Abstract

Musical water landscape combines landscape design with audiovisual art and is loved by the general public. However, the performance control form of musical water landscape generally adopts the manual offline preprogramming method, which needs to use the human subject's consciousness to perceive the style, emotion, and other advanced features of the music first and then choreographs the corresponding landscape performance, which is a high-cost design form and low usage rate of the landscape and is not conducive to the expansion of the music library. In this paper, we design and implement a musical water landscape simulation system using OpenGL and 3Dmax technology in combination with wireless music buzzer sensors, extract and analyze the music features based on this system, and study the system control of musical water landscape. Open GL particle system technology is used to realize the dynamic simulation of weather and fountain inside the landscape and improve the drawing scheme from both modeling and rendering aspects. For the fountain, the physical model and the wireless music beep sensor are combined to design a variety of water type actions for a single spout, and the parameter interface to control the water type changes is reserved. We propose a style recognition method based on CRNN and residual network, which has a higher accuracy rate compared with the existing methods; we use the DP algorithm to segment the pitch sequence of the music to reduce the redundancy of information and improve the calculation speed of the system.

1. Introduction

With the development of society and economy, the urban spiritual environment has become an important indicator of the degree of urban development. The number of urban landscape projects is increasing, and the importance of water features in the environment is considered to be the most important part of landscape projects. More and more urban planning or planning of tourist attractions include the design of large musical water features. In cities, musical water landscapes can play a role in beautifying the surrounding environment, purifying the air, and enriching the lives of citizens [1]. In scenic spots, musical water landscapes can realize the synchronization of music, water, and light to create a magnificent scene, thus attracting tourists and helping the development of tourism. The musical water landscape is becoming more and more diverse in its expression and plays an increasingly important role. Landscape fountains are natural landscapes that are exposed to the ground through the pressure of water. Through artificial means, sprinklers with decorative functions can be constructed to meet the needs of landscaping. The fountain reduces the dust content and ambient temperature in the air and humidifies the surrounding air [2]. Therefore, it can effectively improve the original appearance of the city and continuously enhance the physical and mental health of the inhabitants, allowing them to enjoy a better life. The water landscape has gradually developed from the original miniaturized presentation to various large and diverse forms today.

Anyway, there is still room for improvement in both the technical route of water landscape design and the software layer that performs musical analysis at the back end of the landscape. Many of the musical water landscapes do not fit well with the landscape performance and musicality [3]. On the one hand, because of the water landscape itself, water-type action is simple and single, on the other hand, because there is no extraction of more differentiated high-level musical characteristics, only the sound intensity and tone can not be a good distinction between different musical pieces. Music water landscape control technology is an important part of the whole system, in the back end accurately through the music information retrieval technology to extract the music characteristics, and music water landscape according to these musical characteristics to make the rhythm of the action changes. As for the length of the music delay, it can be analyzed from the control inch sequence diagram. After segment matching, the fountain performance information will be stored in the performance program controller PPC sequence, which will be used as a basis for further design of the fountain performance program. At present most of the music water

landscape manufacturers whether in the design stage or product display stage, music water landscape animation show is relatively simple and can not be a comprehensive and reasonable display of the full picture of the music water landscape [4]. In this paper, we mainly focus on three aspects of technical analysis, virtual simulation, and extraction and analysis of musical features of audio signals, combined with wireless musical beep sensors, to conduct in-depth research on musical water landscape systems. At the level of audio signal feature extraction and analysis, it consists of three parts: firstly, this paper makes improvements to the existing music style identification method and improves the accuracy of extracting style information for each piece of music; secondly, this paper uses the Douglas-spectrum method algorithm to segment the pitch sequence, which reduces the information redundancy of the control signal and improves the calculation efficiency of the system; finally, based on the above work, this paper provides the system design control strategy, so that the music water landscape system can better display the artistic connotation and theme of the music.

2. Related Work

The development direction of modern musical water landscape is to combine garden design with audio-visual art while presenting a diversified landscape performance. As a result, the musical water landscape is loved by the general public, and more and more urban planning or tourism scenes use it as a landmark form of garden art expression. This has attracted the attention of more and more researchers in the field of visual landscape simulation.

Literature [5] extracted audio features such as note intensity, timbre, and rhythm of music for music emotion classification. A classification model based on a Gaussian mixture algorithm was used to classify the music into four emotions. Classical music clips of a fixed length of 20 seconds were used in the system for training, and emotion categories were manually tagged for the music, and their system achieved 85% accuracy on their constructed dataset. Literature [6] uses parametric regression methods to predict the coordinates of music in the two-dimensional space of the valence-arousal sentiment model. Support vector regression was used to map the extracted acoustic features to the two-dimensional space of the V-A model. They labeled 195 music clips with corresponding validity values and activation values and extracted a total of 114 features for each data using the audio feature extraction tool PsySound. A music generation model based on a genetic algorithm was proposed in the literature [7]. The characteristics of the Blues style during the development of musical chords are considered. Their system uses note pitches to represent the nodes of the tree structure in the genetic algorithm, and note pitch values to represent the degree of order. Literature [8] uses the spectrum of the musical signal to calculate the saliency function of the relevant harmonics and converts the obtained pitch contours into MIDI forms of notes marked as melodies. Ruprecht and Li [9] all use the available spectral information to fit a

pitch model, such as a Gaussian mixture model and estimates the probability of each frequency being the main melodic pitch by using the maximum a posteriori probability as a pitch saliency feature and then estimate the best melodic line. Bi et al. [10] describe the changes brought by the network to human life in the digital age and portrays the future urban space appearance, architectural forms, and people's production and lifestyle in a concrete way, which brings a new concept and opens up a new path for landscape innovation design. Literature [11] plans the design of performance venues, activity lawns, community gardens, and interactive water features, and the original old trees add a romantic atmosphere to the site through interactive landscape design, and the park becomes an important place to connect with the surrounding residents. Literature [12] argues that the lack of humanistic concern in modern urban landscape design has led to the indifference to human relationships and that interactive landscape design can improve the relationship between people and space to strengthen the connection between people. Literature [13] proposed new insights on the combination of interactive landscape design in urban parks, forming a series of interactive landscape designs to create interactive activity places to enhance the vitality of urban parks. Adil et al. [14] used writing software programs to coordinate and control the motor, solenoid valve, power supply, and other equipment and components following the set logic law, to form not only the required spray water flower shape, light, and shadow effects, etc. but also for the city to add a lot of beautiful landscape and landmark facilities, in the community to obtain a good response and objective benefits, which laid the foundation for the formation of the musical fountain industrialization. Nassirpour and Tabatabaei [15] optimize the data transmission for single-hop and propose a multihop transmission protocol, which selects the closest node as a transit node when the node is far from the convergence node, avoiding long-distance transmission between the node and the base station. Viñuela [16] makes the model more direct and realistic by rendering the landscape in a variety of materials and colors while simulating the surrounding environment such as terrain and daylight. In [17], computer-aided software is used to simulate the landscape scene in 3D, which can visually show the whole picture of the landscape and its surroundings, and subsequent design modifications can be made easily, reducing the design cost and improving the efficiency in the design process. Elpus and Abril [18] propose a method to simulate water flow by extending the object interaction mechanism in conjunction with particle systems. However, when the water particles are viewed from multiple angles to them, there are often penetrating shots that display two-dimensional images.

