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Application of ARM in automobile central control computer system

Zhi Xu, Xin Wang, Xin Lin

Institute of electrical and automation engineering, Sanjiang University, Yuhuatai District, Nanjing, 210012, Jiangsu, (CHINA)

ABSTRACT

With society becomes more developed, upmost vehicle automobile in people's life has also become more advanced. Nowadays, automobile intelligent exploitation are rapidly increasing, and among them ARM plays an important role. In order to make people more clear about ARM application in automobile, the paper firstly gets simple acknowledge about ARM and automobile central control computer system, subsequently for ARM main applications in automobile central control computer system, in case considering ARM characteristics and automobile required safety, price, discrimination and entertainment as well as other influence factors, by analytic hierarchy process, it gets ARM's automobile central control computer system's main application aspects occupied proportions that proportions in automobile brake, automobile door lock and automobile audio's applications are respectively 0.413,0.404 and 0.183. It makes readers to more clear about ARM application status in automobile central control computer system.

KEYWORDS

Automobile central control; Computer system; Analytic hierarchy process.

INTRODUCTION

The full name of ARM is Advanced RISC Machine that is advanced reduced instruction set processor. Its framework is 32Bit processor framework that is mostly used in embedded design system, such as automobile central control computer system. Because its features as high own performance cost ratio and low energy consumption, it is quite suitable to the aspect of mobile communication. Until 2011, most of high-end technological products in the world have equipped with ARM framework, from which it contains laptop, digital television, multi-media, mobile hard disk drive and camera so on, while in smart phone, ARM framework even occupies 95% of all smart phone.

And automobile central control that is automobile central control computer system. Among them, it includes control system of door lock and window as well as automobile central control board and so on. On a whole, nowadays, most intelligent motions of automobile are functioned by ARM. As automobile brake, automobile audio control and so on. In order to more clear about ARM application status in automobile central control computer system, the paper will analyze and research on the problems.

MODEL ESTABLISHMENTS

Construct hierarchical structure

In order o find out ARM main application contents in automobile central control computer system, firstly it should find out most influential unit of application, find out ARM main application aspects in automobile central control computer system. Therefore, the paper firstly on the basis of analytic hierarchy process, it makes quantization on ARM applications in automobile central control computer system. And then establish target layer, criterion layer and scheme layer relationships.

Target layer:Application of ARM in automobile central control computer system.

Criterion layer: Scheme influence factor, Q_1 is safety, Q_2 is price, Q_3 is discrimination, Q_4 is for entertainment.

Scheme layer: p_1 is automobile brake, p_2 is automobile door lock, p_3 is automobile audio, it gets hierarchical structure, as Figure 1 shows.

