

## Russian Grammar Network Teaching System Research

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**Abstract**— This paper presents a Russian grammar network teaching system based on B/S structure, which aims to solve the boring and ineffective problems in Russian grammar teaching. The structure and function of the network teaching system is introduced firstly, and then, the Russian pronunciation segmentation, scoring method based on the HMM and the scoring criteria setting are covered in detail. Experiment shows that this method can get better segmentation result and is available for Russian grammar network teaching system.

**Keywords**- Network Teaching, B/S structure, Hidden Markov Model, Viterbi algorithm, Speech Score

### I. INTRODUCTION

The Russian grammar network teaching system for students is able to provide a variety of learning contents, including the course textbook learning, extracurricular knowledge learning, practical exams, real-time news acquiring. Those four learning styles achieve the organic combination of the ways, so to ensure that the teaching and learning methods could be well-organized, diversified, and clarified. The system is composed of the exam and quiz realized in video, audio, and text and the rich structured library repository. The repository is a systematic and theoretical text material library, based on flash animation video data, audio data of a real person in order to explain, with clear grammatical category, the level of difficulty of the exam, the problems encountered in the learning process, and to give answers to the questions and answers. Through the online classroom, the system establishes answers, collaboration, discussion and learning competition and a variety of teaching methods to enhance student participation [1]. System can track students' online learning, record students' learning through practical exam and other means of analysis of the recent trends of students' learning and mastering a comprehensive knowledge.

### II. THE ARCHITECTURE AND FUNCTION OF THIS SYSTEM

Currently, the design mode structure of software system has two applications, C/S (client / server) mode and B/S (browser / server). C/S structure is the structure of the client and server (client / server), it works when each of the terminal computer installs giant client systems to access the remote server through the network to exchange data. This model is applicable to small LAN, so it has a relatively

narrow range of applicability. With the development of computer network technology, B/S structure, the browser and the server (Browser/Server) structure mode, works in this way that the user accesses the remote server through the system browser to realize database data exchange. The advantages of the modes is that for the user, client IE browser developers concentrate the core functional part of the system functions on the server so as to simplify the development and maintenance of the system [2].

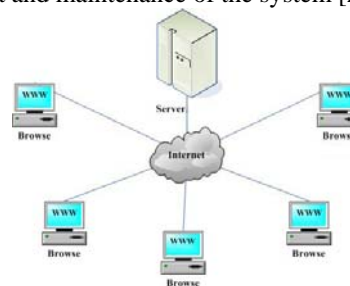


Figure 1. B/S structure diagram

There are three types of users for the system, teachers, students and administrator, with three modules, teacher module, student module and the administrator module, so we need to design the entire system functions in accordance with the user points [3].

**Teacher's modules:** the users have teacher privileges to log on to the teacher module, including teachers teaching, learning content management and monitoring, to add, modify course content, and uploaded learning materials. Teachers can organize learning exchanges, job management, setting examinations and teaching activities and can also manage the exam, personal data and information at the same time. **Students Module:** student privileges user log on to the student module, to learn the student curriculum learning exchanges and discussions, to submit jobs, practice exam learning activities, and also manage personal data and information. **Administrator modules:** user with administrator privileges login on to administrator module, who works as an administrator in the administrator module of the system, to take care of the system settings management. System function structure diagram is shown in the following, which tells the detailed module division, and explain the function of the module [4].

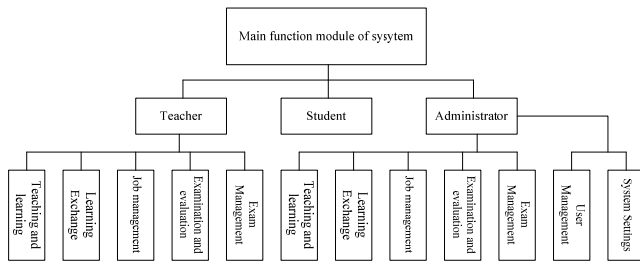


Figure 2. System function diagram

**Main function of the teacher system module:**

The teaching management module has three types of learning resources, course textbook knowledge, curricular knowledge, and the real-time news. Teachers can upload module, modify, delete the course syllabus, teaching plans, lecture notes, upload teaching video, courseware specific information, and can also add, modify, delete the extra-curricular knowledge and the real-time news materials [5].

Learning exchange module is available for the communication and exchange between teachers and students, which provide a good platform for students; teachers can make learning focus and difficult problem to emphasize, to arouse the attention of students, while answer students' questions.

Job management module includes the functions to layout, modify, and delete jobs, browse jobs, shut down operations and feedback operations functions. Teachers provides teaching content assignments and the upload learning content, while students can browse assignment, submit homework and other steps, to submit teacher assignments. Teachers can submit for students critiquing, give scores, and scrutinize the results and achievements which the module would feedback timely to students.

