Research on Music Fountain Design based on Intelligent Water System

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Abstract. With the continuous development of AI intelligent technology, ornamental water resource design has been applied in various fields, and the interactive application of new music fountain and computer is also more extensive, which makes more control circuits need to be completed by computer, and it is developing towards intelligence, dispersion, synthesis and diversity. Artificial fountain music usually has two system composition, one is the control program system, mainly control the style and flow of water, the other is music control system, mainly through computer programming code, and according to different music, programming, so as to achieve shape synchronous music and water combined to send out a different style of artistic effect. Musical fountain landscape entertainment application scene extension is quite rich, the fountain can be designed out of different patterns, through the program programming according to a certain law to control the pattern of water, make it colorful, different shapes. Many squares include large entertainment venues, plus music fountain elements, the overall beauty can be improved, the design of an energy-saving pattern fountain controller in line with the mainstream of the times.

1. Introduction

Music fountain after for a long time, the earliest time only a fountain, its use value is a single, is only a single element to water play, application scenarios are not rich enough, most of the plants and crops irrigation for gardens, then after a long time of accumulation, including programmable control technology and computer code programming technique, the variable control technology, coupled with the application scenario of rich gradually, formed a certain scale including the equipment, including now has a dragon fountain equipment manufacturing as a whole and some commercial trading activities, thanks to start irrigation scenarios, followed by ornamental value gradually rich. Join the element also is more, the most familiar music artistic elements, pattern shape element, synchronous and asynchronous elements, elements gradually became even more will have a lot of request for its internal manufacturing, more difficult to programmable request, makes music fountain discussion paper also more and more, the researchers also is more, in the final analysis is the application scenarios of diverse elements of diversity and complicated. Music fountain will mainly music fountain element and element combination, the combined effect is not so boring, audio signal and fountains of pattern, both synchronous and asynchronous, particularly strong innovative, strong experience in feeling, whether it's senses, or appreciation value, has a very good experience, beautify the environment and artistic value to last long, plus the classical art of fountain form of aesthetic
modelling and rich vitality, bring out the best in each other, light and electricity can more foil out the value of the fountain, the development present situation to the recent breakthrough in the design, the structure is introduced to the control principle and internal important, In addition to the overall summary of the research and value reflection, I believe that there will be a good research value.

This paper expounds the domestic status quo of music fountain and recent breakthrough, then explain the overall structure of the music fountain design and part of answer again music fountain type controller running principle and important link in the PLC control principle, will emphasize emphatically music fountain of the water system design pattern, the final match will water the visual perception of light and music listening experience together, create immersive environment art atmosphere.

2. Research Status
Music fountain of breakthrough is not only on the modelling and elements of innovation, may be more dependent on the accumulation type in science and technology innovation and innovation again, audio and MIDI signal is converted into binary code, this time to experience again and again for translation code and programming code, the centralized control system will signal collection and processing, the application of multimedia technology is also a music fountain, to a certain extent, more stereo, imaging effect is better, PLC control technology can be water type switch, the water through the material medium, to the effect of different shapes, longitudinal fountain field, One moment may gush of particularly high, reached the peak, after a second might be to make it come to an abrupt end, physical level, more use of reflection and refraction of light, to make it look colorful, as well as water valve pressure of refinement gradually improve, so that the water valve to control the water column can present different shape and even thickness of cylinder, on the other hand on the system also has largely innovation, currently the most advanced based on the distributed computer control system under the WINDOWSNT, music signal processing system by programmable technology, this processing system is very efficient and practical, Focused role in distributed control system can make the music signal any delay, can spread music gradually, make seamless synchronization, fountains and music can be real-time collection of music signal delay processing and spectrum analysis, a further advantage of form a complete set of equipment, is the main control machine equipment, the master can target machine equipment, to capture the various states of the fountain, especially the state of equipment failure, or the state of leakage, automatically cut off the corresponding parts, namely has the security, safety work done especially in place, this is to get a guarantee of the safety of the large music fountain, music fountain is generally belong to large exhibition or activity, Will work on the defective cause security problems, this time by control technology, control of main control machine, let his acquisition of the security status of all parts will be collected computer abnormal state of the input to the Treasury, according to different state, have corresponding methods, so you don't have to worry about the fountain in the process of discharge, the security problem of. Spark can drive electric leakage protection device, to avoid the electromagnetic interference, a system failure occurred in a single, for the first time feedback to the system, the system will immediately cut off power supply, so not excessive consumption equipment breakdowns, to a certain extent, also said is equal to extend the service life, coupled with the major manufacturers have their own a set of unique way of earthing protection, further enhance security, the control way directly USES the manual control, and program control, is Have certain visual operation interface, more easy to pass the information, some buttons using graphic method, were also more likely to make the operator look more understanding, from a certain extent, the less education costs, manufacturers want to apt, domestic level steady development, seek improvement in stability, may be more front is more in a short period of time how to make decorative pattern, style more, it may be more dependent on central processor, the further update and strengthen of PLC technology, remains to be seen, looking forward to domestic manufacturers can create better equipment, to meet the needs of the mass of ornamental fountains[1].

