The Design of Touch-Screen Display System based on DSP

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Abstract: This paper takes TMS320C6748 as the core,it achieve the real-time display of EMG signals by the design of real-time control system SYS/BIOS and touch screen module, the real-time processing of the EMG signal acquisition and EMG feedback on the touch screen can help users understand the EMG signals by means of human-computer interaction, and it makes people to achieve the real-time monitoring and analysis of the EMG signal.

Keywords：TMS320C6748,EMG signal,touch screen

1. Introduction

The stroke morbidity and recurrence rate is very high, and it has become the first killer to threat the health of our people, It is about 7 millions of existing stroke patients in our country, and each year it still rising at a rate of 9%. It according to the WHO estimated that in 2030 China's stroke patients will be increased to 31 million 770 thousand, the rehabilitation of patients will take a long time. It will also bring heavy mental and economic burden to their families and our country for the rehabilitation of patients with stroke, the problem also affects the attitude of patients to their life in the future, but many large hospitals because of professional wages,it can not meet the lack of patient health time-consuming exercise needs, so it is necessary to carry out real-time monitoring for patients to ensure its normal muscle function. Therefore, The real-time monitoring of EMG, it is necessary to the scientific planning and rehabilitation programme. EMG can also serve as athletes training in the strength analysis basis, through the observation of the muscle parameters of the muscles get exercise.

2. The Real-Time Operating System SYS/BIOS

2.1 Introduction of SYS/BIOS

The real-time operating system SYS/BIOS, which can be cut on by user conveniently, It mainly consists of three parts: multi thread real-time kernel, real-time analysis tool and support library to chip.

It is convenient to research on complex DSP with the development of real-time operating system. The operating system needs the operation of multi thread, it only need to make the corresponding digital signal processing algorithm as a thread and embedded system. The support library to chip for the management of peripheral resources can be used direct graphical tools to configure complex peripheral registers, it can also use real-time analysis tools to run the algorithm analysis.

SYS/BIOS system in a modular way of encoding, it provides interrupt, timer, threads, memory resources and external resources management set permissions for users, and in the actual application, it can be cut according to users' needs, and the algorithm used as a thread inserted into the SYS/BIOS scheduling queue by SYS/BIOS scheduling.

2.2 The application of SYS/BIOS

For the SYS/BIOS system, The user acc-ording to their own need to cut out the SYS/BIOS operating system[1], the form ation of the configuration file, and on this basis, the algorithm has been defined and the control program as a thread insert task cycle. When DSP started to compile and execute after loading, DSP will first perform the initialization operation, then from the main () function into the task cycle queue, according to the order of priority to perform tasks in the queue. DSP external equipment can be performed through the interrupt service program, SYS/BIOS through hardware interrupt management settings in calling the corresponding interrupt service program to deal with the interruption. This is the general process of development and implementation by SYS/BIOS.

In order to verify the real-time of SYS/BIOS, using fast FFT transform as an example. Using the timer to do 1024 FFT operations, 1000 times per second, Using real-time SYS/BIOS analysis tools, FFT real-time only occupy less than 20% of DSP resource. 1024 point FFT requires 25716 instruction cycles, 453 program space words, 1517 data space words. The SYS/BIOS system has strong ability of real-time signal processing.

2.3 EMG Signal Processing Algorithm

This paper analysis the frequency domain for EMG signal FFT and MPF value to the analysis of the EMG signal,The follows is the formula to calculate the FFT:

