Implementation of Artificial Intelligence Algorithm

In Embedded System

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Abstract: The development of embedded technology directly affects the development of Internet of Things, and the development of artificial intelligence brings great convenience to people's life. Based on this, the implementation method of artificial intelligence algorithm in embedded system is studied. Based on embedded system hardware configuration and the embedded system software running algorithm is optimized, simplifying the operation steps of the embedded system, improve the effect of embedded system, to strengthen the research of embedded technology, and increase investment in manpower and material resources in embedded system research, learning western advanced technology, and the embedded technology is applied in the Internet of things, to improve the effect of artificial intelligence algorithm in the application of the embedded system. The experimental results show that the artificial intelligence algorithm is applied to the embedded system to improve the system performance effectively.

Keywords: Artificial intelligence, Embedded system, Hardware structure, Embedded technology

1. Introduction

With the rapid development of communication network and integrated circuit design, embedded system has become a research hotspot in IT industry[1-2]. Informatization has become a new industrial system to promote the process of China's industrialization. Embedded system is a kind of computer system combining software and hardware, which can complete some special tasks independently. Integrating advanced computer technology, semiconductor technology, electronic technology and the specific application of various industries, it is a comprehensive system with
technology intensive and continuous innovation of knowledge. This paper briefly introduces the composition of embedded system, analyzes the status quo of embedded system, and prospects the development prospect of embedded system. Embedded system is a special computer system based on application and computer technology. Software and hardware can be customized to meet the strict requirements of application system in function, reliability, cost, volume and power consumption. Embedded system is composed of hardware and software[3]. Hardware includes embedded processor and external devices, and software usually includes embedded operating system and application software. Combining with the principle of artificial intelligence to optimize the embedded system can better ensure the operation effect of the system.

2. Embedded system based on artificial intelligence algorithm

2.1 hardware configuration of embedded system based on artificial intelligence algorithm

With the rapid development of embedded technology, embedded system is also developing continuously. Embedded technology has been applied in more and more scenarios, and plays an irreplaceable role[4]. With the development of technology and the continuous improvement of system performance requirements, embedded system has changed from the previous hardware design to software implementation to achieve more efficient software and hardware co-design. With the development of technology and the requirement of system performance, more and more embedded systems adopt dedicated hardware optimization and acceleration algorithm. This paper combines the specific hardware environment and embedded platform to optimize the embedded environment and improve the recognition performance of artificial intelligence algorithm. Embedded devices are mainly embedded computer systems and related hardware. The core of the system is embedded computer, which is mainly composed of software layer, hardware layer, system software layer and intermediate layer. The software layer mainly refers to the software layer used in embedded system development. The hardware layer mainly includes memory, embedded processor, universal device interface and so on. It is the core module of embedded system. The software layer mainly includes file system, network protocol, graphics and RTOS. The middle layer, also known as the driver layer software, separates the underlying hardware from the system software, making the system device driver independent of the hardware. Based on this, the hardware configuration of the embedded system is optimized[5-6]. The basic structure of the embedded system is shown in Fig.1.
Fig. 1 Basic structure of embedded system

For embedded hardware system, in addition to the central control components, we can also consider the storage, communication, debugging, display and other auxiliary functions to the embedded system[7-9]. The embedded peripherals widely used at present can be divided into three categories according to their functions: memory, communication device and display. At present, there are three commonly used operating systems: multi-channel batch operating system, time-sharing operating system and real-time operating system. In these systems, Linux is a set of operating system based on UNIX. Through the task switching mechanism of the system, a real multi task and multi-user environment is realized. One of the great advantages of embedded operating system. The existing embedded microprocessors have the characteristics of small size, low power consumption, low cost, high performance, online control, support of thumb (16 bit) / arm (32-bit) dual instruction set, large capacity of flash memory, low cost, storage of a large number of intelligent programs, fast execution speed, flexible addressing, high execution efficiency, fixed instruction length and mature hardware conditions of embedded intelligent sensors. At present, artificial intelligence, neural network, fuzzy and other technologies have been successfully applied in many fields, and the commonly used theories are relatively perfect. The intelligent control module is mainly composed of four parts: knowledge base, inference engine, knowledge acquisition program, comprehensive database, and stored in the embedded MCU. In hardware, intelligent theory, software and other aspects of embedded intelligent sensor is completely feasible. Based on this, the master control structure of the embedded system is optimized. The optimized structure is shown in Fig.2:

Fig. 2 Main control structure of embedded system

In the field of computer communication, the embedded DSP processor based on the low-end embedded microprocessor, and the highly integrated embedded chip system based on the high-end embedded DSP processor. The intelligent control module is corresponding to the embedded microprocessor + intelligent control module (artificial intelligence technology, neural network technology, fuzzy technology) + sensing system. It is an intelligent control module integrated with intelligent sensors. It has rich expert knowledge in related fields and can simulate the process of human experts solving problems. It can carry out effective reasoning, has a certain ability to acquire
knowledge, but its overall ability is far beyond the level of professionals, flexible, transparent, interactive, with a certain degree of complexity and difficulty.

