Lab Experiment Subject Management Hybrid Application

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***Abstract*— Lab Experiment Subject Management Hybrid Applicaion (LESM) provides online community where laboratories can post their experiment subject recruitment notices. For the people who are hoping to participate as a subject in a experiment, they can simply find and search for experiments that are suitable and apply for them. Using Clinical Subject Management(LESM), laboratories can easily find people they need for experiment and collect sufficient data from experiments. For applicants, they can earn a substantial amount of allowance that laboratories pay for them. Additionally, LESM offers data management service for laboratories. They can figure out their experiment schedule at a glance. Subjects' information will be saved at database server so that laboratories can find a specific data with key information of subjects. By using LESM, laboratories will be able to handle bunch of experiment schedule and result data in a well organized form.**

Role Assignment

Kim Bosung

1) Role: Software Developer

2) Task description and etc.: His main job is to create layout of the whole process of development and setting the database.

Nam Yunwoo

3) Role: Software Developer

4) Task description and etc.: He handles server setting.

Jeon Sujin

5) Role: Development Manager

6) Task description and etc.: He checks the flow of development process.

Ha Dongsu

7) Role: Software Developer

8) Task description and etc.: He designs the front end.

Kim Eunhye

9) Role: User/Customer

10) Task description and etc.: Contact with potential users and get feedback from them.

I. INTRODUCTION

Motivation

Because there was no platform that allows communication between laboratories and people, it is hard for laboratories researcher to find clinical subjects. Previously, they had to find subjects through personal ways. For example, they had to make a recruitment notice to print out and post or to upload at small websites. They also had to receive text and reply one by one with their own phone. And researchers had to put all the information about each applicants and schedules from text messages to excel file. So we decided to create a platform that allows the lab to post recruitment notice and students to look at it and apply for what they want. And Because there were no such things that manage their experimental data, we add one more thing in our app. A simple database system. Researchers can keep their test result or subjects' personal data efficiently. There are a lot of data that researchers want to review afterwards. Since bunch of data are accumulated steadily, they frequently have difficulty finding out the specific information they need without systematic database. By saving all the data related to experiments, it will be a lot easier to handle and search for it.

A. Data Transaction

1) Previous Way Of Data Transaction: Applicants provide their personal information via **text message or e-mail.** Researchers save the information in the format of **excel**. In worse cases,it is saved at their **phone contact list or .txt file**.

Researchers provide information about experiments via recruitment notice posted at **school online community** or at **bulletin board in school buildings**. Applicants have very limited way of obtaining this information

because the preferred posting location is different among diverse laboratories. This means that recruitment notices are dispersed. Also, they usually save the experiment information **by taking a picture or screen shot of the notices.** Experiment result data is saved at **researchers personal PC** in the format of excel, .bdf, .mat or word.

*2) **Data That Applicants Need From Researcher** :*

- Name Of Experiment
- Main Purpose Of Experiment
- Location
- Date and Time
- Expected Duration Time
- Specific Process Of Experiment
- Payment
- Condition For The Adequate Subjects

*3) **Data That Researchers Need From Applicants** :*

- Name
- Age
- Sex
- E-mail Address
- Contact Number
- Possible Date and Time

*4) **Result Data That Researchers Get After Experiment** :*

- Raw data such as .bdf and .mat
- Result data of raw data analysis. Such as excel and doc.
- Special features for each of subjects.

*5) **Data That Researchers Upload To DB** :*

- Result data of experiment
- Name of Lab
- Experiment types that are held in the lab
- Name of University(Location)
- Contact number
- Email address
- Special features for each of subjects
- Schedule of experiments.
- Detailed information of experiments for applicants.

*6) **Data That Database Return To Researchers** :*

- Subjects personal information who have previously participated
- Scheduled experiment date
- Experiment date records
- Result data of experiment

B. Data Transaction Efficiency

Inefficiency of Data Transaction

Fundamentally, the inefficiency is caused by lack of database system between applicants and researchers.

- The recruitment notices are dispersed. Some are posted online and others are printed out to be posted in bulletin board. Like this, there are a number of recruitment notices which are huge volume of data required by people who hope to apply as subject. This inefficiency problem arises since there is no platform that contains these data at a systemized database. Researchers cannot deliver the notice to potential applicants and applicants have no other way but to wander around online community and bulletin board to get the notice information.
- When applicants send their personal information via text message or e-mail, researchers have to copy all the information to excel or .txt file by himself. They also have to save the contact number of applicants in their phone since they need to keep in contact for organizing experiment date and time or to discuss about payment.
- Researchers have to handle bunch of data related to experiments. It includes information of applicants and experiment result or date. Researchers do have their on way of organizing and saving these data but it is inefficient without database server. They usually save the data at local drive with custom folder. Then they inevitably have to memorize the folder location, name and the type of data saved in it.

C. Research on any related application and website

1) Olive C: This application makes it easy to provide recent clinical information. People can participate in that clinical test if it's good for themselves. There are Different things between Olive C and our application. CSM is only used in Hanyang Lab, and it can database the result of the clinic

2) patient cloud: Clinical trial participating applications. You can participate in trials by completing questionnaires. Doctors can manage their patients' health status data on mobile. The researchers can review the saved data immediately.

3) alba.co.kr: It is the biggest online job site in Korea(A.K.A alba heaven). It provides solutions such as electronic contract, free labor counseling, compensation for interview, and 24-hour public inspection system. To increase convenience, it is operating both a web and an app.

4) albamon.com: It is one of the most famous website for students to search part-time job. It provides information of various jobs. Job seekers can set up your own interests and receive push notifications for that. And they can fill out their resumes to keep it in the website.

5) Incruit.com: Incruit is short term of the Internet Recruitment System. it is Internet employment and recruitment brands. It provides internet resume, employment information, part-time information, education information, employment related news and data room, study abroad information and Internet recruitment system for businesses and organizations.

6) worknet.go.kr: It is a national job information web operated by the Ministry of Employment and Labor and the Korea Employment Information Service. It provides employment information, integrated search functions, occupational psychology tests, job support programs, personalized information, and resume management.

7) job.findall.co.kr: You can look for a job in your neighborhood. If you choose an area of interest or category, it can recommend a job. It provides free public notice registration for one case, 10 days.

II. REQUIREMENT ANALYSIS

A. Account Management

1) Separate Account Data: There are two types of users. The lab researchers and applicants for experiments. For each of the user type, different main page will be shown that contains different functions. At the very first page, users have to choose whether they are lab researchers or applicants.

2) Sign Up: For the lab researcher member, it is required to register the lab and his or her e-mail address. Only one account will be assigned to a lab. For the applicants, they have to enter their e-mail address, name and phone number. This information will be delivered to researchers who manage the experiment that the applicant applies.

3) Log In: After clicking the check box whether they are lab researchers or applicants at the very first page, log in page will be shown. Users can sign in with their e-mail address and password.

B. Functions For Lab

1) Main Page: The experiment schedule of the lab will be shown in the form of calender. Also, the list of experiment instances will be shown with drop down. There is another list that shows all the researcher registered in that lab. The general manger has authority with this list. There is a button for adding new experiment instance to the drop down list. When one of the experiment instances is clicked, sub main page for each experiment will be shown.

2) Sub Main Page For Each Type Of Experiment: There are three main functions in this page. One for managing the previous data of specific experiment, another for posting recruitment notice and the other for uploading experiment result data.

3) Reviewing Previous Experiment Reault : The user can easily search for specific experiment data with subject information like name, age or date of experiment.

4) Uploading/Revising Experiment Result Data: If a researcher selects one of the experiments in the list and click this button at the main page, the page of uploading and revising for the experiment result data will be shown. The researcher in charge can enter the date,time, explanatory comment, name and other special features of the subject. It is also possible to request for personal information like age and gender.

5) Create Experiment Instance: After clicking the button for creation of new experiment instance at the main page, pop-up for entering specific information of the new experiment will be shown. Only the general manager can use this function. The name of the researcher in charge, experiment objective and the name and type of the experiment should be entered.

6) Posting the Recruitment Notice: After clicking the button for posting recruitment notice at the main page, the researcher in charge moves to the next page. In this page, the researcher should make the schedule of the experiment date and time via calender UI. Then the researcher should enter the specific information like the payment, condition, the method of experiment, place of the laboratory, expected duration time. The notice form delivered to the applicants page will automatically include these details in addition to name of the experiment, name of the researcher in charge, date and time. This notice form will be loaded to the applicants' main page.

