theory-building. Large survey and review studies in gesture recognition emphasize that algorithmic advances (temporal models, multimodal fusion) must be paired with evaluation practices that measure not only recognition accuracy but also user-centred outcomes such as workload, creativity of produced artifacts, and long-term adoption (systematic reviews in IEEE Access; sensor-modality reviews). In short, modern HCI theory for touch and gesture interfaces is increasingly multi-layered: it couples classic cognitive/interaction theories (affordances, direct manipulation) with embodied and socio-technical perspectives, and demands rigorous, task-relevant evaluation to validate claims about creative support (Osman Hashi et al., 2024).

2.3 Current Applications in Creative Domains

Touch and gesture-based interaction systems have significantly influenced creative industries by opening new possibilities for expression and efficiency. In graphic design and digital art, applications such as *Adobe Fresco* and *Procreate* leverage multitouch and stylus input on devices like the iPad Pro to replicate the tactile experience of traditional media, enabling direct manipulation and intuitive creativity (Adobe Systems Inc., 2025; Apple Inc., 2025). Empirical studies confirm that asymmetric stylus–gesture interaction improves both speed and precision in digital sketching, reinforcing the importance of multimodal workflows for professional artists (Zou, Bai, Gao, Fowler, & Billinghurst, 2024).

In 3D modeling and animation, gesture-based interfaces—particularly in Virtual Reality (VR) and Augmented Reality (AR)—are reshaping production flows. Tools such as *Gravity Sketch* and *Tilt Brush* allow creators to sculpt and paint in immersive 3D environments, providing a more natural and embodied design process compared to traditional desktop software (Gravity Sketch, 2025). Recent research shows that immersive sketch canvases and mid-air gestures support fluid 2D–3D transitions, enhancing creative freedom but also introducing accuracy trade-offs and fatigue challenges (Tan et al., 2024; Dong et al.,

2022. This convergence of academic findings and commercial applications underscores the trajectory toward more embodied, intuitive, and immersive creative workflows.

Emerging sensing and feedback modalities are further expanding creative possibilities in both studio practice and public installations. RF/mmWave sensing has shown promise as a lighting-insensitive, privacy-preserving method for hand tracking in collaborative exhibits and large displays, while advanced haptic technologies—such as vibrotactile and thermal feedback pens—are restoring material cues that improve realism and coordination in digital sculpting (Hao et al., 2024). By combining multimodal sensing with interactive feedback, these systems move closer to replicating the embodied experience of traditional creative practices, although longitudinal evaluations in real-world environments remain necessary to validate their long-term impact.

2.4 Ergonomic Considerations

Based on the website Capian.co, the ergonomic criteria presented were created in the context of a research project in the mid-90s. The method of criteria that allows the integration of human factors in the design process of human-computer interfaces. Bastien & Scapins' ergonomic criteria fit perfectly with the current nomenclature of any digital environment, be it a mobile or web interface. Among the criteria are: guidance, workload, explicit control, adaptability, error management, consistency, significance of code and compatibility (Christian Bastien and Dominique Scapin's, 2025). According to Rob Tanen (Rob Tannen, 2025), there are several body measurements that could be relevant for reaching a touch screen, but a practical one would be Forward Grip Reach distance - roughly the distance from the shoulder axis to the palm of the hand. With those two metrics in mind - eye height and forward grip reach - you could picture any user as the function of two perpendicular lines - a vertical line, representing the individual's eye height, and a horizontal line representing arm reach. The illustration of this research is shown in Figure 2 below.