3. Composition and Structural Design of Music Fountain Intelligent Water System
3.1. Composition of Music Fountain System

Music fountain equipment consists of fountain nozzle, fountain pumps, LED lights, center automation control system of tank, a number of cables and pipelines, and other accessories. There are many kinds of fountain nozzle sort, ice tree nozzle, universal dc nozzle, hemisphere dandelion nozzle, center on nozzle, mist sprinkler, style shower nozzle, etc., there are about hundreds of different species present in the process of the fountain in the form of different, can present a standing water, water, water, water, and other forms of derivative portfolio out colorful change, fountain pump automation style also is more, its flow components, constitute a shell material and external parts are made of stainless steel or cast iron, stainless steel material can increase the life of the pump to a certain extent, the submersible pump has certain leakage protection device, pump adopt stainless steel mesh cover, three phase four wire cable, using special materials to prevent impeller looseness, fountain pump equipment by the pump, motor, cables, water pipe, and four major part control switch, fountain pump is used in the fields, such as landscape fountain, water fountain leds is common, involved control system inside the tank is more, after this paper will focus on the control principle and computer programming technology. The technology in the control system cabinet includes configuration software, programmable controller, frequency converter, sound system, light system and other industrial control devices. The music fountain control system with high technical content and high reliability is also the most important part and the most core part of the fountain system. Core professional music fountain control system is an integral part of the chain, the control system is very important in the whole, music control, process control and artificial intelligent control technology in modern industrial control system, the overall control terminal by PC, PC computer background is increasingly a facilitation, procedural, intelligent, with part of the automation button on it, the overall learning understanding identification threshold is lower, a little familiar with will be able to grasp basic operation, the equipment can realize automation management music control, water pump control, lighting control, can realize the real-time programmable, Self-identification of music melody, rhythm, sense of music and audio intensity, music fountain can be completely under the system command, follow the melody of music, water pump machine release different patterns, especially strong sense of viewing experience, the overall control system equipment is not cheap, large-scale activities, state-owned enterprises to buy more. The following is a description of the specific process:

Control system: Monitor and control the whole fountain system, extract the music emotion and match the program.

Music system: Mainly responsible for the fountain music playing, including sound card, audio equipment.

Fountain system: Responsible for the injection of different fountain water types, including underwater rocking machine, pipeline system, valve control, servo motor, water pump and other equipment.

Lighting system: Responsible for the lighting effect of music fountain, including lighting switch, brightness control and color control.

Water treatment system: Responsible for the treatment of fountain water, including purification and filtration units and recycling units [2].

According to the previous analysis, we firstly extracted by the control system the basic characteristics of the music, the second will be music divided into several segments, after the recognition of each fragment in emotion, according to the emotion for each segment matching fountain control program, and then control the music system, fountains, complete performance system, lighting system, etc. The overall process is shown in Figure 1:
As the execution of music analysis and extraction by the control system requires a certain amount of time, it also takes a certain amount of time to control various water pumps and servo motors of the fountain system for relevant operations. If the music is directly exported, it will cause music and water type, pattern mismatch, affecting the viewing effect.

To solve the problem of playing music and water fountain performance lag, mainly using music delay for a period of time before playing, easier to achieve synchronization. Hardware delay is adopted here to design a delay circuit.

The time delay mainly consists of two parts, namely, feature extraction and emotion recognition of music, and control of water pump and servo motor. Since the time of these two parts is related to equipment, site, length of wire and so on, we need to conduct field tests for many times to obtain accurate time[3].

3.2. Design of Music Fountain Model

Below is a CAD model of the fountain, as shown in the following two pictures. Figure 2 is the top view. Yellow number means the number of fountain water valve, while green indicates the dimension parameters of fountain. Figure 3 is a face view indicating the installation position, installation Angle and height of the water type of the water valve.

Figure 1. Music fountain control flow chart.

