



COMP704 Research and Development Project

**VN01** 3D acupuncture healthcare data management and treatment system

# Project Proposal

**Client:** Dr William Liu

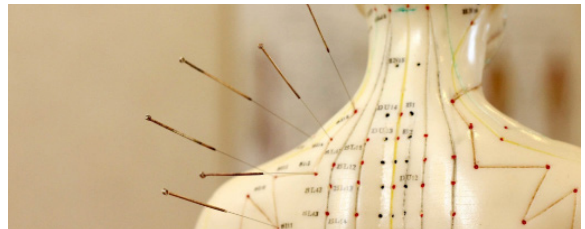
**Supervisor:** Dr Nhan Le Thi

**Team Members:**

21142643	Chuong Pham Dinh
21142377	Nhan Nguyen Cao
21142355	Tan Le Tran Ba
21142358	Trang Ho Ngoc Thao

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## DOCUMENT VERSION CONTROL

### 1. DOCUMENT INFORMATION

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Version	Timestamp	Description	Responsible members
1.0	26 Oct 2022 19:30	The initial version of the project proposal document, covering the required parts and basic information.	<b>Nhan Nguyen Cao</b> (21142377) <b>Trang Ho Ngoc Thao</b> (21142358)
1.1	30 Oct 2022 16:30	Added information about new technology and feasibility evaluation in the Project Approach section.	<b>Nhan Nguyen Cao</b> (21142377)

## I. EXECUTIVE SUMMARY

One of the most intriguing therapy options available in modern medicine is acupuncture. Using needles to stimulate certain points and regions of the human body to relieve pain and treat sickness is one of the ancient Chinese people's greatest discoveries after hundreds or even thousands of years of developing and conserving it.

Despite its beneficial results, acupuncture is typically difficult to relate to science, particularly from the viewpoint of the patients. Young acupuncturists may not be able to treat patients effectively when they first begin their careers since some of the successful therapies used by acupuncturists can only be learned via extensive experience rather than through scientific guidelines.

The proposed project sought to address these issues by investigating and creating a 3-D acupuncture healthcare data management and treatment system. The device would give acupuncturists a modeling platform to test and improve treatments and give patients insight into how treatments affect their bodies.

## II. TERMS OF REFERENCE

### II.1. BACKGROUND

Traditional Chinese Medicine (TCM) has long been one of the most fascinating subjects studied by several researchers in a variety of professions. The system, which is supposed "thousands of years old and has changed little throughout the centuries" (Chinese Medicine, n.d.), contains some of the cures for many illnesses or symptoms that Western medicine cannot simply treat. Acupuncture is one of the most widely used types of TCM that is today practiced in many nations, from the East to the West of the entire world.

According to traditional Chinese medicine, the purpose of acupuncture is to regulate the flow of life force (often referred to as Qi) and energy in your body. It involves inserting extremely tiny needles through your skin at specific locations known as acupuncture points (Acupuncture, 2022). It is indisputable that people who use acupuncture to treat their pain in various body sections might have favorable results.

The human body possesses more than 360 acupuncture points, which are employed in different combinations in clinical settings, according to traditional Asian medicine. Each point combination used in acupuncture treatment is based on the meridian system, which acts as a whole and not only in one specific organ or region of the body. Because the acupuncture points in the body are what causes acupuncture's main effects, where they are located and how they should be combined determines whether a treatment will be successful or not. The experts in the sector face significant difficulty in figuring out how to combine them for improved treatments of common ailments or discomfort.

Therefore, a needed solution in the field of acupuncture is having a related data and treatment management system to assist acupuncturists with the right treatments.

### II.2. PROBLEMS AND OPPORTUNITIES

Knowing the significance of the acupuncture points may be related to one of the issues that our study seeks to address. Determining the combinations of acupuncture points is a difficult step to take even though it is essential to ensuring the therapeutic efficacy of acupuncture treatment. With more than 360 acupuncture points in the human body, it is nearly impossible for beginner acupuncturists to choose which acupuncture points or combinations to use and where on the patient's body to place them.

In addition, despite the fantastic results that acupuncture produces, one of the challenges identified by our client is that it can be extremely challenging for patients to comprehend what is happening during an acupuncture treatment. Due to this, it is exceedingly challenging for acupuncturists to gain their patients' trust and inspire them to use acupuncture for therapy. Additionally, this makes it less likely for the method to have potential benefits.

To solve the difficulties in a way that has never been done before, our project will draw on the opportunities presented by those identified problems and apply various research findings and cutting-edge technology techniques. The use of artificial intelligence, data mining, machine learning, and 3-D model is intended to tackle the identified problems in

a reliable and highly effective manner. Applying technology to various industries is always an interesting topic to investigate given the ongoing expansion of the 4.0 technology world.

### II.3. PROJECT DESCRIPTION

The project's goal is to offer a remedy for raising the efficiency and logistical standards of acupuncture treatments. The ultimate system output, called the 3-D acupuncture healthcare data management and treatment system, is a 3-D model website of the human body that shows the acupuncture points and meridian system and allows users to interact with it directly. The solution will be offered as a Web application with a responsive user interface and experience for desktop and mobile devices.

The data-based system with 3-D model aimed to give acupuncturists a platform, to support the finding, and choose the combinations for treating diseases, or for improving patient data and managing the acupuncture treatments, but it could also be used as a way to increase interactions between the doctor and patient, improving the experience of both parties during treatment.

### II.4. CLIENT

The client for this project is Dr. William Liu, a Senior Lecturer in the Department of Computer Science and Software Engineering (CSSE), School of Engineering, Computer and Mathematical Sciences (SECMS) at the Auckland University of Technology (AUT), New Zealand.



*Figure 1 - Professor William Liu*

The representing organization for the project and Dr. William Liu is FromLabs Solutions, a company providing IT solutions that incorporates new technology offerings to the fundamental communication, learning, and activity-based processes that are based in Singapore and Ho Chi Minh City, Vietnam.



Figure 2 - FromLabs Pte. Ltd

## II.5. TEAM AND KEY ROLES

Our team is made up of 4 people, and each one has the knowledge and experience necessary to do a certain task. By working together, our team believes to be able to complete all the project's portions and achieve the intended results, which matched the client's specifications.

Our team's members, along with the key roles in the project include:

Table 1 - Team members and roles

AUT Student ID	Fullname	Role	Responsibilities
21142643	Chuong Pham Dinh	Quality Engineer	Do the testing phases and ensure the working quality of the project's final product.
21142377	Nhan Nguyen Cao	Business Analyst & Front-end Developer	Communicate with the client to understand the requirements, lead in researching for knowledge and information applicable to the scope of the project, and handle developing the Front-end side of the final system.
21142355	Tan Le Tran Ba	Project Manager and Designer	Managing different phases and sections of the project, as well as supporting the design of the prototype for the final system.
21142358	Trang Ho Ngoc Thao	Back-end Developer	Responsible mainly in the Back-end side for the completion of the final project.

Dr. Nhan Le Thi, a senior lecturer from the Ho Chi Minh City University of Science, is the supervisor for our team on this project. Dr. Nhan Le Thi is an excellent choice to guide our team during the project's implementation because of her extensive experience teaching and conducting research in the field of computer science, her interest in biomedical data mining, and her experience serving as a supervisor for numerous R&D projects of the BCIS off-shore program from Vietnam in the previous years.



### III. RATIONAL FOR THE PROJECT

#### III.1. NEEDS FOR THE PROJECT

Acupuncture points are significant and have evolved into one of the fundamental components of Traditional Chinese Medicine. However, due to the vast amount of data in the sector, traditional technological approaches have not been able to develop a system that is efficient enough to allow acupuncturists, particularly those who are novices, to provide appropriate acupuncture treatments for patients.

