

Customer Service Public Sentiment Early Warning Method, Apparatus, Electronic Device and Storage Medium

Cross-reference of Related Applications

The present application claims the priority of the Chinese patent application CN202410115982.2, titled "Customer Service Public Sentiment Early Warning Method, Apparatus, Electronic Device and Storage Medium", filed on January 26, 2024. The entire content of this application is incorporated herein by reference.

Technical Field

The present application relates to the technical field of artificial intelligence, and specifically, to a customer service public sentiment early warning method, apparatus, electronic device, and storage medium.

Background Art

With a rapid development of the Internet, the e-commerce industry has risen rapidly, and e-commerce platforms have become main channels for consumers to shop online. However, this is accompanied by a large number of consultation and complaint demands, and the customer service departments of e-commerce platforms are facing tremendous pressure.

However, since it is very difficult for customer service staff to handle all consultations and complaints in a timely manner, and the ways some users express themselves may not be rational enough, it is likely to trigger public sentiment issues. In related technologies, prediction methods for public sentiment prediction have been proposed. However, these methods consider relatively few dimensions when making public sentiment predictions, resulting in low prediction accuracy.

Summary

The purpose of the embodiments of the present application is to provide a customer service public sentiment early warning method, apparatus, electronic device and storage medium, so as to improve the accuracy of customer service public sentiment early warning.

In the first aspect, an embodiment of the present application provides a customer service public sentiment early warning method. The method includes: constructing a work order portrait according to an incoming customer service work order, wherein the work order portrait includes at least one of public sentiment occurrence probability in work order dimension, public sentiment occurrence probability in user dimension, and public sentiment occurrence probability in order dimension; predicting public sentiment occurrence probability of the incoming customer service work order according to the work order portrait; and performing public sentiment early warning processing on the incoming customer service work order according to the public sentiment occurrence probability and a public sentiment early warning threshold.

In the implementation process of the above solution, the work order portrait is constructed from at least one of the work order dimension, the user dimension and the

order dimension, so as to predict the public sentiment occurrence probability of the work order according to the work order portrait. This solution uses at least one of the work order dimension, the user dimension and the order dimension to construct the work order portrait, which is beneficial to improving the accuracy of public sentiment early warning.

In an implementation manner of the first aspect, the step of predicting public sentiment occurrence probability of the incoming customer service work order according to the work order portrait includes: if the work order portrait includes at least two of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension, using a trained integrated learning model to predict the public sentiment occurrence probability of the incoming customer service work order according to the work order portrait.

In the implementation process of the above solution, when the work order portrait contains the public sentiment occurrence probabilities of multiple dimensions, by using the trained integrated learning model and combining the public sentiment occurrence probabilities of multiple dimensions to jointly predict the public sentiment occurrence probability of the incoming customer service work order, it is beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

In an implementation manner of the first aspect, the step of constructing a work order portrait according to an incoming customer service work order includes: determining a work order theme of the incoming customer service work order; and determining the public sentiment occurrence probability in the work order dimension of a current incoming customer service work order according to the public sentiment occurrence probability of a corresponding work order theme in historical work order themes.

In the implementation process of the above solution, the public sentiment occurrence probability in the work order dimension of the current incoming customer service work order can be quickly determined through the work order theme of the incoming customer service work order, which is beneficial to improving the efficiency of public sentiment early warning of the above customer service public sentiment early warning method.

In an implementation manner of the first aspect, the step of determining a work order theme of the incoming customer service work order includes: performing word segmentation processing on the incoming customer service work order; determining a word theme of words in the incoming customer service work order; and determining a work order theme of the incoming customer service work order according to the word theme of the words in the incoming customer service work order.

In the implementation process of the above solution, by performing word segmentation processing on the incoming customer service work order and determining the word theme of the words, thereby determining the work order theme of the incoming customer service work order, it is beneficial to improving the accuracy of determining the work order theme, and further beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

In an implementation manner of the first aspect, the step of determining the word theme of the words in the incoming customer service work order includes: performing random initialization processing on the word theme of the words in the incoming customer service work order; calculating, for each word in the incoming customer service work order and its word theme, a first proportion and a second proportion, wherein the first proportion is used to indicate a proportion of the words assigned to a current word theme in the incoming customer service work order, and the second proportion is used to indicate the proportion of the work orders that contain a current word and the work order themes thereof are assigned to the current word theme among the historical customer service work orders; calculating a word theme assignment probability according to the first proportion and the second proportion; updating the word theme according to the word theme assignment probability; and repeating and iterating the step of calculating the first proportion and the second proportion, the step of calculating the word theme assignment probability, and the step of updating the word theme, until a preset iteration stop condition is reached.