Figure 2. Top view of music Fountain mode.
Figure 3. Frontal view of music fountain mode.

By using the program in PLC in advance to design the fountain water type, time, water output, by the site operators according to the live music free choice and switch.

Press the start switch button and the music fountain device starts to run; Press the stop switch button to stop the music fountain.

The operation mode of the music fountain is determined by the pattern selection switch and continuous/single switch [4].

Pattern 1: Select the switch of Pattern 1 and press the start switch. No. 4 sprinkler head starts spraying water and No. 4 underwater color lamp lights up at the same time for 3 seconds; After 3 seconds, no. 4 sprinkler head and No. 4 underwater lights stop running, and No. 3 sprinkler head and No. 3 underwater lights start working for 3 seconds. After 3 seconds, no. 3 sprinkler head and No. 3 underwater lights stop running, and No. 2 sprinkler head and No. 2 underwater lights start working for 3 seconds. After 3 seconds, no. 2 sprinkler head and No. 2 underwater lights will stop running. No. 1 sprinkler head and No. 1 underwater lights will start running for 3 seconds. The total time of the system is 16 seconds. After 16 seconds, if it is in a single operation mode, the fountain will stop running. If the fountain is in continuous operation mode, the fountain continues to circulate the water type.

Pattern 2: Select the pattern 2 switch and press the start switch. The no. 4 sprinkler head will start spraying water and the no. 4 underwater color lamp will be on at the same time for 3 seconds. After 3 seconds, no. 4 sprinkler head and No. 4 underwater lights stop running, and No. 2 sprinkler head and No. 2 underwater lights start working for 3 seconds. After 3 seconds, no. 2 sprinkler head and No. 2 underwater lights stop running, and No. 3 sprinkler head and No. 3 underwater lights will start running. No. 1 sprinkler head and no. 1 underwater lights will start running for 3 seconds. The total time of the system is 16 seconds. After 16 seconds, if it is in a single operation mode, the fountain will stop running. If the fountain is in continuous operation mode, the fountain continues to circulate the water type.

Pattern 3: Select the pattern 3 switch and press the start switch, then no. 1 sprinkler head will start spraying water and no. 1 underwater color lamp will be on at the same time for 3 seconds; After 3 seconds, no. 1 sprinkler head and no. 1 underwater lights stop running, and No. 2 sprinkler head and No. 2 underwater lights start working for 3 seconds. After 3 seconds, no. 2 sprinkler head and No. 2 underwater lights stop running, and No. 3 sprinkler head and No. 3 underwater lights start working for 3 seconds. After 3 seconds, no. 3 sprinkler head and No. 3 underwater lights will stop running. No. 4 sprinkler head and No. 4 lights will start running for 3 seconds. The total time of the system is 16
seconds. After 16 seconds, if it is in a single operation mode, the fountain will stop running. If the fountain is in continuous operation mode, the fountain continues to circulate the water type.

Pattern 4: Select the pattern 4 switch and press the start switch. The music fountain device will operate in the sequence from Pattern 1 to Pattern 2 to pattern 3. If it is in a single operation mode, the fountain will stop running after running this process; If running in continuous mode, the fountain continues to follow this process.

3.3. Selection of Music Fountain PLC and I/O Address Allocation

The design of music fountain does not require many points, the overall analysis decided to use Siemens model for 226,24 DI/16DO 200PLC. Siemens 200PLC has the advantages of low price, expansibility, unity, etc., with 200PLC design, can achieve high reliability, strong communication ability, easy to master and other requirements, so the use of this PLC. Through the research and analysis of the system, the I/O address of PLC was assigned, as shown in Table 1.

| Input signal         | Site   | Describe                          |
|----------------------|--------|-----------------------------------|
| START                | I0.0   | Music fountain starts             |
| STOP                 | I0.0 (false) | Music Fountain closes           |
| Water pattern 1      | I0.2   | Choose 1 water type               |
| Water pattern 2      | I0.3   | Choose 2 water type               |
| Water pattern 3      | I0.4   | Choose 3 water type               |
| Water pattern 4      | I0.5   | Choose 4 water type               |
| Single run mode      | I1.0 (false) | Select single run mode        |
| Continuous operation mode | I1.0     | Select continuous mode           |

| Input signal         | Site   | Describe                          |
|----------------------|--------|-----------------------------------|
| Fountain outlet 1    | Q0.0   | Fountain outlet 1 spouts water    |
| Fountain outlet 2    | Q0.1   | Fountain outlet 2 spouts water    |
| Fountain outlet 3    | Q0.2   | Fountain outlet 3 spouts water    |
| Fountain outlet 4    | Q0.3   | Fountain outlet 4 spouts water    |
| Underwater lights 1  | Q1.0   | Underwater lights 1 on            |
| Underwater lights 2  | Q1.1   | Underwater lights 2 on            |
| Underwater lights 3  | Q1.2   | Underwater lights 3 on            |
| Underwater lights 4  | Q1.3   | Underwater lights 4 on            |

Table 1. Music water fountain distribution plan.