C. Functions For Applicants

1) Main Page: In this page, users can see the list of recruitment notices in a similar form like Albamon bulletin board. They can search specific experiment by setting conditions like the type,payment and date. Then the list will be organized in order of payment and deadline.

2) Detail Information Page: If users click one of the recruitment notices, they move to the next page which contains details of the experiment. It shows the information that are entered by the researcher in charge. Additionally, there is a calender. Each date box in the calendar might contain the time of experiment that researcher has scheduled and posted at previous stage. Small message boxes are attached to each of the scheduled date which indicate whether it is fully booked or not. The applicants can only choose the date that is not full. The applicant should first check one of date boxes and click apply button. This apply button will show pop-up with the message of "successfully applied". Also, as soon as the button is clicked, the message box of that date should be changed to indicate that there is no opening.

3) My Page: In the main page, users can move to MyPage by clicking the button of 'MyPage'. In this page, they can see a list which contains all the experiments that they have applied for. They can see the brief information such as the name of experiment, location, contact number of researcher and the date they have participated or scheduled to participate. On the left side of each element, there are check boxes. If users want to cancel some of the experiments,they should click the check boxes and then click the 'cancel' button. If they want to see the whole detailed information about a experiment, they should click a element in the list. Then they can move on to the information page.

4) Information Page For Experiments In MyPage: This page will contain all the information of the experiment that applicants have applied for. This will fulfill the need that applicants want to review the specific detail of the experiments they are going to participate afterward.

D. Communication Between Applicants and Lab

1) Message Drop Box: If applicant wants to reschedule or make inquiries, sending direct message will be useful. With this service, the researchers do not need to reply with their own phone or e-mail.

2) Communication page for Lab: This page shows the list of scheduled experiments. The elements can be divided according to whether there are applicants or not. There is pop-up notice that tell them every time someone apply for the experiment. Also, there is drop box which contain all the inquiry messages from applicant and reply to them.

3) Communication page for Applicants: After clicking the inquiry message button at the page of detailed information, pop-up will be shown to enter inquiry message. This message will be saved in the account's drop box.

III. DEVELOPMENT ENVIRONMENT

A. Choice of software development platform

Form of application: Hybrid Application

We were trying to create an application only. However, we figured out that the application alone is not sufficient for users and the laboratory to write and post a notice. To be specific, the main problem is that the data file which the lab researchers handle is not a simple task. In most cases, the file format is .bdf and .mat. These data files are usually stored at the desktop computer in the lab. If we create mobile application, it will be difficult to deliver the file from local desktop to the server. Additionally, there are a lot of things to type in when posting a notice, entering personal information and so on. Therefore, we decided to make a hybrid application. We will make a web for the laboratory and use reaction type web for the mobile application.

Programming Language Additionally, we will use html and css to make web page's basic and style, and decorate the web page using javascript (javascript 1.8.5), bootstrap and jQuery (jQuery 3.3.1). In the back-end, we will use the PHP with Laravel framework and MySQL to implement the database.

Tools		
Cordova Adobe Phone-gap	In order to develop the hybrid application, we decided to use Cordova Adobe Phonegap. PhoneGap is the original and most popular distribution of Apache Cordova. It will allow us to turn HTML, CSS and JavaScript into an app on our own device in minutes using the simple desktop and developer apps.With this tool, there is no need to handle android.	Adove Phone-Gap Home-page
Kakao Oven	In addition, we decided to use Kakao oven. This is used as a prototyping tool in the phase of making layout and designing UI in the front page. Each team member is going to communicate through this tool. The team member who took the responsibility of designer will mainly use this tool. Designer makes prototype which designates the overall structure, location and function of buttons, relationship between pages. Kakao oven provides the function of real web testing so that team members can simulate using the pages. The team members who are responsible for developing construct the front and back end based on the Kakao oven prototype.	
Github	For version control system, we are going to use gitgub. Github is a web-based hosting service forversion control using Git. It is used for computer code.It offers all of the distributed version control and sourcecode management functionality of Git as well as addingits own features. It provides access control and severalcollaboration features such as bug tracking, feature requests,task management, and wikis for every project.	
Overleaf	For writing the latex IEEE report, our team decided to use Overleaf. Overleaf (previously WriteLaTeX) is an online LaTeX and Rich Text collaborative writing and publishing tool that makes the whole process of writing, editing and publishing scientific documents much quicker and easier. Created with the goal of making science and research faster, more open and more accessible, Overleaf brings the whole scientific documentation process into one place, from idea to writing to review to publication. Overleaf community offers diverse templates which are very fundamental and powerful. Not only IEEE templates are included, but also other area like book publishing, assignment report, regime are included.	Overleaf Home-page

Sublimtext 3	This editor offers minimap. It's useful to get an impression of how large your file is and also shows you current position while moving the scroll bar. You can even click right into the map to navigate to a certain place. It's a little detail that really comes in handy especially for larger files. And A Multiple Pane feature which I most commonly used when developing in project. I was able to work with many files at the same time, so the work efficiency was very good. Multiple Pane layouts are not fixed, allowing multiple layouts to be used without problems even when multiple windows are floated.	
Chrome Dev-Tools	Google Developers provides features optimized for front-end work. You can see the modified codes on the screen immediately applied. There are many cases where the margin or position does not match due to the nature of the front end. Also, if there is an error or unapplied css or javascript file I can easily find out which class and which file does not apply. Debugging is really simple. So I wrote the code in developer mode and proceed to copy in sublime text 3.	
Phpstorm	PhpStorm is an innovative, Java-based integrated development environment (IDE) engineered by JetBrains for PHP and web developers. The software leverages IntelliJ IDEA to enable developers to write code in multiple languages including CSS, HTML5, JavaScript, and Emmet. It is a sized down version of IntelliJ that comes with the added advantage of fully-fledged PHP support. PhpStorm optimizes topnotch coding assistance, in-depth code understanding, and support for major IDE frameworks and PHP tools.	
Laravel	Laravel is a prominent member of a new generation of web frameworks. It is a free, open-source PHP web framework and intended for the development of web applications following the MVC model.It features modular packaging system with a dedicated dependency manager. It provides different ways for accessing relational databases though Routing. There are utilities that aid in application deployment and maintenance.It aims at easy authentication by providing a simple and easy to use interface and many more.	Laravel Homepage
References : https://phonegap.com, https://www.overleaf.com/about,http		

TABLE I
COST ESTIMATION

Device	Price(per month)
Amazon EC2	22

Platform

Each team member will use their own laptop with windows 10 home.

B. Software in use

1) olive c: This is a smart clinical trial support service to help volunteers who want to participate in a clinical trial. Using this application, you can easily find clinical trials and check if you are adequate for the recent clinical trial. we referenced this application in planning step.

2) database system: A database management system is a set of software tools that allow a large number of users to access data within the database. DBMS can handle the needs of users or other programs and respond appropriately to make data available. There are many functions such as storage operation, sharing, protection, and maintenance.It improves data integrity and accessibility to data, enhances data control and enables easy development and management of application programs.

3) Github: Github is a web-based hosting service for version control using Git. It is used for computer code. It offers all of the distributed version control and source code management functionality of Git as well as adding its own features. It provides access control and several collaboration features such as bug tracking, feature requests, task management, and wikis for every project.

C. Task Distribution

1) Nam Yunwoo: I discussed the function of LAB manager with my team members. We have divided the necessary and unnecessary functions in detail and provided feedback on the functions that should be included on a

page-by-page basis. I also purchased EC2 Ubuntu Server 18.04 LTS 1 year free version from AWS. I installed various development environments such as php7.2, Nginx, Laravel, Composer, and MySql in the root account of the server according to this preference. Then I got the source code of LAB manager from git and finally opened the web page. Finally, I made the final ppt and announcement. I had a chance to look back overall planning and development of this project and was able to promote the lab manager in front of classmates.

2) Ha Dongsu: I was the team leader of the project team. I decided to set the date, time and place of the meeting with my teammates and use slack, not kakaotalk, to work on an efficient project. Clinic subject management in the hybrid app development project, I was in charge of the front-end and I was responsible for implementing the application using PhoneGap Cordova. Especially, I used a lot of bootstrap for responsive webpage, and the simple function implementation was made by referring to the class of css using jquery. Our team member divided the page into researcher pages and user(experiment participants)pages through project planning, and created ten web pages for researchers and four pages for users. After finishing web development and hosting on the server, I implemented the application using PhoneGap Cordova. I installed the cordova inappbrowser plugin and processed the hosted URL as window.open () and displayed it on the smartphone.