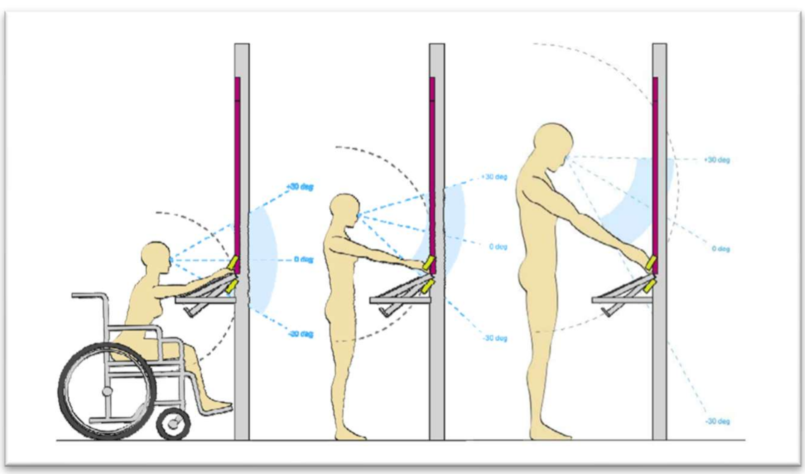


Figure 2: Three different representative users - note that the wheelchair user has a sitting eye height compared with the two standing users. *(Source: Rob Tannen, 2025)*

2.5 Touch and Gesture-based Applications

According to Srinivasa Sesha Sai, based on the research about AI-enhanced hand gestures for dynamic presentations, structured into two primary stages: gesture recognition and slide control (Sai et al., 2024). Based on the gesture recognition, leverage Artificial Intelligence (AI) and computer vision to interpret hand gestures accurately. Through the utilization of advanced algorithms, the system detects various hand gestures, including thumb, index, middle, ring, and little finger movements. These gestures are then analyzed to determine the presenter's intended actions. An illustration of this research is shown in Figure 3 below.

Figure 3: To draw, use the index finger *(Source: Sai et al., 2024)*

Besides, based on an idea from the article "Brain-Computer Interfaces and Creative Expression: Interface Considerations for Restorative and Therapeutic Interactions" by Stephanie M. Scott & Chris Raftery (2021), which relates to ergonomics and creative workflows. By inviting somatic analysis towards the design of BCI interfaces and incorporating tenets of creative arts therapies practices into hybrid navigation paradigms for self-expressive applications (Scott & Raftery, 2021).

Touch-and-gesture systems for creative workflows are rapidly moving toward multimodal sensor fusion, combining stylus dynamics (pressure, tilt), touch, IMU/device motion, audio, and contactless sensors (radar/ultrasonic) to capture both precision and expressivity. Multimodal pipelines reduce recognition errors while preserving bimanual and tool-asymmetric interactions that artists and designers need for complex tasks for example simultaneous fine strokes with a stylus and coarse commands with a gesture. Recent HCI and VR studies demonstrate that asymmetric stylus and gesture mappings improve speed and accuracy for sketching while maintaining expressive affordances, pointing to multimodal fusion as a practical way to reconcile precision and fluid control in creative tools (Zou et al., 2024).

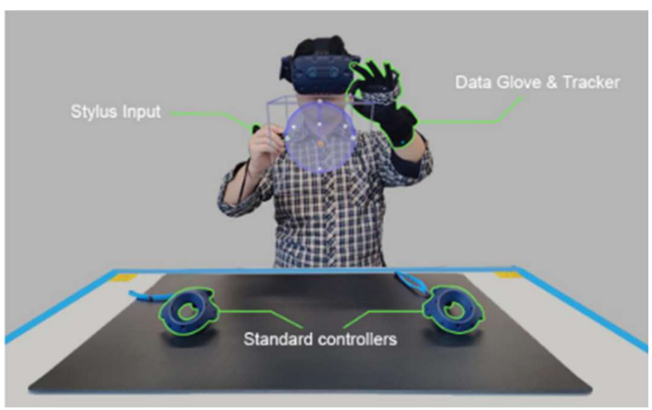


Figure 4: Tool-based asymmetric interaction with stylus and gesture input (*Source:Zou et al., 2024)*

Contact-free sensing modalities notably millimeter-wave (mmWave) radar and other RF-based approaches are emerging as robust, privacy-preserving complements to camera and touchscreen inputs for creative applications. mmWave sensing is resilient to lighting changes and partial occlusion, and can reliably track fine hand/arm motion in cluttered or dim studio environments; when fused with touch or stylus input it enables seamless transitions between surface-detail work and mid-air spatial manipulations (e.g., 2D to 3D workflows in AR/VR). Surveys and systematic studies of FMCW mmWave gesture recognition report growing accuracy and real-world robustness, suggesting radar will be a key sensor for public, multi-user creative installations and large-display art-making (Tang et al., 2023).