2.2 Embedded system software operation algorithm design based on artificial intelligence algorithm

With the continuous development of embedded system, embedded technology has been widely used in various fields, and plays an important role in all aspects of production and life. The definition of embedded system is generally based on application and computer technology. The software and hardware can be customized, which is suitable for special computer system with high requirements of function, reliability, cost, volume and power consumption. Embedded system is closely related to specific applications and has strong pertinence. It can be customized and tailored according to the actual needs, and concentrate the main resources on specific applications, which can play a more effective role in promoting the development of embedded systems[10]. The embedded MCU and embedded software are combined to make the function perfect. Although there is no general embedded system software, it does not affect the intelligence of embedded devices. It can also be developed in a common language such as VC + +. The key of embedded system is application software, which is characterized by high requirements for software storage capacity, high requirements for software code quality and reliability. The implementation of multi task real-time puts forward higher requirements for real-time[11-12]. Based on this, the multi task real-time processing platform of embedded system is constructed. As shown in Fig. 3:

![Fig. 3 Multitask real-time processing platform of embedded system](image)

The embedded system is applied to the field of artificial intelligence. For the core module of the whole system, the embedded system sends the artificial intelligence information to the embedded system for analysis and processing, and finally processes the results according to the predetermined instructions. In this system, the optical module first completes the collection of artificial intelligence information, uses the digital module to convert the artificial intelligence information into the signal format that can be processed by the embedded system, and then transmits these digital signals to the core module for processing. Using artificial intelligence processing algorithm, according to the elements of artificial intelligence, the required artificial intelligence features are obtained, and extracted from the system positioning module for processing and analysis, and then output and execute
control according to the predetermined target value. When the acquisition time is set to A, the information collection can be accurately described by the results of linear equations[13].

\[
B = \frac{(B_2 - B_1)}{(A_2 - A_1)} X + \frac{(B_1 A_2 - B_2 A_1)}{(A_2 - A_1)}
\] (1)

In the formula, A1 and A2 are the start time of information collection, and B1 and B2 are the values of the start time of information collection. Using the data calculated by linear equation to describe the state of information acquisition, the software design of mobile network information intelligent acquisition system based on Embedded MCU is realized. The prediction output \(y_m(k)\) of the model consists of two parts. One part is the free response to \(Y_i(k)\), that is, the input response is 0. This depends entirely on the control of the past moment, and has nothing to do with the control of the current and future moments. The other is the forced response, that is, \(y_f(k)\), which is equivalent to zero state response, is the model response added after the control function is played. The newly added control function can be expressed as a linear combination of several known functions fn in predictive functional control[14]. Based on this, the predictive functional control algorithm is optimized as follows.

\[
u(k + i) = B_t \sum_{n=1}^{N_f} \mu_n \bar{f}_n(i), i = 0, 1, \ldots, N - 1
\] (2)

Where, \(n\) is a basis function, \(f_n(i)\) basis function value, \(t_s\) is a sampling period, \(N_f\) is the best prediction length in time domain, \(U_n\) is a linear combination coefficient. The selection of the basis function depends on the characteristics of the control plant and the set values such as the expected step size, slope and exponential function. Therefore, for the selected basis function, the forced response output can be calculated offline:

\[
y_f(k + i) = u(k + i) \sum_{n=1}^{N_f} \mu_n \bar{f}_n(i), i = 0, 1, \ldots, N - 1
\] (3)

Where, \(g_n(i)\) is the model output of \(f_n(i)\). Based on this, the model prediction output function is standardized

\[
y_m(k) = y_f(k) + y_i(k)/y_f(k + i)
\] (4)

Embedded application software is different from ordinary application software. It selects specific hardware platform according to specific application scenarios, and allocates specific hardware resources according to user’s expected demand. For the development of embedded application software, we usually use the reliable embedded operating system, which not only ensures the real-time performance of all kinds of work, but also ensures the stability of running time, so as to minimize the resource consumption of various systems.

2.3 Optimization of embedded system operation process based on artificial intelligence algorithm
The emergence of intelligent sensor technology is inseparable from the application of embedded technology. The combination of embedded technology and traditional sensor makes the sensor have the function of calculation, communication and intelligent judgment. The embedded program can not only connect to the Internet, but also realize the communication function. With intelligent algorithm, there will be intelligent sensor of Internet of things, and with embedded system, there will be intelligent algorithm. Therefore, embedded technology plays an important role in the Internet of things. Software and hardware collaborative synthesis is to optimize the target by inputting function application and constraint conditions described by a certain model, determine the system calculation, communication resources and task allocation, map drawing, processing, voltage adjustment, etc., and finally obtain the optimized system software and hardware structure. For different architectures such as single processor, dual processor, multi-core / multi-core system, it is necessary to study the algorithm. At present, the application of embedded system is developing rapidly, and the development of embedded system is also increasingly urgent. At present, most embedded products can not meet the needs of practical application. Generally speaking, the embedded artificial intelligence system is based on the embedded platform, which includes graphic acquisition equipment, artificial intelligence processing equipment, artificial intelligence display equipment and artificial intelligence processing equipment. In order to ensure the operation effect of the system, the information collection process of embedded system is optimized based on the principle of artificial intelligence.

