



Computer Vision

Hand Gesture
recognition

Three Parts:

01

Introduction:

What is hand gesture recognition?

Whats its importance in the field of computer vision?

How is it being used in the real-world?

02

Current state-of-the-art:

A discussion on the latest advancements and breakthroughs in hand gesture recognition technology.

03

Ethical and Social Issues:

Are there any potential negative impacts of hand gesture recognition, if so what are they?

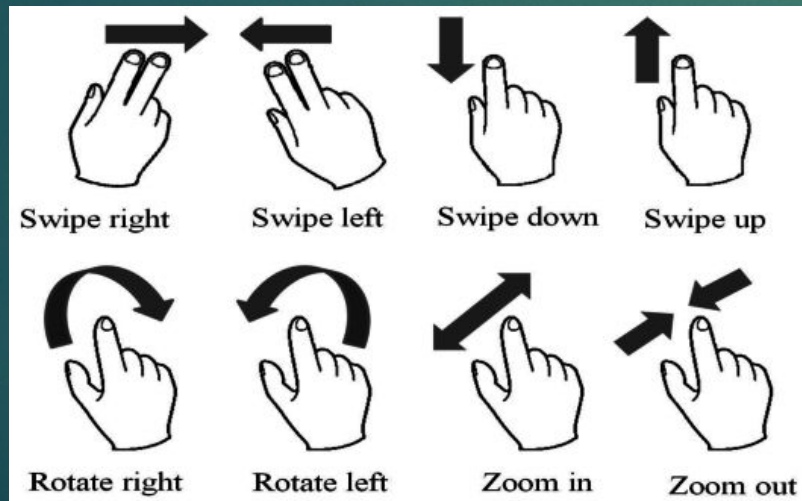
What is hand gesture recognition?

- ▶ Hand gesture recognition is a subfield of computer vision that focuses on detecting and interpreting hand gestures made by a person.
- ▶ Due to its versatility and user-friendliness, it is one of the active topics in the human-computer interface sector.
- ▶ It's a sort of body language where the placement and configuration of the fingers and the center of the palm convey particular meanings.
- ▶ Two different types of hand gestures exist, these are called static and dynamic gestures. [1]

Hand Gesture Types

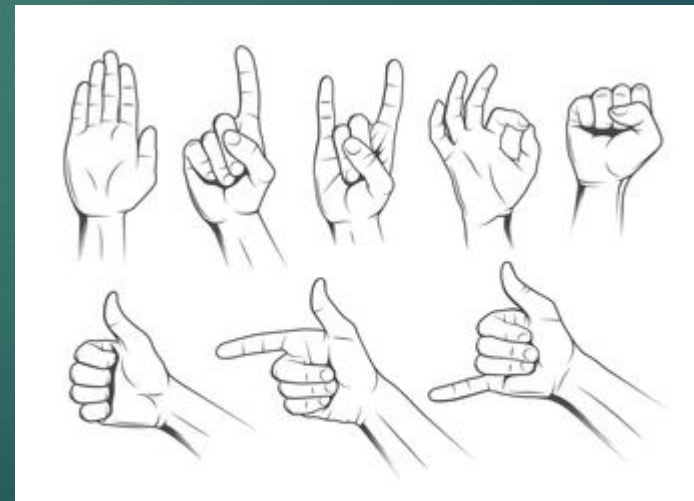
Dynamic hand gestures

- ▶ Made up of a series of hand movements.
- ▶ Rely on the movement of the hand to transfer meaning.