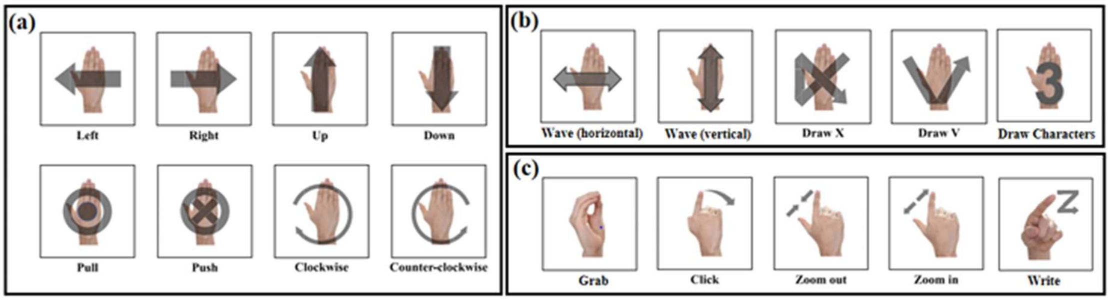
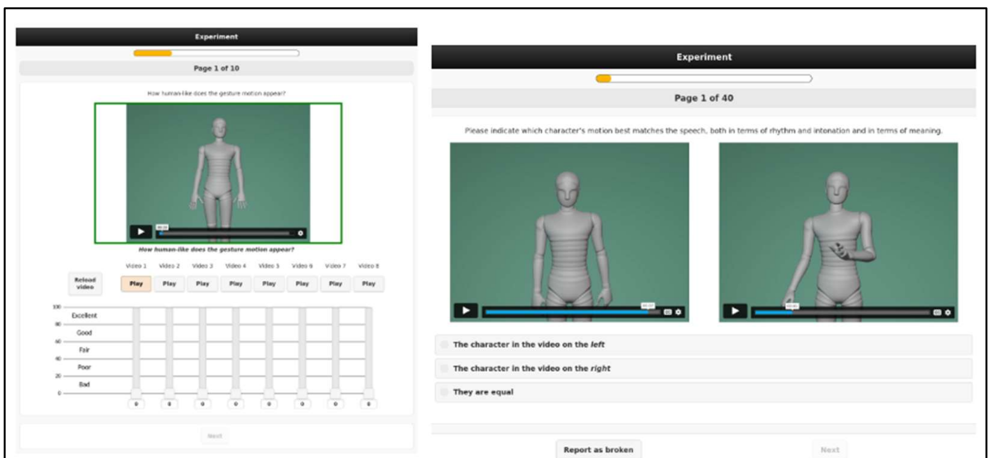


Figure 5: Gesture summary and classification: (a) macro gestures with single-direction, (b) macro gestures with multi-direction, and (c) micro gestures. *Source: (Tang et al., 2023)*

Vision-based and learning-driven gesture recognition have advanced substantially through improved skeleton tracking, temporal modelling (transformers / temporal convolution), and larger labelled datasets are enabling near-real-time recognition of continuous gestures used in performance and creative interfaces. However, progress depends on shared datasets and evaluation protocols: community efforts such as the GENEA challenges for gesture generation (co-speech gesture benchmarks) have shown how common datasets and crowdsourced perceptual evaluation can meaningfully accelerate and standardize progress across labs. Translating these benchmarking lessons to creative-gesture corpora (sketch stroke trajectories, sculpting motion, musical conducting gestures) remains a pressing future task (Yoon et al., 2022).



