# Research on the Development Trend of Broadcasting Network Technology Based on K-Means Algorithm

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***Abstract*—With the coming of the "5 g era", intelligence, digital transformation is a major problem faced by radio, film and television networks. This paper uses the k-means algorithm to analyze its market demand data. According to the clustering analysis, the key attributes of broadcasting network products in the future are extracted. The clustering results can be divided into three categories, and then infer the trend of its technology development: First, the promotion of digital technology, which is from video, audio, text compression coding and modulation transmission, so that the content storage capacity is more abundant, data transmission more rapid. Second, the continuous upgrading of operation platform technology, middleware and system integration technology, including standardization technology, full-service support technology and platform establishment. Third, the improvement of basic network technology, which is from network access technology to network transmission technology, the formation of advanced technology entry point and transmission fluency. Fourth, the optimization of network technology, which is from the network architecture, to form an integrated, mature network system.**

***Keywords-Intelligent Products; K-Means Algorithm; Clustering Analysis***

## I. INTRODUCTION

With the issuance of 5G commercial license by the ministry of industry and information technology, radio and television networks has officially entered the first year of 5G.The Business is also in urgent need of transformation from traditional single business to intelligent diversified business. Radio and television network is facing unprecedented technical challenges, enterprises need to keep up with the market demand, develop high market demand product technology, then clear radio and television network technology development trend.

Experts and scholars have done a lot of work on the research of technology development trend. In terms of research methods, they mainly include technology foresight and patent data mining [1,2]. Technology foresight is from a macro perspective, focusing on the research on the status quo of technology development and the future trend of technology development. The technology foresight lasts for a long time. Due to the relatively few broadcasting network technology patents, the use of patent data mining method is not feasible ,so based on the fact that the development trend of radio and television network technology is closely related to the market demand, this paper takes radio and television network as an example, USES the k-means algorithm to analyze the market demand data, and then according to the analysis results, extracts the key attributes of future products of radio and television network, and obtains its technical development trend.

## II. K-MEANS ALGORITHM FLOW AND CLUSTERING

K-means clustering method is an algorithm that clusters n input information into K class according to its characteristics. Its realization method is mainly to obtain the minimum value of the square sum of the distance between each input information and the clustering center point [3~6], as shown in formula 1:

$$J = \sum_{i=1}^{k} J_i = \sum_{i=1}^{k} \sum_{i=1}^{k} w_{ji} \left\| x_j - c_i \right\| \tag{1}$$

-K is the number of clustering
-$X_j$is the jth input vector
-$C_i$ is the ith clustering center
-$J_i$is the target function of class I clustering
- W = w=[$w_{ji}$]is a binary matrix of $n \times k$
The steps of k-means algorithm are as follows:

*1) K information points Ci, I =1,2,,,, and K were randomly selected as the initial clustering center of each cluster.*

*2) The classification of the group to which each information point belongs can be distinguished by formula 2, and the weight of conformity is Wji=1, otherwise it is 0.*

$$W_{ji} = \begin{cases} 1, if \left\| x_j - c_i \right\| \le \left\| x_j - c_m \right\|, \ \forall m \ne jmeet \\ 0 \end{cases}$$

$$\sum_{i=1}^{k} w_{ji} = 1, \forall j = 1,,,n, \sum_{i=1}^{k} \sum_{j=1}^{n} w_{ji} = n \tag{2}$$

*3) According to formula (1), the objective function J is calculated. If J remains unchanged, it means that the classification result has become stable.*

*4) Update the center point of the group class with formula (3) and go back to step 2.*

If [7]k =3, the object is clustered into 3 clusters. According to the above algorithm, three objects are randomly selected as the three initial cluster centers, and the cluster centers are marked with "+" in the figure. According to the distance and cluster center, each object is assigned to a

recent cluster. The figure depicted by the dotted line in figure 1(a). The average value of each cluster is recalculated based on the objects in the class. Based on these new clustering centers, objects are reassigned to individual classes. Such distribution formed depicted in figure 1 (b) the dotted line contour. Repeat the above process to produce the situation shown in figure 1(c). The process ends when no object redistribution occurs. The result of the cluster is returned.

