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SIGNAL PROCESSING · COMMUNICATION

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Application for a member in your team

Dear Mr. Chen,

About Me

I am a student from Huazhong University of Science and Technology, China. During the second year of my bachelor's learning, I spend two years in a lab of my school and do some researches about network and data transmission. However, when I began to learn the knowledge about sound/image processing, I found that I was becoming more and more interested in signal processing. My project designed for my bachelor's degree is about image recognition. So both of signal processing and communication could become my future direction. I think the most significant ability of me is the programming skill. In the following parts, I would like to introduce some projects that I have designed in my classes and researches.

Final Project

This is my final project designed for my bachelor's degree. It is a matlab simulating system which could recognize serial numbers on American banknotes. It converts the source image into a binarized image, detects the area where the numbers occur and recognizes these numbers separately with the aid of neural networks. Part of this process is as shown in Fig. 3.
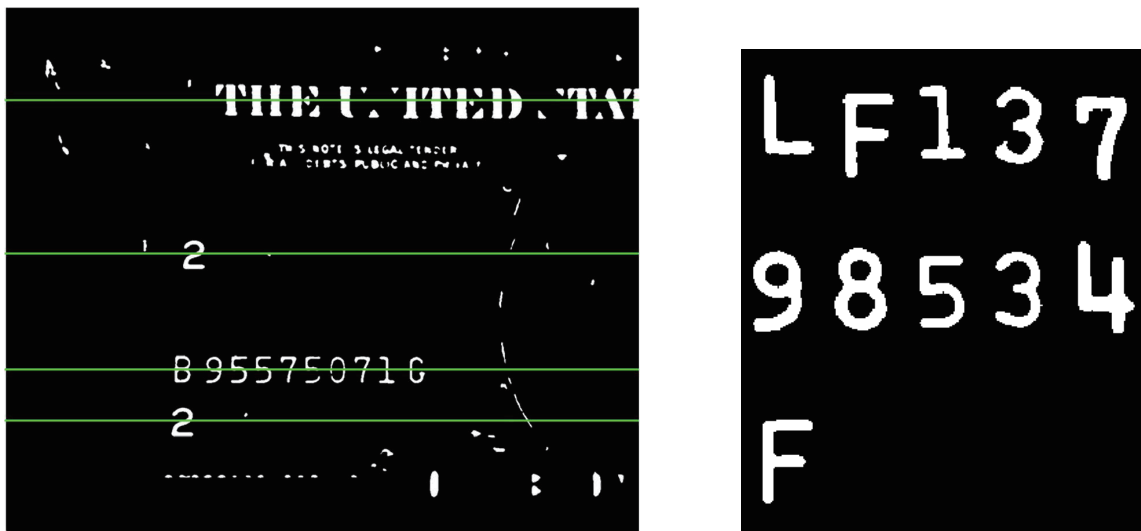

(a) Select positions where text may occur.   (b) A standardized serial number.

Figure 1: Some steps of the preprocessing.

In this research, I have used, improved and compared 5 different patterns including back analysis feature, concentration code, improved line code (shown in Fig. 2), HOG and LBP. The results show that the concentration code, HOG and LBP are effective relatively.

The main work originated from me contains an algorithm for detecting the serial number, some improvements on tradi-
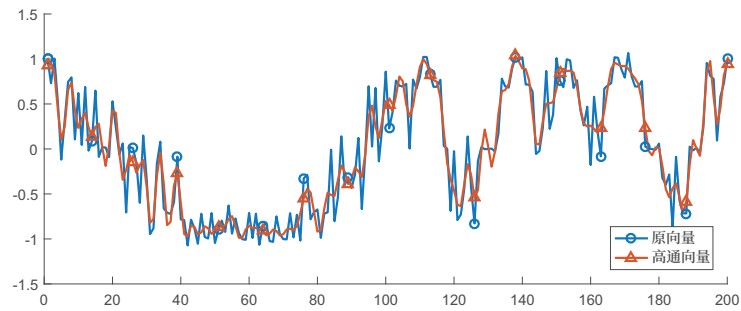
(a) Original linecode and its high-pass code.
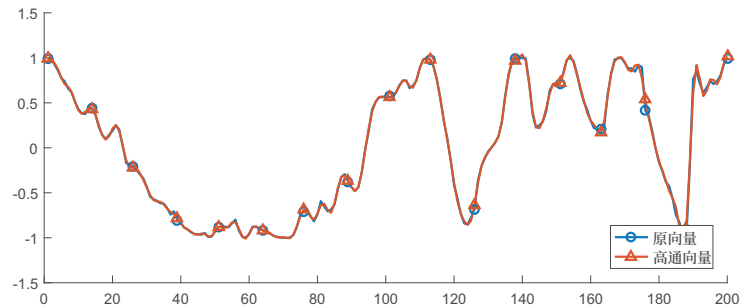
(b) Improved linecode and its high-pass code.

