Application Computer Detection and Control System in Automobile Electronic Control System

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Abstract. The overall development of our society has promoted the development of computer technology, making the various performances of modern cars more perfect. The application of computer detection and control system technology in automobile electronic control devices can realize the intelligence and automation of automobile control. Now in the information age, computer perception and control technology are widely used in various social production fields, and are also widely used in automotive electronic control systems. Due to the emergence of automotive electronic control technology, automotive performance continues to improve, automotive safety performance improves, and automotive dynamic performance becomes stronger. In the automotive electronic control device, to understand the role of the computer detection and control system more specifically, it is necessary to fully understand and master the operation principle of the computer detection and control technology and the application range of the automotive electronic control device. In order to further improve the safety performance of the vehicle, in addition to the structural improvement of the vehicle itself and the addition of safety protection devices, it is a more effective method to perceive the surrounding environment and vehicle status during driving to achieve control. This article first introduces the computer detection and control technology, and analyzes the application program in the automotive electronic control device for reference.

Keywords: Computer Monitoring And Control System; Automotive Electronic Control System; Information Age; Electronic Control Device

1. Introduction
The car contains various types of electronic equipment and electrical systems with different functions, such as air conditioning systems, lighting systems, multimedia systems, etc. The use of computer detection and control technology can ensure the coordinated operation of these electronic systems and meet the needs of driving. On the one hand, it can actually improve vehicle safety [1]. After the 1980s, due to the mature development of single chip technology, microcomputer detection and control technology has been widely used in automotive electronic control devices [2]. In recent years, in order to better meet the driving requirements, the number of automotive electronic control devices is increasing, and the requirements for computer detection and control technology are higher. With the continuous maturity of related technologies, computer measurement and control technology is
gradually developing towards intelligence. In this context, it is also of strong practical value to explore how to optimize the use of computer detection and control technology in automotive electronic control devices [3].

The development goals of modern cars are comfort, safety, energy saving and environmental protection [4]. Automotive electronic products are electronic products developed using a variety of sensing, control, communication, network technologies and related technologies to achieve the above goals. In order to realize the intelligentization of automobile control, the prerequisite is to obtain information, on this basis, to identify, analyze and process the information, and make judgments and decisions for the purpose of control [5]. In the automobile production process, automobile quality inspection is a very important link and an important measure to ensure quality. Computer detection control technology plays an important role in the perception of engine control, automatic transmission control, cruise control, lock brake control, lighting control, air conditioning control, drive anti-skid control, instrument management system, anti-theft and other automotive electronic control devices. Computer control devices are closely related to the electronic control devices of various control systems, and real-time data communication is required at any time [6]. It not only realizes the efficiency of detection, but also provides absolute and accurate guarantee for the detection results, and then provides the technicians with available quality and performance analysis basis, and provides reliable detection technology for the production of high-quality and high-performance automobiles.

At the current level of the entire industry chain, as a popular industrial technology, automotive electronic control systems have high product added value, obvious industry chain effects, extensive inventory increase market, and broad strategic importance. Main features [7]. Automobile electronic control system is the most important supporting platform in automobile control system. With the maturity of new energy vehicles, unmanned driving and in-vehicle information system technologies, the future automotive electronics industry will move towards intelligence, networking and deep integration [8]. Computer detection and control technology for the development of automotive electronic control systems generally consists of two aspects. One is the precise extraction of information, and the other is the automatic detection and control of information by the computer system [9]. The computer detection control system can be divided into two modes: open loop mode and closed loop mode. The computer detection control system is mainly used for automobile engine control system, chassis control system and information electronic control system. With the development of automotive electronic machines, developed countries have adopted electronic control devices in a variety of automotive systems, which are changing and emerging every day. Modern computer detection and control technology is applied to automobile production, and automobiles are becoming more and more automated, and automobile electronic control technology is more mature [10].

2. Apriori Algorithm

2.1. Apriori Algorithm Idea

The realization of Apriori algorithm is based on the breadth-first search strategy. The main idea of the Apriori algorithm is to scan the database, use the iterative method to calculate the support of each candidate item set and compare the minimum support to find out the frequent itemsets, and then generate association rules based on the minimum confidence.