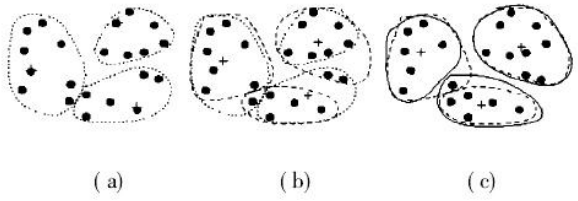


Figure 1. Clustering of a group of images based on k-means algorithm

## III. EASE OF USE DEVELOPMENT TREND OF BROADCASTING NETWORK TECHNOLOGY BASED ON K-MEANS ALGORITHM

The object of this empirical study is radio and television network technology. Based on k-means algorithm, the objective development trend of broadcasting network technology is obtained through the analysis of product demand data in the era of "5G". This paper obtained the research data through questionnaire survey and the content of the questionnaire is the market demand and implementation difficulty of broadcasting network products. Likert five-point scale was used to score, and 1, 2, 3, 4 and 5 respectively represent the "lower", "low", "average", "high" and "higher" requirements of users. Expert scoring in 1-10 points from difficult to easy. A total of 280 questionnaires were distributed and 280 questionnaires were recovered, among which 276 were effective, with an effective rate of 98%. 30 expert questionnaires were collected, among which 29 were effective, with an effective rate of 97%. The arithmetic mean value was calculated for each market demand score, and the questionnaire statistical results were obtained as shown in table 1.

TABLE I. QUESTIONNAIRE SURVEY DATA STATISTICS

| **The market demand** | | **time** | | | | **2019-2021 Ease of implementation** |
|---|---|---|---|---|---|---|
| | | **2016** | **2017** | **2018** | **After 2019** | |
| 1 | 3D | 2 | 3 | 4 | 5 | 9 |
| 2 | interaction | 3 | 3 | 4 | 4 | 9 |
| 3 | video-on-demand | 2 | 3 | 3 | 5 | 7 |
| 4 | Move back to see | 2 | 2 | 3 | 5 | 7 |
| 5 | video surveillance | 2 | 2 | 3 | 5 | 8 |
| 6 | Multiple screen fusion | 2 | 3 | 4 | 5 | 10 |
| 7 | 3Dinteractive | 2 | 2 | 4 | 5 | 10 |
| 8 | high definition | 2 | 3 | 4 | 4 | 10 |
| 9 | HD interactive | 2 | 3 | 4 | 5 | 10 |
| 10 | distance education | 1 | 1 | 3 | 5 | 8 |
| 11 | Online payment | 1 | 1 | 4 | 5 | 7 |
| 12 | program recommendation | 4 | 4 | 4 | 5 | 8 |
| 13 | Innovative interface | 4 | 4 | 5 | 5 | 6 |
| 14 | Record sharing | 3 | 3 | 4 | 5 | 8 |
| 15 | Smooth video | 2 | 3 | 4 | 5 | 8 |
| 16 | Online games | 2 | 2 | 3 | 5 | 6 |
| 17 | Online shopping | 2 | 2 | 2 | 4 | 7 |
| 18 | Online inquiry | 1 | 2 | 3 | 5 | 6 |
| 19 | Online sports | 2 | 2 | 3 | 5 | 7 |
| 20 | Internet video | 2 | 2 | 4 | 5 | 9 |
| 21 | Wi-Fi | 3 | 3 | 4 | 5 | 10 |
| 22 | Video call | 1 | 2 | 3 | 4 | 9 |
| 23 | Fluid network | 1 | 1 | 2 | 5 | 10 |
| 24 | instant message | 2 | 2 | 3 | 5 | 9 |
| 25 | Smart home | 1 | 1 | 3 | 5 | 9 |
| 26 | online reading | 2 | 2 | 2 | 5 | 8 |
| 27 | telemedicine | 2 | 2 | 3 | 5 | 8 |
| 28 | smart terminal | 3 | 3 | 4 | 5 | 10 |

Table 2-5 is calculated by SPSS18.0 software in combination with the questionnaire survey data and the model in section 2 of this paper.

