上海海事大学

Software project plan

Project Name：Fabric Defect Detection System

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1.Project Outline

1.1 Background

Artificial intelligence is a strategic emerging industry in China. With the continuous improvement and upgrading of various industries, industrial informatization has gradually been put on the agenda. AI plays an important role in informatization, which can replace human to complete some complex and time-consuming tasks in the past.

Fabric defect detection is an important part of production and quality management in the textile industry, and intelligent detection of fabric defects has been a technical bottleneck that has puzzled the industry for many years. Currently, almost all of the detection are manual tasks, which are susceptible to subjective factors and lack consistency; And long-term work under strong light has a huge impact on testers' health. Using advanced technologies such as AI and CV to achieve intelligent detection of fabric defects is undoubtedly of great value.

1.2 Project overview

This project aims to develop an online fabric defect detection system. It is mainly composed of an online detection module and a deep learning module. The online detection module provides an interface on which users can upload images for detection or generate images for performance testing. The deep learning module is mainly composed of corresponding models to provide defect detection function.

The system is developed by B/S architecture, and the entire system will be released together after completion, rather than individually for each module.

1.3 Technical advantage analysis of the project

Currently, both industry and academia have do a lot of research on generation models and target detection models, and have achieved excellent performance. Many fabric defect detection systems currently on the market also use the most advanced models. However, these advanced models are often difficult to reproduce and have a large number of parameters, which also require a lot of money to establish. Therefore, our system has chosen the most popular and stable model to provide a relatively reliable system with minimal investment.

1.4 Final Content

The final contents of this system mainly include:System, Source code, trained model files, project plans, technical documents, user manuals, etc.

System: The system refers to a complete system. Users can log in to the system and perform corresponding operations to detect fabric defects.

Source code:The source code mainly includes the source code of the system and the source code of the model. The source code is responsible for showing the specific details and implementation of the project, but also can show the workload. Open source code can also be used by other users and peers for secondary development or reference.

Trained model files: The trained model refers to the model that has been trained locally. Users can directly use the model to fulfill the corresponding requirements.

Project Plan: Project plan refers to the complete plan of the whole project development period, for others to check the introduction of the system, the various arrangements and plans during the development, and the treatment of special cases.

Technical documents: It mainly includes interface documents and test documents. Interface documents are mainly used in coordinated development, and the parameters, return values and excuses of each interface specified in the document are introduced. The test document mainly records the test results of each module of the project, so as to ensure the executable of the code and prevent the occurrence of software defects.

User manuals: The user manual is mainly responsible for helping users understand the main functions of the system, and providing examples to teach users how to use the system.

1.5 Project development environment

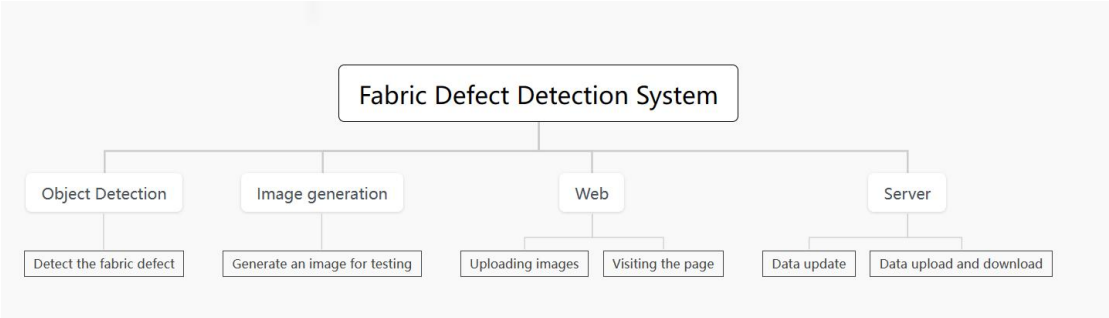
The development environment of this project is four PC.

1.6 Project acceptance method

All content of the system will be submitted to GitHub for teachers to check and the system will be introduced through a presentation in the last week.

