

# **S y s t e m   D e s i g n S p e c i f i c a t i o n**

## Star Gallery

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## 1 PROJECT OVERVIEW

Star Gallery is a gallery platform for autistic children based on the World Wide Web. In addition to viewing children's paintings, users participate in small games. During the game, artificial intelligence algorithms can generate new works based on the original paintings. Users correct the machine's aesthetics by voting , the works with the most votes will be sold on the NFT platform to help autistic families earn treatment fees. The purpose of building a platform is to allow autism to express themselves and realize themselves on the platform, to attract public participation, and to increase the social attention of autism. By participating in the game, users can not only help the disadvantaged, but also participate in artistic creation.

## 2 PROJECT OBJECTIVE

Establish a website platform to share the creations of children with autism, so that children with autism can express themselves and realize themselves, and attract more people to pay attention to the information of this group. Use the self-trained AI model to create new paintings, interact with users through games, vote for works that conform to human aesthetics, and display and sell them in galleries together with children's works.

## 3 DESIGN SCOPE

- Develop a painting portfolio display website.
- The website provides popular information on autism.
- The website provides user registration and login functions.
- Provide users with online game functions.
- Research AI algorithms for improving image style transfer.
- Collect data sets, train AI models, and test the actual effect on various pictures.
- Use AI image generation technology in the game to improve the fun of the game while reducing the workload of manual intervention.
- Automatically record game voting results and add the most popular entries to the gallery display.
- Create an NFT platform purchase link.
- Experimentally establish a children's studio and provide AI-assisted painting functions.
- Train the Stable Diffusion Chinese model for minors.
- Website background maintenance support.
- The website is safe and stable.

## 4 CONDITIONS AND RESTRICTIONS

### 4.1 Conditions:

- Users need to have a device with Internet access, such as a computer, tablet or mobile phone, to use it.
- The image generation algorithm runs on the cloud server and requires sufficient computing power and memory.
- GAN image generation technology needs to use the VGG neural network model for training and optimization in the background.

### 4.2 Restrictions:

- The image generation algorithm takes a certain amount of time to complete, depending on the size of the input image and style file, there may be a delay.
- In the case of generating image requests concurrently, the VACGAN model must have GPU support to run.
- The Stable Diffusion model must run on the GPU.
- The online gaming experience may fluctuate due to network conditions.

## 5 SYSTEM FUNCTIONS

### 5.1 System front-end overview

- Support users to log in to the Star Gallery website through various terminal devices. The front-end main page introduces Star Gallery, showing the basic information of the website, including website name, website introduction, website theme, etc.
- The main menu bar includes Gallery, Games, Autism Science, Team Profile, and User Account Management.
- The gallery page displays works that can be sold through NFT, including children's original works and works generated by AI based on original works.
- Click on each work to enter the detailed information page of a single work, including a brief introduction of the work and a personal introduction of the author.
- The main page of the game includes game rule descriptions, scoring and ranking methods and prizes, and the page provides links to the entrances of each series of games.
- Each series includes multiple branches of children's painters. Each branch page introduces the author and work information in detail, prompts the game start and end date, and provides a game entry link if the game is in progress.
- After entering the game interface, each round of the game will display two works for the

user to choose at the same time. Each round has a countdown function. The user clicks the mouse to select one of the works within the specified time. If there is no operation within the specified time, the system will default to the left. Automatically enter the next round. The total number of rounds can be set for each game. After all the rounds are completed, the page will display the final selected single work and prompt the date and time when the ranking will be announced.

- The autism science page introduces the basic situation, symptoms and social difficulties of autism, helping users understand autism-related knowledge. It can also provide relevant resources and links, such as support organizations, medical institutions, etc.
- The team information page introduces the team members and volunteer information of Star Gallery.
- Users can register as a member of Star Gallery, and need to enter their email address, so that Star Gallery can send out award notifications and how to receive awards.
- Only after becoming a member can you participate in the game and like the work. Each member can only participate in the same game once.
- The member account management page lists the games that the member has participated in, the score ranking and awards of each game, and provides links to award-winning works.
- The thank you page summarizes the member's contributions to children with autism.
- The studio page is a painting space created by the user and AI. The user chooses the type of painting and can submit it to the AI to generate a picture by inputting Chinese prompt words, or upload his own picture to let the AI continue to create.

