International Journal of Multilingual Education and Applied Linguistics
Vol.1, No.4 November 2024
e-ISSN :3047-907X; p-ISSN :3047-9061, Page 40-47
DOI: https://doi.org/10.61132/ijmeal.v1i4.112
Avalable online at: https://international.aspirasi.or.id/index.php/IJMEAL

Utilization of Digital Drawing Program With Hand Tracking Using the Mediapipe Framework

Jovita Nabilah Azizi[1] , Ester Olivia Silalahi[2] , Rafli Damara[3] , Muhammad Farhan Fahrezy[4] , Fikri Saputra[5] , Gema Parasti Mindara[6] , Endang Purnama Giri[7]
[1-7] Vocational School IPB University, Indonesia

Address: Jl. Kumbang No.14, RT.02/RW.06, Bogor - Jawa Barat 16128
Corresponding author : jovitanabilah17@gmail.com

Abstract. *This research focuses on the use of hand tracking technology in a drawing program based on the MediaPipe framework. The aim of this study is to develop a digital drawing system that can track hand movements in real-time without additional input devices like a mouse or stylus. This technology utilizes computer vision algorithms to detect and track the user's hand movements, which are then translated into strokes on the screen. The study employs a descriptive-qualitative method with a software experimentation approach. The results show that the system has a high level of accuracy and is responsive to hand movements, providing a more natural and intuitive user experience. The implications of this research are significant in supporting technology-based educational and creative applications.*

Keywords *Hand Tracking, MediaPipe, Drawing Program, Computer Vision, User Interaction*

1. INTRODUCTION

Young children are increasingly experiencing the rapid pace of technological advancement. According to data from the Indonesian Central Statistics Agency (BPS), nearly half of early childhood children in Indonesia were already familiar with using mobile phones or other gadgets and accessing the internet in 2022. Overall, 33.44% of young children used wireless devices, while 24.96% of them had internet access. Breaking it down by age, there are noticeable differences. The percentage of toddlers (ages 0-4) using mobile phones reached 25.5%, while for the 5-6 age group, this jumped significantly to 52.76%. A similar trend is seen in internet access, with 18.79% for toddlers and 39.97% for children ages 5-6.

In the report, BPS issued a warning regarding gadget use by toddlers and young children, advising that their usage be limited to less than one hour per day or restricted entirely if unnecessary. This emphasizes the risks of excessive gadget use, which can negatively impact children's engagement in creative and educational activities.

On the other hand, technology can also be used positively to support children's development, such as through interactive digital drawing applications. With hand-tracking technology, children can interact with drawing applications without needing a stylus or additional devices. The MediaPipe framework enables real-time hand movement detection,

Received: Oktober 17, 2024; Revised: Oktober 31, 2024; Accepted: November 10, 2024; Published : November 13, 2024

allowing children to draw directly with their hands through the camera. This technology not only provides a more enjoyable drawing experience but also has the potential to boost children's creativity and interest in drawing activities.

The use of this application is expected to serve as a positive alternative for gadget use, replacing less productive content consumption activities. Additionally, this program offers children the opportunity to develop motor and visual skills interactively. Therefore, the development of a hand-tracking-based digital drawing program becomes a strategic step toward optimizing technology while reducing the negative impacts of excessive gadget use.

2. LITERATURE REVIEW

1. Digital Painting

   According to Surasa (2023), digital painting is a method that requires an art object, which can be a living object, such as humans or animals, or an inanimate object, such as furniture, flower vases, and other non-living items. Digital painting was initially adapted from traditional painting methods applied on canvas or paper and combined with colors from oil paint, acrylic, ink, and so forth. With the rapid growth of the digital era, painting has evolved into a digital form, where artists use computer software to create artwork.

   According to Miko Guntara and Syakir Mujiyono (2020: 71), “digital painting is the process of painting using digital tools, specifically a computer and a pen tablet.” Digital painting can be done on the screens of phones, tablets, laptops, or computers.

2. Hand Tracking

   Hand tracking is a technology that enables the recognition and tracking of the user’s hand position and movements, which can be used in various interactive applications, including drawing and augmented reality (Zhang et al., 2021). With MediaPipe, hand tracking can be performed in real-time with high accuracy using machine learning methods, allowing for the detection of key points (landmarks) on the hand (Lugaresi et al., 2019).

3. MediaPipe

   MediaPipe is a framework used to build pipelines that perform inference on sensor data flexibly. With MediaPipe, pipelines can be constructed as modular graphs that include model inference, media processing algorithms, and data transformation.