Among them, rule support and confidence are two very important concepts. For rules X and Y, the support calculation method of X ⇒ Y is:

\[
\text{Support}(X \Rightarrow Y) = P(X \cup Y)
\]  

(1)

X ⇒ Y confidence calculation method is:

\[
\text{Confidence}(X \Rightarrow Y) = \frac{P(Y|X)}{P(X)} = \frac{P(XY)}{P(X)}
\]  

(2)
Assuming that the total number of blocks is N blocks, the minimum support is Min_sup, and the number of transactions in each block is \(D_p\), the calculation formula for the local support count of each block is:

\[
sup_p = Min_{sup} \times D_p (p = 1, 2, 3, \ldots, N)
\]

(3)

In the process of finding local frequent itemsets, it needs to go through two stages, connecting step and pruning step.

Linking step: If \(k-1\) itemsets \(L_{k-1}\) are frequently used for self-connection operations, there are itemsets \(I_A, I_B\), set \(I_A \in L_{k-1}, I_B \in L_{k-1}\). \(I_i[j]\) represents the jth item in item set i. Among them, the connection condition of \(I_i[1] < I_i[2] < \ldots < I_i[k-1]\) then \(L_{k-1}\) is:

\[
(I_1[1] = I_2[1]) \land (I_1[2] = I_2[2]) \land \ldots \land (I_1[K-1] < I_2[2])
\]

(4)

Pruning step: In order to reduce the size of the candidate item set, you can first perform the pre-pruning operation according to the pre-pruning strategy of the local candidate item set.

The time complexity of the traditional Apriori algorithm is:

\[
O(DB_N) + \sum_{k \geq 2}(O(L_k \times L_k) + O(L_k \times C_{k+1}) + O(M + C_{k+1}))
\]

(5)

Assuming that there are n nodes in the P_Apriori_BP algorithm, when calculating the support, the number of comparisons is reduced and the number of transactions after ignoring is m, then the time complexity of the P_Apriori_BP algorithm is:

\[
\frac{O(DB_N) + \sum_{k \geq 2}(O(L_k \times L_k) + O(L_k \times C_{k+1}) + O(M + C_{k+1}))}{n}
\]

(6)

2.2. The shortcomings of the Apriori algorithm

Although the Apriori algorithm has been widely used in various fields, there are many shortcomings and shortcomings in the traditional Apriori algorithm, which cause the efficiency of the algorithm to decrease, as follows:

1. The algorithm needs to scan the database multiple times. Every time the algorithm generates a frequent itemset, it will perform a database scan. If there are too many frequent itemsets, it will take a long time, which will reduce the overall performance of the algorithm.

2. The traditional serialization algorithm increases the I/O cost of the algorithm, and the processing capacity of a single machine is severely reduced in the face of massive data, which cannot achieve the expected effect.

3. The number of candidate sets generated by the algorithm's self-connection process is too large. During the self-connection process, if the value of k is too large, it will consume too much time in the first \(k-1\) comparisons of the algorithm. When the value of k is 50 when connecting, then \(-1\) candidate item sets will be produced. It can be seen that the efficiency of the algorithm is extremely low in this case.

2.3. Design of Apriori Algorithm

In the process of monitoring the electronic control system of the car by the computer detection system, the data processing by the program is generally processed according to the line by default. Doing so does not change the original nature of the car electronic operating system data, and their comparison relationship is also the same. Since the core architecture of the computer detection system is HDFS technology, and for HDFS technology, its core is the two functions of Map and Reduce, so our understanding and writing of these two functions is very important. Important. To realize a complete computer detection system program, it must go through the design of Map function and Reduce function. When the computer detection program is executed, it parses the records in the file into the form of <key, value> key-value pairs, where key represents the line number, and value represents the record of the line. Hadoop will start a job every time a frequent itemset is sought. In this job, each Map function not only processes one data block, the output result of the Map is used as the input of Reduce,
and Reduce will reduce the key-value pairs of these inputs. This characteristic of computer detection system greatly simplifies distributed programming and provides convenience for developers.