(a) Human-likeness interface (HEMVIP) and full-body video
(b) Appropriateness interface and upper-body videos

Figure 6: Screenshots of the evaluation interfaces used in the studies, also showing the camera perspectives used by the tiers. *Source: (Yoon et al., 2022)*

Finally, hardware-software co-design and cost scaling will determine whether research prototypes become practical tools for creators. Low-cost mmWave modules, embedded ML accelerators, energy-efficient haptic actuators, and standardized API layers for multimodal input will lower barriers to commercial and educational deployment. Research that addresses manufacturability, energy use, and integration with existing creative software stacks (DAWs, digital painting suites, 3D packages) will accelerate real-world uptake between 2023–2025 and beyond, turning promising gesture interactions into dependable instruments for professional creative workflows (Hao et al., 2024).

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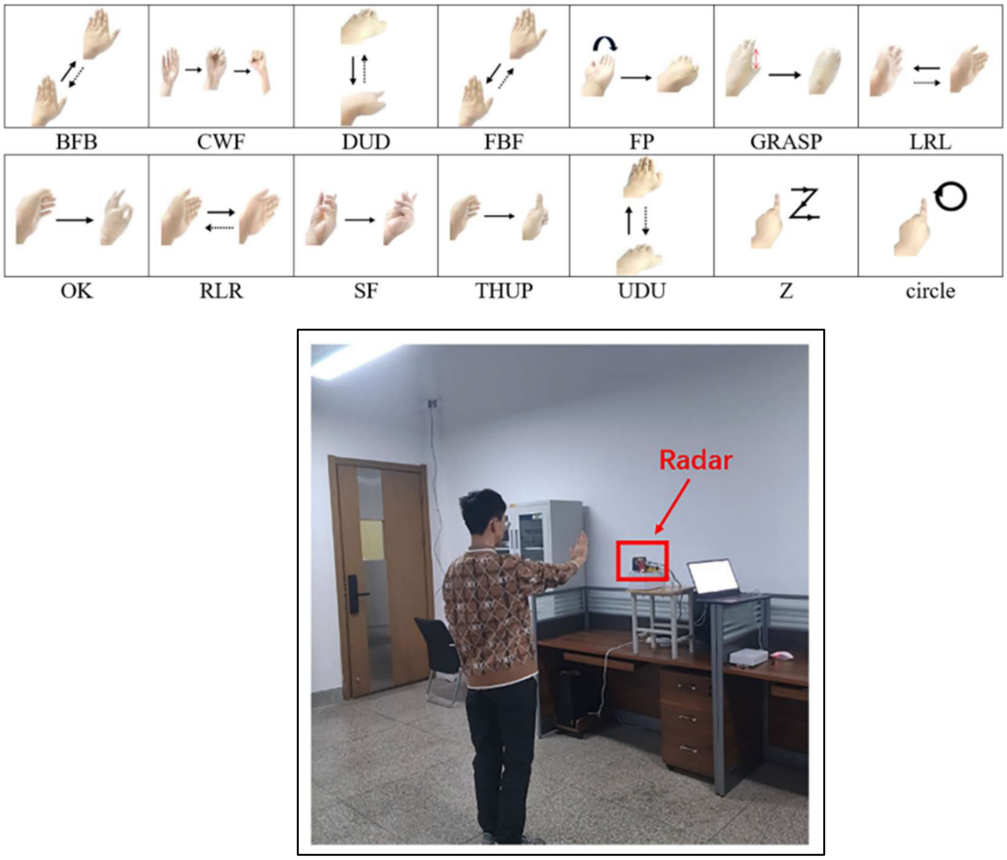

Figure 7: Gestures design with motion amplitudes, directions, angles & speeds
(Source: Hao et al., 2024)

3.0 Methodology

This study uses a structured literature review method, based on secondary sources, including journal articles and recent academic papers. The method of this study was carried out through four phases, whereas, understanding of the context, literature search, selection of criteria and analysis of data. Figure 8 shows the process of this study below.

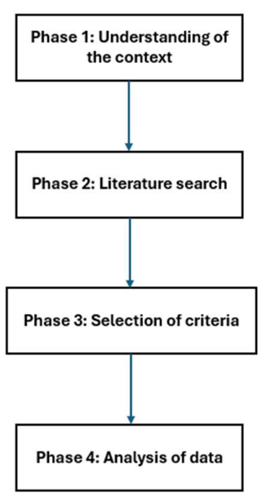

Figure 8: Implementation Phase of Structure Literature Review

3.1 Understanding of the context

This phase is the early-stage activities and was conducted before the main analysis. It is functioning to define the research direction and scope of studying touch and gesture-based interfaces in creative workflows. This phase also begins by investigating and evaluating the title in the problem statement.

