

Research on data exchange methods of different communication ports

Xingguo Qiu^a, Jingang Wu^b

College of Computer Science and Technology, Xi'an University of Science and Technology, Xi'an, China

^a304952426@qq.com, ^bjingang01wu@yahoo.com

Keywords: Multi interface, Periodic task scheduling, Data exchange

Abstract: With the development of information technology, people pay more and more attention to the safety production of coal mines, and the requirements for safety monitoring in coal mines are getting higher and higher. A variety of monitoring devices have emerged, but due to factors such as the environment on the coal mine, the communication methods of these monitoring devices are also diverse. In a monitoring system, it is often necessary to access monitoring devices of different communication modes, such as serial port mode, Ethernet mode, 3G/4G network mode, short message mode, etc.^[1]; and each communication mode has multiple monitoring equipment, then how to manage these various monitoring equipment in a system is the problem to be studied.

1. Introduction

This paper uses three layers of design architecture, scheduling layer, exchange layer and communication layer, as shown in Figure 1. The communication layer is responsible for data reading and writing with each interface, the exchange layer is responsible for data exchange between the communication layer and the scheduling layer, and the scheduling layer is responsible for the cyclic scheduling of each measurement point. This paper mainly studies how the dispatching layer schedules each survey point with different inspection cycle, and does not involve the data reading and writing part of the communication layer.

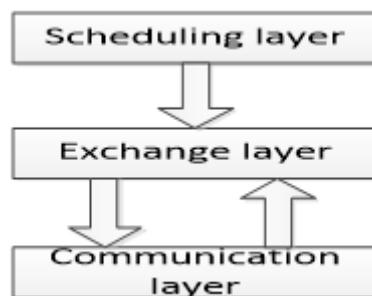


Figure 1 Structure diagram

2. Research on the problem

2.1 Problem decomposition

The mechanism of processor scheduling is referred to in the point scheduling problem. Processor scheduling means that when the number of programs (processes) to be executed is more than the number of processors, the system dynamically allocates processors to a process in the ready queue according to some algorithm to execute. In a reasonable analogy, we compare the test points to jobs (processes), the communication interface to processors, and the time that the thread stays on the communication interface to the execution time of jobs on processors. The problem is similar.

Of course, after analogy, the scheduling of measurement points also has some characteristics: jobs are periodic, and there is no correlation between cycles; job execution processor is fixed; job execution can not be interrupted. According to the fixed feature of the job execution processor, the

problem can be divided into those points to those interfaces and the interface belonging to this point how to schedule periodically.

2.2 Measuring point task and processor

On the issue of how to send the measured point information to its corresponding communication interface, referring to the principle of router protocol, according to the routing protocol, the received IP protocol is forwarded from the appropriate port of router [2].

There are many kinds of routing protocols, but their protocol messages all have some contents: target network address, subnet mask, next hop address and so on. It contains the contents of where and where data come from. According to this idea, the protocol data as shown in Table 1 is designed.

Table 1 Datagram protocol table

Protocol header	Interface address	Data information
-----------------	-------------------	------------------

In data packet, protocol header is used as the symbolic data to distinguish whether the data is legitimate [3]. The interface address is closely followed by protocol header, which interface should the data information part of the data packet be sent to, and the data information is the content to be sent to the interface. According to this form of message, the intermediate switching layer can send data to the corresponding communication interface.

2.3 Periodic task scheduling for known processors

For periodic task scheduling problem, many direct solution and search-based scheduling algorithms have been proposed. On the issue of schedulability of periodic tasks, the related periodic tasks and non-related periodic tasks are mentioned in [4], which refers to how to schedule irrelevant tasks to multi-core on-chip systems. It puts forward a mathematical model of periodic tasks, and then analyses it based on this mathematical model, but there are still many adaptations to solve the problems in this paper. This paper refers to its mathematical model and ideas, carries out modeling analysis to solve the problems in this paper.

