Demo: Finger and Hand Gesture Recognition using Smartwatch

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1. INTRODUCTION

There has been a sharp increase in the popularity of smartwatches in last 2-3 years. Apart from the fitness applications, the smartwatch provides rich graphical interface to users that has enabled applications like email, messaging and navigation using the smartwatch. Since most current smartwatches come equipped with accelerometer and gyroscope sensors, they provide a unique opportunity for gesture recognition. It is expected that user's arm movements can be identified using the smartwatch easily, however it is not clear how much of user's hand and finger gestures can be recognized. For example, when user performs a hand gesture such as volume up by rotating hand right, the amount of motion registered with the smartwatch is likely to be very small. Even worse, when the user performs a finger gesture such as zoom-in or zoom-out using fingers and thumb, the movement recorded at the wrist area can be even smaller than hand gestures. If the hand and finger gestures can be recognized using smartwatch, a plethora of applications can be enabled using gesture recognition. For example, user wearing a smartwatch can remotely control nearby television, computer or smartphone, or user can write different characters on a surface to input the text to the smartwatch.

In this work, we will demonstrate the feasibility of finger and hand gesture recognition using a smartwatch. In our recent work [3], we showed that the motion energy recorded in the wrist while doing finger or hand gestures is enough to uniquely identify the gestures. We have identified that different tendons passing through the wrist create a unique signature of wrist movement while doing different gestures. In our implementation, we use various features [2] of motion energy, posture and motion shape to learn and recognize different gestures in real-time. Our gesture recognition system uses both - accelerometer and gyroscope - sensors in the smartwatch for hand and finger gesture recognition. With the use of machine learning classifier (based on Logistic Regression or Decision Tree), our gesture recognition system can classify 27 gestures (13 finger and 14 hand) with overall accuracy of 96%.

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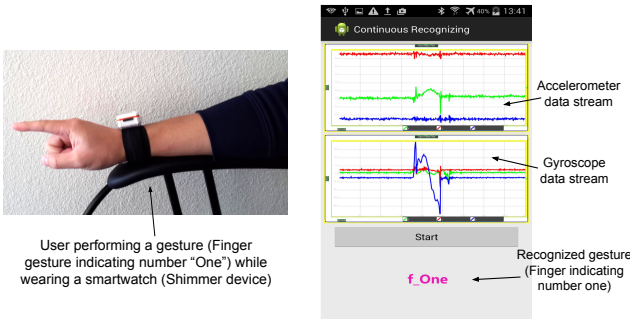

(a) User performing a gesture (b) Real-time gesture recognition on Smartphone

Figure 1: Gesture recognition using smartwatch

2. DEMONSTRATION

Our demonstration uses a Shimmer [1] device as the smartwatch as shown in Fig. 1a. The Shimmer device contains 3-axis accelerometer and gyroscope sensors which are sampled at 128 Hz in our implementation. In the demo, when the user performs a hand/finger gesture, the sensor data is transferred to an Android smartphone via Bluetooth. The android smartphone implements the learning and identification modules that can recognize the gesture in real-time as shown in Fig. 1b. The presenter will use a pre-trained model of 27 gestures to demonstrate the real-time gesture recognition performance. These gestures (complete list in [3]) include hand gestures like RotateRight (Volume up), RightOnce (Next) etc. and finger gestures like MouseClick and ThumbsUp. We will allow users to perform their own gestures while wearing the smartwatch and train their own machine learning classifier. They will be then able to perform the same gestures again and observe the gestures being recognized in real-time. The demonstration will also be accompanied with a short video that will show how a trained user performs different gestures and other related working mechanisms of the system.

3. REFERENCES

[1] `http://www.shimmersensing.com`.

[2] M. T. Emmanuel. *Using machine learning for real-time activity recognition and estimation of energy expenditure.* PhD thesis, Massachusetts Institute of Technology, 2008.

[3] C. Xu, P. H. Pathak, and P. Mohapatra. Finger-writing with smartwatch: A case for finger and hand gesture recognition using smartwatch. In *Proceedings of the 16th International Workshop on Mobile Computing Systems and Applications*, HotMobile '15, pages 9–14, New York, NY, USA, 2015. ACM.