Research Article

Teacher Voice Feature Extraction and Recognition Based on Health Belief Model

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Teachers are professional voice workers who complete their education and teaching tasks primarily through spoken English. Teachers’ voices are the most important tool for completing their professional tasks, as well as an important part of their public image. This paper proposes innovative design strategies with health management as the core concept, in light of the voice health problems of primary and secondary school teachers in the era of intelligence. For a long time, China has had a high percentage of teachers with voice problems. Teachers’ oral English expression is affected by voice diseases, which reduces teaching efficiency. Teachers’ physical and mental health are also jeopardized, and their professional identities are diminished. It is primarily caused by a lack of health-care awareness, excessive use of voice in daily life, incorrect vocalization techniques, a lack of knowledge and methods for voice protection, and ignorance on the part of education management departments. As a result, we must reduce the frequency with which we use our voices and employ scientific feature recognition methods to protect our voices.

1. Introduction

In daily life, voice is an essential tool for information transmission, social activities, and emotional communication between people. Confucius said, “If a worker wants to do his job well, he must sharpen his tools first.” Scientific development is an important strategic thought of China’s economic and social development [1]. Education also needs the scientific concept of development. Professional efficacy is frequently determined by the quality of tools used. Teachers’ treatment has clearly improved, their lives have greatly improved, and teachers are more concerned about their working status, career development prospects, and physical and mental health now that China’s economy and society have reached full development. Multimedia teaching has entered the classroom in well-equipped schools, and more and more teachers are teaching AIDS, but the majority of teachers remain hoarse [2]. For teachers, voice is both a physiological and a professional tool. Teachers account for the majority of outpatients with voice disorders, with varying degrees of pharyngitis symptoms. Their job is linked to the disease’s cause. Teachers’ long-term overloaded lectures, daily contact with chalk dust, and unscientific pronunciation methods cause the throat and pharyngeal mucosa to become congested and swollen due to the long-term impact of strong airflow, resulting in acute and chronic pharyngolaryngitis, vocal nodules, and vocal polyps, causing voice disorders that affect their work [3]. Teachers’ education and teaching activities are information dissemination activities that are frequently disrupted by various “noises” that can come from both sides of the communication, communication channels, and the communication environment. In schools with relatively weak teaching facilities, teachers can only persist in spite of their voice painfully in order to complete various education and teaching tasks, resulting in many voice diseases, and some teachers even have to leave the classroom because of vocal cord diseases and can only engage in some work with less voice [4]. In the voice guidance of professional health care, the limited medical resources are stretched compared with a large number of teachers. Teachers are the backbone of the development of education, and the scientific development of teachers’ profession is one
of the keys to the scientific development of education. So, now, our first task is to strengthen the drinking of teachers’ voices and improve the quality of teachers’ voices.

Teachers are dedicated members of the workforce. They assist us in developing national talents and allowing them to defend their country in all areas. Teachers are the embodiment of China’s ancient knowledge, morality, and social forerunners, but the health risks they face have yet to be adequately addressed and developed. Teachers primarily use audio language to communicate information. The carrier of audio language is voice. Teachers’ coding and students’ interpretation are likely to be affected by voice problems [5]. On this issue, we need to increase teacher awareness and education about voice health, as well as their ability to protect themselves. There is a lack of systematic research on Teachers’ health management products from the perspective of design, and the existing research theory on Teachers’ voice is in the preliminary research and development stage for the application of related products, mainly focusing on technical research. With the deepening of educational system reform, the modern society, with its rapid development and increasing fierce competition, has posed a growing number of serious challenges to teachers’ survival and development. The production of voice is a relatively complex process. It primarily causes a series of sound waves by causing the vocal cords to vibrate on a regular basis as a result of the air flow exhaled from the lungs. Finally, it produces the sound for human communication through the radiation of mouth and nose [6]. The task of sick voice recognition is to recognize sick voice, which comes from a branch of speech recognition, mainly involving voice, pathology, computer science, information science, artificial intelligence, and other disciplines [7].

