

UNDERGRADUATE PROJECT PROGRESS REPORT

Project Title:	Web design platform based on low-code visual components
Surname:	Ruitong
First Name:	Xiao
Student Number:	201918010106
Supervisor Name:	Javier Jia
Module Code:	CHC 6096
Module Name:	Project
Date Submitted:	2023/1/12

Table of Contents

1	Introduction	4
1.1	Background	4
1.2	Aim	4
1.3	Objectives.....	5
1.4	Project Overview	5
1.4.1	Scope	5
1.4.2	Audience.....	5
2	Background Review	5
3	Project Technical Progress	7
3.1	Methodology.....	7
3.1.1	Approach	7
3.1.2	Technology	9
3.2	Testing and Evaluation	9
3.2.1	Purpose of testing.....	9
3.2.2	Scope of testing	9
3.3	Design and Implementation	14
3.3.1	Ui Design (Ui Diagram):	14
3.3.2	Front-end development: Editing Page.....	18
4	Project Management.....	20
4.1	Activities	20
4.2	Schedule	21
4.3	Project Version Management.....	21
4.4	Project Data Management	21
4.5	Project Deliverables.....	22
5	Professional Issues and Risk:	22
5.1	Risk Analysis	22

5.2	Professional Issues	23
5.2.1	Legal Issues	23
5.2.2	Social Issues	24
5.2.3	Ethical Issues	24
5.2.4	Environmental Issues.....	24
6	References	25

1 Introduction

1.1 Background

The rapid development of applications and the constant iteration of applications has become a new trend. Based on statistics, the average cost of an application development project ranges from US\$434,000 to US\$2,322,000, whereas 52.7% of projects will cost 89% more than predicted and only 16.2% of projects will ultimately complete on time, with even 31.1% of projects being cancelled before completion [1]. Additionally, due to a 38% reduction of job growth in 2021, while market demand in the IT field is constantly being updated, in the next few years, thousands of job vacancies might be created, recruiting development engineers is becoming ever more difficult, companies are facing the challenge of not being able to meet the market requirements for new applications in time and having to find faster and cheaper ways to meet their application requirements [2]. In response, the Low Code Development Platforms (LCDPs) has been produced and attempts to provide a quick development method.

With a growing trend of Low Code Development Platforms (LCDPs) which provide a viable solution to the shortage of highly skilled professional developers by allowing "people with no education in programming", i.e. citizen developers [3], to participate in the application development process through higher-level abstractions. According to a concept proposed by Forrester in 2014, LCDPs are being used by citizen developers or non-programmers to build applications that meet their needs based on the drag and drop of components, visual modelling and automatic code generation [4]. Furthermore, LCDPs are conducive to improving the efficiency of application development and significantly reducing the cost of traditional application development projects, addressing the high cost and inefficiency of enterprise application development [5]. Research shows that low-code development is also the most common solution to the skills shortage of development professionals, and that low-code development platforms not only reduce development costs and time, but also produce high-quality products [6].

By 2023, the market for LCDPs is predicted to grow sharply, with more than half of medium to large enterprises will adopt LCDPs as one of their top strategic application platforms [7].

1.2 Aim

The purpose of this paper is to provide a low-code development platform based on a visual environment and drag-and-drop components to enable citizen developers to

design websites quickly and cost-effectively, thereby addressing the high cost and inefficiency of traditional application development as well as the shortage of developers.

1.3 Objectives

- a. Explore the project background, functional priorities and requirements analysis.
- b. Decide on the project development environment and resources.
- c. Design the user interface and visualization components.
- d. Implement the front and back-end development of the project.
- e. Website testing and maintenance

1.4 Project Overview

1.4.1 Scope

The project provides a fast and low-cost, low-threshold application development service that eliminates the programming process and facilitates developers with an advanced graphical user interface and drag-and-drop component design that enhances the user interaction experience, in order to enable everyone to participate in the website development process.

1.4.2 Audience

The platform accelerates the development of applications by reducing the programming process, the main target audience is citizen developers. Unlike professional developers who build solutions using traditional programming, citizen developers are essentially business users with little to no background in application development, and the low-code platform allows with no knowledge of coding and provides them a code-free development experience.

2 Background Review

More and more enterprises have been turning to low-code development platforms in recent years. Below is a table of the existing platforms and their features in comparison.

Products	Strengths	Weaknesses
----------	-----------	------------

Microsoft Power Apps	High abstraction level: Provides drag and drop tools with a high abstraction level.	Constraint: Available only under a traditional PaaS model, which is not a match for customers who must deploy applications on-premises or with other cloud providers.
	API and integration services: Has a rich set of APIs and OData endpoints (execute full create, read, update and delete (CRUD)operations on data in order to support integration with third-party iPaaS.), has sufficient data connectors.	Sales execution and pricing: Complex pricing models and entitlement rules, and some features require extra payments.
Mendix Platform	Functionality: Robust functionality for integration, event processing, workflow and development support using AI	Constraint: Content management only includes the basics of file management and storage
	Innovation: Provides highly customizable chatbots, mobile apps and IoT applications.	
Oracle Application Express (APEX)	Overall viability: Has a huge number of audiences	Hysteresis: Lags behind in modern features.

	Extendibility: Extended with JavaScript, Java and SQL, APEX applications are available to access all the advanced features of the Oracle database platform.	External dependencies: A heavy reliance on PL/SQL, supplemented by Java and JavaScript for business logic
Studio Creatio	Data processing and validation: Providing data processing models and validation.	Lack of teamwork functionality: Lack of multi-cloud/multi-region deployments and seamless auto-scaling of applications
	Matches customers' requirements: Allows citizen developers to create drag-and-drop case design features and their own custom machine learning models.	Innovation: Lags behind in integrating functionality and innovative application development

Table 1. Background Research and Competitive Analysis [8]

3 Project Technical Progress

3.1 Methodology

3.1.1 Approach

3.1.1.1 Software development methodology

Developing projects with incremental models treats the project product as a series of incremental building blocks to be designed, coded, integrated and tested. Each building block consists of multiple interacting modules and is capable of performing specific features. During the testing phase, this project will utilize test-driven development to write test cases code before implementing the development code to drive the entire development through testing.

