

NATIONAL UNIVERSITY OF SINGAPORE

Skylab: NUS Orbital Project Platform

by

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Declaration of Authorship

I, Gu Junchao, declare that this thesis titled, ‘Skylab: NUS Orbital Project Platform’ and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

Date:

“If debugging is the process of removing software bugs, then programming must be the process of putting them in.”

Edsger Dijkstra

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Abstract

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Orbital is the School of Computings self-driven programming summer experience. It is designed to give first-year students the opportunity to self-learn and build something useful. As more and more students join Orbital program, administration and evaluations among teams are becoming increasingly challenging. Therefore, Skylab is designed and implemented to help students to submit submission and evaluate other teams with ease as well as to help the administrator of Orbital program overlook and manage this module well. In this project, we find and solve real-life problems faced by students, advisors and administrators of Orbital program with an extensible system design and continuous contribution in an agile software development process.

Subject descriptors:

D.2 Software Engineering

D.2.11 Software Architectures

D.2.5 Testing and Debugging

H.5.2 User Interfaces

K.6.5 Security and Protection

Keywords:

Software Engineering, User Interface, Security, Usability, Ruby on Rails

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Chapter 1

Introduction

Orbital is the School of Computings self-driven programming summer experience. It is designed to give first-year students the opportunity to self-learn and build something useful. It is designed as a 4 modular credit (MC) module that is taken pass/fail (CS/CU) over the summer. With its focus on hands-on experience, it has been catching more and more attention and an increasing number of year-one students are joining the program to code something useful and interesting. During the academic year of 2015-2016, more than 250 students completed Orbital program.

For the evaluation of Orbital program, students are supposed to submit to Milestones as a team, stating what they have done during that phase. And then assigned peer teams(each team will be assigned for about 3 peer teams) will be giving feedback regarding the submission and the application built by the team of students. At the same time, there will be an adviser who will overlook the whole process and provide evaluation of a team's submission too. After 3 submissions and evaluations are done, a feedback is expected from a team to its peer teams and its adviser regarding the quality of evaluations received.

The nature of Orbital defines the scope of Skylab – A development project built for peer evaluations. It also provides students with a real-life Software Engineering training ground to learn and sharpen programming and system design skills.

1.1 Challenges

1.1.1 System design

Skylab is built on top of Ruby on Rails, a mature convention-over-configuration web framework. So the first challenge for me is to get familiar with the conventions and recommended ways of doing things in Rails community. Then I can design the web application on the top of main-stream philosophy in Rails community. Another issue with the design of Skylab is that this is the first time I have been designing such an application from ground up, without any guidance from any experienced Ruby on Rails developers. Therefore, it is all about try-and-error and explore my own way. Reading books and browsing on-line tutorials helped me a lot and luckily there are plenty of resources about Ruby on Rails development due to its popularity.

1.1.2 Evolving requirements

Although the scope of the project is very clear and well-defined, changes in requirements are expected and did happen a lot due to evolving features of Skylab project and Skylab users' feedback. The challenge is to cope with all changes and sometimes adjustments to the design of system have to be made to accommodate for extensions. Therefore agility in development and adaptability of the system is expected.

1.1.3 Data migration

Sometimes schema migration is required as a result of change in requirements. Therefore, dealing with old data and migration of data without affecting the use of application is another challenge during the development of Skylab. Extreme attention when migrating is required as data may not be clean enough and careless migration may even cause the system to be unusable for some users.

1.1.4 Security

Security is definitely a very important perspective in web development. Although Rails is handling security well by taking measures against SQL injection, XSS attacks and CSRF attacks, there are still quite some vulnerabilities if not handled well. During development of Skylab, various techniques and practices are adopted to make Skylab more secure and trust-able. What is more, with different roles in Skylab, a role based access control system is in place for permitting users to carry out allowed actions only.

1.1.5 Coding quality/maintainability

Although currently there is only me constantly contributing to Skylab repository, a good development cycle which is agile enough is not only important for me to keep track of history and manage different issues but also convenient for developers who will join later to jump in and get started. Testing is also a very important factor when it comes to long-term maintenance. A continuous integration would also help me in catching regression errors in development early and easily. Besides all mentioned above, refactoring is helping in the growth of the project.

1.2 Objectives

In this project, I need to:

- Enable users to login via NUS OpenID if they have NUS Net IDs already.
- Enable users to login via combination of email and password for those who do not have NUS Net IDs and also serve as a backup solution to NUS OpenID login.
- Enable students to edit their own team's details including "Team Name" and "Project Level".
- Enable students to submit for Milestones or edit their previous submissions. Besides, students in the same team should be able to see changes made by teammates.
- Enable students to view submissions from teams that they should evaluate(For example, Team A is supposed to evaluate Team B and Team C; Then students in Team A should be able to view submissions from Team B and Team C).
- Enable students to submit peer evaluations for submissions from teams that they are evaluating.
- Enable students to view peer evaluations from teams that are evaluating their own teams and their adviser(For example, Team B is supposed to be evaluated by Team A and Team C; Then students in Team B should be able to view peer evaluations submitted by Team A and Team C for Team B). For public part of a peer evaluation, students can see response with name of the team that submitted that evaluation; As for private part, students can only see a compilation of all private part responses without team names.

- Enable students to submit feedback to evaluate the evaluations received(For example, Team B is supposed to be evaluated by Team A and Team C; Then students in Team B should be able to submit feedback to Team A and Team C regarding peer evaluations received from each team).
- Enable advisers to view a list of all teams under his/her supervision and edit any of these team's details including "Team name", "Project Level" and "Has Dropped".

1.3 Outline

In this report, I will discuss various accomplishments I have done in the development. Chapter 2 will be an overview of current architecture of Skylab, and methodologies I employed during the development. Chapter 3, 4 and 5 will be talking about problems in the implementation of submissions, peer evaluations and feedback. Then security related issues such as user authentication and access control will be discussed in Chapter 6. Chapter 7 is about adviser focus group meeting and its findings. Last but not least, a summary of work and an overlook of future development will come in Chapter 8.

Chapter 2

Background

Skylab is built on top of Ruby on Rails, a well known web development framework, with a great support of large communities, used widely in the industries by companies like Twitter, Groupon, Bloomberg, Airbnb and many more.

2.1 Literature review

To be continued

2.2 System design

To be continued

2.3 Development process

To be continued

Chapter 3

Submission

3.1 Handling of rich text

3.2 Usability

Chapter 4

Peer Evaluation

4.1 Loading of different evaluation templates

4.2 Storing the response

4.3 Usability

Chapter 5

Feedback

5.1 Survey template system

5.2 Question creation and storing of response

Chapter 6

Security

6.1 Prevention of various attacks

6.2 User authentication

6.3 Access control

Chapter 7

Adviser focus group meeting

7.1 Focus group meeting

7.2 Results and findings

Chapter 8

Conclusion and future work

8.1 Conclusion

8.2 Future work