Research on Computer System Implementation of ISO14443B Protocol Communication Data Acquisition based on FPGA

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Abstract. As a programmable logic device, FPGA can be used as a bridge for logic adaptation and timing matching between chip components. For example, in a data acquisition system, data of ten channels need to be collected at the same time. In this case, ten identical data acquisition modules can be instantiated in the FPGA to connect ten external data sensor chips respectively by taking advantage of the parallelism of FPGA, so as to realize the logical adaptation of chip devices. In certain applications such as audio processing, video processing, digital communications, encryption, decryption, etc., as a result of the FPGA computing can parallelism, and FPGA is algorithm Yu into hardware, namely a logic gate and a register, so its execution efficiency usually than machine code and assembly language of single thread special micro processing, the need to replace DSP parallel supercomputing occasions and microprocessors.

Keywords: ISO14443B Agreement, Communication Data Acquisition, Computer System, The Empirical Research, FPGA

1. Source and purpose of the project

The full name of IC Card is an Integrated Circuit Card, which has the characteristics of readable and readable data, reliable data record and easy to use. According to the communication mode, IC Card can be divided into two types: contact type and non-contact type. The Contactless IC Card is a new technology developed in recent years. The contactless IC Card consists of IC chip and inductive antenna, which are all enclosed in a standard PVC Card. There is no exposed part of the chip and antenna. Contactless IC card is mainly used in electronic wallet, access control system, canteen charge system, attendance device, ID card and other occasions[1].

Current international organization for standardization (ISO) has established two major non-contact card standard: one is the philips, Siemens TypeA, Numbers for ISO14443A, another is based on MOTOROLA, stmicroelectronics company TypeB, Numbers for ISO14443B. The physical properties of the ISO14443 rules on the card, radio frequency power and signal interface, initialization and conflict prevention features, data transfer protocol. The contactless IC card communication system belongs to the digital communication system. The data interaction between the reader and the IC card goes through three steps: data reading, coding and modulation. IC card sends a signal when the read/write machine, for example, the first internal logic control module IC card will be sent in the
block of data from EEPROM read out, and then the data coding, coding before modulation, the low frequency digital baseband signal from low frequency shift to high frequency, and finally with the antenna coupling will be sent high frequency signal, for IC card read-write machine send signals are the same steps.

In a contactless IC card communication system, the reader provides the electromagnetic field and determines the communication rate of data transmission, such as one of 106Kbps, 212Kbps or 424Kbps; Instead of providing an electromagnetic field, the IC card takes energy from the electromagnetic field provided by the reader and, using load modulation, passes the data back to the reader at the same rate. The rf interface model of the communication system can be approximately regarded as a transformer coupling system, in which the reader is the primary coil and the IC card is the secondary coil. Rf read-write device to non-contact IC card sent by rf radio frequency is fixed, non-contact IC card in the integrated chip inside a LC series resonance circuit module, if the machine to send the resonance frequency of the resonant circuit module and literacy of rf radio frequency, LC resonance circuit can produce makes the resonant capacitor charging accumulate a large amount of electric charge 3. A single to the electronic pump at the other end of the resonant capacitance, resonant capacitance charge to another storage capacitance, when capacitance stored charge to 2 v, capacitance is able to provide follow-up circuit working voltage, subsequent data demodulation module for sending machine will accept, speaking, reading and writing data, the data block stored in the EEPROM; The data modulation module is responsible for reading the data in EEPROM and transmitting the data through the antenna. The resistance of C card antenna becomes the load of the reader antenna loop. When the load resistance changes, the voltage of the current of the reader antenna on the internal resistance will change. The IC card controls the connection and disconnection of the load resistance through the data to be sent, which can realize the amplitude modulation of the read-write electromechanical voltage by the IC card, and the data can be transmitted back to the read-write machine. The reader demodulates and decodes the received signal, and finally sends the decoded data to the background computer.

The so-called data acquisition refers to the process of collecting, selecting and storing data from a signal source, which may be a physical quantity of a non-telegraph signal, such as pressure, temperature, light intensity, water level, humidity, etc., or a signal that is already a telegraph signal, an analog signal, or a digital signal. Signal collection can be divided into contact and non-contact. In principle, no matter which method is adopted, the correctness of the collected data should be guaranteed on the premise of not destroying the normal working mode of the object to be collected. Data acquisition system is widely used in aerospace, aviation, industrial production, military and other fields, which has greatly changed the way people get information and improved the real-time and accuracy of people's access to information.

In terms of structure, the data acquisition system can be generally divided into: data input channel, data input channel can be divided into analog signal input channel and digital signal input channel, analog channel is used for the AD conversion of analog signals into digital signals that can be processed by subsequent modules; Data processing module, data processing module is usually MCU, DSP or FPGA, data processing module is usually used in the input data is compressed, codec. FFT processing such as: finally, the data output channel, in order to further data in the computer of the upper machine, according to the data acquisition system can and computer system through the RS232 bus, USB bus and PCI bus connection, also can such as WIFI, bluetooth, etc and by means of wireless computers to connect.

In this paper, the contactless IC card system of communication signal transmission principle, design a suitable for ISO14443B protocol of data acquisition system, the ability to read and write machine between IC card and the interaction of real-time data acquisition and transmission to the computer after converted into 8 bit binary number, finally through the PC shows data collected.

Through the observation of data, the designer of IC card can find out whether there is wrong communication data of IC card, so as to timely correct the design, which is beneficial to accelerate the DEVELOPMENT cycle of IC card design and reduce the design cost[2].
The non-contact IC card wireless communication system is a digital communication system, and the transmitted data needs to be coded before modulation. Several common coding methods are listed in Figure 1.