3. Intelligent Music Fountain Control System Design Based on Wireless Music Beep Sensor

3.1. Wireless Passive Play Surface Wave Sensor Design for Musical Fountains

The antenna of the SAW sensor, as the communication device of the wireless passive SAW sensor system, is an important factor affecting the performance of the system. Since the working environment of the music fountain system will affect the performance parameters of the SAW sensor antenna, different antenna types need to be selected according to the environment. The working principle of the antenna is that the changing current will produce electromagnetic waves, when a pair of transmission lines with opposite current directions are placed in parallel, electromagnetic waves will not be radiated to the outside world, and when the transmission lines are gradually opened, bound in which the electromagnetic waves are radiated to the free space, with the increase of the opening angle, the radiation of electromagnetic wave energy becomes stronger. The basic equation of radiation is
where is the time-varying current, is the length of the current element, is the energy, and is the wavelength. The length of the transmission line affects the intensity of the electromagnetic field radiation, and in the range of wavelength , as the length of the transmission line increases, the intensity of the radiation increases, so that the signal can be propagated in space using such property. When the distance between two parallel transmission lines is less than the wavelength , most of the electromagnetic energy is concentrated on the transmission lines [19]. When the transmission line splits, the symmetry of the transmission line is broken, and the distance between them is larger than the wavelength ; the electromagnetic field will leave the transmission line and propagate into space; at this time, the propagated electromagnetic wave has nothing to do with the current on the transmission line, and the electromagnetic field will gradually advance outward.
The general direction of radiation of the main flap is the largest, and the rest of the side flap or vice flap. In addition, the directionality of the antenna characterizes the radiation capacity of the antenna on a sphere in free space and is the maximum radiation power density of the antenna on a sphere in the radiation field and its average value of the ratio; the formula is as follows:
The direction of electromagnetic waves in free space will be different when the antenna is in different forms. It is known from Abe's law that the direction of the electric field and magnetic field are perpendicular to each other, while the direction of radiation is perpendicular to them. If the propagation direction of the antenna is positioned , then the electric field vector and the magnetic field vector generally vary in the toy plane, and according to the projection of the electric field vector in the joy plane, the antenna is classified as a line polarized, circularly polarized, etc. Therefore, the polarization direction of both needs to be considered when using antennas for transmitting and receiving [20]. Another more important parameter of the antenna is the input impedance, which is the ratio

of input voltage and current, generally complex. Since there will be reflected when the impedance of the antenna and transmission line are mismatched, it is necessary to consider impedance matching when using. There is a certain relationship between the parameters of the antenna and the communication distance, and the equation that represents this relationship is the Fliess power transmission equation, which is expressed as

As can be seen from the above equation, the electromagnetic wave will have a relatively large dissipation of energy in the process of transmission, and the antenna production, impedance matching, and other processes will also produce errors, therefore, the need to improve the performance of the antenna. Generally speaking, when designing an antenna, it is necessary to improve the gain of the antenna when the antenna bandwidth meets the requirements; consider the relationship between bandwidth, efficiency, gain, and antenna size; and try to design the impedance matching of the antenna to ensure that it can have smaller return loss.

As shown in Figure 1, in the framework of the wireless passive buzzer sensor system, the reader part is mainly used to generate and transmit the excitation signal and receive and process the echo signal. The reader generates a specific frequency excitation signal through the transmitter link, which passes through the antenna of the reader and propagates into the free space. Next, the antenna of the SAW sensor receives the electromagnetic wave signal and the fork-finger transducer end generates an electric field that excites a sound surface wave on the surface of the piezoelectric substrate [21]. To achieve synchronous control, the music fountain system divides the music signal into two parts. A part of the signal after preprocessing is sent to the computer through the respective algorithm to extract the characteristics of the music and then through the characteristics of the emotional recognition of the music section, and finally, match the corresponding music fountain water type for the music section to form a fountain performance. The other part of the signal is filtered and sent to the mixer, followed by delay processing, then sent to the amplifier equipment for power amplification, and finally sent to the sound system for playback. The acoustic wave is transmitted from the fork-finger transducer end to the reflection grid, where the direction of the acoustic wave changes due to metal reflection at the reflection grid and is partially reflected by the fork-finger transducer. The incident wave and the reflected wave will constitute a standing wave, and the sound surface wave superimposed; when the frequency of the sound wave and the device itself is the same, the sound wave is the strongest energy. When the standing wave reaches the end of the fork-finger transducer, it is converted to an electromagnetic wave output. In this process, the frequency of the device is transformed by changes in the surrounding environment such as temperature and strain. Finally, the reader's antenna receives the echo signal, which is converted into a digital signal after processing by low-power signal amplifier amplification, filter filtering, mixer frequency mixing, ADC digital-to-analog conversion, etc. The frequency signal with environmental characteristics is extracted from the digital signal, which is transformed into a measured physical quantity through the mathematical relationship between the frequency signal and the surrounding environmental parameters.
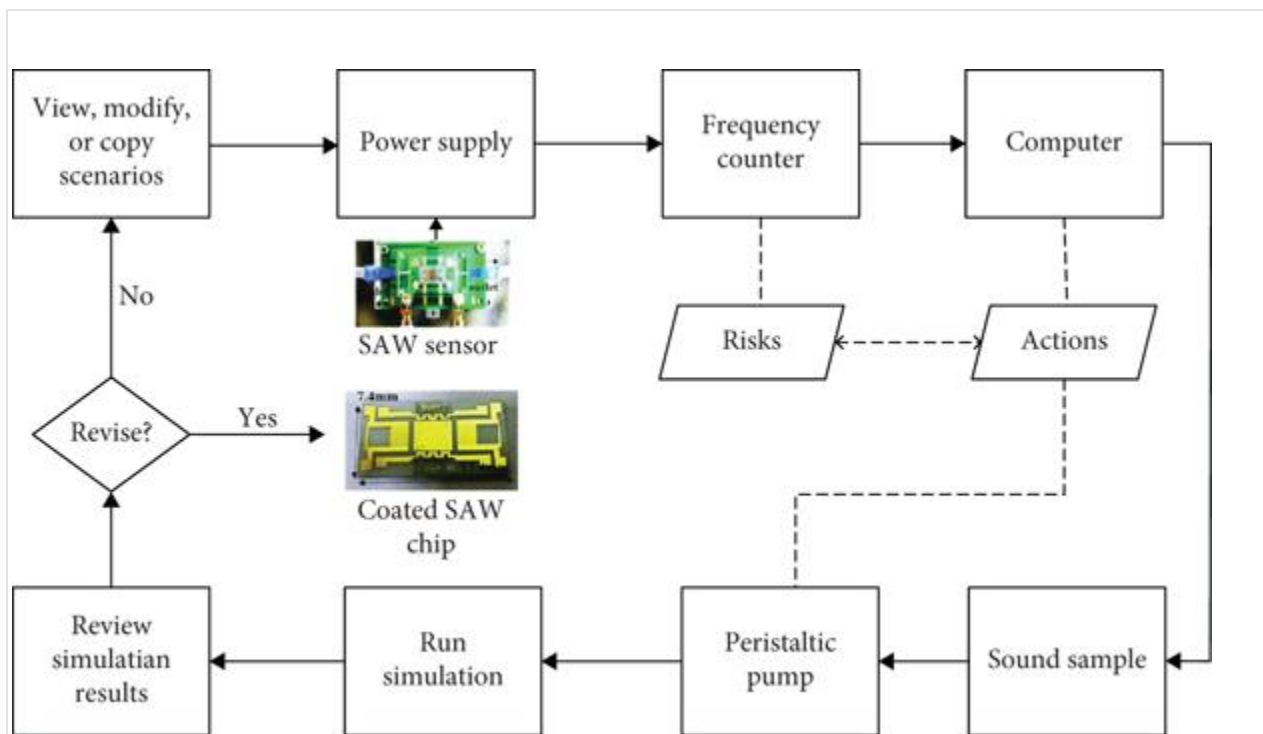
Figure 1

The framework of wireless passive zither beep sensor system.

The frequency-domain sweep method compared to the time domain pulse method is less demanding on the echo signal and can detect the amplitude and phase of the narrow-band response. The frequency-domain sweep method applies a step-by-step approach to send RF pulse signals, which has a relatively high signal-to-noise ratio and can detect longer distances. At the same time, the bandwidth of the frequency domain sweep method measurement is small, and using relatively inexpensive devices can meet the measurement requirements. Therefore, due to the low complexity and low cost of the reader of the frequency domain sweep method, the scheme design of the frequency domain sweep method is used in this system.