More and more scholars began to study the use of noise assessment to assist in the diagnosis of different diseases, such as language disorders, pajinmei, and throat diseases, and use different methods such as subjective perception assessment, psychophysical assessment, and objective physical assessment to evaluate the voice of patients [8]. In recent years, with the advent of the era of big data and the rapid improvement of computer computing ability, deep learning has been widely used in the field of image recognition and speech recognition. The detection and recognition of pathological voice can be completed by extracting characteristic parameters of voice signal and pattern recognition [9, 10]. When voice lesions occur, different voice diseases will produce different noises, and different vocal cord voice disease characteristics may appear in different bands. Therefore, getting rid of the previous methods of time domain or frequency domain analysis on the whole voice and decomposing different frequency components of normal voice and pathological voice has become the key to distinguish voice diseases.

Because of professional reasons, there are many reasons for teachers’ illness. Voice is the most common disease we see, which is also what most teachers have in common. This paper studies this topic based on the current situation of teachers’ voice using big data technology and the method of healthy voice protection.

2. Literature Review

Literature [11]: studies show that voice disorders are extremely common among teachers. Teachers, as professional voice users, should place a high priority on the high incidence of voice diseases reported by education departments and school leaders, and the prevention and control of voice diseases among teachers have emerged as a critical issue that needs to be addressed urgently by relevant departments. Literature [12]: a large number of characteristic parameters and recognizers with strong classification ability have been explored in order to solve the deficiency of clinical voice disease diagnosis ability, and an automatic voice recognition framework has been developed to distinguish normal voice from pathological voice, which is used to complete painless and non-invasive automatic voice detection [13]. Literature: the prevalence of voice discomfort among teachers is high, with preschool and primary school teachers being the most affected. Understanding the current state of teachers’ voices is critical for mastering the prevalence and causative factors of teachers’ voice diseases, guiding teachers in scientific voice use, and extending their careers. Literature [14]: mental health standards for different social groups should also reflect the uniqueness of their groups; for example, we should make a more specific interpretation of teacher mental health standards, so that they not only reflect the commonality of general mental health standards, but also the uniqueness of teachers’ profession. According to the literature [15], voice quality is closely related to human health as a result of the interaction of the human brain, nervous system, various vocal organs, and voice quality assessment, as an auxiliary diagnostic tool, and can provide the necessary foundation for the diagnosis of diseases related to voice quality. Literature [16] detects the objective and quantitative evaluation direction of morbid voice, which is mainly based on the actual needs of the diagnosis of morbid voice and the objective evaluation of postoperative rehabilitation. First, the voice is professionally evaluated subjectively, and the degree of morbid is graded; then, the time domain features such as fundamental frequency are extracted, and finally, the degree of morbid voice is graded by combining pattern recognition method. Literature [17] mentions that teachers have a lot of dissatisfaction and pressure, which are manifested in the problems of student discipline, teachers’ salary, lack of motivation for self-study in sketching, and little parental care, all of which will lead to physical problems of teachers, which is also the main reason for teachers’ physical injuries. Literature [18] can realize the early diagnosis of voice diseases and the evaluation of voice rehabilitation after surgery by acoustic analysis. Literature [19]: test shows that in classrooms with echoes, the size of echoes is directly proportional to the level of voice diseases. The larger the echoes, the higher the incidence of voice diseases, which is nearly 30% higher than that of teachers in classrooms with little echoes. Literature [20]: in the whole disease cycle, there is enough scientific voice management knowledge to standardize and assist the correct voice movement and disease prevention, help teachers to achieve active voice health,
and change the situation that teachers are besieged by health food therapy promotion and long-term medical treatment.

