Design and Implementation of Embedded Intelligent Control System Software Programming Based on Genetic Algorithms

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Abstract. Embedded system has been widely used in the fields of production, life and automatic control with its superior performance since it was developed, and it is developing towards a more convenient and intelligent direction. Because of the limited target machine resources of embedded system, it is impossible to build a huge and complex development environment on it, so its development environment and target operating environment are separated from each other. The application program is downloaded to the target machine for cross-debugging. After debugging, the application program is downloaded to the target machine for cross-debugging and debugging. The intelligent control is used to generate the change value of the controller parameters, so that the parameters of the controller are adaptive and robust. Through the modular design idea, the modules are relatively independent, which is convenient for software programming and debugging. In genetic algorithms, after coding to form the initial population, the task of genetic manipulation is to impose certain operations on the individual's fitness assessment according to their degree of adaptation to the environment.

1. Introduction
Embedded Operating System (OS) is a widely used system software. It has real-time commercial efficiency, strong hardware dependence, and converts human control experience expressed by natural language values into control parameters within the allowable range through qualitative rule controller, so as to achieve stable control of the controlled object [1]. Systems with basic linear and dynamic characteristics that do not change with time can be better controlled, while many processes are non-linear or time-varying. Secondly, the parameters must be tuned according to the dynamic characteristics of the process. If the dynamic characteristics of the process change, for example, the dynamic characteristics of the system may change due to the change of load [2]. The dynamic stack extension mechanism of general operating system can not be used in most embedded systems. At the same time, it is not advisable to over-supply stack resources in the case of unpredictable actual demand. [3]. Therefore, if the optimization of controller parameters and identification of system model parameters can be carried out simultaneously and promote each other, it will be helpful to the design and application of digital servo system [4]. As for the genetic algorithm application embedded intelligent control system software programming design, because the genetic algorithm has search-independent information when searching for the optimal solution, it automatically acquires and accumulates knowledge about the search space in the search process, and adaptively controls the search. Process [5]. After analyzing and organizing the system, forming control commands that mimic the employee's ideas to achieve intelligent control operations is the job of a professional computer personnel. Intelligent control, also known as fuzzy control [6]. Everything the object has to do, it doesn't know who is receiving the signal at the other end. This is the true information encapsulation that ensures that objects are used as a real software component [7].
The controller is the core of the whole system, which consists of the former cloud generator and the latter cloud generator, and extracts the characteristic parameters from the happening events. It can run on various types of microprocessors, and has good compatibility, small kernel, high efficiency, high modularity and expansibility. It has file and directory management, device support, multi-task, network support [8]. Embedded intelligent control system makes full use of intelligent control system to realize a more complex mathematical calculation. The response under excitation is simulated and the objective function value of the control parameters is calculated. The control parameters of chromosome are taken as the controller parameters, and the model parameters of each individual are taken as the model parameters [9]. It can satisfy constraints and vector functions composed of objective functions. These scalar functions form descriptions of the designed performance indicators, and they often conflict with each other. Slots are used to receive signals, but they are common object membership functions [10]. A slot does not know if any signals are connected to itself. Moreover, the object does not understand the specific communication mechanism. The overall development trend is faster speed and better performance. In addition, embedded microprocessors have the advantages of small size, light weight, and low cost [11]. So that the agent can use it. If the reinforcement learning system is perfectly able to obtain all the information in an environment that can influence the system's choice and execution of actions, then the choice of reinforcement learning actions is based on these environmental states [12].

Genetic algorithm is a set of multiple designs, some of which can not solve the optimal decision-making problem, and some can be regarded as special cases of adaptive dynamic programming [13]. Embedded processor is the hardware part used to control and assist the operation of the whole system. It is the central link of the whole embedded system. Therefore, in the whole embedded system, the processor is the central link [14]. As far as processors in the international market are concerned, they belong to more than 1,000 categories of embedded functions. It is possible to connect many signals to a single slot, or a single signal to many slots, or even to connect one signal to another [15]. In the entire control system, the precise mathematical model and the internal structure of the control object do not need to be known, and the adaptability of the system is greatly enhanced [16]. Model parameter identification and control parameter optimization are required to be synchronized. That is, when each generation of control parameters is optimized, the simulation model of the controlled object should be the model parameter of the latest generation estimated to gradually approach the real system [17].