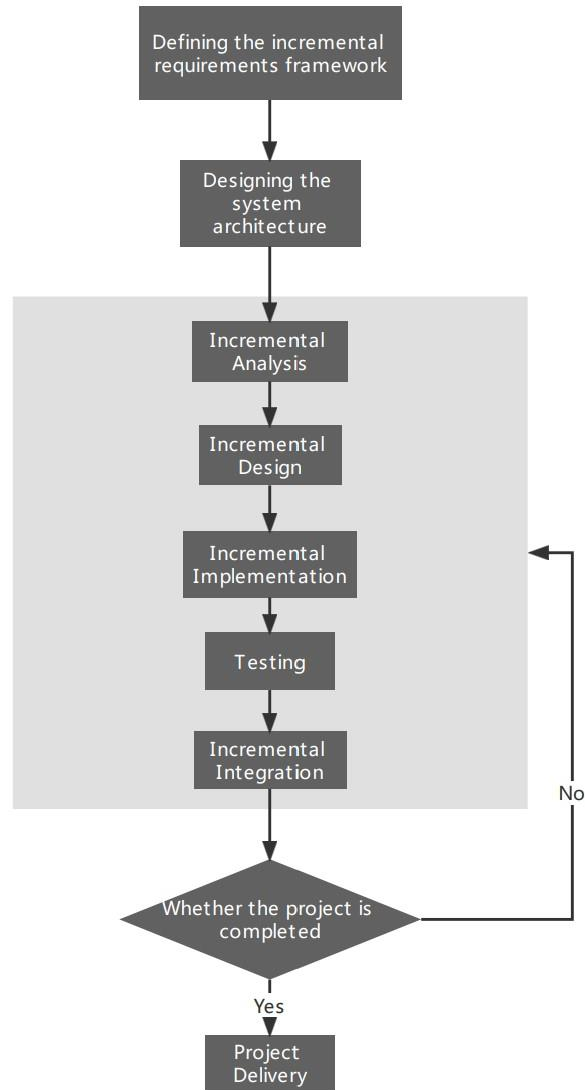


Figure 1.Incremental Development Model Flowchart

3.1.1.2 Requirements gathering methods

Regarding the requirements gathering method, this project will use benchmarking to compare this product with other leading products in the same field, determine the objectives of this product and the implementation methods, as well as to make incremental improvements based on existing methods.

In addition, the project will also employ questionnaires and user interviews to gather user requirements. Questionnaires provide broad coverage and increase efficiency, while user interviews allow for targeted collection of user requirements and more time spent in in-depth communication with users.

3.1.2 Technology

The project relies on the cloud computing technology to integrate hardware and software resources, using Ali cloud mirror source service to build cloud servers, MySQL to achieve database management. The front-end utilizes Vue3 and Vite to provide separate front-end and back-end development, while the back-end development is integrated with Springboot and Mybatis-plus. The main tools chosen for development are IDEA and Visual Studio Code, with Navicat as the database management tool.

To implement project testing, Selenium at 3.2.2.1 will be used as a tool for functional testing, OpenSTA at 3.2.2.2 for performance testing, while in usability testing, Survey Monkey will be employed as a questionnaire tool, UsabilityHub as a user testing tool and Grammarly as a content review tool.

3.2 Testing and Evaluation

3.2.1 Purpose of testing

This test plan adheres to Test Driven Development (TDD), it is intended to serve as a guide for the management and technical aspects of the testing process, in order to optimize product quality and enhance the efficiency of web development. It outlines the scope, content, and strategy of testing, and helps testers quickly understand the testing process and conduct testing activities.

3.2.2 Scope of testing

3.2.2.1 Functional testing

1) The Purpose of Testing

The purpose of website functionality testing is to check that the website functions and the user experience of the website are as expected.

2) Testing methods

Employ black box testing to allow testers to use the website in accordance with its functionality, observe and record the performance of the website.

3) Testing tools:

- Software environment: Selenium.
- Hardware tools: Lenovo Xiaoxin Pro-13IML 2019

4) Testing Case

Testing Type		Functionality testing	Testing Case	User Login
Testing Case Description		This test case is used to test whether the user can log in successfully on the login interface, and if errors occur, whether the error messages can be returned.		
Pre-condition		The user has opened the login page of the website in their browser and the website's database has the correct username and password stored.		
Test ID	Test Items	Steps	Data	Expected results
FT-1	User Login Successful	<ol style="list-style-type: none"> 1. Enter a username that exists and is case sensitive. 2. Enter a username that exists and is case sensitive. 3. Click on the login button. 	<ol style="list-style-type: none"> 1. username: Test 2. password: Test123456 3. N/A 	<ol style="list-style-type: none"> 1. N/A 2. N/A 3. Prompt the user for a successful login and redirect to the home page.
FT-2	User login failure	<ol style="list-style-type: none"> 1. Enter a username that exists and is not case sensitive. 2. Enter a username that exists and is not case sensitive. 3. Click on the login button. 	<ol style="list-style-type: none"> 1. username: test 2. password: test123456 3. N/A 	<ol style="list-style-type: none"> 1. N/A 2. N/A 3. Prompt that the user login has failed because the account name or password is incorrect, and return to the login page.
		<ol style="list-style-type: none"> 1. Enter a username that exists and is case sensitive. 2. Enter a username that exists and is not case sensitive. 	<ol style="list-style-type: none"> 1. username: Test 2. password: test123456 3. N/A 	<ol style="list-style-type: none"> 1. N/A 2. N/A 3. Prompt that the user login has failed because the account name or password is incorrect,

		3. Click on the login button.		and return to the login page.
		1. Enter a username that does not exist and is case sensitive. 2. Enter a username that does not exist and is case sensitive. 3. Click on the login button.	1. username: Aurora 2. password: Aurora123456 3. N/A	1. N/A 2. N/A 3. Prompt that the user login has failed because the account name or password does not exist, and return to the login page.
		1. Click Login button directly without entering anything.	1. N/A	1. Prompt user to enter the account name and password.
FT-3	User login reset or cancel	1. Enter a username that exists and is case sensitive. 2. Enter a username that exists and is case sensitive. 3. Click to reset or cancel.	1. username: Test 2. password: Test123456 3. N/A	1. N/A 2. N/A 3. Clear the input boxes for account name and password.

