A Real-time Face Recognition Board using TMS320C 6414

Jeon DongHoon Son SoonOh Kim YoungMoon
System Division, Firstec Co., Ltd
Foosung Bldg., #113-8, Samsung-Dong,
Kangnam-Gu, Seoul, 135-090, Korea

Abstract - Presently Face recognition solution is operating based on PC, and this delays its commercialization comparing other biometric solutions. Even though embedded face recognition solution is required for this reason, considerable calculation quantity of face recognition algorithm for present IC capability hampers embedded solution development. In addition to this, immaturity of core algorithm ported on IC until now for commercialization in its performance and processing time has been another reason of postponement. Therefore we'd like to develop embedded face recognition system based on DSP having PC based solution level performance in this research.

Keywords: Embedded Face Recognition System

1. Introduction

The importance of the security is desired internationally as well as some individual for years to pass. We have been desired the fingerprint recognition and face recognition at America entrance into country. Currently the concern about the face recognition jumped the research stage over and became already our everyday life. Almost all commercial face recognition systems work on PC and it is faced with many problems with its large size and limited usage. Accordingly embedded product is required. But large size of face recognition core algorithm has not been appropriate for an embedded IC and the algorithm ported on IC has lower performance in its accuracy and processing time for commercialization. We propose DSP-based embedded system development, which has same performance as much as PC-based core algorithm and processing time within one second. This research is also focused on development of solution which can be adopted for various applications.

The outline of the paper is as follows; Section 2 introduces configuration of DSP-based face recognition. In section 3 and 4 basic flow of face recognition algorithm and embedded application technology are described. Section 5 shows the conclusion of the paper.

2. Configuration of DSP-based face recognition

In this section, we will explain each part of a DSP-board and show the flow of the process for overall understanding of DSP based face recognition. The developed DSP-based face recognition system was designed for the application using DSP chip [1], and that was converted from a PC-based face recognition system. The system is composed of various devices such as keypad, TFT LCD, network, sound as shown in figure 1 and the configuration of DSP-based face recognition software is processor, image control, network, booting system, database, sound codec, UART (Universal asynchronous receiver transmitter) and keypad part.

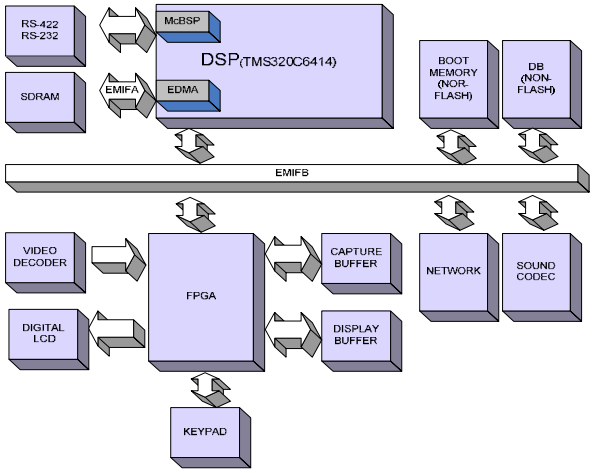

Figure 1. The DSP-based face recognition system configuration

Detailed explanation of each part is as follows. The processor section is core algorithm processing part composed of DSP, processor and SDRAM (Synchronous Dynamic Random Access Memory), program memory.

The Image processing control section consists of FPGA (Field Programmable Gate Array), video decoder, SRAM (Static Random Access Memory), TFT (Thin Film

Transistor) LCD (Liquid Crystal Display). It captures an image from a camera and displays the captured image on LCD. It saves a digital image from a video decoder in SRAM, captures an image in real time and displays it as DSP capture mode or DSP display mode. The network section is a network communication control part and the booting system section indicates a boot loader using a NOR flash. The database section saves an enrolled users' data using a NAND flash. The UART makes communication with an outside device using RS-232 and RS-422. The sound codec section is a wave sound input/output system using a sound codec chip. Lastly, the keypad section is an input part controlling a signal of user.

3. A face recognition algorithm structure

We describe existing PC-based face recognition algorithm and port it at a DSP. A face recognition algorithm is divided initialization, detection[2], representation and verification in a general way.

If a face recognition system is received a reset message at the first, the initialization module is executed. It creates variables and tables that are used in other modules. And it allocates the memory. This process is performed at once when it is received a reset message.

The detection part is a module that acquires eye coordinates. For finding exact eye locations, we use diverse algorithm by in stages. We use the motion method which uses a difference between frames and utilize features such as skin color, shape to find face candidates. And then we use frequency characteristic of face color. Lastly we can find the real face among face candidates and eye coordinates. The representation part is a module that normalizes extracted face image which cut off in detection part. We revise an image distortion by the lighting to extract feature vector data of face. A feature data to be acquired is used variously according to the mode. Feature data is stored at the database in a face enrollment mode and is compared with feature data of the database in a verification mode.

4. Algorithm enhancement plan for DSP embedded system

An embedded system is independent system that is different from a structure of PC entirely. Although a face recognition system to use TMS320C6414 DSP has very high processing speed than a embedded system to use other DSP process, it has low performance in all aspect compared with PC.

Consequently we need an algorithm optimization if we apply a face recognition algorithm to an embedded system. To optimize a PC-based face recognition system in DSP system, we must overcome a defect of DSP system and apply how to make the most of an advantage of DSP system. An algorithm improvement plan for DSP embedded system is as follows.

The first, we must to convert fixed-point algorithm from floating-point algorithm. The difference of two processor is that DSP doesn't have FPU(Floating-Point processing Unit). The FPU is an operator to deals floating-point computing. When we compare computing power of a floating-point with computing power of a fixed-point, the performance is from minimum several tens to maximum tens of thousands. The second, we must utilize the DSP library. Texas Instruments (TI) supports several open library. It is already converted floating-point computing into fixed-point algorithm. Besides it has good performance because fixed-point algorithm is implemented with an assembler. The Third, we must apply an EDMA actively. The EDMA doesn't give a processor a burden entirely and supports very various memory transfer mode. We can reduce a burden of a processor when we apply it. There are diverse methods which can reduce operation quantity like trigonometrical function besides the EDMA.

5. Conclusion

We need an embedded face recognition board to make much smaller solution and to speed it up. DSP performance was improved that we used primary high performance algorithm in embedded board. And hardware board size is much bigger because of adding various functions. Consequently we have to make algorithm much smaller and lighter and improve an embedded board design for preventing problem of mass production.

After developing product, we can extend the market, which is not increased by problem of existing PC market that is hard to expand multi network. Finally we can contribute to enlargement of world face recognition market and also we can develop SoC (System On Chip) of face recognition chip through additional algorithm development.

6. References

[1] TMS320C6414, TMS320C6415, TMS320C6416 Fixed-Point Digital Signal Processors

[2] G. Burel and D. Carel, "Detection and Localization of Faces on Digital Images," Pattern Recognition Letters, vol. 15, no. 10, pp. 963-967, 1994