Web servers have become remotely managed, especially those that do not have a traditional user interface (such as the embedded smart terminal designed in this article). The web browser can communicate with the remote device and display the corresponding data. The micro operating system and control application software embedded in the memory jointly implement various automatic processing tasks such as real-time control, monitoring, management, mobile computing, and data processing. At its core is the embedded microprocessor [18].

2. Materials And Methods

Embedded systems are usually application-centric and based on emblem processors. Software and hardware can be tailored for applications where reliability, cost and power requirements are stringent and objects are specialized [19]. The sensor obtains the controlled variables and outputs the corresponding analog signals; the converter collects the output signals of the sensor and converts them into digital signals; the intelligent controller (cloud controller) according to the input parameters. Many controlled processes have complex mechanisms, such as high nonlinearity, time-varying uncertainty and large delay. Under the influence of noise, load disturbance and other factors, process parameters and even model structure will change. Embedded technology has not affected its advantages and functions, which has become the main reason for its widespread acceptance. Embedded system, which is based on core links, can fully realize multiple tasks and processes of memory protection. In addition, embedded systems are mostly driven by interrupts, and stack detection needs to initiate simulation interrupts. The difference between simulation results and actual situation will lead to inaccurate detection results. The response under excitation is simulated and the objective function value of model parameters is calculated [20]. The objective function of the model parameters is a function of the error between the point output
sample value and the corresponding point simulation output value. Because evolutionary computing has the adaptive characteristics of natural systems, the trade-off between efficiency and efficiency allows it to adapt to different environments and achieve better results. As a different focus, the standard model of the rule is a set of output fuzzy sets; for the latter, the input variables are a linear or linear combination. Intelligent embedded control design parameters are shown in Table 1 and Figure 1.

Table 1. Design parameters of intelligent embedded control

| Control       | Coordinate |
|---------------|------------|
| Kernel core   | 19.75      | 13.19      |
| startup code  | 18.64      | 12.32      |
| Device driver | 19.88      | 13.24      |

Fig.1 Design parameters of intelligent embedded control

Embedded systems are limited to a certain extent in the development process. For example, if they lack the support of software operating system, they can only achieve very simple design functions. The selection of parameterized network is closely related to the performance of the system, so the selection of parameterized network becomes very important. According to different system performance requirements, different choices can be made. The design of the program is to build the connection of the database, set up the connection attributes, and shut down the database in time after the user uses it. The other is to formulate the query conditions. Defects are introduced in the design and coding phases. When these defects are found and eliminated, more time is needed for redesign and re-coding. More defects will also be introduced during this period. Genetic algorithm enhances the adaptability of population by self-organizing behavior such as natural selection and genetic operation. Genetic algorithm simulates a process and implements it. Interruption block plays a very important role in the whole system. It mainly plays the role of interruption, making the whole system consistent with the expected time. Evolution is achieved in the environment through the natural selection mechanism of survival of the fittest. Similarly, the first generation solution in the genetic algorithm is randomly generated, and then the evolution is evaluated by the evaluation of the selection, the intersection, and the mutation operator, and the optimal solution is gradually approached. Self-style interrupts can also be divided into periodic interrupts and aperiodic interrupts. Periodic interrupts are interrupts that are automatically triggered according to a certain period of time, such as clock interrupts and timer interrupts. System components interact directly with the system environment, and the only way to communicate between them is through indirect methods. In the system consisting of the latter, on the contrary, some or even all system elements can interact.
In the design process of embedded system, we should divide the problem into tasks one by one. Each task is a part of the application and completes some functions. They are given a certain priority and have their own set of registers and stack space. Embedded operating system as the development platform, which greatly improves the development efficiency and software performance. In order to initialize the system, it is a common practice to use an assembly file as the startup code. Interrupt-driven embedded systems generally use state machine modeling to extract the state transition matrix of interrupt-related state transition relations in the state machine. The process of using genetic algorithm to optimize is to find the extremum of evaluation function. The fitness function is a function that maps the evaluation function to facilitate the comparison of individual size and selection, crossover and mutation operations. The operation of network database includes two parts. The first part is to set up virtual directories for running network servers. The virtual directories are mainly for restricting access rights; they can be expanded more quickly; they have the function of setting up and supporting the network at will; and they can be applied and developed quickly to achieve independent research and development and thus to enhance the comprehensive competitiveness of the market. To port the development work environment to a personal computer, you only need to download the program compiled on the personal computer to the development board, and it can run normally, which can improve people's work efficiency. Such a technique is cross-compilation technology, and the tools used are called cross-development tool chains. The converter is the interface between the analog signal source and its connection. Its task is to convert continuously changing analog signals into digital signals for processing, storage, control and display by computer and digital systems.