Figure 2: A Comparison between two methods which produce linecode.

tional features (like reducing the number of samples in the concentration code by detecting the positions of representative points) and a structure which combines results from different networks by using libSVM.
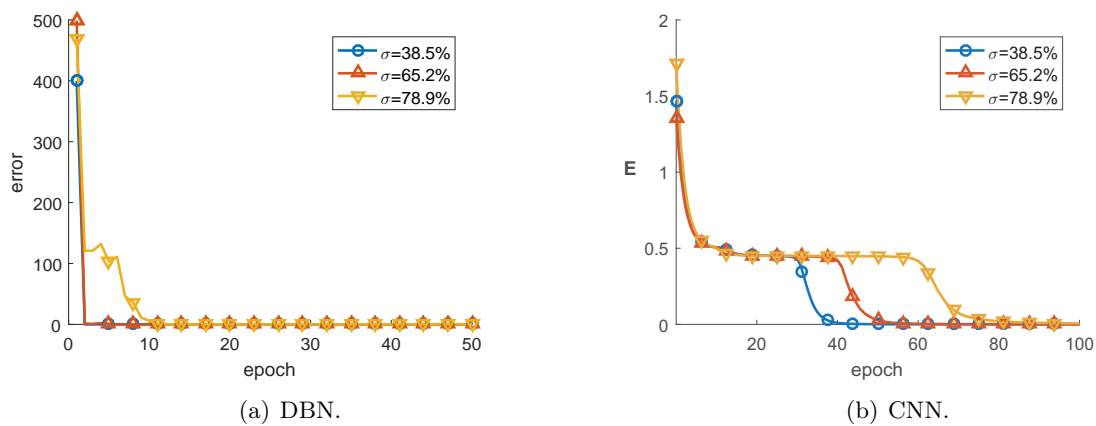

(a) DBN.

(b) CNN.

Figure 3: Training process (BP) of two kinds of networks.

An Unpublished Work

This is the research when I learn in the lab. Because of the limitation of my time, this work was not published at last. But it could show my ability in a sense.

As is shown in Fig. 4, this project aims to enhancing the devices computing ability by sharing data with other devices. So it is based on a device-to-device network. The client who needs to computing some data could cut its data into some parts, transmit it to other devices and receive results from these devices. Although it consumes some communication resources, the efficiency could be improved because computing resources of other spare devices could be made use of.
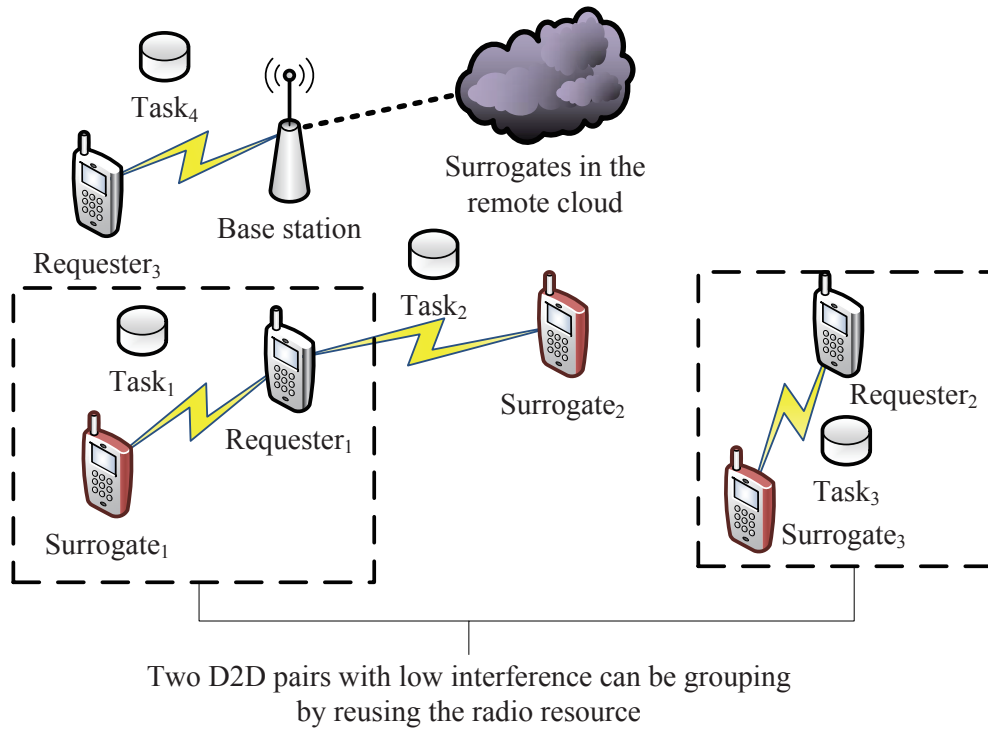
Research Ability

Figure 4: Summarization of improving the computing ability via D2D network.