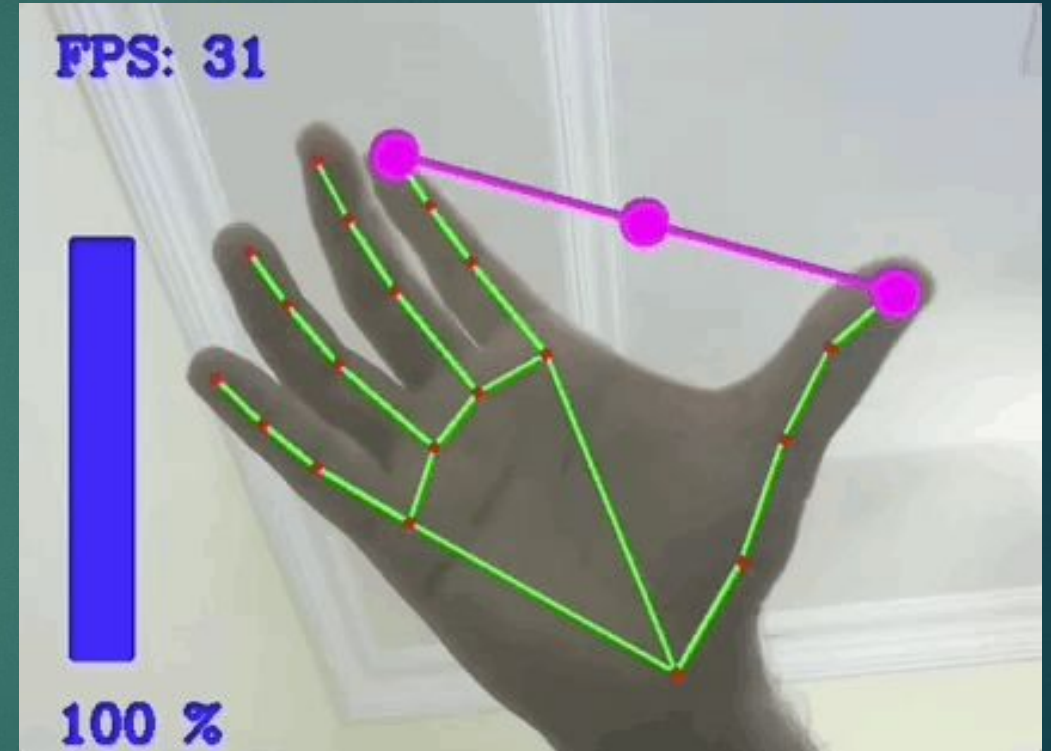
Static hand gestures

- ▶ Based only on the shape of the hand.
- ▶ Rely on the shape of the hand gesture to convey a message.



Whats its importance in the field of computer vision?

- ▶ It enables computers to **interpret and understand** human gestures and movements.
- ▶ This understanding can then be used to **control and interact** with various devices and systems.
- ▶ As a result of this, it can improve human-computer interaction making it more **natural, intuitive and efficient**.

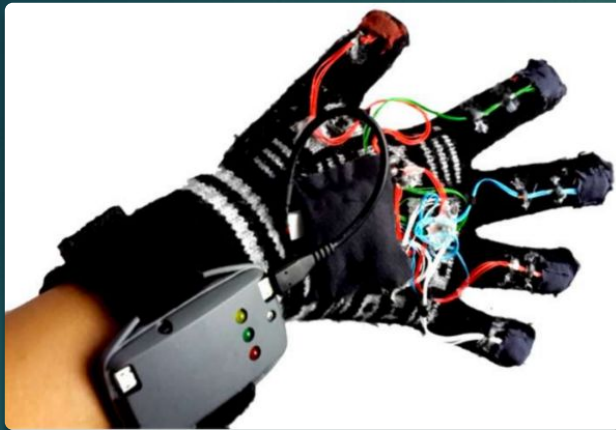




How is it being used in the real-world?

- ▶ **Sign language recognition:** used to recognize and translate sign language, which can help to **improve communication and accessibility** for people who are **deaf or hard of hearing** [2].
- ▶ **Smart homes:** can be used to **control and interact with smart home devices using hand gestures**. For example, users can use hand gestures to **turn lights on and off, adjust the thermostat**, and control other smart home devices [3].
- ▶ **Virtual Reality:** Hand gesture recognition is used in virtual reality to **enable users to interact with virtual environments and objects** using hand gestures. This can **improve the immersion and realism of virtual reality experiences** [4].