$$MPF = \int_0^{+\infty} f * P(f)df / \int_0^{+\infty} P(f)df$$

Through calculating the MPF value of EMG signal, according to its general characteristics, when the EMG fatigue occurs, the MPF value of EMG signal will shift to the low frequency, which can determine the occurrence of EMG fatigue. As shown in Figure 2-1 for the use of DSP for EMG signal FFT.
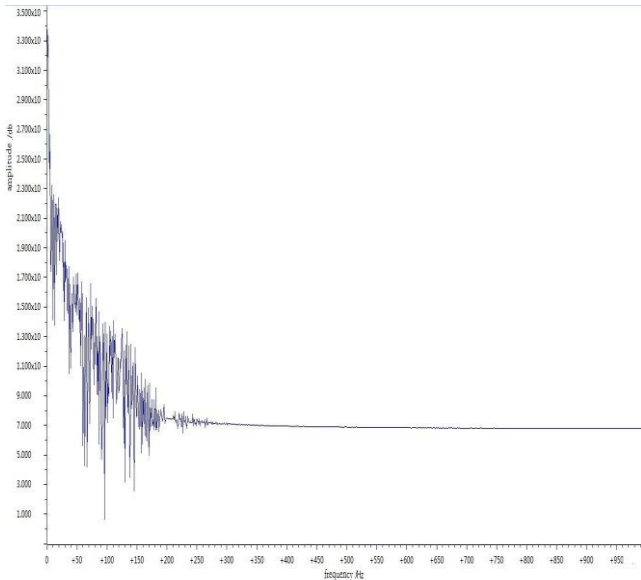
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Figure 3-1: FFT frequency domain map of EMG signals

3. Touch Screen Display

The commonly used touch screen is LCD screen, because it is able to maintain low power and flexible display. It has a LCD controller module, LCD panel can be connected with the embedded system, the controller has 8 bit or 16 bit interface, it makes the embedded system control into controller for LCD panel operation[2], which greatly simplifies the LCD and hardware connected with the programmer to control the program.

3.1 Display Principle of Touch Screen

The touch screen is very important for human-computer interaction system, it can make people get rid of the mouse and keyboard operation, The touch screen has a wide application value as a new type of input device, such as many of the multimedia teaching, communication equipment and the bank's business office Richar field[3], It is a prominent role and facilitate people to operate, and it has the advantages of space saving, quick response and good durability, it has become an essential way of human-computer interaction.

The touch screen includes the touch screen control and the detection components, which is a transparent medium attached to the display, it mainly operation by the user's finger or stylus, then the specific location of touch point detection of user touch screen will send instruction to CPU, CPU will deal with it by the corresponding operation. According to the different types of touch screen sensor technology and its principle, it can be divided into four categories: resistive touch screen, capacitive touch screen, infrared touch screen and surface acoustic wave touch screen[4], This paper will use the capacitive touch screen as the display module.

3.2 LCD Display Software Design

The picture by the recognition to the liquid crystal display the corresponding picture operation process is as follows: (1) Initialize the LCD operation, the specific operation for the first time is reset the LCD, it generally requires more than 500us to reset, after the end of the reset the system need to invoke the register operation function, set the the brightness of LCD back light, then open and set the display layer, and set the LCD mode register, finally the LCD screen; (2) LCD draw points, 7 inches of LCD used in this paper, it uses RGB565 format color, its resolution is 800*480, which contains the 800*480 pixels, and this issue needs to be picture full screen display, so we need to operate on the specified point with specified color, after the set of all points to the touch screen, picture drawing can be completed. The Y address, X address and color value corresponding to the register address 00H~02H, at the same time, when operate a register address pointer , it will automatically point to the next address which need to operate. It need to input three times the data to achieve the operation of draw points in the LCD; (3) BMP file, at first open the specified file by TF card, at the beginning of the file, it's about 70 characters need to read. the file contains the information section of the BMP file, the length and width of the picture file will be get through the analysis of the information, then the software will use the size of the correct analysis of the remaining data matrix; (4) Drawing pictures, on the basis of the data matrix has been analysed. The software will painting in LCD screen, It need to pay attention to that the format of the text file, the data matrix obtained may be inverted, so the data inversion should be considered before operation.