![Fig.4 Information collection flow of embedded system](image-url)
Because the system level synthesis of embedded system needs the co design of software and hardware, this paper calls it hardware / Software Co synthesis or system integration, the meaning of both is the same. Firstly, the function, performance and limitation of embedded system are introduced, and the system is described by natural language, formal language and task diagram. The architecture selection or allocation step is used to determine the computing and communication resources of the system. These resources can be selected from the existing fixed platforms, or the system architecture is composed of various components such as processor, memory, communication unit and special hardware accelerator. The optimization design of embedded system operation process is usually as follows.
Fig. 5 Optimization of embedded system operation process

In order to realize the automatic design of embedded system, efficient optimization algorithm should be worked out according to the specific steps of system synthesis and the limit of design parameters. In general, sub problems such as assignment and mapping are NP hard in solving space. If tasks are independent constants, they interfere with each other in their life cycle and interval. The task priority algorithm is calculated. In order to realize the automatic design of embedded system, it is
necessary to design an efficient optimization algorithm and consider the specific synthesis steps and the limitation of design parameters. Generally speaking, the subproblems such as assignment, mapping and processing belong to combinatorial optimization problems with large solving space and multiple problems. Many optimization algorithms have been studied and applied. When the cycle value is \( a \), the priority of the task is \( r \), and the number of tasks to be processed is \( n \). on this basis, the task is processed by combining artificial intelligence and processing management technology. If tasks are independent constants, they will not interfere with each other during their respective lifecycles and time intervals. On this basis, the task priority algorithm is solved[15].

\[
A \leq y^m(k) + a(\sqrt{2r} - 1)
\]  

Based on the above algorithm, the idle time \( d(t) \) of task margin is further standardized. If \( E_i(t) \) represents the execution time of the task on the CPU of the real-time operating system, and \( I_i \) represents the deadline of the task in the system, we can get the time point sorting algorithm of tasks on each path as follows

\[
L_i(t) = A \sum \lim_{t \to \infty} \frac{d_i(t) - E_i(t) - i}{A\sqrt{2r} - 1}
\]

Based on the theory of artificial intelligence, the operation parameters of embedded system are standardized to judge whether the assigned tasks in the system can be centrally processed. In order to ensure that the scheduling limit of tasks is proportional to the resource utilization rate, so as to realize the monotonous processing of the system operation ratio, based on the artificial intelligence dynamic task priority change algorithm. According to the above analysis, it is found that the advantage of artificial intelligence algorithm lies in the high utilization rate of system operation, so as to realize the monotonous processing of task processing ratio. Step system running effect.

3. Analysis of experimental results

The test environment settings are as follows: first, add virtual machine or ware and kuntu2.0 operating platform to the real-time operating system terminal PC, set 30 processing tasks randomly, and set the processing delay performance. Based on the embedded principle, the delay allocation function is calculated in the processing algorithm. Next, add an internet-core2. 6CPU@1.6GHz Processor, der21gb system memory. Users will choose Windows 8 development platform and Windows Server 2007. The sensor hardware structure is simple by using six bit single chip microcomputer and 256 bit programmable memory. Using 10 KB ram and 12 bit digital signal converter, the transmission speed of information in mobile network is improved. Using mcs1210 as the main chip of embedded MCU, only a small number of external receiving components can form a multi node sensing network. In order to verify the accuracy of the embedded system, compared with the traditional system and the system, regression test results are shown in the figure.
It can be seen from the figure that the system can simulate the running environment of embedded application software and realize dynamic identification of software and hardware by combining with fault injection technology. It has better performance and has more advantages than traditional test behavior and function. This design can simulate the running environment of embedded system and promote the operation of embedded application software. Compared with the traditional test behavior and function, this design has higher software test performance and better guarantees the running effect of the system.

4. Conclusion
With the development of computer software technology and the continuous improvement of embedded processor performance, a variety of commercial embedded operating systems emerge in endlessly, among which microprocessor accounts for a large proportion. Many embedded operating systems have been widely used. In recent years, the rapid development of Internet has created a huge application space for embedded systems. Due to the rapid development of embedded system, the requirements for it are higher and higher. The technology of intelligent embedded system. It can effectively improve people's work efficiency and quality of life, which is the development direction of embedded system in the future.

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