2.Technology Introduction

2.1 System structure diagram



2.2 Model

2.2.1 Main model

The most important function of this system is to realize the object detection module.This system uses the object detection module to detect fabric defects. The model used in the object detection module is yolov5.

Yolov5 model is a very traditional but classic model in the field of object detection. The model mainly consists of four parts.The above diagram shows the network structure of YOLOv5s, which is the smallest and has the narrowest feature map width among the YOLOv5 series. The subsequent variations, labeled as m, l, and x, deepen and widen the network based on YOLOv5s. The network is primarily divided into four parts: Input, Backbone, Neck, and Prediction. Here are the main differences between YOLOv5 and YOLOv3:

Input: Mosaic data augmentation, adaptive anchor box calculation, adaptive image scaling.

Backbone: Focus structure, CSP structure.

Neck: FPN+PAN structure.

Prediction: GIOU Loss.

YOLOv5 adopts Mosaic data augmentation in the input stage, similar to YOLOv4. The Mosaic data augmentation was proposed by a member of the YOLOv5 team. It combines four randomly scaled, cropped, and arranged images to improve the detection performance, especially for small objects.Why is Mosaic data augmentation used? In typical training scenarios, the average precision (AP) for small objects is generally much

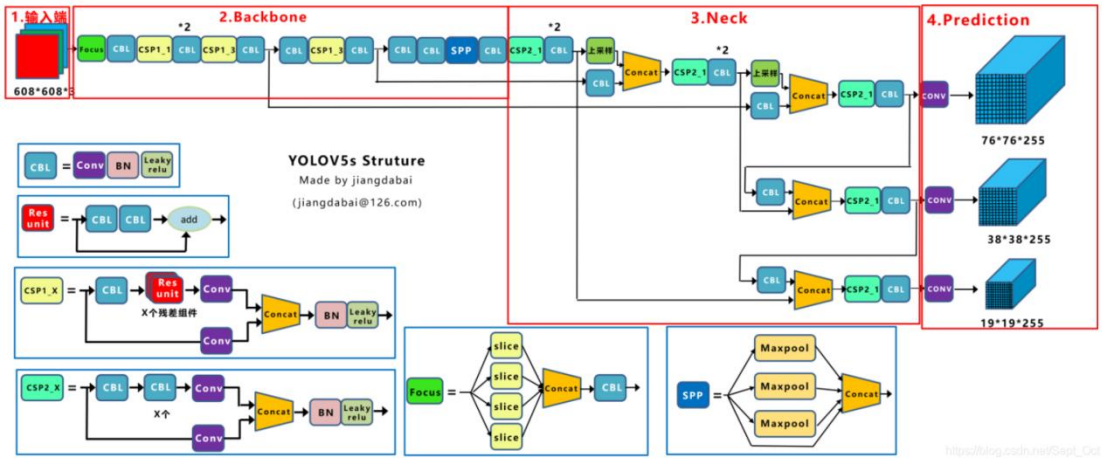
lower than that for medium and large objects. The COCO dataset also contains a large number of small objects, but their distribution is not uniform. Mosaic data augmentation has several advantages:

