ISSN : 1226-7244 (Print)
ISSN : 2288-243X (Online)
논문번호 22-01-20
j.inst.Korean.electr.electron.eng.Vol.26,No.1,133~136,March 2022
https://doi.org/10.7471/ikeee.2022.26.1.133

Proposal of Camera Gesture Recognition System Using Motion Recognition Algorithm

Yu-Sung Moon*, Jung-Won Kim*★

Abstract

This paper is about motion gesture recognition system, and proposes the following improvement to the flaws of the current system: a motion gesture recognition system and such algorithm that uses the video image of the entire hand and reading its motion gesture to advance the accuracy of recognition. The motion gesture recognition system includes, an image capturing unit that captures and obtains the images of the area applicable for gesture reading, a motion extraction unit that extracts the motion area of the image, and a hand gesture recognition unit that read the motion gestures of the extracted area. The proposed application of the motion gesture algorithm achieves 20% improvement compared to that of the current system.

Key words : GESTURE, MOTION RECOGNITION, HMM, DBN, CRF, TOF

Ⅰ. Introduction

Gesture Recognition technology requires a gesture sensor that can receive gesture data, and there are two types of gesture sensors: a contact method that obtain data through the user's physical contact of the sensor or the device, and a non-contact method that obtain data through long-range or short-range sensors[1]. As the contact method require user's physical contact of the sensor, it provides a comparatively more accurate data from the gesture but the inconvenience of physical contact could also act as a disadvantage. In contrast, the non-contact method more convenience for the user as it does not require any physical contact to the sensor or a device. It also allows the user with freer movements, however, there are limits to the range and distance depending on each sensor and the device or the environment may affect the accuracy of its data. As such, there are many studies and improvements regarding wearable sensors that incorporate the pros and cons of these two methods. In order to read motion gestures, studies that use hand coordination data have been using models like the HMM (Hidden Markov Model), DBN(Dynamic Bayesian Network), CRF(Conditional Random Field), or its alternative models for time-series analysis [2],[3],[4]. When using the data of hand shapes, it analyzes the 3D data obtained by TOF(Time of Flight) or a stereo camera to catch the structural characteristics of

* UNITEL ELECTRONICS Co., Ltd.
★ Corresponding author
E-mail : passmiss@netsgo.com, Tel : +82-2-783-8322
※ Acknowledgment
This research was supported by the TIPA(Korea Technology and Information Promotion Agency for SMEs) grant funded by the Korea Goverment(Ministry of SMEs and Startups) (No.S2957605)
Manuscript received Feb. 7, 2022; revised Mar. 2, 2022; accepted Mar. 17, 2022.

the hand or boosting the shape data of the hand. Figure 1.1 is an example of hand gesture recognition to control device around the car. There are various areas to alternatively utilize the hand gesture as it is one of the most effective and accurate motion gesture to deliver an intention [5], [6].

Fig. 1.1. Hand gesture applied to the car mirror.

Motion gesture recognition receives a lot of attention for its efficiency in natural interaction and information exchange between devices and the user, and its use in developing smart IT devices.

This paper is composed as following: Chapter 1 introduction, Chapter 2 will introduce motion gesture recognition, Chapter 3 explains about the results of the experiment, and Chapter 4 will assess the paper based on the results and suggest improvements to further conclude.

II. Motion Gesture Recognition

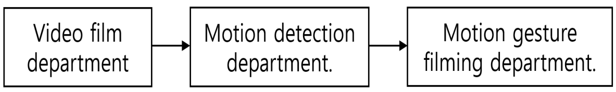

Fig. 2.1. Composition of the motion gesture recognition system.

The motion gesture recognition system, as shown in fig. 2.1, consists of a image capturing unit that captures and obtains the images of the area applicable for gesture reading, a motion extraction unit that extracts the hand area of the image, and a hand gesture recognition unit that read the motion gestures from the extracted images of the motion[7][8].

The motion extraction unit creates the initial binary image, as shown in fig. 2.2 (a), and undergoes a second binary threshold that results in an image like fig. 2.3 (a). As such, the applicable motion area undergoes the second binary threshold to extract the motion area that result in images like fig. 2.3 (b).