The reader based on frequency domain sweep design has two different methods for signal processing, namely, power detector and phase detection. From the previous section, it is known that the closer the pulse signal from the sweep is to the device frequency , the stronger the energy of the standing wave. Therefore, the resonant frequency of the signal can be determined by detecting the amplitude of the echo signal, i.e., the power detection scheme. Phase detection is to determine the value of the physical quantity to be measured by detecting the phase difference between the excitation signal and the echo signal. When the phase difference between the two is calculated, the measured physical quantity can be

calculated by the relationship between the two. The reader needs to have the function of transmitting and receiving signals [22]. The transmitting link generates RF signal pulses through the circuit, and the pulsed signal uses the antenna to radiate electromagnetic waves outward. After the RF signal is transmitted, the reader needs to receive the return signal from the SAW sensor using the antenna; so to increase the isolation between transmitting and receiving, a single-blade double-throw switch is used. When the pulse signal is generated, the switch connects to the transmit link and the antenna; after the pulse signal is transmitted, the switch connects to the receive link and the antenna. After the receiving link receives the response signal, it is sampled by the ADC of the signal processing module through matching filtering, low-noise amplification, and mixing, and the resonant frequency of the SAW sensor is obtained after data processing in the signal processing module.

Because of the temporal nature of music, music as a whole is characterized by "continuity." Music is very important in the continuity of music between different phrases and bars. Using the PRC format as a generator for music generation, the model generates music according to the music bars, and the generated music is likely to be incoherent between different bars. Therefore, a time-structured buzzer-based music generation model is designed by combining a wireless buzzer sensor with a time-structured generator into a generative adversarial network, which allows the model to generate multiple consecutive music bars to form longer music.

3.2. Music Fountain Control Program Design

By studying the characteristics of music, music emotion recognition can be roughly divided into three processes, the first step through the wireless music cover sensor is to extract the basic characteristics of the music, the second part is the analysis of the complex characteristics of the music and the music into several sections, and the third part according to the characteristics of the section is to identify the emotional color expressed by the section after the emotional color of the section, for each section to find the music corresponding to its fountain-water type performance program, and then generate fountain performance program. Then, the fountain system performs this program [23]. The musical fountain program is shown in Figure 2. From the figure, it can be seen that the music fountain system uses real-time audio control, which needs to ensure that the interpretation of the fountain water type and music playback synchronize; otherwise, the music fountain can not achieve the uplifting effect. To achieve synchronous control, the music fountain system will be divided into two parts of the music signal. One part of the signal after preprocessing is sent to the computer through the respective algorithm to extract the characteristics of the music, then through the characteristics of the emotional recognition of the music section, and finally for the music section to match the corresponding music fountain water type, the formation of fountain performance. The other part of the signal is filtered and sent to the mixer, followed by delay processing, then sent to the amplifier equipment for power amplification, and finally sent to the sound system for playback.
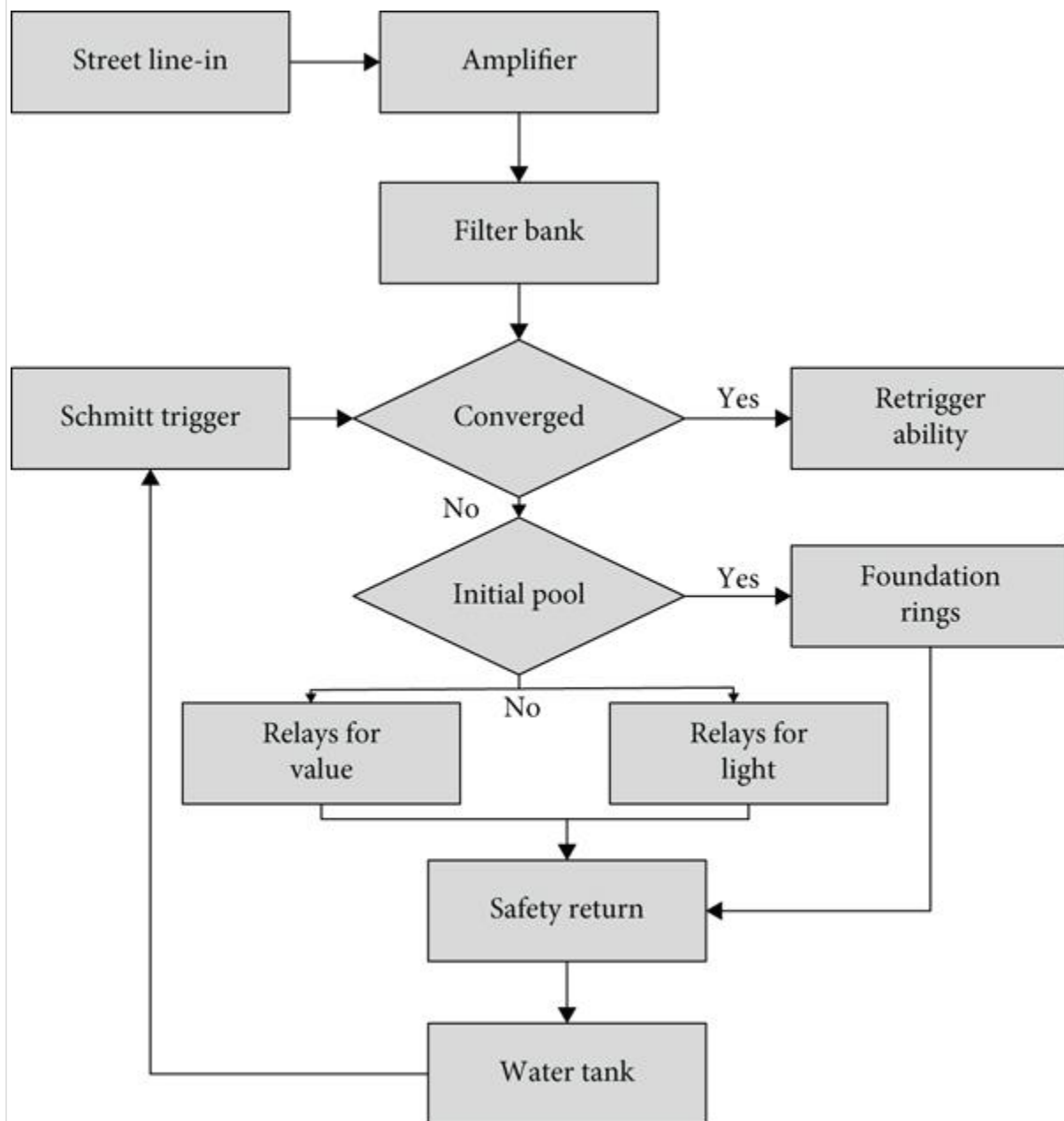
Figure 2

Music fountain control process.

In music files, individual notes cannot convey emotion, so the analysis of a single musical event in MIDI is meaningless. Only a changing set of notes can convey emotion, but how to divide the musical message so that each fragment can and can only convey one emotional