3) Kim Eunhye: At first stage of our team project, I proposed the idea of clinic subject management application based on my experience. Since I have been working in a lab for 6 months, I was able to figure out what specific functions the lab researchers need. I organized and visualized my idea in paper so that other team members could understand my idea. Then, the next phase of our team project was making prototype. Since I am the one who came up with the initial idea, I took the role of designer. I made prototype using Kakao oven. I also wrote latex report. Throughout the development phase I occasionally contacted the potential actual users, the lab researchers. I showed them the prototype and checked whether the application our team is developing serves satisfactory function to them.

4) Kim Bosung: Back-end(Designing database tables, defining their usages and their relationships. Defining every function in each controller. Differentiating of User Authentication and Admin Authentication. Defining route of every Http request. Adjusting front-end templates in accordance with grammar and structure of Laravel framework. Correcting errors occurred when uploading the project onto the server. Testing the demo after the project was uploaded to the server.)

5) Jeong Sujin: Design help, mainly wrote document. (Explain php files and functions. Show directories and modules in table or diagram using Visual Paradigm.)

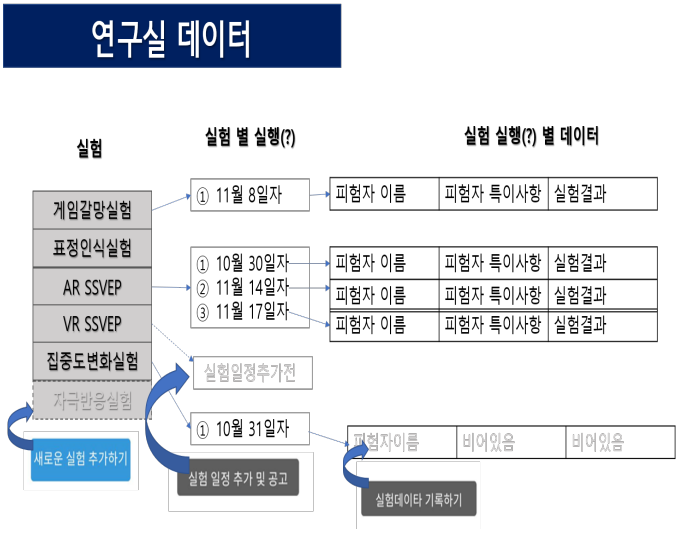
IV. SPECIFICATIONS

A. Database

One of the most fundamental functions of LESM is to ease the managing of experiment data. The information of applicants, schedule, result data forms complicated relationship. In the below section, the structure of database and key code functions will be described.

1) Factories

: Each Model Factory provides a convenient way to generate some model instances to test the functions / to seed the applications database



The above image shows the structure of database. For each experiment instance (Experiment Model), several conducting schedules (Experiment_Details Model) is connected. Then for each of the conducting schedule, experiment result data(Experiment_Result Model) are connected.

2) CreateExperimentTable.php: The leftmost button in the image indicates registering an experiment project. Researchers input information according to table. The notice goes up according to the form. It contains id, name, poa, background, tester-name and time stamps.

3) CreateExperimentDetailsTable.php: The button in the middle indicates registering new schedule for the experiment to be conducted. The notice goes up according to the form. It contains id, experiment-id, name, poa, background, tester-name, objective, location, time-taken, payment, method-desc, end-recruit-date, required-applicant, applicant, date- time and time stamps. In this, 'experiment-id' column refer to id of Experiment Table. This allows it to know what kind of project this small experiment is about. Researchers input information according to table.

4) CreateExperimentResultTable.php: The rightmost button indicates registering results of the experiment that has finished conducting. Researchers input information according to table. Researcher's experiment results are saved in table. It contains ID, experiment-id, participant-id, file,

remark, time stamps and date-time. In this, 'experiment-id' column refer to id of Experiment-Details Table.

5) CreateParticipantsTable.php: Register information of participants . Participants input information according to table. It contains id, experiment-id, exp-name, user-id, name, status, date-time and time stamps. In this, 'experiment-id' column refer to id of Experiment-Details Table.

6) UserMyPageController.php: Check the currently logged in user with auth:user() to import Participants instance that has 'user-id' of that user. comparing experiment-id of participants instance with id, import and list the experimental-Details of user. User can cancel their applying. In cancelling, it send the id of the Experimental-Details instance in the list to parameter. If this parameter value is the same as the 'experimental-id' and id 0f currently logged in user is same as 'user-id, delete it. Then, the applicant column value of the Experimental-Details instance that has same id with 'experiment-id' is reduced by 1

7) ResultRequest.php: It contains rules, message and attributes function that need to be applied when the admin sends a request to store the experiment result data into the table. Rules contains file, remark, experiment-id, participant-id, date time and status. 'file' contains information about the physical path where the uploaded file is located and it requires the size of file being uploaded to be under 20MB. 'remark' means comment which the special attention is need for the subject and it is required, 'experiment-id', 'participant-id' and 'date-time' are also required.

8) UserHomeController.php: Participants fill out the form. It contains id, experiment-id, experiment-name, participant-name, status, date-time. Participants information will be saved according to the form. Obtain the candidate object from the user table and the experiment table of the DB. The number of applicants for the notice increased by 1. It is not implemented if it has already been applied or if it has been recruited.

9) ExperimentResultController.php: Save the experiment-result file. Check if a folder with that name exists, and if it does not exist, create the folder with make directory method of 'file'.

10) RedirectIfAuthenticated.php: Decide where to redirect when you are Authenticated.

construct()
The functions in the Controller are available only when current user is admin.
create()
Bring up a page to save the experiment results. Using id value get by Request, hand over the subject's data corresponding to the experiment results. It passes on information on which of the Experimental-Detail Models you have experimented. And when the Create Results page is returned, the data is handed over together.
show()
Upload the page where the subject's experiment results are stored. Check the subject model with the parameter id value. Hand over the User information corresponding to the Participant. The results of the same kind of experiment that the subjects participated are inquired with the parameter id.
store()
Store the Experiment data of the subject. Store the information received in the Post method per column in the new Experimental Result Object. The status of the subject changes from To be Determined (TBD) to Completed Work (CW) when the experiment results for that subject are saved. Save the test result file if it exists. Check if a folder with that name exists within the Public folder, and if not, create the folder with Make Directory method of File. It save public file route in column and configure the file name as subject name, experiment name, experiment number to save with the file type. Store the address of the actual path in the file column, Used to refer to a file in the physical path.
delete()
Delete the experiment results whose status column is CW from the subject's table. Store and inquire the subject id of the experiment result to be deleted. It only deletes the contents of the table. So, after receiving the address of the"file" column of the table, use the delete method of the file to go to the actual address of the file and delete the file.Among the experimental-result data, the subject id column finds a model that is equal to the value of i and erases the data from the table. When all deletion is complete, return response.
delete-user()
Used to delete a candidate from the list of candidates to be tested. Check the applicant who applied for the test notice with the parameter id. Delete the candidate corresponding to the id value from the Participant table. The number of applying persons in the application column in the test announcement table is reduced by 1 because the applicants for the experiment were deleted. When all deletion is complete, return response.
download()
Download the experiment result file. Grant permission to access to account'admin'. Check the experimental-result data corresponding to the id. The actual file path value saved in the file column of the retrieved data is given. Return response by putting a file path value in the Download() method.

B. Display Design

1) style.css: It is a self-produced css file. I configured the style by adding a class that does not exist in the bootstrap or template oneui.css. We have also added a number of classes for responsive webs using media query.

2) fullcalendar.css: A calendar design file that is essential for experiment scheduling. And this file is used with fullcalendar.js file.

3) fullcalendar.js: A js file that contains basic information about calendar behavior. Refer to the classes in fullcalendar.css here to record the behavior for the button.

4) bootstrap.min.css: A bootstrap design that consists of a class of optimized styles for reactive types.

5) oneui.css: It is a bootstrap based template and has many classes. I can import and use classes that are essential for project front-end configuration.