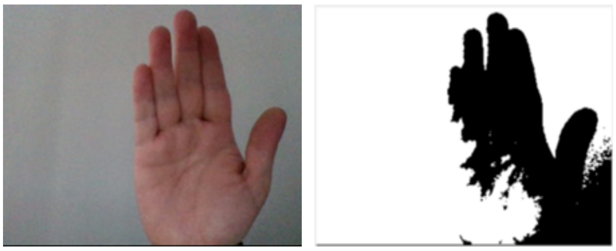

Fig. 2.2. (a)Image (b)1st binary threshold

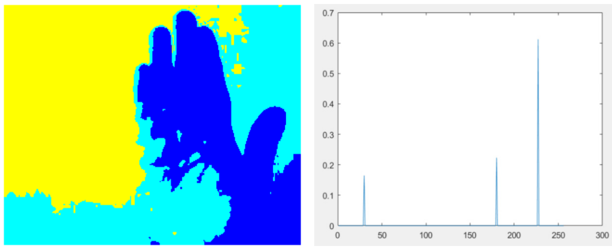

Fig. 2.3. (a) 2nd binary threshold
(b) recognition area of the initial data.

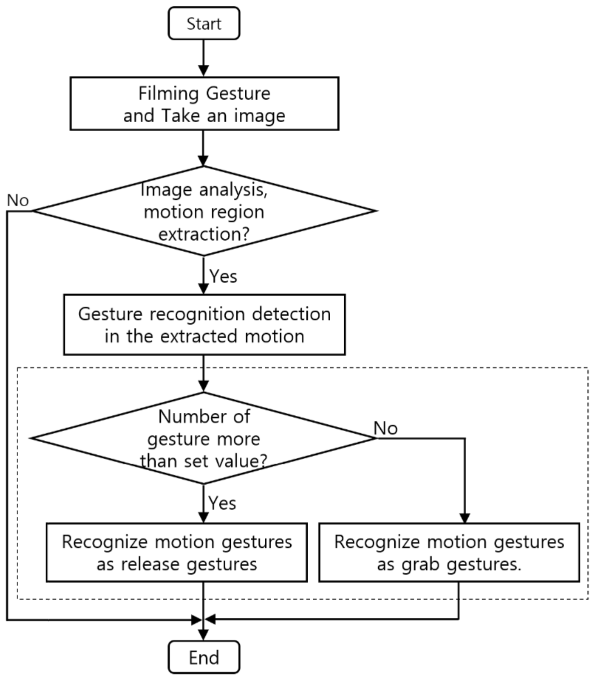

Fig. 2.4. Motion Gesture Recognition Algorithm.

The motion area extraction unit first detects the motion area by applying the motion gesture recognition algorithm, shown in fig. 2.4, to the initial binary image, compares it with a preset maximum data, and extracts the motion area greater than the maximum data. When the motion area extraction unit detects finds more than 2 motion areas whilst undergoing the motion area extract process shown in fig. 2.5, it detects the 2 greatest applicable motion areas.

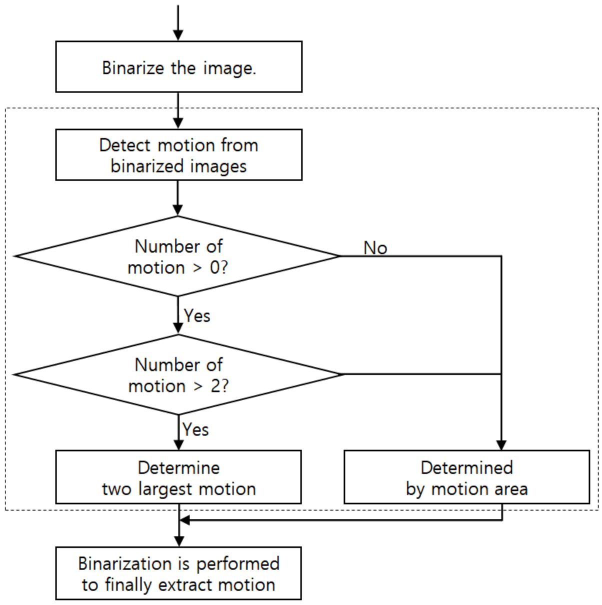

Fig. 2.5. The process of motion area extraction.

When the motion area extraction unit finds less than 2 motion areas, it detects the applicable motion area given. And if it does not find any motion area greater than the maximum data, the unit will decide that no applicable motion area exists in the image. The motion gesture recognition unit detects the gesture recognition area through adaptive binarization of the extracted motion area, and reads the motion gesture based on the number of those gesture recognition area detected.

Ⅲ. The result of the experiment

In order to assess the performance of the camera gesture recognition system, four different gestures, shown in fig. 3.1, have been subjects to the recognition experiment.

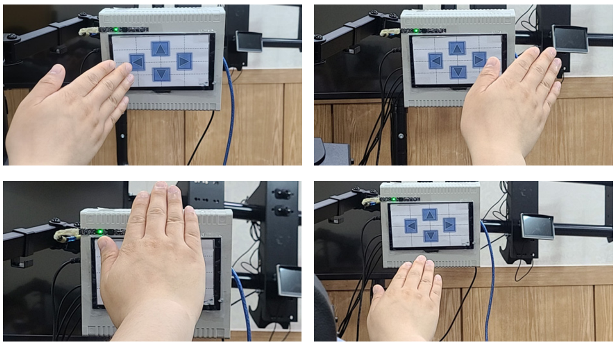

Fig. 3.1. Recognition experiment of right, left, top, bottom.