Table 2. Functionality testing

3.2.2.2 Performance testing

1) The Purpose of Testing

The purpose of website functionality testing is to check that the website functions and the user experience of the website are as expected.

2) Testing methods

Employ black box testing to allow testers to use the website in accordance with its functionality, observe and record the performance of the website.

3) Testing tools:

- Software environment: OpenSTA.
- Hardware tools: Lenovo Xiaoxin Pro-13IML 2019

4) Testing Case

Testing Type		Performance testing	Testing Case	User Add New Project
Testing Case Description		Test submission of new visualisation projects, response time of new projects added to the website.		
Pre-condition		The user is logged in and clicks Add New Project.		
Test ID	Number of Parallel Users	Steps		Expected results
PT-1	25	1. Click on the Add New Item button 2. Edit the project name 3. Click on Save		The response time for the system to process the submission of new project information should not exceed 8 seconds

Table 3. Performance testing

3.2.2.3 Usability testing

1) The Purpose of Testing

The purpose of this test plan is to assess the usability of the website. This test will cover the interface design, functionality and user experience of the website to ensure usability and user satisfaction.

2) Testing methods

- Questionnaire survey: A questionnaire survey was used to collect user satisfaction of the website.
- Review of website content: The content of the website is reviewed to check the correctness and completeness of the content.
- User testing: Allow real users to test the usability of the website and collect user feedback.

3) Testing tools.

- Questionnaire tools: Survey Monkey.
- User testing tools: UsabilityHub.
- Content review tools: Grammarly.

Test Type	Usability testing	Test Case	User visualization design
Test Case Description	This test case is intended to test whether the design of the website interface is understandable for the users and ensure that it is operated quickly by users.		
Pre-condition	User has logged in and entered the design page.		
Test ID	Test items	Test Content	Expected results
UT-1	Navigation Bar Interaction	Mouse hover over an icon in the navigation bar.	Sidebar is able to follow the mouse hover on the navigation bar to change the contents
UT-2	Button Interaction	Click any button to test if it pops up a window/page or executes a command.	Buttons function properly and interaction is smooth
UT-3	Input Box Interaction	Enter any component name and check if the component is found	The search form queries and displays any component successfully
UT-4	Text Display	Check whether the text size and colour are user-friendly	Texts with appropriate sizes and user-friendly colour.
UT-5	Component Addition	Drag the component to the editing area and attempt to edit it.	Components are well-styled and well-displayed, and it is able to add by drag and drop with modify support.

Table 4.Usability testing

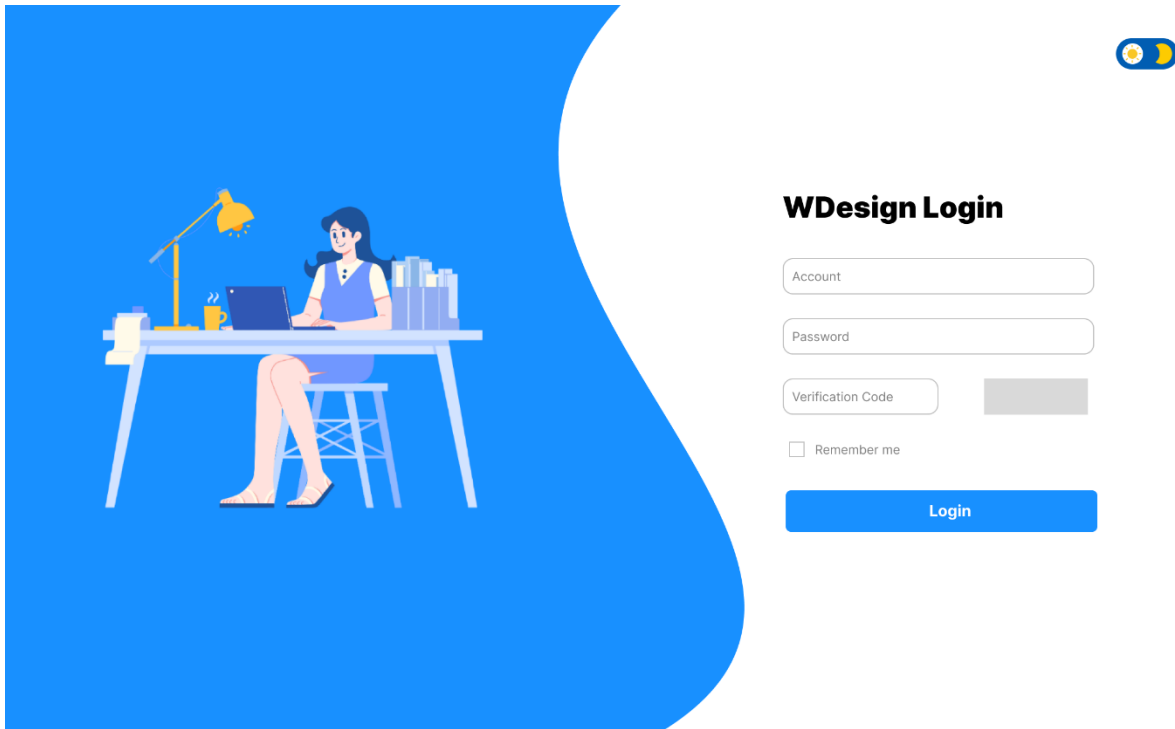
3.3 Design and Implementation

3.3.1 Ui Design (Ui Diagram):

The followings have been achieved:

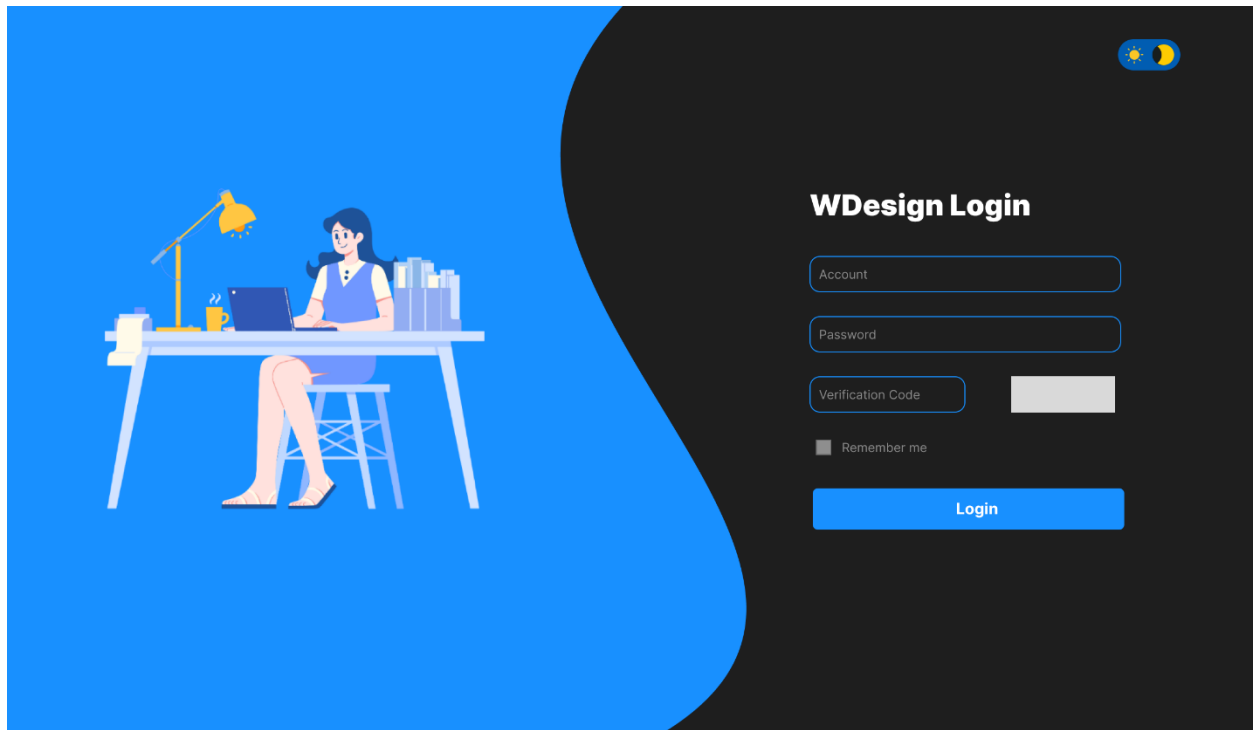
3.3.1.1 Login and Registration Page

a) Light Mode



Screenshot 1. Light Mode Login Page

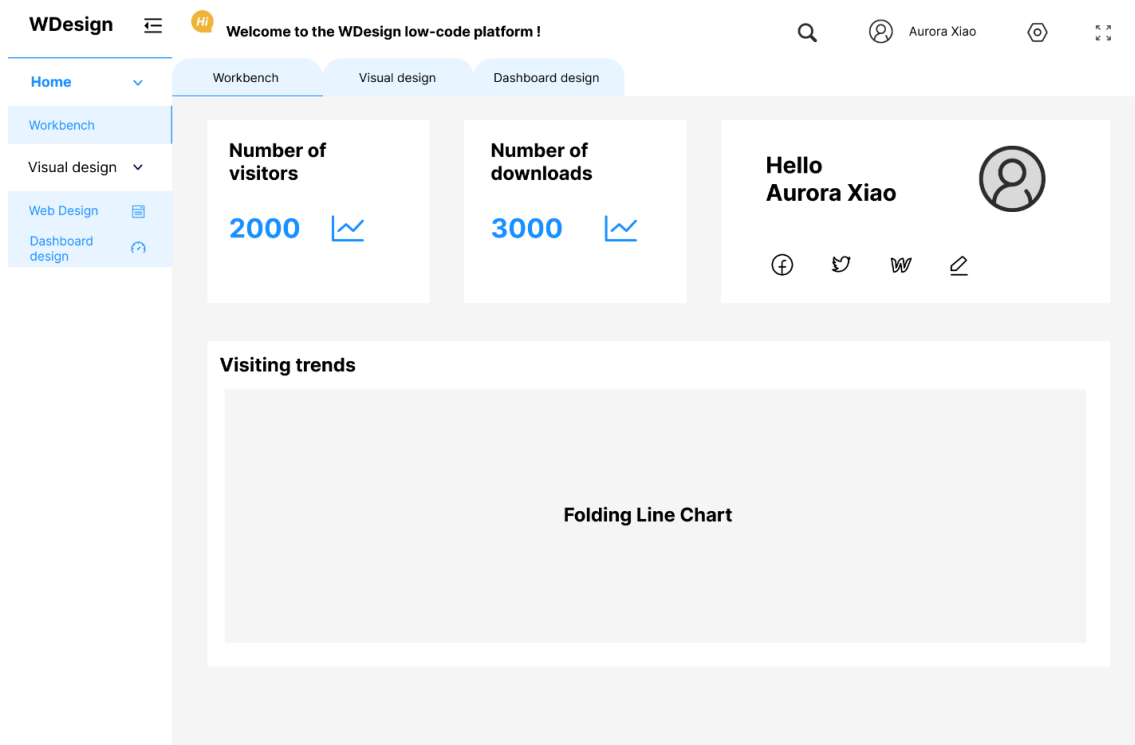
b) Dark Mode



Screenshot 2. Dark Mode Login Page

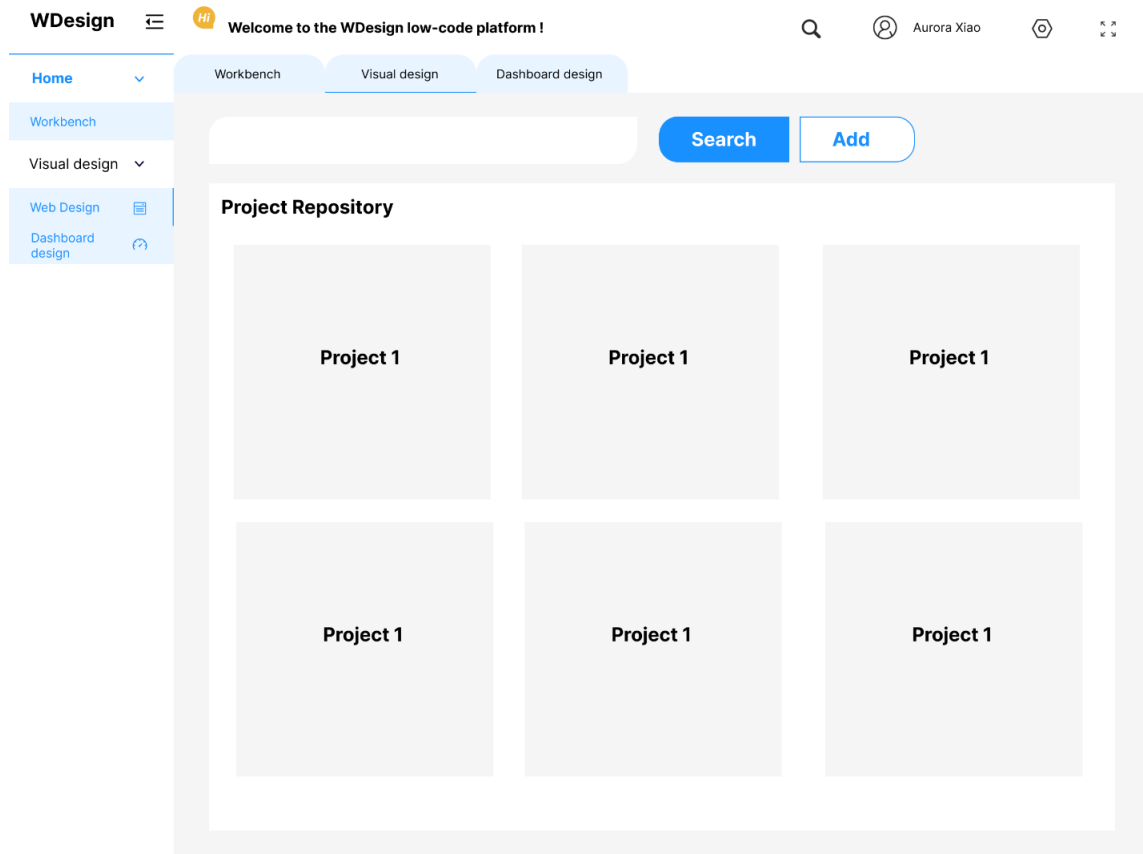
3.3.1.2 Home Page

a) Workbench



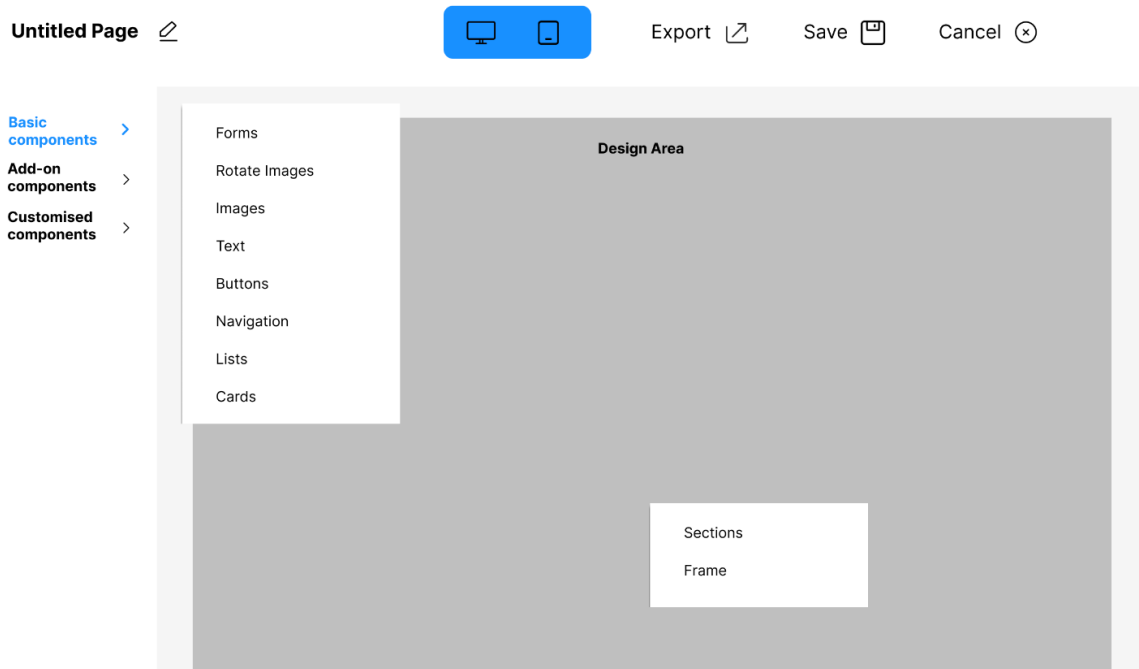
Screenshot 3. Workbench

b) Project Management

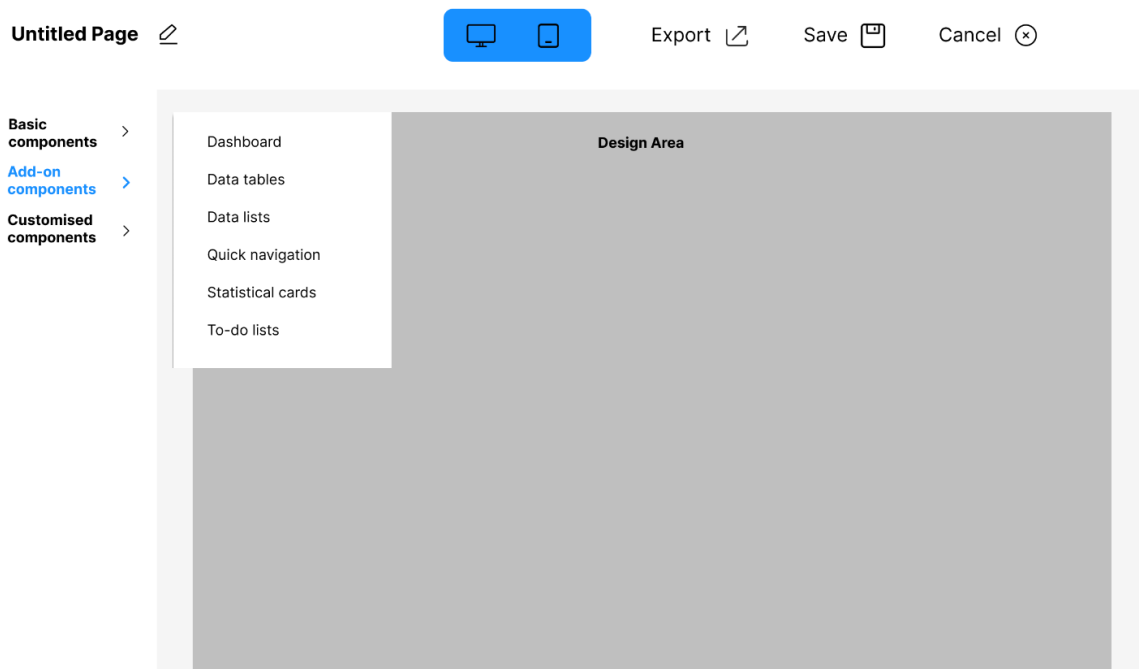


Screenshot 4. Project Management

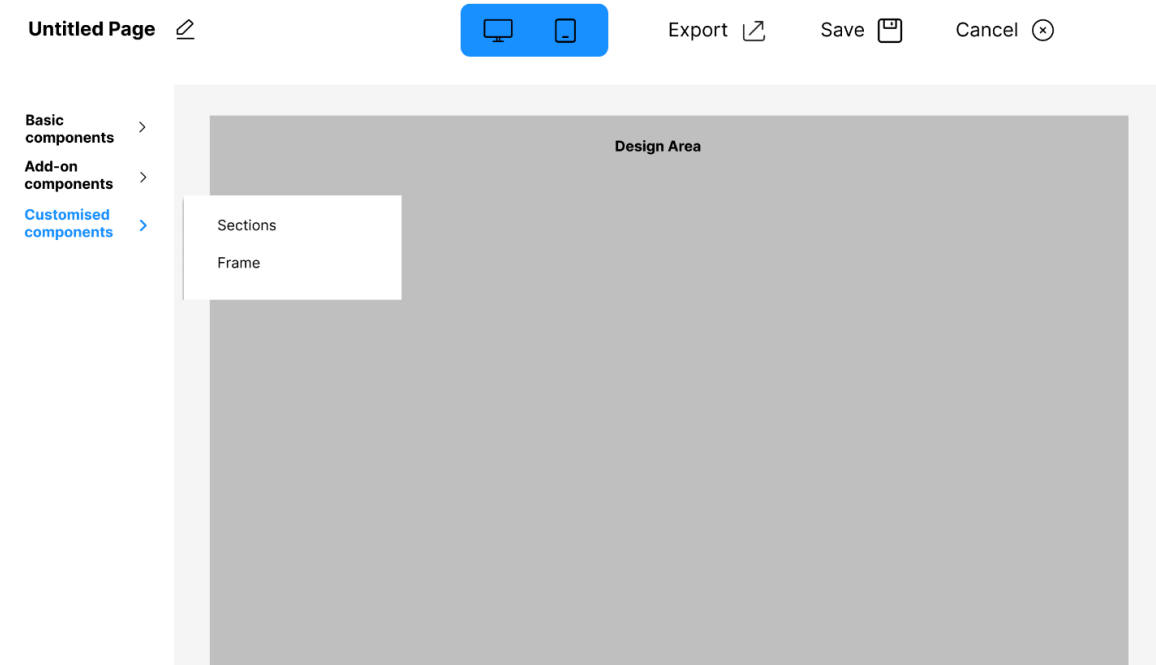
3.3.1.3 Editing Page



Screenshot 5. Editing Page 1



Screenshot 6. Editing Page 2



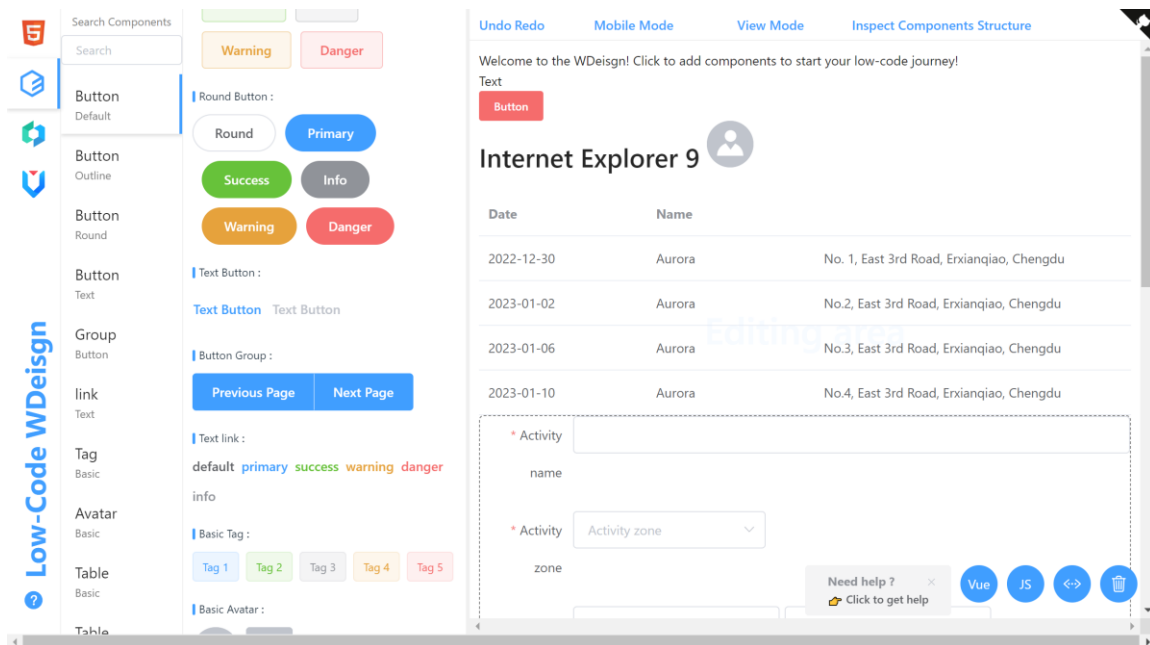
Screenshot 7. Editing Page 3

3.3.2 Front-end development: Editing Page

Implemented Module	Function Name	Function Description
Navigation bar	HTML5	Component libraries for building websites.
	Element-UI	
	Vant	
	Antd	