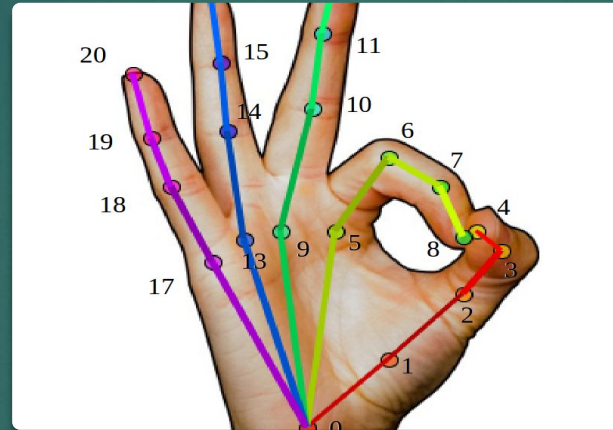
Gesture Recognition Methods



Glove-based wearable devices [5]

Is obligated to wear an additional device.

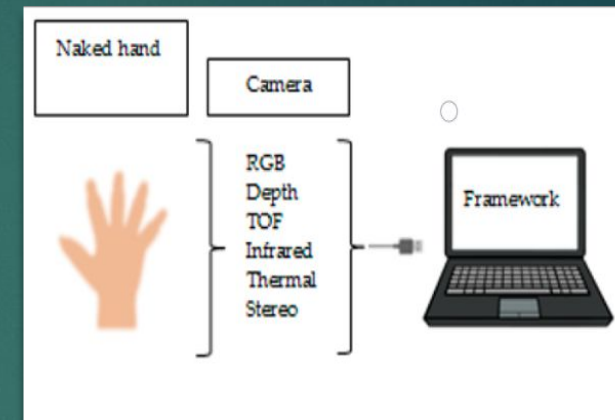
Provides good results in terms of both accuracy and speed.



3-dimensional locations of hand keypoints [6]

Requires an extra step of hand-keypoints extraction.

Typically utilizes supervised learning such as Support Vector Machines (SVM) [8]



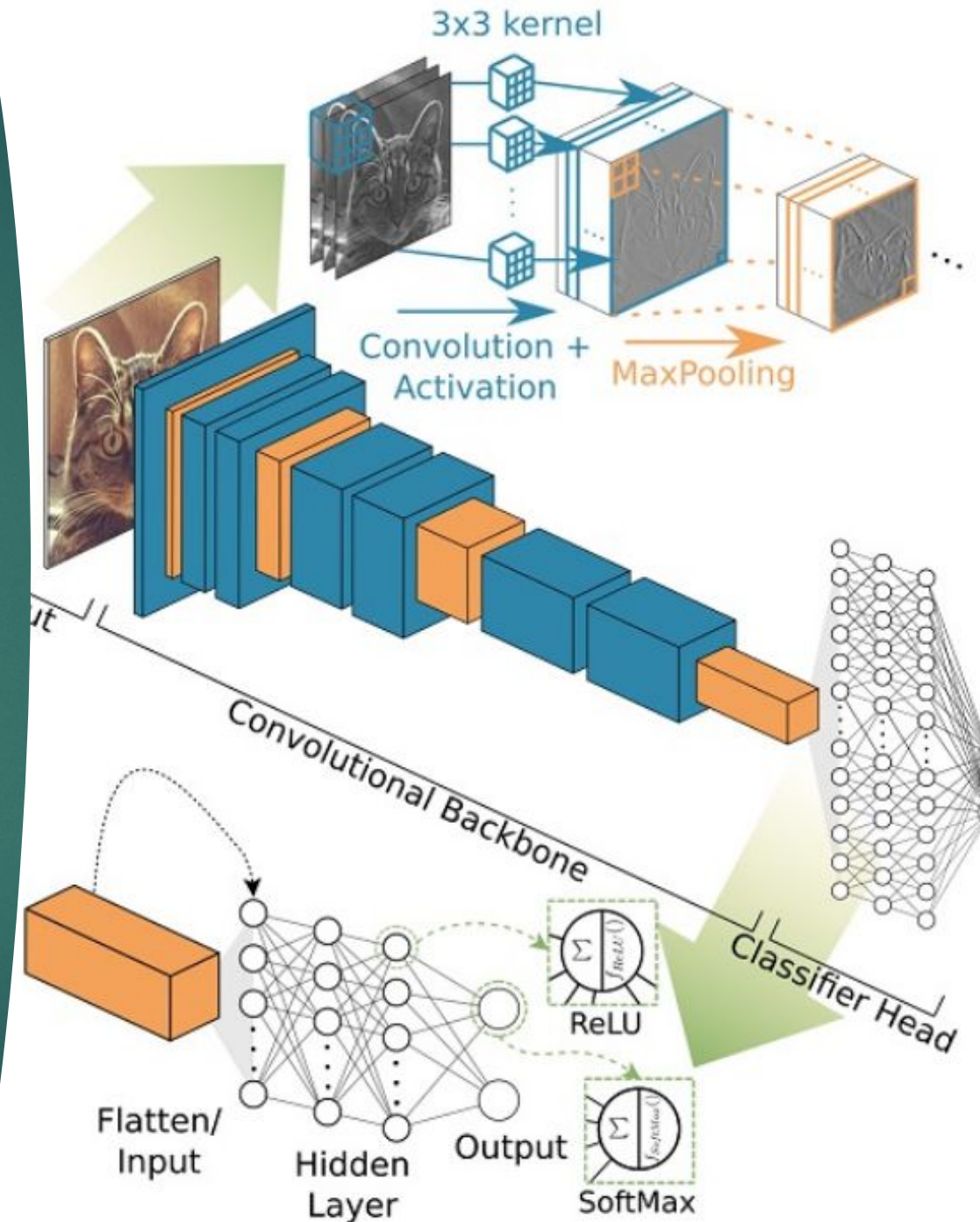
Raw visual data [7]