3.2 Literature of searching

This phase explains searching academic databases such as Google Scholar, ACM Digital Library and IEEE Xplore using the keywords related to touch and gesture, creative workflow, interfaces, effectiveness using touch screen and ergonomic considerations using touch and gesture. For example, search for combinations like "ergonomic considerations for designers in touch and gesture-based interfaces for creative workflow", "key factors that influence the effectiveness of using touch and gesture for creative", or "how does the accuracy of gesture recognition impact user interaction in creative workflows". This study evaluates the titles and abstracts of the search results to identify relevant articles that discuss the key factors of effectiveness and ergonomics in touch and gesture-based interfaces for creative workflows.

3.3 Selection of criteria

This study pays attention to inclusion criteria such as focus on touch and gesture, outcomes related to the user or designer in creative workflows. A total of 67 journal articles were identified from the phase 1 and subsequently through the phase 2 (28 journals), and phase 3 (10 journals), based on the following criteria:
Inclusion of criteria :

- Touch and gesture-based interfaces in creative workflows
- Effectiveness and ergonomics aspects of touch and gesture in creative workflows.
- Indexed journal articles or academic articles published between 2020 until 2025

3.4 Analysis of data

This phase explains how to collect the data into the table. This process will be more detailed in the data collection for the analysis stage, where the data will be converted into categories of effectiveness and ergonomics regarding touch and gesture-based interfaces. This process will make indirectly easy to analyse even the data is cleared to understand. A total of 10 journal articles were collected for this phase.

4.0 Results and Findings

Table 1 below presents a comparison of the ergonomic and effectiveness aspects of touch and gesture-based interfaces in creative workflows. This table reviews ten research papers with the name RP, Research Paper, as the ID paper, starting from 2020 to 2025. Based on this study, the finding focuses on the ergonomic and effectiveness aspects of touch and gesture-based interfaces for creative workflow.

Table 1: Ergonomic and effectiveness aspects of touch and gesture-based interfaces

ID paper	Author (Year)	Ergonomic Aspects	Effectiveness Aspects
RP01	(Arora, 2020)	Whole-body/arm gestures create engaging experiences but risk fatigue (“gorilla arm”).	Very effective for exploratory creativity and embodied expression; less precise for detail work.
RP02	(Mo et al., 2021)	Mid-air gestures may cause fatigue; tool allows designers to refine ergonomic comfort by selecting micro vs macro gestures.	Effective for rapid gesture prototyping; enhances flexibility in HMD creative contexts.

RP03	(Potts et al., 2022)	Stable surface use improves comfort; limits fatigue compared to mid-air.	Effective for 2D creative workflows (sketching, mapping); less suited for immersive 3D precision.
RP04	(Gheran et al., 2022)	Ergonomics supported by visualization, helps refine gesture sets before deployment.	Highly effective in developing systematic, shareable gesture vocabularies for creative tools.
RP05	(Raswan et al., 2023)	User-defined gestures reduce mental/physical load; aligns with natural metaphors.	Improves usability in immersive design; effective for manipulating 3D models intuitively.
RP06	(Pan et al., 2023)	Gesture-based editing integrated with AI; ergonomics depend on gesture vocabulary size.	Increases conceptual design speed and co-creation efficiency; effective in early ideation.
RP07	(Shahi et al., 2024)	Let's users define gestures with a single demo , reduces learning effort and discomfort by aligning with personal movement habits.	Boosts efficiency by cutting repetitive tasks; customization improves workflow integration.
RP08	(Ye et al., 2024)	Tangible props reduce fatigue by offering tactile anchoring; natural hand movement.	Improves speed and creative playfulness; effective balance of precision (touch) and expression (tangible).
RP09	(Liu et al., 2024)	Ergonomic issues: arm extension for long periods; occlusion of writing surface.	Effective for collaborative workflows and remote creative sessions; enhances real-time ideation.
RP10	(Zindulka et al., 2025)	Small screens require precise finger use; ergonomic strain if used for long sessions.	Supports fast creative text/content generation; high effectiveness for mobile, but limited expressiveness.