message is a difficult problem in musical emotion analysis. The more common method is to divide the musical information into several fragments at fixed intervals and then analyze each fragment. This division method ignores the characteristics of the music itself, such as the changes in the song style and melody, and mechanically determines that the music format is unique within the irregular time interval, which makes the analysis of the information more biased. There is also a method based on self-similarity analysis, which divides the audio signal into frame sequences of fixed length, analyzes the sequence with the greatest similarity between each sequence based on some characteristic parameters, and uses it as a representation of the music. In the music separation method or the fixed time separation method, only the method of time length calculation is different. In addition, there is the method of extracting the spectral data of the sound from the frame sequence as a feature parameter and using it to analyze the most characteristic fragment groups in the music, and finally selecting the longest fragment size from the fragment group as the size of the division.
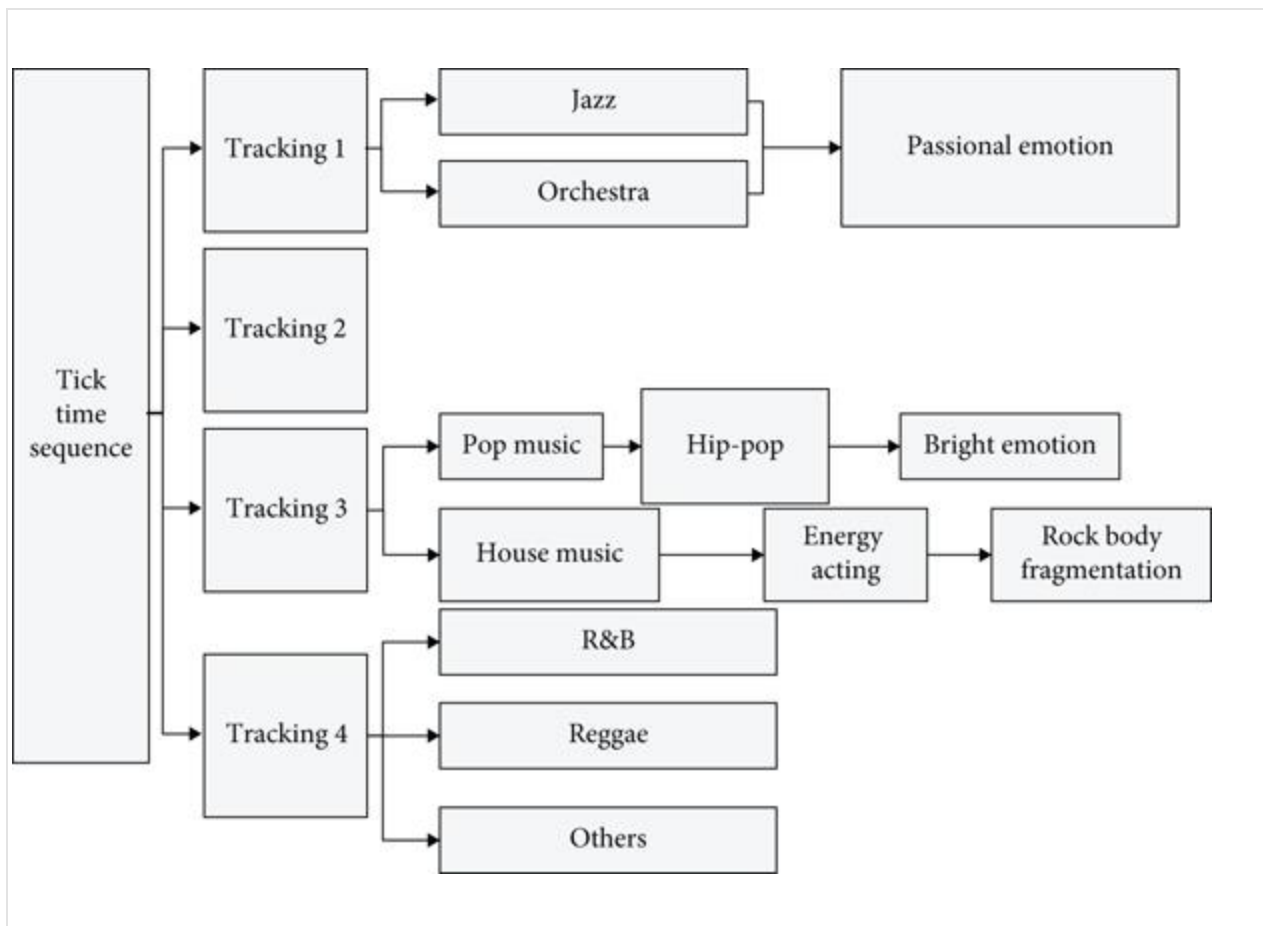
Musical fountains have limited means of expression and cannot fully interpret the emotions in the music. For the music emotion on the score, there is no need to be too precise, which also facilitates the efficiency of the system analysis. Therefore, in the extraction and analysis of the data, a relative approximation can be used that can reflect the main emotions of the music. Many main elements express emotions in music, combined with the MIDI file format, which mainly involves six parameters: intensity amplitude, playing speed, beat number, chord, tone density, and note density.where is the main sentiment element and is the feature parameter.

When analyzing music events, the analysis is performed sequentially according to the tick time sequence of music playback. In each tick time sequence, the data is read in the order of the tracking number and inserted into the end of the temporary data queue for each track. The frequency domain sweep method compared to the time domain pulse method is less demanding on the echo signal and can detect the amplitude and phase of narrow band response. The frequency domain sweep method applies a step-by-step approach to send RF pulse signals, which has a relatively high signal-to-noise ratio and can detect longer distances. At the same time, the frequency domain sweep method measures the small bandwidth, using relatively inexpensive devices that can meet the measurement requirements. After the data of all the tracks in the current time sequence are recorded, the data of all the tracks are combined to form a complete chord or beat number, i.e., an analysis point. If the current tick time sequence satisfies the analysis point condition, the relevant emotion element is extracted and the data queue for each track is emptied.

The current solution to the problem of music playback and fountain water type show lag has two methods: one method is to send the water type control signal in advance, so that the actuator of the water valve, servo motor, etc. prestart; this method is more difficult to implement; prestart time is not easy to control, and there is no room for adjustment; another method is to lag the music, let the music delayed for some time before playing; this method is less difficult to implement [24]. This method is less difficult to implement than the first

method, for the time has a lot of adjusting abilities, and can more easily achieve the synchronization of music and fountain. The music can be delayed into software delay and hardware delay; this paper will use hardware delay. Designing a delay circuit, the music will be delayed for some time before playing. The delay logic is set as follows:

The length of the music delay can be analyzed from the control inch sequence diagram. Segment after segment matching, fountain performance information will be stored in the performance program controller PPC sequence, which will serve as a basis for further design of the fountain performance program, as shown in Figure 3. From the figure, it can be seen that the performance program controller stores six data: the first data is the section number; the second data, the melody tree number, which holds the melody line of the section; the third data is the beginning of the music, which holds the location of the beginning of the section; the fourth data is the end of the music, which holds the location of the end of the section; the fifth data is the emotional classification of the section; and the sixth data is the number of the basic performance program after the matching of the phrases.