3.3 The use of graphics drive library

The graphics library can be divided into three layers, respectively, display driver layer, the basic graphics layer and widget layer[5]. The display driver layer is mainly responsible for the need to show something to integrate it into the display buffer[6]; basic graphics layer is also called matrix graphic element layer, it provides some low-level drawing operations and the layer can also provide a screen buffer rendering, which can be graphics to outside buffer drawing, and update to the LCD display for the user. The control layer is a kind of integrated many solid graphics primitives, with its response to user input, the most typical is the control of a button, when pressed will perform the designer defined action. The Figure 2-1show is the three layer architecture of the graphics driver:
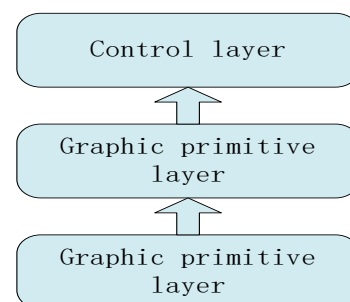

Figure 2-2 graphics library three drive structure

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For an interface, it always has a lot of control object, In order to facilitate the management. StarterWare graphics library will manage to control in the form of a tree, so that not only can it control the the join tree control list and determine the screen to display, but also when the screen need to update the content from a specific node start rendering, it can draw the sub nodes to reduce the waste of resources.

Graphics library will regard the virtual control WIDGET_ROOT as the top level of the control, and other controls as its sub nodes or lower subnodes, the same layer on the same level of different controls in the tree list. For each tree controls, it has three attributes, respectively father controls (parent), a control (next) and controls, each property will points to the surrounding nodes, so it forms a typical control tree, figure 2-2 shows is a tree control:
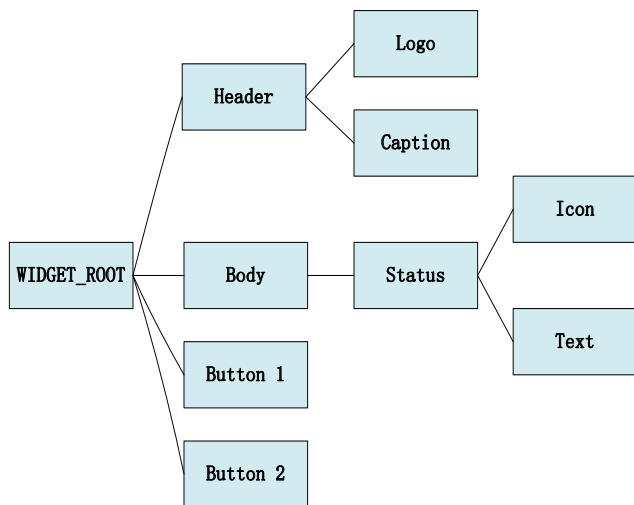

Figure 2-3 graphics library control tree diagram

It uses the control tree to draw the control, in this paper, It use the canvas function Canvas and the rectangular button operation function RectangularButton, two functions to achieve the function is as follows:
1) Canvas(sName, pParent, pNext, pChild, pDisplay, lX, lY, lWidth, lHeight, ulStyle, ulFillColor, ulOutlineColor, ulTextColor, pFont, pcText, pucImage, pfnOnPaint)

The canvas function defines the display module as sName, and its three attribute coordinate pParent, pNext and pChild, It defined the specific location of the canvas display by the pDisplay, 1X 1Y, lWidth and lHeight, and the button style to display, fill color, appearance color and text color ulStyle, ulFillColor, ulOutlineColor, ulTextColor. In addition, pFont and pcText can point to direction buttons which need to fill in the font and text, pucImage is a pointer to point to button drawing, pfnOnPaint is a pointer used to achieve the function drawn on the canvas. The main use of this function is initialization operation, and define of canvas function can achieve. the FFT panel will display FFT waveform in the designated area. Therefore, it is necessary to initialize operation on the canvas and draw the FFT waveform displayed by this function.

2)Rectangular ButtonStruct (pParent, pNext, pChild,

pDisplay, lX, lY, lWidth, lHeight, ulStyle, ulFillColor,ulPressFillColor,ulOutlineColor,ulTextColor,pFont, pcText, pucImage, pucPressImage, usAutoRepeatDelay, usAutoRepeatRate, pfnOnClick)

The parameters of this function are basically same as Canvas, The ulPressFillColor is the color when the button is pressed down, pucPressImage is a pointer to point to where need to draw a picture when the button is pressed, usAutoRepeatDelay is a automatic repeat operation in delay time after the start, usAutoRepeatRate is the execution rate of automatic repeat event, pfnOnClick defined as a pointer when press the button and perform a operation. This function performs the settings on the button and defines the function of the button that is pressed to perform the function. This paper defines the two buttons, respectively, when the implementation of the display EMG signal FFT value and the MPF waveform display.

