IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Contactless Canvas Powered by Vision for Gesture-Based Interaction.

Mrs. Punam C. Patil[1], Mr. Nilesh Chaudhari[2],

[1]Assistant Professor, :0009-0002-3084-4645, KCE'S COEM ,Jalgaon, India, 425001
[2]Assistant Professor, :0009-0002-2928-6201,Godavari College of Engineering Jalgaon , India , 425001

Abstract *-The fingertip acts as a virtual colored marker. Using Open CV, the captured frames are converted into HSV colour space, where colour detection and segmentation techniques are applied to isolate the fingertip region. The detected fingertip coordinates are continuously tracked and mapped onto a digital canvas, allowing the system to draw strokes corresponding to the user's hand movement. With designers and performers using digital media, touch and gesture-based interfaces are increasingly widely used in the creative industry. There are issues or flaws with these touchscreens, such as ergonomic strain and accuracy. The goal of this research is to thoroughly analyse how well these interfaces facilitate accuracy, expressiveness, and intuitive interaction while taking ergonomics into account.*

According to the report, creative software and hardware are increasingly utilizing hybrid approaches—which combine touch, stylus, and gesture input—to provide more flexible and inclusive designs.
Future improvements could include cloud functionality, multi-user support, gesture-based menus, and interaction with professional software. This experiment shows how gesture recognition might revolutionize interactive digital experiences.
The project's inclusive concept is its true driving force. In addition to fostering digital innovation, the technology is intended to offer a clean, convenient substitute in communal environments. By bridging the gap between digital precision and physical freedom, it seeks to make technology more human.

Keywords*- computer vision, virtual drawing, human-computer interaction, gesture recognition, hand tracking, and real-time processing*

INTRODUCTION

Innovative solutions that lessen or do away with the necessity for physical contact with electronic devices have been developed as a result of the quick development of computer vision and human-computer interaction. The Contactless Air Canvas, which offers a hands-free digital drawing, is one such new technology.

Environment in which users can write, draw, or carry out interactive tasks without coming into contact with a mouse, keyboard, or stylus. The Contactless Air Canvas system uses computer vision algorithms to identify and analyse hand motions, particularly fingertip movements. Real-time video frames of the user's hand movements are recorded using a regular webcam. After that, image processing is applied to these video frames.

Our interactions with technology are changing quickly, shifting toward more immersive, natural, and intuitive approaches. Why? Particularly in fields like education, digital art, or accessibility, traditional interfaces like the mouse, stylus, or touchscreen frequently restrict flexibility and creativity. The Hand Tracking Canvas can help with that gesture-based, touch less drawing system that allows users to engage with a digital canvas in real time using basic hand motions. algorithms to identify and monitor the fingertip's location. The user can create figures, symbols, or words in the air by using the detected fingertip as a virtual marker and mapping its movement onto a digital canvas.

Using Media Pipe for fingertip tracking, Mittal et al. (2023) created a virtual drawing tool that is limited in gesture variation but appropriate for simple contactless interaction. Hussain et al. (2023) used CNNs and YOLOv5 to increase gesture accuracy, but real-time execution required high-performance GPUs. Using TensorFlow.js, Sinha and Ranjan (2023) developed a web-based system that is platform-neutral but constrained by gesture simplicity and browser performance.

LITERTATURE REVIEW

Touch less systems like the Contactless Air Canvas, where users communicate via hand movements recorded by webcams and processed in real time, are made possible by recent developments in computer vision and human–computer interaction. In order to imitate drawing without the need for actual equipment, these systems mostly rely on fingertip tracking and image processing algorithms[14] Mittal and associates. suggested a virtual sketching system based on MediaPipe that is effective at recognizing simple gestures but has a limited range of gestures. Although it demands a lot of processing power,[15] Hussain et al. used deep learning models like CNNs and YOLOv5 to improve gesture detection accuracy. [16] TensorFlow.js, Sinha and Ranjan created a web-based system that offers platform freedom but is restricted by gesture complexity and browser speed.

Existing System and its Limitations in Tabular Format :

Year	Author(s)	Paper Title	Technology Used	Limitations
2026	Various (Springer Paper)	Enhancing Accessibility Through Gesture-Based HCI: A Virtual Mouse Approach	Computer Vision, Webcam, Real-time Gesture Tracking	Limited precision, affected by lighting and background noise (Springer)
2025	C. L. Lishan et al.	A Comprehensive Survey on Gesture-Controlled Interfaces	Computer Vision, Depth Sensors, Machine Learning, Wearables	Gesture ambiguity, high computational cost, environmental sensitivity (IJIRSIT)
2025	Bhupendra Sinha	Hand Gesture Recognition Using Deep Learning	Deep Learning, CNN, Camera-based input	Heavy models, not suitable for low-resource devices (Research Gate)
2025	Gowthami A. et al.	Advances in Gesture-Driven Human-Machine Interfaces	Computer Vision + Machine Learning (OpenCV, Neural Networks)	Requires large datasets, real-time performance challenges
2024	Applied Ergonomics Study	3D Gestural Embodied HCI Systems Review	3D Gesture Recognition, Sensor-based Systems	Mismatch between user-preferred gestures and system design