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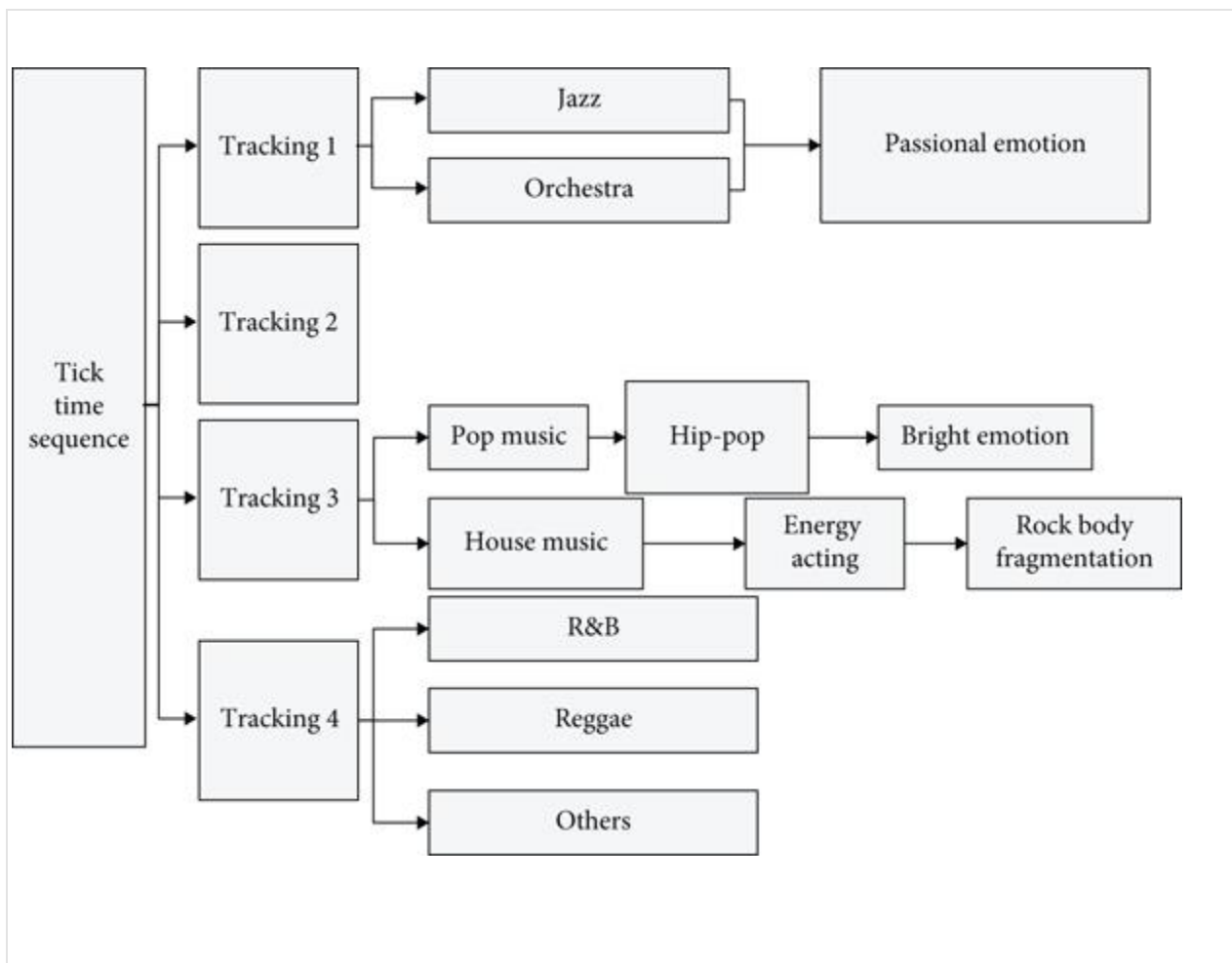
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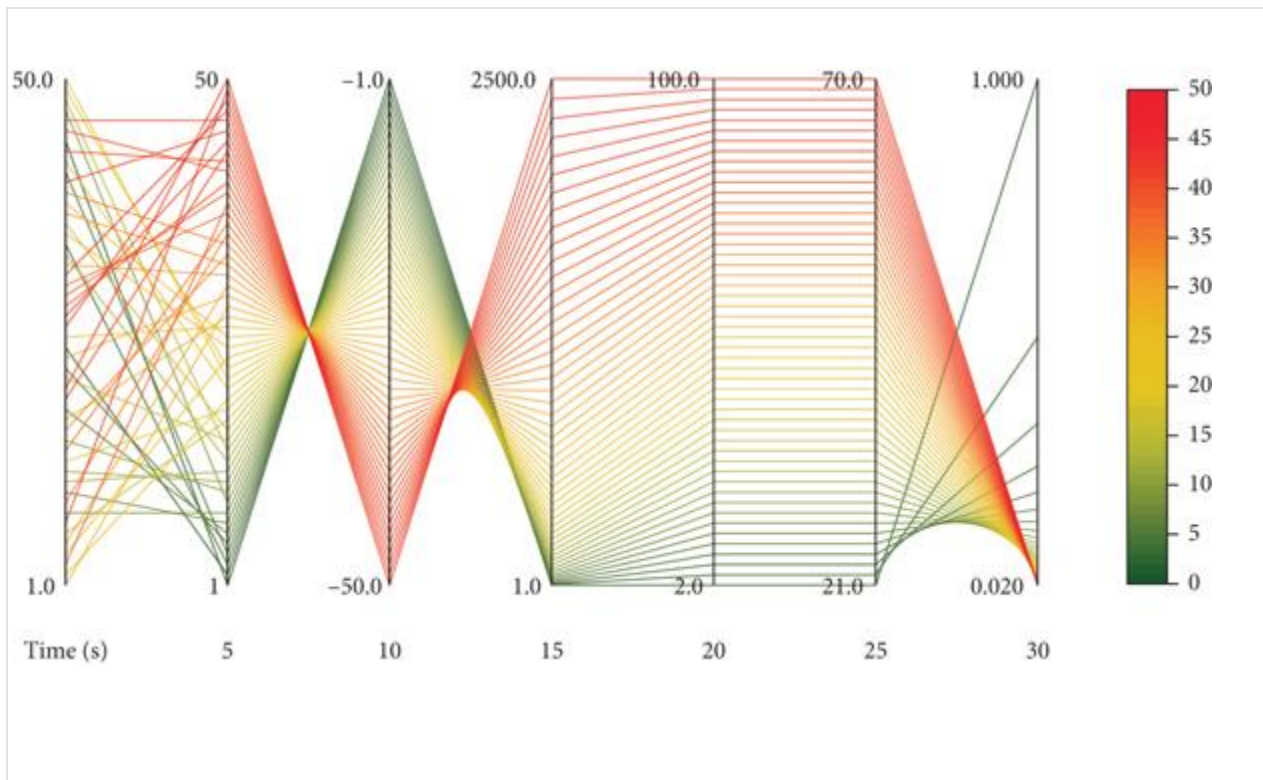
Figure 3

Performance program controller (PPC).

4. Music Fountain Automatic Control System Design

Software control system using Windows + RTX design scheme not only can play the advantages of Windows in graphics and window management, to provide the system with a friendly human-computer interface but also use RTX to improve the real-time performance of the system, to provide efficient computing speed. The structure of the software control system mainly includes music file analysis, fountain performance control, system status monitoring, and system input water pressure control four subsystems.

First of all, the music file is analyzed by the wireless play music buzzer sensor, and the complete music is divided into subblocks according to the specified rules; then, the designed emotion model is used to analyze the data of each subblock, and according to the obtained emotion type, the corresponding performance content is designed, or the responsive performance model is selected from the basic performance model library, and the final output is controlled. To obtain a better performance effect, the music analysis and performance control are divided into two relatively independent subsystems, and the data is shared between the systems using the database. Fountain before the performance, a one-time read of all the data into memory was done, to avoid repeatedly reading the database, to improve operational efficiency. In addition, in the fountain performance control program, the Windows process only achieves a graphical interface, providing a performance control UI control interface and the current performance status display function. The main parameter analysis, performance unit control, and other functions of the RTX process are to achieve. RTX event bodies and shared memory are used between processes to interact with data and synchronize information. In the previous bar of music for the next bar of analysis, when the performance event is reached, the Windows process notifies RTX to switch the performance, RTX process uses the performance thread to achieve the dynamic flower performance effect of the fountain. The input water pressure control of the fountain system does not require high real-time requirements and can be controlled by a subthread of the Windows process, which also reduces the pressure on the RTX process, simplifying the development complexity. Because the water pressure control system is a constant pressure feedback control system, there is no interaction with the main function, the water pressure control system is independent of other subsystems.

The bar booster vectors are extracted step by step by the algorithm. Then, the segmentation of music with different emotional types is performed using the segmentation IT proposed above, and the minimum length threshold MNLT in the segmentation algorithm is set to 15, the similarity threshold EST of the feature vector is set to 0.52, and the maximum length threshold is set to MALT is set to 80. Figure 4 shows the results of the segmentation part of the music.

Figure 4

Music section division simulation diagram.

After segmenting the music into individual segments, the seven-dimensional feature vectors of the segments are further extracted by arithmetic and used as the input layer of the BP neural network, which can output the emotional type of the segments through network recognition. The number of neurons in the input layer of the network is determined according to the number of dimensions of the segment feature vectors. The number of neurons is seven because the feature vector of the emotion of the segment above is seven-dimensional. The output layer of the network is the emotion type of the segment. In this paper, a simplified A-V emotion model is used, so the music segment after the neural network is divided into four emotions: intense, cheerful, calm, and sad.