TABLE II. CLUSTER MEMBERS

| number | cluster | distance |
|---|---|---|
| 1 | 1 | 0.742 |
| 2 | 1 | 1.420 |
| 3 | 3 | 1.146 |
| 4 | 3 | 0.364 |
| 5 | 3 | 0.877 |
| 6 | 1 | 0.940 |
| 7 | 1 | 1.218 |
| 8 | 1 | 0.940 |
| 9 | 1 | 1.429 |
| 10 | 3 | 1.608 |
| 11 | 3 | 1.118 |
| 12 | 2 | 1.118 |
| 13 | 2 | 1.756 |
| 14 | 1 | 1.489 |
| 15 | 1 | 1.223 |
| 16 | 3 | 1.430 |
| 17 | 3 | 1.330 |
| 18 | 3 | 1.397 |
| 19 | 3 | 0.364 |
| 20 | 1 | 0.696 |
| 21 | 1 | 1.323 |
| 22 | 1 | 1.597 |
| 23 | 1 | 2.560 |
| 24 | 1 | 0.904 |
| 25 | 1 | 1.971 |
| 26 | 3 | 1.260 |
| 27 | 3 | 0.877 |
| 28 | 1 | 1.323 |

TABLE III. FINAL CLUSTER CENTER

| | cluster | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| VAR00001 | 2.07 | 4.00 | 1.73 |
| VAR00002 | 2.47 | 4.00 | 1.91 |
| VAR00003 | 3.67 | 4.50 | 2.91 |
| VAR00004 | 4.80 | 5.00 | 4.91 |
| VAR00005 | 9.33 | 7.00 | 7.18 |

TABLE IV. DISTANCE BETWEEN CENTERS OF FINAL CLUSTERING

| cluster | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0.000 | 3.503 | 2.375 |
| 2 | 3.503 | 0.000 | 3.480 |
| 3 | 2.375 | 3.480 | 0.000 |

TABLE V. NUMBER OF CASES IN EACH CLUSTER

| | | |
|---|---|---|
| **cluster** | 1 | 15.000 |
| | 2 | 2.000 |
| | 3 | 11.000 |
| **efficacious** | | 28.000 |
| **deficiency** | | 0.000 |

According to the calculation, the clustering results can be divided into three categories:

*A.* 3D, interaction, Multiple screen fusion, 3Dinteractive, high definition, HD interactive, Record sharing, Smooth video, Internet video, Wi-Fi, Video call, Fluid network, instant message, Smart home, online reading.

*B.* Video-on-demand, Move back to see, video surveillance, distance education, Online payment, program recommendation, Innovative interface, Online shopping, Online inquiry, Online sports, telemedicine

*C. Online games, online reading*

The key attributes of broadcasting network products are obtained through the extraction of clustering results, and the schematic diagram of the extraction of clustering results of broadcasting network products is shown in figure 2.

