HUMAN-COMPUTER INTERACTIVE PROJECT ALLOCATION MANAGEMENT SYSTEM

Project Proposal

THE UNIVERSITY OF SYDNEY

Information Technology/Data Science Capstone Project

COMP5703/DATA5703

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ABSTRACT

This article introduces the human-computer interaction project assignment management system we developed based on the capstone allocation of the University of Sydney. The purpose is to make the allocation of projects more convenient, and it is necessary to design the user interface and digitize the result data. When users use this product, they need to log in to the domain name of our website, enter the number of projects, team member information and three preferences in two csv files. We will allocate projects to the groups in the order of first-come, first-serve based on the group number and three preferences. In addition, we will also propose group combinations for two or more groups whose number of groups is less than the number required for the subject. The website will display the distribution results in real time, and the results can be displayed in the form of pictures or tables. It is convenient for users to capture information more intuitively. Moreover, customers can also download the distribution results in the form of csv files for subsequent use.

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1. INTRODUCTION

Due to the rapid development of information technology, many things are slowly becoming intelligent. This is because computers and the Internet have played more and more important roles in recent years. People tend to use computers to reduce the burden of work. This has greatly improved people's work efficiency. Nowadays, human-computer interaction has become a relatively new and hot field. This is the communication and communication that is studied through mutual understanding between humans and computers, making computers truly an assistant for people to work and study. Computers can complete user information management, serve customers and process user requirements (Preece, Jenny et al., 1996).

Figure 1. Retrieved from: http://deesun.cn/3g/display/123026.html

In this day and age, there are still many schools and companies that always rely on human resources to collect and process information when allocating projects. Undoubtedly, it will not only consume a lot of time, but also lead to some mistakes. On the other hand, for many managers, they are not very good at using computers or networks, so some systems with complex operation methods will not be easy to accept for this group of people. In addition, not all managers can accurately and clearly understand every form of data, so for most people, the data displayed by the system is easy to understand and easy to process, which is also necessary for project management.

Our project is to build a human-computer interaction management system to manage and allocate the capstone project of the University of Sydney. This project mainly uses the computer's powerful computing power to process data. And allocate projects according to requirements. Finally, use the relevant functions of data visualization to display the results in the form of pictures. Moreover, the design of the user interface is also the focus of this project. The management system using human-

computer interaction can reduce errors while saving time. Improve people's work efficiency. And visualizing the data can make the results clear to the user. The same good operation interface will also increase the user experience.

2. RELATED LITERATURE

Our project is a human-computer interaction system, which means that we have to understand a lot of computer-related knowledge. First of all, in terms of computer language, we have to master java language and python language to write algorithms and connection parts. In addition, we have to use mapping software to display important information to be conveyed, such as tableau. And in terms of web design, we will use javascript or Django to achieve the final result output. Regarding the output and input files, we will use Excel to make a data set for testing.

2.1 Literature Review

2.1.1 The basic knowledge of human-computer interaction

A science that mainly studies the relationship between users and systems is called human-computer interaction. Among them, this system can be a variety of machines, such as computers, tablets, and mobile phones (Guo, 2014). Various software developed by the computer can also be used as a system. Usually users only interact with the machine or software through the interface of the system.In fact, computer interaction is mainly based on user considerations, not the designer's concept. How to make a better and more convenient control system for users is what needs to be studied in human-computer interaction. The essence of human-computer interaction is to let users understand what the computer can do for them and how the computer handles it. In this way, developers can concentrate on studying the preferences and needs of "people" instead of the technical field (Dix et al., 1998).

2.1.2 The background research of data visualization

Data visualization is to represent data in a graphical way. It usually transmits the data and the relationship between the data to the viewer through images. Visualization can be expressed using statistical graphics, graphs, information graphics and other graphics, and different colors and sizes can also be used to represent data relationships or information. It can also encode data with some dots or lines to ensure that the visual

analysis results and reasoning evidence of the data are effectively provided to the viewer. When data is visualized, complex data becomes easy to access, use as well as understand (Few, 2004). Data analysis is a combination of art and science. It is regarded as a branch of statistics. Due to the increasing amount of data on the Internet and the increasing number of sensors, data processing, analysis, and communication in the "big data" era or the Internet of Things era pose challenges for data visualization. However the scientists in the field of data science meet these challenges (Press, 2013).

