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Research Article

Interactive Display of New Media's Intelligent Robots for the Music Culture Industry

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This article mainly studies the interactive display that the new media intelligent robot can bring to us in the context of today's music culture industry. In view of the topics that people are more concerned about today, the main channel of this article is to effectively combine music and intelligent robots. First, the music needs to be transmitted to the robot as a wave signal. Before that, the music is specially processed, and then the music identification function of the relevant robot is systematically loaded. Secondly, the relevant robot can express the music in time and correctly. During the experiment, light music, heavy music, slow music, and fast music were used. A total of 6 groups of light music and light music were compared for input. Two groups of normal music were placed for comparison. The lighter the music, the more the robot in the interactive display process. The performance is not obvious. With the continuous increase of the corresponding coefficient, the accuracy of music robot's signal recognition gradually increases. When the coefficient is 0.8, the accuracy is the highest. The accuracy of the music robot in the heavy music environment is 88%, and light music is in a slow rhythm. The accuracy rate is the lowest under the condition of only 60%. From the experimental results, it can be seen that the characteristics of different music have an impact on robot identification and its correlation. Popularizing new media robots in the music industry can promote the sustainable development of the music market.

1. Introduction

1.1. Background and Significance. The study of music-based robots can be said to be a very cutting-edge industry. The continuous development of various fields in the world today is urgently demanding a more intelligent technology similar to programming [1]. Electronic music or handmade music makes people's lives rich and colorful. When people's living standards gradually improve, the application of music in the field of intelligence becomes particularly important [2]. In the smart electronics industry, the industrial robot industry has set foot [3, 4]. Likewise, intelligent robot arms are widely used in factories and the automotive industry. The use of a robot arm can prevent unnecessary problems when the labor is relatively scarce or the manual operation is not standardized. It can be applied to a variety of special working environments to minimize safety risks. For larger parts, the arm robot can be used for physical operations. The emergence of robots has made up for the shortcomings of labor and technology in various countries [5, 6].

1.2. Related Work. In recent years, many scholars have carried out in-depth research on the robot and its various application values. Yap et al. introduced a fully fabric-based two-way soft robotic glove designed to assist patients with hand impairments in rehabilitative exercises and activities of daily living. Manufactured by heat-pressing and ultrasonically welding a flexible thermoplastic polyurethane-coated fabric, the glove provides active finger flexion and extension for hand assist and rehabilitation training through its embedded fabric-based actuator [7]. Axel believed that although robot-assisted surgery (RAS) is used in many cases, soft tissue surgery is still a manual or remote operation procedure, which is largely due to the unpredictable changes in soft tissue during the surgery [5]. Saunders et al. believed that the care issues and costs associated with an increase in the elderly population are becoming the main concerns of many countries. He suggested using auxiliary robots in a "smart home" environment as a possible solution to these problems. One of the challenges is the personalization of robots to meet the changing needs of the elderly over time. One method is to allow the elderly or their caregivers or relatives to let the robot learn the activities in the smart home and teach the robot to respond to these activities. The most important premise is that such teaching is both intuitive and "nontechnical." To assess these problems, retail robots have been deployed in houses in ordinary suburbs that have been completely covered. They described the design methods of teaching, learning, robots, and smart home systems as an integrated unit, and gave the results of the evaluation of the teaching part of 20 people and the initial evaluation of the learning part of 3 people [8, 9].

1.3. Innovation and Content of This Work. This article takes a deep analysis of the combination of music and robots in the context of contemporary music culture. Based on the previous research and development of many robots, it continuously improves the industrialization of robots, and then produces a further technical collision between the aesthetics of music and the correct expression of robots, and develops a popular music robot today. The specific work content is as follows:

(1) First, analyze the development background of the robot industry at home and abroad and use this as a clue to explore the full text.

(2) The second is to make bold assumptions about the relevant algorithm design that may be used for robot-related design. The robot industry is the cradle of industrial technology, and music is the embodiment of cultural heritage. The combination of the two marks the continuous progress of China's culture and technology.

(3) Then carry out specific experiments on relevant content. Screen the relevant data and then make standard specifications and summarize them.

(4) Finally, discuss the experimental results. Find the best research plan as much as possible, conduct an inductive analysis based on the relevant data, and conduct further drawing research on the experimental results.

The research in this paper can provide a new idea for the integration and application of intelligent technology in the context of the music industry in the new era, and can also provide a novel research direction for music interaction and signal recognition.