In the implementation process of the above solution, by continuously and iteratively updating the word theme in the incoming customer service work order, and then determining the work order theme of the incoming customer service work order according to the iteratively updated word theme, it is beneficial to improving the accuracy of determining the work order theme, and further beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

In an implementation manner of the first aspect, the step of constructing a work order portrait according to an incoming customer service work order includes: obtaining a user data associated with the incoming customer service work order; extracting user features from the user data; and using a trained user dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the user dimension according to the user features.

In the implementation process of the above solution, by predicting the public sentiment occurrence probability in the user dimension using the user features extracted from the user data associated with the incoming customer service work order, the work order portrait is enriched, which is beneficial to improving the accuracy of the public sentiment early warning of the above customer service public sentiment work order method.

In an implementation manner of the first aspect, the step of constructing a work order portrait according to an incoming customer service work order includes: obtaining an order data associated with the incoming customer service work order; extracting order features from the order data; and using a trained order dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the order dimension according to the order features.

In the implementation process of the above solution, by predicting the public sentiment occurrence probability in the order dimension using the order features extracted from the order data associated with the incoming customer service work order, the work order portrait is enriched, which is beneficial to improving the accuracy

of the public sentiment early warning of the above customer service public sentiment work order method.

In the second aspect, an embodiment of the present application provides a customer service public sentiment early warning apparatus. The apparatus includes:

a portrait construction module, configured to construct a work order portrait according to an incoming customer service work order, wherein the work order portrait includes at least one of public sentiment occurrence probability in work order dimension, public sentiment occurrence probability in user dimension, and public sentiment occurrence probability in order dimension;

a public sentiment occurrence probability prediction module, configured to predict the public sentiment occurrence probability of the incoming customer service work order according to the work order portrait; and

an early warning processing module, configured to perform public sentiment early warning processing on the incoming customer service work order according to the public sentiment occurrence probability and a public sentiment early warning threshold.

In the third aspect, an embodiment of the present application provides an electronic device, including: a processor, a memory, and a communication bus, wherein, the processor and the memory communicate with each other through the communication bus, the memory stores a computer program instruction executable by the processor, and when the computer program instruction is read and run by the processor, the method provided in the first aspect or any possible implementation manner of the first aspect is executed.

In the fourth aspect, an embodiment of the present application provides a computer-readable storage medium, wherein the computer-readable storage medium stores a computer program instruction, and when the computer program instruction is read and run by a processor, the method provided in the first aspect or any possible implementation manner of the first aspect is executed.

Other features and advantages of the present application will be set forth in the subsequent specification, and in part will become obvious from the specification, or can be understood by implementing the embodiments of the present application. The objectives and other advantages of the present application can be realized and obtained through the structures particularly pointed out in the written specification, claims and drawings.

Brief Description of Drawings

In order to illustrate the technical solutions of the embodiments of the present application more clearly, the following briefly introduces the figures that need to be used in the embodiments of the present application. It should be understood that the following figures only show some embodiments of the present application, and therefore should not be regarded as a limitation of the scope. For those of ordinary skill in the art, without creative efforts, other related figures can also be obtained according to these figures.

Fig. 1 is a schematic flowchart of the customer service public sentiment early warning method provided in an embodiment of the present application;

Fig. 2 is a schematic structural diagram of the customer service public sentiment early warning apparatus provided in an embodiment of the present application;

Fig. 3 is a schematic structural diagram of the electronic device provided in an embodiment of the present application.

Detailed Description of Embodiments

The following will describe the technical solutions in the embodiments of the present application in combination with the accompanying drawings in the embodiments of the present application. The following embodiments are only used to more clearly illustrate the technical solutions of the present application, and therefore are only used as examples and cannot be used to limit the protection scope of the present application.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the technical field of the present application. The terms used herein are only for the purpose of describing specific embodiments and are not intended to limit the present application. The terms "comprise" and "have" and any variations thereof in the specification and claims of the present application and the above description of the accompanying drawings are intended to cover non-exclusive inclusions.

In the description of the embodiments of the present application, technical terms "first" and "second" are only used to distinguish different objects, and cannot be understood as indicating or implying relative importance or implicitly indicating the quantity, specific order or primary-secondary relationship of the indicated technical features. In the description of the embodiments of the present application, the meaning of "multiple" is two or more, unless otherwise clearly and specifically defined.

When referring to "embodiment" herein, it means that the specific features, structures or characteristics described in combination with the embodiment can be included in at least one embodiment of the present application. The appearance of this phrase at various positions in the specification does not necessarily refer to the same embodiment, nor does it represent an independent or alternative embodiment that is mutually exclusive with other embodiments. Those skilled in the art explicitly and implicitly understand that the embodiments described herein can be combined with other embodiments.