According to the above literature, teachers’ voices are not well protected, which has a negative impact on their physical and mental health, policies, and the pressure that students place on teachers. Teachers have initiative and blindness in the prevention and treatment of voice diseases, and preventive measures before illness are insufficient. Teachers are unable to self-examine their throat condition and, as a result, opt for medical treatment because their voice problems are severe and their voice is unable to recover elastically. Voice disease is a problem that manifests itself in various stages as a result of long-term excessive use of the voice, and it necessitates systematic solutions.

3. Teacher Voice Status

3.1. The Main Reasons for Threatening Teachers’ Voice Health. “Teachers, preaching and teaching are also confusing.” Teachers’ occupation determines the frequency and intensity of teachers’ voice, which is characterized by large amount, high intensity, and long duration [21]. For professional language speakers, different colors, such as the intensity of voice, light, and shade, restrict the transmission efficiency of voice. For example, if the voice is clear and loud, the voice will be more easily perceived. The principle of sound generation is shown in Figure 1.

In order to explore the crux of the high incidence of voice diseases, it is necessary to clarify the relationship between teachers’ profession and voice behavior. So what is the reason for the teacher’s hoarseness?

The first issue is that teachers do not use proper grammar. The majority of teachers are not like TV hosts, vocal music teachers, or doctors. They have not been exposed to systematic vocal processing and cannot master scientific vocal skills, resulting in unbalanced and uncoordinated movements of various vocal organs [22]. In order for the teacher’s voice to reach every corner of the large classroom and the many students’ desire for knowledge, he or she must speak in a voice several times louder than usual. He does not pay attention to respiratory support, does not use breath to coordinate the movement of the vocal band, and does not use resonance appropriately, resulting in light and dark sound, no luster, and no penetration.

Second, teachers have a weak awareness of voice health protection. Teachers do not realize how to prevent their voices from being damaged, how to adjust the frequency of their voices in class, and how to maintain their voices after class. If the teacher’s workload is too heavy, and he does not pay attention to rational use of voice or bad habit of using voice, he often uses voice excessively or abuses voice, he cannot get rest and adjustment for a long time, and voice diseases will easily occur. When the body is uncomfortable, most people just start taking medicine, and they will feel fine when they are relieved, which will lead to no symptomatic solution to the voice. At present, some students still study by themselves in the morning and evening, have a lot of class time, and have to revise their home-work in the afternoon; so, not getting a good rest is also the reason for threatening their voices.

The third factor is the teacher’s own psychological stress. “Education is the hope for revitalizing the nation, and teachers are the hope for revitalizing education” is the key to a good education in school. Education is becoming a more important and difficult part of people’s and society’s development, and the accomplishment of new and difficult tasks is dependent on the key factor of teachers. With the advancement of social development and educational reform, the demands on teachers are increasing, and the treatment of teachers is putting pressure on them. Teachers face a lot of pressure because of their low social status, high labor intensity, and other factors. At the same time, how teachers are evaluated at school, how they are evaluated, and whether they accept the evaluation have a significant impact on teachers’ psychology. Furthermore, the teaching and teacher management system necessitates an excessive number of teachers, inspections, and evaluations, all of which add to teachers’ workload. Teachers will be put under a lot of stress as a result of this.

The fourth is the lack of attention of relevant government departments. Looking at the teacher training and lectures offered by education departments at all levels, there are very few training and lectures concerned about teachers’ health. Primary and secondary school teachers do not know enough about voice protection because they ignore voice problems. Training and health lectures on “voice” are rare. Most teachers just think that if their voice is dry, they can drink more water and prescribe some voice protection drugs casually, which is simple and lack of scientific knowledge and methods of voice protection.

These reasons are the main causes of hoarseness. In order to further improve the recognition rate between normal and pathological voice and pathological voice of vocal cord, researchers continue to explore various features (linear or nonlinear) and preprocess the voice signal before extracting the features, so as to fully characterize the pathological characteristics of voice signal and facilitate more effective detection of voice diseases. The flow of the sick voice recognition system is shown in Figure 2.