Each gesture frames have been separated from a continuous movement to assess the performance of the recognition system – it consists of four different gestures: right, left, top, and bottom. The x, y coordination of the right hand have been extracted for the procedure, and 4 people have each tested to extract their x, y coordination 100 times for the experiment. The table 3.1 shows the result before applying the algorithm. It finds a low recognition rate as it misinterprets right, left gesture as top, bottom gesture. Further analysis of the misinterpreted gesture data allowed to understand that the gesture pattern of “right” and “top” or “left” and “bottom” commonly showed resemblance. In order to minimize the misinterpretation caused by resemblance of the gesture patterns, the next test applied an algorithm that resulted in a table like tab. 3.2. The comparison analysis between tab. 3.1 and tab 3.2 proves that application of the algorithm is necessary to minimize misint-erpretation. From tab. 3.3 the test result shows

Teble 3.1. Test result before applying algorithm.

Recog / Target	Researcher				Recognition rate (%)
	A	B	C	D	
Right	68	66	70	72	69
Left	73	70	71	74	72
Top	82	79	82	77	80
Bottom	83	80	84	85	83

that 20% of gesture recognition rate has been improved after applying the algorithm.

Teble 3.2. Test result after applying the algorithm.

Target \ Recog	Researcher				Recognition rate (%)
	A	B	C	D	
Right	88	91	94	95	92
Left	93	94	98	95	95
Top	100	100	100	100	100
Bottom	96	98	100	98	98

Teble 3.3. Comparison table of the gesture recognition rate before and after applying the algorithm.

Recognition Target	Recognition rate before algorithm(%)	Recognition rate after algorithm(%)
Right	69	92
Left	72	95
Top	80	100
Bottom	83	98
Result	76	96.25

Ⅳ. Conclusion

This paper proposes a motion gesture recognition system and such algorithm for live gesture categorization. The data has been collected through an experiment of 4 different gestures done by 4 different people 100 times in a continuous movement. Through this experiment testing the performance of the recognition rate of the proposed algorithm, it was found that the proposed method achieved a 20% higher accuracy. Increasing the number of detected motion area from 1 to 2 or more motion areas improved the detection of motions and increased the accuracy rate. In addition, the higher accuracy rate allowed live gesture recognition. Experiments shall apply more types of gestures and increase the number of models for further study.

References

[1] Jung Hyun-tae, “Gesture recognition technology trend using wearable devices,” *The Institute of Electronics and Information Engineers*, Vol.42, No.6, pp.56-62, 2015

[2] I. Sin, D. Cheon, H. Park, “Implementing Leap-motion-based Interface for Enhancing the Realism of Shooter Games,” *Journal of The Human Compute rInteraction Society of Korea*, Vol.22, No.1, pp.67-74, 2017.

[3] H. Ju, M. Jo, S. In, G. Jo, J. Min, “Development of Baseball Game Using Leap Motion Controllers,” *Korean Institute of Information Scientists and Engineers Transactions on Computing Practices,* Vol.21, No.5, pp.343-350, 2015.
DOI: 10.5626/KTCP.2015.21.5.343

[4] Jonathan J Tompson, Arjun Jain, Yann LeCun, Christoph Bregler, “Joint training of a convolutional network and a graphical model for human pose estimation. In Advances in Neural Information Processing Systems,” pp.1799-1807, 2014.

[5] Alexander Toshev, Christian Szegedy, “Deeppose: Human pose estima-tion via deep neural networks. In Computer Vision and Pattern Recognition (CVPR),” *2014 IEEE Conference*, pp1653-1660. 2014. DOI: 10.48550/arXiv.1312.4659

[6] Cho Seong-shik, Seok Heuk-il, Lee Seong-hwan, “Robot Vision-based Gesture Recognition Research Trend,” *KROS : Korea Robotics Society,* Vol.7, No.1, pp.16-23, 2010

[7] E.-J. Woo, Y.-S. Moon, U.-S. Choi, and J.-W. Kim, “Proposal of Image Detection Algorithm to Implement Hand Gestures”, Journal of IKEEE Vol. 22 No. 4 pp.1222-1225.

[8] Yu-Sung Moon, Ung-Se Choi, Jung-Won Kim, “Proposal of Image Noise Improvement Algorithm for Implementing Hand Gestures,” *Journal of IKEEE,* Vol.23 No.4 pp.1465-1468, 2019.
DOI: 10.7471/ikeee.2019.23.4.1465