

# VR-Based Interactive System for Simulating Psychological Stress Relief in Deep Learning

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**Abstract:** In this paper, the goal of text mining is to extract meaningful and valuable content from massive text. Text mining is different from traditional data mining. Traditional data mining is usually processed with structured data, while text mining is usually unstructured, these text data can not be directly recognized by computers, and need to be transformed into structured data with the help of text extraction theory and technology, we need to do chinese word segmentation, remove stop words, word frequency statistics, and so on, and then extract useful information by data extraction and statistical analysis.

**Keywords:** wireless sensor networks, intelligent workshop products, moving target tracking, untraced Kalman filter, TF-IDF algorithm, deep Learning, LSTM

## 1. Introduction

In recent years, the technology of conversational applied language based on deep learning has developed rapidly, and clinical psychological counseling is a typical field to achieve the goal[1]. At present, there are some problems in domestic psychological consultation industry, such as unbalanced supply and demand, uneven professionalism of practitioners, imperfect service system, low public acceptance, and great consumption of time and financial resources, etc. , the urgent need for mental health makes people look at the theory of deep learning.

In 2006, Geoff Hinton published a paper in the journal Science on the concept of deep learning, which explores how hierarchical abstractions can be used to automatically extract multiple layers of features from data, that is, the original feature space is transformed into a new feature space by layer-by-layer feature transformation to promote classification or prediction. Collobert, Weston first put forward a method that can effectively use pre-trained word embedding, which forms the basis of many methods. Text mining is a technique for discovering unknown and valuable information and processes in a text database. It utilizes the knowledge and skills of computers, machine learning, natural language processing, and statistics, this information is quickly extracted from the mass of text and applied to better organize and refer to it [2]. Because of its wide application and importance, it has been paid more and more attention by researchers in the field of text-related research.

## 2. Methodology

### 2.1 TF-IDF algorithm to calculate text heat

By using the CountVectorizer class, we can vectorize the text of the input system so that the frequency of each keyword is taken as the value of the corresponding feature, it is too one-sided to consider only the frequency, but also the number of occurrences in the corpus in its documents.

Term Frequency-Inverse Document Frequency (TF-IDF) algorithm is a commonly used method for calculating word importance in documents. It combines Term Frequency (TF) and Inverse Document Frequency (IDF). TF refers to the number of times a word appears in a document, indicating the importance of the word to the article. IDF measures the importance of a word in a document set, i.e. the fewer documents contain the word, the more discriminative the entry.

The TF-IDF algorithm, first proposed by Jones KS, can adjust the weight of a keyword in a text to measure the importance of a word or a keyword in a text. The TF-IDF algorithm is the product of TF and IDF expressed as follows:

TF (Term-Frequency) word frequency, the number of times a word appears in a document, expressed as follows:

$$TF = \frac{m}{M} \quad (1)$$

Among them, M stands for the number of features in the text, M stands for the total number of words in the text. IDF (LNVERSE Document-Frequency) is an inverse document frequency, expressed as follows:

$$IDF = \log\left(\frac{N}{n} + 0.01\right) \quad (2)$$

Where n is the total number of texts and N is the total number of texts containing a feature item. The feature extraction function of TF-TDF is:

$$F(w) = TF(w).IDF(w) \quad (3)$$

The normalized TF-IDF formula is as follows:

$$W_{ij} = \frac{tf_{ij} \cdot \log\left(\frac{N}{n_{ij}} + 0.01\right)}{\sqrt{\sum_{j=1}^M \left[tf_{ij} \cdot \log\left(\frac{N}{n_{ij}} + 0.01\right)\right]^2}} \quad (4)$$

Among them,  $W_{ij}$  indicating the weight of a feature item,  $tf_{ij}$  indicating the frequency of a feature item existing in the text of a counseling guest,  $\log\left(\frac{N}{n_{ij}} + 0.01\right)$  is the inverse text frequency, N denotes the total number of texts in the interactive system with the type input VR stress relief,  $n_{ij}$  represents the amount of text in which a feature item exists.

## 2.2 Long Short Term Memory Networks

Deep Learning (DL) is a new field developed in artificial neural networks, and it is developing rapidly towards artificial intelligence [3]. DL is the technique of building and training an artificial neural network that simulates the human brain and is used to analyze learning data. The technique is characterized by mimicking transmission between brain neurons, in which each neuron receives and processes information, which is then transferred to its neighboring neurons. By constructing a deep nonlinear network structure, changing the hidden nodes, learning the most essential features of data, feature transformation layer deep, the feature representation in the original space of the sample data is transformed into the new feature space, and the intrinsic information of the classification and prediction data is obtained finally. Nowadays, DL has been widely used in data mining, computer vision, natural language processing and other related fields.

Recurrent Neural Network (RNN) is a kind of Neural Network structure with memory function, which can deal with the correlation between input values. Its main feature is that loop connections are added between the nodes of the neural network so that the nodes can receive the output of the previous moment as the input of the current moment. This circular connection helps the network "Remember" past information and apply it to current calculations.

In RNN, each node has its own state, including a hidden state and an output state. The hidden state is used to remember past information, and the output state is used to output the result of the current moment. At each moment, the RNN receives a new input, computes a new output, and updates the state of the node, each time taking the previous output to the next hidden layer for training, reflects the relevance of learning before and after. Through continuous iteration, RNN can process any length of input sequence, and output the corresponding sequence. The features that RNN learns at each step of

the network can be shared at all time steps. LSTM model is a long-short-term memory model, which is established to improve the shortcomings of RNN model, especially the most fatal disadvantage of RNN is easy to occur gradient explosion and gradient disappearance. So LSTM model can also be regarded as a special RNN model [4]. The point of improvement is that the LSTM model adds the structure of the control door. So that it can solve the problem of long-term dependence. Good transfer of historical valid data. Because of the above characteristics, others have advantages in time series prediction , as shown in Figure 1.