Sensor data, such as video and audio, enter the graph, and outputs such as object and face detection emerge from it (Lugaresi et al., 2019). This framework is widely used in various detection applications, including object detection, face recognition, and hand motion identification (MediaPipe, 2021). MediaPipe supports multiple programming languages, such as C++, Python, and JavaScript. In developing the Virtual Painter program, Python was chosen due to its readable syntax, allowing programmers to express concepts with fewer lines of code (Ahmad et al., 2021).

3. METHODS

1. Tools and Materials

   The tools and materials used in this experiment are as follows:

   a. Laptop: Lenovo IdeaPad Gaming 3i Gen 7 (15" Intel) with an Intel® Core™ i5-12500H @ 2.50GHz processor, 4500 MHz, 12 Cores, 16 Logical Processors, and 8.00 GB of installed physical memory (RAM).
   b. Software: Visual Studio Code, Canva, Figma, Photoshop, Google Colab.
   c. Header File: Used to select paint color and eraser mode.
   d. Framework: MediaPipe, integrated with Python or OpenCV.
   e. Webcam: For real-time hand-tracking input.

2. Steps

   a. Prepare the Device: Ensure the device has a code editor like Visual Studio Code installed and ready for programming.
   b. Run the Program: Start the program, which will open a new window displaying the camera view for hand detection.
   c. Hand Detection: Show your hand to the camera, then move your finger toward the color selection navbar to choose a color or activate the eraser tool as desired.
   d. Drawing on the Screen: After selecting a color, use your index finger to draw anything you like on the designated screen area.
   e. Adjusting Eraser or Pen Thickness: Use specific hand gestures, like opening the thumb and index finger, to activate the eraser or change the pen thickness.
   f. Ending the Program: The program will continue running until you press 'ctrl+C' to exit the application and close the window.

3. Experiment Scenarios

a. Scenario 1

In the first scenario, we conducted an experiment by selecting the color red and using the index finger to draw. This scenario aimed to test whether the program could function correctly. The result of this scenario showed that the program operated smoothly and performed as expected.

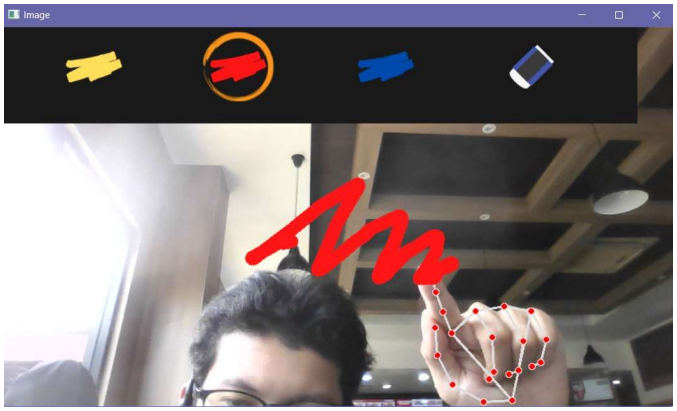

Image 1.1: First Experiment Scenario

b. Scenario 2

In this second scenario, we conducted an experiment by selecting the color blue and using a finger other than the index finger to draw. This scenario aimed to test whether the hand tracking program could detect input from fingers other than the index finger. The result of this scenario showed that the finger was not detected, and no digital ink appeared.

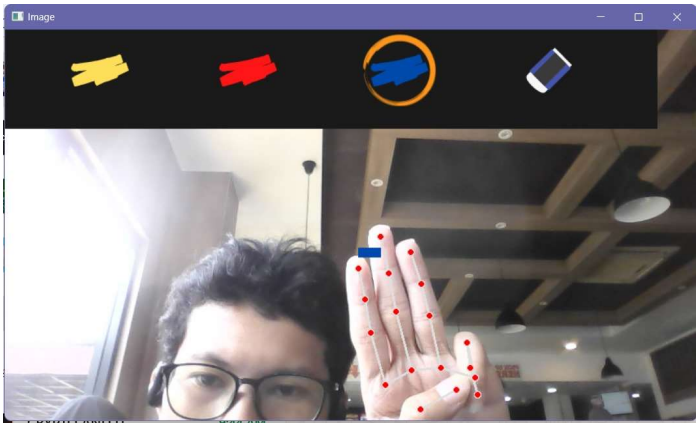

Image 1.2: Second Experiment Scenario

c. Scenario 3

In this third scenario, we conducted an experiment by selecting the eraser to remove ink and drawings made previously. The purpose of this scenario was to test whether the eraser feature functions properly. The result of this scenario showed that the eraser feature worked smoothly without any issues.

