

Study and Design of Intelligent Management System for Student's Attendance

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Abstract: Aiming at the problems existing in the work of traditional student's attendance, using computer technology combined with the more advanced technology of face recognition, a real-time processing intelligent management system for student's attendance has been studied and designed. The system is mainly composed of image collector and attendance management computer. Its control core is the digital signal processor TMS320DM6437, and peripheral circuits of TMS320DM6437 are given. In the image collector, the collection of student's face image is completed by the CMOS camera. After collection, the face image is two valued, noise filtered, and the face region is fixed roughly. And then through vertical and horizontal projection, eyes are positioned precisely, according to the geometric characteristics of human face. The face image is cut out, and then through the image normalization and histogram equalization, the standard face image of the student is obtained. Finally, the standard image is decomposed by two-layered wavelet, feature vectors of the student's image are extracted, and, in this way, student's attendance is completed. The attendance results are stored in the memory, at the same time, the results are sent to the attendance management computer through the network. When a student is absent, messages are sent to his mobile phone through the wireless communication module in image collector. In the image collector, the C language is used to program, and the control function of attendance management computer is achieved by Visual Basic.

Keywords: Attendance management, Face detection, Face recognition, TMS320DM6437, Visual Basic.

1. INTRODUCTION

Students are the largest group in the school, and its management is very complex. A student's successful graduation is closely linked to his daily attendances. The traditional way of attendance not only takes up a lot of class time, but also the attendance information cannot really reflect the student's attendance. Besides, the data summary and the statistical results of student's attendance information are quite tedious, which impart great difficulties to the attendance report and the attendance statistics. Hence, according to the actual teaching situation, it is imperative to develop a practical intelligent management system for student's attendance [1]. The application of intelligent management system for student's attendance will greatly improve the work efficiency of school attendance management, and consumption of manpower, material resources and time in the process of attendance will be saved. It will not only make the attendance work simple, faster, but also the goal of accurate and comprehensive attendance data, and real-time information sharing will be achieved. Students' attendance will be better managed, their learning will be supervised, and teaching and classroom can be better evaluated.

2. HARDWARE DESIGN OF THE SYSTEM

2.1. Structure of the System

The intelligent management system for student's attendance is designed according to the module, mainly including

controller DM6437, image collection module, processing module, storage module, communication module, power module and attendance management computer [2], and its structure diagram is shown in Fig. (1). The image collection module consists of a CMOS camera, a video decoding chip and a video processing front of the digital signal processor. The processing module is implemented by TMS320DM6437, and it mainly receives and processes collected images. The memory module mainly includes DDR2 SDRAM and NAND FLASH. The communication module is completed by the wireless network, and it is convenient for the transmission of the network attendance and the related information. The power supply module mainly provides power to TMS320DM6437 and its peripheral circuits.

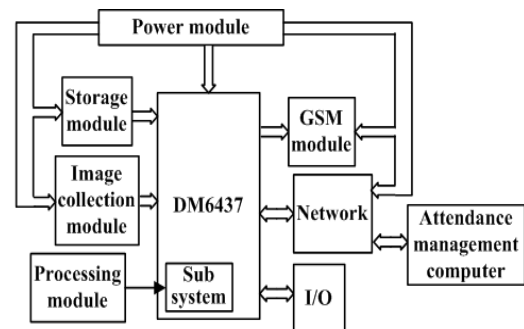


Fig. (1). Structure diagram of the system.

2.2. Design of Partial Unit Circuits

2.2.1. Power Circuit

The intelligent management system for student's attendance requires three kinds voltage of 3.3V, 1.8V and 1.2V.

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The voltage of 3.3V supplies power to the GPIO module of DM6437, the CMOS camera module, the video decoding module TVP5146 and the NAND FLASH memory module. The voltage of 1.8V supplies power to the DDR2 SDRAM memory module and the DDR2 controller module. The voltage of 1.2V supplies power to the kernel module of DSP. The power circuit uses a switch power supply regulator TPS54310. TPS54310 integrates field effect tubes required by the switch power, and the power regulator can output stable and adjustable voltage requiring few external components. In order to reduce the pollution of digital power, the power output end of TPS54310 is connected with an inductance filter circuit [3]; the 3.3V power circuit is shown in Fig. (2).