5.0 Analysis and Discussion

Based on Table 1, from an ergonomic perspective, examples of research studies like RP03 (Potts et al., 2022), RP07(Shahi et al., 2024), and RP08 (Ye et al., 2024) are better aligned with the natural human movement. These methods allow resting positions, reduce mid-air weariness and permit resting positions. However, while immersive mid-air and full-body gesture systems like RP01 (Arora, 2020) and RP05 (Raswan et al., 2023) offering captivating engagement, it is still ergonomically demanding and often causes discomfort when used for long periods of time. Interestingly, tools like research studies in RP07(Shahi et al., 2024), RP02 (Mo et al., 2021), and RP04 (Gheran et al., 2022) that allow users to define their own gestures help address ergonomic issues by changing the way they handle things based on what the user wants. This shows that personalization can help solve ergonomic problems.

The data about the effectiveness aspect, based on Table 1, by the creative stage of the workflow. Early ideation and exploration are greatly enhanced by gesture-rich VR/AR systems, which provide flexibility and encourage embodied creation. But it often lacks the precision needed for detailed editing or enhancement. Whereas, for precision-driven tasks like drawing, structural editing, or collaborative refinement RP06(Pan et al., 2023) and RP010 (Zindulka et al., 2025) touch-based and hybrid tangibility techniques are consistently more effective. To fill these gaps, hybrid systems that combine anchored touch with freeform gestures (such as RP03 and RP08) offer task precision and expressive freedom.

A significant gap in the research is the lack of long-term evaluation. There are still unanswered concerns about long-term ergonomic strain, learning curve, and workflow usability, as the majority of testing focuses on short-term usability rather than consistent creative practice. Similar to these, the collaborative aspect is not well studied. While RP06 editing tools and systems, and research studies, RP07 handle remote or multi-user situations, few studies have comprehensively examined how gesture/touch interactions affect group creativity dynamics. Besides, the integration of AI-powered support (such as RP09 and RP10) is still in its early stages but shows promise, suggesting that future systems may move away from input-only modalities and toward collaborative collaboration.

In conclusion, the analysis shows that no single modality provides a comprehensive solution: touch and tangible modalities (RP08) promote comfort and accuracy at the expense of less expressive flexibility, while immersive gestures (RP09) optimize creative fluency but sacrifice ergonomics. To balance exploration, accuracy, and ergonomic sustainability, the most promising path is toward hybrid, adaptable systems that combine modalities and utilize AI. However, additional studies are needed to validate these results in practical long-term creative workflows.

6.0 Conclusion

These studies on gesture and touch-based creative interfaces (2021–2025) demonstrate that no single modality can meet all the requirements of a creative flow. Gesture-based systems enable ideation and physical discovery, but are constrained by ergonomic fatigue and precision. In contrast, touch or physical interfaces are comfortable and accurate but decrease the fluency of expression. For designers and developers, combining adaptive gestures, mindful-rest interaction patterns, and hybrid input approaches can reduce ergonomic risks while maintaining a creative edge. This study is limited by its focus on specific interface types and short-term usage contexts. A possible approach in the future that allows users to maintain a balance between creative freedom and ergonomic readiness is AI or hybrid and customized assistance systems(Płaza et al., 2025).