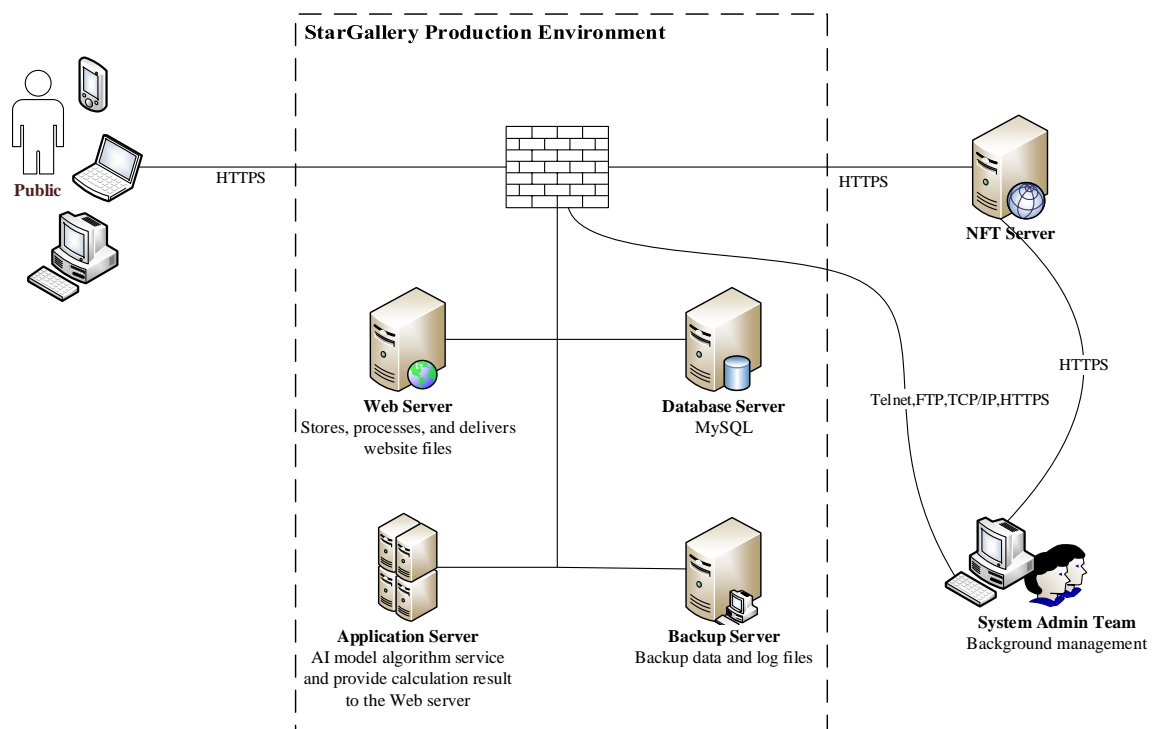
## 5.2 System Backend Overview

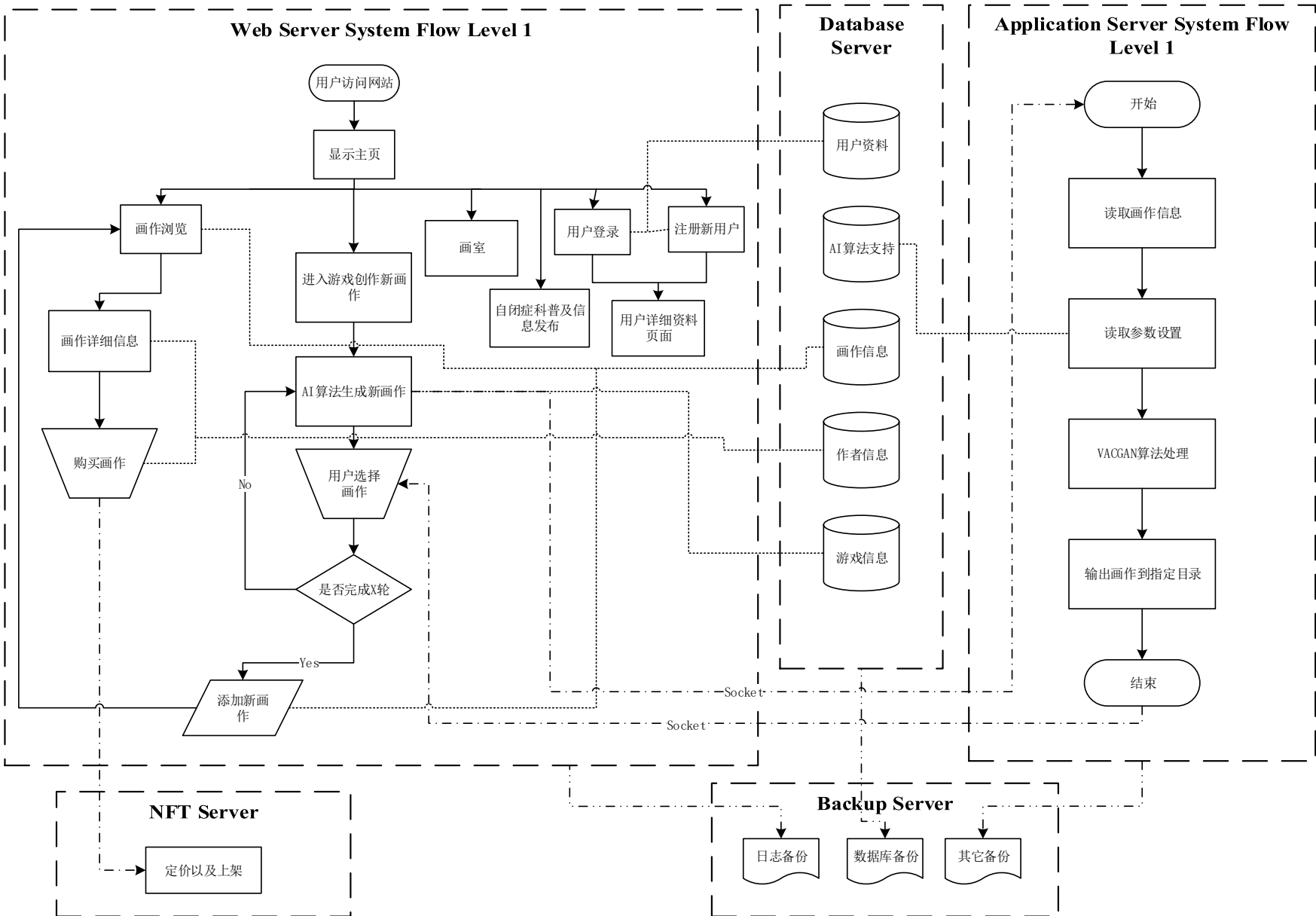
- The cloud server provides 7x24 uninterrupted service at the back end, the web server is responsible for responding to front-end requests, the database server is responsible for providing data storage, and the application server provides the AI algorithm operating environment.
- Website pages and game functions run on the web server, and user requests are mainly fed back by HTML and Javascript.
- The AI image generation function runs on the application server, provides an API standardized interface to respond to the calculation request from the web server, reads the locally stored AI model file, saves the generated image to the specified directory, and returns the status information.
- AI Image Generation Algorithm: The VACGAN algorithm uses a Generative Adversarial Network (GAN) structure to train the generator and discriminator networks by pairing input images with target images. Input the original image or the winning image, and the AI algorithm will process it into an image with more artistic beauty.
- The Stable Diffusion model requires GPU computing support.
- The database server provides data support for the Web server and application server.
- In the initial stage of website construction, the amount of data is not large, and the comprehensive console will not be developed for background maintenance for the time

being, and small tools will be provided for different business needs.

- Background maintenance work includes author data collection, sorting and uploading, work data collection, sorting and uploading, work AI model pre-running, game design and uploading, AI model update and maintenance, autism data collection, sorting and uploading, member management, work NFT on the shelves, and prize distribution.
- Reports are regularly generated in the background every day, including new member list, game list, score statistics of completed games, list of newly generated works, and website traffic report.
- The background automatically backs up all files and databases every day, and provides instant backup and recovery functions.
- Security and performance optimization functions: guarantee the security and performance optimization of the website, such as using the HTTPS protocol to ensure the security of data transmission, and using caching and compression technologies to optimize the response speed of the website.