Music Processing

Here are a music mixer and a music equalizer in Fig. 5. Both of them could adjust the environment effects of played music, and they are based on FFT. To achieve good effect, I inputed an impulse signal into Adobe Audition, collected and analyzed the results to reconstruct the sound effect tool of this software.
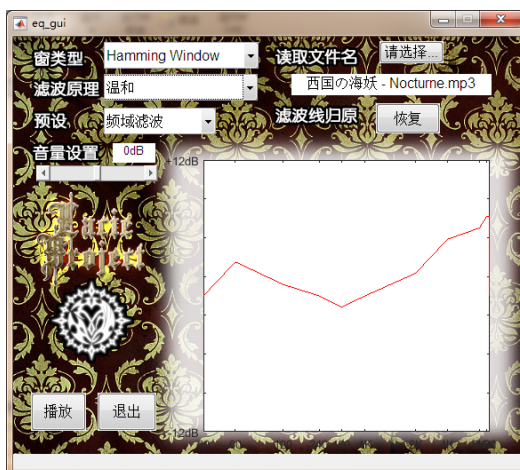
(a) The GUI of the equalizer.

(b) The GUI of the mixer.

Figure 5: Music effect tools with matlab GUI.

Audio Signal Processing

This project is based on Hidden Markov Model. It accepts an audio file recording a person's speech, cuts it into pronunciation segments, classifies these segments into different kinds, constructs HMM so that another speech from the same person could be recognized. I asked one of my classmates do some audio records and tested that this system worked well. Fig. 6 and Fig. 7 show the training and testing results respectively.
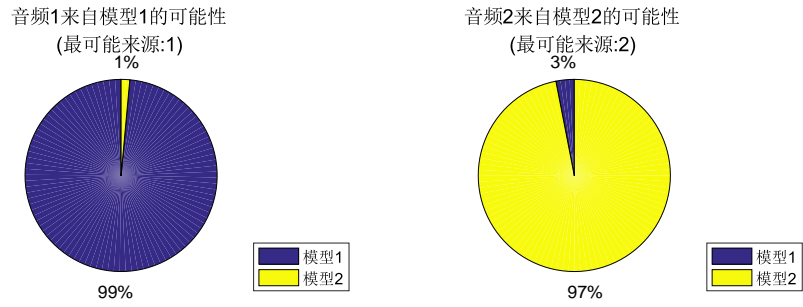
音频1来自模型1的可能性
(最可能来源:1)

音频2来自模型2的可能性
(最可能来源:2)

Figure 6: Training results of the HMM.

来自模型的可能性(最可能来源: 1)

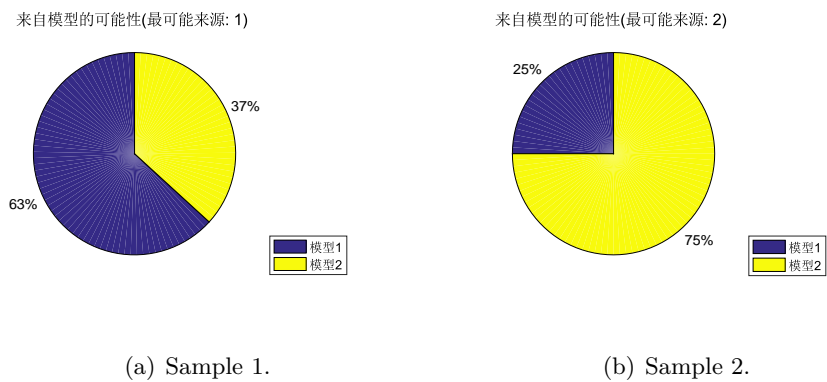来自模型的可能性(最可能来源: 2)

(a) Sample 1.

(b) Sample 2.

Figure 7: Testing results of the HMM.