3.2. Building a Voice Feature Recognition Database. Any artificial intelligence application field [23] requires database support, and the quality of the pathological voice database has a direct impact on the classification effect of experiments. There is no standardized method for recognizing and extracting voice features. The speech signal becomes easier to analyze after preprocessing. However, because of the high sampling rate, speech in one second contains a large amount of data; so, speech features must be extracted. The goal of extracting feature vectors from speech is to reduce the amount of data by removing unnecessary information from the original speech that is not relevant to the experiment. Different databases’ experimental results will differ, and the experimental results of a single database may be random, weak in persuasiveness, and unable to reflect the algorithm’s robustness. The first step is to figure out what pitch the voice signal is. We should analyze the morbid voice
using the normalized crosscorrelation function, which can reflect the commercial quality, tension, and other characteristics of vocal cords through this frequency. The correlation between the two waveforms is based on the minimum square cost function principle, which has the following formula:

$$E(\tau) = \sum_{n=0}^{N-1} [s(n) - \beta s(n + \tau)]^2,$$  \hspace{1cm} (1)

where \(s(n)\) is the voice signal obtained by sampling, \(n\) is the detection length, \(\tau\) is the displacement between two voices, and the chip is the gain used to change the level of the control signal. The formula that makes \(\partial E(\tau)/\partial \beta = 0\) available is as follows:

$$\beta = \frac{\sum_{n=0}^{N-1} s(n)s(n + \tau)}{\sum_{n=0}^{N-1} s^2(n + \tau)},$$

$$E(\tau) = \sum_{n=0}^{N-1} s^2(n) - R^2(\tau),$$  \hspace{1cm} (2)

$$R(\tau) = \frac{\sum_{n=0}^{N-1} s(n)s(n + \tau)}{\sqrt{\sum_{n=0}^{N-1} s^2(n + \tau)}}.$$

When \(E(\tau)\) is the minimum, \(R(\tau)\) takes the maximum value, and \(\tau\) corresponds to the pitch period. Before the actual extraction, the speech signal should be deaveraged, low-pass filtered, and numerical filtered to eliminate the influence of formants and make the periodicity of the speech signal more obvious. After extracting the pitch, it is necessary to perform postprocessing in order to avoid displaying multiples of the actual pitch as the final value. Despite the differences in the environment and sampling frequency used to record the normal and pathological voice samples, it is a widely used database in most speech pathology detection and classification studies. The clinician selects each clinical case by using a laryngoscope to confirm the diagnosis and determine the severity of the disease. The frequency scale of using Mel frequency domain cepstrum coefficient is more in line with human hearing characteristics because there is no linear relationship between the frequency of human hearing sound and the actual signal frequency. This parameter is used in the Mel frequency scale for sound analysis, and its relationship with frequency can be approximated by the following formula:

$$\text{Mel}(f) = 2595 \log (1 + f/700),$$  \hspace{1cm} (3)

where \(f\) represents the actual frequency of the sound signal, in Hz. Figure 2 is the MFCC feature extraction flow chart as shown in Figure 3.

According to the mathematical model of the speech signal, the speech signal is formed by convolving the glottal excitation signal and the vocal tract response signal. In the research of this chapter, in order to extract the voice information reflecting the characteristics of vocal cord vibration, the vocal tract response information must be removed by deconvolution. According to the mathematical model generated by the voice signal, the voice signal is obtained by convolution of the glottal excitation signal and the vocal tract response signal. The formula can be expressed as follows:

$$s(t) = e(t) \ast v(t),$$  \hspace{1cm} (4)

where \(s(t)\) is the speech signal, \(e(t)\) is the glottic excitation signal, \(v(t)\) is the vocal tract modulation signal, and symbol \(\ast\) represents convolution. Fourier transforms equation (4) to obtain the following formula:

$$S(u) = E(w) \times V(w),$$  \hspace{1cm} (5)

\(E(w)\) represents the frequency spectrum of glottis excitation signal, and \(V(w)\) represents the frequency spectrum of vocal tract response signal. The advantage of time-frequency analysis technology lies in that it can transform one-dimensional time signal into two-dimensional space with both time domain and frequency domain characteristics, so that it
can clearly reflect the law of signal frequency changing with time, which is beneficial to the analysis and processing of pathological voice signals.

