# Research and Application of Intelligent Scheduling Method Based on AI Voice Interaction

Tiankun Wang*[1,a], Yanan Cao[1,b], Xiaohua Yan[2,c], Ruofei Liu[2,d]

corresponding author: 328492092@qq.com [a], 16801001@ceic.com [b], 11688302@ceic.com [c], 20049919@ceic.com [d]

GD POWER DEVELOPMENT CO., LTD Beijing, China[1]
CHN ENERGY DIGITAL INTELLIGENCE TECHNOLOGY DEVELOPMENT(BEIJING) CO.,LTD Beijing, China[2]

**Abstract.** With the increasing demand of energy enterprises for the effectiveness and efficiency of production operation data and the implementation of operation system scheduling, the traditional way exists the problems of many search steps, many interfaces, and many data layers, and the whole process is cumbersome and inaccurate, which has been difficult to meet the actual business scenarios, and the intelligent scheduling of voice is aimed at improving the scheduling efficiency and optimizing the allocation of resources utilizing voice recognition and other technologies. This paper takes intelligent voice interaction as the research object, explains its concept, principle and advantages, analyzes the current application status of intelligent voice interaction in the field of intelligent scheduling, and introduces voice recognition technology, natural language understanding technology, dialogue management technology and intelligent scheduling algorithm technology of intelligent voice interaction. It is proposed to enhance the intelligent voice interaction experience by improving the voice recognition rate, optimizing the voice interaction design and strengthening the intelligent analysis capability, and finally further discusses the application of intelligent scheduling methods of intelligent voice interaction by taking the energy enterprise management and control platform as an example.

**Keywords:** intelligent voice interaction; intelligent scheduling methods; state of the art; commonly used techniques; optimisation paths

## 1 Introduction

Intelligent scheduling method based on interaction and recognition with natural voice has accurate voice recognition capability, which can achieve rapid identification of business data, fast response to scheduling instructions, and friendly enhancement of user experience, in recent years, it has been widely used in the fields of electric power scheduling, logistics scheduling, and traffic scheduling. In order to implement the National Energy Group, promote the digital transformation of Guodian Power, achieve data-driven business innovation and organizational change, and promote the upgrading of management and control to achieve the overall goal of the intelligent operation, The Entire Business Domain Intelligent Control Platform designed and developed by GD POWER DEVELOPMENT CO.,LTD's(for short: GD) came into being. The platform covers the business of four industrial sectors such as thermal power, hydropower, new energy and mining, and builds business modules such as

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cockpit, statistical analysis, intelligent report, intelligent alarm, etc. It contains massive data such as production and operation, equipment operation, alarm, statistical dimension, etc. The platform has many page designs and a wide analysis dimension, and in order to achieve the purpose of rapid intelligent scheduling, intelligent voice interaction plays a crucial role.

## 2 Overview of Intelligent Voice Interaction

### 2.1 Concepts and Principles

Intelligent voice interaction refers to the technology and method of human-computer interaction through the use of voice, which can make use of sound and voice recognition technology to transform the user's voice commands into executable operations or provide relevant information. Intelligent voice interaction has been widely used in a variety of scenarios by its advantages, such as intelligent 0 assistant, smart home, car navigation, voice search, and so on. The basic principle of intelligent voice interaction is speech recognition and natural speech processing. Speech recognition technology converts the user's voice signals into textual information, and then natural speech processing technology analyses and understands these texts, so as to achieve the understanding and response to the user's intention[1].

### 2.2 Advantages of Intelligent Voice Interaction

Artificial intelligence technology is deepening in the field of intelligence and automation[2].With the development of artificial intelligence technology, voice-based intelligent systems, such as AI speakers and virtual assistants, are intervening in human life[3,4].The advantage of intelligent voice interaction lies in its simplicity and intuition, convenience and speed. Users only need to input commands by voice without keyboard or mouse operation, making the interaction no longer limited by hardware devices. The intelligent voice interaction system can identify the user based on the user's voice, intonation, speed of speech and other information to provide personalized services, for example, based on the user's preferences and history, the intelligent voice assistant can provide customized suggestions, recommendations and messages. The system is also able to understand semantics in combination with contextual information, including keywords, named entities, and contextual logic are able to, so as to better understand user needs and provide accurate services to users.