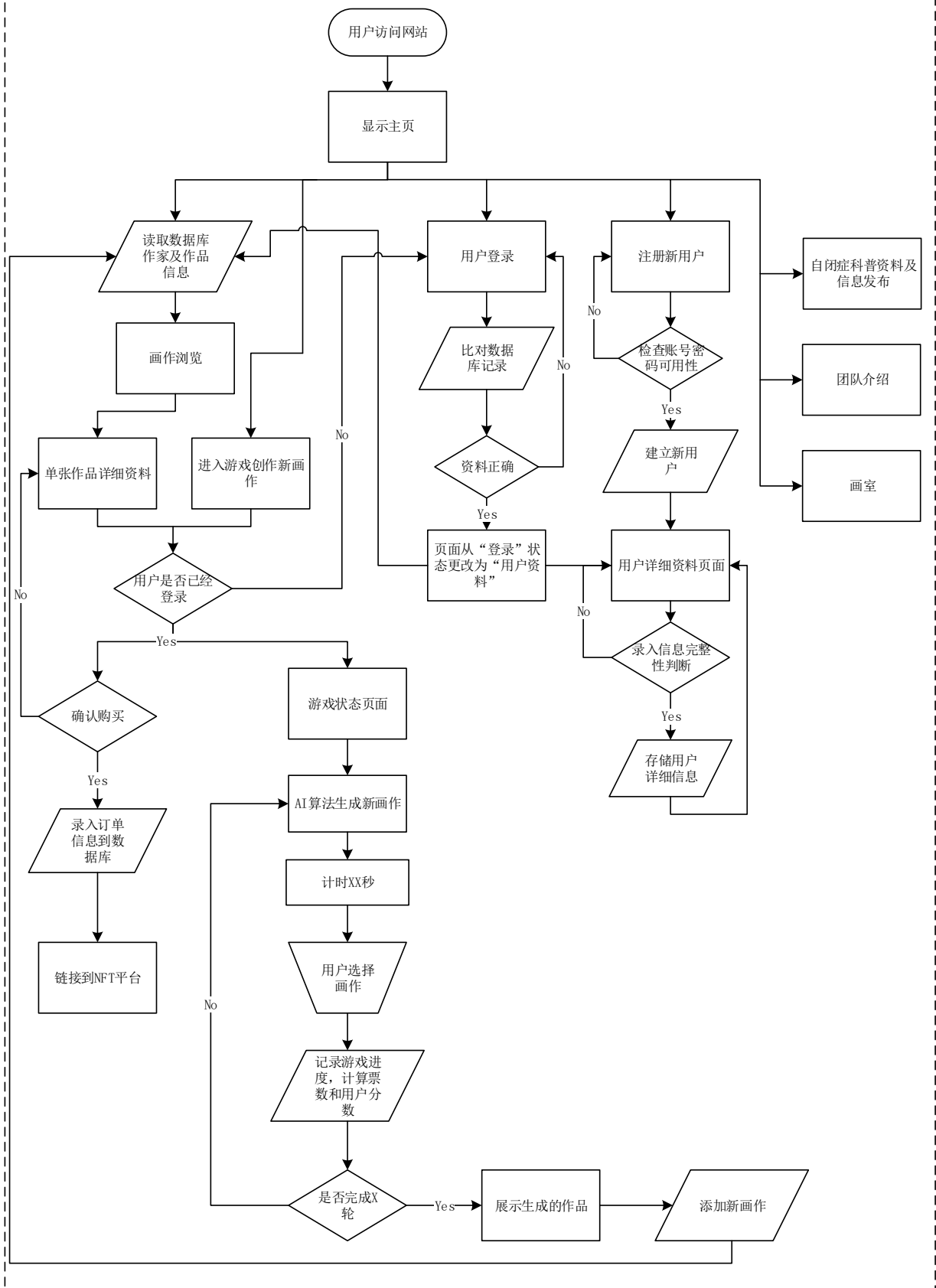
### 5.3 Process Flow

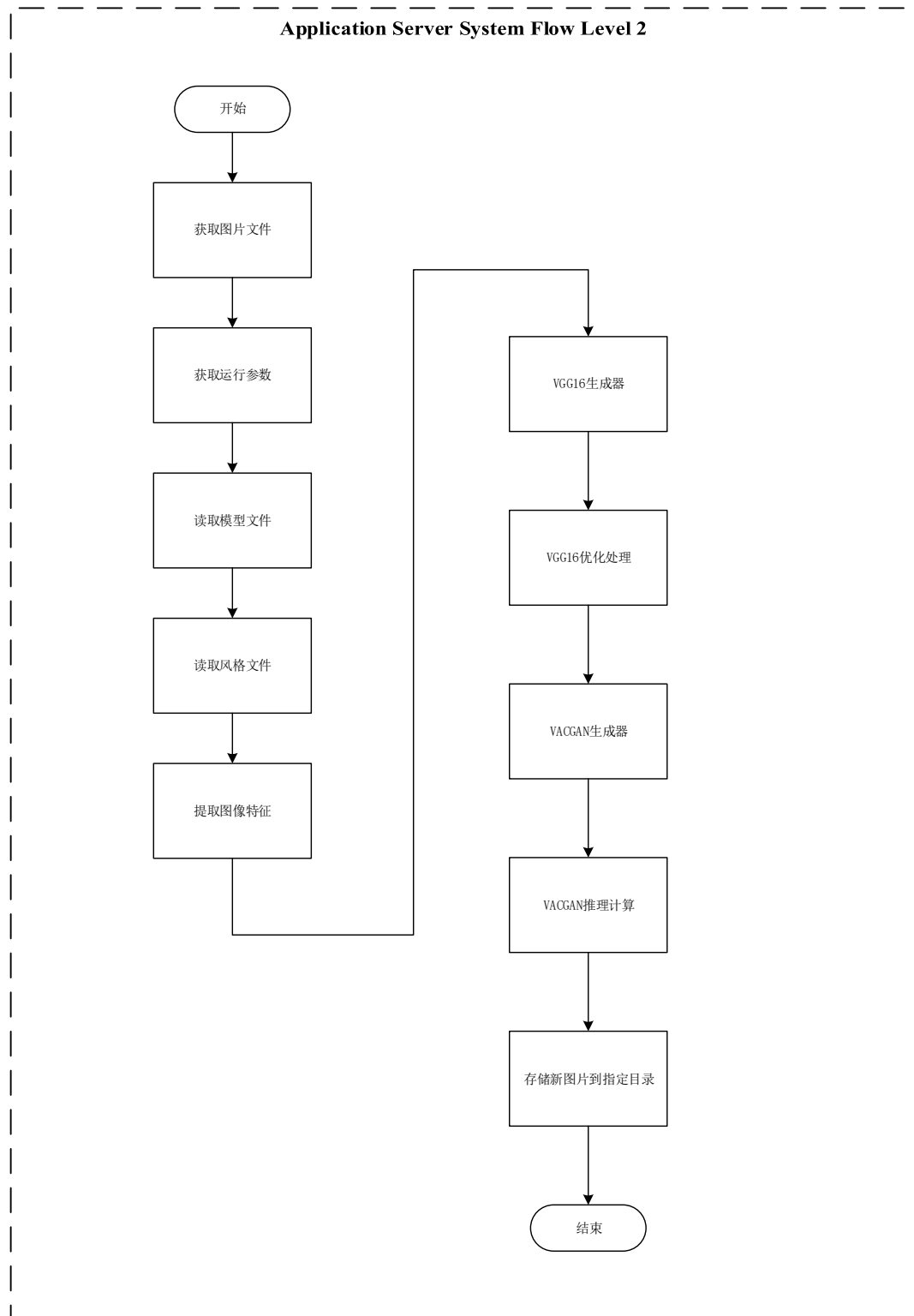






## Web Server System Flow Level 2





## 5.4 AI Algorithm Process

The AI algorithm process used in this project is as follows:

Input Data -> Neural Network Extraction Features -> Two Generators and Discriminators -> Loss Calculation -> Output Image -> Manual Selection -> Image Iteration

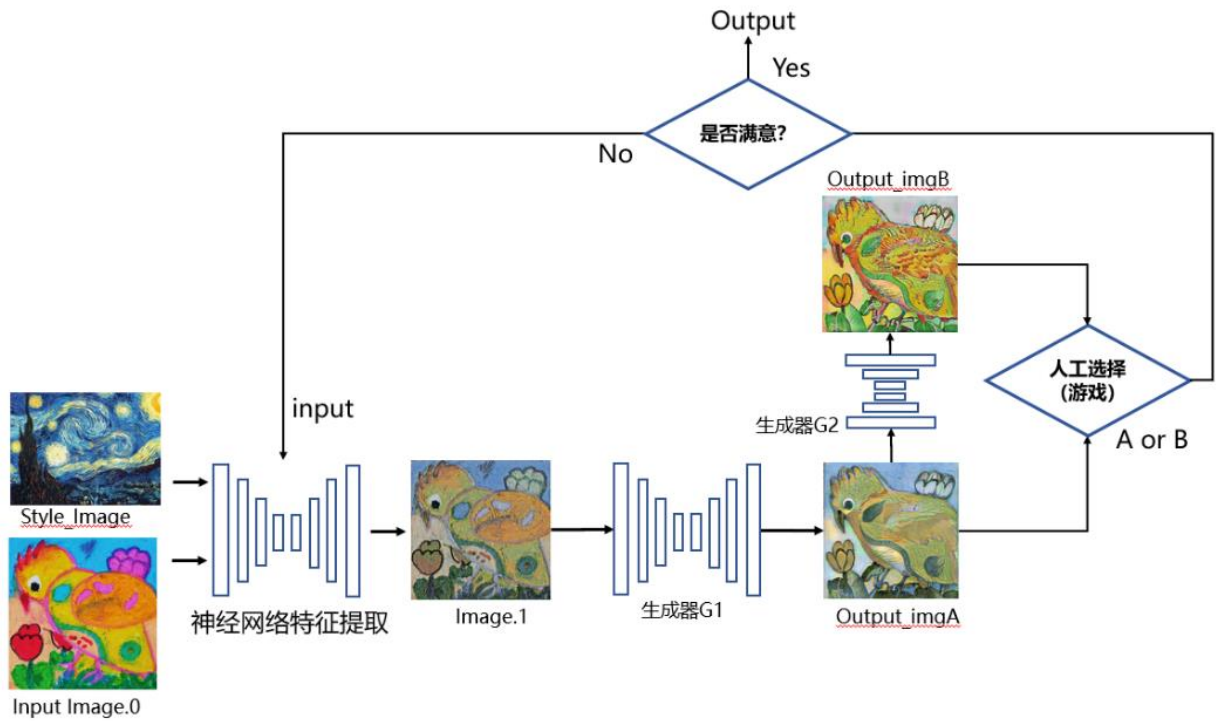


图 1 算法流程图

## 5.5 Model Architectre

The VACGAN model can be divided into two parts: the convolutional neural network and the generated confrontation network. During training, the image features are first extracted by the neural network, and then converted between different domains in the improved Cyclegan.

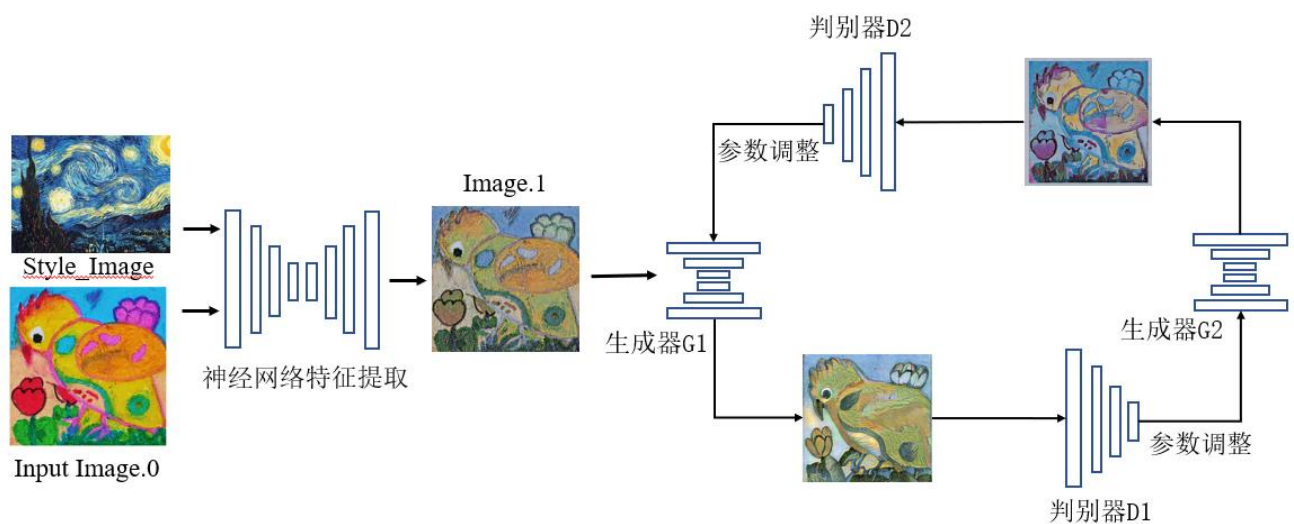


图 2 模型结构图

## 5.6 Neural Network Extraction of Image Features

Before generating an image, a neural network with a specific structure is used to extract image features, so that the generative adversarial network can customize the drawing for each image-specific feature, and generate an image that is more in line with people's expectations. The neural network structure for extracting features is as follows:

- Input layer: The size of the input image is  $224 \times 224 \times 3$ .
- Convolutional layer 1-2: Both convolutional layers use a  $3 \times 3$  convolutional kernel with a step size of 1 and padding of 1. The first convolutional layer uses 64 convolutional kernels, and the second convolutional layer also uses 64 convolutional kernels.
- Pooling layer 1: Use a  $2 \times 2$  pooling kernel for downsampling, with a step size of 2, to generate a feature map with a size of  $112 \times 112 \times 64$ .
- Convolutional layer 3-4: Both convolutional layers use a  $3 \times 3$  convolutional kernel with a step size of 1 and padding of 1. The first convolutional layer uses 128 convolutional kernels, and the second convolutional layer also uses 128 convolutional kernels.
- Pooling layer 2: Use a  $2 \times 2$  pooling kernel for downsampling, with a step size of 2, to generate a feature map with a size of  $56 \times 56 \times 128$ .
- Convolution layer 5-7: All three convolution layers use a  $3 \times 3$  convolution kernel with a step size of 1 and padding of 1. The first convolutional layer uses 256 convolutional kernels, the second convolutional layer uses 256 convolutional kernels, and the third convolutional layer uses 512 convolutional kernels.
- Dilated convolutional layers 8-10: The three dilated convolutional layers all use a  $3 \times 3$  convolution kernel with a step size of 1 and padding of 1. The first hole convolution layer uses 512 convolution kernels, and the hole rate is set to 2; the second hole convolution layer uses 512 convolution kernels, and the hole rate is set to 4; the third hole convolution layer uses 512 The convolution kernel, the hole rate is set to 4.