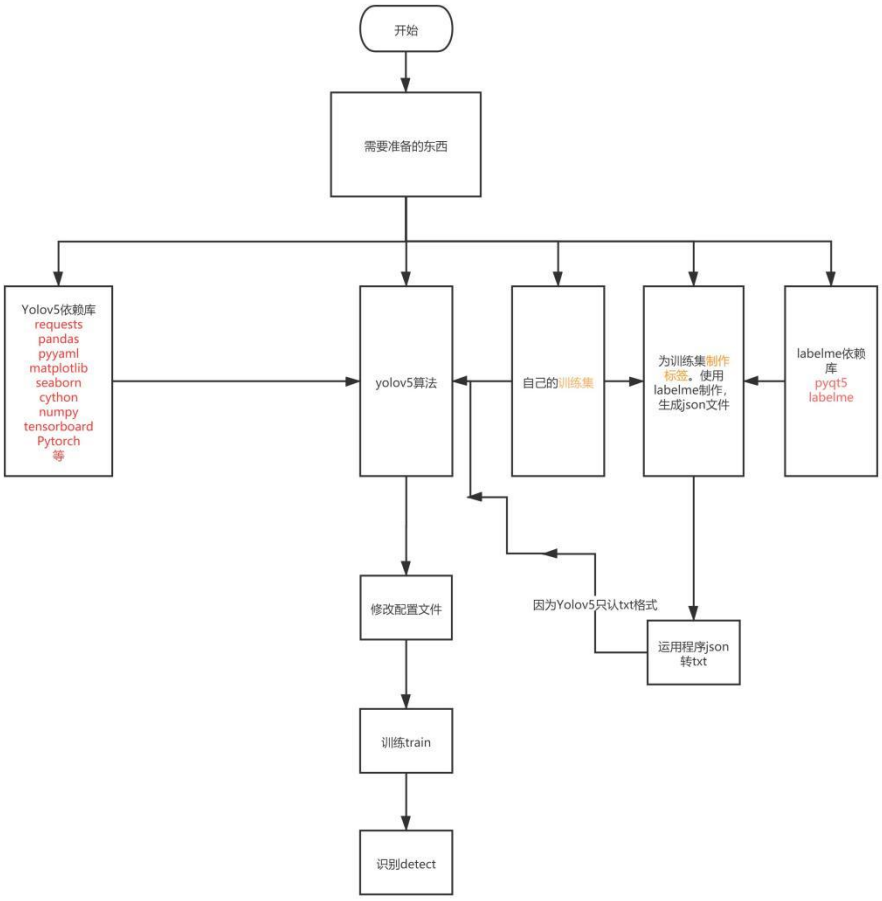
Enriching the dataset: By randomly selecting and combining four images with random scaling and arrangement, the detection dataset is significantly enriched. Random scaling increases the number of small objects, improving the robustness of the network.

Reducing GPU requirements: While random scaling and other conventional data augmentation techniques can be used, the Mosaic augmentation allows for direct computation of data from four images during training. This means that a smaller mini-batch size is sufficient to achieve good results with a single GPU.

Taking the structure of YOLOv5s as an example, the original input image of size 608x608x3 is passed through the Focus structure. The image is sliced to form a feature map of size 304x304x12, followed by a convolution operation with 32 filters, resulting in a final feature map of size 304x304x32. It's important to note that the Focus structure in YOLOv5s uses 32 filters, while the other three variations use a higher number.

In contrast to YOLOv4, which only applies the CSP structure to the backbone network, YOLOv5 introduces two types of CSP structures. For YOLOv5s, CSP1_X is applied to the backbone network, while CSP2_X is used in the Neck. YOLOv5 initially employed the FPN structure for the Neck, but later added the PAN structure. Additionally, other adjustments were made throughout the network.