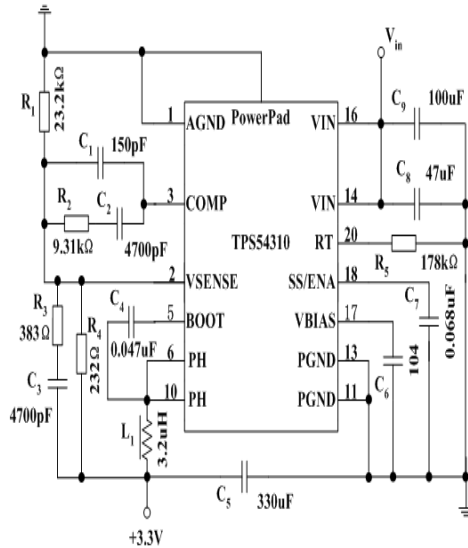


Fig. (2). +3.3V power circuit.

2.2.2. Storage Circuit

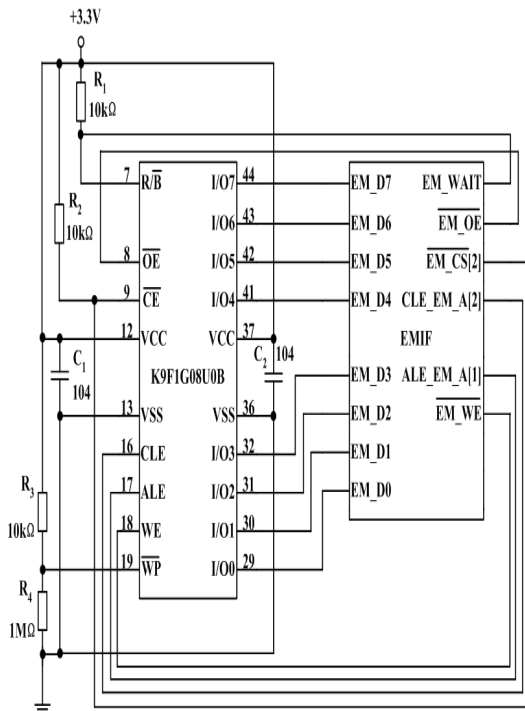


Fig. (3). Connection between K9F1G08U0B and EMIF.

The internal memory of DM6437 cannot store a large amount of system code and image data, so it is needed to improve the memory capacity of the system by the way of external extended memory. The external expansion memory mainly includes NADN FLASH memory and DDR2 SDRAM; NADN FLASH memory is used to store the curing system code and algorithm configuration information; and DDR2 SDRAM memory is used to store system procedure and image data [4]. The interface (EMIF) of external memory can connect with many kinds of memories. The K9F1G08U0B developed by SAMSUG Company is chosen as the NADN FLASH memory; its connection with EMIF is shown in Fig. (3).

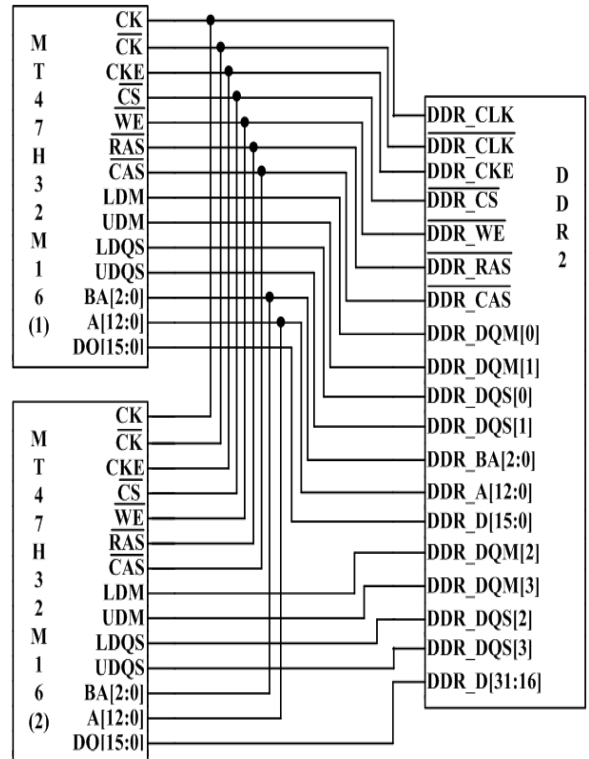


Fig. (4). Connection between MT47H32M16 and DDR2.