Because the software running space in embedded system is limited and the memory space is very precious, we must always consider the efficiency of the software in the process of software programming, and select high-quality compiler tools at the same time. The fully decentralized way of scheduling task independent heterogeneous resources using genetic algorithm is given. The genetic algorithm is used in scheduling applications. In this event, computing nodes can connect and leave the system. The system uses dynamic Web service lookup as a dispatcher. This emphasis makes task sets and heterogeneous sub-parts. In addition, the algorithm runs in each sub-part. Schedule the requested user. Data monitoring and scheduling requests are obtained through the use of grid monitoring services. When a program is executed, the maximum value of a line is recorded. When a logical line is executed, the pointer points to the first input functional element of the first line of the next logical line, which is executed sequentially. Tasks are divided into priority levels, and sub-tasks with the same priority can execute different grid nodes in parallel. At the beginning of the task-level prerequisite, the execution sub-task level is completed and the result is returned. This is followed by when the grid nodes leave the grid and we have to rearrange all the subtasks. Use again. Once the previous results of all task-level priorities are returned to the original node, the next sub-task priority is executed in parallel at the beginning. The subtasks are executed in parallel to the individual mesh nodes at the same priority level, as shown in Figure 2.

Fig.2 Sample task
3. Result Analysis and Discussion

Because the data and signals of different production lines need to be monitored are quite different, the system platform should provide as many protocols as possible to transmit different data and signals. The project of more intelligent embedded systems, i.e. fully programmable and more intelligent systems, is dedicated to providing hardware and software programming products as well as complete intelligent systems. Most real-time operating systems are based on priority scheduling algorithms. That is, each task is given a certain priority, and the CPU always performs the highest priority task in the ready state. However, each dimension is independent, so the analysis of the algorithm can be simplified to one dimension. In order to simplify the calculation, it is assumed that the location of the optimal solution found by the particle itself and the optimal position found by the whole population remain unchanged. All test data in the same equivalence class have the same test objectives, and select a group of representative data as the sub-region, which can effectively reduce the test data. The fitness function evaluation is the basis for the selection operation. In the specific application, the design of the fitness function must be combined with the requirements of solving the problem. In general, it can be derived from the objective function that solves the problem. Multi-segment multi-decision process After the decision-making system process with time as the variable, the decision of each stage of the system is obtained according to the current state of the system, and the decision obtained at the same time immediately causes the current state to shift to the state of the next moment. The decision process is shown in Table 2 and Figure 3.

Table 2. Multi-stage and multi-decision process

| State          | Policy decision |
|----------------|-----------------|
| Stage variables| 15.33           |
| Time variable  | 14.50           |
|                | 16.18           |
|                | 17.26           |

Software programming design of embedded intelligent control system. According to the situation of embedded intelligent control system itself, the system adopts the control method combining centralized control with distributed control. Java multi-threading technology can ensure good real-time performance for monitoring the production process. Production managers can control the instructions and directly control the field equipment. In order to improve decision intelligence, the network transmitting key information must be intellectualized. Intelligence and analysis functions should be integrated in the whole network domain to answer the questions of intelligent decision-making, to make applications with high throughput and low latency, or to provide mission-critical data. Objects can be divided into two different situations: out-of-process and in-process. If you choose an out-of-process situation, you can run on the same process space or the same device. It can realize interface control and data processing of peripheral interface. By using bus technology to communicate with microcomputers, the speed is much higher than that of plug-in mode, and it can meet the requirements of real-time control system. The
realization of multi-task operation depends on switching and scheduling among many tasks. Task scheduling is to decide which task to run, which is one of the main responsibilities of the kernel. Every task is an infinite cycle. Each task is in a state in which one of the following states is a sleep state, a ready state, an active state, a suspended state, waiting for an event to occur, and an interrupted state, and the sleep state is equivalent to the task being resident in the memory. However, it is not scheduled by the multitasking kernel. For complex intermediate units, it can be converted into an independent state transition matrix, so that the interrupt transition relationship of the embedded system specification can be composed of multiple state transition matrices with a certain hierarchical structure.