6) lang-all.js: Basically, it provides a function to modify the English language set in the fullcalendar.js file to suit the language of each country. I created a Korean calendar by referring to lang-all.js and specifying 'ko' as the default language in the jquery script file that specifies the calendar value.

7) app.js: It contains the main functions for using the header function. We set up user interface init, declare uiInit as a variable, and use jquery to create the behavior for the main functions used in the header. In particular, I created a function that declares the header-navar-fixed class so that the header size is fixed even if the scroll size is exceeded.

8) show.blade.php: This php file is a page where users can select the experiment they want and apply for information such as eligibility, time and salary. We have added a property to the calendar that indicates whether the recruitment is over or not, so that we can apply for a more efficient experiment. I created a jquery function and referenced the fullCalendar class with ('calendar'). fullCalendar in it. In the event attribute, variables were set so that the experiment name, completion of the recruitment, experiment researcher name, and experiment time can be displayed for each calendar date. Since I could not output up to four basic attributes, we declared eventRender as follows.

eventRender()
element.find('.fc-title').append("¡br/¿" + event.time);
element.find('.fc-title').append("¡br/¿" + event.tester);
element.find('.fc-title').append("¡br/¿" + event.condition);
events:[] we bring the value(columns) in database from app/Http/Controllers. So, I added the value of the fullcalendar attribute to the scripts. A total of four display values were retrieved from the DB and displayed on the calendar.

9) header.blade.php: The header.blade.php file contains basic attribute values that are imported from all the front php files. I have referenced all the css files, fonts, images, js files etc that I need to refer to, and I have added the homepage icon, KakaoTalk preview image, and a brief description of the homepage using the meta property. I also added my own script file. The code shown below is the logic of the page header portion, which is common to all pages. I used jquery to code the header, login, and my page menu to be included in the button when the size of the mobile device became smaller. When you click the button, the menu will drop down in the drop-down format as if it were created in the header bg class, and the rest of the screen will be displayed in black. In addition, I created the arrow list class and designed the logic to return to its original state by clicking the arrow.

10) index.blade.php: This file under the mypage directory is the My Page of the user who wants to experiment. Through this page, you can check the lists you have applied, and you have unintentionally implemented a function that allows you to select and delete experiments. The table header function selects all the checkboxes in the table when you click the checkbox in 'thead'.

C. Account Management

Page01:Choosing User Type

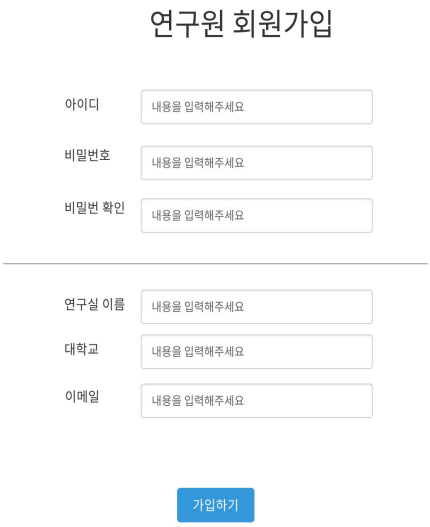
1) Separate Account Data: At the very first page, users should check whether they are lab researcher or applicant. After choosing their type, then the sign up and sign in page will be shown like above. The information of users should be organized at MySQL database. Whether they registered as a lab researcher or applicants must be included in the column. The column which contains the type of the users will determine which of the two main pages will be selected at the server.

Underlying Class Or Function

HomeController.php	Separately manage researcher's account and applicant' account. Show home page that contains routes to user sign-in/ sign-up and admin sign-in/ sign-up.

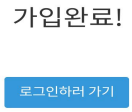
2) Sign Up: Applicants and researchers can register with email address and password. If users click the register below, the message saying that the sign up process is successfully done will be shown. In that page, users can click the log in button which will pop the sign-in pop up window.

Page02:Sign Up For Researchers



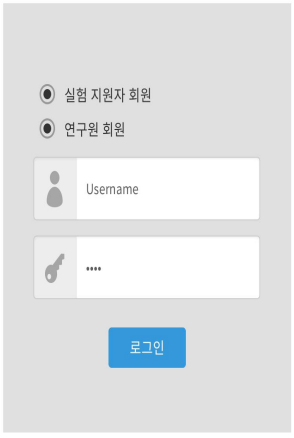
Page03:Sign Up For Applicants

Page04:Sign Up Completion Message



3) Log in: Users can select whether they are applicant or researcher. Then they have to enter ID and PW correctly. Then click the log in button. According to user's member type, different main page for lab researcher or applicants will be shown.

Page05:Sign In



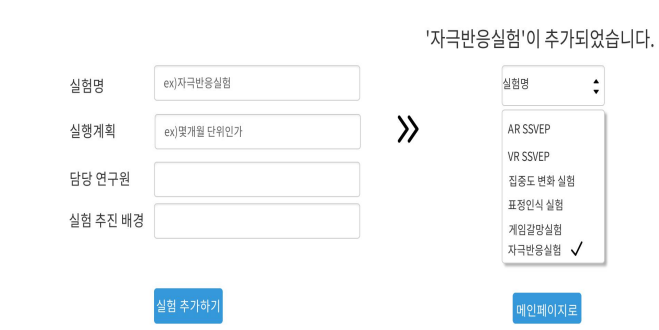
D. Functions For Lab

1) Main Page

:

- Experiment Schedule Calender : Similar as google calender. User can see all the scheduled experiments at the month at a glance. It also includes the experiment schedule that no applicants had applied.
- List of Experiment Instances With Drop Down List of Researchers In The Lab : This list will function as interface between main page and other functional pages. Just check one of the drop down elements and click the buttons below.
- Button For Creating New Experiment Instance

2) Create Experiment Instance:



When the lab researchers decided to hold a new type of experiment, the instance of that experiment should be created in database. Enter the name of experiment, expected schedule, researcher in charge and the purpose of it.

3) Main Page For Experiment Instance

The most recently held experiments will be at the top of table. Lab researchers can search for a specific data by entering several information of applicants or key words about that experiment.

- Information of experiment which is chosen at the drop down list.
- Button For Posting Recruitment Notice
- List Of Applicants Who are scheduled but did not conduct yet.
- List of applicants who have finished conducting experiment.
- Search Bar For Applicant's Information
- Button for cancel.
- Button For Uploading Experiment Result Data
- Button for reviewing uploaded experiment result data

4) Reviewing Uploaded Experiment Result Data:

If researcher select one of the applicants name and click the button for reviewing uploaded experiment result data, the above page will be shown.

- A table which contains the conducted experiment organized in the order of date.

- Name, age, gender and email address of applicant.
- Button for downloading uploaded experiment result file.

5) Uploading/Revising Experiment Result Data:

If researcher select one of the applicants name and click the button for uploading experiment result data, users can enter the specific features of applicants and upload the data file.

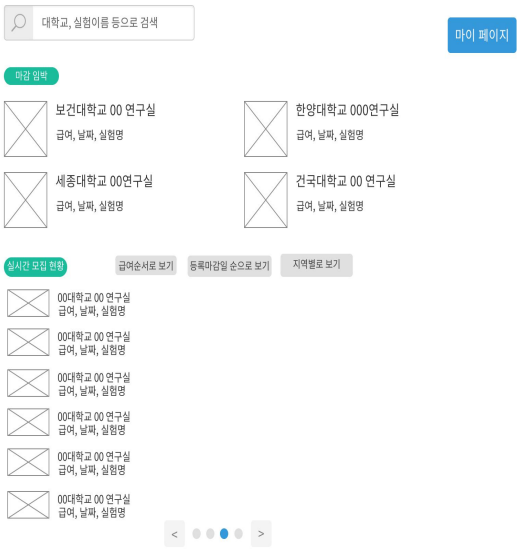
- Text bar for entering the special features of applicants
- Uploading bar

6) New Experiment Schedule and Posting Recruitment Notice:

The scheduled experiments will be shown in the form of calender. Lab researchers can choose the date and time to conduct experiment. They should type in the purpose of experiment, requirements for applicants, location, expected duration time, pay and the steps of experiment. All these information will instantly posted in the applicants' main page list in a well organized form as the button is clicked.