## 5.7 Model Advantage

### 5.7.1 Visual Effects

Observing the paintings generated by different algorithms on the same input image, it can be seen from Figure 3 that CycleGAN and Vgg are basically improving the image tone. The images generated by CycleGAN and Vgg16 algorithms are dark in color, part of the content details are lost, and the texture is not clear, the VACGAN algorithm effectively avoids these problems, and is superior to the original algorithm in terms of texture details and content details. The existing filters of Diffusion and Graphite have changed a lot in the style of the brush, but they are still far from the target style of painting, while the visual effect of the painting generated by VACGAN is similar to the use of thick oil paint and bright colors, thus creating It produces a rich visual effect, which is relatively closer to the painting style of Van Gogh's works.



图 3 VACGAN 与其他算法生成梵高风格画作

5.7.2 Train Cost

The training time cost of the model is an important factor when choosing an image generation algorithm. Therefore, we compare the convergence speed and test speed of VACGAN and other algorithms through experiments. The number of images in the data set ranges from 400 to 1072. The usage time ranges from 201.35s to 532.20s. The larger the number of images in the data set, the more time each round of training will increase.

By comparing the time required for one round of training on the four data sets of VACGAN, as shown in Table 1, it can be seen that although VACGAN has a neural network similar to Vgg16 for extracting image features in addition to the confrontation generation network, but only Order of magnitude times faster than CycleGAN networks. Compared with the Diffusion network, the training cost is greatly reduced.

Table 1 The time required for VACGAN and other algorithms to train one round on four data sets (/s)

Dataset	CycleGAN	Vgg16	Diffusion	VACGAN
vangogh2photo	196.26	689.31	1492.23	201.35
Ukiyoe2photo	276.77	750.49	2103.75	284.77
cezanne2photo	257.71	747.64	1891.17	266.14
monet2photo	524.68	973.42	4791.87	532.20

In the test phase, only one forward pass is needed to generate the stylized image. The test time of VACGAN and other algorithms on the four data sets is shown in Table 2. The data volumes of the test sets of the four style image datasets are 58, 121, 263, and 400, respectively, and the data volume of the content image test set is 751 pieces. It can be seen from Table 2 that when stylizing 751 images at one time in the test phase, the VACGAN algorithm increases the time compared with the CycleGAN algorithm by 0.43s at most, and the minimum is 0.05s, and there is almost no additional time consumption. Compared with the Diffusion model , which saves nearly double the time.

After the analysis in Sections 4.1 to 4.5, it can be seen that the VACGAN algorithm can produce stylized images with better visual effects, and the algorithm has stronger stability and faster

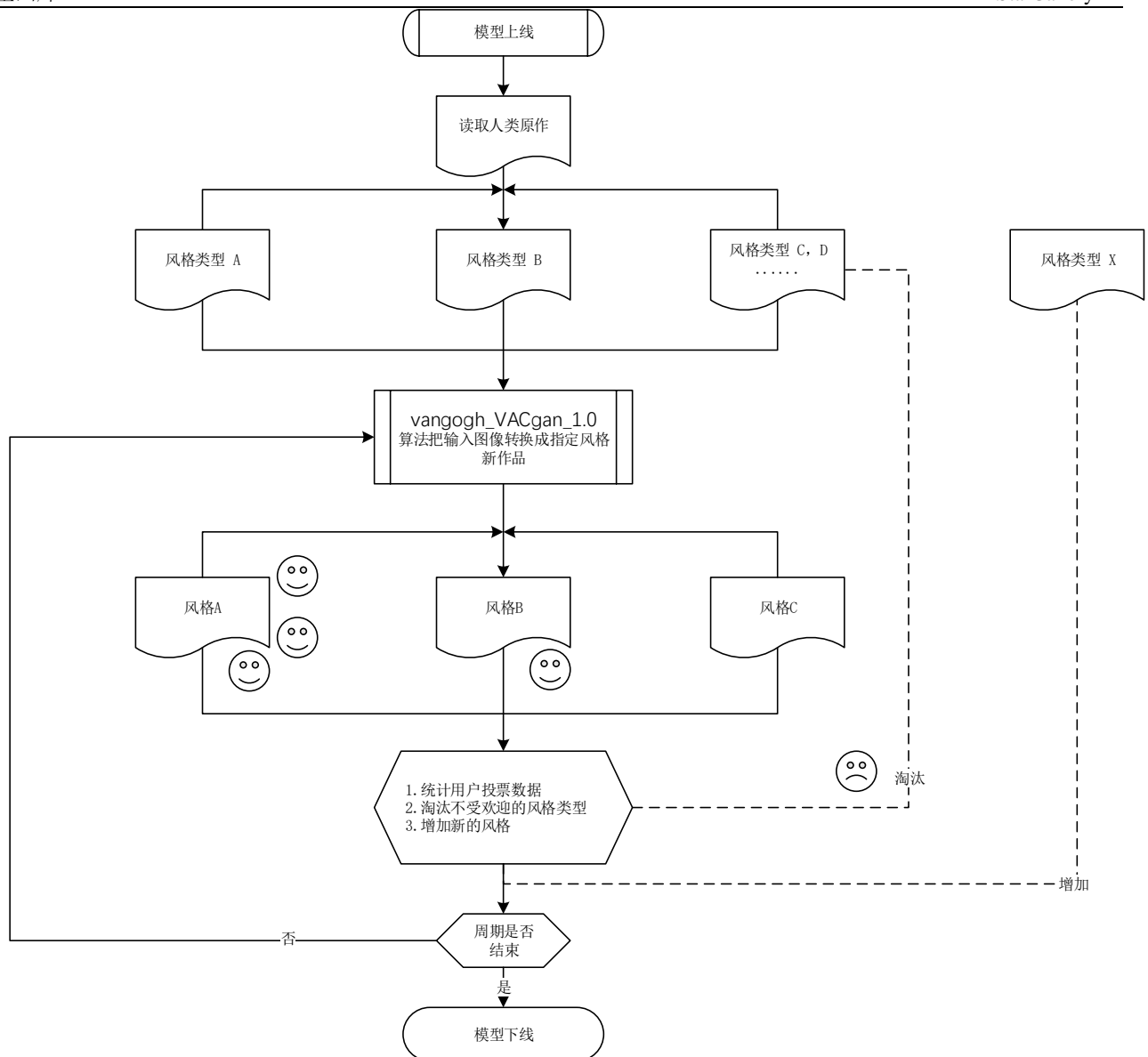
convergence speed. This is because AdaLIN normalization imposes a global regularization on the discriminant network, preventing network parameters from strengthening in a certain direction, enhancing the generalization ability of the network, and thus improving the quality of image stylization. Moreover, AdaLIN normalization makes the input and output of the discriminant network strictly meet the requirement of 1-Lipschitz continuity, which enhances the stability of the network and improves the convergence speed of the network.

Table 2 Test time of VACGAN and other algorithms on four datasets (/s)

Dataset	CycleGAN	Vgg16	Diffusion	VACGAN
vangogh2photo	35.45	61.58	78.09	35.63
Ukiyoe2photo	35.50	62.73	81.32	35.76
cezanne2photo	35.75	63.91	91.57	36.18
monet2photo	36.12	77.42	98.49	36.75

## 5.8 Scope and Assumptions of AI Algorithms

- The models trained according to different data sets are different, so the models can be continuously trained and updated to improve the effect of generating pictures in line with the public aesthetics of human beings. So far, the Star Gallery project has used the innovative and improved VGG+CycleGAN algorithm to collect different data sets to train two models vangogh\_VACgan\_1.0 and monet\_VACgan\_1.0. In the future, we can continue to increase the amount of data collectively, continue to train and improve these two models, and launch new versions.
- A well-trained model, such as vangogh\_VACgan\_1.0, has completely different conversion effects for the same input image using different style modes, but not all conversion output effects are in line with the aesthetics of the human public. Star Gallery collects users' voting data in the game, constantly eliminates the style conversions that are rarely accepted by users, keeps the styles that are mostly chosen by users, and continuously adds new style types to the game for users to choose.



- The calculation speed of VACGAN depends on the number of iterations of VGG and the computing power of the machine. It is necessary to adjust the number of iterations according to the actual operating capacity of the application server to achieve a balance.