The work of DDR2 SDRAM memory is controlled by the DDR2 controller. The new high speed MT47H32M16 memory developed by CRON Company is chosen as the DDR2 SDRAM memory. In order to meet the needs of data communication, and ensure the normal operation of the intelligent management system for student's attendance, two chips of MT47H32M16 are selected; their connection with DDR2 controller is shown in Fig. (4).

2.2.3. Image Collection Circuit

Firstly, face images of students are collected through the CMOS camera, and they are converted into facilitative analog video signals for the transmission by the converter. And then the analog video signals are converted into digital video signals by the video decoder chip TVP5146. Finally, digital video signals are transmitted to the Video Processing Frond-End of DM6437. Thus the image information collection is completed [5], and its application circuit is shown in Fig. (5).

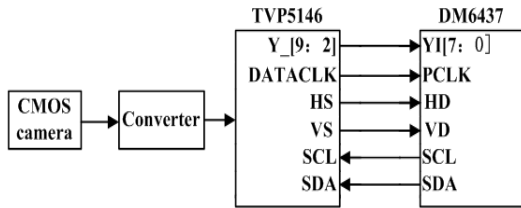


Fig. (5). Image collection circuit

2.3. Face Detection Algorithm

Face detection algorithm mainly includes two parts of face processing and face location [6]; the structure diagram of face detection is shown in Fig. (6). Image binaryzation and image denoising are part of image preprocessing, whereas eye location, face cutting, scale normalization and histogram equalization are part of face location.

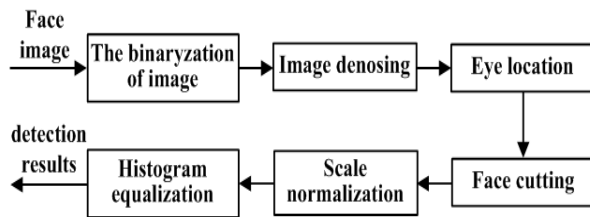


Fig. (6). Structure diagram of face detection.

2.4. Face Recognition Algorithm

The key to success of face recognition is features extracted from the image whether it can fully reflect the features and attributes of the target. In order to improve the recognition accuracy of the system, wavelet transform is applied to extract face features [7, 8]. Face recognition algorithm includes two parts of training and recognition; the diagram of face recognition algorithm is shown in Fig. (7).

3. SOFTWARE DESIGN OF THE SYSTEM

In order to achieve the strong control function of the intelligent management system for student’s attendance, software of the system is programmed by C language and Visual Basic [9-12]. The flow chart of face detection algorithm, the flow chart of face recognition algorithm, the functional diagram of attendance management computer is shown in Figs. (8-10) respectively.

4. TESTING OF THE SYSTEM

4.1. Methods of the Testing

In the process of developing the intelligent management system for student’s attendance, we used the method of white box testing technique and logical overlay to test the system comprehensively, which are discussed in the following sections.

4.1.1. Testing of the Menu

In order to ensure that each pull-down menu can correctly implement functions of the system, according to attendance, leave early, be late and absenteeism parameters, the complete information required for attendance system was input into the system, so that each menu is increased, delet-

ed, modified, traced and printed repeatedly, so as to ensure the accurate realization of the menu item.

4.1.2. Tracing of Data

After the testing of menu items is completed, each attendance data in the system was traced and modified, and the correctness of data stream processing in statistics and analysis module was verified.

4.1.3. Transplant Testing

Since the system is copied to run on other computers, the scope of application and performance requirements of the transplantation have been affirmed.

4.1.4. Comprehensive Testing

Based on the above testing, the overall function of the system is tested, in order to find whether functions of the system meet the design requirements.

4.2. Decision of the Wavelet Decomposition Layer and the Wavelet Function

As already established, the more the layers of wavelet decomposition, the more precise the low frequency information can be obtained. Also, the more the loss of information is, the increased the recognition time will be. From the dialectical relationship, it is identified that more wavelet decomposition is not recommended, as there is a marginal value. In this paper, the experimental method is used to determine the decomposition layer of wavelet; the experimental results are shown in Table 1.

