International Journal of Multidisciplinary Research and Growth Evaluation
ISSN: 2582-7138
Received: 27-08-2021; Accepted: 13-08-2021
www.allmultidisciplinaryjournal.com
Volume 2; Issue 5; September-October 2021; Page No. 337-339

Experiment hand gesture recognition and classification using machine learning algorithm

Giao N Pham
Department of Computing Fundamentals, FPT University, Hanoi, Vietnam

Corresponding Author: **Giao N Pham**

Abstract
In this paper, I would like to present experimental results facilitate hand gesture recognition and classification based on machine learning algorithm and computer vision techniques. This is accomplished by two subtasks. First, computer vision techniques are used to detect and track a hand, identifying key features such as the location of each fingertip and the center of its palm. The system implements a Support Vector Machine to both train and classify gestures. By using both computer vision techniques and artificial intelligence, enough knowledge is made available to the system to support human-machine interaction via hand-gestures. I developed a system that gathers the aforementioned knowledge using frames captured by the webcam and wrote a host of applications that use this knowledge such as video-playback control and gesture-based drawing.

Keywords: Hand Gesture Recognition; Hand Gesture Classification; Support Vector Machine Deep Learning

1. Introduction
Recent ears, technological devices have seen increases in complexity, capability, and speed of performance. According to a UN report from 2020, more than 7.5 billion people have access to a mobile phone. Although there has been an explosion in circulation of devices, much is left to be implemented in terms of new ways to use all of this technology. Traditional human-machine interaction such as via keyboard and mouse works well but is limited in functional flexibility. For example, buttons on a keyboard and mouse don't support intuitive operations. Voice recognition [1] is a promising alternative but is not suited to workplaces requiring quiet environments. Moreover, hand-gesture recognition can facilitate human-machine interaction noiselessly and is widely flexible in application. Therefore, I would like to experiment on hand based gesture recognition as it would allow us to facilitate new ways for humans to interact with machines. In this experiment, devices like the x-Box Kinect [2] already use gesture based tracking to recognize and classify hand gestures. Sec. 2 briefs the related work in hand-gesture recognition and classification. The proposed experiment method is shown in Sec. 3. Experimental results and discussion are shown in Sec. 4 and Sec. 5.

2. Related Work
Hand gestures recognition has been a hot topic in the area of Human-Computer Interaction and much research has already been done. Suganthy *et al*. [3] adopted Principal Component Analysis to extract key features from hand gestures images. The features are the representation of 25 particular gestures in an optimal coordinate system. Jagdish *et al*. [4] used a filtering technique to predict fingertip locations in successive frames and analyzed the relation between predicted locations and detected locations. This empowers the system to give multiple fingertips trajectories to improve fingertips tracking.

3. The Proposed Experiment Method

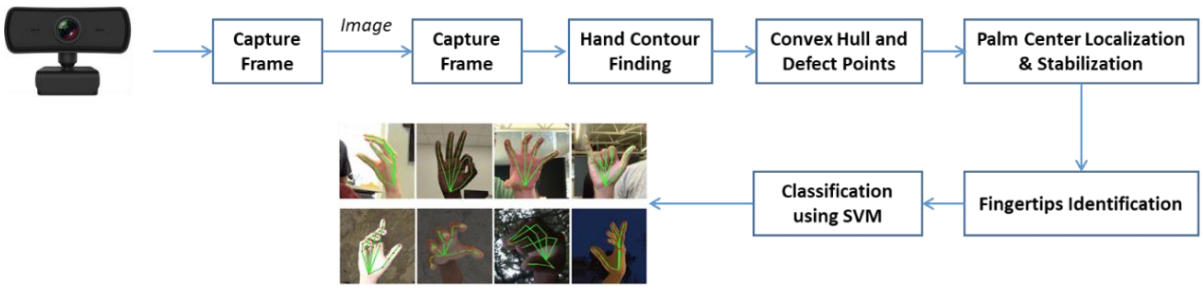

Fig 1: The Proposed Experiment Method

The proposed experiment method is shown in Fig. 1. One of my system's features is being able to detect either one hand or two hands in a video stream in real time. It is an essential part of our project because without it we can't implement hand gesture classification. For my experiment, I used a Logitech HD C310 webcam to capture hand gesture videos. I performed the following steps to detect hands and compute coordinates of the palm center and fingertips: 1. Receive image frame from Camera. 2. Convert the image to a binary image and find the contour of the hand. 3. Find convex hull and defects points. 4. Locate and stabilize the palm center. 5. Identify fingertips [5]. These steps are implemented by the Open-CV Library.

Once my system was able to identify individual fingertips, I tried to classify the open palm gesture and closed palm gesture by the number of fingertips detected. For example, if the number of fingertips is 5, the system would classify the gesture as an open palm, and if the number of fingertips is 0, the system would classify the gesture as a closed palm. To do that, I used Support Vector Machine (SVM) method. It is a tool that supports data classification using a discriminative classifier implemented as a separating hyperplane. In the context of this experiment, SVM is a good tool to use for gesture-classification as it enables the system to be trained to recognize any gesture.