Examination and evaluation module is an important teaching link, with which teachers can better understand students' mastery of knowledge. With the module, teachers can manage the questions subjects, questions, examination papers, and also set the exam questions, after students submit exam papers, the system can score automatically and the results would feed back to the students instantly.

Exam management module supports the online exercises and exam. The exams can be classified according to the type of syntax to establish, add, view, delete questions, and item difficulty level is set.

**Main function of student system module:**

Learning module helps students to learn online curriculum resources, and the teaching resources can query for video, voice and content learning, and can also expand curricular knowledge.

Learning exchange module makes students to communicate with the teacher online to deal with the problems encountered in their learning, students can submit their own questions, and can also browse other students' questions.

Job management module is used when students want to view teachers' assignments, teach handsome assignments, answer and save, upload, submit jobs.

Examination and evaluation module: Student network test is usually set by the teacher; at the end of the examination, the system can automatically give the results of objective questions.

**Functions of administrator system:**

User management module: the module's function is to manage the system's users (teachers, students, and administrators). Administrators can audit the personal information of teachers or students, to modify already registered teacher or student information, and can see the teachers' or students' registration, a teacher or student can be removed from the system. The highest authority of the administrator can view all user information; you can also add a new administrator to the system, or delete an administrator.

System management module: you can set some basic parameters of the system, such as the type of attachment, picture size, etc. Teachers, students and administrators log on to the system with distinguished identity; different users will enter different functional subsystems. The module is determined according to the user's name and passwords, teachers, while students or administrators shunt in login, that is, teachers enter teacher interface, students enter the student interface, and administrators enter the administrator interface.

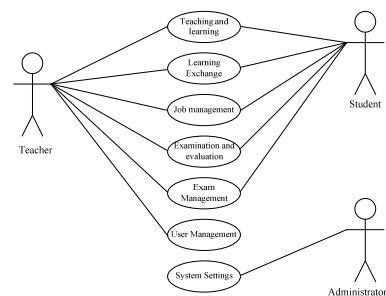


Figure 3. Top-level function diagram

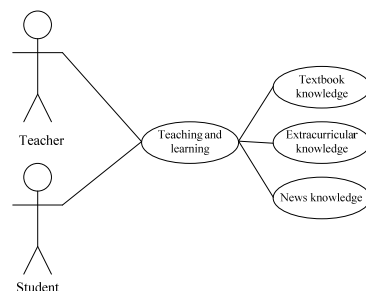


Figure 4. Teaching function diagram

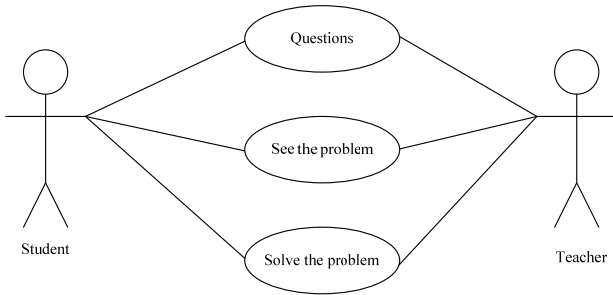


Figure 5. Learning Exchange schematic diagram

### III. SPEECH SCORE RESEARCH BASED ON HMM

Verbal Learning has historically been an important content of the Russian language teaching process, the only clear standard pronunciation enables us to express the correct view in the Russian exchanges, visible pronunciation score is a very important part of interactive smart Russian learning system, the module can feedback to the students the good or bad Russian pronunciation quality, help students master the pronunciation skills, improve pronunciation quality [6]. The basic idea for pronunciation scoring is to choose a reference or a standard measure for the quality of our pronunciation, usually used in two ways:

- (1) By means of DTW technology with standard voice and data feature.
- (2) By means of a statistical model of HMM score.

Hidden Markov Model is a statistical model, with a double random process. A heavy random process is used to describe the statistical characteristics of non-stationary signals and short-time plateau is observed, while another re-describes how to convert a short-term plateau to the next short-term plateau, and that short-term steady statistical characteristics, dynamic characteristic and heavy stochastic process cannot be observed, which is hidden in the observed sequence. In the process, we can hear the fat sound of human voice, which corresponds to the first re-random process, but we can not hear the voice infer the mutual position of the throat, tongue and oral, that vocal organs make the change invisible, which in turn corresponds to the second double random process. Visible HMM model can well simulate our pronounce process [7].