The need for a system to be widely used as a companion for acupuncturists has increased as a result of the development of technology and how advanced technologies can be applied to solve many long-standing problems and challenges in a much better way. This system should improve acupuncture treatments through visualization and data, as well as increase patient interaction, give patients a better experience receiving acupuncture, and help them understand and trust the method.

Because of that, we anticipate that our supported project, which offers the system of the 3-D acupuncture healthcare data management and treatment system, will be enthusiastically received not only by those working in the field of medicine or the scope of acupuncture but also by patients or other people who want to understand the method better, particularly from the scientific perspective.

#### III.2. FOCUSES OF THE PROJECT

There are currently no databases of frequently used acupoint combinations for treating certain illnesses or pain in particular parts of the human body, which gives our project the chance to fully address the issue and offer a ground-breaking answer for the field of acupuncture.

Some 3-D acupuncture model applications are already on the market and may be downloaded for no cost from the app stores of various mobile operating systems. Some of these would be excellent choices for those looking to learn more about acupuncture or advance their skills in the practice.

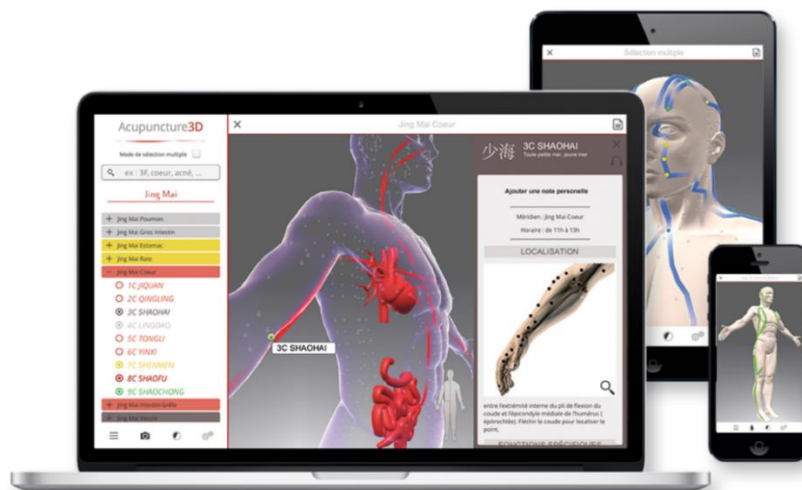


Figure 3 - One of the best existing systems supports studying and upskilling in acupuncture (Coulais, n.d.)

However, the majority of the current systems shared a weakness in that they were merely model applications and had no connection to databases containing combinations of acupuncture points for treating disorders.

Taking advantage of the situation, our team devised a plan to carry out the project that had the following objectives:

- *Research:* To determine if any noteworthy discoveries might be better included in our final product, we would look for and review a variety of article papers and postings.
- *Data collection:* We planned to use cutting-edge technologies, like Data Mining and Artificial Intelligence, to see whether they can help promote better data and recommendations, as well as provide instructions for the functions of our final product.
- *Modeling:* Our technology also has the fundamental capabilities for displaying a 3-D representation of the human body with marked meridian and acupuncture points. The system would also be given the functionality that may be attained from the outcomes of the two prior foci, such as the usual combinations for treating particular ailments or suggestions for which acupoint combinations to choose.

Overall, our project entails both research and development; it began as a project for a scientific paper and is intended to conclude as an engineering project with a finished system delivered to the client. The project is anticipated to be extremely needed by the acupuncture community due to the chances for our system to differ from those already available on the market.

## IV. PROJECT SCOPE AND OBJECTIVES

### IV.1. GOALS & OBJECTIVES

#### IV.1.1. PROJECT GOALS & OBJECTIVES

Our detailed goals and objectives for the project of the 3-D acupuncture healthcare data management and treatment system include:

- Acquire an understanding of acupuncture, the basic concept, and principles of the technique in healing pain and treating common diseases.
- Acquire an understanding of the findings of existing experiments on advanced technology to the scope of acupuncture, as an inspiration for the project.
- Being able to come up with proposals about applying advanced technology in acupuncture modeling, to better the functionalities and resolve the problems of some existing solutions in the market.
- Provide a 3-D model of a cut-off human body, with acupuncture points marked and related internal organs, and components included to guide and instruct the implementation of acupuncture treatment.
- Provide a data-based management and information system, from the research of experiments done by experts, for better guidance of acupuncture points combination in treating specific diseases.

#### IV.1.2. PERSONAL GOALS & OBJECTIVES

From the perspective of each member of our group, our goals and objectives for this project include achieving the following skill sets:

- Technical skills
  - Paper research skill
  - Data mining techniques
  - Programming skills: Web Development skills with 3-D rendering products
  - Testing skills
  - Version control and source management skills
- Soft skills
  - Project management and development skills: SCRUM Framework, Agile methodologies
  - Documentation skill
  - Brainstorming skill
  - Team-work skill
  - Communication skill
  - Human relation skill

### IV.2. PROJECT SCOPE DESCRIPTION

The research phase includes upskilling and acquiring useful knowledge and information related to acupuncture treatments, and experiments in the field. The final product includes a 3-D model platform for acupuncture treatments, with acupuncture points and a human body model displayed.

#### IV.2.1. WHAT IS TO BE INCLUDED – IN SCOPE?

- A research about the experiments of applying advanced technologies into the field of acupuncture treatment.
- Collection of data from experiments, and article papers, to be stored as a database for the system to promote commonly used acupuncture points combinations for curing specific diseases.
- A 3-D model website for interacting and understanding acupuncture treatments.
- A 3-D model website for experimenting, and justification of different treatments using acupuncture for specific diseases.
- A data-based information base for recommendations about acupuncture points combinations to be used for diseases.

#### IV.2.2. WHAT IS NOT TO BE INCLUDED – OUT OF SCOPE?

- Advanced 3-D animation for visualizing acupuncture treatments.
- Recommending or providing information about diseases that are not available in the database, management system, or those not commonly cured by acupuncture.
- Inclusion of deep medical knowledge of the internal organs and blood vessels, as well as explain or provide information about how they can be beneficial from acupuncture treatment from an advanced point of view.

### IV.3. PROJECT REQUIREMENTS

#### IV.3.1. FUNCTIONAL REQUIREMENTS

Table 2 - Project's functional requirements

No.	Functional requirement
1	The system should allow users to view the 3-D model of human body, with the acupuncture points marked.
2	The system should allow users to interact with the 3-D model with some basic options like spin, zoom-in, and zoom-out of the view space.
3	The system should allow users to view information about the acupuncture points, including the names, descriptions, and functionalities to the body, by clicking on the acupuncture points in the 3-D model.
4	The system should allow users to view the meridians on the 3-D model of the human body.
5	The system should allow users to view specific treatments for diseases with the acupuncture points included in the treatment marked on the 3-D model.
6	The system should allow users to choose and examine the combinations of acupuncture points for acupuncture treatment.
7	The system should allow users to input new medical acupuncture treatments with the combination of points included in the system.
8	The system should be able to visualize an inputted acupuncture treatment on the cut-off 3-D model of the human body.