2. Intelligent Music Robot

2.1. Work Flow of the Intelligent Music Robot. The identification of signals is inevitable during the working process of intelligent robots [10]. Music signal refers to the information carrier of frequency and amplitude variation of regular sound waves with music and sound effects [11]. First of all, the music needs to be identified and processed, among which there are related commands. Secondly, the robot needs to find the corresponding track. This requires adding a music library on the main board of the robot to store music. After finding the corresponding track, the robot needs to be able to express the action or music correctly. At this time, the robot's head, which is the main control system, conducts information transmission to the torso circuit, and the torso system starts to drive the limbs to perform. Under the buffer of intermittent current, the robot's horn starts to work, which is called vocalization [9, 12]. The workflow of the robot during the performance is shown in Figure 1.

As can be seen from Figure 1, the robot needs to meet the following conditions at the same time during the entire work process:

(1) It needs to be able to correctly identify and read data.

(2) The current required during the work must be uninterrupted.

(3) The main system must be able to maintain communication with other branches during the work.

(4) The output current needs to be correctly expressed through the horn [13, 14].

2.2. Sound Principle of the Music Robot. We all know that sound is transmitted through a certain medium, and in an absolute vacuum environment sound cannot be transmitted. Because the three mediums required for sound propagation do not exist in a vacuum environment. If the sound wants to propagate, it needs to satisfy both the sound source, the propagation medium, and the signal receiving object. Sounds with relative frequencies become chord music, and relatively irregular sounds become noise [15, 16]. Normal music is gathered by the collision of cold metals, but like electronic pianos, pianos, etc., it is buffered by current to sound [17]. Whether the sound is good or bad depends on your emotions. The better the mood, the better the sound, and the worse the mood, the worse the sound. Music robots make sound through the conduction of the electric current. However, before the sound is emitted, it needs special system processing so that the sound can be expressed more accurately [18, 19]. Its working principle is shown in Figure 2.

2.3. Formula Used in the Work Process of the Intelligent Music Robot. Generally speaking, music signals are guided by related formulas just like other sounds. Sound is transmitted in the form of waves, and it takes a certain amount of time during its transmission. There will be a corresponding mathematical model [20, 21].

2.3.1. Loudness of Sound. Set the loudness of the sound to $S_{(m)}$, then the time taken to pass each wavelength is set to t, then the formula of the change in loudness of the music signal after the time passed t with time is

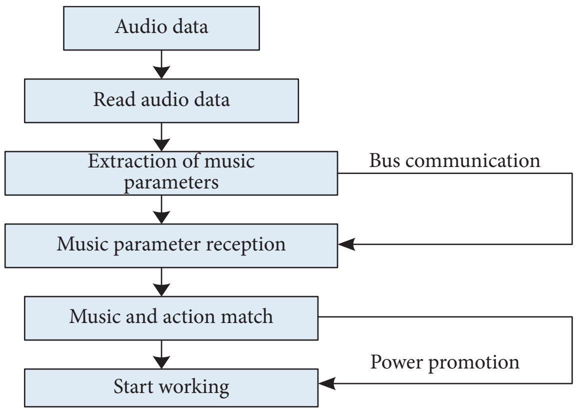

Figure 1: Work flow chart of the robot.

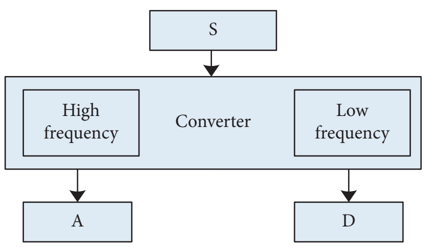

Figure 2: The working principle of the sound converter.

$$R_n(t) = \sum_{m=0}^{N-t-1} S_n(m)S_n(m+t). \quad (1)$$

From the above formula, we can see that when the time is $t = 0$, the correlation between the two adjacent wavelengths $S_{(m)}$ is similar. In other words, the correlation of loudness changes periodically with time. The initial value is the same, and the loudness of music is periodically doubled based on this formula.

2.3.2. Frequency of Music. Generally speaking, the change of music frequency determines the change of loudness to a certain extent. As the amplitude gradually increases, the loudness will gradually be affected, but this is not necessary. The frequency may be low-frequency or high-frequency [22, 23]. Low-frequency sounds are below 200 Hz, and high-frequency sounds are 170,000 Hz and above. Lower frequency sounds are difficult to detect.