In addition, , it uses the OnButtonPress to draw a rectangle frame, its size, color, font style and the reaction after touch, and for the circular button to set the function CircularButton. Its function is similar to a rectangle button, therefore no longer tautology. When we define the control, we need to add these controls to the control tree, and you can display the corresponding graph.

3.4 Touch Screen Display and Debug

This paper mainly to muscle telecommunication number FFT waveforms and MPF values as the research object, the touch screen test is mainly to the control and read the calculation income of MPF value, the former operation is when you press the control of sEMG signal FFT, LCD will switch to another piece of graph, and collected FFT wave chart to display in real-time, the latter for the press control MPF value, the system will be the calculated MPF values are displayed on the touch screen and analysis of the results of the calculation. Figure 4-4 shows a touch screen after initialization, figure 4-5 is respectively FFT waveform display and the calculated value of MPF.
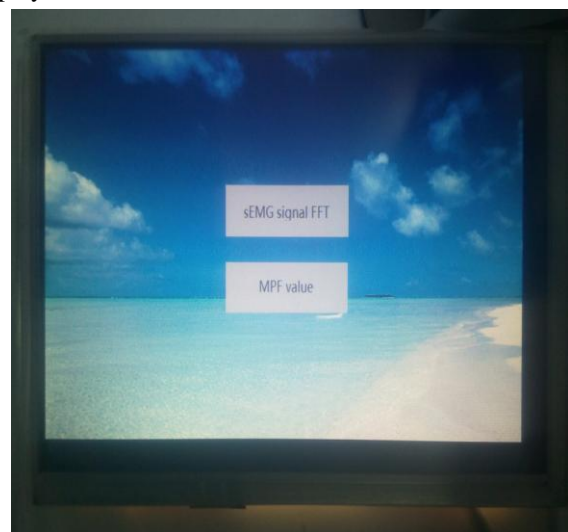

Figure 2-4 Initialize the screen
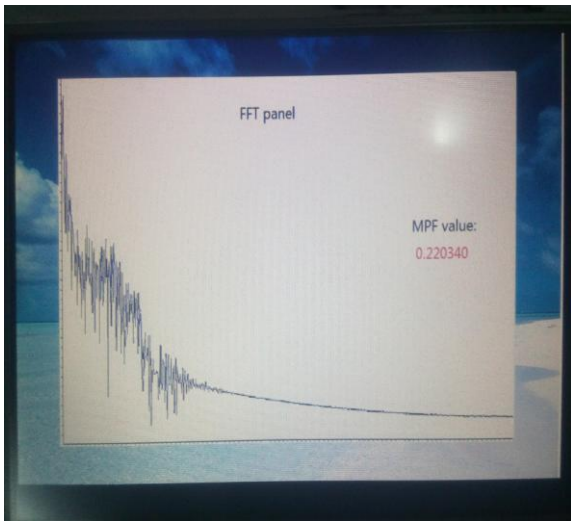
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Figure 2-5 touch screen display waveform and MPF value screen

As shown in figures 2-3 and 2-4, press the two buttons, the touch screen will refresh FFT waveforms and MPF values according to the calculation results, which can result in real time detection of EMG signal processing, and display the calculated results through the touch screen. The calculation results can not only ensure the need of myodynamia recovery of patients in the training process, and it can play a guiding role to athletes muscle exercise, And touch screen running in the SYS/BIOS system, can greatly improve the detection of real-time, the analysis of related parameters to muscle is necessary.

4. Conclusion

In this paper, It is based on the display screen module and TMS320C6748 real-time operating system SYS/BIOS, it can display the waveform of EMG signal processing, but for the design of DSP make it more friendly, this content involved still need to improve in the future.

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