9	The system should be able to recommend appropriate acupuncture treatment for a specific common disease selected by the user.
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#### IV.3.2. NON-FUNCTIONAL REQUIREMENTS

Table 3 - Project's non-functional requirements

No.	Non-functional requirement
1	The system should be able to provide a user interface viewport for both desktop devices and mobile devices, allowing users to be able to access and use the system from different groups of devices.
2	The system should be able to render the 3-D model in no more than 30 seconds, from the time the rendering request is made by the user.
3	The system should be able to handle the requests for inputting data from the system or retrieving information within the system in no more than 5 seconds.
4	The system should be available for access for no less than 23 hours each day.
5	The system should be compatible with the newest versions of all common browsers, such as Google Chrome, Mozilla Firefox, Opera, Microsoft Edge, etc.
6	The system should be able to handle the features without consuming up to more than 1GB of RAM from the browser.

#### IV.4. PROJECT ENVISAGED DELIVERABLES

The planned deliverables for the project at different phases are expected to include the followings:

Table 4 - project's envisaged deliverables

Type	Deliverable	Description
Document	Project Proposal	A document defining the goals, and objectives for the project and justifying the approach used to deliver the project outcomes.
Document	Requirements Specification	A document with details about the requirements for the project at different abstract levels, and different types of requirements.
Design	User interface designs	Designs planned for the final product (the system) were sketched by the member of the role designer.
Design	Prototype	Final approved version for the design and prototype of the final product (the system).
Document	Project Roadmap & Plan	A document detailing the roadmaps of the project implementation, including details about different phases, milestones, and plans for each phase.
Product	Data for the DADDY4ISA System	Database of acupuncture points' information, acupuncture treatments for common diseases, which are gathered using different data collection techniques and from research results.

<b>Product</b>	<b>Final System Version 1</b>	– A website with an interactive cut-off 3-D model of the human body, with acupuncture points marked and allowing basic interactive features.
<b>Product</b>	<b>Final System Version 2</b>	– The final version of the product, with all the defined features.
<b>Document</b>	<b>Testing documentation</b>	A document including the procedures, agreement levels, detailed descriptions of test plans, and test cases for the final product.

#### IV.5. KEY MILESTONES

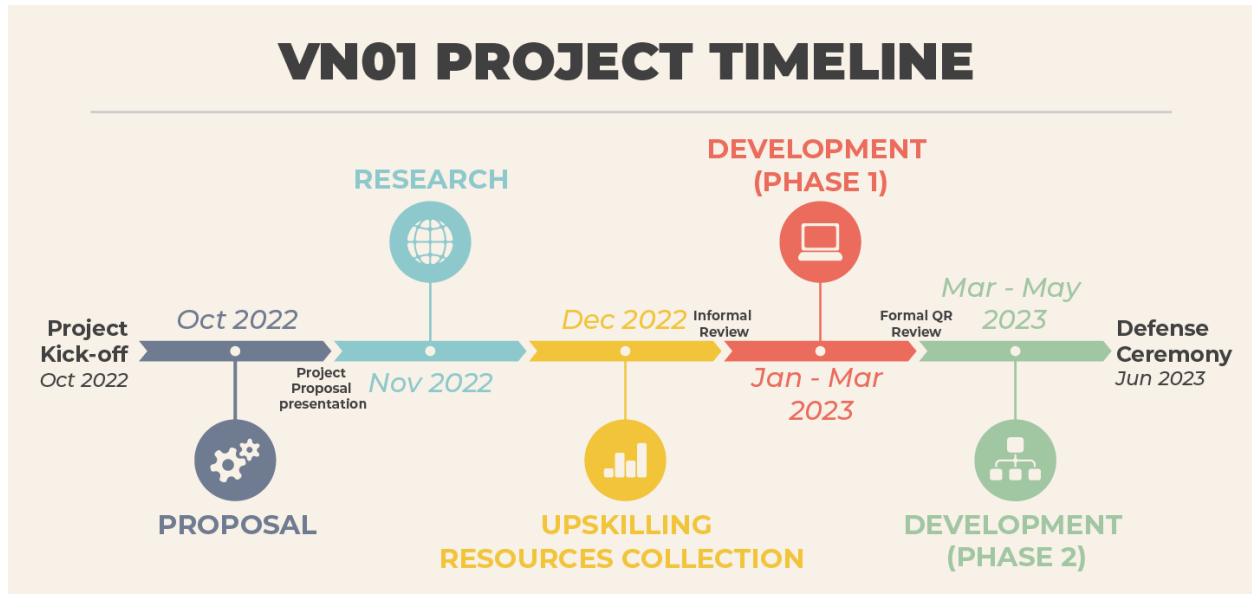


Figure 4 - Project timeline

The project is aimed to last for about 8 months, covering all of the phases of the project. The project team decided to apply the Scrum project development and management framework during the implementation of the project. The main milestones defined for the project, covering the different phases, are as follows:

Table 5 - Project's key phases and milestones

Phase	Description	Milestone	Planned Schedule
<b>Proposal</b>	Deliver the Project Proposal document for the project, and evaluate the feasibility of the project	Project Proposal Presentation (early November 2022)	October 2022
<b>Research</b>	Agreement on the Idea and scope of applying the research results to the final product	Report on the research result (at the end of November 2022)	November 2022
<b>Upskilling &amp; Resources Collection</b>	Related data would be collected to be used later for the final system.	Report on skill improvement and data selected	December 2022

	Acquire the required skills for implementation of the project: data mining skills and techniques, 3-D development skills, etc.	<i>(at the end of December 2022)</i> Informal Review <i>(January 2023)</i>	
<b>Development (phase 1)</b>	Build the first version of the system with basic interactive features and the rendering of the 3-D model.	Formal QR Review <i>(mid-March 2023)</i>	January – early March 2023
<b>Development (phase 2)</b>	Develop the final project with all defined requirements.	Defense Ceremony <i>(at the beginning of June 2023)</i>	late March – June 2023

#### IV.6. BUDGET

This project, which is classified as a university research project, will only be supported by the client and the institution (Auckland University of Technology (AUT) and the Ho Chi Minh City University of Science) (HCMUS). The project's budget is restricted to covering the costs of the mentor and team members while the project is being carried out. However, if the initiative were to pique the interest of local acupuncturists in both nations, more money would likely be obtained. The document's subsequent portion would include a detailed definition of the budget assumptions.

## V. PROJECT METHOD & APPROACH

### V.1. PROJECT METHOD

After consulting with the client as well as with the supervisor, the team decided that this R&D project would be managed using the Agile approach.



Figure 5 - Agile methodology

The Agile methodology takes an iterative approach to software development. Agile projects consist of several smaller cycles called Sprints. Each one of which is a project in miniature: it has a backlog and consists of design, implementation, testing, and deployment stages within the pre-defined scope of work. At the end of each Sprint, a potentially shippable product increment is delivered. Thus, with every iteration new features are added to the product, resulting in gradual project growth. With the features being validated early in development, the chances of delivering a potentially failed product are significantly lower (Agile Project Management: Best Practices and Methodologies, n.d.).

This approach is suitable for this project because, in Agile project management, the main deliverable can be broken down and produced, resulting in a more fit-for-purpose end product. This is because of the heavy emphasis on collaboration and communication, between team members and the client, through frequent reviews and feedback (Lonergan, 2014).

Some of the benefits of the Agile methodology include (Most 5 Valuable Benefits of Agile Methodology, 2018):

1. **More control:** Regular meetings that are part of agile allow project teams to share progress, discuss problems and work out solutions, making the entire process more transparent.
2. **Better productivity:** The incremental nature of the agile method allows products to be rolled out quickly and changes to be easily made at any point during the process.
3. **Better quality:** One big benefit of agile methodology is the ability to find problems and create solutions quickly and efficiently. The flexibility of the agile method also



allows the team to respond to the client's reaction and constantly improve the product.