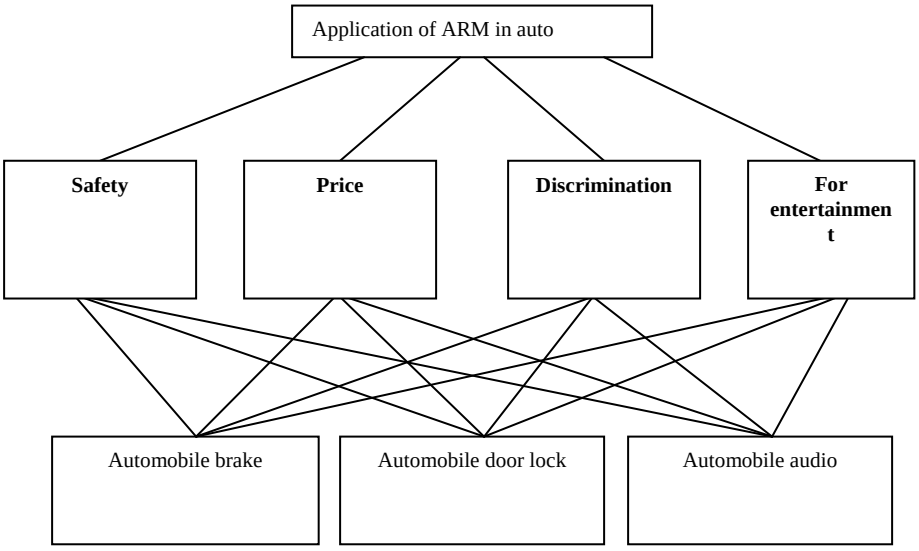


Figure 1 : Hierarchical structure

Construct judgment matrix

In order to get each factor comparison quantified judgment matrix, here set 1~9 scale, as TABLE 1 shows.

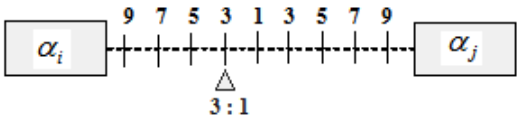
TABLE 1 : 1~9 scale table

Scale a_{ij}	Definition
1	factor i and factor j have equal importance
3	factor i is slightly more important than factor j
5	factor i is relative more important than factor j
7	factor i is extremely more important than factor j
9	factor i is absolute more important than factor j
2, 4, 6, 8	Indicates middle state corresponding scale value of above judgments
Reciprocal	If i factor compares to j factor, it gets judgment values is, a_{ji} =1/ a_{ij} , a_{ii} =1

Now set a_{ij} to represent ratio of β_i and β_j to G influence, and get judgment matrix A, in the paper set judgment matrix between layer two and layer one is A_1, element a_{ij}, divisor α_i, α_j, factor is A_1, then it has following formula showed judgment matrix A_1

$$A_1 = \begin{bmatrix} A_1 & \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 \\ \alpha_1 & a_{11} & a_{12} & a_{13} & a_{14} \\ \alpha_2 & a_{21} & a_{22} & a_{23} & a_{24} \\ \alpha_3 & a_{31} & a_{32} & a_{33} & a_{34} \\ \alpha_4 & a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

And in above formula, for a_{ij} values defining, we generally adopt 1~9 proportion scale to assign value on influence extent, as Figure 2 shows.



$$a_{ij} = 3, a_{ji} = \frac{1}{3}$$

Figure 2 : Nine scale assignment schematic diagram

According to lots of experts experiences and refer to lots of documents as well as 1~9 scale setting, it gets paired comparison matrix that are respective as TABLE 2-6.

TABLE 2 : Comparison matrix

G	Q_1	Q_2	Q_3	Q_4
Q_1	1	1/3	4	3

Q_2	1/3	1	4	5
Q_3	1/4	1/4	1	1
Q_4	1/3	1/5	1	1

TABLE 3 : Comparison matrix

Q_1	p_1	p_2	p_3
p_1	1	1	1/4
p_2	1	1	1/4
p_3	4	4	1

TABLE 4: Comparison matrix

Q_2	p_1	p_2	p_3
p_1	1	6	6
p_2	1/6	1	6
p_3	1/6	1/6	1

TABLE 5 : Comparison matrix

Q_3	p_1	p_2	p_3
p_1	1	3	7
p_2	1/3	1	6
p_3	1/7	1/6	1

TABLE 6 : Comparison matrix

Q_4	p_1	p_2	p_3
p_1	1	4	5
p_2	1/4	1	6
p_3	1/5	1/6	1

Consistency test

Use consistency indicator test formula as: $CI = \frac{\lambda_{\max} - n}{n-1}$. From which $\lambda_{\max}$ is comparison matrix maximum feature root, n is comparison matrix order. It is clear that judgment matrix is inversely proportional to CI value.