The two-way fountain can rotate in the horizontal direction, as well as the vertical direction of rotation, with a more complex form of expression, can produce more changes, suitable for the performance of emotions on the complex side, such as excitement, uncertainty, etc... can enable people to produce a thousand feelings. Lighting is also an important form of emotional expression, usually red is more enthusiastic and positive; yellow is warmer and cheerful; purple is more romantic and gentle; blue is more melancholy and sad. And the intensity of the light can play a role in strengthening the emotions expressed. In addition, the fountain's different flower shapes and jet height can also perform different emotions. This paper designs and implements a musical water landscape simulation system using OpenGL and 3Dmax technology in combination with wireless musical beep sensors, and based on this

system, we extract and analyze musical features and study the system control of musical water landscape. Open GL particle system technology is used to realize the dynamic simulation of weather and fountain inside the landscape and improve the drawing scheme from both modeling and rendering aspects. Usually, the flower shape is clear and neat to convey a more positive emotion; the height of the jet can reflect the intensity of emotion. Through the wireless music beep sensor for automatic control, these features of the musical fountain can be matched with a variety of landscape combinations to meet the needs of a variety of situations.

The fountain system will have the same way of working performance units to form a subsystem, the main system to send control instructions in a fixed format, and the subsystem is responsible for parsing data to control the work of the specified performance units. This makes the data analysis and hardware control independent of each other, applying different implementation methods on different occasions, which can maximize efficiency, make the system structure clearer, and facilitate later maintenance. The performance unit of the fountain system is divided into several performance subsystems based on the movement characteristics. As each subsystem can use different means of expression, the form of performance is different. With different emotional parameters, the performance of the subsystem form also varies. The performance of the fountain system is the combination of subsystem performance, that is, the performance model of the system is equal to the collection of a subsystem performance model. The performance model is used to define the fountain in different emotional parameters of the performance method and is a parametric record of a dynamic movement process, it should contain an initial state and the rules of change. The definition of the command data structure can be seen; it records the fountain in a period of the performance form, is relatively static data, and can be used as the initial state of the format. Change rules are used to define the rules of movement and change for each means of expression in all performance units. The main means of performance in the fountain system are colored lights, solenoid valves, vertical motors, and horizontal motors; four different types of rules are defined differently, to facilitate data storage and analysis, and the use of a relatively uniform format.

5. Experimental Verification and Conclusion

5.1. Wireless Play Beep Sensor Music Emotion Recognition Verification

In this paper, we use the constructed neural network emotion recognizer to identify the emotion of the music section, as shown in Figure 5. The H, P, S, and F in the figure represent four emotions, H represents cheerfulness, P represents calmness, S represents sadness, and F represents intensity. The red color represents the predicted segment category, and the blue color represents the actual segment category, where the vertical coordinate represents the clingy feeling type and the horizontal coordinate represents the segment. From the graph,

we can see that most of the emotion recognition is accurate, but there are some errors in the emotion recognition of individual phrases.

True music category
Predict music category
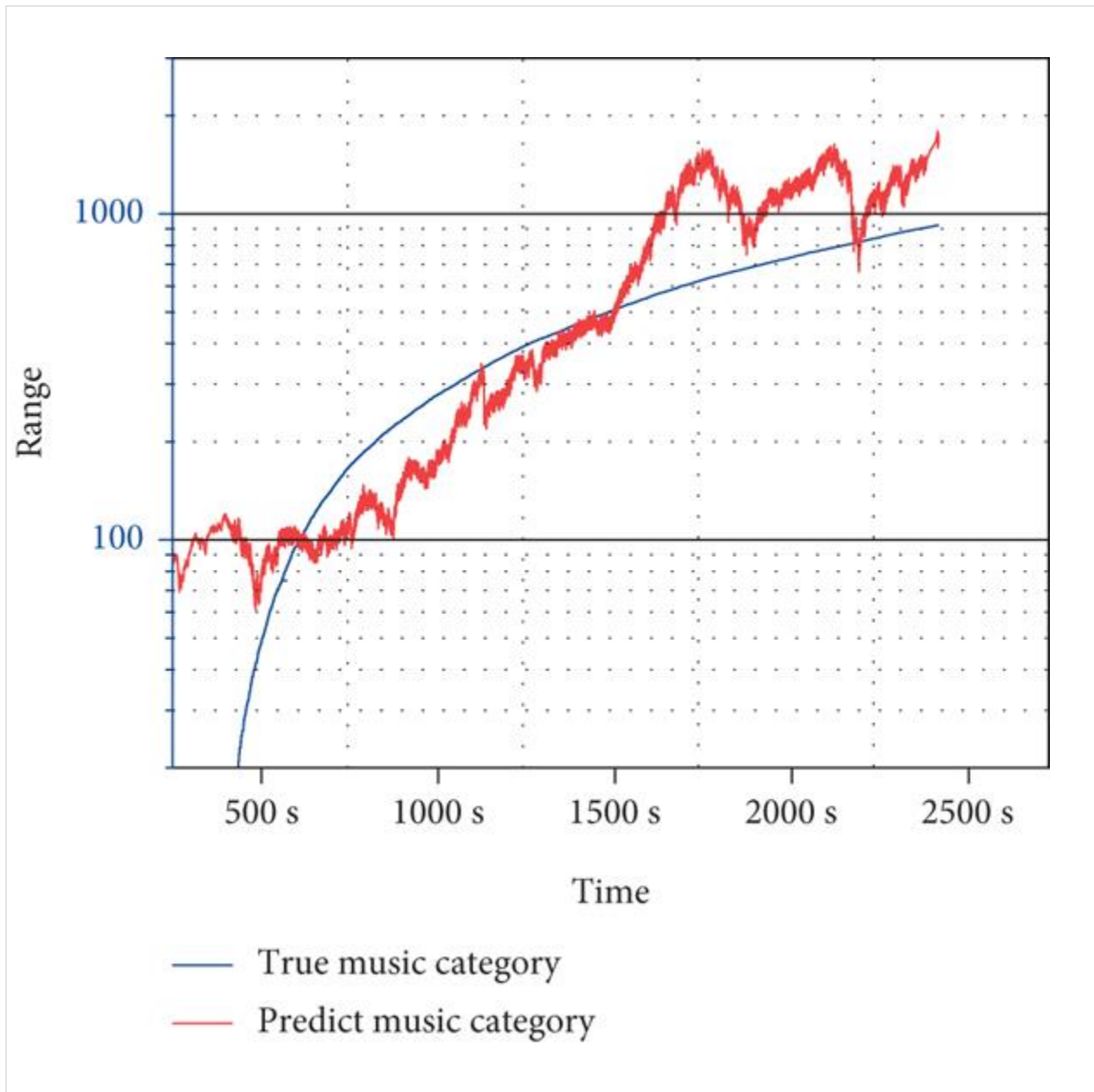
By counting the number of correctly classified four emotions, there were 35 segments for sad emotions, 49 segments for calm emotions, 42 segments for cheerful emotions, and 48 segments for intense emotions. Finally, an accuracy rate of emotion recognition is calculated for the musical segments.where AC stands for accuracy rate and stands for a total number of sentiments.

Due to the temporal nature of music, solving the music generation problem using generative adversarial networks is more difficult than solving the image generation problem. For composers to create music, music is often described as a multilevel hierarchical structure: the beat and note values and pitches are regarded as the smallest repetitive structure, and music measures are combined by notes, chords, etc.; while a certain number of music measures are combined into musical phrases, and variations of musical phrases are combined into movements; finally, multiple movements are combined into complete music. The quality of music is directly influenced by the time dependence between musical measures and their coherence, so it is important to model the time structure in the generative adversarial network. At present, most of the music water landscape manufacturers whether in the design stage or product display stage, music water landscape animation shows are relatively simple and can not be a comprehensive and reasonable display of the full picture of the music water landscape. Moreover, generative adversarial networks are suitable for generating continuous data, for example, the target output of the video generation task is continuous video. In contrast, for the monotrack music generation task, the target output is discrete notes (which do not necessarily have sound at every moment). A music clip presented using the Piano roll format is shown in Figure 6, where it can be noticed that the music is composed of a series of discrete notes or chords, and each point in the graph indicates whether that note is played at that moment in time. Therefore, the problem of generating discrete-valued music using generative adversarial networks needs to be addressed.