The unit structure diagram of the LSTM model, shown below, differs from RNN in that it has more cellular states . Although the overall structure is still the same as RNN, the hidden state is calculated based on the current input, and the previous hidden state. The unique gate structure of LSTM model is added [5]. These include input door, forgotten door and output door. Its function is mainly to control the increase or deletion of information. The role of long-term memory information has been improved [6].

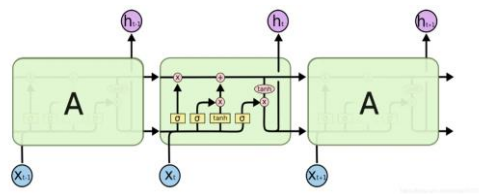


Figure 1: The structure of LSTM

### 3. Results and discussion

#### 3.1 Data pre-processing

The experimental data are a psychological counseling corpus constructed by the interactive system of virtual reality (VR) simulating psychological stress relief. After calculating the text heat by TF-IDF algorithm, the data can be divided into the following three types, 24,000 data points on family relationships, campus stress, and relationships. In a 3:2 ratio, 14,400 pieces of data were used as training data and 9,600 pieces of data were used as test data.

#### 3.2 Construction of LSTM neural network model training

The training model is to find the optimal parameters of the model under the condition of certain cost LSTM or loss function. The optimal parameter is the parameter that can make the lowest cost or loss of the model. The process flow of model training is as follows shown in Figure 2:

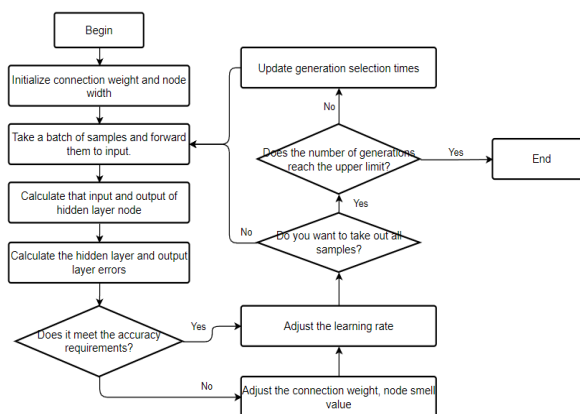


Figure 2: The chart of LSTM

The choice of the model parameters also directly affects the training results of the model, so it is necessary to set the specific parameters before the model training. Such as:

Loss function. The loss function used in this paper for LSTM is the mean square error (MSE), which reflects the square of the distance between all predicted values and the true values. The smaller

the value is, the higher the prediction accuracy is. The formula is as follows:

$$MSE = \frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2 \tag{5}$$

**Iterative epoch number.** The iteration epoch number means the number of iterations that will be trained for all samples. When the number of iterations is too small, it will not work well, but if the number of iterations is too large, it will lead to the model over-fitting state. choosing a suitable number of iterations is critical. This article iterates 90 times.

**Dropout ratio.** Dropout ratio is a technique in training that allows the model to randomly ignore hidden neurons. A value of 0.1 means that one-tenth of the hidden neurons will be randomly ignored at each cycle. This makes the model insensitive to the characteristic weights of neurons. It is often used to solve the over-fitting problem of the model.

The experiment is based on the Python and based on Tensorflow's deep learning framework. Other model parameters such as optimizer selection, batch size selection will affect the results of model training. In this paper, LSTM model parameters are set as follows shown in Table 1:

Table 1: Parameter setting value

Parameter	Value
Loss function	MSE
Optimizer	Adam
Iterative epoch number	90
Batch size	128
Dropout ratio	0.1

### 3.3 Results and discussion

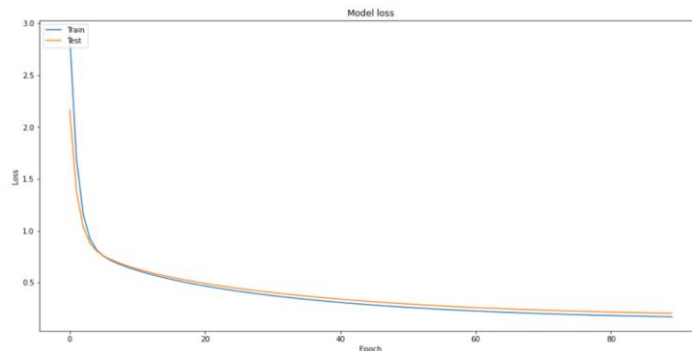


Figure 3: The chart of model loss

As can be seen from the graph, the loss value gradually decreases as the epoch, or the number of iterations, increases. This shows that the model works well, as shown in Figure 3 and table 2.

Table 2: Experimental results

A corpus of psychological counseling	Family relationships, campus pressures	Family relationships, campus pressures	Feelings of love and marriage
The number of data sets	6328	7889	9783
Average Score	0.897	0.951	0.926
Weighted average score	0.925		

### 4. Conclusion

In this paper, the TF-IDF algorithm is used to calculate the text heat, three types of mental semantic database are constructed and the interactive system of virtual reality simulation mental stress relief based on deep learning is established. It improves the validity and accuracy of the feature extraction, enhances the interactive experience between the system and users, and meets the needs of people for

mental health.

### References

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