The Anti-Jamming Design Based on DSP System

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***Abstract*—This paper describes the sources of interference in the DSP system and its harm. The designs of both the hardware and the software anti-jamming technology are given respectively, and the purpose of the DSP system anti-jamming is realized.**

***Keywords*- DSP; Anti-jamming**

I. INTRODUCTION

With the rapid development of DSP chip, its computing speed and processing power is being raised, the embedded system using DSP as the core has been widely applied. Complex environment of the embedded systems, DSP itself is a fairly complicated system with a wide range of types and a mix of numbers and analogs of many subsystems. So, once the system is not under an ideal working environment, for example, the electromagnetic interference or the working environment beyond the DSP proper working range, which may cause the DSP program execution flow in disorder, and then runaway or crashes and etc. may come up. In addition, under the interference environment, the crosstalk of various transmission channels between the internal system components and the subsystems will have an impact on the DSP and the data, which poses a serious threat to the stability, reliability and security of the system work. The anti-jamming design based on DSP system is of great importance.

II. THE SOURCES OF INTERFERENCE AND THE INTERFERENCE CHANNELS

Electromagnetic interference can invade the DSP system not only along various lines, but also in the form of field from space invade. There are there interference channels: the space interference, the power supply system interference and the process channel interference. The space interference occurred near the high-voltage, high current and high frequency electromagnetic field, and then through the electrostatic induction, electromagnetic induction and so on, the intrusion within the system is realized; the power supply system interference is caused by the noise of power supply; the process channel interference enters the system by interfering the forward channel and backward channel.

The roles of electromagnetic interference to the DSP system can be divided into three parts, the first part of it is the input system. When the interference invades the forward channel of DSP system, and is superimposed on the signal, the data collection error will be multiplied, especially when the channel sensor interface is a small voltage signal input, it will be more severe. Therefore, if the DSP system reacts according to this kind of input information, the wrong the results will be unavoidable. The second part is the output system, this kind of interfere can make the output signal in confusion, the real output of the DSP system can not react correctly, and finally results in a series of serious consequences. The third part is the kernel of the DSP system, it can make the three digital signal on the bus in disorder, triggering a series of serious consequences, such as the program runs disorders, more specifically, the pointer disorder of internal procedures, running the wrong program, the failure of control state, the wrong results of the program caused by the modified RAM data, what's more serious is that it will lead to crashes, the system will completely collapse.

III. HARDWARE ANTI-JAMMING DESIGN

In the actual printed circuit board, there is crosstalk between the adjacent signals which should be minimized in design, so the error level can be avoided. The size of the crosstalk has to do with the distributed inductance and distributed capacitance between the loops. The greater the distributed inductance and distributed capacitance is, the greater the crosstalk between the signals. While for the digital signal, the distributed inductance between the loops has greater impact on the crosstalk.

To solve the mutual electromagnetic interference between signals, the following measures can be taken:

1) Select a reasonable wire width. Due to the impact interference produced by the transient current on the PCB line is mainly caused by the inductance component of the printed conductor, the inductance of the printed conductor should be minimized. Printed wire inductance is proportional to its length, and is inversely proportional to its width, and therefore short and thick wire is favorable to interference suppression. Clock leaders, line drive or bus driver 's signal lines often contain a large transient current, the printed wire should be as short as possible, for the discrete component circuits, the printed wire width of about

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1.5mm can fully meet the requirements; for the integrated circuits, the width can be selected between 0.2-1.0mm.

2) Correct routing strategies, well-shaped mesh routing architecture will be the best. The specific practices: horizontal wiring in the layer of the PCB and vertical wiring to the next layer.

3) In order to suppress the crosstalk between conductors on printed boards, long-distance running line level should be avoided in the design layout. The distance between the lines be pulled as much as possible, no cross is between the signal lines and ground and power lines as far as possible. A ground printed line can be layout among the sensitive signal lines to effectively suppress the crosstalk by hitting a hole across a small distance and connecting it to the ground.