In the description of the embodiments of the present application, the term "and/or" is merely a description of the association relationship of associated objects, indicating that there can be three relationships. For example, A and/or B can mean: A exists alone, A and B exist simultaneously, and B exists alone. In addition, the character "/" herein generally indicates that the associated objects before and after are in an "or" relationship.

At present, e-commerce platforms have become the main channels for consumers to shop online, and the customer service departments of e-commerce platforms need to handle a large number of consultation and complaint demands. In such an environment, users' satisfaction with the platform and their evaluation of the

e-commerce platform have become important issues. An important aspect of users' satisfaction with e-commerce platforms is whether public sentiment occurs. Therefore, it is possible to make preparations in advance to deal with the upcoming public sentiment by issuing early warnings about public sentiment, or to handle relevant issues in a timely manner before public sentiment occurs, so as to improve users' satisfaction with the platform .

Most of the public sentiment prediction methods in the related technologies create portraits of users, and judge the public sentiment occurrence probability of these users to issue public sentiment early warnings. However, since this solution only considers the user dimension, the accuracy of public sentiment early warnings is relatively low.

Based on this, an embodiment of the present application provides a customer service public sentiment early warning method. Different from the way of using user portraits to issue public sentiment early warnings in the related technologies, the above solution can construct the work order portrait from at least one of the work order dimension, the user dimension, and the order dimension, so as to predict the public sentiment occurrence probability of the work order according to the work order portrait. This solution uses at least one of the work order dimension, the user dimension, and the order dimension to construct the work order portrait, which is beneficial to improving the accuracy of public sentiment early warning.

The following provides a detailed introduction to the above customer service public sentiment early warning method. Please refer to Fig. 1. The embodiment of the present application provides a customer service public sentiment early warning method, which includes:

Step S110: construct a work order portrait according to the incoming customer service work orders,

wherein the work order portrait includes at least one of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension;

Step S120: predict the public sentiment occurrence probability of the incoming customer service work orders according to the work order portrait; and

Step S130: carry out public sentiment early warning processing on the incoming customer service work orders according to the public sentiment occurrence probability and a public sentiment early warning threshold.

The work orders in the above step S110 are documents and spreadsheets that record and track customer problems and needs. Customer service work orders refer to the work orders manually or automatically created when users raise problems or demands to the platform, which record one or more of the user's basic information, problem description, demand description, and processing progress, etc., for use by the customer service system.

The above customer service public sentiment refers to the public sentiment situation of the customer service department of an enterprise or organization. This kind of public sentiment usually involves customers' evaluations and opinions on the

service quality, service attitude, service efficiency, etc. of the enterprise, and is an embodiment of customers' comprehensive attitude towards the service department.

The public sentiment occurrence probability in the work order dimension in the above step S110 refers to the public sentiment occurrence probability in a single dimension obtained from the work order dimension. The solution for obtaining the public sentiment occurrence probability in the work order dimension is as follows:

As an optional implementation manner of the above customer service public sentiment early warning method, the above step S110 includes: determining the work order theme of the incoming customer service work orders; and determining the public sentiment occurrence probability in the work order dimension of the current incoming customer service work orders according to the public sentiment occurrence probability of the corresponding work order theme in the historical work order themes.

It can be understood that the public sentiment occurrence probability in the work order dimension of the current incoming customer service work orders can be determined by the public sentiment occurrence probability of the corresponding work order theme in the historical work order themes. The probability of public sentiment occurrence of the corresponding work order theme in the historical work order themes, in turn, is determined by the proportion of the work orders with public sentiment occurrence under the corresponding work order theme to the total number of historical work orders under that theme.

It can be understood that the above solution can use a rule-based theme extraction method to extract the work order theme of the incoming customer service work orders. Rule-based theme extraction methods include, for example, keyword matching, regular expressions, etc., and the rules can be artificially set extraction rules.

The above solution can quickly determine the public sentiment occurrence probability in the work order dimension of the current incoming customer service work orders through the work order theme of the incoming customer service work orders, which is beneficial to improving the efficiency of public sentiment early warning of the above customer service public sentiment early warning method.

In addition, it can be understood that the above work order theme can also be determined by a method based on reinforcement learning. The following introduces an optional implementation manner of the theme extraction method based on reinforcement learning:

As an optional implementation manner of the above customer service public sentiment early warning method, the step of determining the work order theme of the incoming customer service work orders includes: performing word segmentation processing on the incoming customer service work orders; determining the word theme of the words in the incoming customer service work orders; and determining the work order theme of the incoming customer service work orders according to the word theme of the words in the incoming customer service work orders.