$$C=\begin{Bmatrix} 1 & 1/3 & 4 & 3 \\ 3 & 1 & 4 & 5 \\ 1/4 & 1/4 & 1 & 1 \\ 1/3 & 1/5 & 1 & 1 \end{Bmatrix}$$

$$\xrightarrow{\text{Column vector normalization}} \begin{Bmatrix} 0.225 & 0.182 & 0.4 & 0.4 \\ 0.065 & 0.568 & 0.3 & 0.3 \\ 0.132 & 0.113 & 0.2 & 0.2 \\ 0.211 & 0.113 & 0.1 & 0.1 \end{Bmatrix}$$

$$\xrightarrow{\text{Solve sum by line}} \begin{Bmatrix} 1.176 \\ 2.13 \\ 0.334 \\ 0.334 \end{Bmatrix}$$

$$\xrightarrow{\text{Normalization}} \begin{Bmatrix} 0.331 \\ 0.294 \\ 0.217 \\ 0.158 \end{Bmatrix} = Y^{(0)}$$

$$CY^{(0)}=\begin{Bmatrix} 1 & 1/3 & 4 & 3 \\ 3 & 1 & 4 & 5 \\ 1/4 & 1/4 & 1 & 1 \\ 1/3 & 1/5 & 1 & 1 \end{Bmatrix}\begin{Bmatrix} 0.331 \\ 0.294 \\ 0.217 \\ 0.158 \end{Bmatrix}=\begin{Bmatrix} 3.536 \\ 2.775 \\ 2.183 \\ 1.588 \end{Bmatrix}$$

$$\lambda_{\max}^{(0)}=\frac{1}{4}\left(\frac{3.536}{0.331}+\frac{2.775}{0.294}+\frac{2.183}{0.217}+\frac{1.588}{0.158}\right)=4.15$$

$$y^{(0)}=\begin{pmatrix} 0.351 \\ 0.275 \\ 0.217 \\ 0.157 \end{pmatrix}$$

Judgment matrix is:

$$C_1=\begin{Bmatrix} 1 & 1 & 1/3 \\ 1 & 1 & 1/3 \\ 3 & 3 & 1 \end{Bmatrix}, C_2=\begin{Bmatrix} 1 & 1 & 4 \\ 1 & 1 & 4 \\ 1/4 & 1/4 & 1 \end{Bmatrix}, C_3=\begin{Bmatrix} 1 & 6 & 6 \\ 1/6 & 1 & 6 \\ 1/6 & 1/6 & 1 \end{Bmatrix}, C_4=\begin{Bmatrix} 1 & 3 & 7 \\ 1/3 & 1 & 6 \\ 1/7 & 1/6 & 1 \end{Bmatrix}$$

Corresponding maximum feature value and feature vector in successive are:

$$\lambda^{(1)}{}_{\max}=3.44, y^{(1)}{}_1=\begin{Bmatrix} 0.262 \\ 0.262 \\ 0.541 \end{Bmatrix}$$

$$\lambda^{(2)}{}_{\max}=3.56, y^{(1)}{}_2=\begin{Bmatrix} 0.629 \\ 0.295 \\ 0.082 \end{Bmatrix}$$

$$\lambda^{(3)}{}_{\max} = 3.51, y^{(1)}{}_3 = \begin{Bmatrix} 0.630 \\ 0.231 \\ 0.135 \end{Bmatrix}$$

$$\lambda^{(4)}{}_{\max} = 3.14, y^{(1)}{}_4 = \begin{Bmatrix} 0.602 \\ 0.242 \\ 0.188 \end{Bmatrix}$$

According to $CI = \frac{\lambda_{\max} - n}{n-1}$, it gets RI value that can refer to TABLE 7.

TABLE 7 : RI value

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

For judgment matrix C, $\lambda^{(0)}{}_{\max} = 3.56, RI = 0.75$

$$RI = \frac{3.56 - 3}{3 - 1} = 0.028$$

$$CR = \frac{CI}{RI} = \frac{0.028}{0.75} = 0.037 < 0.1$$

It shows C inconsistency degree within permissible range, at this time it can use C feature vector to replace weight vector. Similarly, to judgment matrix C_1, C_2, C_3, C_4, all passed consistency test by using above principle. Therefore, calculation results from object layer to scheme layer can refer to Figure 3.