Piano roll music clip format diagram
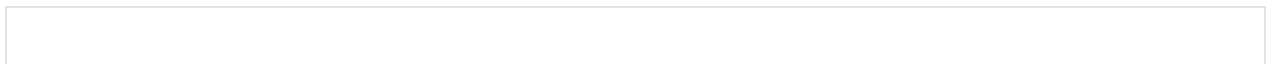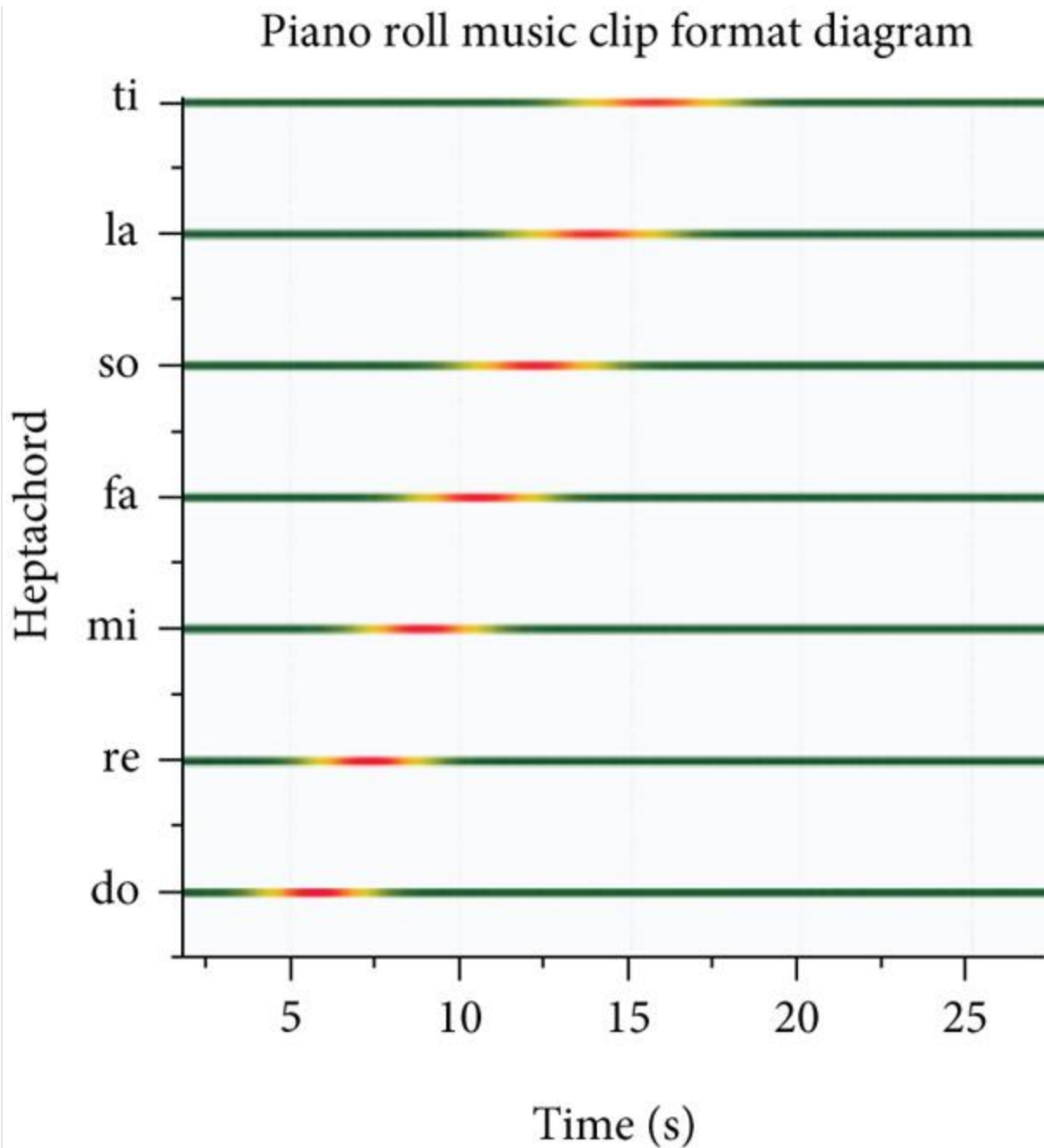
Figure 6

Piano roll music clip format diagram.

The controller can also view the working status of the specific performance unit of the fountain system, that is, click with the mouse on any of the performance units on the way, and its relevant information will be displayed in the upper right corner of the window,

including the movement of the fountain mode, color lights, and jet height. The more common method at present is to separate music information into several individual segments at fixed time intervals and then analyze each segment. This division method ignores the characteristics of the music itself, such as the changes in song form and melody, and mechanically determines that the music format is unique within the irregular time interval, which makes the analysis of the information more biased. Fountain system auxiliary subsystem information will be in the upper left and lower right reality of the monitoring area; according to this information, the controller can determine whether the system is working properly. The bottom of the window will be realistic about the current show and progress, to remind the controller to operate.

5.2. System Performance Testing

From the results of the BP neural network emotion recognizer, compared with other algorithms' emotion recognition results, the music segment emotion recognition has a high accuracy rate and can more accurately identify the emotion category to which the segment belongs. For the later music fountain, water-type lighting matching provides the basis. The test method of hydraulic control is to set the hydraulic pressure value and calculate the rise time, adjustment time, overshoot, and steady-state error of the signal response by collecting the change curve of the signal at the servo valve end, where the conversion formula of the signal amount and the pressure is as follows.