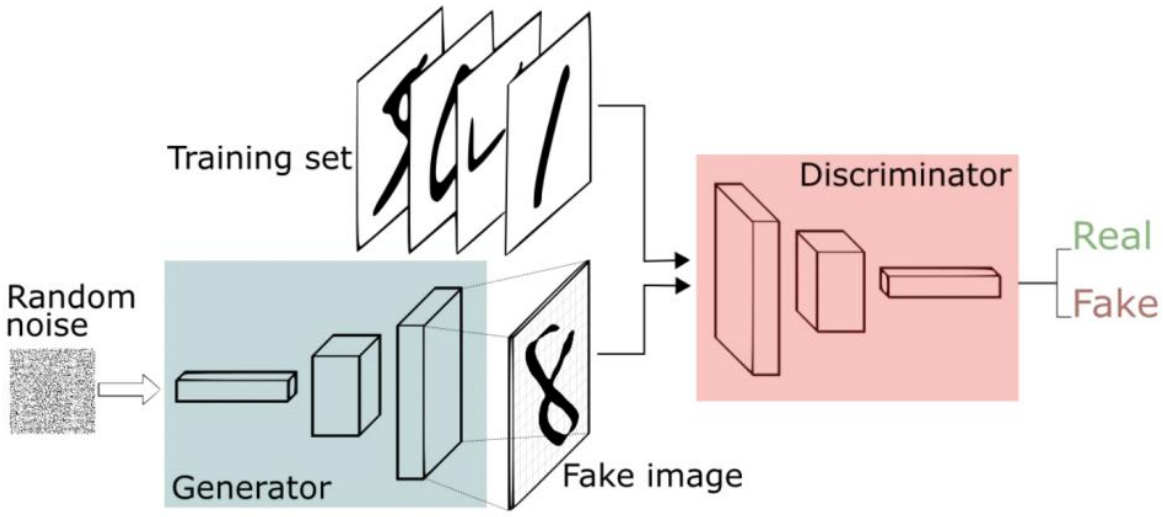
2.2.2 Secondary model

The secondary function of our system is to use the generative model to assist the object detection module.

In this system, high qulity images with 2K resolution are used to train the object detect model, but in real application scenarios, many images cannot achieve 2K resolution, so we proposed two method to solve this problem.Firstly, we can use low-qulity fabric images to fine-tune the model, but we lack a low-qulity image dataset, so we propose a solution: A Generative Adversarial Network can be used to generate fake and low-quality images. At the same time, for users who want to use the system but can not upload pictures for various reasons, the system can generate a picture for testing.Secondly, if the first method can not solve the problem, we will try to use a genrative model to transfer a low-qulity picture to a high-quality picture so that the detect model can detect a high-qulity picture instead of a low-qulity picture.

This system uses generative adversarial networks to generate fabric images.GAN is

the one of most famous generative model .The main structure of GAN includes a generator G and a discriminator D. The generator will use random noise to fit the true distribution and train it with the true distribution in the discriminator until the discriminator cannot distinguish whether the image comes from the true distribution or the generator fitted distribution.



2.3 System

This system needs a carrier to display the predicted and generated results of the model, so we choose to develop a webapp with B/S architecture to display the prediction and generated results. The B/S architecture is chosen because the current mainstream webapp is this architecture, and users only need to use a browser to access our website to obtain services, which greatly improves the user experience.

The web of this system is implemented with Vue.js, which is a Javascript framework for building user interfaces. It is built based on HTML,CSS and Javasccript, and provides a set of declarative and component-based programming models to help users develop user interfaces in a funny way.

The system server is written in java, and Springboot is used to build the whole server. Spring Boot is a new framework from the Pivotal team that's designed to simplify the initial process of building and developing Spring applications. The framework uses a specific way to do configuration so that the developer does not need to define boilerplate configuration. In this way, Spring Boot is committed to becoming a leader in the burgeoning field of rapid application development.

3.Project Team Organization

3.1 Character

For efficient development and effective project management, this system mainly has the following roles:

Project Manager(PM, 1 person): The project manager is responsible for coordinating the planning and execution of the project to ensure the smooth and active operation of the team. The project manager is also responsible for managing relevant stakeholders and coordinating relationships between different departments. The project manager manages all the processes, assigning tasks and ensuring that each team member is consistent with the project schedule.

Developer(2 person): Responsible for the development of the front-end and back-end of the system and the construction of the model. Develop the person responsible for writing the actual code. The front-end developers work on the visible elements of the product, the back-end developers work on the server side of the product, and the algorithm developers build the models.All three are called Developer.

Test(1 person) : The tester is responsible for testing the various modules of the system.

Quality Assurance (QA, 1 person) : A quality assurance engineer tests the product to ensure that it meets standards and customer expectations. Think of them as the ultimate editor with a keen attention to the tinier details. They detect errors and defects in a timely manner so that the team can fix them before the end users evaluate the product.

3.2 Organization structure

The project called “fabric-defect-detection system” is developed by our team. In terms of the organization structure of the team, it’s not fixed but everone has his main character. There are four members in the team, in different periods of development, members with relatively less task will become project managers to organize and supervise the progress of the project, so as to ensure the project can be completed

Name	Advantage	Character
Yichen Xie	Development	1.Developer 2.PM
Yuchen Song	Development	1.Developer 2.QA
Lu Lu	Manage	1.PM 2.Test
Duohan Xu	Manage	1.PM 2.QA

3.3 Task

There are four members in the team. As mentioned above, the core function of the project is defect detection, which will mainly have four functional modules: detection model corresponding to target detection, generative model corresponding to generation adversarial net, basic web page, and server. The target prediction model will be led by one person and assisted by others, while the generation model will be led by one person and assisted by others. The web page display will be led by one person, and the server will be led by two person. As mentioned above, a single functional module will be led by one person and assisted by others, and the team members will participate in the whole project development. Everyone need work in the whole project cycle.