4. *Higher customer satisfaction*: Close collaboration between the project team and the customer provides immediate feedback. The customer can make tweaks to their expectations and desires throughout the process.
5. *Higher return on investment*: The benefits of the agile method are cutting costs and time to market in half while increasing application quality and customer satisfaction.

In detail, we would implement the Scrum Framework for this project as it is most suitable for this project. As the team doesn't know everything at the start of a project and will evolve through experience.

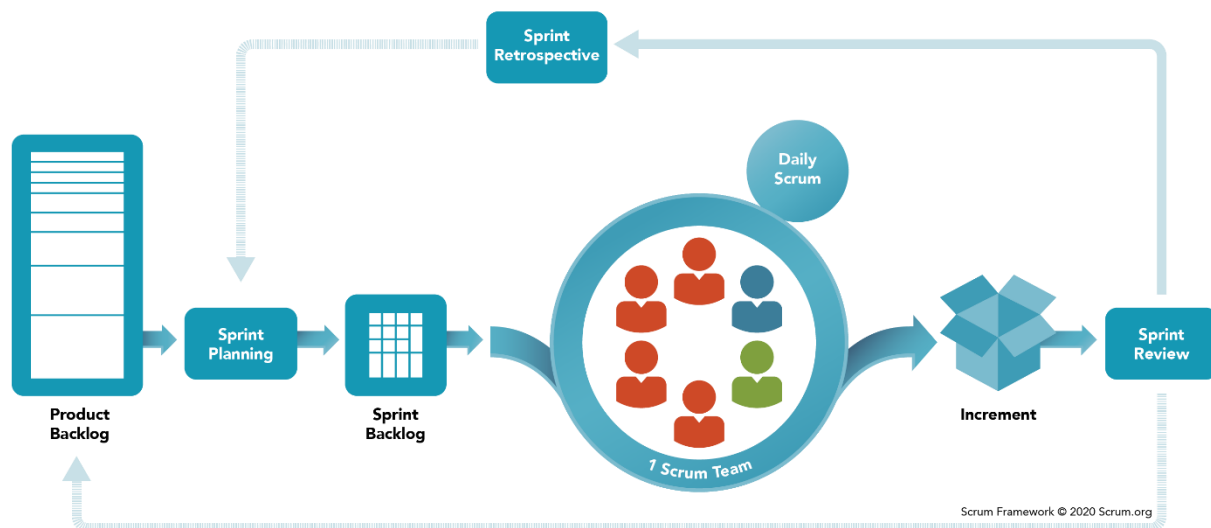


Figure 6 - Scrum Framework

We have discussed and agreed with the supervisor to conduct Scrum meetings once a week (flexible schedule) for about 2 hours to report the progress, as well as to determine the direction and the agenda of the following sprint. Internal team meetings will be held online twice a week to assign and check individual and group tasks. As for meetings with the client, the schedule will be once every two weeks to report, review, and collect feedback, ensuring the project stays on track and corrects to requirements. This frequency is appropriate for the project, both comfortable and sufficient with the busy schedule of the supervisor and the client while maintaining effective communication among team members for instant troubleshooting.

## V.2. PROJECT APPROACH

As a result of the members of my team's existing knowledge and our initial conversation with the client regarding the project's requirements, we decided that the finished product would be released as a website that supports 3-D rendering of human body, with acupuncture points and meridians marked.

Because each team member has knowledge in a certain area of web development, it was mostly based on this that the roles for our project's development phase were assigned.

Table 6 - Team members' roles assigned based on prior experience

Member	Prior experience	Assigned role
<b>Chuong Pham Dinh</b>	Completed the testing documentation for the project, and performed acceptance testing and integration testing for the projects from earlier classes.	Quality Engineer
<b>Nhan Nguyen Cao</b>	Has some background in database management and front-end development. Nhan was also in charge of defining the requirements, finishing the corresponding paperwork, and liaising with the stakeholders in the earlier projects.	Business Analyst & Front-end Developer
<b>Tan Le Tran Ba</b>	Experienced in creating and producing artwork for a variety of extracurricular activities and class projects. Tan has also had experience leading teams and groups for both social and academic endeavors.	Project Manager & Designer
<b>Trang Ho Ngoc Thao</b>	Knowledgeable about developing Back-end side using Node.js-related frameworks and libraries. Trang is the team member with the most NoSQL database development experience.	Back-end Developer

The rendering of the 3-D model on the website was one of the innovative techniques used by our team during this project, which was also regarded as the most difficult one. After some preliminary study, we decided to use the Three.js JavaScript library to complete the work. Three.js is a cross-browser JavaScript library, used by developers to create and display 3-D computer graphics in web browsers, using WebGL. The library is provided with a variety of documentation and has already been implemented in open-source projects, earning it the title of most widely used JavaScript library for 3-D graphics.

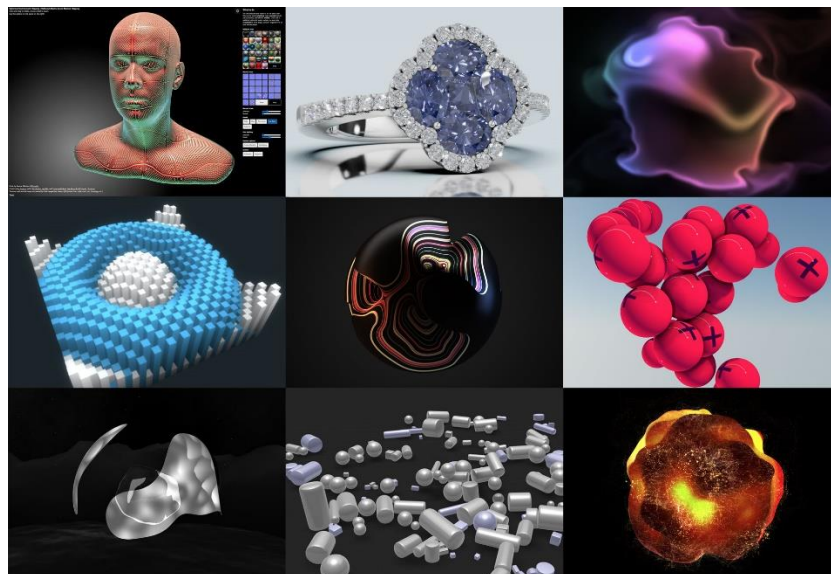


Figure 7 - Some demo projects built using Three.js library

Additionally, we discovered numerous projects that had already been created using Three.js to create 3-D human body models, and as a result, we believe that our proposal for a website with an interactive 3-D human body model and acupuncture features is feasible.