It can be understood that a mature word segmentation model can be used to perform word segmentation processing on the incoming customer service work orders.

The word themes of the words in the above incoming customer service work orders and the work order themes of the incoming customer service work orders can

be obtained through word segmentation algorithms such as the NMF (Non-negative Matrix Factorization) algorithm, the LSA (Latent Semantic Analysis) algorithm, and the HDP (Hierarchical Dirichlet Process) algorithm. The NMF algorithm, LSA algorithm, and HDP algorithm are all relatively mature algorithms in the related technologies, and will not be elaborated in the embodiments of the present application.

In the above solution, by performing word segmentation processing on the incoming customer service work orders and determining the word theme of the words, thereby determining the work order theme of the incoming customer service work orders, it is beneficial to improving the accuracy of determining the work order theme, and further beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

As an optional implementation manner of the above customer service public sentiment early warning method, the step of determining the word theme of the words in the incoming customer service work orders includes: performing random initialization processing on the word theme of the words in the incoming customer service work orders; for each word in the incoming customer service work orders and its word theme, calculating the first proportion and the second proportion, wherein, the first proportion is used to indicate the proportion of words assigned to the current word theme in the incoming customer service work orders, and the second proportion is used to indicate the proportion of work orders whose work order themes are assigned to the current word theme among the historical customer service work orders that contain the current word; calculating the word theme assignment probability according to the first proportion and the second proportion; updating the word theme according to the word theme assignment probability; and repeating and iterating the step of calculating the first proportion and the second proportion, the step of calculating the word theme assignment probability, and the step of updating the word theme, until the preset iteration stop condition is reached. For example, this implementation manner includes:

for the incoming customer service work orders after word segmentation processing, randomly initializing the word themes of the words to one of the K themes (the K themes can be all the optional work order themes selected in advance);

for the incoming customer service work order D and the word W in the incoming customer service work order, calculating the first proportion and the second proportion, wherein, the first proportion is used to indicate the proportion of words assigned to the word theme of the current word W in the incoming customer service work order D, and the second proportion is used to indicate the probability of words assigned to the work order theme T among all the historical customer service work orders that contain the word W; in which,

the calculation method of the first proportion is:

$$P_1(T|D)$$

the calculation method of the second proportion is:

$$P_2(W|T)$$

the method of calculating the word theme assignment probability P_3 according to the first proportion and the second proportion is:

$$P_3 = P_1(T|D) * P_2(W|T)$$

updating the word theme according to the word theme assignment probability;
and

repeating and iterating the step of calculating the first proportion and the second proportion, the step of calculating the word theme assignment probability, and the step of updating the word theme, until the word theme no longer changes, or until the preset number of iterations is reached.

It can be understood that the work order theme calculated by the above solution can be an LDA (Latent Dirichlet Allocations) theme.

In the above solution, by continuously and iteratively updating the word theme in the incoming customer service work orders, and then determining the work order theme of the incoming customer service work orders according to the iteratively updated word theme, it is beneficial to improving the accuracy of determining the work order theme, and further beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

It can be understood that before performing word segmentation processing on the incoming customer service work orders, pre-processing such as content cleaning, removing special characters and punctuation marks can also be performed on the incoming customer service work orders.

The following provides a detailed introduction to the solution for obtaining the public sentiment occurrence probability in the user dimension:

As an optional implementation manner of the above customer service public sentiment early warning method, the above step S110 includes: obtaining the user data associated with the incoming customer service work orders; extracting user features from the user data; and using a trained user dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the user dimension according to the user features.

It can be understood that the incoming customer service work orders are associated with users. Therefore, user data can be obtained according to the users associated with the incoming customer service work orders. The user data includes age, region, and historical transaction behaviors, where historical transaction behaviors include but are not limited to placing orders, after-sales services, making inquiries, filing complaints, etc.

In addition, it can be understood that after obtaining the user data associated with the incoming customer service work orders, pre-processing such as missing value handling and feature binning can also be performed on the user data.

The above user dimension public sentiment occurrence probability prediction model can use the LightGBM model. The LightGBM model is a gradient boosting framework model based on the decision tree algorithm. The LightGBM model can be trained based on the existing public sentiment black samples at the user level, so that

the LightGBM model can be used to predict the public sentiment occurrence probability in the user dimension according to the user features.

The above solution predicts the public sentiment occurrence probability in the user dimension through the user features extracted from the user data associated with the incoming customer service work orders, thereby enriching the work order portrait, which is beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

The following provides an introduction to the solution for obtaining the public sentiment probability in the order dimension:

As an optional implementation manner of the above customer service public sentiment early warning method, the above step S110 includes: obtaining the order data associated with the incoming customer service work orders; extracting order features from the order data; and using a trained order dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the order dimension according to the order features.