## 3 Status of Intelligent Voice Interaction in Intelligent Dispatch Field

The application of intelligent interaction technology in the field of intelligent dispatching is relatively limited, and it is the first time it has been applied in GD, and the functions that can be realized at present include, but are not limited to, the following: First, Voice command control. Intelligent voice interaction can be used to send voice commands to the intelligent scheduling system to control equipment, perform operations or obtain real-time information, for example, the dispatcher tells the system to start or stop certain equipment, adjust the equipment parameters, etc. through voice commands; Second, intelligent assistant. Intelligent voice interaction, as an assistant of the intelligent dispatching system, dialogues with the dispatcher through voice communication and provides relevant information, query data and

other services, and, at the same time, interacts with the system according to the dispatcher's voice commands to help complete a variety of scheduling tasks and improve efficiency and accuracy; Thirdly, real-time monitoring and warning. Through intelligent voice interaction technology, the intelligent scheduling systems can monitor the status of equipment, environmental parameters in real-time, etc. When some abnormal situations or events need to be handled promptly, the intelligent voice interaction system will send out voice alerts, prompting the dispatcher to take action promptly; Fourth, data query and analysis. Intelligent dispatching system usually needs to deal with a large amount of data and information, intelligent voice interaction is used for the dispatcher to query the data in the system by voice, get real-time reports or conduct basic data analysis, so as to facilitate the dispatcher to understand the on-site operation situation and make the right decision[5].

## 4 Research on Intelligent Scheduling Technology for Intelligent Voice Interaction

### 4.1 Speech recognition technology

The development journey of ASR has seen quite a few milestones and breakthrough technologies[6]. Speech recognition is utilised not only in mobile devices, but also in embedded systems, modern desktop and laptop computers, operating systems, and browsers[7]. Speech recognition technology analyses the input audio signal, proposes the speech features in it, and then converts them into corresponding text sequences. Speech recognition technology in intelligent scheduling technology for intelligent voice interaction needs to go through the following steps when applied: First, Preprocessing. Preprocess the input audio signal, such as removing noise, reducing interference, etc., to improve the accuracy of speech recognition; Second, Feature extraction. Speech features are extracted from the preprocessed audio signal, such as pitch, timbre, tone intensity, and other features that can be used to distinguish between different speech sounds; Thirdly, acoustic modeling. Mapping speech features onto an acoustic model to obtain the probability distribution of each phoneme in speech; Fourth, language model. Text conversion of speech using the language model to convert speech features into corresponding text sequences; Fifth, Dictionary and decoding. The converted text sequence is converted into comprehensible text by the dictionary, while the result is optimized according to the decoding algorithm. The technique is highly applicable and can be combined with other techniques to improve recognition accuracy, such as deep learning techniques can be used to process more complex speech features, while also combining contextual information and grammar rules to improve recognition accuracy.

### 4.2 Natural language understanding technology

Natural Language Understanding (NLP) technology can automatically identify, analyse and understand a variety of information in human speech such as text, speech, images, and so on, to carry out intelligent voice interaction. In the application process, natural speech technology will first perform basic processing such as word division and lexical annotation on the input text to convert the text into a form that can be understood by the computer, and then analyse the sentence structure, understand the relationships and semantics in the sentences, and initially understand the concepts, intentions and emotional information expressed in the text.

Then it extracts key information from the text, such as time, place, people, etc., automatically retrieves relevant information and generates concise and clear answers according to the user's questions, and finally automatically generates text that meets the grammatical and semantic rules by specific topics and requirements[8].