E. Functions For Applicants

1) Main Page



:

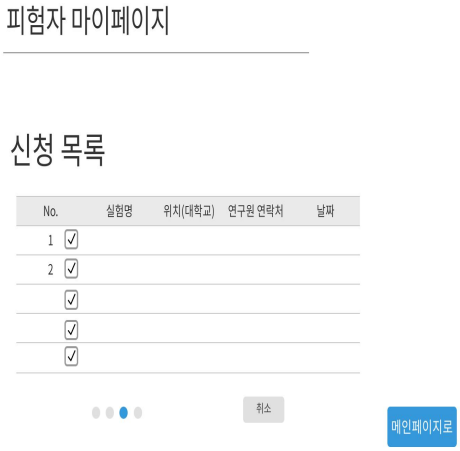
Users can search for a specific experiment they prefer with key words like the name of experiment, related major or the name of university that the lab belongs to. At the top f list, recommended recruitment will be shown. Below this, the list of all the notices is located. This list is updated real time. If applicant click one of these elements, the page of Detailed Information Page will be shown.

2) Detailed Information Page:

Information of the experiment will be shown in the form as above image. Applicants should click a date and time then click the apply button. Their personal information which is entered at sign up phase will be transferred to lab.

Underlying Models and Operation	
Participant Model	When User apply for an experiment by clicking 'apply' button, new Participant is created. With this Participant Model, User's data is connected to Experiment-Details Model.
User Model	The account type of which who are willing to participate as applicants.

3) Mypage For Applicant:



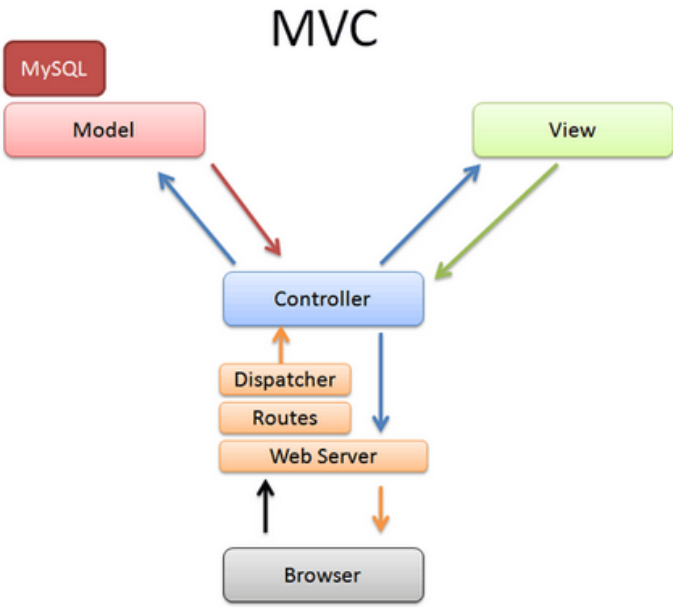
There is a list that contains all the experiments that applicant has applied for. They are organized in the order of the applying date. In the next column, applicant can see the name of experiment, location, contact of researcher in charge and the scheduled date. Click one of the elements, then the detailed information page will be shown.

4) Information Page For Experiments In Mypage:

V. Architecture Design Implementation

A. Overall Architecture

1) MVC pattern:



2) Model

: **MODEL**

App/

The logic that deals with the information, data, and data of the application

3) View

: **VIEW**

Resources/views/

Contains the display output logic

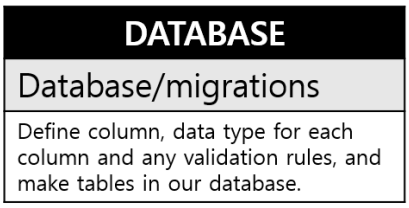
4) Controller

: **CONTROLLER**

App/Http/Controllers/

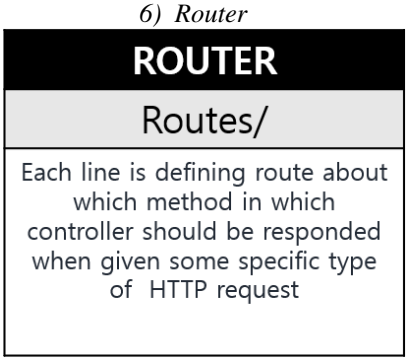
Contains control logic.
Transfer data back to the screen.
Group related HTTP request handling logic into a class.

5) Database



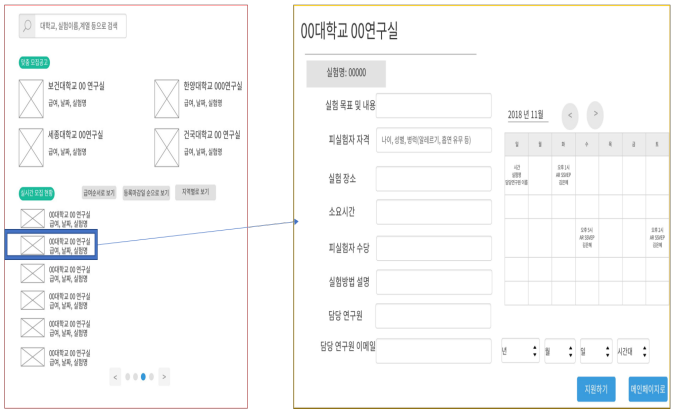
:

6) Router



:

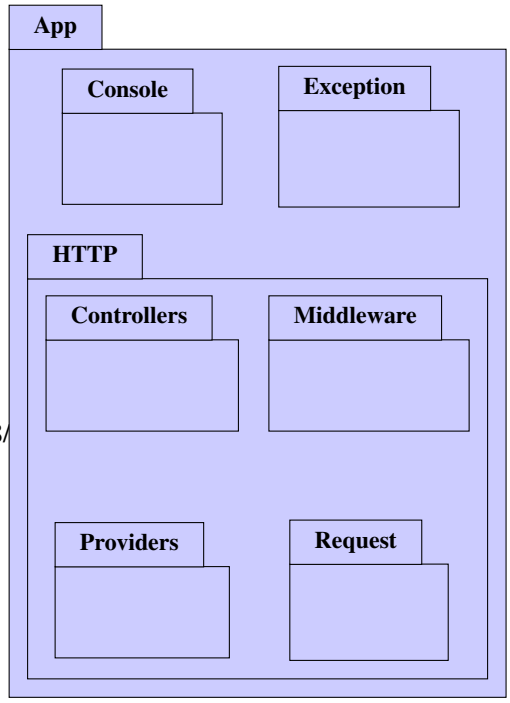
2) Link Of Applicants' Pages



:

C. Overall Modules Structure

In this section, the overall directory is visualized. Also, codes that have key role in our application are explained.



1) App/Console

:

- Console/Kernel.php: class kernel is responsible for specifying which custom commands should be made available to users and when to automatically execute various commands and tasks (by using the task scheduler).

2) App/Exception

:

B. Relation Between Pages

With the Kakao Oven prototyping tool, it is possible to test the web application almost same as the actual web application that our team has developed.

Prototype link

https://ovenapp.io/view/bSZQZZQtyBhVFc5Ymd1DWZQ9O6uBGb58/

1) Link Of Sign Up and Sign In Pages

:

- Exceptions/Handler.php: class Handler is where all exceptions triggered by your application are logged and then rendered back to the user.
  report() is the method used to log exceptions or send them to an external service. The report method passes the exception to the base class where the exception is logged
  render() is the method responsible for converting a given exception into an HTTP response that should be sent back to the browser. By default, the exception is passed to the base class which generates a response for you.

3) App/Http/Controllers/Admin :

- AdminSearchController.php: search around Experiment_Result model and Experiment_Details model.
- ExperimentDetailsController.php: Let admins search, read, create, store, edit, update, delete data by using ExperimentDetails Model.
- ExperimentController.php : Let admins search, read, create, store, edit, update, delete data by using Experiment Model.
- ExperimentResultController.php: Let admins search, read, create, store, edit, update, delete data by using ExperimentResult Model.

4) App/Http/Controllers/user :

- UserHomeController.php: Show the latest data among experimentdetails model and let users check if there is new experimentdetails data and their detailed information.
- UserMyPageController.php: Show what experiments users applied for and let them cancel the application. By using Auth::check function to check who is currently logged in and get the information about the logged in user, we can bring the data from Participants Model, which has the two foreign keys that correspond to User's id and ExperimentDetails' id, respectively.

5) App/Http/Middleware :

- Authenticate.php: Get the path the user should be redirected to if they are not logged in.
- RedirectIfAuthenticated.php: Handle an incoming request. Two redirecting routes for user and admin.