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References

Aleksei. (2024). *The Future of UI: Designing for Voice and Gesture | by Aleksei | Medium*. Medium. https://medium.com/@Alekseidesign/the-future-of-ui-designing-for-voice-and-gesture-84f5f7061c65

Arora, R. (2020). Creative expression with immersive 3D interactions. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3334480.3375028

Bailenson, J. N., Yee, N., Blascovich, J., Beall, A. C., Lundblad, N., & Jin, M. (2008). Wang, X., Zhu, C., Du, H., & Zhang, D. (2017). (2023). *Exploring the Role of Gestural Interaction in User Interface Design: Challenges and Opportunities | Association of Human-Computer Interaction*. HCI Association of Human-Computer Interaction. https://www.hci.org.uk/article/exploring-the-role-of-gestural-interaction-in-user-interface-design-challenges-and-opportunities/

Buxton, B. (2010). 31.1: Invited paper: A touching story: A personal perspective on the history of touch interfaces past and future. *48th Annual SID Symposium, Seminar, and Exhibition 2010, Display Week 2010*, *1*(May), 444–448. https://doi.org/10.1889/1.3500488

BUXTON, W. (2020). There's More to Interaction Than Meets the Eye: Some Issues in Manual Input. In *User Centered System Design* (pp. 319–338). https://doi.org/10.1201/b15703-15

Christian Bastien and Dominique Scapin's. (2025). *Bastien & Scapin Ergonomic Criteria for the Evaluation of Human-Computer Interfaces – Capian*. Capian & UX-Co. https://capian.co/ergonomic-criteria-bastien-scapin

Daniel Wigdor and Dennis Wixon. (2011). Brave NUI world:designing natural user interfaces for touch and gesture. *ACM SIGSOFT Software Engineering Notes*, *36*(6), 29–30. https://doi.org/10.1145/2047414.2047439

Gheran, B. F., Villarreal-Narvaez, S., Vatavu, R. D., & Vanderdonckt, J. (2022). RepliGES and GEStory: Visual Tools for Systematizing and Consolidating Knowledge on User-Defined Gestures. *ACM International Conference Proceeding Series*. https://doi.org/10.1145/3531073.3531112

Greenberg, S., Carpendale, S., Marquardt, N., & Buxton, B. (2012). Sketching User Experiences. In *Sketching User Experiences*. https://doi.org/10.1016/C2009-0-61147-8

Hao, Z., Sun, Z., Li, F., Wang, R., & Peng, J. (2024). Millimeter wave gesture recognition using multi-feature fusion models in complex scenes. *Scientific Reports*, *14*(1), 1–21. https://doi.org/10.1038/s41598-024-64576-6

Ivan Edward Sutherland. (2003). Sketchpad: A man-machine graphical communication system. In *University of Cambridge Computer Laboratory* (Vol. 30, Issue 1). https://doi.org/10.5802/ambp.417

Jaanhavi bansal. (2023). Gesture-based Human-Computer Interaction using Wearable Devices. *International Journal for Research Publication and Seminar*, *14*(4), 141–150. https://doi.org/10.36676/jrps.2023-v14i4-020

Liu, X., Zhang, Y., & Tong, X. (2024). Touchscreen-based Hand Tracking for Remote Whiteboard Interaction. *UIST 2024 - Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology*. https://doi.org/10.1145/3654777.3676412

Matthis Rousselle. (2025). *How Touchless Interaction is Changing UX/UI Design | by Matthis Rousselle | UX Planet*. UX Planet. https://uxplanet.org/how-touchless-interaction-is-changing-ux-ui-design-588300e0d053

Mo, G. B., Dudley, J. J., & Kristensson, P. O. (2021). Gesture Knitter: A Hand Gesture Design Tool for Head-Mounted Mixed Reality Applications. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3411764.3445766

Myers, B., Hudson, S. E., & Pausch, R. (2000). Past, Present, and Future of User Interface Software Tools.

ACM Transactions on Computer-Human Interaction, *7*(1), 3–28. https://doi.org/10.1145/344949.344959

Osman Hashi, A., Zaiton Mohd Hashim, S., & Bte Asamah, A. (2024). A Systematic Review of Hand Gesture Recognition: An Update from 2018 to 2024. *IEEE Access*, *12*(1), 143599–143626. https://doi.org/10.1109/ACCESS.2024.3421992

Pan, L., Yu, C., He, Z., & Shi, Y. (2023). A Human-Computer Collaborative Editing Tool for Conceptual Diagrams. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3544548.3580676