3. Modeling Method

3.1. Linear Two-Degree-Of-Freedom Manipulation Model

In the process of using the computer detection system to perform the detection operation of the automobile electronic control system, it is necessary to design and preview the detailed process of the experimental operation in advance to ensure the success of the experiment. However, the prerequisite for solving these problems is to design a complete model. After obtaining the low-frequency sub-image \( I'_L \) of \( I'_0 \) in the above, next, use the SIFT feature extraction method to extract the feature points of \( I'_L \), which mainly includes the following steps:

Scale space extreme value detection:

\[
L(x, y, \sigma) = G(x, y, \sigma) * I'_0(x, y) \tag{7}
\]

Among them * is the convolution operator. The larger the value, the more it can describe the overall content of the detection process, and the smaller the value, the more it can describe the details of the detection process in detail. The expression of Gaussian function \( G(x, y, \sigma) \) is shown in formula (8):

\[
G(x, y, \sigma) = \frac{1}{\sqrt{2\pi}\sigma^2} e^{-\frac{(x^2+y^2)}{2\sigma^2}} \tag{8}
\]

Then, the Gaussian difference function is convolved with the image \( I'_0 \) to obtain the scale difference function \( D(x, y, \sigma) \).

\[
D(x, y, \sigma) = D(x, y, \sigma) + \frac{\partial D}{\partial x} x + \frac{1}{2} x^T \frac{\partial^2 D}{\partial x^2} x \tag{10}
\]

\[
x = \frac{\partial^2 D^{-1}}{\partial x^2} \frac{\partial D}{\partial x} \tag{11}
\]

After completing the above steps, construct a linear combination of classifiers:

\[
f(x) = \sum_{m=1}^{M} a_m T_m(x) \tag{12}
\]

The final data cloud processor obtained from the scientific research is:

\[
T(x) = \text{sign}(f(x)) = \text{sign}\left[\sum_{m=1}^{M} a_m T_m(x)\right] \tag{13}
\]

Direction distribution. For the feature point \((x, y)\), the scale image with the scale of the feature point is:

\[
L(x, y) = G(x, y, \sigma) * I'_0(x, y) \tag{14}
\]

The gradient amplitude \( m(x, y) \) and direction \( \theta(x, y) \) can be approximated by the difference operation of the adjacent car electronic control, as shown in formulas (15) and (16):

\[
m(x,y) = \sqrt{(L(x+1,y) - L(x-1,y))^2 + (L(x,y+1) - L(x,y-1))^2} \tag{15}
\]

\[
\theta(x,y) = \tan^{-1}\left(\frac{(L(x,y+1) - L(x,y-1))/L(x+1,y) - L(x-1,y))}{L(x,y+1) - L(x,y-1))}\right) \tag{16}
\]

Update the probability distribution of the training data set:

\[
D_{m+1} = (W_{m+1,1}, \ldots, W_{m+1,i}, \ldots, W_{m+1,N}) \tag{17}
\]

\[
W_{m+1,i} = \frac{w_m}{s_m} \exp\left(-a_m y_i T_m(x_i)\right), (i = 1,2, \ldots, N) \tag{18}
\]
4. Evaluation Results and Research

Automobile collision avoidance technologies are being studied at home and abroad, and computer detection and control systems are used to support car drivers in real-time monitoring of road traffic safety of people, cars, roads and the environment. The control system actively hinders driving control, supports the driver in emergency handling, and prevents car collisions. The first problem that the technology to prevent car collisions needs to solve is the safety distance between cars. If the safe distance between the vehicle and the vehicle is exceeded, an alarm should be automatically issued and braking measures should be taken.

When a car runs at different speeds, the emergency braking distance of the car is also different. It is necessary to calculate the braking distance when the car is running at different speeds. The dangerous braking distance refers to the distance that the braking part of the vehicle moves before the vehicle stops safely. According to the experimental investigation and analysis, the braking distance of different vehicle speeds when the driver controls the braking with his own consciousness is finally calculated as shown in Figure 1.

![Figure 1. Braking distance at different vehicle speeds under manual operation](image1)

In the same environment as the above manual operation, the computer detection and control system is used to perform emergency stop operations on the vehicle electronic control system control vehicle. When the computer detection and control system is used to perform emergency stop operations on the vehicle electronic control system control vehicle The size of the dangerous braking distance when driving at different speeds is shown in Figure 2:

![Figure 2. The computer detects the dangerous braking distance at different vehicle speeds when the control system is operating](image2)
computer detection control system performs emergency stop operations at different speeds, the braking distance is significantly smaller than the economic braking distance during manual operation. It can also ensure the safety of the drivers and passengers in the car, and it can also ensure the safety of driving.