3.4 Implementation and communication

In terms of project implementation and communication, the team will hold a weekly meeting to arrange tasks and summarize the current project results. If necessary, a temporary online meeting will be held to communicate and implement the project.

4.Project development plan

4.1Task description

This part shows all the tasks of the system and their corresponding subtasks, and gives the approximate submission time and the content to be submitted.

Task	Sub-task	Finish Time	Submit Content (most important content)	Description
Preparing	Making team	Week 3	Team list	
	Selecting project	Week 4	Brief description of the project	Fabric defect detection
	Write plan	Week 5 Week 6	Project Plan	Because of the lesson,we will submit it at Week 7.
	Modify the plan	Week 7 Week 8	Modified Project Plan	We will update the project plan with more details.
Learning	Learning deep learning and developing	Week 7 To Week 15	A report	The report is about what you have learned or worked in this week
Model building	Learning the generative model and detection model	Week 8	Submit a demo	Member who is responsible for the model should sumbit a demo using open access datasets.The demo is about the model you learned.
	Building the model for the project.	Week 9	Submit the model	The model may not be prefect or complete. However,it must be used to solve the real problem
	Finishing the model	Week 10	Submit the model	The model must be used to solve the proposed problem. Member need to submit a relatively complete model.

Work	Sub-work	Finish Time	Submit Content (most important content)	Description
	Updating the model	Week 10 To Week 15	Update the model	If the model can't solve problem perfectly, members can update the model.
Development	Developing the server of system	Week11 To Week12	Source Code of the server.	
	Developing the web page	Week 13 To Week 14	Source Code of the web page.	
Testing	Testing the module of the system	Week 8 To Week 14	Test Documentation	
	Testing the complete system	Week 15	Test Documentation	
Finishing	Finishing the project	Week 15	The complete system and documents	