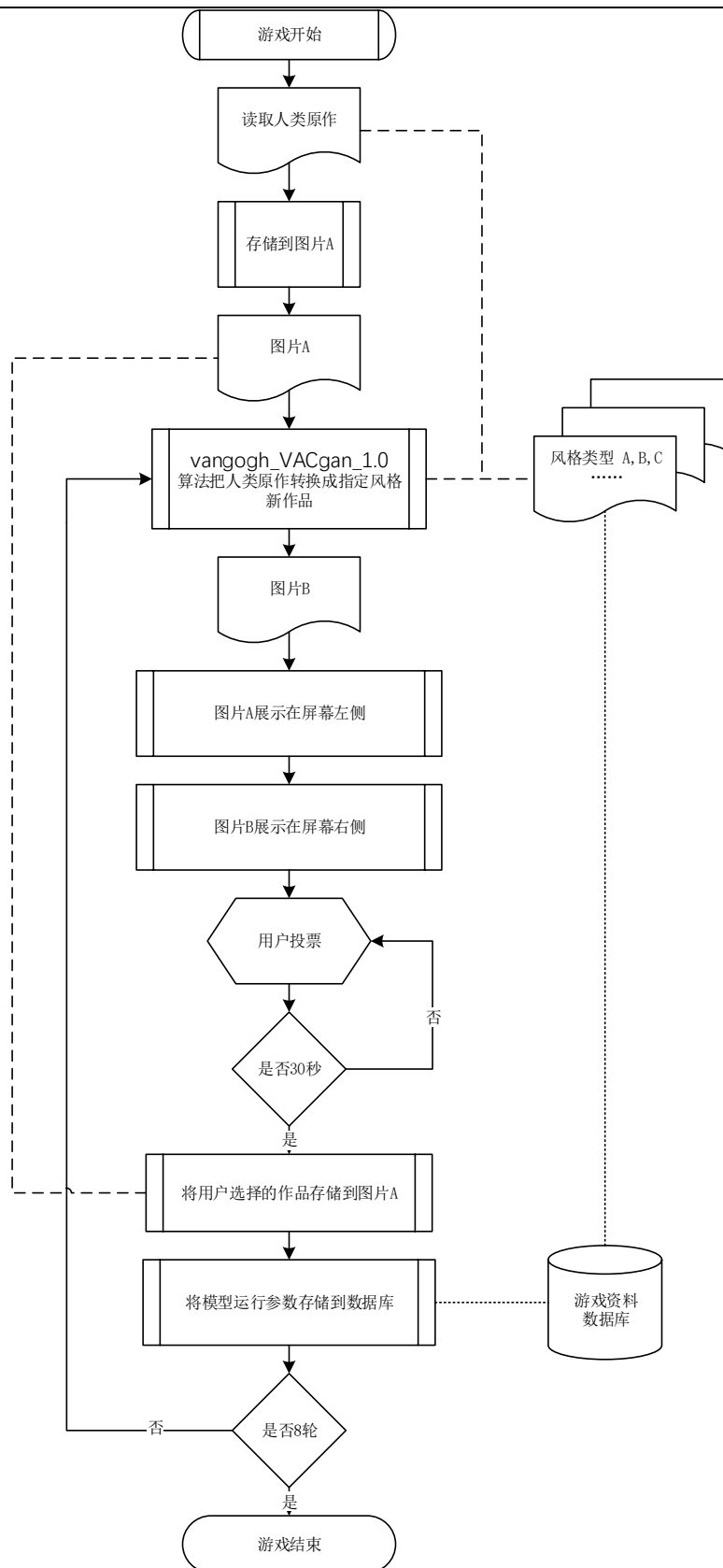
## 5.9 Game Design Overview

- Set the game cycle in the background, such as 5 days.
- During the game period, Star Gallery opens the game entrance.
- During the game period, members log in to Star Gallery and can enter the game page through the game entrance to vote at any time.
- Each member can only participate in the game of the same work once.
- The game voting rounds are set in the background, tentatively for 8 rounds, and will be adjusted according to user experience feedback in the future.
- Each round of the game shows two pictures for the user to choose.
- At the beginning of the first round, the left side is the original human picture A without AI

processing, and the right side is the picture B generated by AI through style type A conversion.

- Members can vote for one of the pictures.
- Starting from the second round, the picture on the left is the picture selected by the user in the previous round, and the picture on the right is the picture generated by AI conversion.
- The input of the AI algorithm can be the original work or the picture converted from the previous iteration.
- The selection of input image and style type for each round is determined during the game design process and is set through the background.
- If the member does not vote within 30 seconds, the system will select the picture on the left by default and automatically enter the next round.





## 5.10 Train Stable Diffusion Model

- Taiyi-Stable-Diffusion-1B-Chinese-v0.1 is the first open source Chinese Stable Diffusion model, which is trained based on 20 million screened Chinese image-text pairs.

- Further train IDEA-CCNL/Taiyi-Stable-Diffusion-1B-Chinese-v0.1 on the self-built dataset, point the datasets\_path in the script to the dataset, and modify the corresponding hyperparameters, such as model\_path, batch\_size, ckpt\_path.
- Improve training efficiency through Deepspeed, thanks to the technology of Zero Redundancy Optimizer, which can significantly reduce memory usage and increase batch\_size to achieve higher efficiency

### 5.11 AI Painting Studio

- The studio filters all content that is not suitable for minors to watch, and the prompt words only accept Chinese input for the time being.
- Try to avoid content that produces obvious negative energy.
- During the trial period, the studio will restrict the painting style, and open more styles after the results of the fully experimental model generation meet the requirements.
- During the trial period, users can only input Chinese prompt words, and the system will automatically generate negative prompt words to filter bad content.
- Users can upload their own pictures and let AI continue to create on this basis.
- During the trial period, too many parameters are not open for users to modify. The output size is fixed at 512x512. The Euler a sampler is used by default, the number of sampling steps is 30, the prompt word guide factor is 50, the redrawing intensity is 0.8, and one image is generated each time.

### 5.12 Registration and login process

- The user visits the registration page of the application.
- The user enters the required registration information, such as username, email address, and password, and confirms agreement to the terms and conditions of the application.
- The user clicks the "Sign Up" button.
- The system verifies that the information entered is valid and checks to see if the username already exists.
- If the information entered is valid and the username is not registered, the system creates the user account and sends a confirmation email to the user.
- The user receives a confirmation email and clicks on the confirmation link to activate their account.
- The system redirects the user to the main page.

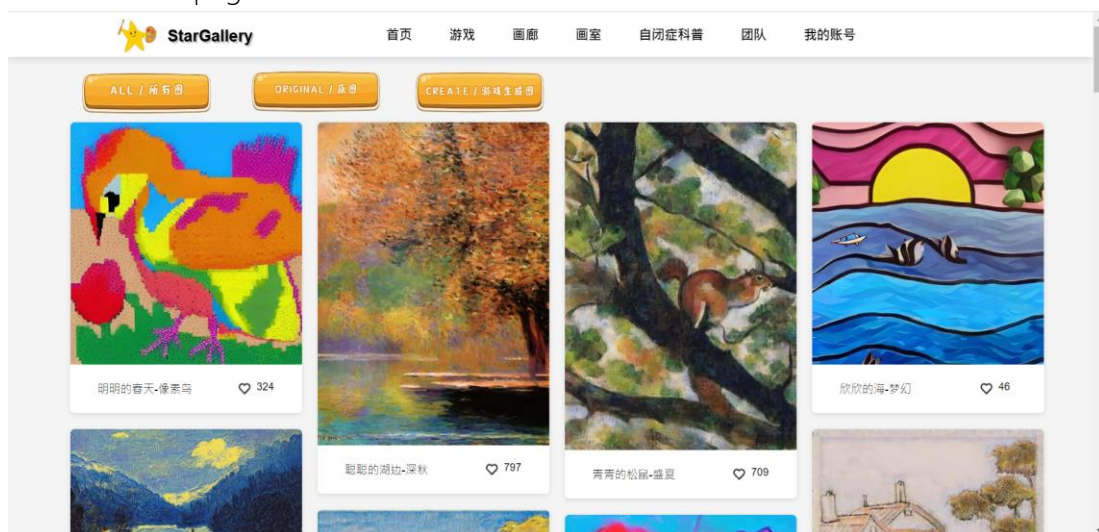
## 6 SYSTEM DESIGN

### 6.1 Front-end page layout

- On the homepage of the website, the main menu bar includes games, galleries, studios, autism science, team profiles, and user account management.



- The gallery page displays works that can be sold through NFT, including children's original works and works generated by AI calculations based on the original works. The page has a classification and filtering function. Clicking on each painting can link to the work's detailed information page.



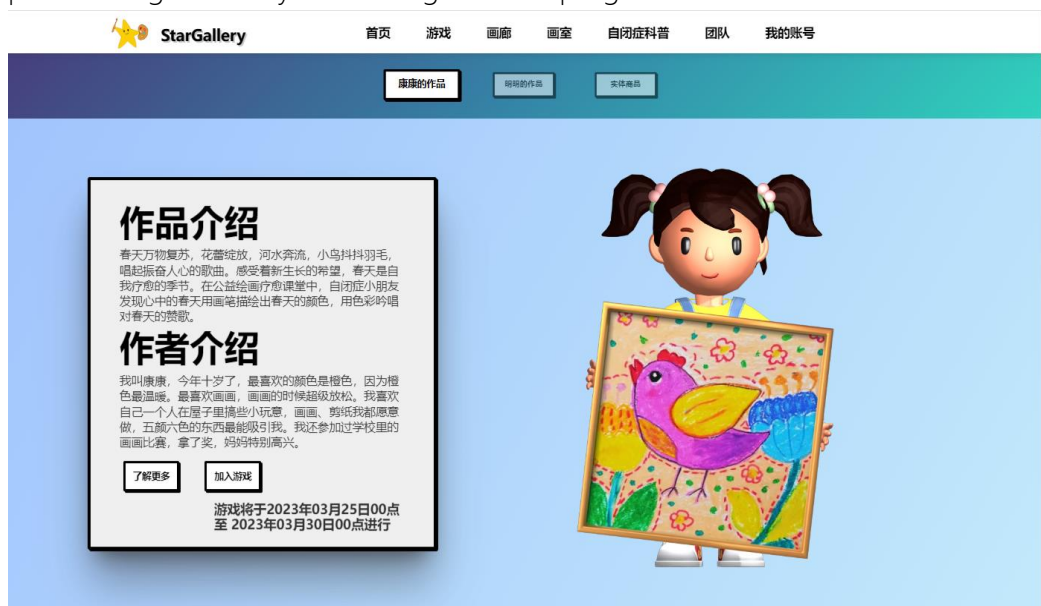
- Work details page, including work introduction and author's personal introduction, like function and NFT purchase link.