### 4.3 Dialogue management techniques

Dialogue management techniques are mainly responsible for controlling and coordinating the whole voice interaction process, including the initiation, maintenance and ending of the dialogue, etc. Common dialogue management techniques include: First, Dialogue state tracking. Dialogue state tracking techniques are used to track and update the current state information in the dialogue, and by analyzing the user's voice commands and the system's responses, the dialogue is transformed into a structured representation for subsequent processing and decision-making; Second, Intent recognition and slot filling. Intent recognition technology identifies the user's intent and purpose, while slot filling technology is used to extract relevant parameter values from the user's voice commands, and the combination of intent recognition and slot filling helps the system to understand the user's needs and commands; Thirdly, dialogue strategy. Dialogue strategy determines how the intelligent scheduling system responds to the user's voice commands, and based on the current dialogue state and the identified user's intent, it selects appropriate system behaviors and responses to meet the user's needs; Fourth, Context management. Context management techniques are used to process the contextual information in the dialogue to maintain the coherence and consistency of the dialogue; Fifth, Error handling and correction. Intelligent scheduling systems need to have error handling and correction mechanisms to cope with errors or incomplete information in user voice commands. By identifying and correcting user errors, the system can more accurately understand the user's intent and perform scheduling operations accordingly.

### 4.4 Knowledge mapping technology

Knowledge graph technology is a key technology used in the intelligent answers, personalized recommendation, content distribution, and other fields, which takes knowledge graph as a carrier, integrates massive data on the Internet into structured knowledge, and establishes entity semantic relationships. The application of this technology requires the establishment of a knowledge spectrum graph, that is, the collection, extraction and integration of knowledge information from multiple data sources, which usually involves the modeling and description of entities, attributes, relationships and other elements in the domain, and then the extraction of knowledge from text with the help of technologies such as natural language processing and information extraction, which ultimately results in the formation of a structured form of the graph. Entity recognition and linking technology are used to identify specific entities in the text and associate them with the corresponding entities in the knowledge graph. Through entity recognition and linking, the intelligent scheduling system can match the key information of the user's voice commands (e.g., people's names, place names, etc.) with the entities in the knowledge graph. And the system can infer more effective information from the user's voice commands for corresponding scheduling operations based on the existing relationship rules and knowledge. In addition, the intelligent scheduling system can update and maintain the related scheduling knowledge through the knowledge graph, e.g., when there is new

equipment, rules or environmental information, the system can add it to the knowledge graph, so as to maintain the consistency between the system knowledge base and the actual situation[9,10].

### 4.5 Intelligent Recommendation Technology

Intelligent recommendation technology is a kind of intelligent interaction technology based on machine learning algorithms, which masters a large amount of effective information by collecting a large amount of user data, such as historical browsing records, purchasing records, search records, collection records, etc., and then carries out the operations of data cleansing, feature extraction, and data conversion on the collected information. Then use machine learning algorithms to train the processed data to establish a recommendation model, generate personalized recommendation information based on the established recommendation model and the user's current behaviour, and finally improve the model based on the user's feedback to improve the quality of the recommendation.the hybrid recommendation is one of the main advantages of intelligent recommendation technology, such as collaborative filtering and content-based recommendation, which combines many different technologies and algorithms, and dynamically adjusts and optimizes according to the user's needs and scenarios.

### 4.6 Intelligent Scheduling Algorithm Technology

Intelligent scheduling algorithm technology is a method to achieve efficient voice interaction by optimizing resource allocation and task scheduling, collecting data related to tasks and resources, such as task priorities, workloads, time constraints, and personnel. Comprehensively process and analyse the collected data to extract feature information related to subsequent decision-making, and then construct models based on the collected data and user requirements, commonly used models include machine learning models, deep learning models, etc. Train the model with the collected data to improve the accuracy of the model, and finally decide the start time and end time of the task, resource allocation method, etc. based on the results of the model prediction and specific scheduling strategies.