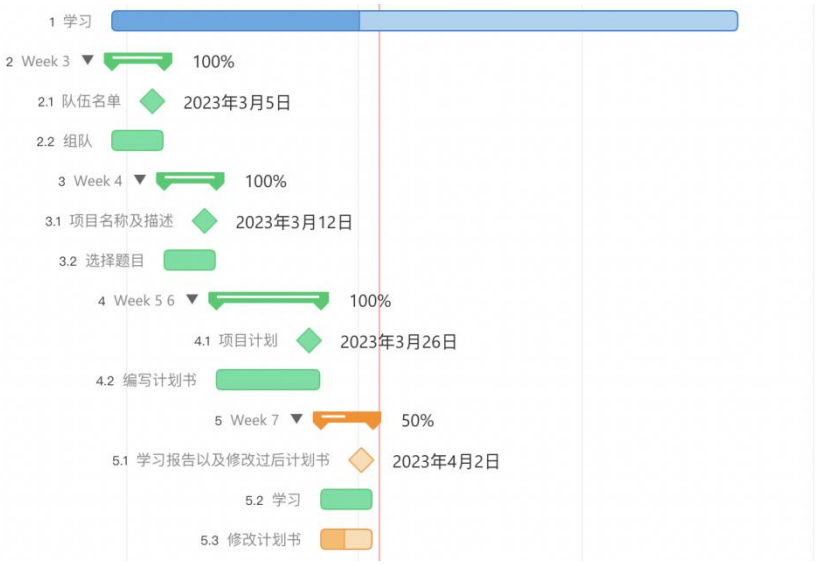
4.2Project Schedule

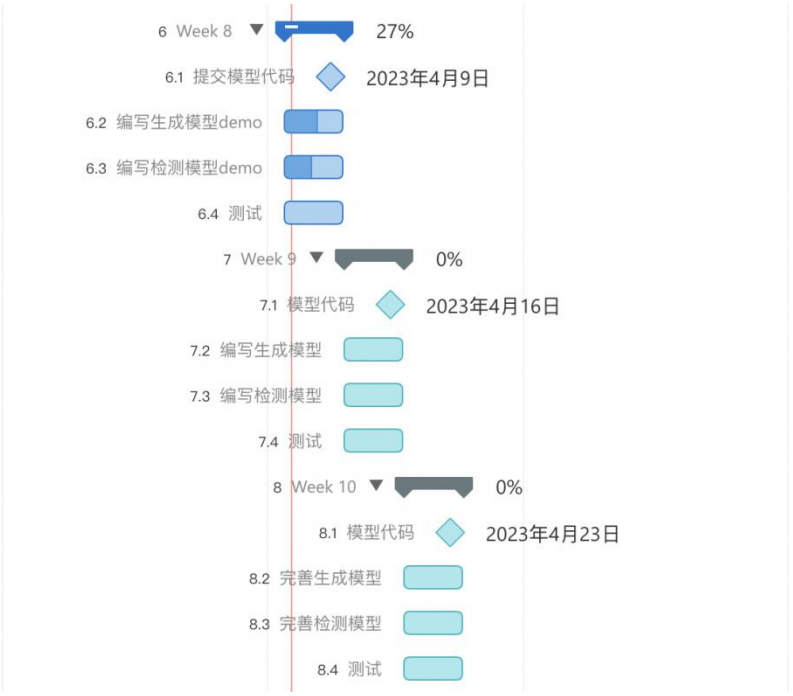
This section mainly introduces the schedule of the whole project, and gives the project schedule and Gantt chart. The specific content is shown in the figure below.