2.1.3 The market research of human-computer interaction

In recent years, human-computer interaction systems have been widely used in various fields such as medical care, education, national defense, and transportation. The system mainly has three functions, namely the exchange of information between communicators, the interaction between humans and computers, and the perception of each other(Karpov & Yusupov, 2018). Currently, the demand for the project matching system for students is increasing. The system can match the corresponding student group according to the project requirements and automatically assign it without using traditional manual completion methods(Lightfoot & Pratt-Hartmann, 2016). And our project is to help customers solve the problems assigned to students by the project, and display important information in real time in the form of charts to facilitate customer follow-up.

2.1.4 Relate project research of of human-computer interaction

According to a document on the distribution of human-computer interaction in financial management, we found a similar idea. Automated tools handle regular data and information tasks in financial management. However, when a little judgment is required, then the staff needs to operate this step(Ruissalo, 2018). Compared with our project, the algorithm rules are also written by computer processing. When the group is insufficient, the teacher will be required to operate this step personally, and merge the groups with insufficient numbers and interested in the same project. According to Chiarandini, Fagerberg, and Gualandi (2019), the condition is that students sort the items of interest after forming groups according to their preferences, and each item will have incidental requirements, such as having to complete a certain course. In the subsequent processing, we follow the first in first out principle to allocate, instead of considering the overall final allocation to a result that everyone is satisfied with.

In terms of visual expression, we can use the color difference to reflect whether the project is full or vacant. Refer to the example in the applet program. Yellow means student freedom, green means the main task between the student and the project, and orange means the project is full (Moussa & El-Atta, 2011). For example, in this project, we can use blue color to represent how many groups are remaining in the project, and red color to indicate that the project team is full. In addition, graphics distribution, parallel coordinates, and various charts are used for customer preview and query (Wortman & Rheingans, 2007).

2.1.5 User interface research

Finally, in terms of interface design, the interface can add several windows, with student preferences and function buttons (Moussa & El-Atta, 2011). For example, we display important chart information and add a brief description, and then set a few buttons, the client can click to enter a new page to view other information. Other information can also be conveyed in the form of charts.

3. RESEARCH/PROJECT PROBLEMS

3.1 Research/Project Aims & Objectives

The purpose of this project is to create a portal website, which can help managers to manage and allocate all projects better through information input and feedback. In this project, we want to put all of these functions which include data input, data analysis, data visualization into one human-computer interactive portal system. Its specific function is to input the information of all projects, all groups and the first, second and third preference of each group for the project in the format of CSV. After that, the website will allocate all projects according to the pre-set algorithm, and feedback the results to the project manager in a clear form.

3.2 Research/Project Questions

At the beginning of the project, the four challenges proposed by the client for this portal site are very important standards and also the goals we need to achieve. The first challenge we need to complete is to show the information of all groups, including not only the information about the members of each group and the three projects selected by each group, but also the accurate display of the projects assigned to each group.

The second challenge is that our website should ensure real-time information update and display, when the system allocates items to each group, it is necessary to ensure that the group with the first number has more priority, so we also need to realize that the information of the next group should be read after reading all the application selections of the previous group through website-algorithm.

The third challenge is the data visualization. For designing the final website interface, we should ensure that all information is shown completely, and at the same time, managers can get the information they need more quickly and simply from the web page, even if the managers are not proficient in using computers and the Internet.

The fourth challenge is to check the number of members in each group, and then sort out those groups without enough members, and then give suggestions for group merging according to each groups' respective projects. This challenge is more difficult because in order to realize this function, we must consider the sorting problem between the original group and the new group if the group reorganization is successful.

In addition to the related technical problems, we also encountered some other environmental problems. First of all, due to the lack of experience in website development, we are not proficient in the use of corresponding software and programming language. Secondly, because of the epidemic, it is not convenient for us to have face-to-face communication in schools as before, sometimes online meetings will be affected by network fluctuations.

3.3 Research/Project Scope

Project Justification / Need:

This project is aimed at the capstone projects allocation system of the University of Sydney to develop a human-computer interaction management system. This project not only needs to match the capstone project with the students, but also display the results and graphs on the user interface. This requires us to do data visualization and a popular UI.

Product Characteristics and Requirements:

This product can help Client to allocate the capstone projects of the University of Sydney. The user needs to enter the project and group information in the format of

csv.file. The results are output to the Database through the calculation of the product in the back-end of the algorithm. Then the server transmits to the web. Finally, the data is visualized on the user interface of the website.