- Work details page, including work introduction and author's personal introduction, like function and NFT purchase link.



- Each series includes multiple branches of children's painters. Each branch page introduces the author and work information in detail, prompts the start and end date of the game, and provides a game entry link if the game is in progress.

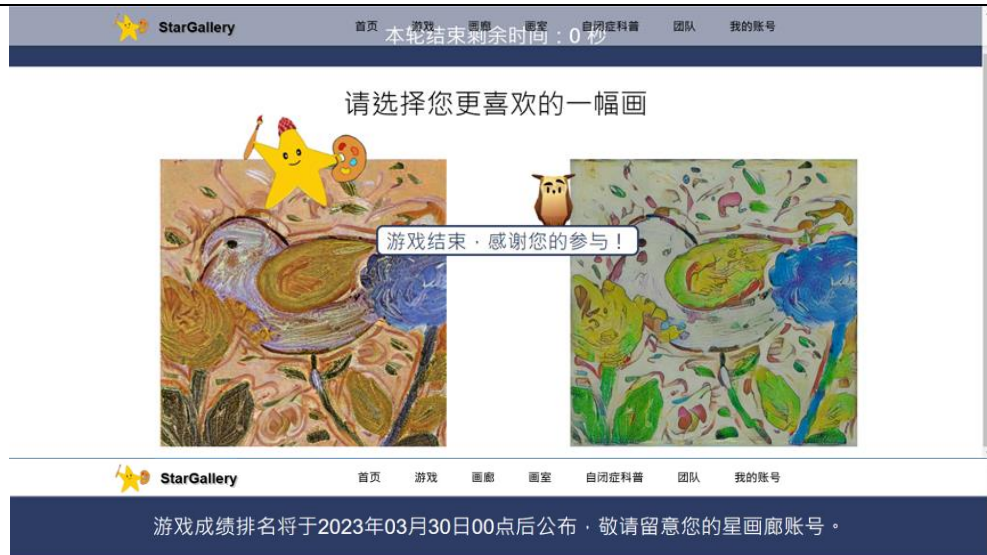




- After entering the game interface, two works are displayed for the user to choose in each round of the game. Each round has a countdown function. The user clicks the mouse to select one of the works within the specified time. If there is no operation within the specified time, the system defaults to the left work. And automatically enter the next round. The total number of rounds can be set for each game. After all the rounds are completed, the page will display the final selected single work and prompt the date and time for the announcement of the ranking.







- The autism science page introduces the basic situation, symptoms and social difficulties of autism, helping users understand autism-related knowledge. Can also provide relevant resources and links, such as support organizations, medical institutions, etc.



- The Team Information page introduces Star Gallery team members and information.



## 团队介绍

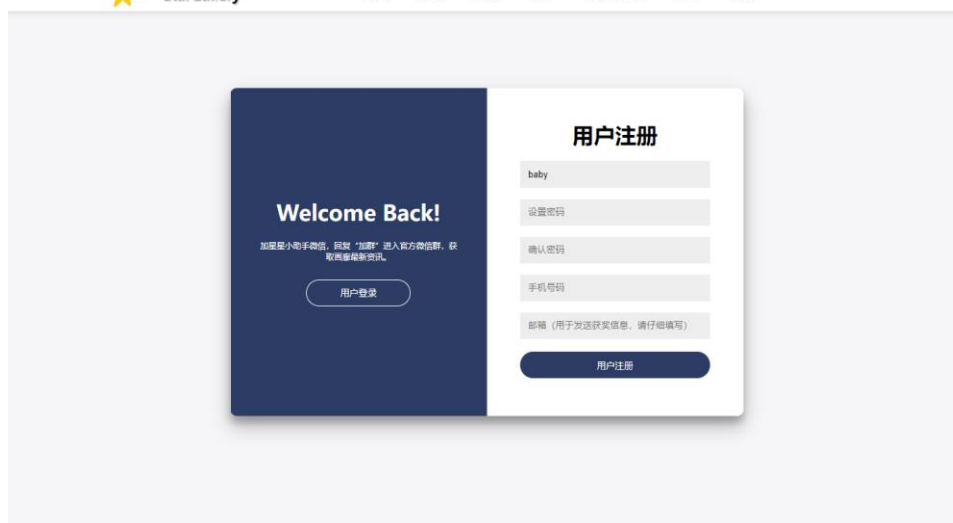


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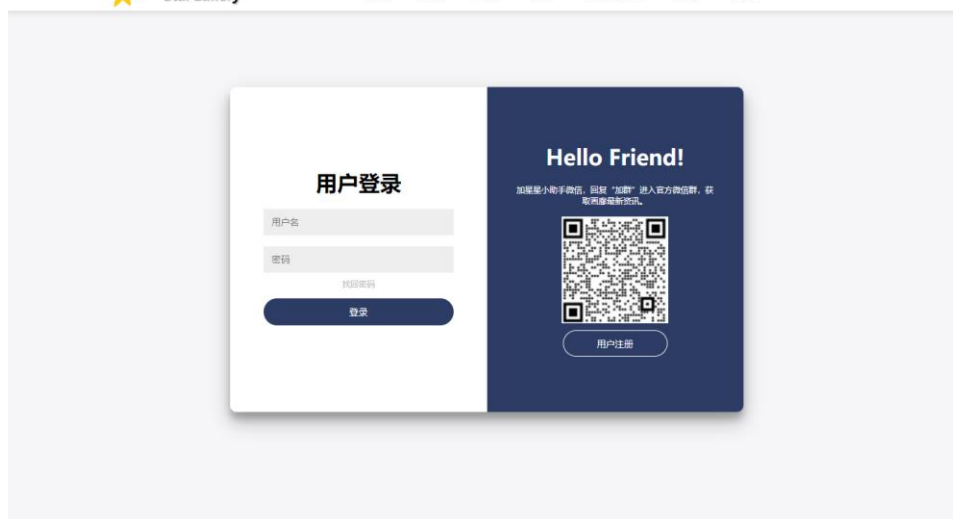
邮箱:stargallery2023@163.com

NFT中国账号:星画廊

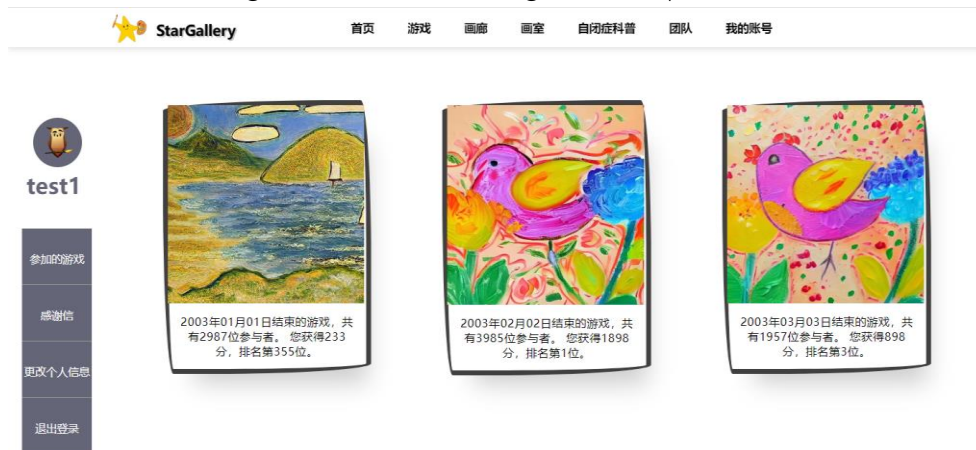
- Users can register as members of Star Gallery, almost without providing any personal information, and voluntarily enter their contact phone number and email address, so that Star Gallery can issue award notifications and ways to receive awards.



- Only after becoming a member can you participate in the game and like the work. Each member can only participate in the same game once.



- The member account management page lists the games that the member has participated in, the score ranking and awards of each game, and provides links to award-winning works.

