

CHAPTER 7 CONCLUSION AND FUTURE WORK

In order to design tone recognition for mobile equipment, the tone recognition has to achieve real-time and low calculation complexity. This thesis proposes a parallel architecture of tone recognition for the automatic tonal speech recognizer. The architecture reduces total calculation costs by using a vowel magnitude difference function (V_{MDF}) method. However, the series tone recognition operates the number of arithmetic operations in sequence. This results in high computation cost, especially in the case of automatic tonal speech recognizer (ATSR) in natural communication. We therefore develop the tone recognition in pipeline and parallel architecture in order to achieve a high throughput and accelerate the tone recognition. To achieve real-time processing, the architecture is operated in 32 parallelisms of three process elements. Each process is executed by pipeline processing. This results in a high throughput and real-time processing. The experiment is tested by 110 Thai words comprising 187 syllables. The results show 4.4% improvement of tone recognition accuracy and 44.6% computation cost reduction, compared with the autocorrelation method. The automatic tonal speech recognizer (ATSR) performance is tested by 2,250 training data and 45 testing words. The recognition accuracy shows 26.3% improvement of ATSR with tone recognition.

7.1 Limitation and Future Work

This thesis proposes efficient tone recognition and parallel architecture of the tone recognition in order to apply tone recognition for portable devices. In order to improve our tone recognition performance, we focus on the tone recognition and optimize tone recognition architecture improvement.

Tone recognition using vowel-magnitude different function (V_{MDF}) achieves processing time competitive compared with autocorrelation method (AC). However, V_{MDF} may require more complexity if we need to design very high performance vowel segmentation. This may cause higher calculation cost.

We therefore concern with either processing time of AC or vowel segmentation part of V_{MDF} improvement. We test our AC performance by correlating an input speech samples. However, the recognition accuracy is low. We then try to apply other features with AC, for example, centre clipping which provides smoother fundamental frequency (F_0). However, it may require high computation cost due to the whole input speech input. In addition, AC neighboring syllable error rate should be concerned.

In contrast, V_{MDF} requires the lower number of operations to process the tone recognition. It still requires improving vowel segmentation performance. To improve ATSR recognition accuracy, we should also prepare more training data.

To design tone recognition for portable equipment, power efficient should improve energy efficiency of the tone recognition architecture. We propose parallel architecture of the tone recognition architecture to reduce calculation cost. In a reconfigurable design, parallelism does not reduce processing times as multiple steps can be computed concurrently. The more degree of parallelism, the more resources and complex design. We therefore should optimize the degree of parallelism. In addition, we should also optimize pipelined designs since pipeline stages often perform very similar functions to reduce the area and configuration time.