In scope:

- Data processing
- Algorithm of project allocation
- Server construction and website development
- User interface development
- Visualize the distribution result data
- Group query unit
- Team recommends merge unit

Out of scope

- Recommendation unit

4. METHODOLOGIES

4.1 Methods

For software development, we use agile development, because our project is not a big project, and the goals of each part can be achieved step by step. We can first achieve the initial goals and then slowly change them to better meet the needs of our customers. Using agile development means that we can complete our responsible part in a shorter time, and then integrate them into the final Web app. We are divided into three parts. The first part is the back-end algorithm development. This part is mainly to analyze the data provided by the user and output the result data we want to deliver to the user. The second part is the design of the back-end Web app framework. This part is mainly about the deployment of some environments. So that data can be effectively, efficiently, and safely delivered to the client. The third part is the front-end UI design and data visualization. This part is mainly to visualize the data transmitted from the server to the client. Then some customer interactions on the client side will be written here.

4.2 Data Collection

For data collection, our client will provide us 3 csv files as input. The first input group_preference.csv contains each group's id and their first, second and third preferred project. The second input project_infos.csv which contains each project's id, title, and number of groups allowed. The third input student_groups.csv contains each student's id, the id of their group and their unikeys.

Our web application will read the input from group_preference.csv, project_infos.csv and student_groups.csv, which is provided by our client. It will generate the output as allocation_list.csv and vacancy_list.csv and store it in MongoDB. The first output file allocation_list.csv contains each group's id and the allocated project id. The second output file vacancy_list.csv contains each project's id and the number of groups allocated to each project.

4.3 Data Analysis

For data analysis, we have implemented a python algorithm to allocate each group dynamically based on the given input data. The algorithm follows the "First In First Out" principle required by our client, which prioritizes the student groups by the order that they register on the website. Besides the allocation list, we also kept a vacancy list which indicates the number of groups still allowed to choose each project. If the first preference is already chosen by another group and the project reaches the maximum number of groups allowed, then consider the second preference and so does the third preference. The allocation list will be printed on our web application, showing a list of group id and its allocated project. The vacancy list is also displayed in a way that for each preference of each group, there will be a number in the bracket that indicates how many groups are still allowed to choose that project. This number is also retrieved from the database dynamically.

4.4 Deployment

As a web app development, we will first deploy this web app to a local server to run. We use the local as a server to call our mongoDB through the address and port. The overall back-end of our web app development uses a Django framework.

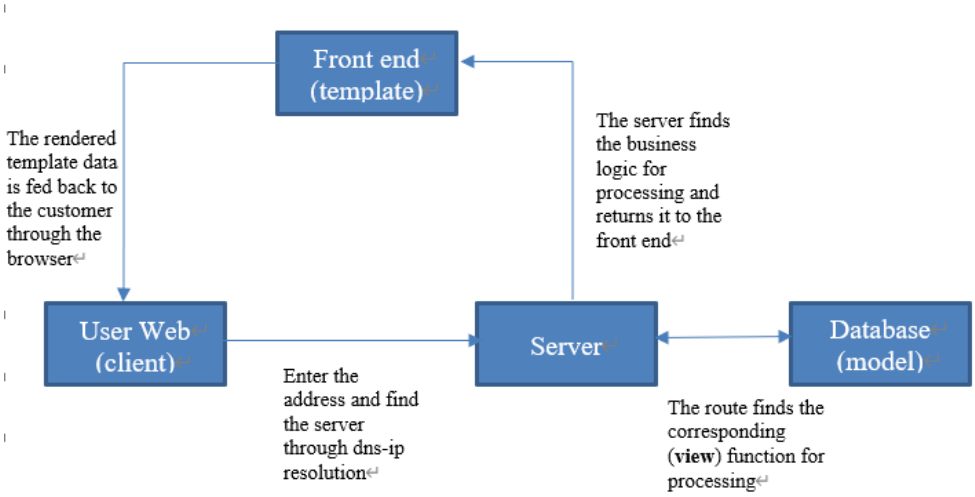


Figure 2

Server deployment: Use **GUnicorn** to deploy, Gunicorn is a high-performance Python WSGI UNIX HTTP Server widely used on unix. It is compatible with most web frameworks, and has the characteristics of simple implementation, light weight, and high performance. It can monitor the address and port, and provide transmission data. And write down our visit and other logs. One thing to note is that deploying our GUnicorn requires changing the addresses of some static files.

In order to enable our data to be fed back to the client in real time, we will choose to write the websocket protocol in the server, so that we can maintain feedback, and feedback to our client in real time when there is a new update in the database.

Service process management deployment: use **supervisor** deployment. Monitor the process status, and automatically restart when exiting abnormally.

Nginx reverse proxy GUnicorn service: **Nginx** is a high-performance proxy server. Support load balancing, multi-process, multi-thread, data compression, log monitoring, current limiting and other functions.