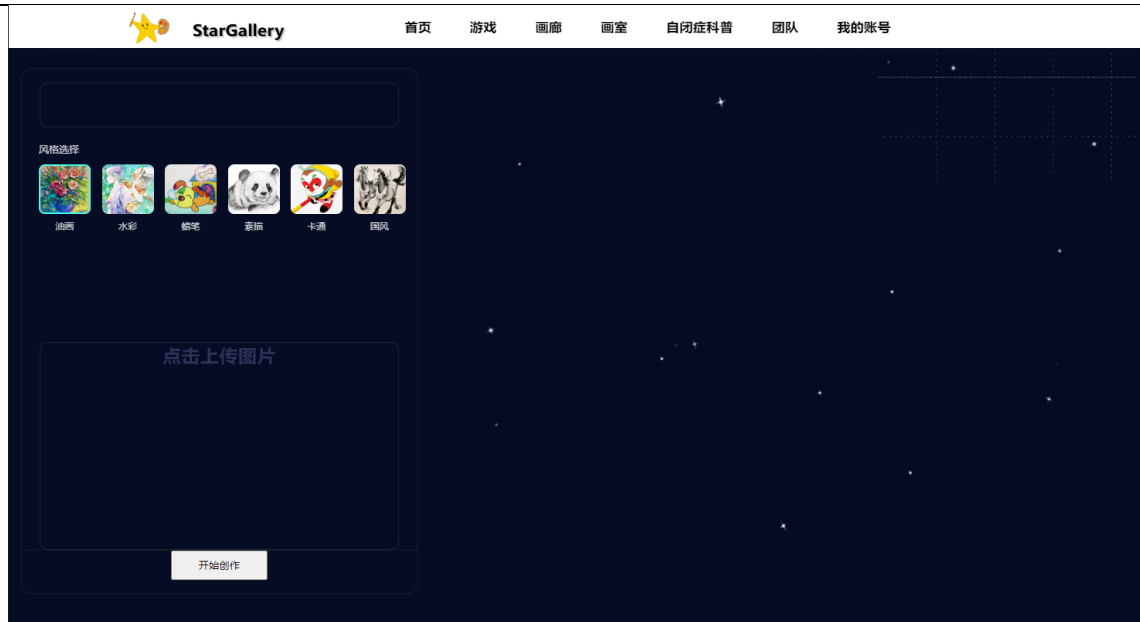


- The thank you page summarizes the member's contributions to children with autism.

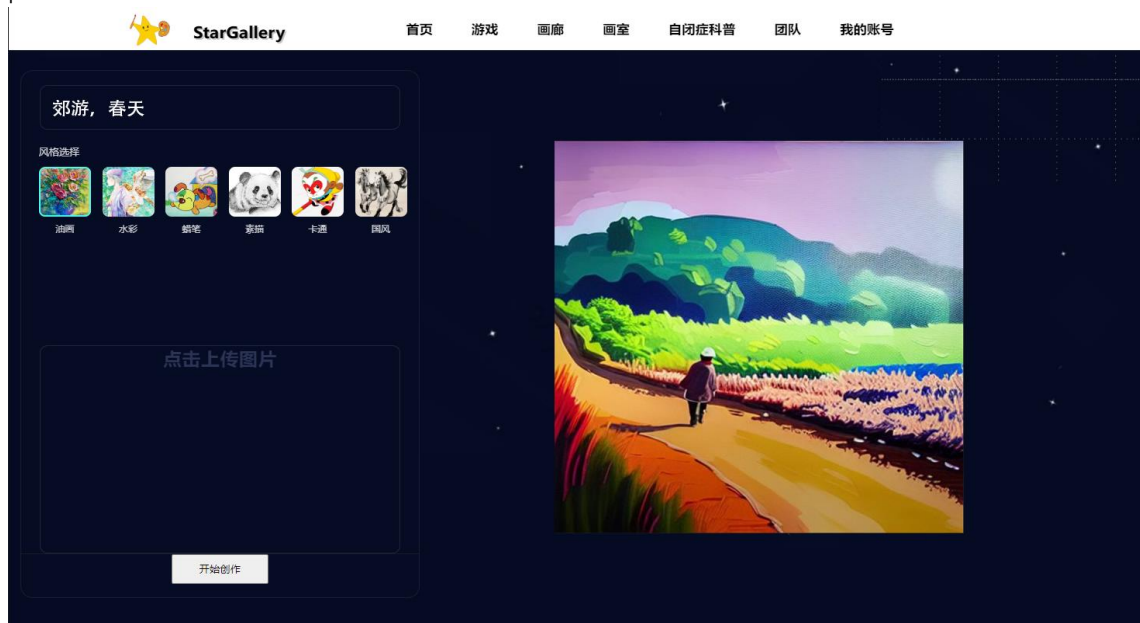


- Studio page  
The content of the page includes prompt word input box, style selection button, image upload area, start creation button and image output area.

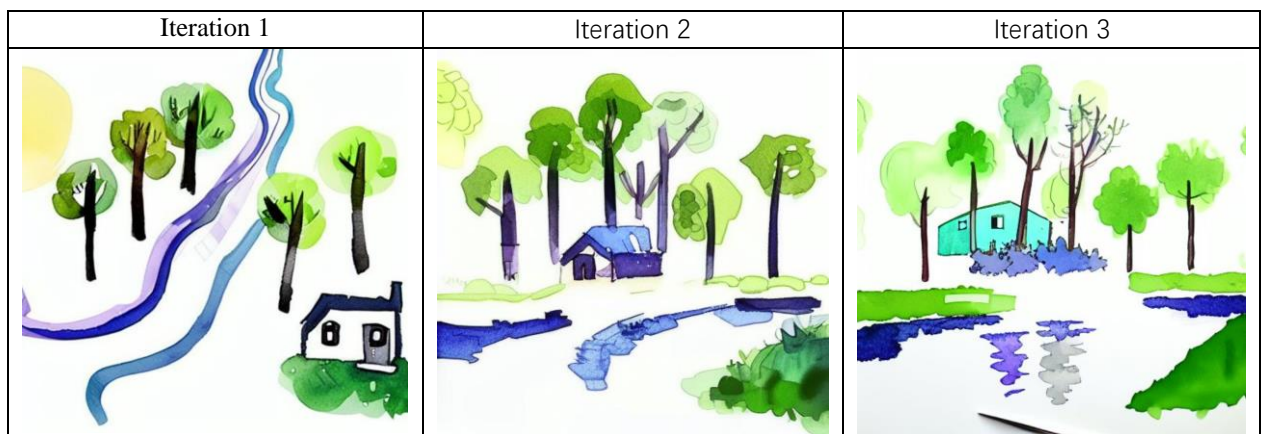




Generate pictures based on prompt words, and only one picture will be generated during the trial period.



根据用户上传的图片生成新的图片



## 6.2 Back-end Processing

- The web server waits for port 80 requests and returns the html of each page.
- Gallery page access requests, read works and authors database tables, display all works on sale in reverse order of publication time.
- Work detail page request, query the work and author database table according to the work number, and the NFT website data table.
- Game introduction page request, read game information table.
- Enter the game request, query the game information table, the user game record table, if you have not logged in or have already participated, return a rejection message.
- Start the game request for each round, read the game information table, obtain the model parameters of each round, make a running request to the AI algorithm, transmit the input file address, output address and parameter settings, wait for the AI to return successfully, and notify the front end to update the picture and start a new one round of voting.
- At the end of each round, record the voting results to the database to determine whether the game has been completed.

- Autism popular science page request, read the science popularization information sheet.
- Login page request, query user table, compare username and password, return result.
- Register page request, query whether it has been used, if not, add a new record to the user table, and return the result.
- User account page request, query user profile table and game record table.
- Run the batch program at regular intervals every morning to count the game voting data from the previous day, calculate the score ranking, and update the database records.
- Run the batch program regularly every morning, count the database data, and generate reports, including: new member registration, website traffic, work views, game running report, finished game ranking report, model style preference report, automatic generation of new work report, NFT Shelf report, award-winning member report, error log, website exception report.

### 6.3 VACGAN Model Train

A total of 7090 children's art collections were collected on kaggle, Pinterest, Rye Art and other websites. Since the famous paintings of a certain writer are limited, cropping and tone transformation are used to increase the number of training sets. For example, the sample size of the oil painting set of the Van Gogh training set is increased from 864 to 20890, and the oil paintings of the Cézanne training set are increased from 918 to 36872. The GPU model used for training is NVIDIA-A-100, and the epoch is set to 160 or 180. It takes nearly 100 hours to train a model.