Define task set $M=\{N1, N2, N3, \dots, Ni\}$, M contains I periodic tasks, each task is independent and irrelevant. Ni denotes the first task, where each task is represented by a triple, i.e., $Ni=\{ai, ti, Pi\}$, where ti denotes the execution time of the task, Pi denotes the cycle time of the task, and AI denotes the start time of the task. The periodic task Ni is distributed on the timeline of its fixed processor as shown in Figure 2:

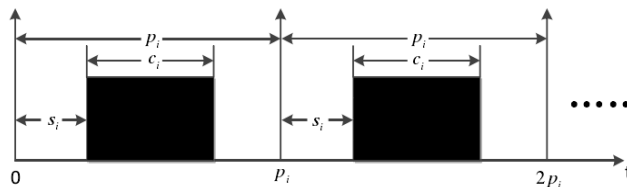


Figure. 2 periodic mission model diagram

Then, by studying the schedulability of the eigentask [5], the schedulable analysis of the original task is carried out. The condition that the task can be scheduled is that the execution time of the task is less than or equal to the corresponding continuous idle time of the intrinsic task of the task.

Connecting with the problem in this paper, the schedulability of the task is analyzed. Because the task that needs to be scheduled in this paper is schedulable in practice, and the execution time of the task on the communication interface is much shorter than the period time of the task, so it is schedulable.

After the schedulability is determined, the next step is how to schedule. Define the set $M=\{N1, N2, N3, \dots, Ni\}$ of the periodic tasks at the measuring point, and the order of $N1, N2, N3, \dots, Ni$ is ascending according to the task cycle. If the time unit of coordinate axis is 1 and the execution time of task Ni is 1, the arrangement of task $N1$ on the time axis can be shown as Figure 3:



Figure. 3 Periodic task distribution

On the basis of Figure 3, N2 is arranged on the time axis as shown in Figure 4:



Figure. 4 Periodic task distribution

Arranged sequentially, when the time axis is 0 to + all the periodic tasks on the top will also show periodicity, and this periodic period is $T = \text{LCM}(a, b, \dots)$, where a, b, \dots is the non-repetitive period of all the periodic tasks, and $T = \text{LCM}(a, b, \dots)$ is the minimum common multiple of a, b, \dots . For example, the set of tasks cycle of a point task is $Mt = \{2, 2, 4, 8, 11, 11, 11\}$, then $T = \text{lcm}(2, 4, 8, 11) = 88$. That is, periodic T is the smallest repeating unit on the time axis.

At this point, we find out the minimum repetitive unit of task set M distributed on the time axis, and then apply it to practice. Since the periodic task of measuring point satisfies the execution time t and the periodic P of measuring point, it can be treated as an intrinsic task. The minimum repetitive unit L of intercepting task set M distributed on the time axis is sorted according to the period L of the periodic task of the measuring point. When the starting time of multiple measuring point tasks is the same for the period L , the repetitive measuring point will not appear when the execution time of each measuring point is longer than that of the periodic measuring point, because it satisfies $t \leq P$. The minimum cycle time is condition (1), Therefore, when arranged in a small range according to the size of the period, the original order will not be affected, that is, Figure 4 becomes as shown in Figure 5

$$\sum_{1}^n t_n > P_{\min} \quad (1)$$



Figure. 5 Periodic task distribution

After the sorting is completed and the position of periodic points on time segment L is recorded, the position between adjacent points is changed. If not 0, the interpolation is put between adjacent points to form a new sorting queue S . Then set up an annular list, put the sorting queue S into the linked list, as shown in Figure 6. Then according to the time slice theory transformation method [6], when the head of the table is the measuring point, the dispatcher waits for the time difference. This completes the periodic scheduling of measuring points

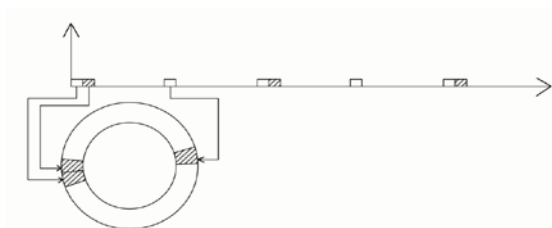


Figure.6 Queue list correspondence

In the process of scheduling, in order to prevent conflicts between other threads in the process and the switch layer when they operate on the communication interface. In paper [7], a polling strategy relying on the status of master and slave devices is proposed, which uses "1" to indicate that there is data transmission between master and slave devices, and "0" to indicate that there is no data

transmission between master and slave devices. Referring to this method, when a program reads and writes the communication interface, the interface flag is set to "1", which is "busy" state; after the interface operation is completed, the interface flag is set to "0", which is "idle" state.