Table 1. The experimental results.

Wavelet decomposition layer	The correct rate of recognition(%)	The recognition time(s)
1	30	0.3
2	92	0.8
3	96	2.2

At present, because there is no fixed theory as a guide for the selection of wavelet basis, so the test data are still used to select the most appropriate wavelet basis. Three kinds of wavelet functions named DB series, SymN series and CoifN series, are selected respectively. The recognition results of different wavelet bases are shown in Table 2.

Table 2. The recognition results of different wavelet bases.

Wavelet function	The correct rate of recognition(%)
Db1	69.8
Db2	76.2
Db3	79.0
Sym5	88.7
Sym6	90.2
Sym7	92.6
Coif1	73.5
Coif3	79.8
Coif5	70.1

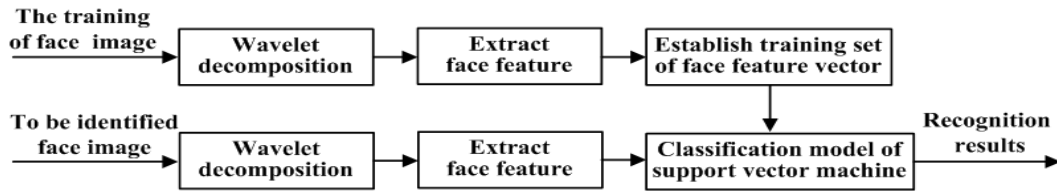


Fig. (7). Diagram of face recognition algorithm.

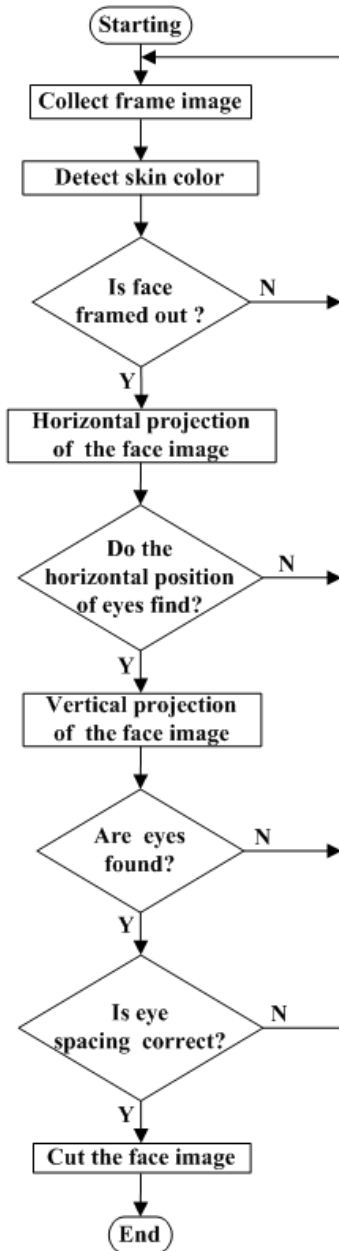


Fig. (8). Flow chart of face detection algorithm.