Image Processing

This project aims at recognizing a person's iris. It detects the area of iris from a photo, converts the round iris into a rectangle by polar axis transformation and extracts the features by using a group of garbor filters. The main work originated from me is an algorithm for detecting the iris by utilizing the generic algorithm. Fig. 8 shows some key steps of the whole process.
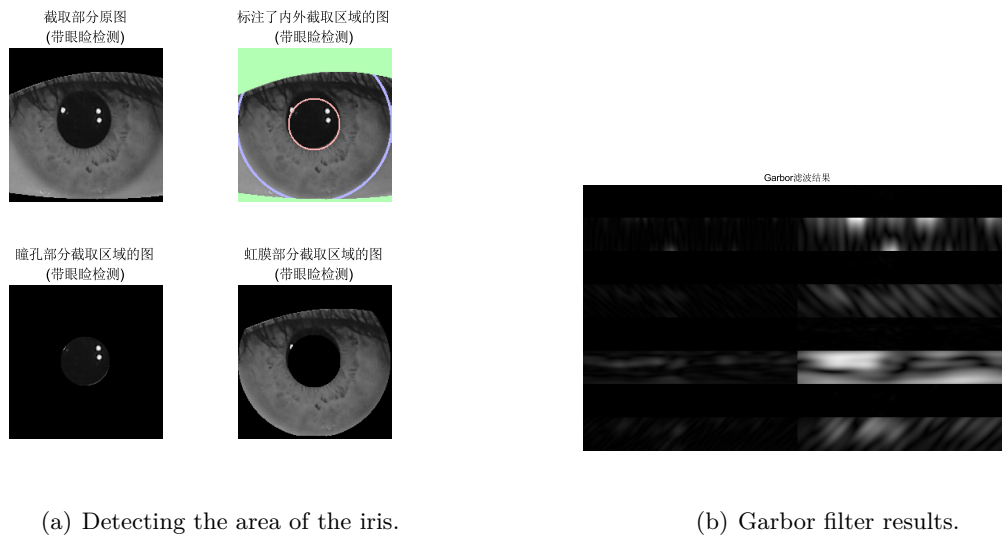

(a) Detecting the area of the iris.

(b) Garbor filter results.

Figure 8: Some steps of iris recognition.

Programming Ability about Other Languages

Fig. 9 shows a program designed for downloading and saving data from the database of meteorology bureau. It is constructed by using pyQt and python-c-api.
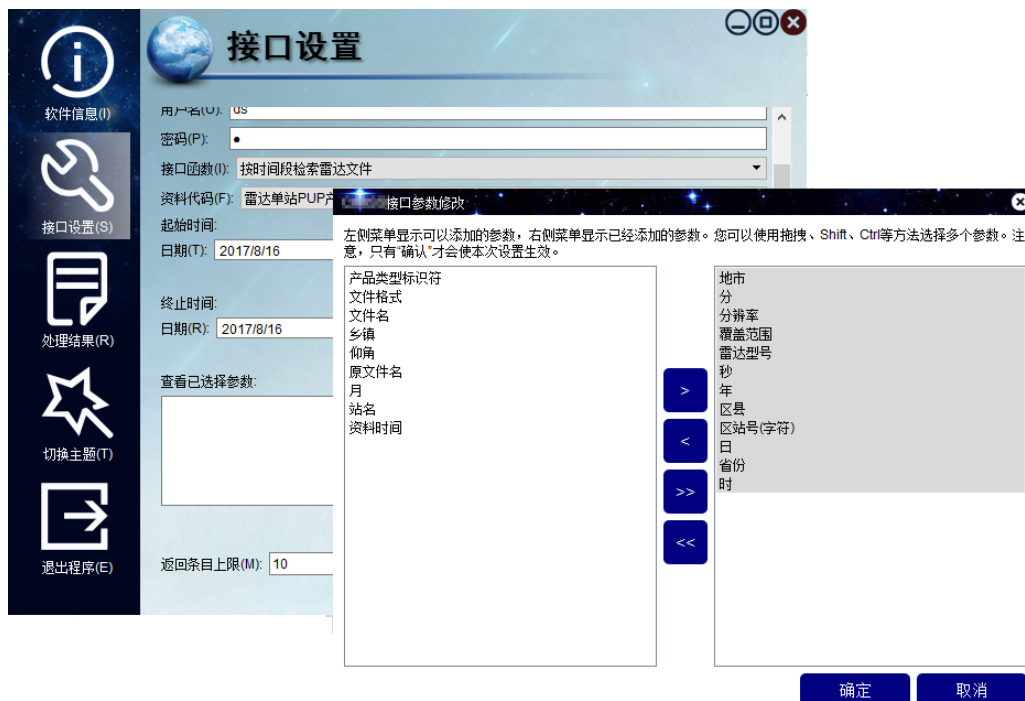

Figure 9: A view of the program designed by pyQt.

Fig. 10 a game (like Plants vs Zombies) designed on the FPGA and Altera Cyclone II Core. Its equipments include a PS2 Keyboard, an SD card and a screen. I designed a graphic engine based on the C-api of the FPGA and a hardware accelerator for mixing graphs based on Verilog. Becaused of the limitation of time, although this project was almost complete, it could

not produce sound and save/load functions.

(a) The title UI of the game.

(b) A screenshot during the game.

Figure 10: A game developed on Altera FPGA with Cyclone II.

Sincerely,

YuchenJin

Attached: Curriculum Vitae