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Design and Research of Electric Power Knowledge Service System Based on Multi-source Data Fusion

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Abstract

With the help of deep learning semantic perception and analysis, this paper establishes the data fusion technology of knowledge sharing and interaction channels between different majors. Using the collaborative filtering recommendation algorithm to provide personalized and accurate recommendation services, then we obtain collaborative interaction, consultation Q & A and learning iteration for specific scenes and personalized needs. Aiming at the problems of strong professionalism and high complexity of man-machine integration in the power field, we employ the technologies of power information extraction, semantic understanding, information retrieval and knowledge map embedding, continuously reduce the complexity of system interaction, solve the problems of knowledge extraction and construction of unstructured natural language data such as text, voice and image, and build an intelligent knowledge service platform for multi-agent knowledge sharing, which satisfies the learning needs of rapid update and iteration of high elastic grid knowledge, and ensures the high efficiency and quality of Intelligent Knowledge Service under the new power business scenario.

Keywords

Data fusion, Knowledge atlas, Intelligent knowledge platform, Deep learning.

1. Introduction

With the continuous expansion of the scale of the power grid and the continuous addition of new energy and new equipment, the power structure and grid pattern have undergone profound changes, the power system has become increasingly complex, and the safe and stable operation of the power grid is facing huge challenges. At the same time, under the background of digital transformation of power grid production, enterprise operation and customer service, it is urgent to use digital technology to comprehensively improve the ability of power grid holographic perception, efficient processing and shared services[1]. Power grid data presents the characteristics of mass and diversity, mining the value of power grid data, helping to improve the service level of the power grid, expanding the innovative application of power grid data, and becoming the core engine and new growth pole of power grid companies. The data related to the power system includes six major links including generation, transmission, transformation, distribution, utilization, and dispatch. From the source of the data, the grid data can be simply divided into grid internal data and grid external data. The internal data of the power grid mainly refers to the data from the internal systems of the power grid, such as the usage system, the marketing system, the wide-area detection system, the production management system, the energy management system, the customer service system, and the financial system. The external data of the power grid comes from external service data such as GIS suppliers, weather, timing, and government. From the frequency of data changes, data can also be divided into dynamic data and static data. Dynamic data mainly includes operational data, marketing data, etc., and static data mainly includes some metadata such as CMDB. The

ubiquitous power IoT big data has the 4V characteristics of volume (huge data), varity (various types), velcity (high computing efficiency), and value (value generation)[2].

With the continuous development of artificial intelligence technology, intelligent retrieval and analysis methods based on knowledge graphs are gradually applied in the field of smart grid. Extract semantic information such as entities, attributes, and relationships from data in various fields through extraction technology[3], and build knowledge bases through technologies such as knowledge fusion and knowledge processing. The retrieval and analysis service required by the user is realized through the matching analysis between entities[4]. In addition, knowledge graph is based on data structure, adopts the format of ontology terminology and semantic expression, and has a standardized and standard conceptual model, which can well solve a large number of multi-source and heterogeneous operation data accumulated by the power grid system, including numbers, texts[5], Moreover, the knowledge graph enhances the relationship between data through the semantic link function, which can make the data expression more standardized and structured, and can be well adapted to the application scenarios of technologies such as intelligent question answering, intelligent retrieval, and auxiliary decision-making. At the same time, the retrieval analysis of power grid knowledge is also applicable.

2. Multi-source power data intelligent fusion technology

2.1. Intelligent semantic perception of power data

First of all, in the area of intelligent detection and perception of electrical semantic objects, convolutional neural networks are widely used in the field of image semantic segmentation and have achieved outstanding achievements in image semantic segmentation, but the current semantic segmentation networks with high performance usually have complex network structure or large amount of network parameters and computation, so it is difficult to apply to the scenarios with high real-time requirements. For this reason, this project comprehensively considers the parameter quantity, running speed and performance of the network, and proposes a lightweight image semantic segmentation network based on multi-level feature parallel. The network has good real-time performance and achieves good performance effect. First, we selected a lightweight feature extraction network as the benchmark network structure, which improved the large amount of parameters caused by the widespread use of networks with deeper network depth and wider network width as the benchmark network for feature extraction in current semantic segmentation algorithms. Insufficient computation. In addition, in order to ensure the segmentation accuracy of the network while reducing the network size, this project also proposes a hole residual enhancement module and a deep hole spatial pyramid module. The hole residual enhancement module is composed of two residual branches, which are used to enhance the edge contour information of objects of different scales in shallow features. The deep hole spatial pyramid module is composed of deepened hole convolutions with different receptive field sizes, which are used to strengthen the target semantic information of different scales of deep features. Compared with the existing semantic segmentation algorithms, the lightweight image semantic segmentation algorithm based on multi-level feature paralleling proposed in this paper better takes into account the accuracy of semantic segmentation and real-time performance. It is used in application scenarios such as mobile devices and embedded devices with real-time requirements.