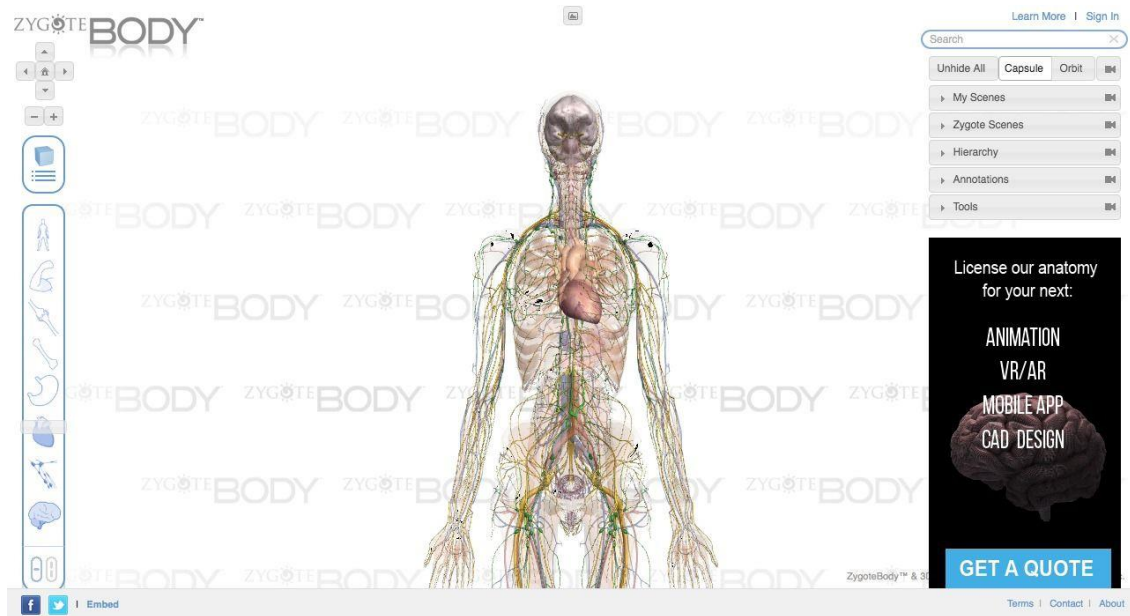


Figure 8 - An existing medical project built using Three.js library

With the help of the market's available supporting libraries and frameworks, we determined, from the above information, that the project idea is technically possible and that it can be used to develop the features. As a result, the project is feasible to implement from the viewpoint of our team.

For this project, we use a Work Breakdown Structure (WBS) to divide the scope into tasks that can be appointed and managed. The tasks will be distributed over 8 months and will be carried out according to each task's priority level. Based on this WBS, we can estimate the total financial and human resources cost and time it takes to complete this project, as well as construct the Gantt chart.

In implementing the Scrum framework for the project, we plan that each Sprint will last for about 2 weeks, covering from 1-2 features. For the 2<sup>nd</sup> Development phase, Sprint can last longer (3 weeks) to handle more complex tasks of the project.

Table 7 - Project's Work Breakdown Structure

Task ID	Task	Predecessor	Estimation (man-days)
<b>1</b>	<b>Proposal</b>		
1.1	Analyze the requirements for the project	-	5
1.2	Define the milestones and schedule for the project	-	3
1.3	Complete the Project Proposal document	1.1, 1.2	7
1.4	Complete the Project Proposal presentation	1.3	5
<b>2</b>	<b>Research</b>		
<b>2.1</b>	<b>Acupuncture</b>		
2.1.1	Read acupuncture research articles, papers	-	10
2.1.2	Understand the data technique used to optimize the acupoint combinations	-	5
2.1.3	Define the workflow for implementing the project from the research's results	2.1.1, 2.1.2	3
<b>2.2</b>	<b>3D Model</b>		
2.2.1	Explore different choices for platforms supporting rendering 3-D	-	7
2.2.2	Define the 3-D rendering framework and libraries to be used for the project	2.2.1	3
<b>3</b>	<b>Upskilling and Resources collection</b>		
<b>3.1</b>	<b>Upskill technical skills</b>		
3.1.1	Learn and practice using the ReactJS library	-	5
3.1.2	Learn and practice using the ThreeJS library	-	15
3.1.3	Learn and practice using the NestJS framework	-	5
3.1.4	Improve and practice Git skills	-	5
<b>3.2</b>	<b>Resources collection</b>		
3.2.1	Find the human anatomy 3-D model	-	5
3.2.2	Collect database about acupuncture points and meridians	-	5
3.2.3	Collect the acupoint combinations from research articles, papers, etc.	-	15
<b>4</b>	<b>Development (phase 1)</b>		
4.1	Design the prototype for the final system	-	3
<b>4.2</b>	<b>Front-end</b>		

4.2.1	Integrate the interactive 3-D model of human anatomy into the site	3.2.1, 4.1	10
4.2.2	Build acupoints marking function on the model	3.2.2, 4.1	10
4.2.3	Build the authentication system	4.1	5
<b>4.2</b>	<b>Back-end</b>		
4.2.1	Build the authentication server	-	8
4.2.2	Design the structure for a database	-	5
4.2.3	Fill up acupoints for the database	3.2.2	7
<b>4.3</b>	<b>Testing</b>		
4.4.1	Test the 3-D human body anatomy model	4.2.1	5
4.4.2	Test the display and information displayed on the acupuncture points	4.2.2, 4.3.3	5
4.4.3	Test the authentication features	4.2.3	5
4.4.4	Complete the testing document for phase 1	4.4.1, 4.4.2, 4.4.3	5
<b>5</b>	<b>Development (phase 2)</b>		
<b>5.1</b>	<b>Front-end</b>		
5.1.1	Build the meridians management system	3.2.2, 4.2.1, 4.2.2	
5.1.2	Build the acupuncture treatment system	3.2.2, 3.2.3, 4.2.1, 4.2.2	
<b>5.2</b>	<b>Back-end</b>		
5.2.1	Build the server and storage for meridians	3.2.2	
5.2.2	Build the recommendation server for acupuncture treatments	3.2.2, 3.2.3	
<b>5.3</b>	<b>Testing</b>		
5.3.1	Test the display of meridians and information	5.1.1, 5.2.1	10
5.3.2	Test the acupuncture treatment system	5.1.2, 5.2.2	10
5.3.3	Complete the final testing document	4.4.4, 5.3.1, 5.3.2	8
<b>5.4</b>	<b>Deployment</b>		
5.4.1	Deploy the Front-end side of the system	4.2, 5.1	5
5.4.2	Deploy the Back-end side of the system	4.3, 5.2	5
5.4.3	Perform integration testing	5.4.1, 5.4.2	10

### V.3. PROJECT MANAGEMENT TOOLS

Every good project needs a set of good tools. Here is a set of tools that our team will utilize in this project, most of which are familiar to our team:

*Table 8 - Selection of PM Tools to be used for the project*

Purpose	Tool
Issue and Project Tracking	Jira
Documentation	Microsoft Office, Google Docs, Google Sheets, Notion
Diagram	Lucidchart, draw.io, StarUML
Prototype	Figma
IDE	Visual Studio Code
Testing	Jest, Puppeteer, Apache JMeter
Version Control	Github
Storage	Google Drive
Worklog	Toggl
Communication	Microsoft Teams
Screen Capture and Recorder	OBS Studio, Bandicam

## VI. PROJECT PLAN

### VI.1. PROJECT TIMELINE

The following images show our initially planned Gantt Chart for the important tasks of the project. The project is planned to last from October 2022 and finish in the second half of May 2023. The empty slots would be kept for reservation, to be used during the project if there are emergency cases and more time is required to complete the Sprints.