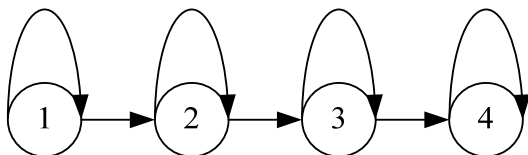


Figure 6. Hidden Markov Model

Assuming HMM model state is  $\{1, 2, \dots, N\}$ , each state of the observation symbol can be set as  $V = \{v_1, v_2, \dots, v_M\}$ , Observed sequence is  $O = \{o_1, o_2, \dots, o_\gamma\}$ ,  $\gamma$  shows the observed length of the sequence. Then HMM can be defined

as  $\lambda = (M, N, A, B, \pi)$ , each of these parameters are described below.  $M$  represents the number of symbols of each state which can be observed.  $N$  represents the number of states of the hidden Markov model.  $A$  is the state transition probability matrix.  $B$  is the observation symbol probability distribution matrix.  $\pi$  is the initial state probability vector. The above figure is a more common, simpler hidden Markov chain, it is known as left-right hidden Markov chain.

The HMM model involves three basic questions:

- (1) The model assessment question.
- (2) The best path problem.
- (3) Model training

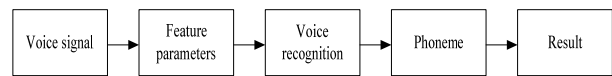


Figure 7. Speech recognition score model

According to the figure, we know that the speech recognition process, in fact, is the process of converting voice into a word or phrase, and the minimum audible units of Russian words or phrases is phoneme, here it comes to solve the problem of the optimal path, that is, for a given observation sequence  $O = \{o_1, o_2, \dots, o_\gamma\}$ , and model  $\lambda = (M, N, A, B, \pi)$  calculates the best state sequence of the model for the observed sequence  $Q = \{q_1, q_2, \dots, q_\gamma\}$ , it can be learned in accordance with the best state sequence of its corresponding phoneme [8].

Problem-solving optimal state sequence is the best path which is not only the core of the speech recognition problem, but also the key step of pronunciation scoring. The Viterbi algorithm is the key to solving the optimal state sequence algorithm, which calculates the posterior probability of each state for the observation sequence, and save the largest posterior probability that a path is the demand in the state sequence on this path implied state sequence. Viterbi algorithm criteria:

$$\delta_i(i) = \max P[q_1, q_2, \dots, q_{i-1}, q_i = i, o_1, o_2, \dots, o_i | \lambda] \quad (1)$$

HMM-based pronunciation scoring is a statistical model based on the scoring mechanism, it reflects to some extent the ability of students in Russian pronunciation, rather than simple standard voice and data features. As the basic unit of the Russian pronunciation of phonemes that sound standard, we need each phoneme's pronunciation quality ratings and logarithmic likelihood score commonly involves score method, after the number of inspection probability score, we use the log-likelihood degree score, defined as follows [9]:

$$S_i = \sum_1^i \lg[P(q_i | q_{i-1})P(o_i | q_i)] \quad (2)$$

With the above formula, we know when the system identifies the user's correct pronunciation, the best path is to solve the optimum implied state series through the Viterbi algorithm, which will be the basis of the obtained best hidden state sequence, and the HMM turn calculates the

current of the logarithm of the observed characteristics of the sequence likelihood according to the output demand and input logarithmic likelihood. The greater the likelihood is, the more easily the description of this sequence is observed. And the characteristics hidden in the state sequence shows how much higher the quality of our pronunciation is [10].  $S_i$  rating stands for each phoneme, so if we want to score any Russian word or phrase, each phoneme score of the word or phrase needs to be calculated, and then averaged. Russian word or phrase pronunciation quality scoring method goes as follow,

$$S = \frac{\sum W_i S_i}{\sum W_i} \quad (3)$$

$S_i$  is each phoneme score,  $W$  is the length of the phoneme, then  $S$  is the pronunciation of the English word or phrase rating.

Russian grammar network teaching system user interface is shown in follow. B/S structure land interface is shown below.



Figure 8. Login screen

User function operator interface is shown in following figure.



Figure 9. Functional interface

#### IV. EXPERIMENTS AND RESULTS ANALYSIS

Experiments are done under different speed, and based on HMM method, DTW method and dynamic Bayesian network method. The recognition rate is shown in follow.

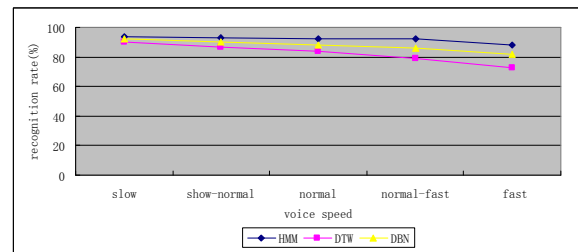


Figure 10. Recognition rate curve

The experiment result shows that we could use HMM method to segment the sentence and score the pronunciation, which will definitely contribute to the development of Russian grammar network teaching system.

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