Toolbar	Undo and Redo	Undo and redo acts in the editing area.
	Mobile/Desktop Model	Provides customisation for different devices.
	Preview	Preview pages.
	Delete	Delete all page contents.

	Real-Time Code	Provides real-time code modification and copying, as well as download projects in different output formats.
	Vue Editor	Parsing Vue code.
	JS Editor	Modify and import JS code.
	Component Structure	Display the hierarchical structure of the current page.
Editing area		Provides the functions to add, delete and modify components.

Table 5. Front-end development Table



Screenshot 8. Editing Page

Please check the video for more detailed descriptions.

4 Project Management

4.1 Activities

The following are the activities required for each objective:

1. Explore the project background, functional priorities and requirements analysis.
 - 1.1 Conduct literature search
 - 1.2 Analyse and compare competitors
 - 1.3 Defining the project objectives
 - 1.4 List item functions and prioritize project functions
 - 1.5 Analysis of user requirements from role, scenario and time
2. Decide on the project development environment and resources.
 - 2.1 Explore the existing front and back-end technologies
 - 2.2 Select the most suitable development technologies
 - 2.3 Select the appropriate development tools
3. Design the user interface and visualization components.
 - 3.1 Complete prototype diagrams, information architecture diagrams, flowcharts
 - 3.2 Complete UI diagrams based on prototype diagrams
 - 3.3 Collection of common front-end components and icon libraries
4. Implement the front and back-end development of the project
 - 4.1 Front-end interface development from UI diagrams
 - 4.2 Implementing back-end interface development
 - 4.3 Create and connect to database