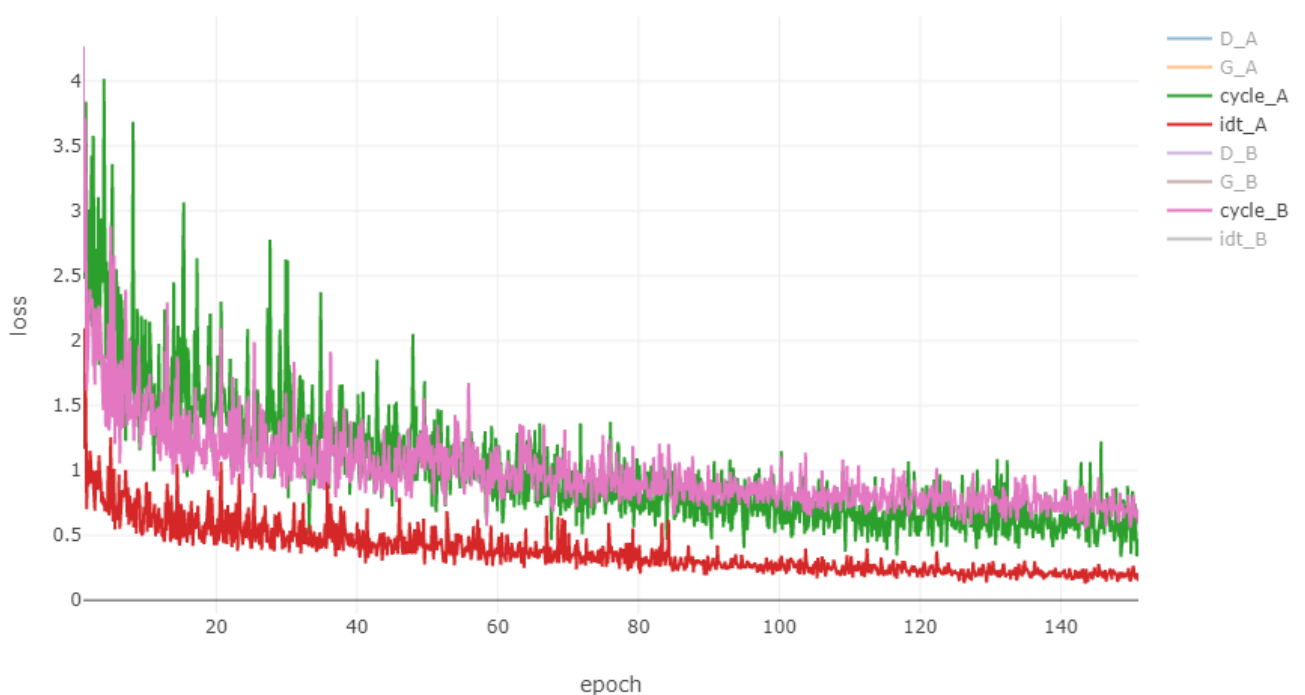


图 4 训练过程中的损失函数变化

## 6.4 Stable Diffusion Model Train

- The Noah-Wukong dataset is a large-scale multimodal Chinese dataset.
- The dataset contains 100 million preset <image, text> pairs.
- Images in the dataset are filtered based on size and aspect ratio
- Texts in the dataset are filtered according to their language, length and frequency, private and sensitive words are also taken into consideration.

## 7 SYSTEM INTERFACE

- Use the Flask framework to encapsulate the VACGAN algorithm and provide an API interface for generating images.
- External requests call the VACGAN algorithm to generate images through this interface.
- Request type: POST, request address: /api/VACGAN.
- Returns the URL to the generated image on success.
- An error code is returned when the operation fails.
- The interface must consider concurrent requests and use a thread pool to improve stability.
- For network exceptions, database exceptions, etc., the interface should have a corresponding error handling mechanism to ensure stability.
- The interface must have high performance to ensure fast response to requests.
- The interface should limit the flow of requests to prevent malicious requests from causing system crashes.

## 8 RUNNING CONTROL

Operation control will be implemented strictly in accordance with the function call relationship between modules. In each business center module, it is necessary to make a correct judgment on the operation control and select the correct operation control path. In terms of network transmission, after the server sends the data, it will wait for the server to confirm receipt of the signal. After receiving the signal, it will wait for the server to send the reply data again, and then confirm the data. After receiving the data, the server sends a confirmation signal, and after processing the data and accessing the database, sends the returned information back to the database server and waits for confirmation.

general user:

- When not logged in, you can browse open web pages, such as galleries, autism science, game rules, etc.
- After the user logs in, he can view different games in the game series and choose the game he wants to participate in

- After the game starts, the user can make multiple rounds of selections within the specified time. Points can be obtained by selecting pictures with more correct people. Finally, rewards will be distributed according to the accumulated points of the users.
- After the game is over, users can view the games they participated in and thank you letters on our account page
- manager:
- The background management personnel will set the game rules, start time, etc.
- The background management personnel issue rewards to users after the game is over
- Background management personnel can query user game voting and other information

## 9 ERROR HANDLING

### 9.1 Error output information

- Error output information There are mainly two kinds of errors when the program is running:  
1. The errors caused by inputting information or failing to meet the requirements are called soft errors. 2. Problems caused by other problems, such as network transmission timeout, are called hard errors.
- For soft errors, it is necessary to judge that the input data verification module conducts data analysis from the data, judges the type of error, and then generates corresponding error prompt sentences and sends them to the output module.
- For hard errors, a simple error statement can be output in the corresponding module where the error occurred, and the program will be reset. Return to the input stage. The error message must give the corresponding error reason.

### 9.2 Error handling countermeasures

#### 9.2.1 Countermeasures for database connection failure:

- When the client connects to the database, a connection test is performed to determine whether the database connection is successful. If the connection fails, a clear prompt message is given to inform the user that the database connection failed, and corresponding solutions are provided.
- Check whether the database configuration is correct, whether the database service is enabled, and whether the network connection is normal.
- If the database service is not started, start the database service and reconnect to the database.
- If the network connection is not normal, check the network settings to confirm whether the network connection is normal.
- If none of the above countermeasures can solve the problem, contact technical support

personnel to solve the problem.

#### 9.2.2 Countermeasures against data format errors:

- When the user enters data, check the data format, if the data format is incorrect, give a clear prompt message to inform the user that the data format is incorrect, and provide a corresponding solution.
- Format the data entered by the user to ensure that the data format is correct.
- Perform data verification before data input, including data type, data length, data range, etc., to ensure the correctness of the data.
- If the above countermeasures cannot solve the problem, give a clear prompt message to inform the user that the data cannot be processed, and provide corresponding solutions.

#### 9.2.3 Countermeasures for network transmission failure:

- In the process of network transmission, the data is checked and verified to ensure the accuracy of data transmission.
- If the network transmission fails, perform a retransmission operation and set the number of retransmissions to ensure that the data can be transmitted successfully.
- If the network transmission fails for many times and the problem cannot be solved, a clear prompt message will be given to inform the user that the data transmission failed and corresponding solutions will be provided.
- For data transmission failures caused by network problems, users are advised to check whether the network connection is normal, or try to use other network connection methods.

#### 9.2.4 Countermeasures for database access failure:

- When accessing the database, check the accessed database to ensure the availability of the database.
- When accessing the database, check the accessed tables and fields to ensure the existence and correctness of the tables and fields.
- If the access to the database fails, retry the operation and set the number of retries to ensure that the data can be accessed successfully.
- If the database access fails for many times and the problem cannot be solved, a clear prompt message will be given to inform the user of the database access failure and corresponding solutions will be provided.
- If the database access failure is due to database failure, users are advised to contact technical support to resolve the issue.

## 10 SECURITY AND CONFIDENTIALITY

- Authentication and access control:  
Users must first register and log in to access the Star Gallery system. The system will use encryption technology to protect the user's login information and authenticate it. Once the user logs in successfully, the system will implement access control to only allow them to access the information and operations authorized by them.
- Data encryption:  
All sensitive data will be encrypted during storage and transmission, including user login information, user data, game data and website display data, etc.
- Data backup and recovery:  
All data will be backed up regularly to ensure data recovery under any circumstances.
- System monitoring and logging:  
The system will regularly monitor and record all user actions and system events so that security issues and vulnerabilities can be quickly detected and responded to.
- Security audit:  
The system will conduct regular security audits, including analysis of system vulnerabilities and attacks, and take corresponding measures to mitigate risks.
- Employee training:  
In order to ensure that employees can protect user data and system security, the system will provide employees with security training and education on a regular basis. In addition, employees will sign non-disclosure agreements to ensure that they do not disclose any sensitive information.
- Security Updates:  
The system will regularly update its software and hardware to ensure it is up to date with the latest security threats and vulnerabilities.

## 11 RISK MANAGEMENT

- Copyright protection: In the process of collecting paintings, ensure the validity, validity and authenticity of copyright.
- Data security: During the development process, it is necessary to protect the security of the database and take certain security measures, such as encrypted storage and access control.
- Network security: In web services, it is necessary to implement security control on user network requests to prevent malicious behaviors such as SQL injection and XSS attacks.
- Privacy protection: When collecting user information, it is necessary to abide by relevant laws and regulations, protect user privacy, and not disclose user personal information.
- Stability: In the case of high concurrency, it is necessary to ensure the stability of the system and avoid system crashes.

## 12 MAINTENANCE

- Backup strategy:

When the amount of data is large, it is necessary to back up the data regularly. Database backup can use physical backup or logical backup. We recommend performing physical backups during off-peak hours every night, as well as incremental and full backups at the same time to ensure data integrity and timeliness.

- Recovery:

In the event of a system failure, failure recovery operations are required. We recommend regularly checking the integrity and consistency of the database on the basis of backups to prevent data damage and loss. When the system fails, you can restore the database through backup, and perform operations such as data repair and index rebuilding.

- Performance optimization:

In order to ensure the efficiency and stability of the system, regular performance optimization is required. You can improve system performance by adjusting database parameters, optimizing SQL statements, and rebuilding indexes. In addition, by monitoring the operation of the system, performance bottlenecks can be found and resolved in time to ensure the normal operation of the system.

- new version update:

With the development of business and changes in requirements, the system needs to be updated. Before the version is updated, sufficient testing and verification are required to ensure the stability and compatibility of the new version. At the same time, it is necessary to formulate a detailed version update plan, including update time, update content, update method, etc., to minimize the impact on the system.

- Safe maintenance:

During the operation of the system, it is necessary to maintain the security of the system to prevent the system from being illegally invaded, data leakage and other problems. System security can be improved by strengthening system access control, using encryption technology, and regularly updating system patches. At the same time, regular security and risk assessments are required to discover and resolve security risks to ensure system security and stability.

## 13 APPENDIX

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