The change formula of its frequency with time is

$$X_t = A \sin(\omega t + m). \quad (2)$$

It can be seen from the curve of music frequency with time. When the coefficient is 0, the mathematical model is an odd function. The period is expressed as $2\pi/\omega$, and its change is periodic. When the time is the initial time, it is a fixed value. It can be seen that the change of music frequency with time is very obvious, but there is a maximum value after periodic changes.

2.3.3. Amplitude Difference of the Current Signal. The magnitude of the current signal affects the quality of the outgoing sound. If the output current is too high, the sound will be distorted. Each intermittent current difference will have an impact on sound quality [24]. The value of this discontinuity is the amplitude difference of the current signal. It can be expressed by the following formula:

$$D(t) = x(t) - x(t+k). \quad (3)$$

In the above formula, the numerical difference between current signals always tends to zero. When the time changes, as long as the value of the coefficient is not the number 0, then the amplitude difference will have a certain change. The changes in the music signal are superimposed on the amplitude, so they can be changed accordingly. When the coefficient is larger, the amplitude difference will be larger.

2.3.4. Period of the Audio Signal. Most chord music shows periodic changes, and its periodic expression is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (4)$$

In the above formula, when the time approaches zero, the period of the audio signal is roughly the corresponding coefficient, and the difference between its adjacent wavelengths can be viewed approximately as the period of the absolute value, even function. When the value of time is equal to the coefficient, the wavelength of the sound can be regarded as the value 0. At this time, when music changes periodically, it can be regarded as the production of the same accompaniment.

2.3.5. Music Score of Robot Music. Generally speaking, the music spectrum is to modify the music. That is the modification of original music. This can show whether the music robot can accurately express the beauty of music. The general expression is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (5)$$

2.3.6. Wavelength Changes during the Musical Robot Performance. The change of the wavelength during the performance of the music robot can well transmit the signal to the audience. The change of the wavelength will directly affect the audience's feelings about music. The related expression is

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (6)$$

It can be seen from the above formula that when the coefficient before the time and the corresponding coefficient correspond to the same, the change value of the wavelength can be approximately regarded as an even function, and the change of the even function approximately moves one unit up or down on the coordinate axis.

2.3.7. Music Resolution. We all know that when music is performed by robots, the most important thing is to allow the audience to receive it in time and effectively [25]. At this time, the resolution of the music we often mentioned will be derived. The higher the resolution of music, the easier it is to be recognized by people. Because in theory, the higher the bit rate and sampling frequency, the more detailed the sound can be, and the more realistic the music will be. The corresponding expression is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (7)$$

When the coefficient value of the index is close to the value k, the music resolution in the a stage will increase, and when the value is close to $2r$, the music resolution in the b stage will increase.

2.3.8. Test Distance. During the experiment, it is often necessary to measure the distance of the limbs of the robot during interaction.

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (8)$$

According to the above measurement formula, the initial value can be used to measure the robot's limb distance.

2.3.9. Voltage. It is necessary to measure the voltage before conducting the experiment. For the series circuit, the voltage value is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (9)$$

When the time changes, the average voltage changes as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (10)$$

Within a certain range, the voltage value exhibits periodic changes.

2.3.10. Selection of the Music Robot Motor. When the AC motor is selected, the formula is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (11)$$

When the selected motor is a DC motor, the formula is as follows:

$$F_n(t) = \sum_{t=0}^{M-t} \left| x_n(t) - x_n(t+M) \right|. \quad (12)$$

3. Music Robot Simulation Experiment

3.1. Experimental Equipment. Music robots need corresponding hardware and software support when conducting experiments. The related experimental equipment and its functions are shown in Table 1.

The characteristic of the music robot to ensure a quick response during the experiment depends on the adjustment rate of the main control system to each branch circuit. It is especially important to choose a cost-effective CPU. And the selected CPU should not be too large, because the CPU is too large, the yield rate will also change, resulting in a decline. The processor heat dissipation to the CPU should be fast. During the experiment, the power supply needs to be kept sufficient. The signal device does not allow signal interruption.

3.2. Overall Framework of the Music Robot Design. The design of music robot-related software and hardware will directly affect the effect of the robot's overall interaction. If hardware and software can provide sufficient support, the interaction effect of the music robot will be better. The robot moves through the drive system during the performance. With the support of the power signal, the CPU begins to command the branch, which involves signal conversion between the music storage unit and the signal receiving unit. The overall block diagram of the music robot is shown in Figure 3.

The robot used in the experiment in this paper not only improves the reaction speed, but also has high design requirements for the expression of music by the robot. The power source used for this is four 12 V batteries to ensure the overall power supply of the robot.