Common intelligent scheduling algorithm techniques include: First, Greedy algorithm. Greedy algorithm is an algorithm based on local optimal selection, in intelligent scheduling, greedy algorithm can select the operation with maximum benefit or minimum cost according to the current state and constraints, and make scheduling decisions step by step; Second, Genetic algorithm. Genetic algorithm is an optimisation algorithm that mimics the natural evolutionary process by encoding a sequence of device operations and using operations such as selection, crossover and mutation to generate a new scheduling scheme that selects and improves the optimal solution based on a fitness evaluation function; Thirdly, Linear programming. Linear programming is a method to find the optimal solution by establishing a mathematical model and constraints, abstracting the resource allocation problem into a system of linear equations, and then determining the optimal device scheduling scheme by solving the system of linear equations; Fourth, Simulated Annealing Algorithm. The simulated annealing algorithm is based on an optimisation algorithm with stochastic search, which gradually reduces the temperature and searches the optimal solution space by simulating the annealing process in the metal smelting process.

# 5 Optimization design of Intelligent Scheduling Methods with Intelligent Voice Interaction

## 5.1 Business and application scenario analysis

Users of GD dispatching centre need to realize the in-depth linkage control between various business systems, and realize the system linkage control, interaction and automatic guarding function of terminal equipment such as PC and digital big screen by natural language interaction. It provides effective voice assistants and aids for dispatchers to operate the business systems, realises intelligent scheduling, intelligent pushing, intelligent guarding, intelligent explanation and intelligent training of the business system data, and provides a zero-work guarding mode for the duty personnel to comprehensively enhance the office efficiency of the duty personnel.

## 5.2 Overall realisation of the implementation design

The virtual duty officer is a sub-system of the intelligent control platform of the whole business domain, which automatically recognises personnel's voice and converts it into text or semantics through the linkage of the system by means of intelligent voice interaction robots and other technologies, obtains relevant semantics, understands the personnel's oral expression through multilingual recognition, correctly recognises the personnel's voice and understands the meanings, and transforms the user's complete expression into the corresponding keywords, and finally inquires into the relevant answers by means of the linkage with the system. Through linkage with the system, the user's complete expression is converted into the corresponding keywords, and finally the answer is queried and expressed by the image of the virtual robot, thus completing the natural language dialogue between man and machine, realizing the functions of voice manipulation, data display, voice broadcasting, alarm interaction and intelligent scheduling, etc. It reduces manpower, automates and intellectualizes the process of explaining, and strengthens the ability of the company's system linkage.The module logical design is shown in the Figure 1.

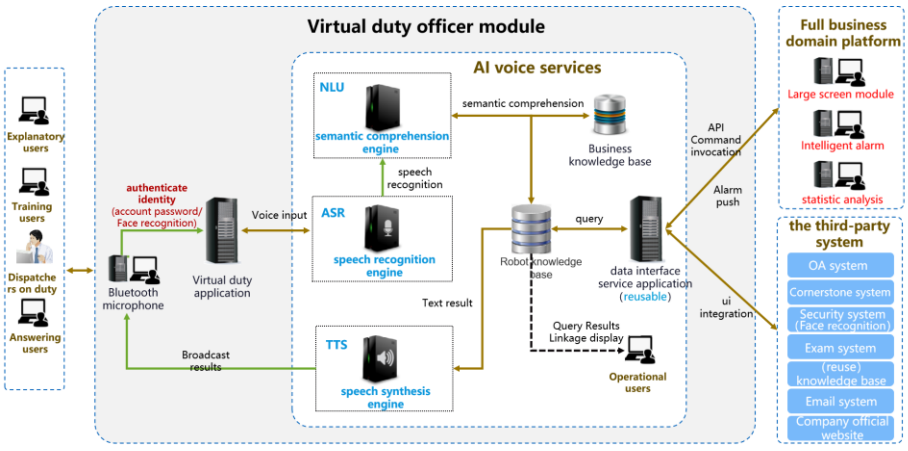


**Fig. 1.** Logical design of the Virtual Duty Officer module

### 5.3 Intelligent scheduling implementation design

The Virtual Attendant System integrates services and data with other full-service domain modules of the big screen and PC, and realises multi-level scheduling of services, service drilling and data querying through different commands with voice recognition and semantic understanding of different scheduling voice instruction commands.The AI voice interaction business process is shown in the Figure 2.