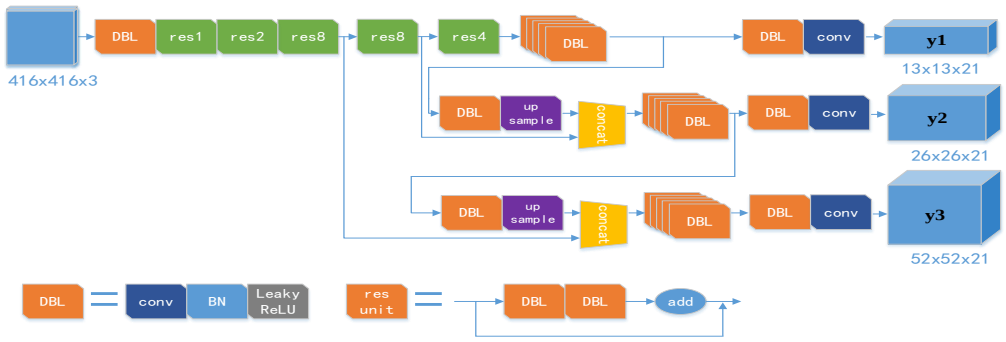

Figure 1 Semantic segmentation network architecture

At the same time, in the application of power operation, maintenance and service, due to the large interference of environmental factors in complex scenarios, the efficiency of existing algorithms is not high. An end-to-end fully convolutional neural network model suitable for mobile power line detection is proposed. First, a symmetric encoding-decoding structure is adopted. The encoding part uses the maximum pooling layer for downsampling to extract multi-scale features, and the decoding part uses the nonlinear upsampling method of the maximum pooling index to upsample and fuse features of different scales layer by layer. to restore the image details; secondly, a weighted loss function is used to train the model for the problem of imbalance between the target and the background. Compared with existing methods, the proposed semantic segmentation model is fast and efficient.

2.2. Intelligent fusion method of power data

Aiming at the problems of modal incompleteness, modal imbalance and difficult semantic expression of multi-modal data in practical applications, a multi-modal and cross-level power data intelligent fusion method based on deep learning and semantic drive is studied.

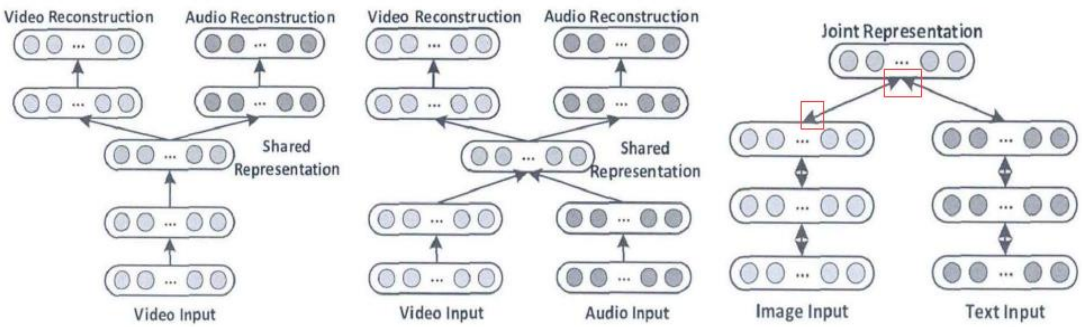

Figure 2 Multimodal data fusion based on deep learning

The research proposes a fusion method for incomplete multimodal data analysis. Aiming at the problem that the existing incomplete multimodal analysis and fusion algorithms are difficult to effectively learn the shared semantics of cross-modal data, an incomplete multimodal data fusion algorithm based on deep semantic matching is proposed. Using the high-level semantic abstraction characteristics of deep learning networks, a unified deep model that couples modal private deep networks and incomplete modal sharing feature learning is designed to achieve deep correlation fusion of incomplete multimodal data and reduce the semantic bias of modal shared features. . Based on the geometric characteristics of the modal space, a local invariant graph regularization factor is designed to couple the multi-modal shared features and the original modal features in the subspace to further improve the accuracy of the fusion results.

