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## **Finger Mouse - Web Cam based Hand Gesture Mouse Movement using AI and Vision Transformer**

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**ABSTRACT**: In today's digital world, interacting with computers has largely depended on physical devices like a mouse and keyboard. But what if you could control your computer just by waving your hand? FingerMouse, proposes a hand gesture-controlled virtual mouse system developed specifically for healthcare environments. It enables doctors to interact with computer systems through AI-powered, real-time hand gesture recognition using a webcam, minimizing physical contact and maintaining sterile conditions in clinical settings. It leverages Temporal Convolutional Networks (TCN), Convolutional Networks (CNN), and Region Proposal Networks (RPN) for efficient hand tracking, gesture detection, and cursor control. This innovation addresses the need for hygienic, contactless human-computer interaction in hospitals and surgical rooms. The system accurately detects hand landmarks and gestures, mapping finger movements to cursor actions and clicks using OpenCV, MediaPipe, and Python.

**KEYWORDS**: Hand Gesture Recognition, Virtual Mouse, TCN, CNN, OpenCV, MediaPipe, AI in Healthcare, Contactless Interaction, Real-Time Hand Tracking, Region Proposal Network, Computer Vision, Sterile Environment Interaction

#### I. INDRODUCTION

In healthcare, maintaining sterile environments while interacting with digital systems is a constant challenge. Traditional Human-Computer Interaction (HCI) methods such as keyboards and mice can pose contamination risks in clinical and surgical settings. To address this, FingerMouse introduces a contactless, webcam-based virtual mouse system designed for doctors, enabling them to control computer systems with simple hand gestures. This system applies AI techniques like Temporal Convolutional Networks (TCN) for gesture recognition, CNN for landmark detection, and RPN for hand segmentation. It offers healthcare professionals a seamless, hygienic way to access patient records, diagnostic tools, or digital imaging systems without compromising sterility.

#### **II. LITERATURE SURVEY**

Over the years, researchers have experimented with different ways to track and understand hand gestures. Older methods involved traditional machine learning algorithms like Support Vector Machines (SVM) or Hidden Markov Models (HMM). While effective to an extent, these systems often struggled with dynamic gestures, lighting changes, and required large, labeled datasets. More modern systems use deep learning approaches such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), but these can be slow and memory-hungry. This project uses Temporal Convolutional Networks (TCNs), which are not only faster but also better at handling video sequences — making them a perfect fit for recognizing hand gestures on a live video feed.

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#### **III. METHODOLOGY**

The FingerMouse system operates by first capturing a live video feed through a standard webcam. Using a Region Proposal Network (RPN), it dynamically segments the hand region from each video frame, isolating it for further processing. A Convolutional Neural Network (CNN) then identifies and tracks 21 specific landmark positions on the hand, such as fingertips and joints. These landmarks are analyzed by a Temporal Convolutional Network (TCN), which detects patterns in the movements over time to recognize gestures like cursor movements, clicks, and drags. The forefinger's position is mapped to control the on-screen cursor, while a click is triggered when the system detects the forefinger and middle finger coming within a predefined distance. The entire system is built using Python, integrating tools like OpenCV, MediaPipe, and TensorFlow for real-time image processing and deep learning. An optional graphical user interface (GUI) displays the camera feed, detected gestures, and cursor status for user feedback. To ensure reliability, the system has been optimized to perform consistently under various lighting conditions and with different hand types, and it has been tested across multiple screen resolutions to confirm its accuracy and responsiveness.

#### **IV. EXPERIMENTAL RESULTS**

Here are the screenshots of initial page. First we have to login.





Once you login, you can see the page shown below.





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Then you can choose the service you want. Where  $1^{st}$  figure shows that we can operate the PowerPoint presentation without any interaction. And the  $2^{nd}$  figure shows that the mouse operations using hand gesture.





1.Cursor movement with one finger.

2.Clicking with two fingers.



#### V. CONCLUSION

The FingerMouse system offers an innovative, AI-powered solution designed specifically for healthcare professionals, enabling them to interact with digital systems without the need for physical contact. By integrating cutting-edge technologies such as TCN, CNN, OpenCV, and MediaPipe, the system delivers fast, accurate, and reliable real-time gesture recognition. This allows doctors to access patient records, navigate imaging software, or operate digital interfaces without ever compromising sterile conditions in clinical or surgical settings. Beyond its current capabilities, the system's modular and scalable design sets the stage for future advancements, including 3D hand tracking, multi-user collaboration in operating rooms, and seamless integration with IoT-enabled medical devices, further enhancing patient care and operational efficiency in healthcare environments.

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