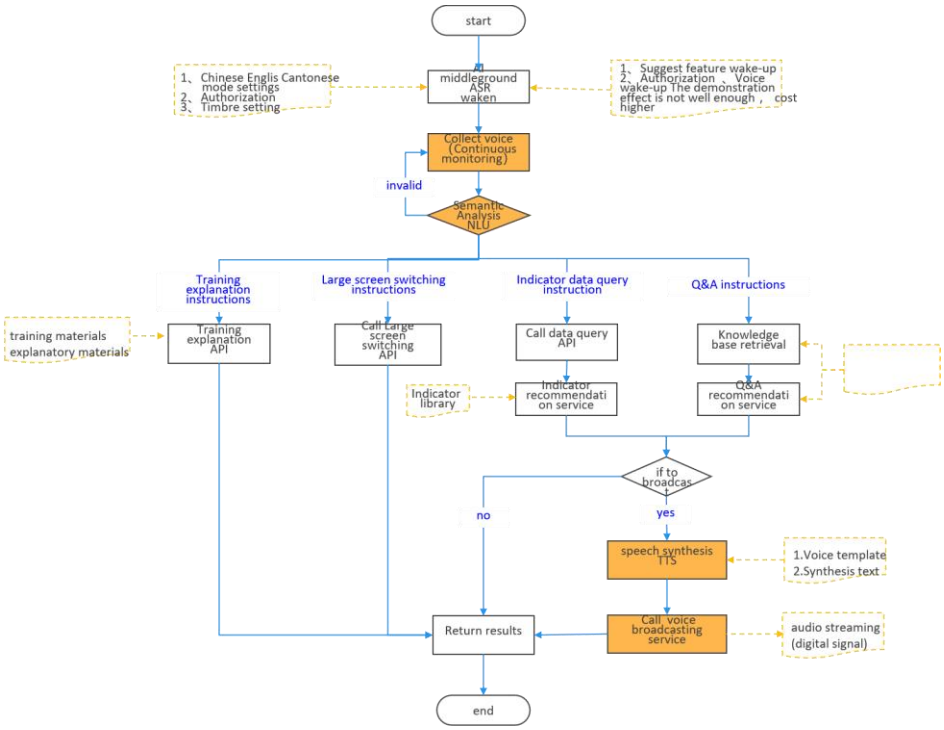


**Fig. 2.** AI voice interaction process design

### 5.4 Intelligent guarding implementation design

The virtual watchman system integrates services and data with the statistical analysis module of the intelligent control platform of the whole business domain and external mail and SMS systems, and carries out process automation for the daily work tasks of the dispatching watchman, including automatic downloading and sending of daily reports, automatic reporting and approval of processes, and automatic sending of SMS. Real-time monitoring of duty tasks, real-time voice reminder of tasks and interactive broadcast of tasks through voice synthesis technology.The process design for intelligent guarding is shown in the Figure 3.