IV. SOFTWARE ANTI-JAMMING DESIGN

A. *Watchdog method*

The watchdog program design is the most common method in order to improve the anti-jamming capability of the DSP system software. The watchdog module monitors the running of the system software and hardware, which can generate, interrupt or reset the system in accordance with user-set time intervals. If the software is in non-normal cycle or runs to the illegal program space, making the system work abnormally, then the counter of the watchdog timer will overflow, an interrupt or reset signal will be generated, allowing the system to enter the user pre-set state. In most cases, the abnormal situation of the system caused by outside interference can be removed by the operation of the watchdog module to restore the system to normal working condition. Therefore, reasonable set of the watchdog module can greatly improve stability and reliability of the system.

The Watchdog functional block diagram is shown in Figure 1. When 8 watchdog counter counts up to a maximum value (0xFF), the user can select a watchdog module to reset the CPU by outputting a low pulse through WDRST or generating a peripheral interrupt event through WDINT. In the normal working of the system, in order to avoid the watchdog module generate undesirable pulse signal, the user requires to shield the watchdog module or write sequence 0x55 +0xAA to the counter of the watchdog reset register WDKEY through the software periodically to clear the counter for the watchdog.

The instructions to realize the watchdog function are as follows:

```
Void DisableDog(void) // shield watchdog timer
{
EALLOW;
SysCtrlRegs.WDCR=0X0068;//WDDIS=1,WDCHK=101,WDPS=000
EDIS;
}
Void EnableDog(void)  // shield watchdog timer
{
EALLOW;
SysCtrlRegs.WDCR=0X0028;//WDDIS=0,WDCHK=101,WDPS=000
EDIS;
}
Void KickDog(void) // reset the watchdog timer, clear the watchdog count register
{
EALLOW;
SysCtrlRegs.WDKEY=0X0055;
SysCtrlRegs.WDKEY=0X00AA;
EDIS;
}
```

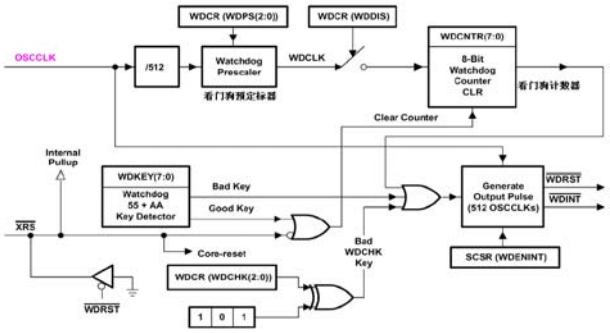

Figure 1 The Watchdog functional block diagram

B. *Software code design*

It is the most thorough and reliable method to use the watchdog to make hardware reset, but after each reset, DSP needs to reload the program code from the EPROM or chain junction, and then initialize. These two steps take a long time, for the monitoring equipment which needs a quick speed appropriately, such a long time to reset is intolerable, it is necessary to avoid or reduce program running phenomenon on the software. Specific practices：

1) In order to achieve the optimization of program execution speed and memory, the mixed code and data are usually stored in the on-chip RAM, but when DSP is interfered from outside, the processing results will be written to the code area, resulting in that the instruction is modified. An improved method for this is to store the code in a specific PM District, besides, only data which require no change can be stored like a fixed coefficient of forms and etc. The allocated data pointer register x should be used carefully, and especially be careful of the usage of circular addressing, set the loop base register Bx and cycle length register Lx promptly.

2) Avoid the use of interrupt nesting and multi-level subroutine call. Under normal circumstances, this is reasonable, but once the program is subject to interference, a stack overflow, the probability of runaway and other anomalies will be greatly increased.

V. CONCLUSION

Importance must always be attached to the basic principles of anti-interference optimization of hardware and software design in design process of DSP system to ensure the normal work of the system. Anti-jamming measures discussed above, are not used in the design of an embedded system at the same time, but selected some of these measures according to the actual situation. Successful anti-jamming design requires not only a certain amount of theoretical guidance, but more accumulation of experience. Only when the two combines, can a system of high-quality, high reliability and continuous stable operation be designed in the short term.

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