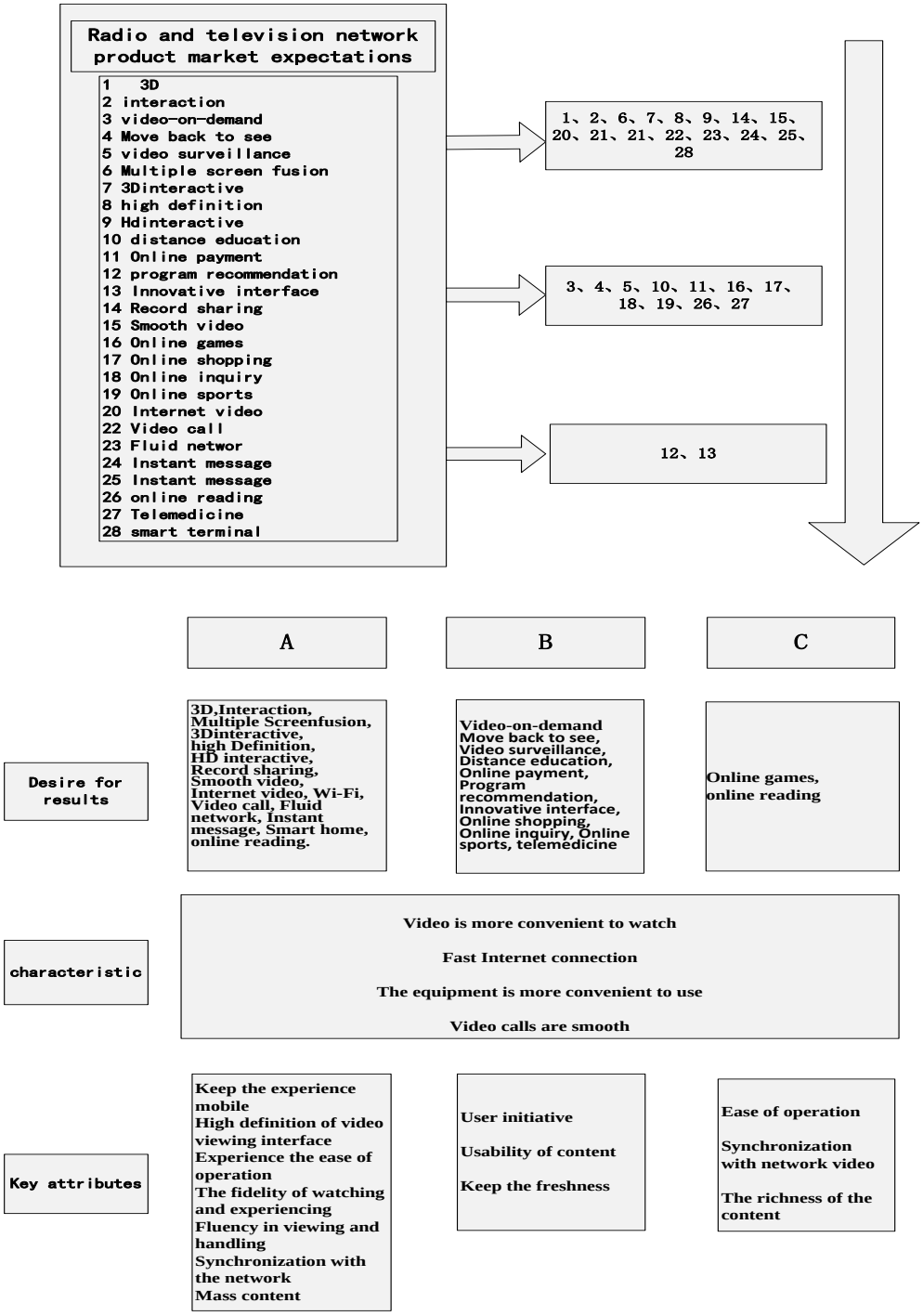


Figure 2. Schematic diagram of clustering results of broadcasting network products

According to the analysis of clustering results and the extraction of key technologies, we can get the development trend and research direction of broadcasting network industry technology: First, the promotion of digital technology, which is from video, audio, text compression coding and modulation transmission, so that the content storage capacity is more abundant, data transmission more rapid. Second, the continuous upgrading of operation platform technology, middleware and system integration technology, including standardization technology, full-service support technology and platform establishment. Third, the improvement of basic network technology, which is from network access technology to network transmission technology, the formation of advanced technology entry

point and transmission fluency. Fourth, the optimization of network technology, which is from the network architecture, to form an integrated, mature network system.

## IV. CONCLUSION

This paper uses the k-means algorithm to analyze its market demand data, and extract the key attributes of intelligent products of broadcasting network, and then infer the trend of its technology development. It is an attempt to apply k-means clustering algorithm to the analysis of the development trend of broadcasting network technology. Its clustering results can analyze the market demand, and then get the development trend of broadcasting network technology. However, the k-means algorithm is only applicable to the case where the clustering mean is meaningful. Therefore, the sample dimension should be increased as much as possible, and the corresponding sample data should be obtained by filtering abnormal and invalid data. In addition, another disadvantage of k-means algorithm is that the user must specify the number of clustering in advance. If the number of clustering is not accurately defined, the clustering result will be unreasonable.

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