3.3. Health Care Strategies for Teachers’ Healthy Use of Voice. Feature extraction through big data is one aspect, and now it is more important to improve teachers’ self-protection awareness.

Teachers should pay attention to voice protection and voice training, learn scientific protection methods, and master the skills of using voice at the first school, which should organize lectures on voice health care and online video teaching. To avoid dryness and dust at work, create a clean and humid environment. During minor illnesses such as colds and respiratory infections, avoid using your voice for long periods of time. Second, schools should schedule teachers’ class time in a reasonable manner to keep them in a positive frame of mind. Teachers can also control the volume of their voice and the length of time they use it depending on the situation. The microphone is also used by most teachers as an auxiliary tool to measure volume, which is the solution. It is naturally easy to achieve the effects of saving breath, being unified, transparent, and reaching far through long-term practice. Simultaneously, practice developing the “small power amplifier” in the body. Third, if a teacher’s throat is bothering them, they should seek medical advice as soon as possible and follow the doctor’s advice so that they can receive prompt treatment and recovery and avoid missing work due to illness. Maintaining a positive mindset, avoiding exaggerated emotions, increasing sports, insisting on physical activity, avoiding subhealth, and gradually strengthening self-care consciousness can all help to ensure voice health. Fourth, we should maintain a positive outlook on life, develop good speaking and living habits, and refrain from talking loudly or becoming enraged in class. Changes in tone, pronunciation, and intonation in classroom language, along with eye contact, gesture, expression, and other auxiliary means, can improve students’ listening effect and reduce unnecessary voice consumption, lowering the frequency of using voice and protecting it.

4. Simulation Training of Healthy Voice Characteristics

With the rapid development of society, we should not only ensure that modern industry, medicine, and the army keep up with the progress but also ensure that teaching keeps up with the pace of the times. Now with the deepening of educational reform, teachers’ professional pressure is also huge, which will affect teachers’ health. Everyone’s compensative ability is different. Excessive work pressure will not only affect our teachers but it will also affect the healthy growth of our students. In view of this, I conducted a 20-week survey on this point to verify the voice prevalence of teachers in complex courses in detail, as shown in Figure 4.

Figure 4 shows that the voice prevalence rate of teachers has been steadily increasing over the course of the 20-week test, and the longer the class hours, the more obvious the rising trend of the prevalence rate. This demonstrates that, in response to the education policy, we should plan teachers’ class time wisely, ensure their health, and provide postguarantee to teachers. However, this does not prevent the teachers’ voices from being harmed. The function of the vocal system cannot be changed for teachers, which is a requirement of the profession. Most factors in the vocal environment and system structure can be controlled and adjusted, but this control and adjustment cannot be achieved entirely through the teachers’ personal strength. Excessive work stress is undoubtedly a factor in the development of vocal cord and throat diseases in most teachers, but a large part of the problem is due to teachers’ lack of awareness of self-protection and voice health. In light of the aforementioned strategies, we used feature extraction to compare the rate of disease prevention formation before and after health education, and we simulated the number of teachers’ long-term pronunciation, which included excessive use of their voices. A comparison of the related formation rates of voice disease prevention behaviors is shown in Figure 5.