The goal of learning is defined by a concept called reinforcement function, which is a function that maximizes the sum of future benefits of an agent. The application of the design can make the requirement of intelligent control function management easy to be realized in related fields, and the combination of software and hardware system can truly realize embedded products. The idea of programming is to assign the tasks of the software, and the contents of each module are independent of each other. The priority-based genetic algorithm is used for each task in the system function module. In each logical line, the same row of functional elements point to the left and right connecting elements, and the connecting elements point to the left and right functional elements; the upper row of connecting elements in the same column points to the next row of connected components, and the next row of connected components points to the previous row of connected components. When a function is defined as an ISR, the compiler automatically adds the interrupt on-site stacking and popping code required by the interrupt service routine for the function. In order to obtain better rising section characteristics and improve the dynamic quality of the controller, the output of the fuzzy controller can also be segmented, that is, when the deviation is "large", the absolute quantity of the control quantity is output, and when the deviation When "small" or "medium", it is still output in increments of control.

In order to test the robustness of the controller, a disturbance of magnitude is added to the output of the controller at sampling time. The corresponding response results are shown in Figure 4.

![Fig.4 Response result](image)

Shared memory is the common resource of the front-end interface process and the back-end intelligent algorithm process. Through it, data exchange between processes can be realized, and then the control and coordination of data reading and writing can be realized. When each program is executed, it can be considered a task. In addition, a special dispatcher is used to allocate and schedule tasks. The system is similar to a multi-task and timely operating system. Rotation can be used for the allocation of various tasks. Through selection, crossover, mutation and other operations, the trigger frequency of each interrupt is updated by continuous evolution. Running state task refers to the control right of the task. Suspended state in operation can also be called waiting event state. It means that the task is waiting for an event to occur, if interruption occurs, it will provide corresponding interruption service. The difference between defining variables and declaring variables is that defining operations that generate memory allocation is the concept of assembly phase, whereas declaring only tells the module containing the declaration to look for external functions and variables from other modules in connection phase. Extensible and customized high performance computing solutions. The inherent parallel structure of the architecture is suitable for high throughput data processing and software acceleration. Supports many
high speed parallel and serial connection standards. In particular, it provides an open communication protocol. On the basis of multi-tasking operation and real-time performance, the system can connect different control buses and transmit information to other substations through the network. Preprocessing the data by its own CPU reduces the probability of the host, improves the effective data storage space of the host, and disperses the risk of failure of the host relative to the virtual mode. Software programming of the embedded intelligent control system is realized through parameter adjustment and setting of the user interface and genetic algorithm.

By defining a serial interface, the corresponding memory structure can be determined. When a component object class inherits an interface, it inherits the memory structure. However, this memory structure is allocated only when the component object class implements this interface. From the point of view of software programming, genetic algorithm can compile well according to the logical relationship, scan all paths in the logical line along the positive direction only once according to the principle of depth first, and do not take repetitive paths. Modular design, according to different application requirements, chooses different hardware interfaces, guarantees low power consumption of the system, adapts to various complex environments, versatility and other characteristics. In this way, debugging and modification are very convenient. The remaining problem is the running environment for each subroutine or function. Structured programming language, in the division of modules, mainly based on functions, calls the task stack initialization function to initialize the task stack structure. The cost function's derivation of the input vector. In order to do this, you need to find a function that reflects the derivative of the cost function of the system state. In the structure, the implementation of the network is the same. The stack depth detection module returns the test results to the genetic algorithm module. Each individual is evaluated according to the fitness function, and then selected, crossed, and mutated to form a new population. According to the system requirements, the allocation timer is the highest priority, and the bus priority is second. When the system is running, the system performs scheduling of various tasks according to different situations, performs task queue sorting, and executes each task separately.

4. Conclusion

In this paper, the software programming design and implementation of embedded intelligent control system based on genetic algorithm are studied. Embedded processor is the core hardware for system control and operation. It has the advantages of fast speed, strong performance, low cost, portable and so on. All kinds of component objects can realize the specification of component model through different types of interfaces and characteristic functions in interfaces. Embedded technology has become an important element in the field of modern control, especially in intelligent control, playing an important role. With the continuous development of controller parameter tuning methods, we are required to make full use of the known information of the system to obtain better controller parameter tuning values and robustness of the controller itself. The purpose of simulating object-oriented thinking is not to simulate the behavior itself, but to solve the problem that the overall framework structure of the program is scattered, data and functions are disconnected when programming is used in some cases. It reduces the number of conversions between communication protocols, making the connection between the user and the scene more intuitive. A fully open bus network is realized, which can increase and decrease the hardware and replace it, and strengthen the autonomy and independence of each node.