5. Website testing and maintenance
 - 5.1 Defining the test plan, cases and software testing techniques
 - 5.2 Test and maintain website functionality until delivery

4.2 Schedule

The following is a schedule of the project development process, which shows the entire project phase.

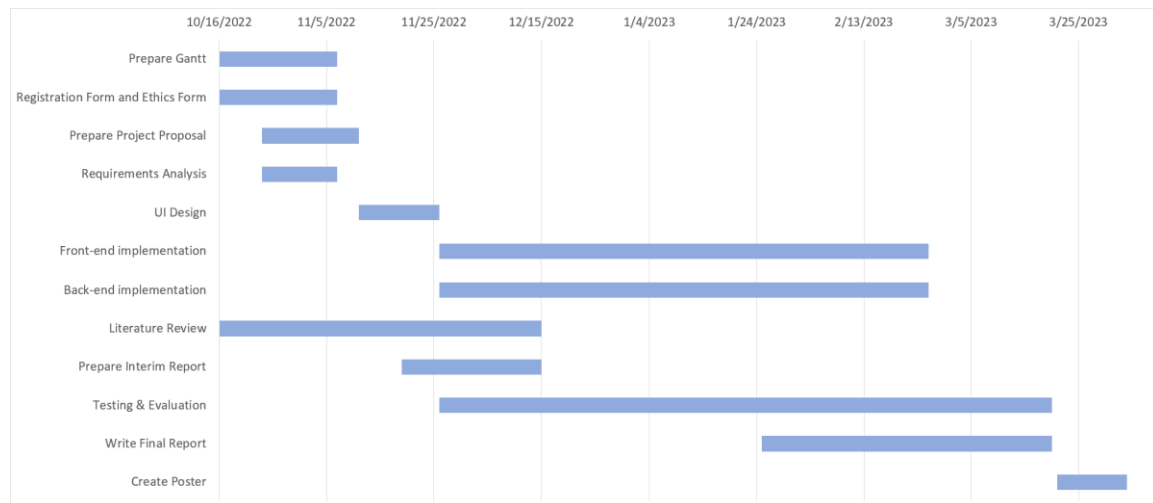


Figure 2.Gantt Diagram

4.3 Project Version Management

Use GitHub to manage project versions and project-related files, and update them after each development phase.

GitHub Repository: [AuroraXiao/Web-design-platform-based-on-low-code-visual-components: 201918010106 Aurora \(github.com\)](https://github.com/AuroraXiao/Web-design-platform-based-on-low-code-visual-components)

4.4 Project Data Management

The project's reports, weekly report sheets are stored in the FeiShu cloud, allowing students and supervisors to update the project content and provide feedback.

