Gesture Recognition via 3D Accelerometer

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ABSTRACT
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Categories and Subject Descriptors
Wireless Network [**Research Project**]: [report]

General Terms
Algorithm, Application

Keywords
Gesture, Accelerometer, Dynamic Time Warping(DTW)

1. INTRODUCTION
Gesture-based interactions are now widely used in mobile phone and laptop, which requires gesture pattern recognition. There are several methods to recognize gestures, for example, XBOX can recognize by vision approaching. Some researchers used wearable sensors like "glove" to detect motion of hands. But those works cost computing resource, power and hardware a lot. We focused on light-weight gesture recognition system: just use simple 3D accelerometer, which is common in your mobile phone.

Our project is mainly based on previous work uWave[2]: A state of art gesture recognition method. It just uses templates of gesture. When it tries to detect gesture, it records gesture and uses Dynamic time warping(DTW) to compute time series Euclidean distance between gesture and templates. Then it outputs the template which matches best as recognition result. So it doesn't need a lot of computation or training compared to statistical methods.

What we have done are 1, Building the uWave on a Android mobile phone and run some experiments. 2, via experiment we got some shortcomings of uWave and we believe we could improve it. Our goal of this project is improving performance of gesture recognition and building an application based on gesture recognition. So we researched in advantages and disadvantages of uWave and then we make plan of our work.

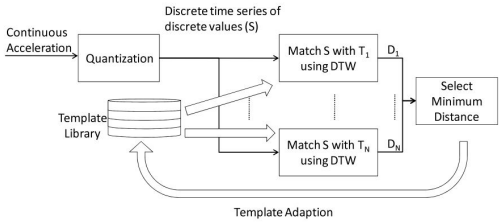

Figure 1: Basic idea of uWave

Our report is organized as following: section 2 discussed the work of uWave. We will show some shortcomings and what we can improve in the section. section 3 will show project and experiments we have done. Section 4 shows our future plan, what we will add in our research project.

2. UWAVE
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For recognition, uWave leverages a template library that stores one or more time series of known identities for every vocabulary gesture, often input by the user. Figure 1 illustrates the recognition process. The input to uWave is a time series of acceleration provided by a three-axis accelerometer. Each time sample is a vector of three elements, corresponding to the acceleration along the three axes. uWave first quantizes acceleration data into a time series of discrete values. The same quantization applies to the templates too. It then employs DTW to match the input time series against the templates of the gesture vocabulary. It recognizes the gesture as the template that provides the best matching. The recognition results, confirmed by the user as correct or incorrect, can be used to adapt the existing templates to accommodate gesture variations over time.

3. PROJECT AND EXPERIMENTS WE HAVE DONE
We implemented uWave on Android mobile phone and did some experiments about the accuracy.

4. FUTURE PLAN
We plan to do two aspects in the future, one is improving performance by SVM approaching. Another is implementing

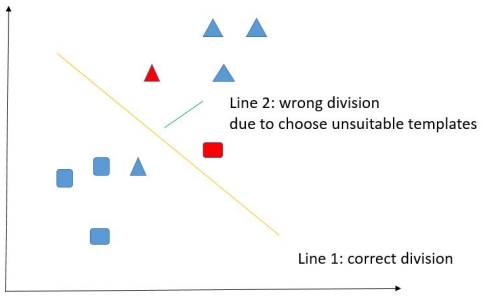

Figure 2: SVM is better than uWave when we have similar gestures

an application to use gesture recognition.

4.1 SVM based method

We could see from above section, the accuracy will decrease with number of gestures grows. It can be improved. This is because of shortcoming of uWave: we call it confusing gesture. With number of gestures grows, some gestures may be similar. Using template and distance approaching may not be suitable. For example in figure 2: the triangles and rectangles represent two kind of gesture data. We see two gestures are somehow similar. If we choose red triangle and red rectangle as templates, it will result in wrong classification. In this case, SVM will produce more correct division. Also, SVM can also produce classification when just use templates and find division between templates. So we think this will be better. We will try improving gesture recognition based on SVM method or some machine learning related technics.

4.2 Gesture control application

Since now we have built the uWave on Android mobile phone. The application can input gesture library templates and recognize input gesture. We plan to build an application using gesture recognition. This phone application sends signals to blue tooth adapter connected to computer and let our application control the computer in the air! We plan to have following gestures:

1. Control slide show: previous and next slide
2. Can write some English letters and numbers in air and recognize them.

We can show these cool work in course presentation.

5. CONCLUSION

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6. REFERENCES

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