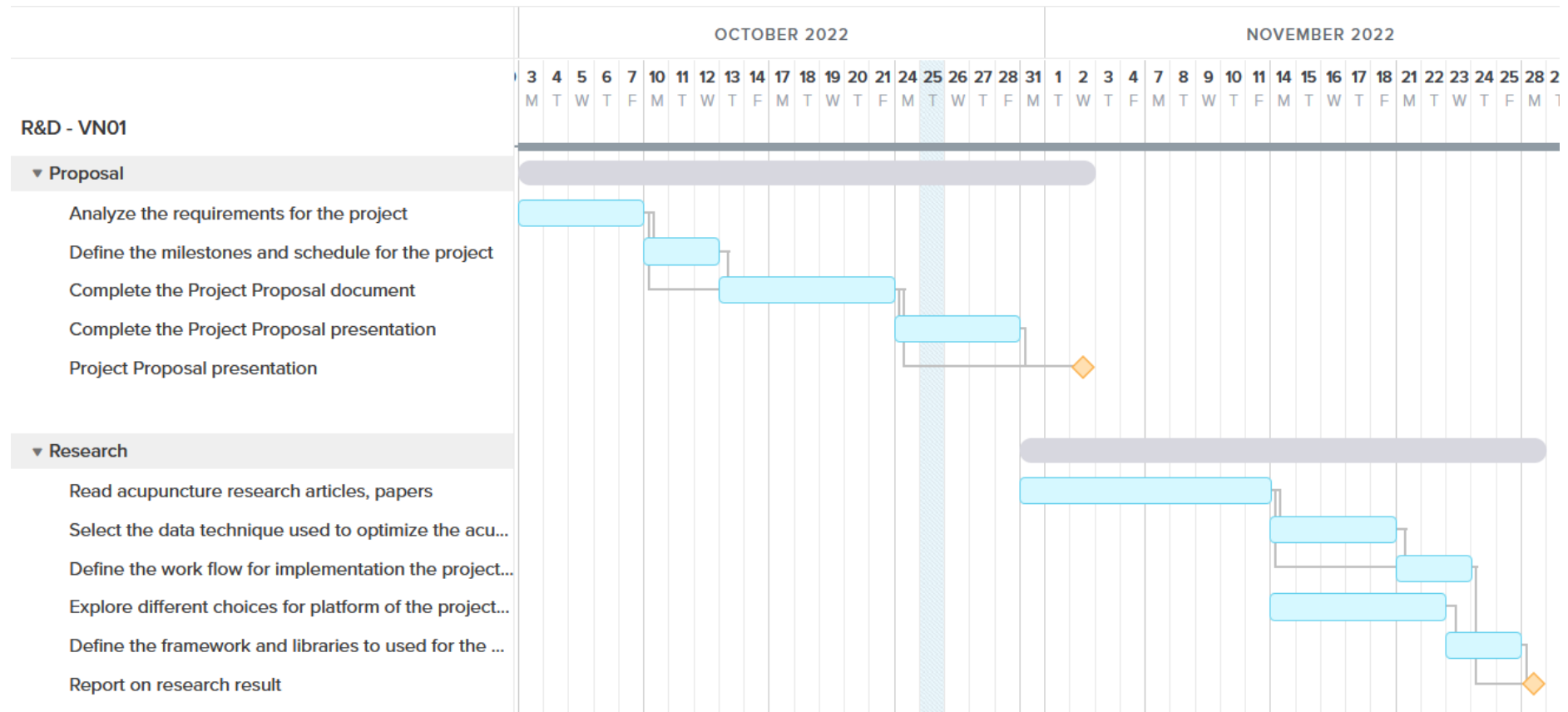


Figure 9 - Gantt Chart for Proposal and Research phases

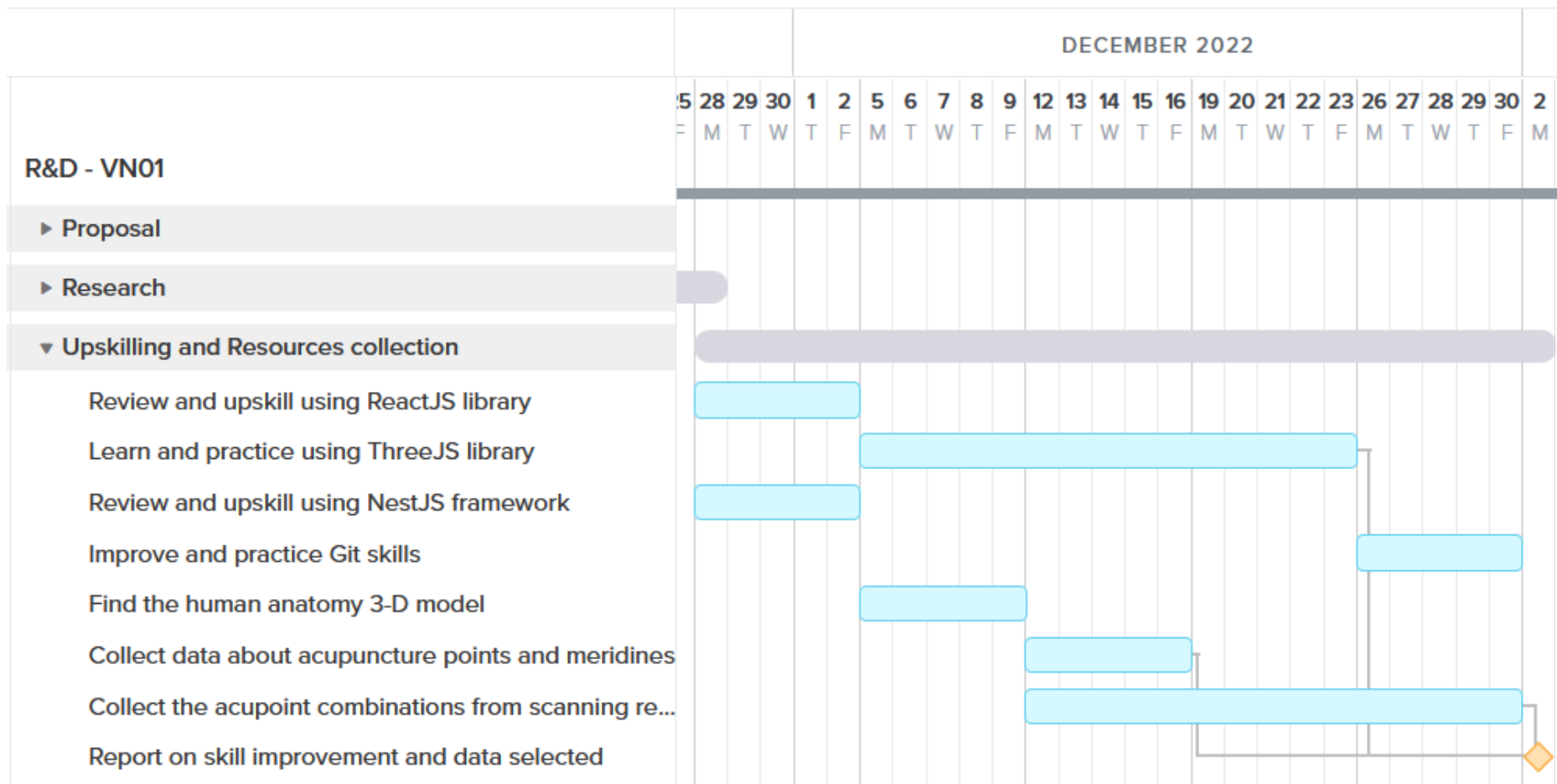


Figure 10 - Gantt Chart for Upskilling and Resources collection phase



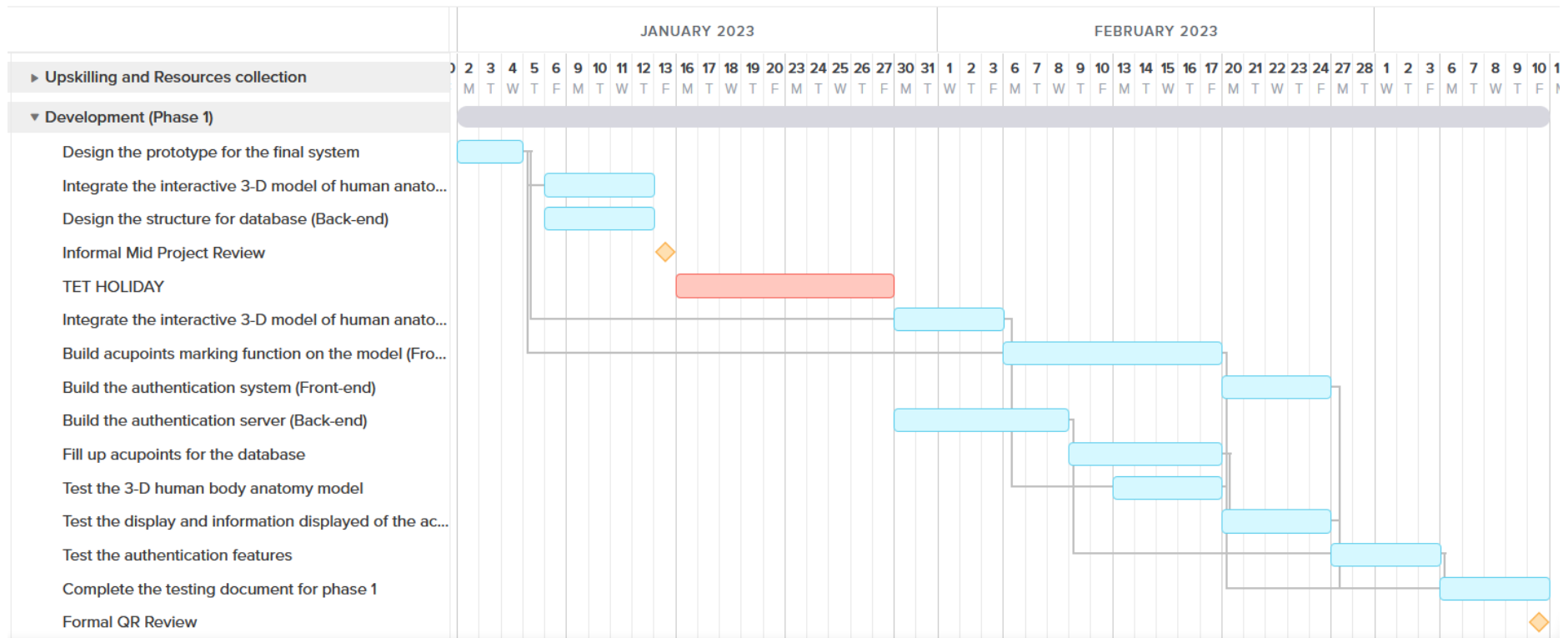


Figure 11 - Gantt Chart for Development (phase 1)

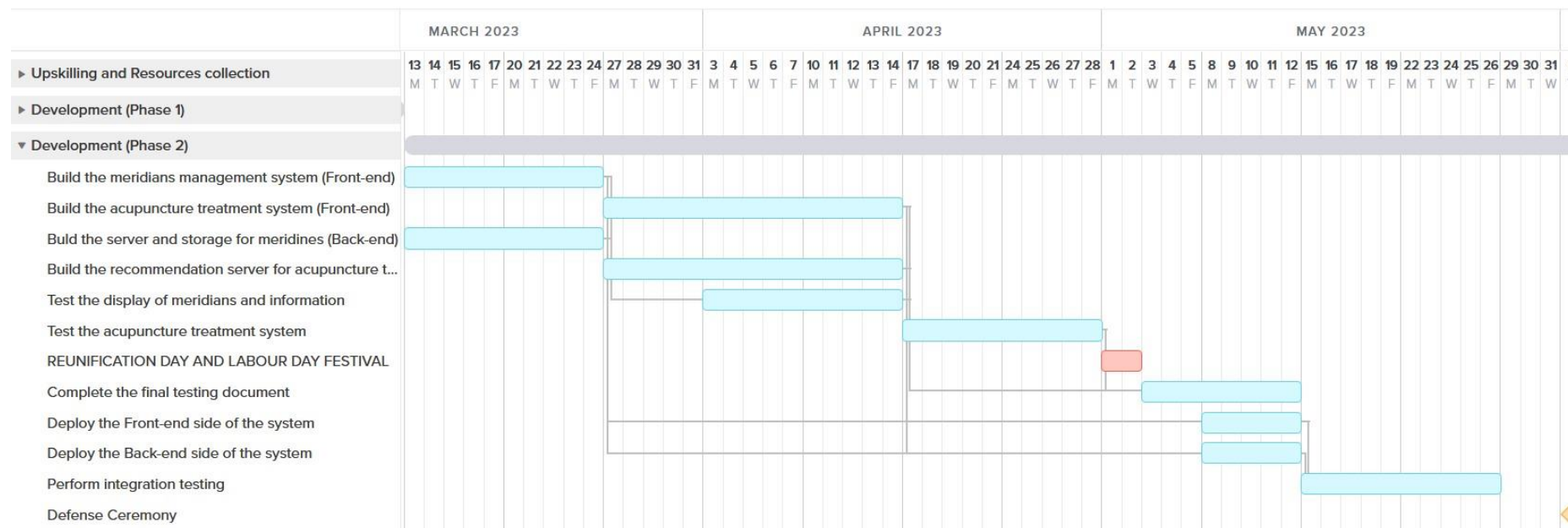


Figure 12 - Gantt Chart for Development (Phase 2), up to the Defense Ceremony

## VI.2. PROJECT RISKS

Table 9 - Project Risk Response Plan

Risk ID	Risk Description	Risk Likelihood	Risk Impact	Preventative Actions	Mitigation Actions
1	Scope and requirements mismatch	3 – Medium	4 – High	Discuss and understand the requirements with the client clearly at the initial meetings Continuously verify the requirements during the sprints	Contact the client to verify the requirements again and make changes to the following sprints
2	Scheduling problem: conflicts in the schedule between the project implementation and the school schedule	3 – Medium	3 – Medium	Divide the working time for each week for both: school works and the R&D project Consider the schedule of school tasks, and exams when planning the sprints the for R&D project	Reorganize and replan the process, prioritize the tasks based on the allocated time for the R&D project
3	Illness problem: team member(s) are infected with diseases and have to pause the assigned tasks for some time	2 – Low	4 – High	None (considered emergency)	Select the critical tasks from the infected member(s) and divide them among the others, the remaining tasks will be pushed to a later sprint, when the infected member(s) has recovered.