A fusion method for low dimensional sharing of multimodal data is proposed. Aiming at the problem that the existing multi-modal low dimensional feature sharing and fusion algorithms are difficult to effectively eliminate the influence of modal private information, an unsupervised multi-modal data non negative correlation feature sharing and fusion algorithm is proposed. A

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co learning model of modal private (uncorrelated or negatively correlated) features and cross modal shared (correlated) features is designed to improve the accuracy of low-dimensional shared feature representation through the separation of modal private features. The joint optimization objective function of each mode is established by using the coupling of shared features, and the regularization of mode invariant graph and sparsity of projection matrix are used to assist the model optimization process, so as to further improve the accuracy of fusion results. The robust cross-modal shared fusion features in the low-dimensional potential subspace are obtained by training and updating the iterative correlated and uncorrelated features. As shown in the figure below, the average fusion performance is improved by 30% and the average fusion quality is improved by more than 55%.

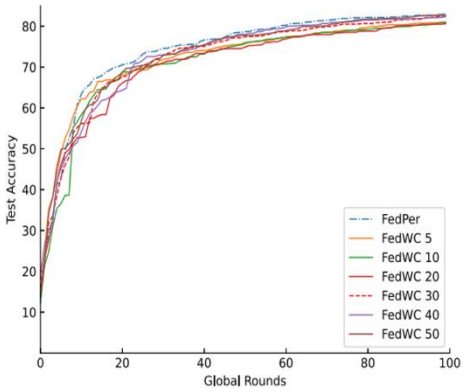

Figure 3 Fusion efficiency results

3. Design of power knowledge service platform based on Knowledge Map

As a knowledge organization and construction method based on artificial intelligence technology, the information expression of knowledge map is closer to the form of human cognitive world. It can express complex relationships from the semantic level and provide an ability to better manage and understand massive information. The power domain knowledge map aims to make full use of the data information carried by the power Internet of things to describe the concepts, entities, events and their relationships in the power system in a structured way, so as to provide a more effective cross media big data organization, management and cognitive ability for the power industry chain. The construction of knowledge map in the power field can fully explore the value of diversified and heterogeneous data in the power grid, and solve the problems of low business processing accuracy and poor timeliness caused by the difference and lack of knowledge reserves of professionals in the power field to a certain extent. It is an effective way to improve knowledge sharing and collaborative processing ability and efficiency of professionals.

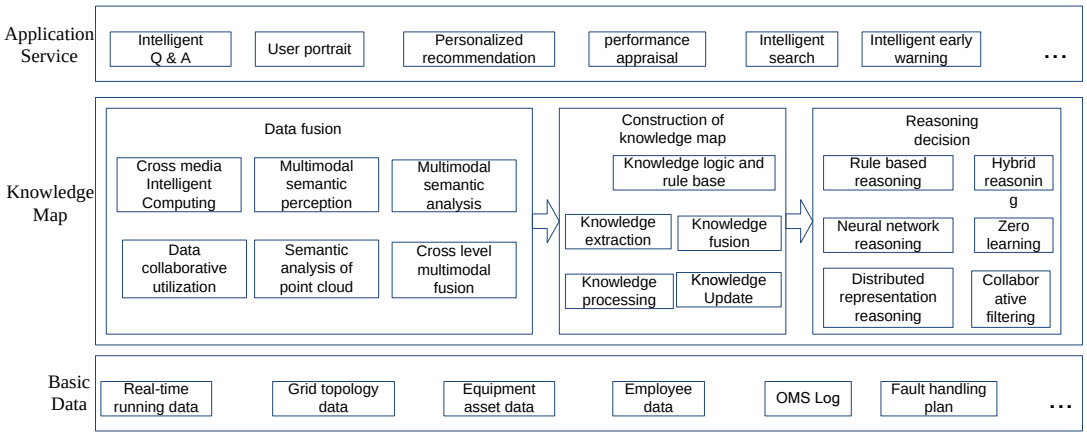

Figure 4 Construction of Intelligent knowledge service platform based on Knowledge Map