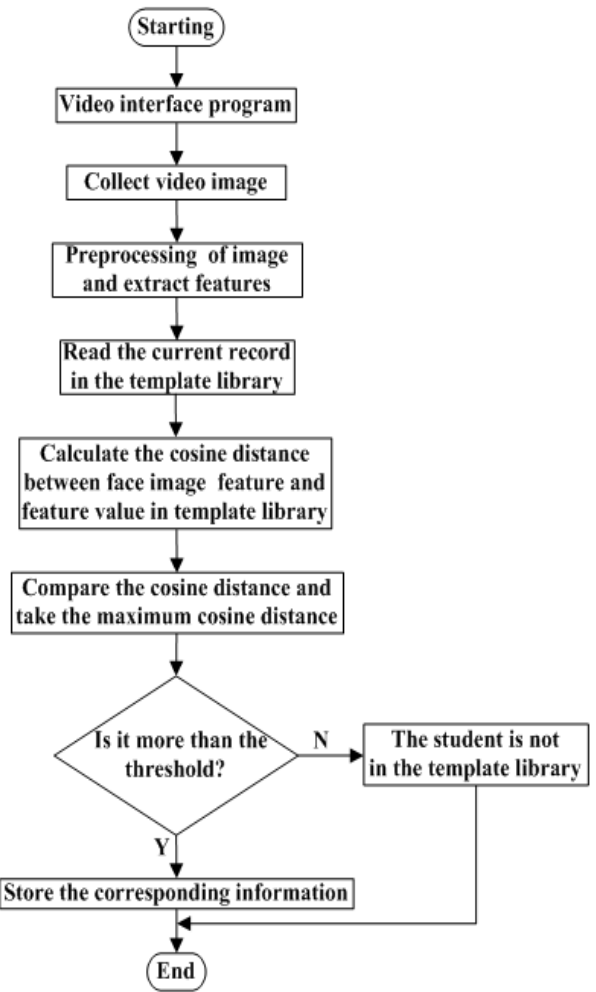


Fig. (9). Flow chart of face recognition algorithm.

4.3. Realization of System Functions

4.3.1. System Login

The interface of system login is shown in Fig. (11). Through inserting the user name and password as input, the data is queried from the database, and compared with login information input. If the database contains the output user

name and password data, and they are consistent with the one inputted, then it skips to the main interface. If the password is not correct, password error is prompted, at the same time the counter increases 1. When the password input error is more than 3 times, the program will be terminated, and automatically exit.

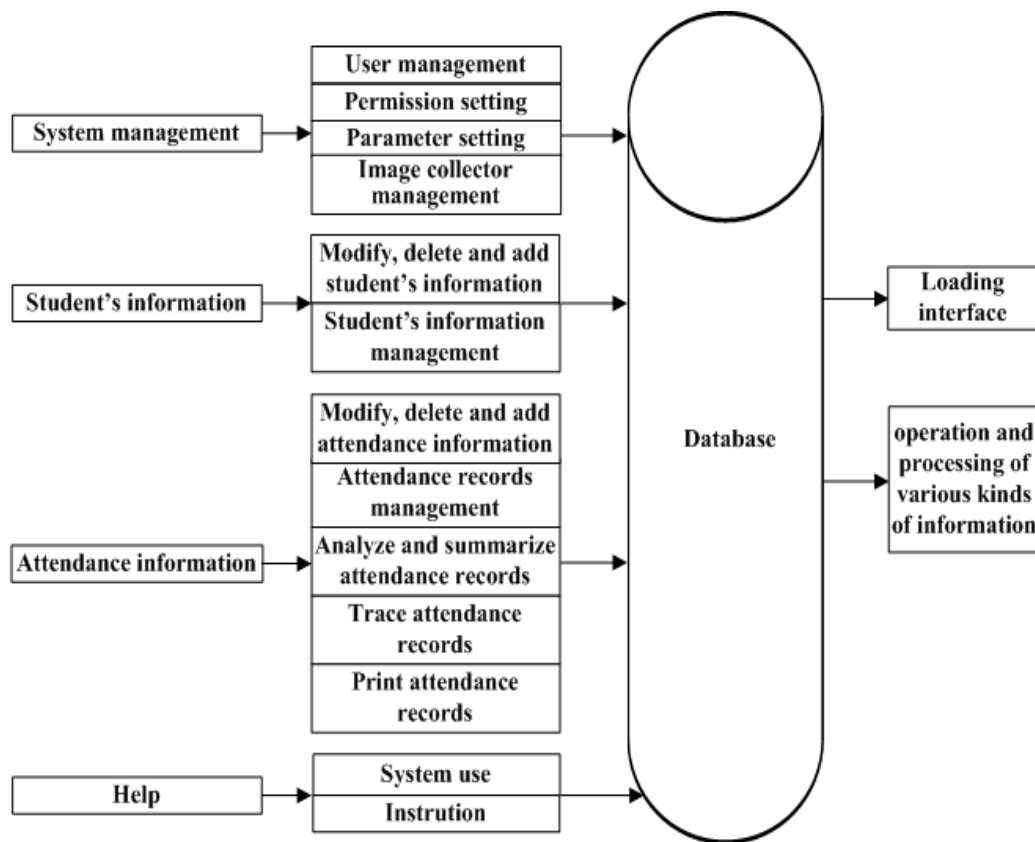


Fig. (10). Functional block diagram of attendance management computer.