It can be understood that the incoming customer service work orders are also associated with orders. Therefore, order data can be obtained according to the orders associated with the incoming customer service work orders. The order data includes but is not limited to the current transaction orders, historical transaction orders, commodity types, commodity prices, logistics time, etc.

In addition, it can be understood that after obtaining the order data associated with the incoming customer service work orders, pre-processing such as filling in missing values and feature binning can also be performed on the order data.

The above order dimension public sentiment occurrence probability prediction model can also use the LightGBM model. The LightGBM model can be trained based on the existing public sentiment black samples at the order level, so that the LightGBM model can be used to predict the public sentiment occurrence probability in the user dimension according to the order features.

The above solution predicts the public sentiment occurrence probability in the order dimension through the order features extracted from the order data associated with the incoming customer service work orders, thereby enriching the work order portrait, which is beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

The following provides a detailed introduction to step S120:

Since the work order portrait can include at least one of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension, the following provides a detailed introduction to two implementation manners: one where the work order portrait contains only one public sentiment occurrence probability and the other where the work order portrait contains multiple public sentiment occurrence probabilities:

In the first implementation manner, the work order portrait contains only one public sentiment occurrence probability. In this case, step S120 includes:

determining the one public sentiment occurrence probability contained in the above work order portrait as the public sentiment occurrence probability of the incoming customer service work order.

In the second implementation manner, the work order portrait contains multiple public sentiment occurrence probabilities. In this case, step S120 includes:

using a trained integrated learning model to predict the public sentiment occurrence probability of the incoming customer service work order according to the work order portrait.

Integrated learning refers to the idea of combining individual algorithms in machine learning for modeling. There are three methods of integrated learning: Bagging (Bootstrap Aggregation), Boosting, and Stacking. The core idea of Bagging is joint voting, where each base model has only one vote, and the result with the most votes is taken as the final result. The core idea of Boosting is to select the "elite" models through testing and screening basic the models, assign more voting rights to the elite models and fewer to the other models, and then obtain the final result by aggregating the votes of all models. The Stacking method consists of two parts: a meta-estimator and a base estimator. The meta-estimator takes the prediction results of the base estimator as input variables and finally makes a prediction of the explained variable. The base estimator can be combined by different algorithm models (such as logistic regression and KNN), and the meta-estimator can also select completely different algorithm models (such as decision trees) to achieve a better effect of finally reducing the error.

The integrated learning model in the embodiments of the present application can adopt the Boosting method for learning. For example, by combining historical public sentiment samples, the influence relationships of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension on the public sentiment occurrence probability of the incoming customer service work orders are respectively determined. For example, it is determined that the influence degree of the public sentiment occurrence probability in the work order dimension on the public sentiment occurrence probability of the incoming customer service work orders is relatively large, while the influence degrees of the public sentiment occurrence probability in the user dimension and the public sentiment occurrence probability in the order dimension on the public sentiment occurrence probability of the incoming customer service work orders are relatively small. Therefore, a larger voting right can be given to the public sentiment occurrence probability in the work order dimension, and smaller voting rights can be given to the public sentiment occurrence probability in the user dimension and the public sentiment occurrence probability in the order dimension. Based on this, the following integrated learning method can be adopted:

(1) When the public sentiment occurrence probability in the work order dimension is high, if the public sentiment occurrence probability in the user dimension is high, or the public sentiment occurrence probability in the order dimension is high, or the public sentiment occurrence probability in the user dimension is moderate and the public sentiment occurrence probability in the order dimension is moderate, the integrated

learning model assigns a relatively high value to the public sentiment occurrence probability;

(2) When the public sentiment occurrence probability in the work order dimension is moderate, if the public sentiment occurrence probability in the user dimension is high and the public sentiment occurrence probability in the order dimension is high, the integrated learning model assigns a relatively high value to the public sentiment occurrence probability;

(3) When the public sentiment occurrence probability in the work order dimension is low, the integrated learning model assigns a relatively low value to the public sentiment occurrence probability.

In the above solution, when the work order portrait contains the public sentiment occurrence probabilities of multiple dimensions, by using the trained integrated learning model and combining the public sentiment occurrence probabilities of multiple dimensions to jointly predict the public sentiment occurrence probability of the incoming customer service work orders, it is beneficial to improving the accuracy of public sentiment early warning of the above customer service public sentiment early warning method.

The following provides a detailed introduction to step S130:

It can be understood that the public sentiment early warning threshold in step S130 can be a preset public sentiment early warning threshold, or it can be the optimal public sentiment early warning threshold regularly selected or real-time selected with the recall rate and precision rate of risk work orders as evaluation indicators.