6) App/Http/Providers :

- AuthServiceProvider.php: Determine if a user is authorized to perform a given action.

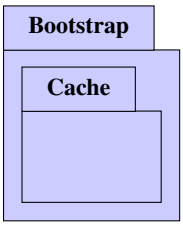
7) App/Http/Requests :

- ResultRequest.php:It contains validation rules for each field that apply to the request thrown by admin when they create, edit, update, store result for the experiment.
- UploadRequest.php: It contains validation rules for each field that apply to the request thrown by admin when they create, edit, update, store new recruitment for experiment.

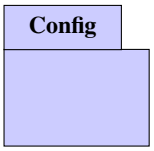
8) Models: Models are located at App/. Roughly, there are two types of accounts. Researcher and applicant. Admin Model handles researcher's account and User Model handles applicant's account.

- Admin Model (Admin.php) allow us to fluently query the database table associated with the Admin model, as well as insert new records into the Admin table.
- Participant Model (Participant.php): When User apply for an experiment by clicking 'apply' button, new Participant is created. With this Participant Model, User's data is connected to Experiment_Details Model.

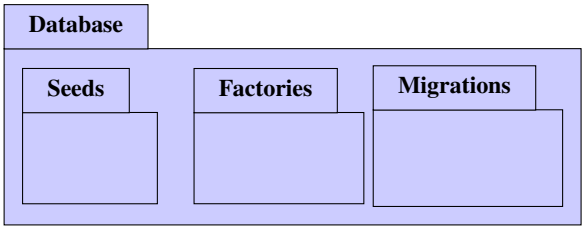
9) Kernel.php: This file is located at App/Http/. It contains application route middleware groups and application's global HTTP middleware stack that are run during every request to application.



10) Bootstrap/Cache : Contain information about binding the important interfaces and returning the application instance.

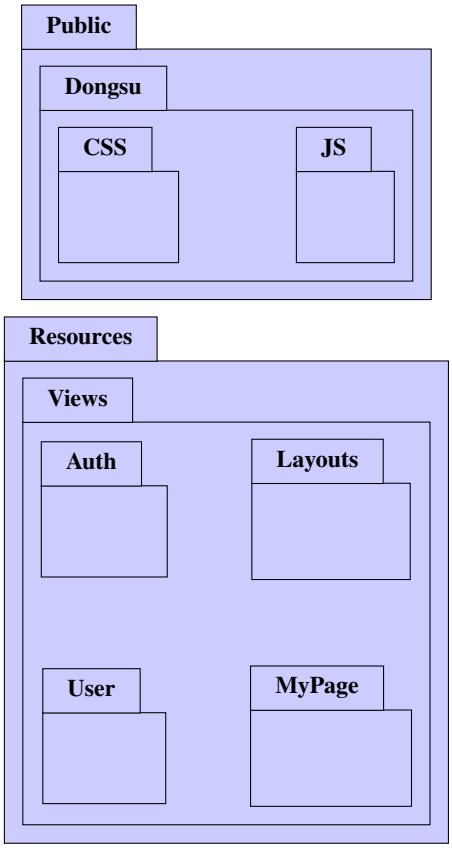


11) Config : It contains basic functions of Laravel framework, and defines how each system works.

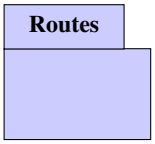


12) Database : Each Model Factory provides a convenient way to generate some model instances for testing / seeding the applications

database.By running the migrations we can define column, data type for each column and any validation rules, and make tables in our database. We also can add extra column to table or change the shape of table. Seeder in the Seeds folder directory seed the application's database.

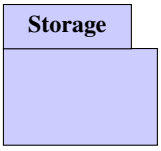


13) Public and Resources : This part is mainly described at IV.SPECIFIATIONS-B.Display Design section.

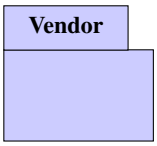


14) Routes:

- Web.php: It defines routes that are for your web interface. These routes are assigned the web middleware group, which provides features like session state and CSRF protection. It may be accessed by entering the defined route's URL in your browser. Each line is defining route about which method in which controller should be responded when given some specific type of HTTP request.



15) Storage: The storage directory contains your compiled Blade templates, file based sessions, file caches, and other files generated by the framework. This directory is segregated into app, framework, and logs directories. The app directory may be used to store any files generated by your application. The framework directory is used to store framework generated files and caches. Finally, the logs directory contains your application's log files. The storage/app/public directory may be used to store user-generated files, such as profile avatars, that should be publicly accessible. You should create a symbolic link at public/storage which points to this directory.

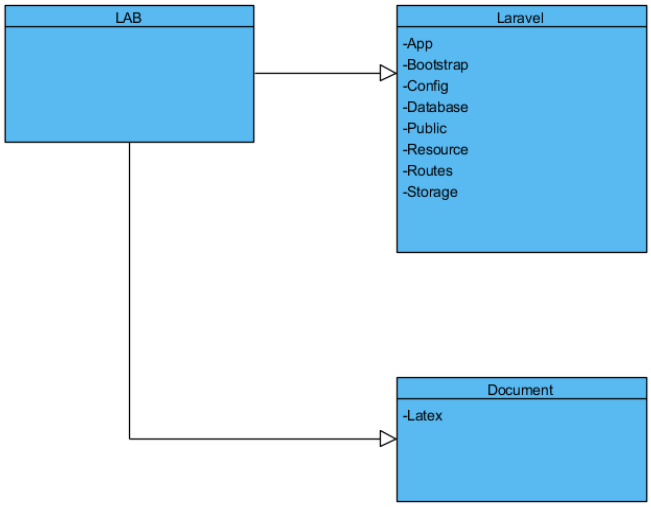


16) Vendor: The vendor directory contains your Composer dependencies.Composer is a tool for dependency management in PHP. It allows you to declare the libraries your project depends on and it will manage (install/update) them for you.

17) Composer.json: Configuration file that contains list of composer dependencies.

D. Directory Organization

This picture is our directory organization using UML with visual paradigm. We have two big folders, which follows the overall system architecture. One is Laravel and the other is a folder for the LaTex documentation.

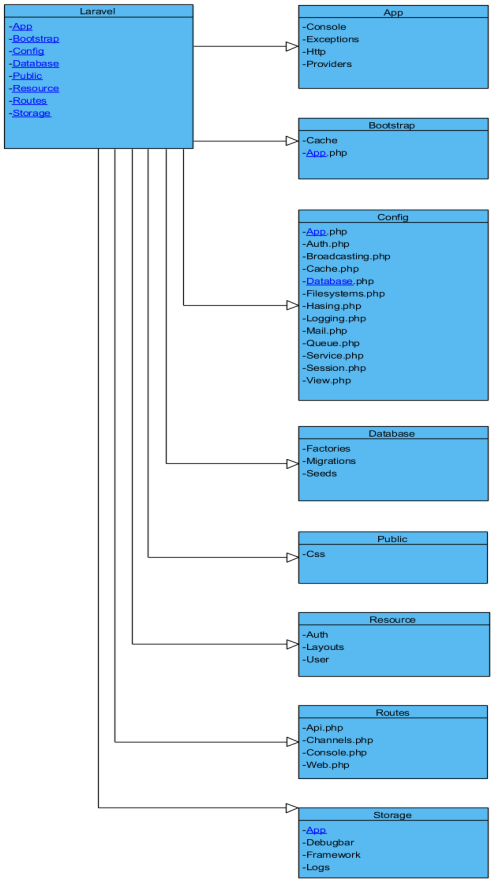


This table shows Directory, File name and Module name.