![Common coding methods of contactless IC CARDS.](image)

The characteristics of the above three coding methods are summarized as shown in Table 1.

| Encoding mode                  | Advantages                        | disadvantages                                      |
|-------------------------------|-----------------------------------|----------------------------------------------------|
| Reverse does not return to zero coding | Simple and intuitive              | It's easy to lose step                             |
| Manchester code               | Easy to lose step                 | There is a problem of uncertain phase due to the high occupancy frequency band |
| Miller's code                 | No phase uncertainty problem, narrow frequency band | The design of decoding scheme is difficult         |

**2. The research significance of FPGA technology**

FPGA(Field-Programmable Gate Array), which was first invented by Xilinx, was developed on the basis of early Programmable logic devices (CPLD and PAL). FPGA is different from other programmable Logic device, FPGA Logic Cell Array using LCA (Logic Cell Array) between the different ways of connection circuit functions that are required, LCA include CLB programmable Logic module (Configurable Logic BLOCK), such as the OUTPUT module IOB (INPUT OUTPUT BLOCK) and the attachment three part 6. There are a large number of lookup table resources in FPGA, which is called RAM (16 rows and 1 column). Each RAM is connected to the input port of a D flip-flop, which is used to drive other logical circuit modules or connect to IO port, thus forming an independent LOGICAL unit array. Block when the FPGA to electricity, EEPROM data is loaded into the FPGA internal static storage module, static storage module data connection of logic cell array configuration, so as to achieve the function of different logic circuit, block because the EEPROM can wipe, and all data within the FPGA after power-fail without saving, so the FPGA can infinite programming.

In the complicated system development, the FPGA can due to the embedded DSP module and microprocessor kernel, so with certain peripheral port circuit and the software operating environment can be composed of a large system of the basic platform, such as FPGA and computer technology to combination of V4 and V5 series Xilinx FPGA embedded POWER CPU, combined with peripheral circuit on input/output interface, on the basis of this platform, can achieve a basic computer operating system, run LINIX operating systems support. As FPGA becomes more and more mature in terms of technology level, design means and architecture in recent years, FPGA shows more and more advantages in the field of system design and complete machine manufacturing: it doesn't need to change the design of system hardware circuit, but can realize different functions simply by burning...
different firmware. Volume and cost greatly reduced, through the integration of a number of different
IP core, just by a chip, FPGA can meet the requirements of complex system design: to promote the
speed of the machine system and upgrading, alternative ASIC, FPGA was relieved from the late for
layout design and process flow sheet, so as to shorten the development cycle, improve the
competitiveness of the products\cite{4}.

3. The research status
In the early stage, the core processing module of the data acquisition system was mainly based on
single chip microcomputer, and in the later stage, it developed to use special digital processing chip
DSP, FPGA and advanced embedded chip ARM, etc. Data acquisition system with the single chip
processor as the core, the main use of SCM small size, low power consumption, the characteristics
of the control function is strong, flexible expansion, combined with the outside of the different sensor
module and ADC chip, make its can be applied to different occasions, such as the information such as
voltage, temperature, light intensity, distance measurements, is advantageous to the realization of data
acquisition system more portable, intelligent and low power consumption. However, the data
acquisition system based on SCM has some shortcomings. Only by running the software can the
MCU perform the relevant functions, and it takes a certain amount of time for the software to run in
the process of data sampling, while the frequency of the MCU is low, so the efficiency is difficult to
improve, and it is not suitable for the field of high-speed data acquisition. DSP chip has special
hardware multiplication unit, which is suitable for intensive multiplication and addition operation. By
cooperating with programming software, it can be competent for the occasions when FFT algorithm
processing of signals is needed. However, the shortcoming of DSP chip is that compared with other
general microcontrollers, DSP chip's peripheral hardware control capability is weak, so its
adaptability range is limited, and it usually needs to cooperate with other microcontrollers to complete
the requirements of complex system design\cite{5}.

FPGA has the incomparable advantage over single chip computer and digital signal processor, first,
because it recommend suite, FPGA frequency is very high, is now the latest FPGA can support more
than 1 g frequency, run the rate of increase is advantageous to the sampling period is reduced, at the
same time the FPGA can get more data than single chip microcomputer, is again the FPGA parallel
processing characteristics of micro control is different from those of the other, the FPGA rely on its
internal logic resources for work, on the time between each logic module is work in parallel,
Therefore, FPGA is very suitable for the field of data acquisition in parallel. Secondly, FPGA
solidifies algorithm into hardware, that is, logic gate circuit and register one by one, so its execution
efficiency is usually higher than single-thread special microprocessing which executes machine code
and assembly language. Finally, FPGA has the characteristics of SOC system and its composition
form is very flexible. It can integrate peripheral control module, interface control circuit, data
decoding operation module and so on according to the needs of system design\cite{6}.

A great deal of research work has been done on the application of FPGA in data acquisition both at
home and abroad. More and more types of data acquisition system have been designed, with more and
more powerful functions and wider and wider application scope. Although domestic started late
applications of FPGA in the related field, but since the 21st century, is developing very rapidly,
represented by huawei communications enterprises in the communication data of FPGA acquisition
research has reached the international advanced level, in the FPGA data acquisition of high-end
applications such as high-speed image data acquisition, real-time radar signal acquisition, etc., many
universities and research institutes also achieved fruitful results.

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