The embodiments of the present application also provide a specific implementation manner of the above customer service public sentiment early warning method in a certain scenario. In this scenario, the work order portrait includes the public sentiment occurrence probabilities of three dimensions: the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension. In this case, the above customer service public sentiment early warning method can include:

Step 1: data collection;

Obtain the incoming customer service work orders and the order data and user data associated with the incoming customer service work orders;

Step 2: data sorting in the work order dimension;

Perform pre-processing such as content cleaning, removing special characters and punctuation marks on the incoming customer service work orders, and perform word segmentation processing on the incoming customer service work orders;

Step 3: random initialization of word theme;

For the incoming customer service work orders, randomly initialize the word theme of the words as one of the K themes (the K themes are the optional themes selected in advance);

Step 4: iteration of word theme;

For the incoming customer service work order D , browse the word W , and calculate $P(T|D)$ and $P(W|T)$, where $P(T|D)$ represents the proportion of words assigned to the theme T in the incoming customer service work order D ; and $P(W|T)$ represents the proportion of words assigned to the theme T among all historical customer service work orders that contain the word W ;

Considering all other words and their theme assignments, reassign the word W and the theme T with the probability $P(T|D)*P(W|T)$;

Step 5: establishment of the LDA theme model;

Repeat and iterate the above Step 4 until the word theme is stable, and jointly determine the work order theme of the incoming customer service work order according to the word themes of the words in the incoming customer service work order;

Step 6: calculation of the public sentiment occurrence probability in the work order dimension;

Based on the work order theme of the incoming customer service work order and the public sentiment occurrence probability of the corresponding work order theme in the historical customer service work orders, jointly determine the public sentiment occurrence probability in the work order dimension;

Step 7: data sorting in the user dimension;

The user data includes but is not limited to: age, region, historical transaction behaviors;

Among them, historical transaction behaviors include but are not limited to: placing orders, after-sales services, making inquiries, filing complaints, etc.;

It can be understood that after sorting the data, pre-processing such as filling in missing values and feature binning can also be performed on the data;

Step 8: calculation of the public sentiment occurrence probability in the user dimension;

Based on the LightGBM supervised model trained with the existing public sentiment black samples in the user dimension, predict the public sentiment occurrence probability in the user dimension;

Step 9: data sorting in the order dimension;

The order data includes but is not limited to: current transaction order information, historical transaction order information, commodity types, commodity prices, logistics time, etc.;

It can be understood that after sorting the data, pre-processing such as filling in missing values and feature binning can also be performed on the data;

Step 10: calculation of the public sentiment occurrence probability in the order dimension;

Based on the LightGBM supervised model trained with the existing public sentiment black samples in the order dimension, predict the public sentiment occurrence probability in the order dimension;

Step 11: integration of features of real-time incoming customer service work orders;

Based on the unique ID of the real-time incoming customer service work order, associate the work order portrait of the incoming customer service work order, and integrate it into integrated learning features;

Step 12: real-time model training;

Based on the existing sample data, through integrated learning, determine the optimal public sentiment early warning threshold by using the recall rate and precision rate of risk work orders as evaluation indicators;

Step 13: based on the optimal public sentiment early warning threshold, conduct real-time customer service public sentiment early warning for the incoming customer service work orders, and promptly conduct relevant processing for the customer service work orders with early warnings.

It should be noted that the user-related data pointed out in the above content is obtained after the user's consent.

Please refer to Fig. 2. Based on the same inventive concept, an embodiment of the present application also provides a customer service public sentiment early warning apparatus 200. The apparatus includes:

a portrait construction module 210, configured to construct a work order portrait according to the incoming customer service work orders, wherein, the work order portrait includes at least one of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension;

a public sentiment occurrence probability prediction module 220, configured to predict the public sentiment occurrence probability of the incoming customer service work orders according to the work order portrait; and

an early warning processing module 230, configured to carry out public sentiment early warning processing on the incoming customer service work orders according to the public sentiment occurrence probability and a public sentiment early warning threshold.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the above public sentiment occurrence probability prediction module 220 is specifically configured to: when the work order portrait includes at least two of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension, use a trained

integrated learning model to predict the public sentiment occurrence probability of the incoming customer service work orders according to the work order portrait.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the above portrait construction module 210 includes:

- a work order theme determination unit, configured to determine the work order theme of the incoming customer service work orders;