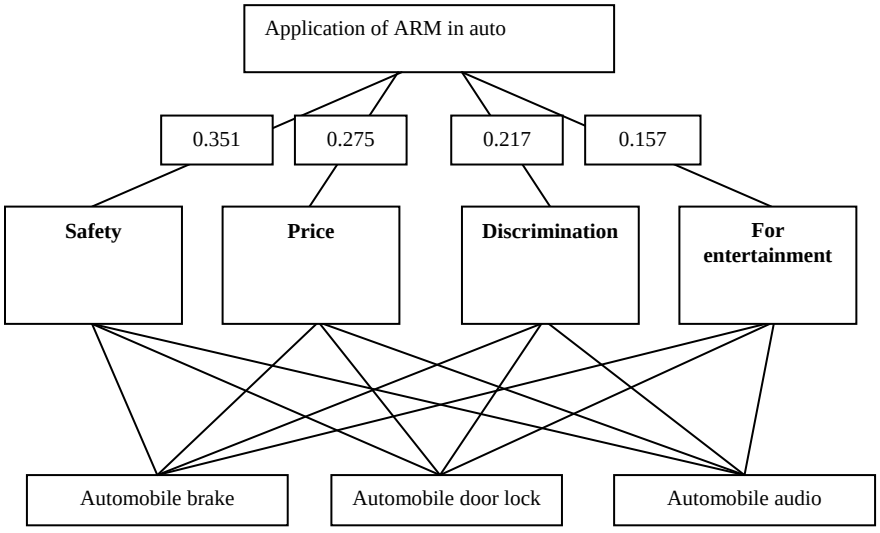


Figure 3 : Target layer to scheme layer calculation result

$$\begin{Bmatrix}0.262\\0.262\\0.541\end{Bmatrix},\begin{Bmatrix}0.629\\0.295\\0.082\end{Bmatrix},\begin{Bmatrix}0.630\\0.231\\0.135\end{Bmatrix},\begin{Bmatrix}0.602\\0.242\\0.188\end{Bmatrix}$$

Calculation structure is as following:

$$y^{(1)} = (y_1^{(1)}, y_2^{(1)}, y_3^{(1)}, y_3^{(1)})$$
$$= \begin{Bmatrix}0.262 & 0.629 & 0.630 & 0.602\\0.262 & 0.295 & 0.231 & 0.242\\0.541 & 0.082 & 0.135 & 0.188\end{Bmatrix}$$

$$y = y^{(1)} y^{(0)}$$
$$= \begin{Bmatrix}0.262 & 0.629 & 0.630 & 0.602\\0.262 & 0.295 & 0.231 & 0.242\\0.541 & 0.082 & 0.135 & 0.188\end{Bmatrix}\begin{Bmatrix}0.351\\0.275\\0.217\\0.157\end{Bmatrix}$$
$$= \begin{Bmatrix}0.413\\0.404\\0.183\end{Bmatrix}$$

On above, it is clear that for ARM main applications in automobile central control computer system, in case considering ARM characteristics and automobile required safety, price, discrimination and entertainment as well as other influence factors, by analytic hierarchy process, it gets ARM's automobile central control computer system's main application aspects occupied proportions that proportions in automobile brake, automobile door lock and automobile audio's applications are respectively 0.413、0.404 and 0.183.

CONCLUSION

The paper firstly gets simple acknowledge about ARM and automobile central control computer system, subsequently for ARM main applications in automobile central control computer system, in case considering ARM characteristics and automobile required safety, price, discrimination and entertainment as well as other influence factors, by analytic hierarchy process, it gets ARM's automobile central control computer system's main application aspects occupied proportions that proportions in automobile brake, automobile door lock and automobile audio's applications are respectively 0.413, 0.404 and 0.183. It makes readers to more clear about ARM application status in automobile central control computer system.

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