BW02035_309382_206_210METHODOLOGY

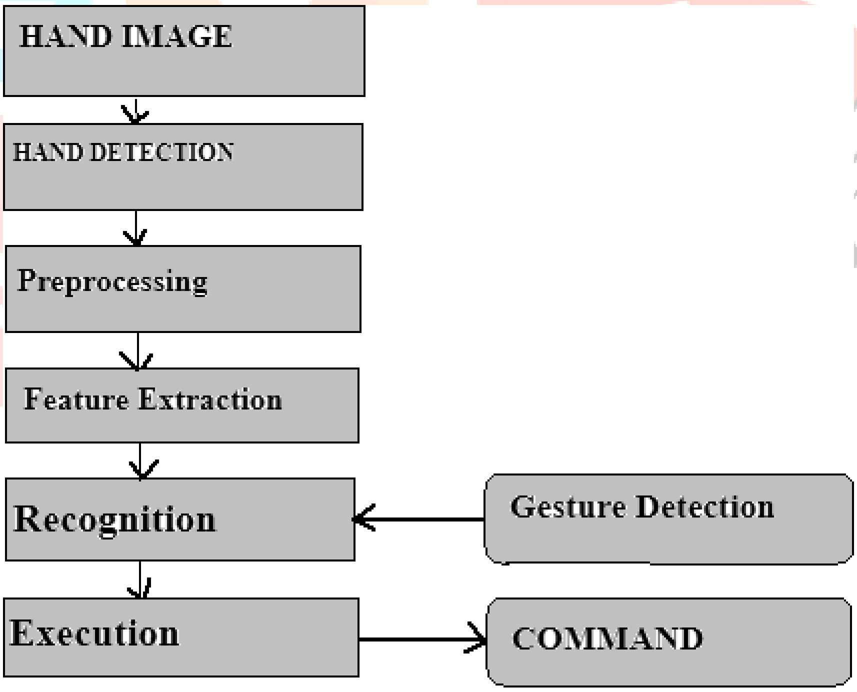
The study described in this project, "Hand Tracking Canvas: A Real-Time Gesture-Based Drawing "System Using Computer Vision" uses computer vision methods to recognize gestures and track hands in real time. The main technique used is to identify hand landmarks and converting gestures into commands for virtual drawings without the need for conventional input devices. Using Open CV and Media Pipe, the implementation technique is real-time, flexible, and optimized for desktop platforms.

PROPOSED ARCHITECTURE

The suggested system architecture for a gesture-based contactless interaction system, like a vision-driven contactless canvas, is shown in the provided diagram. The first step in the procedure is to use a webcam to take a picture of your hand, which will be used as the system's input. After that, the image is sent to the hand detection stage, where the hand region is identified and separated from the backdrop using computer vision algorithms. After the hand is identified, pre-processing is carried out to improve the image quality by eliminating noise, modifying size, and enhancing clarity. This ensures more accuracy in later stages [1].

Following pre-processing, the system carries out feature extraction, which identifies and transforms key landmark points and finger positions into a structured format. In the recognition stage, these extracted features are examined and the gesture is interpreted by machine learning or deep learning algorithms. In addition, the gesture detection module helps identify and validate the particular kind of gesture. The system moves on to the execution phase, where the proper action is carried out, based on the identified gesture. Lastly, this action is converted into a command, such drawing, erasing, or choosing a screen option. As a result, the entire system enables natural and touch less human-computer contact by translating real-time hand movements into meaningful digital commands.

Fig 1: Flow Diagram For Proposed Model



The diagram (Gesture Recognition System) is explained point-by-point as follows:

1. Hand Image

- ➢ The system first captures an image of the hand using a camera.
- ➢ This is the raw input for the entire process.

2. Hand Detection

- ➢ The system identifies and isolates the hand region from the background.
- ➢ It removes unnecessary parts of the image (like face, objects, etc.).

3. Pre-processing

- The detected hand image is cleaned and prepared.
- Common steps include:
  - Noise removal
  - Resizing
  - Converting to greyscale or binary image
  - Background subtraction

4. Feature Extraction

- Important characteristics of the hand are extracted.
- Examples:
  - Finger positions
  - Hand shape
  - Edges or contours
- These features help in identifying gestures.

5. Recognition

- The system compares extracted features with stored patterns.
- It identifies which gesture the hand represents.
- This step connects with **Gesture Detection**, meaning:
  - The system detects the type of gesture (e.g., open hand, fist, swipe).

6. Execution

- After recognizing the gesture, the system performs an action.
- This action is converted into a **command**.