where is the actual test voltage value, is the expected pressure value, is the line resistance, and the total resistance of the test circuit is 1300 Ω. After calculation, 1 MPa theoretical test data should be approximated to 2.1 V, and the test results are shown in Figure 7. After calculation, all the indicators meet the system design requirements.
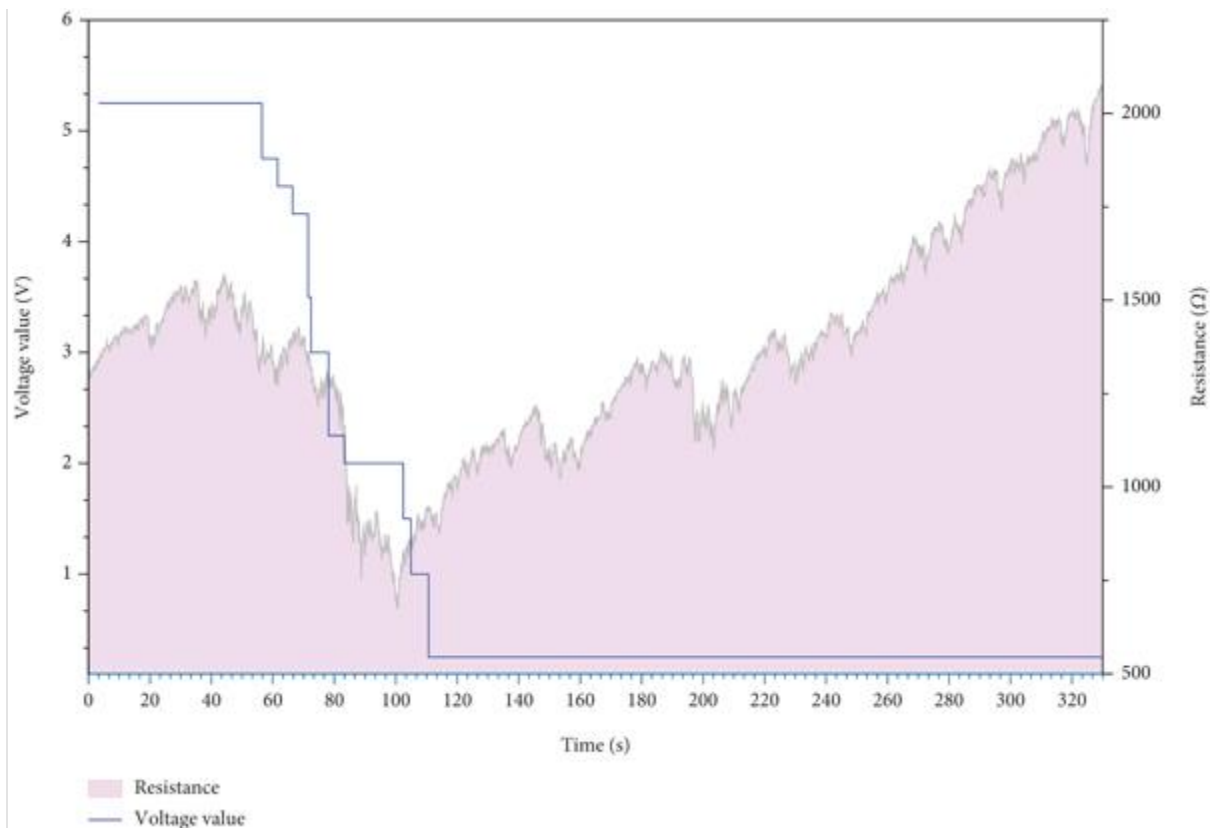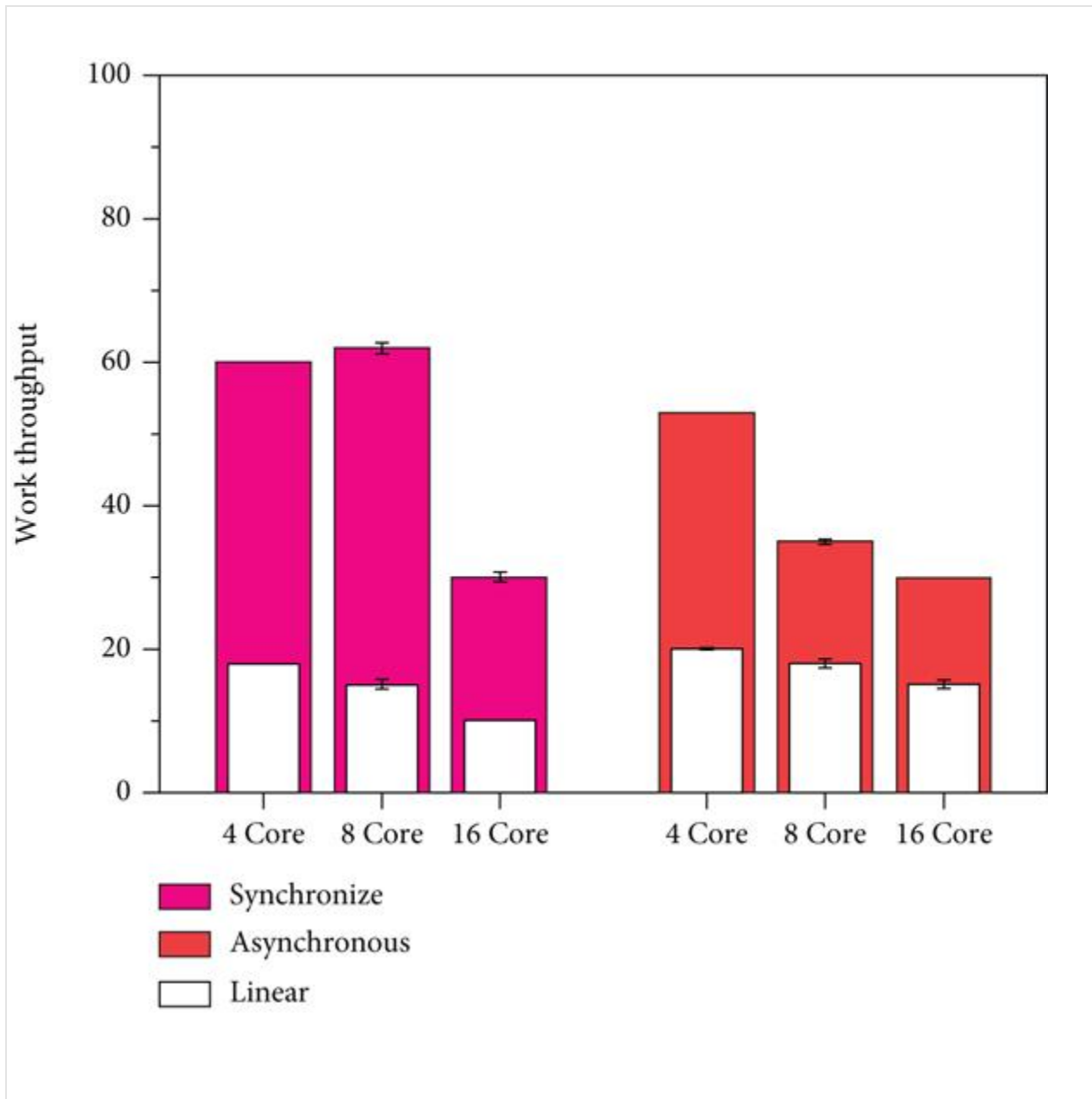
Figure 7

The hydraulic test data graph.

In the system implementation, the music emotion recognition function is designed as an asynchronous task to increase the throughput of the function, ensure certain stability and high availability, and bring a better experience to the users. As is shown in Figure 8, to simulate the scenario of real users using the music emotion recognition function, a test script was written using the Locust tool to simulate 200 users calling the music emotion recognition API for music emotion classification without interruption. When the system area is stable, the throughput of the music emotion recognition function is counted, and the performance results of both synchronous and asynchronous scenarios are tested by Celery's task synchronous and asynchronous switching function. One method is to send out the water type control signal in advance so that the actuator of the water valve, servo motor, etc. prestart; the implementation of this method is more difficult; prestart time is not easy to control; and there is no room for adjustment of time. By analyzing the experimental results, it can be concluded that the throughput of the single-core case using asynchronous tasks for music emotion recognition is about 1.3 times higher than that of the synchronous task; meanwhile, in the asynchronous case, the throughput of the music emotion recognition

function increases linearly with the increase in the number of CPU cores, while in the synchronous case, the throughput hardly changes with the increase in the number of CPU cores.

Figure 8

System throughput results.

The modules in the music intelligent processing system for the wireless music buzzer sensor music fountain intelligent control platform were tested for functionality, and the tests showed that the system's functionality met the system requirement criteria; then, the

system's comprehensive load performance and asynchronous task performance were tested to verify that the system has a certain availability, timeliness line, and high concurrency and can meet the current user requirements.

6. Conclusions

As people pay more and more attention to the living environment and health, the application of musical fountains in the city is increasing. In another way, with the development of society, the technology of music fountains is also in the process of continuous updating, so people's expectation of music fountains is also increasing. From the current state of technology, the intelligent music fountain based on music feature recognition has become a future development trend. In this paper, combined with the wireless zither buzzer sensor, through the study of the music composition structure, this paper provides an effective algorithm to extract the features of music such as notes and bar phrases. And a simplified A-V emotion model is proposed to represent the music phrase emotion. By analyzing the WAV music file format and using the algorithm, note features and music bar information are obtained, after which bar features are further extracted, and then, the music is divided into musical segments by judging the similarity between adjacent bars. Based on this proposed intelligent music fountain system based on music feature recognition, through the algorithm to identify the music section emotion transmitted by the wireless play music buzzer sensor, after that for each section to find the appropriate music fountain water type. Traditional program-controlled music fountain requires professionals to analyze and edit the music, need to write a specific water type program for each song, and also need to have a certain knowledge of music. The intelligent music fountain proposed in this paper does not require specific editing of each song, only for the four emotions proposed in the article to write a specific emotional water-type library; each emotional section will match the corresponding emotional water type library. This paper also conducts some research on the emotional water-type library, analyzing the types of emotions represented by different colors of lights, and the types of emotions represented by different water types. After the test showed that the system's function met the system requirement standard, then, the comprehensive load performance and asynchronous task performance of the system were tested, which verified that the system has certain availability, timeliness line, and high concurrency and can meet the current user's demand.