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3.1. Knowledge extraction

Knowledge extraction is mainly oriented to text data. Available knowledge units are extracted through automatic/semi-automatic technology. Knowledge units mainly include three types of knowledge elements: entity, relationship and attribute. The early knowledge extraction mainly used the method based on rules or dictionaries. This method matched through templates under the condition of limiting the text field and the type of semantic units. It not only needed to rely on experts for a large number of compilation, and the coverage was limited, but also it was difficult to meet the application needs of complex language environment and changeable forms. With the continuous development of artificial intelligence technology, a knowledge extraction method based on machine learning has gradually formed. In view of the non-standard natural language expression in the power field and the different expression of entity names in various business systems, the platform adopts the name extraction method based on conditional random fields to extract entity names from text data, and obtains a training model according to some training problems of conditional random fields and manual labels, In this way, the actual text can be labeled for each word through this training model, that is, there is no need to manually set the label for each text. In this way, the equipment information involved in the scheduling text can be obtained through the model, and then the power grid text data can be searched and statistically analyzed according to the equipment name.

3.2. Knowledge fusion

The knowledge extracted from unstructured scheduling rule text may contain a large amount of fuzzy or redundant information. The purpose of knowledge fusion is to clean and integrate it, so as to ensure the quality of knowledge. The main contents are entity link and knowledge merging. Entity link is to link the entity object extracted from the text to the corresponding correct entity object in the knowledge base through similarity calculation, including entity disambiguation and co reference resolution. The knowledge extracted from the unstructured scheduling rule text may contain a large amount of fuzzy or redundant information. The purpose of knowledge fusion is to clean and integrate it, so as to ensure the quality of knowledge. The main contents are entity link and knowledge merging. Entity link is to link the entity object extracted from the text to the corresponding correct entity object in the knowledge base through similarity calculation, including entity disambiguation and co reference resolution. This platform adopts the method of combining expert manual evaluation and automatic evaluation, defines the quality evaluation function according to different business needs, and carries out comprehensive evaluation to determine the final quality score of the knowledge map. In this way, through the trusted measurement evaluation process of new knowledge before adding it to the knowledge base, knowledge errors or conflicts can be eliminated.

3.3. Knowledge decision

Intelligent decision-making refers to the auxiliary decision-making that combines artificial intelligence and knowledge engineering, makes full use of descriptive knowledge, process knowledge and reasoning knowledge, and then helps solve complex decision-making problems through logical reasoning. In view of the diversity of semantic expression of entities and relationships in the knowledge base, as well as the complexity of relationships between entities, which is accompanied by a high amount of information but small samples, this platform organically combines zero learning and collaborative filtering, uses a zero learning method based on collaborative filtering, models the zero learning task as a label matrix filling problem, and draws lessons from the idea of collaborative filtering, The sparse label matrix is decomposed into non sparse visual feature matrix and semantic feature matrix, and then the classification and prediction of new category samples is realized. Based on the idea of collaborative filtering, this method mines the label matrix of known category samples, learns

the corresponding pattern between visual features and category semantic knowledge, and further migrates to the classification task of new category samples. In order to use less cost to learn accurate semantic representation for each category, knowledge is introduced in the form of semantic graph to establish the semantic association between known categories and new categories.

4. Conclusion

By using data fusion and knowledge extraction technology, this paper extracts semantic information such as entity, attribute and relationship from data in various fields, and constructs the knowledge base of intelligent service by knowledge fusion and knowledge processing technology. Through the matching analysis between entities, the retrieval and analysis services required by users are realized. Based on the data structure, the knowledge map adopts the format of Ontology terms and semantic expression, and has a standardized and standard conceptual model, which can well solve the large amount of multi-source and heterogeneous operation data accumulated by the power grid system, including numbers, words, images, etc., make the data expression more standardized and structured, and can well adapt to intelligent question answering, intelligent retrieval Application scenarios of auxiliary decision-making and other technologies.

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