Cloud server deployment: After the local server is running well, we may deploy our server to a cloud server similar to A-li Cloud, so that our Web app can go online and our Web app client can be accessed directly through the domain name.

4.5 Testing

Test Business Logic:

It is a functional test that compares the output of different types of fake data with the output that should be obtained through the back-end business logic to ensure that the realization of our function is complete. Ensure we do not have any problems with data processing.

Test Web Afford Pressure:

Adjust the parameters of the test environment to suit the production environment, run the stress test program on the server, avoid the network layer to see the performance of the server application. Our Web app must satisfy at least 1000 concurrent connections to occur simultaneously. This ensures that the server will not crash under high load.

Test the permissions of various roles:

The test content is that after logging in as an administrator, the group can be changed artificially, and after logging in as a student, only the final result of the group assignment can be seen. The grouping cannot be changed.

Test web app compatibility:

The first test is to test whether the website can be used normally under different browsers, and whether the layer representation has different displays. Is the expression of the data within expectations? The second step is to test whether the mobile phone can open the Web app normally. We use **Weinre** to test whether the browsers of our different mobile phones can access and operate our Web app normally.

Integration Test:

After deploying Nginx, configure request forwarding rules. Then we use the continuous integration tool **Jenkins** to create multiple Web services. To test whether our Web app integrates all functional parts effectively.

5. RESOURCES

5.1 Hardware & Software

Since we are developing a web application, there is no specific hardware requirement, all major operating systems (Windows, Mac and Linux) should be able to run it in mainstream browsers such as Google Chrome and FireFox. We also support mobile devices such that our web application can be run in modern hardware architectures such as iPhones and Android smartphones. In the development of our web application, we decided to use Django, a python framework as it saves a lot of time to make it possible to create a web application within 2 months. MongoDB will be used to store the group and project information as well as the allocation list. As a NoSQL database design, MongoDB is chosen because it has many benefits such as high elastic scalability and reliability for big data.

5.2 Materials

As additional materials, we need data inputs from our clients that contain related information of each student, group and project. As mentioned in the data collection section, our client will provide us 3 csv files as input. The first input group_preference.csv contains each group's id and their first, second and third preferred project. The second input project_infos.csv which contains each project's id, title, and number of groups allowed. The third input student_groups.csv contains each student's id, the id of their group and their unikeys.

5.3 Roles & Responsibilities

ENHAO LIU: Project manager. Coordinating the development process. Contact with the client to report the progress of the project.

CHEN GUO: Data visualisation and UI design. Working on making the prototype of the UI design.

JIANAN LUO: Data analysis and visualisation and web application development.

DONGCHEN SUI: Algorithm developer. Developing and improving the algorithm to generate the best allocation based on the given input file of the group preferences. Generate CSV output as client required.

JIEQI HUANG: Web application developer. Helps to merge the algorithm with the web application. Using the Django python framework to develop.

6. EXPECTED OUTCOMES

6.1 Project Deliverables

There are six major deliverables included in this project.