Only an image capturing sensor is required such as camera, infrared sensor or depth sensor, which are independent of the user.

The most practical solution.

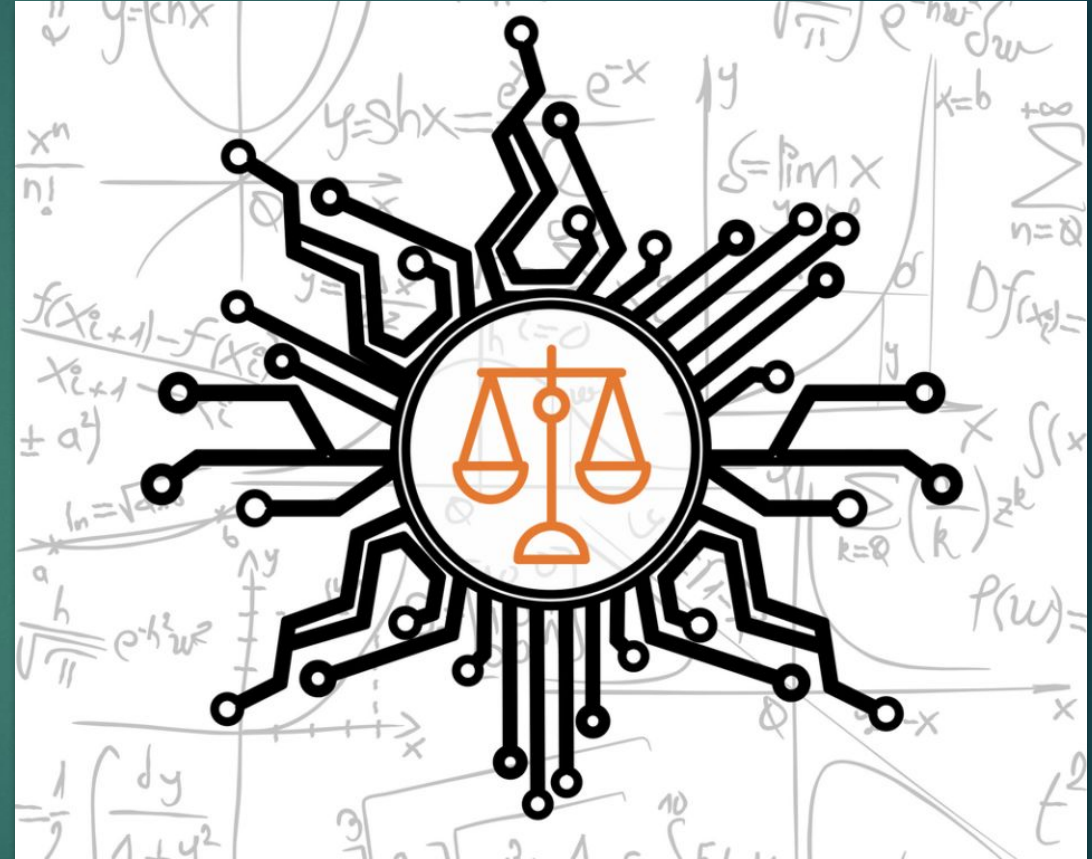
The state-of-the-art

- ▶ Recent advances in computer vision and machine learning have led to the development of **real-time hand gesture recognition**.
- ▶ These systems are able to work on **raw video data**.
- ▶ This is achieved by using **deep convolutinal neural networks** (CNNs)
- ▶ CNNs have led to **significant improvements in the accuracy and robustness** of hand gesture recognition systems.
- ▶ In [7], the **ResNeXt-101 architecture** was used to achieve 91.04% and 77.39% Levenshtein accuracies in EgoGesture and nvGesture datasets respectively.
- ▶ These two datasets had 431 and 482 videos, respectively in their test sets.



Ethical and Social Issues

- ▶ **Safety:** Can be used in critical applications such as industrial automation and could lead to safety concerns if it isn't properly designed and tested.
- ▶ **Bias:** Can be trained on biased data, leading to inaccuracies in identifying certain individuals or groups of people, such as those with disabilities, or different ethnicities.
- ▶ **Privacy:** Can collect and store sensitive personal information, such as biometric data, which can be vulnerable to hacking and misuse.





Questions?...

References

- ▶ 1. Al Farid, F.; Hashim, N.; Abdullah, J.; Bhuiyan, M.R.; Shahida Mohd Isa, W.N.; Uddin, J.; Haque, M.A.; Husen, M.N. A Structured and Methodological Review on Vision-Based Hand Gesture Recognition System. *J. Imaging* 2022, 8, 153. <https://doi.org/10.3390/jimaging8060153>