3.3. Acquiring the Music Robot Signal in the Experiment. For musical robots, it is necessary to fully demonstrate the interactive characteristics of musical robots. Therefore, it is particularly important to obtain robot-related signals. During the experiment, light music, heavy music, slow music, and fast music were used, and a total of 6 groups of light music and light music were compared for input. Among them, 2 groups of normal music were placed for comparison. From the experimental results, it can be seen that the characteristics of different music to robot identification and its correlation have implications.

4. Discussion

4.1. Processing of Experimental Data. Record the change of the accuracy of the signal when the music robot receives the signal. The recognition accuracy of robots in different groups of music under different coefficients is shown in Table 2.

The experimental data of the control group is shown in Table 3.

Table 1: Experimental equipment and related functions.

Experiment equipment	Quantity (PCS)	Related functions
MATLAB software	1	Draw and describe the experimental results
Power supply	4(12 V/section)	Power the robot continuously
Driving device	2	Robot moves
Speed detector	1	The change of reaction speed in the process of the robot experiment
Signal transmitting device	1	Signal the robot
Obstacle detection device	2	Detection of road obstacles before and after moving
CPU	1	Robot brain

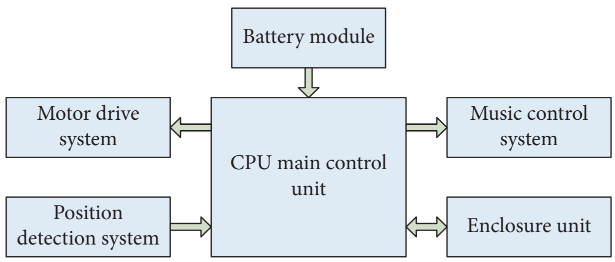

Figure 3: Overall diagram of the music robot.

Table 2: Recognition of robot music changes with the coefficient.

Number of (%) groups	Coefficient Accuracy								
	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6
Group1	5	14	27	47	76	48	26	13	6
Group2	6	20	30	50	88	52	32	18	7
Group3	4	11	25	45	75	47	26	14	6
Group4	4	12	24	43	75	44	22	10	3

Table 3: Control experiment table values.

Number of (%) groups	Coefficient Accuracy								
	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6
Group5	10	20	32	47	72	45	29	14	6
Group6	10	21	33	48	69	37	32	15	7

4.2. Music Robot Signal Recognition. According to Table 2, the corresponding data distribution is shown in Figure 4.

As can be seen from Figure 4, with the continuous increase of the corresponding coefficient, the accuracy rate of music robot's signal recognition gradually increases. When the coefficient is 0.8, the accuracy rate is the highest. The accuracy rate of the music robot is 88% in a heavy music environment. The accuracy is the lowest under slow-tempo conditions, which is only 60%.

As shown in Figure 5, it can be seen from the cubic diagram that the sensitivity tends to be normally distributed around the coefficient of 0.8, and then gradually diffuses to both sides. Each group of experiments showed a steplike increase or decrease, indicating that the music robot has certain restrictions on the recognition of music, and the optimal recognition degree within a certain range.

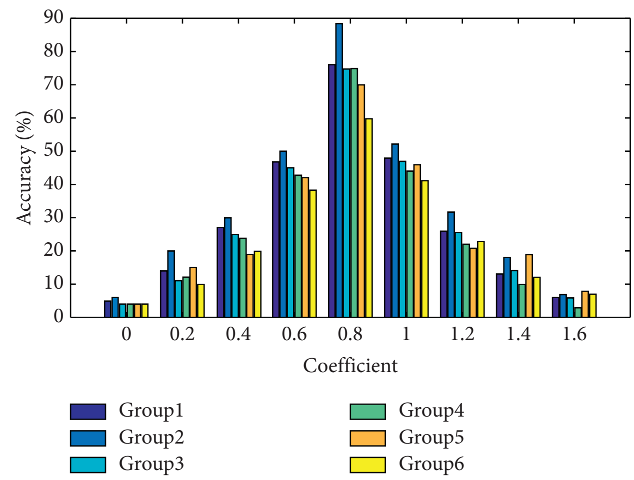

Figure 4: Distribution histogram of the experimental group.