First delivery: Project research and project definition

1. Project evaluation

2. Human-computer interaction research

3. Demands research

4. Define functions

Second delivery: Project planning

1. Define requirement

2. Define project scope

3. Estimate project time

4. Estimate project source (software)

Third delivery: Project back-end design

1. Algorithm development

   1.1 Analysis the input and output

   1.2 Algorithm write by python

1.3 Debug

2. Web app framework development

2.1 framework design

2.2 Server deploy

2.3 Integrated algorithm

2.4 Debug

Fourth delivery: Project front-end development

1. Data visualization

2. UI design

Fifth delivery: Project test

1. Unit testing

2. Assembly testing

3. System testing

4. Integration testing

5. User testing and feedback

Sixth delivery: Project release

1. Final product and services

2. Project document

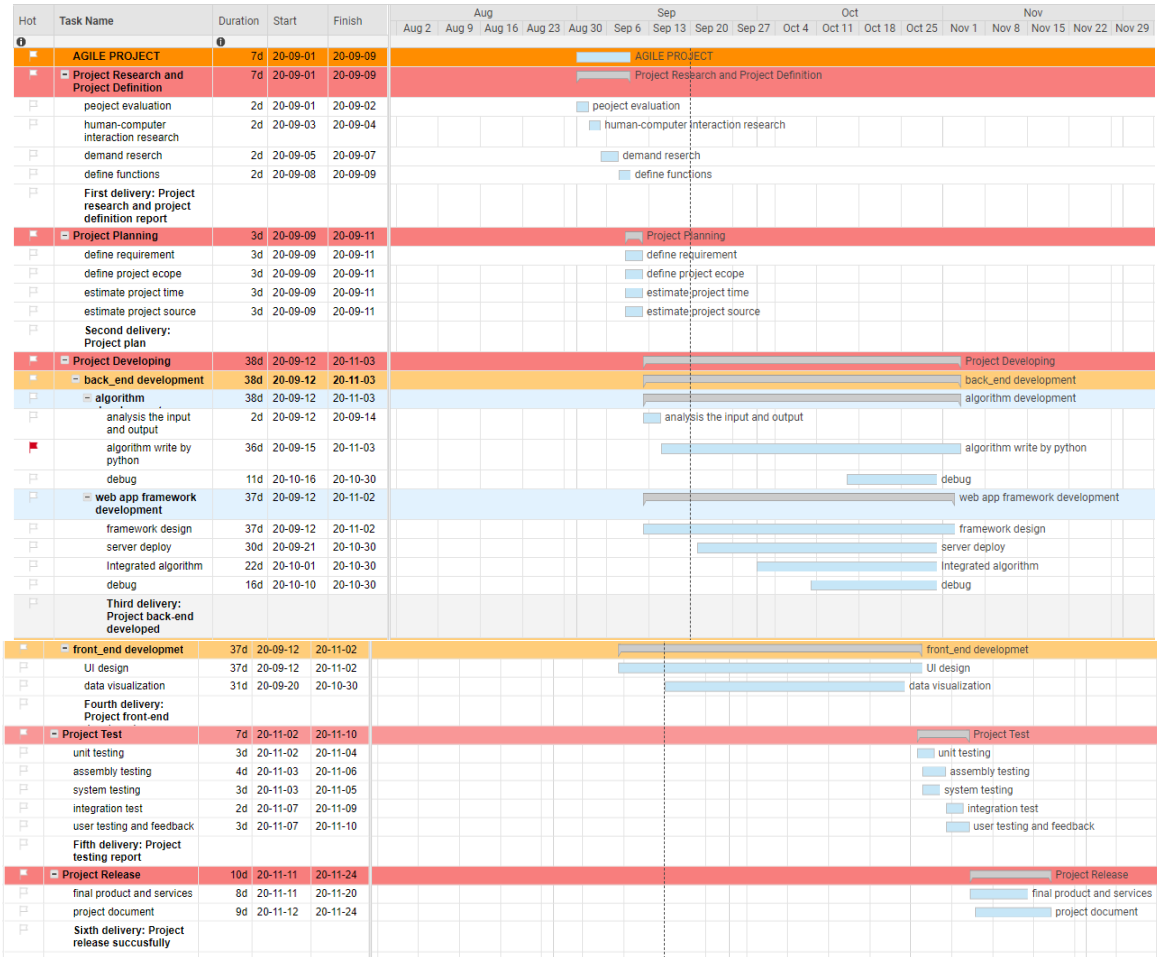
6.2 Implications

The significance of the project is to provide a more convenient and intelligent website for the imperfect academic project allocation system of some schools, including the University of Sydney. In addition, the project aims to simplify the management system and present the data to managers in a more explicit way. One of the reasons we designed this website is that anyone can use the platform quickly without a lot of knowledge about the Internet. If the website in this project can be designed successfully, it can greatly reduce the manager's time for project allocation and the probability of error, which can not only ensure that the project can be more equitable allocation, but also save a lot of time required for manual allocation, so as to make more adequate preparation for each group.

But on the other hand, when the website redistributes projects, the highest priority factor is the group number of each group, which is the time sequence of the group submitting applications. There is no doubt that if the ability and achievements of small internal staff can be more integrated in project allocation, the distribution results of this system will become more reasonable.

7. MILESTONES / SCHEDULE

7.1 Gatt chart



7.2 Milestone and dependencies

Finish market research: The team should complete the background research and project preparation, and determine the feasibility of the project. At this time the team should have a complete understanding of the project.

Finish project management: When we end this milestone, we should complete the related work of project management. Deeply understand the scope and requirements of the project, clarify the software to be used, and proceed with the project according to the schedule.

Finish design: When we reach this milestone, we should complete the design of each unit and the interface of the two units that need to be docked, and design the following connections in detail.

Finish connection: At this stage, the design of all units should complete the required functions, and the units have been connected. The project is ready for testing.

Finish text: When this milestone is reached, all functions have been tested and debugged. And also tested by the client, get feedback, modify and improve. At this point, all development and debugging work has ended. And ready to release.

Finish release: Release the product, indicating that all tasks are completed and the project is over.

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