When the automotive electronic control system has multiple ultrasonic transducers, use sequential and periodic stamping. According to the effective stamping range, the shortest pulse interval transmission time and cycle time can be estimated. The real-time performance of the system can be estimated according to the cycle time, that is, the system processing time.

| Reversing speed (KM/H) | Number of ultrasonic transducers (a) | Maximum detection distance (m) | Ultrasonic round-trip time (s) | System group processing time (s) | Vehicle driving distance within processing time (m) |
|------------------------|-------------------------------------|------------------------------|-------------------------------|---------------------------------|-----------------------------------------------|
| 10                     | 4                                   | 4                            | 0.0248                        | 0.100                           | 0.28                                           |
| 5                      | 4                                   | 4                            | 0.0248                        | 0.100                           | 0.14                                           |
| 1                      | 4                                   | 4                            | 0.0248                        | 0.100                           | 0.03                                           |
| 10                     | 3                                   | 4                            | 0.0248                        | 0.075                           | 0.21                                           |
| 5                      | 3                                   | 4                            | 0.0248                        | 0.075                           | 0.10                                           |
| 1                      | 3                                   | 4                            | 0.0248                        | 0.075                           | 0.02                                           |

In the table, the CPU processing time is basically ignored. The processing time of the system is mainly spent on waiting for the ultrasonic echo. Since the speed of the vehicle when reversing generally does not exceed 5KM/H, the above table shows that even if there is an obstacle 0.5 meters behind the vehicle, the driver can take timely measures and avoid collision. That is, the real-time performance of the system can meet the requirements.

5. Conclusion

Recently, due to the continuous improvement and development of computer detection and control technology, computer detection and control systems have begun to be used in China's automotive electronic control system devices. The computer detection and control system has played many roles in the automotive electronic control device system. The maturity of the near-field communication technology has made the original single-car control system into a multi-functional integrated control system. Judging from the current development situation, computer detection and control technology is not perfect. In order to achieve automation, intelligence and humanization, and to ensure the safety of the car, further research is needed to fully control the car. Network and intelligence are the future development trends of automobiles. Therefore, in the application of automobile electronic control systems, computer detection and control technology should be continuously added to ensure the safe and stable operation of automobiles and realize the necessary automation and intelligence. In general, the application of computer detection and control technology to automotive electronic control systems can completely make up for the shortcomings of current automotive electronic control systems and realize the intelligence, automation and humanization of automotive electronic control systems.

References

[1] Wajman R. Computer methods for non-invasive measurement and control of two-phase flows: a review study[J]. Information technology and control, 2019, 48(3):464-486.
[2] Jin X, Zhao K, Ji J, et al. Design and experiment of intelligent monitoring system for vegetable fertilizing and sowing[J]. The Journal of Supercomputing, 2020, 76(5):3338-3354.
[3] Trilokinath U A, Singh S K. Enhanced Automaton Monitoring Method on Satellite Receiving Position[J]. Indonesian Journal of Electrical Engineering and Computer Science, 2018, 9(2):289-293.
[4] Garg M, Lai R. A Method for Measuring the Constraint Complexity of Components in Automotive Embedded Software Systems[J]. International Journal of Software Engineering
and Knowledge Engineering, 2018, 29(1):1-21.

[5] Zhengbao L, Amp W S, Xiaoyuan Z. The Electronic Control System of the Second-Generation CST Vehicle Collision Energy Absorption System[J]. Journal of Bacteriology, 2018, 200(4):710-721.

[6] Ding Z, Lei Z, Singh A K. The design of automotive electronic control suspension system based on digital simulation[J]. Journal of Intelligent and Fuzzy Systems, 2019, 37(1):1-11.

[7] Menezes B C, Kelly J D, Leal A G, et al. Predictive, Prescriptive and Detective Analytics for Smart Manufacturing in the Information Age[J]. IFAC-PapersOnLine, 2019, 52(1):568-573.

[8] Bernhardt, Wesley, M. A Clash of Principles: Personal Jurisdiction and Two-Level Utilitarianism in the Information Age[J]. Washington University Jurisprudence Review, 2019, 11(1):8-8.

[9] Sundaramoorthy K, Thomas V, O'Donnell T, et al. Virtual synchronous machine-controlled grid-connected power electronic converter as a ROCOF control device for power system applications[J]. Electrical Engineering, 2019, 101(3):983-993.

[10] Sunico R J A, Argana E. Development and Evaluation of Automated Gate Pass System[J]. International Journal of Advanced Trends in Computer Science and Engineering, 2020, 9(5):8846-8850.