References

[1] Sahingoiz, Koray O. Generation of Bezier Curve-Based Flyable Trajectories for Multi-UAV Systems with Parallel Genetic Algorithm[J]. Journal of Intelligent & Robotic Systems, 2014, 74(1-2):499-511.
[2] Ali S., Kim D H. Optimized Power Control Methodology Using Genetic Algorithm[J]. Wireless Personal Communications, 2015, 83(1):493-505.
[3] Nassif, Nabil. Modeling and optimization of HVAC systems using artificial neural network and genetic algorithm[J]. Building Simulation, 2014, 7(3):237-245.
[4] Li N, Su Z, Bi Z, et al. A supportive architecture for CFD-based design optimisation[J]. Enterprise Information Systems, 2014, 8(2):246-278.

[5] Wei H, Tang X S, Liu H A genetic algorithm(GA)-based method for the combinatorial optimization in contour formation[J]. Applied Intelligence, 2015, 43(1):112-131.

[6] Chang H C, Liu T K. Optimisation of distributed manufacturing flexible job shop scheduling by using hybrid genetic algorithms[J]. Journal of Intelligent Manufacturing, 2015:1-14.

[7] Khan A, Jaffar M A. Genetic algorithm and self organizing map based fuzzy hybrid intelligent method for color image segmentation[J]. Applied Soft Computing, 2015, 32:300-310.

[8] Lopez-Garcia P, Onieva E, Osaba E, et al. A Hybrid Method for Short-Term Traffic Congestion Forecasting Using Genetic Algorithms and Cross Entropy[J]. IEEE Transactions on Intelligent Transportation Systems, 2015, 17(2):1-13.

[9] Takeyasu K, Kainoshio M. Optimization technique by genetic algorithms for international logistics[J]. Journal of Intelligent Manufacturing, 2014, 25(5):1043-1049.

[10] Kanarachos S., Kanarachos A. Intelligent road adaptive suspension system design using an experts’ based hybrid genetic algorithm[J]. Expert Systems with Applications, 2015, 42(21):8232-8242.

[11] Borangiu T, Raileanu S, Trentesaux D, et al. Distributed manufacturing control with extended CNP interaction of intelligent products[J]. Journal of Intelligent Manufacturing, 2014, 25(5):1065-1075.

[12] Vanti C V M, Leite L C, Batista E A. Monitoring and control of the processes involved in the capture and filtering of biogas using FPGA embedded fuzzy logic[J]. IEEE Latin America Transactions, 2015, 13(7):2232-2238.

[13] Hamza M F, Yap H J, Choudhury I A. Recent advances on the use of meta-heuristic optimization algorithms to optimize the type-2 fuzzy logic systems in intelligent control[J]. Neural Computing and Applications, 2015, 28(5):1-21.

[14] Asadzadeh, Leila. A local search genetic algorithm for the job shop scheduling problem with intelligent agents[J]. Computers & Industrial Engineering, 2015, 85:376-383.

[15] Modeling and Sliding Mode Control of a Micro Helicopter-Airplane System[J]. Journal of Intelligent & Robotic Systems, 2014, 73(1-4):469-486.

[16] Tarokh M, Zhang X. Real-Time Motion Tracking of Robot Manipulators Using Adaptive Genetic Algorithms[J]. Journal of Intelligent & Robotic Systems, 2014, 74(3-4):697-708.

[17] Ghanim M S, Abu-Lebdeh G. Real-Time Dynamic Transit Signal Priority Optimization for Coordinated Traffic Networks Using Genetic Algorithms and Artificial Neural Networks[J]. Journal of Intelligent Transportation Systems, 2014:1-12.

[18] Juang J G, Yu S T. Disturbance encountered landing system design based on sliding mode control with evolutionary computation and cerebellar model articulation controller[J]. Applied Mathematical Modelling, 2015, 39(19):5862-5881.

[19] Faliszewski P, Sawicki J, Schaefer R, et al. Multiwinner Voting in Genetic Algorithms[J]. IEEE Intelligent Systems, 2017, 32(1):40-48.

[20] Gong D, Wang G, Sun X, et al. A set-based genetic algorithm for solving the many-objective optimization problem[J]. Soft Computing, 2015, 19(6):1477-1495.