Directory	File name	Module
App/Console	Kernel.php	Laravel
App/Exceptions	Handler.php	Laravel
App/Http/Controllers/Admin/Experiment	ExperimentController.php Experiment-DetailsController.php	Laravel
App/Http/Controllers/Admin/Experiment Result	Experiment-ResultController.php	Laravel
App/Http/Controllers/Auth	AdminLoginController.php AdminRegisterController.php ForgotPasswordController.php LoginController.php RegisterController.php ResetPasswordController.php	Laravel
App/Http/Controllers/Operator/System	SystemController.php	Laravel
App/Http/Controllers/User	UserHomeController.php UserMyPageController.php	Laravel
App/Http/Controllers	Controller.php HomeController.php	Laravel
App/Http/Middleware	Authenticate.php RedirectIfAuthenticated.php	Laravel
App/Http/Requests	ResultRequest.php UploadRequest.php	Laravel
App/Http	Kernel.php	Laravel
App/Providers	AppServiceProvider.php AuthServiceProvider.php BroadcastServiceProvider.php EventServiceProvider.php RouteServiceProvider.php	Laravel
App	Admin.php Dept.php Experiment.php Experiment-Details.php Experiment-Result.php Participants.php Role.php Univ.php User.php	Laravel
Bootstrap/Cache	Config.php Packages.php Services.php	Laravel
Bootstrap	App.php	Laravel
Config	App.php Auth.php Broadcasting.php Cache.php Database.php Filesystems.php Hasing.php Logging.php Mail.php Queue.php Services.php Session.php View.php	Laravel
Database/Factories	Experiment-DetailsFactory.php ParticipantsFactory.php UserFactory.php	Laravel
Database/Migrations	...	Laravel
Database/Seeds	AdminTableSeeder.php DatabaseSeeder.php Experiment-DetailsTableSeeder.php ParticipantsTableSeeder.php RoleTableSeeder.php UserTableSeeder.php	Laravel
Public/Css	App.css	Laravel
Public	.htaccess Favicon.ico Index.php Robots.txt Web.config	Laravel
Resource/Auth/Passwords	Email.blade.php Reset.blade.php	Laravel

Resource/Auth	Admin-login.blade.php Login.blade.php Register.blade.php Register-researcher.blade.php	Laravel
Resource/Layouts/Partials	Header.blade.php User-navbar.blade.php	Laravel
Resource/Layouts	Admin-app.blade.php App.blade.php	Laravel
Resource/User/Home	App.blade.php Index.blade.php Show.blade.php	Laravel
Resource/User/Mypage	Index.blade.php Show.blade.php	Laravel
Resource/User	Home.blade.php	Laravel
Routes	Api.php Channels.php Console.php Web.php	Laravel
Document/Oven	root.tex	Document

E. Module 1:Laravel



1) Purpose: We write a code using architecture of Laravel framework. This is because it can let us manage frontend, backend, DB management and routing management at the same time. It can also connect them each other. Laravel internal libraries are useful and are suitable for Phpstorm.

2) functionality: Laravel is a free, open-source PHP web framework, created by Taylor Otwell and intended for the development of web applications following the model–view–controller (MVC) architectural pattern and based on Symfony. Some of the features of Laravel are a modular packaging system with a dedicated dependency manager, different ways for accessing relational databases, utilities that aid in application deployment and maintenance, and its orientation toward syntactic sugar

3) Location of Source Code: LabManager-SW/LAB

4) Where it is taken from: We collected information about Laravel in Laravel official homepage.
(https://laravel.com/docs/5.7/)

VI. Use Cases

Actors

Roughly, there are two types of actor. The applicant and laboratory. A laboratory will be assigned only one account. From the moment they sign up and log in at separate processes, they go to different main pages and perform different actions.

A. Sign up and Sign in

SITUATION: For both type of actors, first thing they need to do is making an account and sign in at the proper path for each of their type. At the sign up process, they will be classified whether they are applicant or laboratory.

NAME OF USE CASE: SignUpSignIn

ACTORS: Laboratory and applicant

FLOW OF EVENTS:

1) Go to the main front page
2) If applicant sign up button is chosen, the page for entering ID, PW, name, birth year, sex and email address will be shown.
3) if researcher sign up button is chosen, the page for entering ID,PW,name of laboratory, name of university it belongs to and the main email address will be shown.
4) After entering such information, click the sign up button.
5) A new page with the message of ”Sign Up Completed” will be shown.
6) Click the button going for sign in.

7) Choose one of the radio buttons which are labeled as researcher and applicant
8) Type in accurate ID and PW.
9) Click the sign in button and then the main page for each type of actors will be opened.

B. Creating a new experiment

SITUATION: A lab has decided to conduct a new experiment named NIRS. In the server, there is not any database set for the new experiment. So the lab has to enter basic information about it at the data management page.

NAME OF USE CASE: AddNewExperiment

ACTORS: Laboratory

FLOW OF EVENTS:

1) At the researcher main page, click the button for adding new experiment.
2) The researcher actor will move to the page for entering information about the experiment.
3) Type in the name of experiment, plan, name of researcher in account and the goal and background of conducting new experiment.
4) Click the button below if all the information is properly entered.
5) The message of confirmation will be shown. The name of that new experiment will be visible at the dropdown list along with other existing experiments.
6) Go back to the main page.

C. New Schedule For Conducting and Posting Recruitment Notice

SITUATION: Suppose there are more than one type of experiments that the laboratory is currently planning to conduct. For each type of experiments, it will be conducted several times throughout a substantial length of period. The function of adding new conducting schedule and recruitment process for that specific date is needed.

NAME OF USE CASE: ManagingConductAndRecruitment

ACTORS: Laboratory

FLOW OF EVENTS:

1) At the main page, click one of the experiment items listed at drop down box.
2) Then the sub-main page for that chosen experiment will be shown
3) Click the button for posting recruitment notice and adding new schedule for conducting the chosen experiment .
4) Moves on to the next page.
5) Checkout the conducting schedule of that experiment with the calender showing the whole schedule only for that experiment.
6) Through the drop box, choose the data and time period that the lab is going to conduct the experiment.
7) Enter the information which is going to be posted as explanatory information for applicants.
8) After entering all the information, click the register button.
9) Then click the button to go to the previous page.

D. Uploading Experiment Result Data

SITUATION: After conducting a experiment with a applicant, the result data for that specific applicant is formed. This data should be managed at the server. Researchers can enter comment for important features of the applicant and his or her results. It is also possible to upload the file itself.

NAME OF USE CASE: UploadResultData

ACTORS: Laboratory

FLOW OF EVENTS:

1) At the main page, click one of the experiment items listed at drop down box.
2) Then the sub-main page for that chosen experiment will be shown.
3) There is a list of applicants who have applied for the experiment but did not actually participated at the experiment yet.
4) If one of applicants in the list participated at the experiment as a subject, click the check box and then click the button for uploading experiment data.
5) Write a comment in the text box if their is any necessary features of the result data for the chosen applicant.
6) It is possible to upload file itself
7) Click the button if uploading and entering is completed.
8) Click the button for going back to the previous page.

E. Reviewing Experiment Data

SITUATION: After the experiment data for each of subject is uploaded and recorded, it is occassionally needed to get the data from the server. The function for showing the information of the subject and experiment results in a well organized form is needed. The database format is established based on the fact that a subject can participate in the same experiment for multiple times at different date.

NAME OF USE CASE: ReviewExperimentData

ACTORS: Laboratory

FLOW OF EVENTS:

1) At the main page, click one of the experiment items listed at drop down box.
2) Then the sub-main page for that chosen experiment will be shown.

3) There is a list of subjects that already have participated in the experiment. Each of their result data has been uploaded.
4) If the researcher wants to see one of the subjects' result data, click its check box and then click the button of reviewing experiment result data.
5) Moving on to the next page. The name of the subject, age, sex, email address and the previously entered data will be shown.
6) Select one or more check boxes which belong to a date one for each.
7) Then click the download button.
8) The file will be download to local desktop.
9) Click the button for going back to the previous page.

F. Experiment Data Query

SITUATION: There is certain situation that researchers have to find experiment data of a specific subject. It is difficult for them to remember subjects all the time. It is also tricky to match the experiment results with its subject. Therefore, it will be helpful if researchers can search for the complicatedly linked data of a subject with simple keywords.

NAME OF USE CASE: SearchWithKeyword

ACTORS: Laboratory

FLOW OF EVENTS:

1) At the main page, click one of the experiment items listed at drop down box.
2) Then the sub-main page for that chosen experiment will be shown.
3) At the page, there are two types of lists.
4) For each of the lists, researchers can search with keywords.
5) The searching process of the two lists is separated.
6) For each of the list, there is a text box in which researchers type in key words.
7) Enter name, age, sex or date of experiment.
8) The list will be reset and it will contain rows of data instance that are related to entered key word.
9) Researchers can then utilize the functions at the previous stages' use cases.
10) Click the main page button then go back to the main page of the laboratory.