4	Tools problem: deprecated library or service run out	3 – Medium	4 - High	Select multiple alternatives at the beginning to swap in case of depreciation.	Move to the prepared alternative libraries and services. Re-plan the sprints, including reperforming the tasks affected by the problem

5	Communication problem: lost contact with the client	4 – High	5 – Critical	None (considered emergency)	Note multiple contact gateways to be able to reach the client if the main contact method is inaccessible.  Prepare an alternate plan of how to proceed with the project during the period of not being able to contact the client.
6	Skills problem: lack of required skills or skill levels to perform a task	3 – Medium	4 – High	Plan at the first step set of tools and skills used during the project, to come up with an early plan for upskilling.  Prioritize tools that are more familiar during the	Consider moving temporarily to a more familiar tool, and discuss with the client to reduce the scope based on the range of the new tool.
7	Members drop out: a member withdraws from continuing with the project	1 – Very low	5 – Critical	During the sprints, the team should discuss risks that may happen during the next sprints, especially emphasizing the intention of withdrawal to be able to early prepare if there exists the probability.	Redefine the scope and requirements of the project, and reduce and modify to match the new team size.  Discuss with the client immediately about the new set of requirements and scope, mentioning the reduction in team size.
8	Schedule problem: team member(s) failed to catch up with the planned schedule	4 – High	4 – High	Keep track of each member's progress and identify the failure to catch up with the schedule early	Help the team member(s) to resolve any problems existing, and note the strong and weak points for better task division during the later sprints.