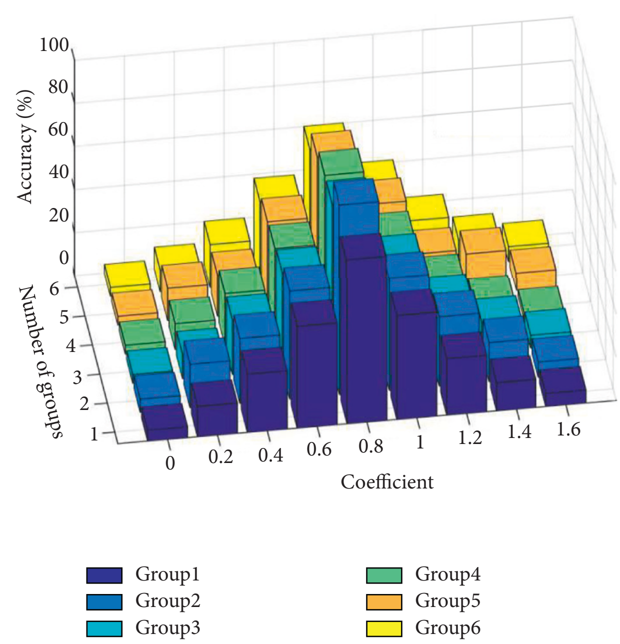

Figure 5: Cubic diagram of music robot music recognition.

It takes a certain amount of time for the robot to recognize music, and there will be a certain amount of energy loss. The linear graph of music robot's music recognition is shown in Figure 6.

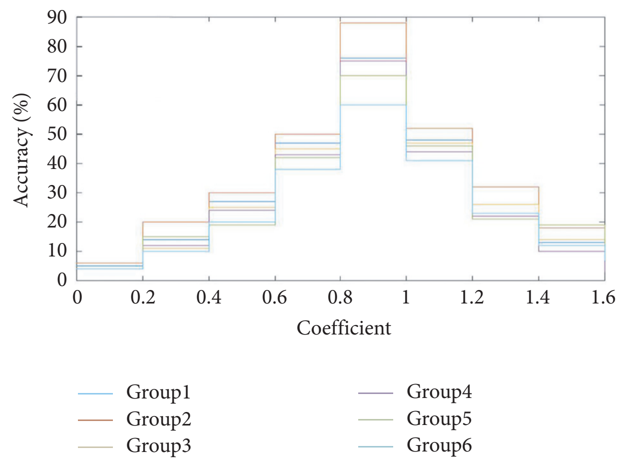

Figure 6: Music robot recognition linear graph.

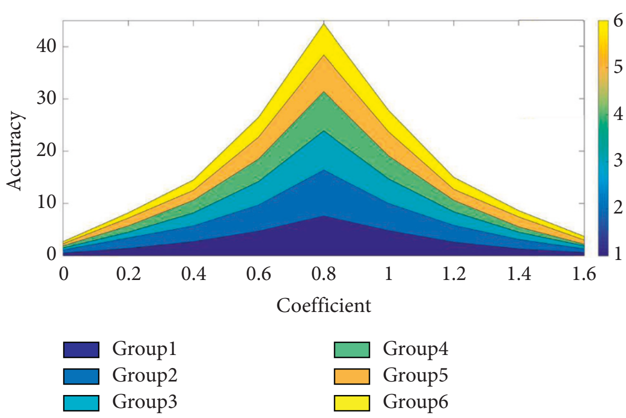

Figure 7: Interactive effect of the music robot.

4.3. Interactive Effect of Music Robots. According to Figure 7, the correct signal processing result of the music robot shows an approximate symmetrical distribution. The dividing line is located above the 0.8 factor. Under relatively longer wavelengths and slower audio, the interaction of the robot is more obvious, and the detected interaction accuracy is about 97%. In the case of short-wavelength and fast audio, the interactive display of music by the music robot is relatively slow, and the accuracy of the detected interaction is about 86%.

5. Conclusion

With the rapid development of today's technological revolution, robots are gradually moving towards people's field of vision. This paper mainly studies the interactive display of music robots under different music backgrounds. The robot designed in this paper has low energy consumption and fast running speed. During the interactive display, it has been improved accordingly. A signal detection system has been added to prevent the robot from being affected by obstacles during the interactive display. In addition, the signal detection system can accurately and timely determine the circulation of the entire system circuit, thereby ensuring that the robot can safely and accurately complete the interactive test requirements.

Although this paper has carried out a profound study on the interaction of music, there are still many deficiencies. The depth and breadth of the research in this paper are not enough, and my academic level is also limited. In the future work, based on the existing technology and level, we will improve music interactivity from more angles, and continuously optimize the research method.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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