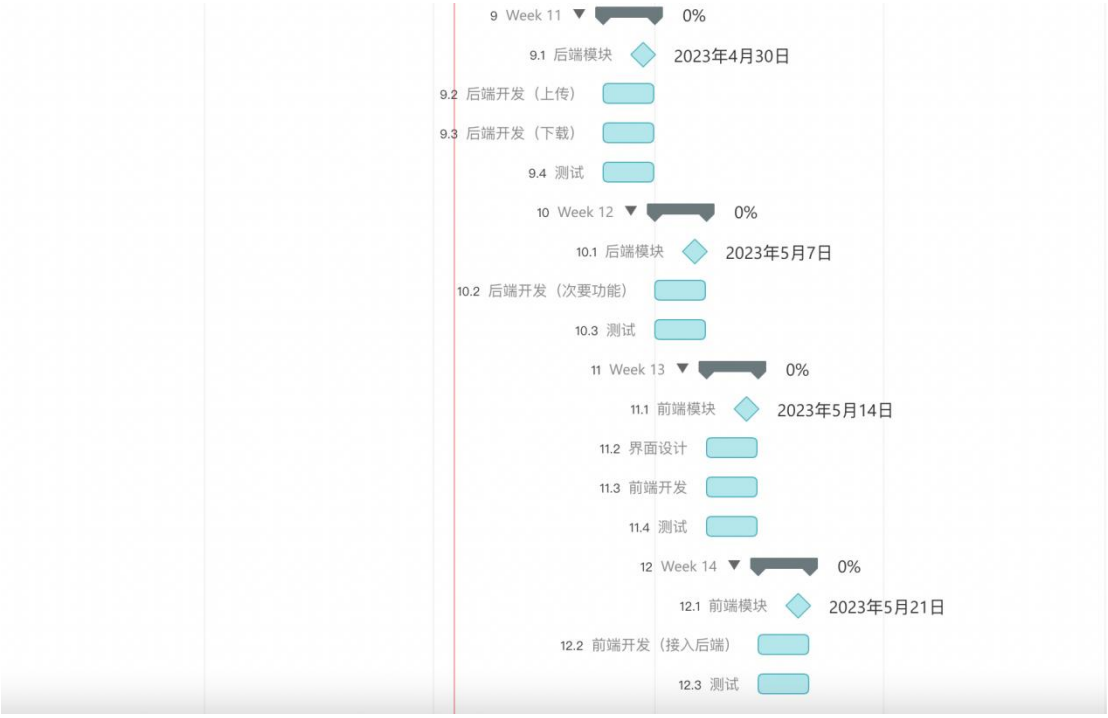
项目进度计划

Project Schedule

编号	工作名称	类型	开始日	预计工期	结束日	完成比例	完成天数	完成情况	备注
3.1	组队	计划开始日	27-Feb-23	6	05-Mar-23				
		实际开始日	27-Feb-23	6	5-Mar-23	100%	6.00	已经完成	
4.1	选择题目	计划开始日	06-Mar-23	6	12-Mar-23				
		实际开始日	6-Mar-23	6	12-Mar-23	100%	6.00	已经完成	
5.1	编写计划书	计划开始日	13-Mar-23	6	19-Mar-23				
		实际开始日	13-Mar-23	6	19-Mar-23	100%	6.00	已经完成	
6.1	编写计划书	计划开始日	20-Mar-23	6	26-Mar-23				
		实际开始日	20-Mar-23	6	26-Mar-23	100%	6.00	已经完成	
7.1	学习	计划开始日	27-Mar-23	6	02-Apr-23				
		实际开始日	27-Mar-23	6	2-Apr-23	100%	6.00	已经完成	
7.2	修改计划书	计划开始日	27-Mar-23	6	02-Apr-23			滞后	
		实际开始日	30-Mar-23			70%	0.00	未完成	
8.1	编写生成模型demo	计划开始日	03-Apr-23	6	09-Apr-23				
		实际开始日	3-Apr-23			60%	0.00	未完成	
8.2	编写检测模型demo	计划开始日	03-Apr-23	6	09-Apr-23				
		实际开始日	3-Apr-23			50%	0.00	未完成	
9.1	编写生成模型	计划开始日	10-Apr-23	6	16-Apr-23				
		实际开始日				0%	0.00	未完成	
9.2	编写检测模型	计划开始日	10-Apr-23	6	16-Apr-23				
		实际开始日				0%	0.00	未完成	
9.2	编写检测模型	计划开始日	10-Apr-23	6	16-Apr-23				
		实际开始日				0%	0.00	未完成	
9.3	测试模型	计划开始日	10-Apr-23	6	16-Apr-23				
		实际开始日				0%	0.00	未完成	
10.1	完善生成模型	计划开始日	17-Apr-23	6	23-Apr-23				
		实际开始日				0%	0.00	未完成	
10.2	完善检测模型	计划开始日	17-Apr-23	6	23-Apr-23				
		实际开始日				0%	0.00	未完成	
10.3	测试模型	计划开始日	17-Apr-23	6	23-Apr-23				
		实际开始日				0%	0.00	未完成	
11.1	后端开发（上传）	计划开始日	24-Apr-23	6	30-Apr-23				
		实际开始日				0%	0.00		
11.2	后端开发（下载）	计划开始日	24-Apr-23	6	30-Apr-23				
		实际开始日				0%	0.00	未完成	
11.3	测试	计划开始日	24-Apr-23	6	30-Apr-23				
		实际开始日				0%	0.00	未完成	
12.1	后端开发（次要功能）	计划开始日	01-May-23	6	07-May-23				
		实际开始日				0%	0.00		
12.2	测试	计划开始日	01-May-23	6	07-May-23				
		实际开始日				0%	0.00	未完成	
13.1	界面设计	计划开始日	08-May-23	6	14-May-23				
		实际开始日				0%	0.00	未完成	
13.2	前端开发	计划开始日	08-May-23	6	14-May-23				
		实际开始日				0%	0.00	未完成	
13.3	测试	计划开始日	08-May-23	6	14-May-23				
		实际开始日				0%	0.00	未完成	
14.1	前端开发（接入后端）	计划开始日	15-May-23	6	21-May-23				
		实际开始日				0%	0.00	未完成	
14.2	测试	计划开始日	15-May-23	6	21-May-23				
		实际开始日				0%	0.00	未完成	
15.1	整体测试	计划开始日	22-May-23	3	25-May-23				
		实际开始日				0%	0.00	未完成	
15.2	汇报	计划开始日	25-May-23	0	25-May-23				
		实际开始日				0%	0.00	未完成	