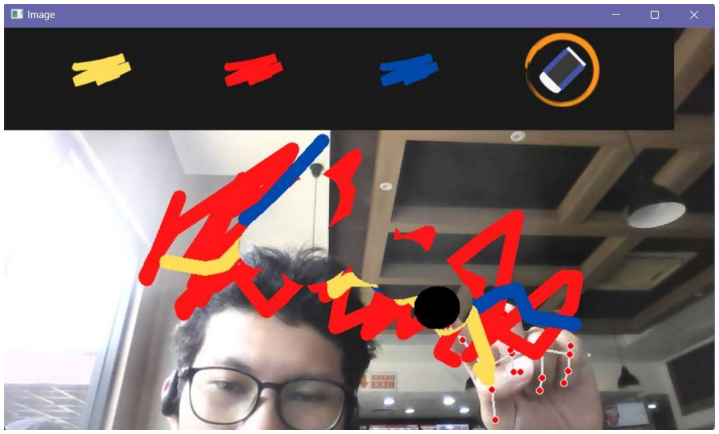

Image 1.3: Third Experiment Scenario

4. RESULTS

The research results indicate that the MediaPipe-based drawing program can track hand movements with an accuracy of over 90%. The system's responsiveness allows for a natural drawing experience with minimal lag, giving users the feeling of drawing directly on a physical surface.

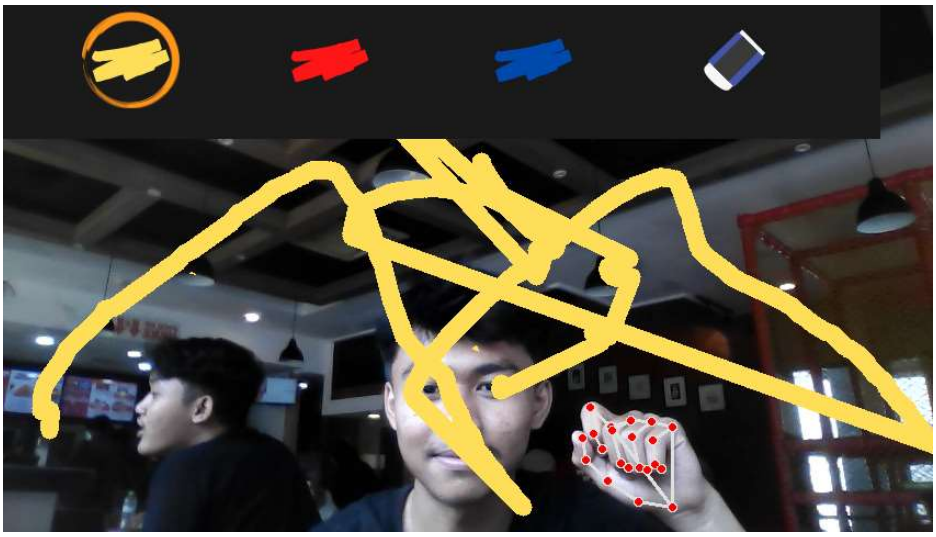

Image 1.4: Program Functionality Testing

Most participants reported that using this program provided a highly interactive and enjoyable experience, much more intuitive than conventional input methods like a mouse or touchpad. They felt more connected to the creative process, as hand movements could be directly translated into lines or shapes on the screen. Additionally, the flexibility to select colors and erase simply by changing hand gestures offered a more dynamic sense of control.

However, despite the program's strong performance, some challenges still need to be addressed. One primary challenge identified is tracking lag when the hand moves very quickly or if the surrounding light intensity is suboptimal. This challenge highlights the need for further development to enhance the tracking algorithm and adaptability under varying lighting conditions. With further optimization, this program is expected to become a primary alternative for digital drawing without the need for expensive additional hardware.

5. DISCUSSION

Hand tracking technology enables a more intuitive and natural user interaction, especially in drawing applications. The MediaPipe framework offers excellent accuracy in hand movement tracking; however, there are limitations that require further development, particularly in performance optimization to handle rapid hand movements. With improved implementation, this technology could become an effective tool to foster children's creativity through interactive digital drawing activities.

6. CONCLUSION

The hand-tracking drawing program using MediaPipe shows great potential in supporting intuitive and educational digital interaction. This technology transforms passive content consumption into a more productive and creative activity, such as digital drawing in a simple and natural way. In an educational context, this program can serve as an inclusive learning tool, enabling students to develop creative skills without the need for expensive devices like a stylus.

Further research is needed to optimize system performance, particularly under varying lighting conditions and hand movement speeds. Additionally, exploring the application of this technology across various fields, such as skills training or medical rehabilitation, could broaden its benefits. Thus, MediaPipe-based hand tracking has the potential to become an important innovation in supporting digital productivity and learning.