3. Conclusion

So far, after solving the above two problems, the contents of this paper are basically completed. In the initial stage of the program, the measurement points are classified according to the interface information of the measurement points. Then the linked list is established according to the above method. Then the dispatching program starts to execute and exchange data with the exchange layer. The overall flow chart of the program is as follows:

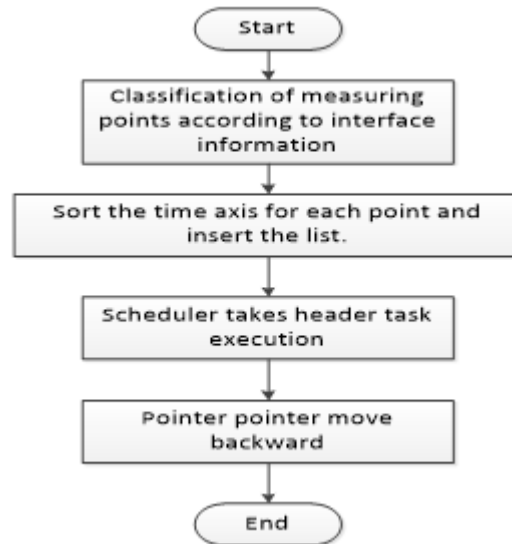


Figure. 7 Dispatching flow chart

4. Experimental verification

This experiment mainly verifies whether the program scheduling can achieve incomplete information, no loss and the correct running cycle of the measuring points under the circumstances of multiple periodic measuring points and multiple interfaces. Due to the limitation of conditions, the communication interface of this experiment adopts two serial ports, three UDP interfaces and one TCP communication. The communication between UDP and TCP is server side. The following is the experimental data:

Table 2 Experimental data

Interface	Measuring point (cycle)	Periodic error	Data frame deletion
UDP	Measuring point 1,2(1min); Measuring point 3,4,5(5min);	No error	No deletion
TCP	Measuring point 6,7(2min); Measuring point 8(10min);	No error	No deletion
Serial port	Measuring point 9(8min); Measuring point 10(15min);	No error	No deletion

From the experimental data, we can see that all the periodic measurement points in this experiment can run completely, and there is no case of inaccurate cycle or data loss.

5. Summary and Prospect

In this paper, the problem of periodic patrol scheduling for monitoring points with different periods is solved, and a reliable and easy-to-implement scheduling method is obtained. However, in practical projects, there will be more urgent burst measurement tasks. For this burst, and the priority of the high-level measurement tasks how to deal with, because of space reasons, this paper does not propose a good solution, follow-up can be based on the study of this paper, burst priority time research.

References

- [1] Yang Cheng, Yuan Shaobo, Huamei. Current situation and development trend of coal mine communication in China [J]. Information Communication, 2011 (04): 163-164.
- [2] Zhao Bing, Chen Xinxin and Liu Qian. Brief analysis of router principle and routing protocol [J]. Journal of Shanxi Radio and Television University, 2007 (06): 40-41.
- [3] Tan Boping, Zhou Xianwei, Yang Jun, Song Cunyi. Research on Secure Routing Technology for wireless sensor networks [J]. Journal of Sensing Technology, 2006 (01): 16-19
- [4] Zheng Hongliang. Research on periodic task scheduling technology [D]. University of Electronic Science and technology, 2018.13-15.
- [5] Chen J, Du C, Xie F, et al. Schedulability analysis of non-preemptive strictly periodic tasks in multi-core real-time systems [J]. Real-Time Systems, 2016, 52(3):239-271.
- [6] Tang Xiaodan, Liang Hongbing, zhe Feng Ping, Tang Zi Ying. Computer operation system.89-91.
- [7] Liu Zhenzhang. Research and Implementation of Communication Scheduling Algorithms for Smart Home Based on Bluetooth [D]. Hunan Normal University, 2009.9-12.