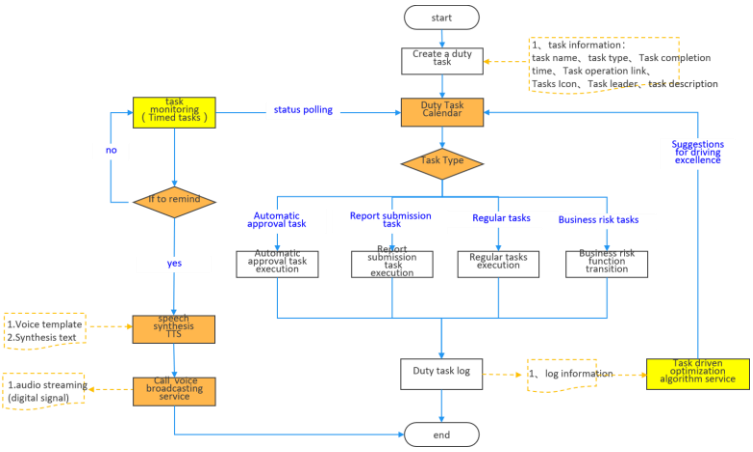


**Fig. 3.** The process design for intelligent guarding

### 5.5 Intelligent Explanation and Training Implementation Design

The virtual watchman system is integrated with the large-screen cockpit system to assist the watchman in completing the multi-scene system explanation and publicity material explanation business through interactive explanation and preset content explanation. Interactive explanation design adopts the question and answer mode, through the semantic and voice synthesis technology, the hit content feedback to the user; preset content explanation design adopts the PPT, video, graphic DIY and system interactive explanation to engage in the system preset, through the voice scheduling instruction form, access to the different explanation material and through the voice of "sentence, paragraph, chapter "Three-dimensional broadcast. Through the construction of the knowledge base, to achieve system training, knowledge quiz business. System training design is the preset system training content, through voice synthesis and automatic broadcasting technology to complete the training business.The process design for intelligent explanation and training is shown in the Figure 4.

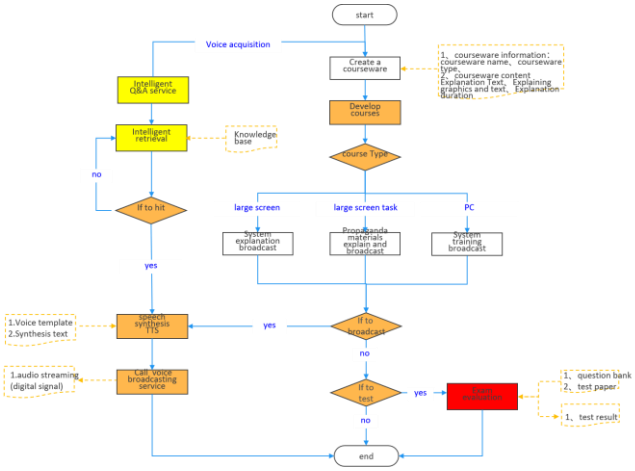


**Fig. 4.** The process design for intelligent explanation and training

## 6 Application Analysis of Intelligent Scheduling Methods with Intelligent Voice Interaction

GD's business covers thermal power, hydropower, new energy, mining and other four industrial sectors, including more than 60 grassroots units. Intelligent scheduling methods are applied to the intelligent control platform of Guodian Power's entire business domain through intelligent technology to build a "virtual duty officer", which deeply participates in human-computer interaction to achieve the analysis, control, and prejudgement of key indexes for enterprise production, management, and operation, and to enhance business supervision and risk pre-control of the affiliated enterprises, so as to achieve the goal of promoting the overall level of operation and improving the quality of the business. The goal of promoting the overall operation level is achieved.

On the one hand, it serves the dispatching duty personnel, through the application of intelligent voice interaction robots and other technologies, and business system linkage control, to achieve the natural language interaction on the PC, digital screen and other terminal equipment for system linkage control, through the voice synthesis technology to alarm warning information to remind and automatically guard the business functions. As a voice assistant and auxiliary tool for dispatchers, it will comprehensively improve the office efficiency of the duty officer. On the other hand, AI robots, provide users with system demonstration, content explanation, interactive Q&A, etc., with a new sense of technology, and the overall enhancement of the corporate image of science and technology.

## 7 Conclusion

In summary, the intelligent scheduling method based on intelligent voice interaction is a research topic involving artificial intelligence, speech recognition, natural language processing and scheduling algorithms and other fields, which provides people with a more convenient and natural way of interaction and is extremely compatible with the development trend and requirements of the intelligent era, and therefore has received extensive attention at home and abroad. It started late in China, and the recognition and understanding technology of intelligent voice interaction is not perfect enough. In the future, it is necessary to strengthen the research, explore and improve the intelligent scheduling algorithm, optimize the design of voice interaction, and improve the voice recognition rate, in order to improve the accuracy and naturalness of intelligent voice interaction.

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