3.4. Music Fountain Emotional Match

We need to design a lot of different fountain water type programs, or water type performance action sequences, and store these water type programs in the basic fountain performance program library, and these action sequences should be combined to match the music emotion [5].

Music emotions in music cannot be directly recognized by the computer, the computer can only recognize binary files [6]. Therefore, it is necessary to quantify the emotional characteristics of the musical part of the music, and convert the emotional information into binary files, so that the computer can recognize these numbers. In order to express the emotion of music, we need to choose appropriate musical characteristics to express music. Through the study and analysis of music features, it can be divided into three levels: the bottom layer is the basic feature, the middle layer is the complex feature, and the top layer is the overall feature, as shown in the Figure 4.
Figure 4. Music water fountain emotional picture.

The basic features include pitch, intensity and duration, which are the most basic elements of a musical feature. These basic features can be extracted from notes, as described in the previous chapter. Basic features such as pitch, intensity, and length do not directly express the emotions of a segment. The emotion of a piece needs to be analyzed from the complex characteristics, including rhythm, playing speed, melody and so on. Depending on the tempo of the music, the water pattern of each emotion should also be designed for different periods of time, generally based on 1 bar /1 second. As the length and speed of music are different, the control and action time of fountain system also need to be adjusted automatically to achieve the synchronization of music and fountain. We divide the music emotion into four categories: calm, cheerful, passionate and sad. Each category is designed with three to five different sequences, which strictly follow the timing sequence of the single chip microcomputer, the emotional water type and the rhythm of music fragments. The analog signal of the control pump and servo motor is made from the digital signal output sequence of the microcontroller and modulated by PWM [7].

3.5. Music Light Emotion Match
At the same time, the lighting system also requires us to design several programs to cooperate with the interpretation of music emotions. Here, we use different colors to express people's emotions, as shown in Table 2.

| Emotion pattern | Color of light                  |
|-----------------|---------------------------------|
| Calmness        | Light blue, light white, green  |
| Happy           | Light purple, light green, light red |
| Passionate      | Red, brown, light yellow, orange|
| Sadness         | Black, white, grey, Burgundy, blue|

Table 2. Emotion matching diagram.

The control system selects the emotional mode of light color according to the emotion of the music segment, and then selects the color in the mode according to the volume, pitch, length and rhythm of each beat, so as to achieve the harmony between music and light [8].

3.6. Water Treatment System
Music fountain uses water storage pool and pipeline to carry water, to achieve recycling, reduce the waste of water resources.

As the fountain absorbs the haze and dust in the air, it needs to be purified and filtered. Only the water purification system device is needed.

Water purification system can effectively remove the bacteria, viruses, solid suspended solids and
dust in the water, and then by activated carbon to further remove all kinds of organic matter [9].

Most of the water ejected from the fountain is recovered from the pipe below the fountain and returned to the reservoir for storage. If there is not enough water, tap water will be automatically replenished and pressurized by the water pump to the fountain system for fountain performance [10].

4. Summary and Prospect

This paper, by using PLC as the controller, with the drive to achieve precise control of motor speed, the I/O port is connected when programming with the assurance of the corresponding components, at the same time, according to the beat of music is different, each a water type design different length of the emotion, emotional patterns according to the shape of the music of the light transform show different, in the smart fountain of humid air at the same time, reduce the temperature, bring pure and fresh environment, small water droplets and air molecules on the human body the oxidation of the anion can promote human body and metabolism, improve respiratory and circulatory function, enhance immunity. Modern fountain project is a multi-disciplinary, multi-field system engineering, especially the construction of music fountain project, the research content is quite extensive. Music feature recognition is one of the frontier topics in fountain control field, and there are few relevant researches and data. This is a relatively new attempt in this field, but there are still many theoretical and practical problems to be further solved. In the follow-up work, the author will draw lessons from these new methods and ideas, combine more achievements of music feature recognition with modern control technology, and make more attempts in the fountain control system, so as to make the effect of music fountain control system more ideal.

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