7. Command

- The final output of the system.
- Examples:
  - Move cursor
  - Play/Pause video
  - Turn on/off device

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. Through real-time hand tracking, contactless air canvas systems show how computer vision may facilitate natural, touchless human-computer interaction. Nevertheless, issues with gesture complexity, computing demands, and platform-specific performance constraints continue to plague current methods.

REFERENCES

[1] D. Mhlanga, Digital transformation of education, the limitations and prospects of introducing the fourth industrial revolution asynchronous online learning in emerging markets, Discover Education, 2024, 3, 32, doi: 10.1007/s44217-024-00115-9.

[2] A. Šorgo, M. Ploj Virtič, K. Dolenc, The idea that digital remote learning can happen anytime, anywhere in forced online teacher education is a myth, Technology, Knowledge and Learning, 2023, 28, 1461–1484, doi: 10.1007/s10758 023-09685-3.

[3] A. Forkosh-Baruch, J. Voogt, G. Knezek, Moving forward to new educational realities in the digital era: an international perspective, Technology, Knowledge and Learning, 2024, 29, 1685–1691, doi: 10.1007/s10758-024 09785-8.

[4] A. Haleem, M. Javaid, M. Asim Qadri, R. Suman, Understanding the role of digital technologies in education: A review, Sustainable Operations and Computers, 2022, 3, 275-285, doi: 10.1016/j.susoc.2022.05.004. [6] E. Dritsas, M. Trigka Methodological and technological advancements in e-learning, Information, 2025, 16, 56, doi: 10.3390/info16010056.

[5] M. Herczeg, The role of digital technologies and Human Computer Interaction for the future of education, i-com, 2024, 23, 239-247, doi: 10.1515/icom-2024-0008.

[6] W. Strielkowski, V. Grebennikova, A. Lisovskiy, G. Rakhimova, T. Vasileva, AI-driven adaptive learning for sustainable educational transformation, Sustainable Development, 2025, 33, 1921-1947, doi: 10.1002/sd.3221.

[7] S. Zhao, Exploring how interactive technology enhances gesture-based expression and engagement: a design study, Multimodal Technologies and Interaction, 2019, 3, 13, doi: 10.3390/mti3010013.

[8] D. Xuanfeng, Gesture recognition and response system for special education using computer vision and human computer interaction technology, Disability and Rehabilitation: Assistive Technology, 2025, 1–18, doi: 10.1080/17483107.2025.2527226.

[9] R. P. Sharma, G. K. Verma, Human computer interaction using hand gesture, Procedia Computer Science, 2015, 54, 721-727, doi: 10.1016/j.procs.2015.06.085.

[10] Yaseen, Real-time face gesture-based robot control using ghostnet in a unity simulation environment, Sensors, 2025, 25, 6090, doi: 10.3390/s25196090.

[11] J. Qi, L. Ma, Z. Cui, Y. Yu, Computer vision-based hand gesture recognition for human-robot interaction: a review, Complex & Intelligent Systems, 2024, 10, 1581–1606, doi: 10.1007/s40747-023-01173-6.

[12] Bertolasi J, Garcia-Hernandez NV, Memeo M, Guarischi M, Gori M. Evaluation of HoloLens 2 for Hand Tracking and Kinematic Features Assessment. Virtual Worlds, 2025, 4, 31, doi: 10.3390/virtualworlds4030031.

[13] D, M. Mulla, N. Majoni, P. M. Tilley, P. J. Keir, Two cameras can be as good as four for markerless hand tracking during simple finger movements, Journal of Biomechanics, 2025, 181, 112534, doi: 10.1016/j.jbiomech.2025.112534.

[14] Mittal et al. – MediaPipe-based Virtual Drawing System using Hand Tracking. [15]Hussain et al. – Hand Gesture Recognition using CNN and YOLOv5.

[16] Sinha and Ranjan – Web-based Hand Tracking Canvas using TensorFlow.js.

[17] Y. Xiao, Z. Huang, Y. Gao, From wrist to finger: hand pose tracking using ring-watch wearables. in proceedings of the extended abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25). Association for Computing Machinery, New York, NY, USA, 2025, 294, 1 7, doi: 10.1145/3706599.3720220.

[18] T. R. Gadekallu, G. Srivastava, M. Liyanage, Iyapparaja M., C. L. Chowdhary, S. Koppu, P. K. Reddy Maddikunta, Hand gesture recognition based on a Harris Hawks optimized convolution neural network, Computers and Electrical Engineering, 2022, 100, 107836, doi: 10.1016/j.compeleceng.2022.107836.

[19] A. Sen, T. K. Mishra, R. Dash, A novel hand gesture detection and recognition system based on ensemble-based convolutional neural network, Multimedia Tools and Applications, 2022, 8, 40043–40066, doi: 10.1007/s11042 022-11909-0.