Philippe H. (2025). *How Gesture-Based Interaction Is Transforming UX/UI Design - Raw.Studio*. RAW. https://raw.studio/blog/how-gesture-based-interaction-is-transforming-ux-ui-design/

Płaza, G., Kabiesz, P., & Jamil, T. (2025). ERGONOMICS / HUMAN FACTORS IN THE ERA OF SMART AND SUSTAINABLE INDUSTRY : INDUSTRY 4 . 0 / 5 . 0 University of the Witwatersrand. *Management Systems in Production Engineering*, *0*. https://doi.org/10.2478/mspe-2025-0022

Potts, D., Dabravalskis, M., & Houben, S. (2022). TangibleTouch: A Toolkit for Designing Surface-based Gestures for Tangible Interfaces. *ACM International Conference Proceeding Series*. https://doi.org/10.1145/3490149.3502263

Raswan, M., Kay, T., Camarillo-Abad, H. M., Cibrian, F. L., & Qi, T. Di. (2023). Guess the Gesture: Uncovering an Intuitive Gesture-based User Interface for 3D Content Interaction in Virtual Reality. *ACM International Conference Proceeding Series*, 361–364. https://doi.org/10.1145/3591196.3596610

Rob TannenRob Tannen. (2025). *Ergonomics for Interaction Designers Understanding and applying physical fit in user interface research & design*.

Rogers Y., Sharp H., P. J. (2011). *INTERACTION DESIGN: beyond human-computer interaction, 3rd Edition* (3rd Editio). John Wiley & Sons. http://proquestcombo.safaribooksonline.com/book/web-development/usability/9780470665763/chapter-11-design-prototyping-and-construction/navpoint-86?uicode=open

Sai, M. S. S., Sunaina, S., Sravanthi, Y., & Mounika, S. (2024). AI - Enhanced Hand Gestures for Dynamic Presentations. *International Journal of Innovative Research in Science ,Engineering and Technology*, *13*(3). https://doi.org/10.15680/IJIRSET.2024.1303158

Scott, S. M., & Raftery, C. (2021). Brain-Computer Interfaces and Creative Expression: Interface Considerations for Rehabilitative and Therapeutic Interactions. *Frontiers in Computer Science*, *3*, 718605. https://doi.org/10.3389/FCOMP.2021.718605/BIBTEX

Shahi, S., Mollyn, V., Park, C. T., Kang, R., Liberman, A., Levy, O., Gong, J., Bedri, A., & Laput, G. (2024). Vision-Based Hand Gesture Customization from a Single Demonstration. *UIST 2024 - Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology*. https://doi.org/10.1145/3654777.3676378

Tang, G., Wu, T., & Li, C. (2023). Dynamic Gesture Recognition Based on FMCW Millimeter Wave Radar: Review of Methodologies and Results. *Sensors*, *23*(17), 1–19. https://doi.org/10.3390/s23177478

Ye, Q., Yong, Z. Z., Han, B., Yen, C. C., & Zheng, C. (2024). PaperTouch: Tangible Interfaces through Paper Craft and Touchscreen Devices. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3613904.3642571

Yoon, Y., Wolfert, P., Kucherenko, T., Viegas, C., Nikolov, T., Tsakov, M., & Henter, G. E. (2022). The GENEA Challenge 2022: A large evaluation of data-driven co-speech gesture generation. In *ACM International Conference Proceeding Series* (Vol. 1, Issue 1). Association for Computing Machinery. https://doi.org/10.1145/3536221.3558058

Zindulka, T., Sekowski, J. M., Lehmann, F., & Buschek, D. (2025). Exploring Mobile Touch Interaction with Large Language Models. *Conference on Human Factors in Computing Systems - Proceedings* . https://doi.org/10.1145/3706598.3713554

Zou, Q., Bai, H., Gao, L., Lee, G. A., Fowler, A., & Billinghurst, M. (2024). Stylus and Gesture Asymmetric Interaction for Fast and Precise Sketching in Virtual Reality. *International Journal of Human-Computer Interaction*, *40*(23), 8124–8141. https://doi.org/10.1080/10447318.2023.2278294