1 学习
2 Week 3
100%
2.1 队伍名单
2023年3月5日
2.2 组队
3 Week 4
100%
3.1 项目名称及描述
2023年3月12日
3.2 选择题目
4 Week 5 6
100%
4.1 项目计划
2023年3月26日
4.2 编写计划书
5 Week 7
50%
5.1 学习报告以及修改过后计划书
2023年4月2日
5.2 学习
5.3 修改计划书


6 Week 8
27%
6.1 提交模型代码
2023年4月9日
6.2 编写生成模型demo
6.3 编写检测模型demo
6.4 测试
7 Week 9
0%
7.1 模型代码
2023年4月16日
7.2 编写生成模型
7.3 编写检测模型
7.4 测试
8 Week 10
0%
8.1 模型代码
2023年4月23日
8.2 完善生成模型
8.3 完善检测模型
8.4 测试



4.3Milestone Description

Time	Milestone	Description
Sprint 1		
Week3	Team leader submits team list.	
Week 4	Team leader submits the project and a brief description on the online document.	
Week 5 Week 6	Team leader submits the project plan	Team leader submits the project plan at week 7.
Week 7.	Everyone must submit a report about what you have learned in this week.	
Week 8	The member who is responsible for the model submits a demo.	The demo must be runnable and the member must submit the outcome of the demo. The outcome must be a picture or a document which shows the result of the model.

		For detect model, the demo need to detect something. For generative model, the demo need to genrate something.
Week 9 Week 10	The member who is responsible for the model submits the complete model.	The model is used to solve most of the real problem we proposed. The model contains of souce code ,the parameter and outcome. The outcome must be a picture or a document which shows the result of the model. For detect model, the model need to detect the fabric defect and generate a picture with the result. For the first generative model, it need to generate a low-qulity picture. If the first generative model can not solve the problem, member need to submit the second generative model which can transfer a low-quality picture to a high-quality one.
Sprint 2		
Week 11 Week 12	The member submits the a module of the server.	The module can be used to solve the corresponding requirement. The main module need to upload the picture to the server and download the picture from the server.
Week 13 Week 14	The member submits the a module of web page.	The module can be used to solve the corresponding requirement. User can use the web page to download and upload picture for detect. User can use the web page

		to generate a picture for preview.
Week 15 Week 16	The teams submit the system and all of the document.	The team give the presentation of the system.

5.Project Risk

During the execution of the project, it is inevitable that there will be various kinds of accidents, which may lead to the failure of the whole project. Therefore, we must put forward all possible accidents in the plan, and propose corresponding solutions for these accidents.

Risk Type	Risk	Impact	Solution
schedule risk	Unable to complete due to time constraints. The project plan may faces delays.	High	Member should fully consider various potential factors and make plans. Breakdown of tasks should be in detail. Members should strictly follow the project plan,.
Technical risks	Team is unable to build a robust model due to hardware performance. Team chooses a wrong model that can't solve the problem proposed.	High	The performance of the model can be allowed to be weak , but it must be able to complete corresponding tasks.
Human Resources Risk	Members cannot complete this week's task due to special reasons.	Low	Members need to notify other members in advance, and other members are responsible for completing the module.
Requirement Risk	There are imperfections in the requirements presented, resulting in	Medium	Team members need to inform the project manager of the new

	the need to change the requirements and revise the overall plan.		requirement, and the project manager will organize a meeting to discuss whether to add the new requirement. If all team members agree, the new requirement will be added.
Management Risk	The difference in the ability and level of the project management team brings uncertainty risk to the project construction. These management capabilities and levels include: the preparation and implementation of project schedule plan, the ability to plan and manage project human resources, the ability to manage project change, the ability to manage project communication, and the ability to manage project risk.	High	Each team member needs to be familiar with project management and keep learning. At the same time, it is necessary to strengthen communication. When there is any problem, it is necessary to inform the project manager, and then the project manager organizes a meeting to discuss.