Live Demonstration: A HMM-based Real-Time Sign Language Recognition System with Multiple Depth Sensors

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I. Overview

Automatic sign language recognition plays an important role in communications for sign language users. Most existing sign language recognition systems use single sensor input. However, such systems may fail to recognize hand gestures correctly due to occluded regions of hand gestures. In this work, we propose a novel system for real-time recognition of the digits in American Sign Language (ASL) [1]. The proposed system [2] utilizes two Leap Motion sensors [3] to capture hand gestures from different angles. Sensory data are preprocessed using a multi-sensor data fusion approach and ASL digits are recognized in real-time from the fused data using Hidden Markov models (HMM) [4]. Experimental results of the proposed sign language recognition system demonstrates its improved performance over single sensor systems. With a low implementation cost and a high recognition accuracy, the proposed system can be widely adopted in many real world applications and bring conveniences to world-wide ASL users.

II. Visitor Experience

In the live demonstration, the system can perform hand gesture recognition without the necessity to perform calibrations beforehand. Classified results will be displayed on screen in real-time. Visitors will have the opportunity to interact with the system.

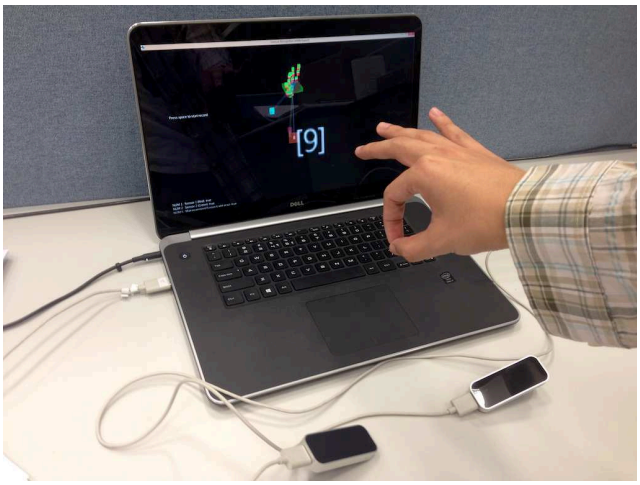

Fig. 1. The setup of the proposed system with 2 Leap Motion sensors.

III. Demonstration Setup

For a smooth execution of the proposed system, it is recommended to use a computer unit with following configurations: Windows 7/8 or Mac OS X 10.7 Lion, AMD Phenom II or Intel Core i3, i5, i7 processor, 4 GB RAM, and two USB 2.0 ports. Two Leap Motion sensors are required for gesture recognition. An illustration of the setup is shown in Fig 1.

IV. Summary

Identifying sign language is challenging as small changes on a gesture could alter a sign completely. In this work, a gesture recognition system for ASL digits based on HMM using multiple depth sensors is proposed. To improve gesture recognition accuracy, measurements obtained from different sensors are fused using Kalman filters. A set of HMMs are used for gesture recognition. Experiment results show that the proposed system with multiple depth sensors can provide a higher average recognition accuracy than its counterparts' with a single sensor.

Acknowledgement

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References

[1] "American Sign Language — National Association of the Deaf," (Accessed: 2014-09-12). [Online]. Available: http://nad.org/issues/american-sign-language

[2] K. Y. Fok, C. T. Cheng, and N. Ganganath. (2015, Jan) A HMM-based real-time sign language recognition system with multiple depth sensors – a technical report. (Accessed: 2015-01-10). [Online]. Available: http://www.eie.polyu.edu.hk/~bcheng/Papers/Fok2015TR.pdf

[3] "Leap Motion — Mac and PC Motion Controller for Games, Design, and More," (Accessed: 2014-09-05). [Online]. Available: https://www.leapmotion.com

[4] L. Rabiner, "A tutorial on hidden markov models and selected applications in speech recognition," *Proceedings of the IEEE*, vol. 77, no. 2, pp. 257–286, 1989.