- ▶ 2. Razieh Rastgoo, Kourosh Kiani, Sergio Escalera. Sign Language Recognition: A Deep Survey, *Expert Systems with Applications*, Volume 164, 2021, 113794, ISSN 0957-4174. <https://doi.org/10.1016/j.eswa.2020.113794>
- ▶ 3. Neßelrath, R., Lu, C., Schulz, C.H., Frey, J., Alexandersson, J. (2011). A Gesture Based System for Context – Sensitive Interaction with Smart Homes. In: Wichert, R., Eberhardt, B. (eds) *Ambient Assisted Living*. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-18167-2_15
- ▶ 4. Sagayam, K.M., Hemanth, D.J. Hand posture and gesture recognition techniques for virtual reality applications: a survey. *Virtual Reality* 21, 91–107 (2017). <https://doi.org/10.1007/s10055-016-0301-0>
- ▶ 5. Ahmed, M.A.; Zaidan, B.B.; Zaidan, A.A.; Salih, M.M.; Lakulu, M.M.b. A Review on Systems-Based Sensory Gloves for Sign Language Recognition State of the Art between 2007 and 2017. *Sensors* 2018, 18, 2208. <https://doi.org/10.3390/s18072208>
- ▶ 6. R. Wen, L. Yang, C. -K. Chui, K. -B. Lim and S. Chang, "Intraoperative visual guidance and control interface for augmented reality robotic surgery," *IEEE ICCA 2010*, Xiamen, China, 2010, pp. 947-952. [10.1109/ICCA.2010.5524421](https://doi.org/10.1109/ICCA.2010.5524421)
- ▶ 7. O. Köpüklü, A. Gunduz, N. Kose and G. Rigoll, "Real-time Hand Gesture Detection and Classification Using Convolutional Neural Networks," 2019 14th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2019), Lille, France, 2019, pp. 1-8. [10.1109/FG.2019.8756576](https://doi.org/10.1109/FG.2019.8756576)
- ▶ 8. Q. De Smedt, H. Wannous, J.-P. Vandeborre, J. Guerry, B. Le Saux, and D. Filliat, 2017. 3D hand gesture recognition using a depth and skeletal dataset: SHREC'17 track. In *Proceedings of the Workshop on 3D Object Retrieval (3DOR'17)*. Eurographics Association, Goslar, DEU, 33–38. <https://doi.org/10.2312/3dor.20171049>