## VII. SKILLS ANALYSIS

### VII.1. TOOLS AND SKILLS INVOLVED

Those are some of the tools and skills set defined by our team as involved in this project, categorized by the groups of related items:

- **Front-end Development:**
  - **React.js:** a JavaScript front-end library for building user interfaces based on UI components, maintained by Meta and a community of developers and companies. React.js will be used as the main building library for the Front-end side of the project.
  - **Three.js:** a cross-browser JavaScript library and API used to create and display animated 3-D computer graphics in a web browser using WebGL. Three.js will be used as the main library for handling the rendering of 3-D models in the final product's user interface.
- **Back-end Development:**
  - **NestJS:** a progressive Node.js framework for building efficient, reliable, and scalable server-side applications. NestJS will be used as the main framework for building the server side of the final system.
- **Databases:**
  - **MySQL:** will be used as the DBMS for a relational database storing a part of the data of the system.
  - **MongoDB:** a cross-platform document-oriented database program. MongoDB will be implemented as a NoSQL database for storing some data of the system.
- **Continuous Integration / Continuous Delivery:**
  - **CircleCI:** will be used to implement the DevOps practices, including Continuous Integration from the source code repository and Continuous Delivery to the deployment site.
- **Testing:**
  - **Jest:** a JavaScript testing framework developed and maintained by Meta. Jest will be used as the framework for writing and testing the unit tests for both the Front-end and Back-end side of the project.
  - **Puppeteer:** a Node.js library that provides a high-level API to control Chrome/Chromium over the DevTools Protocol. Puppeteer will be used as the library to implement automation testing for the Front-end of the project.
  - **Apache JMeter:** an Apache load testing tool for analyzing and measuring the performance of a variety of services. Apache JMeter will mainly be used in the Back-end side of the project for load testing and unit testing.
- **Package manager and version/dependency management:**
  - **npm:** a package manager for the JavaScript programming language, which is the default package manager for the JavaScript runtime environment Node.js

- **Git and Github:** Git is a software for distributed version control, and Github is an Internet hosting service for software development and version control using Git.
- **Deployment:**
  - **Vercel:** Vercel will be used to deploy the Back-end server of the system.
  - **Firebase Hosting:** Firebase Hosting will be used to deploy the Front-end side of the system.
- **Soft skills**
  - **Self-discipline**
  - **Teamwork**
  - **Professionalism**
  - **Critical thinking**
  - **Working under pressure**
  - **Documentation**
  - **Presentation**

## VII.2. SKILLS ANALYSIS MATRIX

Table 10 - Skills analysis matrix

Group	Skill	Chuong Pham Dinh				Nhan Nguyen Cao				Tan Le Tran Ba				Trang Ho Ngoc Thao				Total
		<1	1-3	3-5	>5	<1	1-3	3-5	>5	<1	1-3	3-5	>5	<1	1-3	3-5	>5	
Front-end	React.js		✓					✓			✓				✓			10
	Three.js	✓					✓			✓				✓				2
Back-end	NestJS	✓					✓			✓						✓		6
Databases	MySQL			✓					✓			✓				✓		18
	MongoDB		✓				✓				✓					✓		10
CI/CD	CircleCI		✓					✓			✓					✓		12
Testing	Jest			✓				✓			✓					✓		14
	Puppeteer			✓			✓				✓				✓			10
	Apache JMeter		✓				✓				✓					✓		10
pm, version, and dependency management	npm		✓					✓			✓						✓	14
	Git & Github		✓						✓			✓					✓	18
Deployment	Vercel		✓					✓			✓					✓		12
	Firebase Deploy		✓						✓		✓					✓		14
Soft skills	Self-discipline			✓				✓				✓				✓		16
	Teamwork				✓			✓					✓				✓	22
	Professionalism			✓				✓				✓				✓		16
	Critical thinking			✓				✓				✓				✓		16
	Working under pressure			✓			✓						✓			✓		14
	Documentation			✓					✓		✓					✓		16
	Presentation				✓		✓						✓		✓			16

## VIII. COSTS ESTIMATION

Table 11 - Project's costs estimation

Element	Unit cost	Total cost
Transport	50\$ / member	200\$ (4 members)
Academic material (research articles, papers, etc.)	1.5\$ / private paper	75\$ (est. 50 private papers)
Supplies (Stationaries, Printing, etc.)	20\$	20\$
Salaries	100\$ / month / member	2,800\$ (est. 7 months, for 4 members)
Infrastructure (3 <sup>rd</sup> party services, hosts, platforms, domain, etc.)	150\$	150\$
3-D model of human body anatomy	100\$	100\$
Mentor's hour	142\$ / hour	7,952\$ (2 hours/week, est. 7 months)
Utility consumption (electricity, water, etc.)	Free	Free
<b>Total</b>		<b>11,297\$</b>



## IX. APPENDICES

### Auckland University of Technology Bachelor of Computer & Information Sciences

#### Research & Development Project

##### Disclaimer:

**Clients should note the general basis upon which the Auckland University of Technology undertakes its student projects on behalf of external sponsors:**

While all due care and diligence will be expected to be taken by the students, (acting in software development, research, or other IT professional capacities), and the Auckland University of Technology, and student efforts will be supervised by experienced AUT lecturers, it must be recognized that these projects are undertaken in the course of student instruction. There is therefore no guarantee that students will succeed in their efforts.

This inherently means that the client assumes a degree of risk. This is part of an arrangement, which is intended to be of mutual benefit. On completion of the project it is hoped that the client will receive a professionally documented and soundly constructed working software application, some part thereof, or other appropriate sets of IT artifacts, while the students are exposed to live external environments and problems, in a realistic project and customer context.

In consequence of the above, the students, acting in their assigned professional capacities and the Auckland University of Technology, disclaim responsibility and offer no warranty in respect of the “technology solution” or services delivered, (e.g. a “software application” and its associated documentation), both in relation to their use and results from their use.

## CONTACT INFORMATION

### Development team:

ID	Fullname	Role	Phone number	Email
21142643	Chuong Pham Dinh	Quality Engineer	+84 842 231 056	rdz6635@autuni.ac.nz
21142377	Nhan Nguyen Cao	BA & Front-end Developer	+84 704 448 681	mmr6179@autuni.ac.nz
21142355	Tan Le Tran Ba	Project Manager and Designer	+84 915 592 659	xkk1463@autuni.ac.nz
21142358	Trang Ho Ngoc Thao	Back-end Developer	+84 708 083 600	yzn9799@autuni.ac.nz

### Client:

Title	Fullname	Role	Phone number	Email
Mr.	William Liu	Client	5210 (AUT)	william.liu@aut.ac.nz

### Client company:



#### FromLabs Pte. Ltd

SG office: 8 Burn Road, Singapore 369977

VN office: International Plaza, 343 Phạm Ngũ Lão, Phạm Ngũ Lão Ward, District 1, Ho Chi Minh City, Vietnam 700000

Tel: +65 9235 4689, +1 917 410 0388

Email: info@fromlabs.com

Title	Fullname	Role	Phone number	Email
Mr.	Petteri Kaskenpalo	Company's Contact person	28699 (AUT)	petteri.kaskenpalo@aut.ac.nz

### Supervisor:

Title	Fullname	Role	Phone number	Email
Mrs.	Nhan Le Thi	Supervisor	-	ltnhan@fit.hcmus.edu.vn

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