- a work order dimension public sentiment occurrence probability determination unit, configured to determine the public sentiment occurrence probability in the work order dimension of the current incoming customer service work orders according to the public sentiment occurrence probability of the corresponding work order theme in the historical work order themes.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the above work order theme determination unit is specifically configured to: perform word segmentation processing on the incoming customer service work orders; determine the word theme of the words in the incoming customer service work orders; and determine the work order theme of the incoming customer service work orders according to the word theme of the words in the incoming customer service work orders.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the step of determining the word theme of the words in the incoming customer service work orders includes: performing random initialization processing on the word theme of the words in the incoming customer service work orders; for each word in the incoming customer service work orders and its word theme, calculating the first proportion and the second proportion, wherein, the first proportion is used to indicate the proportion of words assigned to the current word theme in the incoming customer service work orders, and the second proportion is used to indicate the proportion of work orders whose work order themes are assigned to the current word theme among the historical customer service work orders that contain the current word; calculating the word theme assignment probability according to the first proportion and the second proportion; updating the word theme according to the word theme assignment probability; and repeating and iterating the step of calculating the first proportion and the second proportion, the step of calculating the word theme assignment probability, and the step of updating the word theme, until the preset iteration stop condition is reached.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the above portrait construction module 210 includes:

- a user data acquisition unit, configured to obtain the user data associated with the incoming customer service work orders;

- a user feature extraction unit, configured to extract user features from the user data;

- a user dimension public sentiment occurrence probability prediction unit, configured to use the trained user dimension public sentiment occurrence probability

prediction model to predict the public sentiment occurrence probability in the user dimension according to the user features.

As an optional implementation manner of the above customer service public sentiment early warning apparatus, the above portrait construction module 210 includes:

an order data acquisition unit, configured to obtain the order data associated with the incoming customer service work orders;

an order feature extraction unit, configured to extract order features from the order data; and

an order dimension public sentiment occurrence probability prediction unit, configured to use the trained order dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the order dimension according to the order features.

Fig. 3 is a schematic diagram of an electronic device provided in an embodiment of the present application. Referring to Fig. 3, the electronic device 300 includes: a processor 310, a memory 320, and a communication interface 330, which are interconnected and communicate with each other through a communication bus 340 and/or other forms of connection mechanisms (not shown).

Among them, the memory 320 includes one or more memories (only one is shown), which can be, but is not limited to, Random Access Memory (RAM), Read Only Memory (ROM), Programmable Read-Only Memory (PROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), etc. The processor 310 and other possible components can access the memory 320 and read and/or write data therein.

The processor 310 includes one or more processors (only one is shown), which can be an integrated circuit chip with signal processing capabilities. The above processor 310 can be a general-purpose processor, including a Central Processing Unit (CPU), a Micro Controller Unit (MCU), a Network Processor (NP), or other conventional processors; it can also be a special-purpose processor, including a Digital Signal Processor (DSP), an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA), or other programmable logic devices, discrete gate or transistor logic devices, discrete hardware components

The communication interface 330 includes one or more communication interfaces (only one is shown), which can be used to communicate directly or indirectly with other devices for data interaction. For example, the communication interface 330 can be an Ethernet interface; it can be a mobile communication network interface, such as the interface of 3G, 4G, or 5G networks; or it can be other types of interfaces with data sending and receiving functions.

One or more computer program instructions can be stored in the memory 320, and the processor 310 can read and run these computer program instructions to implement the customer service public sentiment early warning method provided in the embodiments of the present application and other desired functions.

It can be understood that the structure shown in Fig. 3 is only schematic. The electronic device 300 may also include more or fewer components than those shown in Fig. 3, or have a configuration different from that shown in Fig. 3. The components shown in Fig. 3 can be implemented by hardware, software, or a combination thereof. For example, the electronic device 300 can be a single server (or other device with computing and processing capabilities), a combination of multiple servers, a cluster of a large number of servers, etc., and it can be either a physical device or a virtual device.

An embodiment of the present application also provides a computer-readable storage medium, which stores a computer program instruction thereon. When the computer program instructions stored on the computer-readable storage medium are read and run by the processor of a computer, the customer service public sentiment early warning method provided in the embodiments of the present application is executed. For example, the computer-readable storage medium can be implemented as the memory 320 in the electronic device 300 in Fig. 3.

In the embodiments provided in the present application, it should be understood that the disclosed device and method can be implemented in other ways. The device embodiments described above are merely illustrative. For example, the division of units is only a logical functional division, and there may be other division methods in actual implementation. For another example, multiple units or components can be combined or integrated into another system, or some features can be ignored or not executed. In addition, the coupling, direct coupling, or communication connection shown or discussed among them can be an indirect coupling or communication connection through some communication interfaces, devices, or units, and it can be in the form of electrical, mechanical, or other types.

In addition, the units described as separate components may or may not be physically separated, and the components displayed as units may or may not be physical units, that is, they may be located in one place, or may be distributed over multiple network units. Some or all of the units can be selected according to actual needs to achieve the purpose of the solution of this embodiment.