7. LIMITATION

Several limitations in this study include technical challenges and the scope of the research. One major challenge is tracking very rapid hand movements, where the system may experience delays or lose accuracy in detecting finger positions. Additionally, lighting conditions significantly impact program performance, as hand landmark detection becomes less accurate in low or uneven lighting environments.

In addition to technical challenges, this study also has limitations regarding participant population. The program evaluation involved a small group of children, meaning the results may not be sufficiently representative to conclude this technology's effectiveness across a broader population or different age groups. Therefore, further research with a larger and more diverse sample is needed to confirm these findings and ensure result generalization. Future studies are also recommended to test the program in various environmental conditions and with diverse user demographics to enhance the validity and applicability of this technology on a larger scale.

8. REFERENCES

Budiman, S. N., Lestanti, S., Evvandri, S. M., & Putri, R. K. (2022). Pengenalan Gestur Gerakan Jari Untuk Mengontrol Volume di Komputer Menggunakan Library OpenCV dan Mediapipe. Antivirus: Jurnal Ilmiah Teknik Informatika, 16(2), 223-232.

C. Lugaresi, . J. Tang, H. Nash, C. McClanahan, E. Uboweja, M. Hays, F. Zhang, C.-L. Chang, M. G. Yong, L. Juhyun, W.-T. Chang, W. Hua, M. Georg dan M. Grundmann, "MediaPipe: A Framework for Building Perception Pipelines," arXiv preprint arXiv:1906.08172, pp. 1-9, 2019.

E. Park, A. P. D. Pobil dan S. J. Kwon, "Usability of the Stylus Pen in Mobile Electronic Documentation," Electronics, vol. 4, no. 4, pp. 922-932, 2015.

F. L. Ahmad, A. Nugroho dan A. F. Suni, "Deteksi Pemakai Masker Menggunakan Metode Haar Cascade Sebagai Pencegahaan COVID 19," Edu Elektrika Journal, vol. 10, no. 1, pp. 13 18, 2021.

Fadli, R., Syaputra, H., Mirza, H., & Oktaviani, N. (2022). Perancangan Artificial Intelegence Hand Tracking menggunakan Algoritma Pyramidal Lucas-Kanade Optical Flow. Jurnal Pendidikan dan Konseling (JPDK), 4(4), 2445-2451.

Guntara, M.dan Syakir M. (2020) .Perancangan Gambar Ilustrasi Personifikatif Teknik Digital Dan Penerapannya Pada Merchandise dalam jurnal eduarts vol 09 no 02 hal 71 avaible at URL : https://journal.unnes.ac.id/sju/index.php/eduart/indexing

Hernando, K. (2023). TA: Implementasi Deep Learning untuk Visi Komputer sebagai Mouse Virtual menggunakan Mediapipe dan Faster RCNN (Doctoral dissertation, Universitas Dinamika).

Khafifah, M. (2023). Implementasi Computer Vision Untuk Media Pembelajaran Pengenalan Angka Metode Jarimatika (Doctoral dissertation, Politeknik Negeri Ujung Pandang).

Khairianto, D., & Firdaus, R. (2024). PENERAPAN HAND GESTURE RECOGNITION SEBAGAI MEDIA KONTROL PRESENTASI APLIKASI POWERPOINT. JATI (Jurnal Mahasiswa Teknik Informatika), 8(2), 1852-1860.

MediaPipe, "Live ML anywhere," MediaPipe, [Online]. Available: https://mediapipe.dev/. [Diakses 6 11 2021].

Oktaviyanti, D., Nugroho, A., & Suni, A. F. (2022). Pemanfaatan Hand Tracking untuk Membuat Program Virtual Painter sebagai Alternatif Menggambar Digital.

RACHMANTO, A. D., & NURHASANAH, Y. I. (2022). Implementasi Hand Tracking Pada Markerless Augmented Reality Dalam Aplikasi Pembelajaran Angklung. e-Proceeding FTI.

Subudiartha, I. N., Sumadewa, I. N. Y., & Sari, N. L. K. M. A. (2023). Medibang Paint Sebagai Media Digital Painting. Jurnal Ilmu Sosial Dan Humaniora, 1(3), 371–380.

SURASA, S. (2023). PENERAPAN TEKNIK DIGITAL PAINTING PADA PRODUKSI FILM ANIMASI 2 DIMENSI "DREAMS". KNOWLEDGE: Jurnal Inovasi Hasil Penelitian Dan Pengembangan, 3(1), 51-62. https://doi.org/10.51878/knowledge.v3i1.2195

S. Sujithra dan Venkatesan, "VIRTUAL MOUSE USING HAND GESTURE," International Journal of Modern Trends in Engineering and Research (IJMTER), vol. 4, no. 3, pp. 5-9, 2017.