Back up and upload all relevant literature to Mendeley for management and citation of the literature.

Weekly Report Sheets Link: [\(201918010106 Aurora\) Weekly Report Sheets](#)

Project Report Link: [\(201918010106 Aurora\) Project Report](#)

4.5 Project Deliverables

- a) Project Proposal
- b) Ethics Form E1
- c) Progress Report
- d) Final Report
- e) Weekly Report Sheet
- f) Poster Presentation
- g) Project Code

5 Professional Issues and Risk:

5.1 Risk Analysis

Risk ID	Potential Risk	Cause ID	Potential Causes	Severity	Likelihood	Risk	Mitigation ID	Mitigation
R1.1	Missed deadline	C1.1.1	Illness	1	3	3	M1.1.1	Register exceptional circumstances if ill.
		C1.1.2	Cannot choose topic	1	1	1	M1.1.2	Conduct research early and meet supervisor
		C1.1.3	Poor time management	4	2	12	M1.1.3	Make a Gantt plan early
R1.2	Feature creep	C.1.2.1	Unsuitable or unachievable project plans	3	2	6	M1.2.1	Discuss plan with supervisor early. Create basic goals and enhancements.

		C.1.2.2	Unsuitable User Interface Design	3	2	6	M1.2.2	Discuss the UI design with supervisor, and be aware of the functionality and usability of the design.
R1.3	Software bugs	C1.3.1	Non-modular design	1	3	3	M1.3.1	Create highly modular design before implementation
		C1.3.2	Poor test plan	4	3	12	M1.3.2	Create test plan at start
R1.4	Loss of data	C1.4.1	Poor version control	4	4	16	M1.4.1	Implement version control strategy at start.
R1.6	Technical vulnerabilities	C1.6.1	Applying new technologies	4	2	8	M1.6.1	Testing of various aspects of the application of the technology.
R1.7	Data Breach	C1.7.1	Hacking of the website	5	1	5	M1.7.1	Set up firewalls and keep access logs.

5.2 Professional Issues

5.2.1 Legal Issues

The most potential legal issue for the project is related to the processing of personal data of users. All collection and processing of users' data on this website require the prior consent of the data subjects. The General Data Protection Regulation (GDPR)

stipulates that the data subjects have the right to be informed about the processing of their data, whereby the utilisation of personal data by the website must be based on the data subject's consent [9]. In this regard, the website of the project will only collect and utilise the personal data of the users with the consent of the user, as well as providing the users with the right to withdraw consent.

5.2.2 Social Issues

The availability of low-code websites and visual components increases the efficiency of website development, but also increases the potential risk to website security, since there is the possibility that developers fail to correctly identify and deal with security issues. Based on this, it could lead to a website hacking which could result in the disclosure of user data, thus causing a further risk to social network security.

5.2.3 Ethical Issues

A notable ethical implication is that the utilisation of low-code web development platforms may erode the skill level of developers, thereby squeezing traditional advanced programming skills or preventing traditional developers from earning same incomes as before, resulting in a conflict of interest between those with low development skills and those with high development skills, which is contrary to the principles of Institute of Electrical and Electronics Engineers (IEEE) Code of Ethics [10].

5.2.4 Environmental Issues

Although low-code web development platforms can reduce the time taken to develop a website, if the volume of users on the website increases, the server may not be able to support the demand, in which case additional hardware will have to be added to expand the service. This may lead to a waste of resources and indirectly affect the environment.

6 References

- [1] M. Fryling, 'Low Code App Development', J. Comput. Sci. Coll., vol. 34, no. 6, p. 119, Apr. 2019.
- [2] T. Breaux and J. Moritz, 'The 2021 software developer shortage is coming', Commun ACM, vol. 64, no. 7, pp. 39–41, Jul. 2021, doi: 10.1145/3440753.
- [3] M. Oltrogge et al., 'The Rise of the Citizen Developer: Assessing the Security Impact of Online App Generators', in Proceedings - IEEE Symposium on Security and Privacy, Jul. 2018, vol. 2018-May, pp. 634–647. doi: 10.1109/SP.2018.00005.
- [4] V. Phalake, S. Joshi, K. Rade, and V. Phalke, 'Modernized Application Development Using Optimized Low Code Platform', in 2022 2nd Asian Conference on Innovation in Technology (ASIANCON), Aug. 2022, pp. 1–4. doi: 10.1109/ASIANCON55314.2022.9908726.
- [5] A. C. Bock and U. Frank, 'In Search of the Essence of Low-Code: An Exploratory Study of Seven Development Platforms', in Companion Proceedings - 24th International Conference on Model-Driven Engineering Languages and Systems, MODELS-C 2021, 2021, pp. 57–66. doi: 10.1109/MODELS-C53483.2021.00016.
- [6] S. Rafi, M. A. Akbar, M. Sánchez-Gordón, and R. Colomo-Palacios, 'DevOps Practitioners' Perceptions of the Low-code Trend', Sep. 2022, pp. 301–306. doi: 10.1145/3544902.3546635.
- [7] P. Vincent et al., 'Licensed for Distribution Magic Quadrant for Enterprise Low-Code Application Platforms', 2020. [Online]. Available: <https://www.gartner.com/doc/reprints?id=1-24BBDEDZ&ct=201005&st=sb>
- [8] J. Bratincevic and R. Koplowitz, 'The Forrester Wave™: Low-Code Development Platforms for Professional Developers, Q2 2021 The 14 Providers That Matter Most And How They Stack Up Why Read This Report', 2021.
- [9] The European Parliament And The Council Of The European Union, "on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance)," 2016. [Online]. Available: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679>

[10] "IEEE Code of Ethics," *IEEE Potentials*, vol. 23, no. 2, pp. 32–33, Apr. 2004, doi: 10.1109/mp.2004.1301956.