Furthermore, the functional modules in the various embodiments of the present application can be integrated together to form an independent part, or each module can exist separately, or two or more modules can be integrated to form an independent part.

The above are only the embodiments of the present application, and are not intended to limit the protection scope of the present application. For those skilled in the art, the present application can have various modifications and changes. Any modifications, equivalent replacements, improvements, etc. made within the spirit and principles of the present application should be included in the protection scope of the present application.

What is claimed is:

1. A customer service public sentiment early warning method, comprising steps of:

constructing a work order portrait according to an incoming customer service work order, wherein the work order portrait comprises at least one of public sentiment occurrence probability in work order dimension, public sentiment occurrence probability in user dimension, and public sentiment occurrence probability in order dimension;

predicting public sentiment occurrence probability of the incoming customer service work order according to the work order portrait; and

performing public sentiment early warning processing on the incoming customer service work order according to the public sentiment occurrence probability and a public sentiment early warning threshold.

2. The customer service public sentiment early warning method according to claim 1, wherein the step of predicting public sentiment occurrence probability of the incoming customer service work order according to the work order portrait comprises:

If the work order portrait comprises at least two of the public sentiment occurrence probability in the work order dimension, the public sentiment occurrence probability in the user dimension, and the public sentiment occurrence probability in the order dimension, using a trained integrated learning model to predict the public sentiment occurrence probability of the incoming customer service work order according to the work order portrait.

3. The customer service public sentiment early warning method according to claim 1, wherein the step of constructing a work order portrait according to an incoming customer service work order comprises steps of:

determining a work order theme of the incoming customer service work order; and

determining the public sentiment occurrence probability in the work order dimension of a current incoming customer service work order according to the public sentiment occurrence probability of a corresponding work order theme in historical work order themes.

4. The customer service public sentiment early warning method according to claim 3, wherein the step of determining a work order theme of the incoming customer service work order comprises steps of:

performing word segmentation processing on the incoming customer service work order;

determining a word theme of words in the incoming customer service work order; and

determining the work order theme of the incoming customer service work order according to the word theme of the words in the incoming customer service work order.

5. The customer service public sentiment early warning method according to claim 4, wherein the step of determining a word theme of words in the incoming customer service work order comprises steps of:

performing random initialization processing on the word theme of the words in the incoming customer service work order;

calculating, for each word in the incoming customer service work order and its word theme, a first proportion and a second proportion, wherein the first proportion is used to indicate a proportion of the words assigned to a current word theme in the incoming customer service work order, and the second proportion is used to indicate a proportion of the work orders that contain a current word and the work order themes thereof are assigned to the current word theme among the historical customer service work orders;

calculating a word theme assignment probability according to the first proportion and the second proportion;

updating the word theme according to the word theme assignment probability; and

repeating and iterating the step of calculating the first proportion and the second proportion, the step of calculating the word theme assignment probability, and the step of updating the word theme, until a preset iteration stop condition is reached.

6. The customer service public sentiment early warning method according to any one of claims 1 to 5, wherein the step of constructing a work order portrait according to an incoming customer service work order comprises steps of:

obtaining a user data associated with the incoming customer service work order;

extracting user features from the user data; and

using a trained user dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the user dimension according to the user features.

7. The customer service public sentiment early warning method according to any one of claims 1 to 5, wherein the step of constructing a work order portrait according to an incoming customer service work order comprises steps of:

obtaining an order data associated with the incoming customer service work order;

extracting order features from the order data; and

using a trained order dimension public sentiment occurrence probability prediction model to predict the public sentiment occurrence probability in the order dimension according to the order features.

8. A customer service public sentiment early warning apparatus, comprising:

a portrait construction module, configured to construct a work order portrait according to an incoming customer service work order, wherein the work order portrait comprises at least one of public sentiment occurrence probability in work order

dimension, public sentiment occurrence probability in user dimension, and public sentiment occurrence probability in order dimension;

a public sentiment occurrence probability prediction module, configured to predict the public sentiment occurrence probability of the incoming customer service work order according to the work order portrait; and

an early warning processing module, configured to perform public sentiment early warning processing on the incoming customer service work order according to the public sentiment occurrence probability and a public sentiment early warning threshold.

9. An electronic device, comprising: a processor, a memory, and a communication bus, wherein

the processor and the memory communicate with each other through the communication bus;

the memory stores a program instruction executable by the processor, and

the processor is capable of executing the method according to any one of claims 1 to 7 by invoking the program instruction.

10. A computer-readable storage medium, storing a computer instruction, wherein the computer instruction, when run by a computer, enables the computer to execute the method according to any one of claims 1-7.