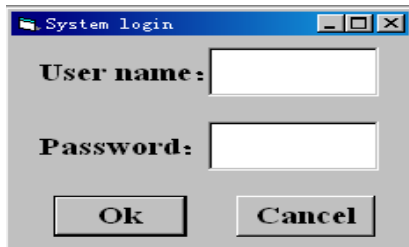


Fig. (11). Interface of system login.

4.3.2. Interface of the Main Function

When the administrator inputs the correct user name and password, the system skips to the interface of the main function; the interface of the main function is shown in Fig. (12). The main function menu includes system management, student's information, attendance information, help and exit menu options. By clicking on the above menu options, the corresponding functional interface will be popped up, and a series of operations can be performed.

4.3.3. Addition Interface of Student's Information

The administrator can modify, add and delete student's information, accounts and passwords. The addition interface of student's information is shown in Fig. (13).

4.3.4. Interface of the Attendance Records Trace

The Interface of the attendance records trace is shown in Fig. (14). In the interface of the attendance records trace, when the corresponding information is selected, the relevant

information and the status information of students can be clearly seen. When day trace, week trace or term trace is selected, the time selection menu is not available.

4.4. Result Analysis

The intelligent management system for student's attendance has been tried out in laboratory of department of physics and electronic engineering. The running results show that the system can better complete intelligent attendance of students, it achieves the expected requirements, and the system's function is perfect. The experimental results show that it more appropriate for this intelligent management system to choose the two-layered wavelet decomposition of Symn series, in order for its recognition effect to be better. There are many reasons leading to recognition errors, the main reasons are as follows:

- 1) Face recognition is in complex conditions.
- 2) Glasses do not affect correct recognition. But if the light is too strong, glasses can cause reflection of light, due to which the recognition effect is not good.
- 3) When the facial expression changes greatly, the system still has very good recognition ability.
- 4) When the face deflects within 10 degree, the system can recognize correctly. But when the face deflects more than 10 degrees, the recognition effect is not ideal.



Fig. (12). Interface of the main function.

Fig. (13). Addition interface of student's information.

- 5) The system has very high requirements for light, such as too dim light will affect recognition effect.

CONCLUSION

Comprehensively using multiple technologies and combining hardware design with software design, the intelligent management system for student's attendance has been designed, which is integrated with a variety of functions of image collection, image processing, face detection and face recognition.

- 1) TMS320DM6437 developed by TI Company is used as the microprocessor. Design and analysis around TMS320DM6437 of the hardware system are not only advanced, stable and have comprehensive control function, but also they can be easily extended for more function.
- 2) Methods, principles and algorithms of face collection, face detection and face recognition have been introduced,

through a lot of experiments, two-layered wavelet decomposition of Symn series is used for face recognition.

- 3) The interface of attendance management computer is designed by Visual Basic, and a set of the advanced intelligent management system for attendance is achieved, and the humanization of the system is greatly improved.
- 4) From the overall operation of the system, the system has the characteristics of friendly interface, convenient operation and stable performance. The system can be extended to other schools or large enterprise to carry out daily attendance management.
- 5) Application of the intelligent management system for student's attendance plays an important role on improving student's attendance rate and enhancing classroom teaching quality, and it has a certain positive role to realize intelligent management of students.

Applied electronic technology of 2012

ID	Name	Course	State	Approver	Record
2012084001	Wang Nini	EDA	Attendant		Total: 12 Absent: 1 Leave: 1
2012084002	Li Hong	EDA	Attendant		
2012084003	Li Li	EDA	Attendant		
2012084004	Zhang Ying	EDA	Absent		
2012084005	Li Haiying	EDA	Attendant		
2012084006	Zhao Zifei	EDA	Attendant		
2012084007	Liu Tao	EDA	Attendant		
2012084008	Li Zipeng	EDA	Attendant		
2012084009	Meng Xiang	EDA	Leave	Zhang ming	
2012084010	Zhao Peng	EDA	Attendant		
2012084011	Wang Hao	EDA	Attendant		
2012084012	Yu Dandan	EDA	Attendant		

Fig. (14). Interface of the attendance records trace.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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