4. Experimental Results

The best version of my experiment identifies gestures with over 85% accuracy and works reasonably well on every gesture as shown in Fig. 2. However, this is not always the case. As mentioned earlier, using computer-vision techniques for gesture-classification sometimes produced erroneous results. The first such error is the improper identification of fingertips. The other three fingers are not extended and thus should not have lines drawn to their tips. Artifacts like this make computer-vision gesture-classification very difficult because the correct number of fingertips being identified is heavily relied upon. Looking at Tab. 1, we can see that for most gestures, the computer-vision techniques correctly identify fingertips 100% of the time.

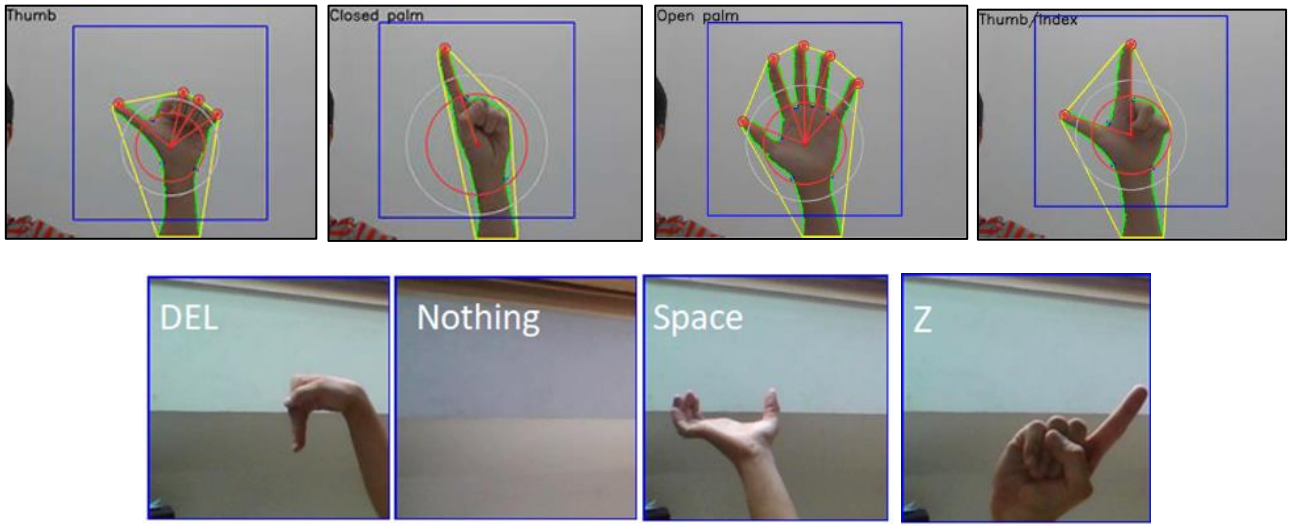

Fig 2: Experimental Results

Table 1: Accuracy of computer vision finger labeling

Gesture	Accuracy (%)
Open Palm	100
Close Palm	100
Sign	97
Index	99
Pinky	98
Middle	99

5. Conclusion

In this experiment, SVM was a good choice for gesture-classification as it is easy to understand and easy to implement in addition to being commonly used. However, implementation of a Support Vector Machine came at a measurable performance cost. Binary string representation didn't work well for some gestures which is why our system had a difficult time with complex gestures. The final issue with SVM is that unlike hand detection, which runs in real time, classification of gestures does not. Next time, I could represent gesture images as binary strings which worked well in most cases for SVM training and classification.

6. Acknowledgments

This work is supported by FPT University, Hanoi, Vietnam

7. Disclosure of conflict of interest

On behalf of all authors, corresponding author declares that there is no conflict of interest to publish this research.

8. References

1. Voice Recognition, available online: https://searchcustomerexperience.techtarget.com/definition/voice-recognition-speaker-recognition, accessed on 20 Sep. 2021.
2. How Does the Xbox Kinect Work. Available online: https://www.jameco.com/Jameco/workshop/Howitworks/xboxkinect.html, accessed on 20 Sep. 2021.
3. M Suganthy, P Ramamoorthy. Principal Component Analysis Based Feature Extraction, Morphological Edge Detection and Localization for Fast Iris Recognition, Journal of Computer Science. 2012; 8(9):1428-1433.
4. LR Jagdish, D Karen, C Ankit. An Efficient Real Time Method of Fingertip Detection, International Conference

on Trends in Industrial Measurements and Automation TIMA-2011.
5. DJ Rios-Soria, SE Schaeffer, SE Garza-Villarreal. Hand-Gesture Recognition Using Computer-Vision Techniques, Universidad Autónoma de Nuevo, San Nicolás de los Garza, 2012.