The middle item means the following:

1. Long-term treble vocalization
2. Excessive use of voice
3. After getting sick, I still use my voice excessively
(4) Always clear your throat
(5) Drink
(6) Smoking
(7) Take medicine indiscriminately
(8) Physiological period
(9) Angry
(10) See a doctor in time

It can be seen from Figure 5 that after the defense of technical means, the high-risk behavior causing voice diseases has decreased significantly, which shows that our proposed method has achieved preliminary results. Thirdly, we also test the age of teachers. The age of each stage is different, and their psychological stress resistance and handling methods in the face of reality are also different. The prevalence of age is shown in Figure 6.

Figure 6 shows that the prevalence rate of young people rises linearly and declines in the middle and late stages, but remains relatively high after old age. Teachers who are new to the profession are bound to be enthusiastic about their work, and their attitude toward work will similarly improve. The data trend is also increasing in the later stages. This suggests that teachers frequently choose to ignore their own causes when they are young, resulting in their inability to be treated after a long period of time. We continue to call on relevant departments to carry out related activities to raise teachers’ awareness of defense; the school guidance office should do everything possible to avoid having teachers attend multiple classes in a row, particularly teachers of general knowledge courses in the arts and sports, and teachers should be regularly checked for occupational diseases, including not only voice diseases but also joint diseases and gynecological diseases. In the distribution proportion of schools, both male and female teachers exist. Is the prevalence rate different? Eight male and eight female
teachers were chosen and tested for ten weeks in this study. The results are shown in Figure 7.

Figure 7 shows that the prevalence rate of female teachers is slightly higher than that of male teachers in long-term teaching. This is mainly because female teachers usually spend more time using their voices than male teachers, women’s physical condition is more prone to mental stress, anxiety, and emotional excitement, and female teachers have a special physiological period, which is one of the important reasons for increasing the female prevalence rate. The prevalence of male teachers is combined with Figure 5, and in fact, it is not difficult to see that most male teachers are stimulated by excessive smoking and drinking and spicy food. The smoke in cigarettes contains many harmful substances, such as nicotine, tar, and acrolein, which seriously damage the health of vocal organs. Teachers should pay attention to their own health, develop good life rules, reduce food stimulation, avoid social activities at night, ensure adequate sleep, and avoid overwork. Strengthen self-exercise and improve the ability to resist diseases: Teachers should pay more attention to nutrition and actively participate in physical exercise and recreational activities. Only by strengthening their physique can they resist diseases.

Comparing the values of baseline period and processing period, the ratio of the two groups of data is less than, and there is no autocorrelation. The value of significance test is less than, and there is extremely significant difference.
between the baseline period and the treatment period, which indicates that the second treatment is effective in controlling glottic noise energy. The data trend of the baseline period and processing period is shown in Figures 8 and 9.

5. Conclusion

The most important basic skills for teachers who use oral English as their primary professional tool to engage in teaching activities are accurate pronunciation, scientific use of sound, reasonable timbre modification and beautification, and rich expression of sound. Despite the fact that teachers work with their voices on a daily basis, the majority of them are unaware of the importance of proper voice care. Voice abuse and misuse, a lack of scientific diet, a noisy working environment, bad habits such as drinking and smoking, and poor psychological quality are all factors that contribute to voice disease. The voice extraction system we have chosen is currently being used in the teaching profession. This technical method can effectively identify normal and pathological voices in the teacher industry, which has some practical application value for the early diagnosis and treatment of laryngeal diseases. Front-line teachers’ efforts, as well as the attention and concern of education management departments at all levels, are required for voice health. The majority of primary and secondary school teachers will be able to have a healthy and beautiful voice as a result of early prevention of various voice problems, effectively ensuring their health and the smooth progression of their careers. The health belief is at the heart of this paper, big data technology from the current network era is used to extract the teacher’s voice at all times, data is used to test the characteristic parameters with particularity, and the characteristic points are processed into digital signals by computers. The sick voice will be screened in a centralized manner in order to achieve automatic voice recognition and detection, thereby resolving the issue of teacher voice health and allowing teachers to teach and impart knowledge in a more conducive environment.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author does not have any possible conflicts of interest.

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