G. Main Page Of applicants

SITUATION: Quite a lot of people are willing to participate at experiment as subject and get paid. Although there are a lot of experiments that laboratories are planning to conduct, the recruitment notices are dispersed. Some of them are posted at university's community web site and others are printed out. Therefore, the platform that gather bunch of information of experiments and then deliver to people is needed.

NAME OF USE CASE: BulletinBoardOfExperiments

ACTORS: Applicants

FLOW OF EVENTS:

1) After sign in, the main page for applicants is shown
2) The main page has the form of bulletin board
3) There is list of recruitment notices which is updated real time.
4) There is another list or recruitment notices that are close to deadline.
5) Applicants can change the order of real time list.
6) By clicking each button, the elements of the list will be reorganized in the order of payment, deadline or place.
7) They can also search experiments they especially want to participate with keywords such as the name of university.
8) If they click one of the notices, detailed information page will be shown.

H. Detailed Information Page

SITUATION: Applicants are going to check the detailed information about the experiment they chose. They have to figure out whether they fit the condition of the experiment. Also, there is a calendar that shows all the possible date and time period they can apply

NAME OF USE CASE: CheckInformationAndApply

ACTORS: Applicants

FLOW OF EVENTS:

1) After clicking one of notices, the detailed information page will be shown.
2) Check the information such as payment, location, expected conducting time and the steps of the experiment.
3) If unwilling to participate as subject, click the button for going back to the bulletin board main page.
4) If every condition is ok, check the date and time on the calender.
5) Select the date and time at the drop down.
6) Click the button for applying
7) Pop up with the message of successfully applied.
8) Click the button for going back to the bulletin board main page again.

VII. Server Installation Steps

FLOW OF EVENTS:

1) Buy Ubuntu Server 18.04 LTS (HVM), SSD Volume Type.
2) Edit inbound rule from security group and add HTTP port.
3) Download PuTTY and make Private key,
4) Using private key, login to root account on server.
5) Open /etc/ssh/sshd config file and change permissions.
6) Update apt-get, Install nginx and MySql Server.

7) Set Mysql password with Capital letter, small letter, number, and special letter.
8) Install php-fpm, php-mysql, php-mbstring.
9) Create folder for Laravel.
10) Install Composer.
11) Go to local and git push the application to Server IP address.
12) Go back to server's Laravel folder and modify permission.
13) Open mysql and create new database to migrate.
14) Modify .env file to set DB host, username, password etc.
15) Open config file and change the URL of application.
16) Migrate the application on Internet.

VIII. Discussion

In this section, the role of each team member is described specifically. Also, each team member wrote the difficulties they encountered and meaningful experiences.

A. Difficulties and Experiences

1) Nam Yunwoo

: **Difficulty with Server**

When trying to connect to the EC2 Ubuntu server, I encountered a serious problem which are frequently involved with server setting. To be specific, when I entered the ssh root@(ip address) in local cmd in order to connect to the server with my public ip address, the error of "Publickey access denied" occured. I have struggled to solve this problem so that I spent a significant amount of time searching google. After 2 days of hardworking, I finally managed to find out the solution like below.

- First connect to the server using putty and then enter vi / etc / ssh / sshd_config to access the ssh configuration file.
- Modify the 'PermitRootLogin' setting. Set 'No' to 'Yes'.
- Modify 'PasswordAuthentication' setting. Set 'Prohibited' to 'Yes'.
- Click 'save' to close the file.
- Enter 'sshd -t' to check the error in sshd.
- Type 'service sshd restart' in order to apply the revised ssh setting.

After completion of these steps, I was allowed to access the root of the ip address by entering 'ssh root@(ip address)' and password of server root account in local cmd. I had no experience to set the server before so I have deleted and restarted server more than 5 times throughout this project.

2) Ha Dongsu

: **Difficulty with Cordova**

The implementation of the application using cordova was not as difficult as it was thought. I spent a lot of time setting the environment first, but I did not need much code to launch the screen on my smartphone. In order to run cordova from cmd, we needed a lot of node js and android studio, but there were a lot of issues in environment setting including the emulator of android studio. First, I solved the problem by entering a command that allowed the license in the path where sdkmanager was installed and an error was made because the sdkmanager license was not accepted. Also, the default emulator for android stuido was not set correctly. Solved the problem by changing the default emulator settings of android studio itself with the help of stack overflow.

Difficulty with Calendar Combined With DB

The most difficult part of the web front end was the linkage between calendar and db values. It was necessary to display experiment name, experiment time, research person, and whether to recruit by date. We refer to the calendar class with jquery and use the eventRender property to add variables to be displayed in the date. The part that registers the value is fetched from db using php code. However, since the date field of the calendar is very small, it was hard to see all four values. I was troubled by the fact that all the devices had to be displayed correctly without being broken. First of all, we can reduce the font size and enlarge the size of the calendar using the css grid so that a maximum of four values can be displayed.

Difficulty with Referencing

Also, there was an issue that the script file or css file referenced in header.blade.php could not recognize. It was a problem in the order of reference, and I solved the problem by writing the references in order by debugging through Google Developer mode.

Meaningful Experience

I was able to learn configuration management using github. Often, we needed to collaborate with our team-mates who were responsible for the back-end. I made a dongsu branch and committed it to the existing master branch if necessary. It is a good opportunity to learn about efficient configuration management using git, and to learn how to write code for efficient collaboration with the back-end. In addition, I was able to learn how to create a service-level front-end by considering all device sizes and browser environments such as chrome, IE, edge and firefox. In order to do this, I received feedback from the graduate school researchers who will use this app in practice and reflected the modifications. I realized how important feedback is to our users as we work on the project.

3) Kim Eunhye

: **Difficulty with Web Application Prototyping**

I was totally new to making prototype of web application. I did not know the basic development process of web application. It took a quite a long time for me to understand the mvc pattern. I put a lot of effort not to make terrible prototype that is incompatible with the development environment of our team. So I started watching the basic tutorial of web server development.

Difficulty with Composing Latex Report

I had to study about the Latex program language from the beginning. When I finally got used to it, the next problem was writing all the development processes and details to fit

the IEEE format. It took a lot of effort to come up with effective way of organizing the overall structure of report. In addition, I had to understand the directory organization and modules. The communication between me and other team members were critical. Although they have given me the thorough description of codes they wrote, it was still time consuming to understand it.

Feedback From Actual Users

I showed the final result of development to the lab researchers. They told me that our team's web application seems to be very useful to save their time. To be specific, with this web app, they will not have to spend time writing and posting recruitment notices, contacting and scheduling with applicants, organizing bunch of data in their local pc. I was pleased with these comments since this means that I accurately observed the inefficiency of experiment managing in lab.

4) Kim Bosung

: **Difficulty with Framework**

The most difficult task I had was getting used to Laravel Framework. Since it was the first time using that kind of framework. I had to practice several times to get used to this kind of format. However, there were lots of php or built-in functions in Laravel that would be useful to our project, and could reduce a lot of time by adjusting the functions instead of making the function with raw coding.

Difficulty with Custom Functions

The other difficulties I had was defining the delete function and delete user function. When user cancel the registration for the experiment in the My Page, the column that shows the number of people applied should also be decremented. I could solve the problem by sending id as the parameter and finding the instance that has relationship and the same value with the id from the Experiment_Details table. Similar problem happened when deleting the applied user for specific experiment in the admin page, but I could solve the problem by using the similar method that I used for delete function in the User's MyPage. Also, it was not difficult but time-consuming task to apply the front-end templates or directory format in accordance with the proper structure of Laravel framework for getting the data by querying database tables in the controller and passing the data to display values the view file.Also, it was not difficult but time-consuming task to apply the front-end templates or directory format in accordance with the proper structure of Laravel framework for getting the data by querying database tables in the controller and passing the data to display values the view file.

Meaningful Experience

I could learn the importance of communication among team members, project time scheduling and task division. We would not have to be in a hurry if we had divided the project into several pieces and assign exact scope of the task to individuals, and if we had made out the exact schedule for specific task. Also, it was an experience from which I could learn that good coordination is done through good communication, since keeping in harmony with team members will result in better collaboration.

5) Jeong sujin

: **Difficulty with LaTex report**

Although it was interesting to write the paper using code, I had a hard time using LaTex because it was my first time using it. Sometimes tables were cut off or get out of the page. And sometimes paper showed different from our code (maybe because of its effort for balanced arrangement). It was hard to understand php code or function that developer explained. I was lacking much, I feel sorry and grateful to our team members.