AUT UNIVERSITY
NEW ZEALAND

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:

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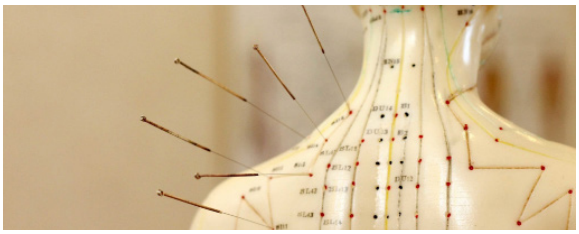

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1.1	30 Oct 2022 16:30	Added information about new technology and feasibility evaluation in the Project Approach section.	**Nhan Nguyen Cao** (*21142377*)
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2.0	27 Nov 2022 22:18	Modified the section to match with new approach for the project, including the changes of stakeholders, functional requirements and plans for different phases.	**Nhan Nguyen Cao** *(21142377)*

2.1	01 Jan 2023 15:50	Minor fix in the Gantt chart to match with new plan and schedule presented in Informal QR Review	**Nhan Nguyen Cao** *(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.

Learning traditional medicine in general or acupuncture in particular is never a simple process. It is a difficult task to locate the acupuncture points accurately, as well as to study their functionalities, the necessary injecting methods, and be aware of which acupuncture points should be related for common diseases or symptoms. This is especially true for medical university students, intern acupuncture practitioners, and doctors who have very little experience performing the treatments.

Considering this, the proposed project aimed to resolve these problems by researching and developing a 3-D acupuncture healthcare data management and treatment system. The system would be a helpful tool for students studying traditional medicine or acupuncture because it would allow them to interact, visualize, and gain experience finding and remembering important details about acupuncture points on the human body.

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 acupoints, 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. Although acupuncturists may choose different combinations of acupuncture points depending on the disease or symptom they are treating and the Traditional Chinese Medicine school they are attending, it is essential for all acupuncturists to have a basic understanding of the key points and know how to trigger them correctly to minimize the risk of harming the internal organs.

Therefore, a needed solution in the field of acupuncture is having a related data and treatment management system to assist the learners, students or inexperienced acupuncturists to learn about the meridians and acupuncture points more visually and more effectively.

II.2. PROBLEMS AND OPPORTUNITIES

Despite the fact that there is a wealth of information related to the practice of acupuncture, such as knowledge of the body's 12 major meridians and 8 extraordinary meridians, or knowledge of the hundreds of acupuncture points identified by the ancient Chinese people, including their locations and functions, as well as knowledge of how to safely and correctly stimulate them while being aware of the their anatomy locations and surrounding internal organs, there is still much to learn.

While our team has just spent a month conducting research on the ground, one of the challenges we have encountered is that although there appear to be several sources of information, they are not always reliable. A comprehensive data system that would enable professionals working in the field, particularly less experienced students, to look up reliable information during the study is one thing the area of acupuncture lacks.

Additionally, the physical model of the human body is still how most modern acupuncturists study. However, it is not always possible to utilize them because they are

typically quite expensive and only accessible in schools, hospitals, clinics, or laboratories. Learning to locate the acupuncture points is a very difficult task without the observation on a model or on a real human body. Imagine having the identical model available digitally rather than physically; this may be a tremendously effective method for helping students learn by using images to help them recall the concepts

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 simulation aimed to provide acupuncture students with a platform to look for reliable knowledge and information related to their field of interest, as well as a good companion that makes it much easier for them to study the acupuncture points, meridians, and important acupuncture locating techniques, with relation to other fields of medicine, in a way that is efficient and simple.

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

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, Designer	Managing different phases and sections of the project, as well as supporting the design tasks involved within the project.
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.

II.6. SPECIALIST CONSULTANTS

We consulted with two acupuncturists in Vietnam, who are also lecturers in traditional medicine at two famous universities of medicine and pharmacy in Vietnam, to ensure the accuracy of the information and knowledge about acupuncture included in the project's final product. The acupuncturists who are serving as our team's specialist consultants have the following profiles:

- **MMed. Minh Ma Hoang**: with 15 years of experience in acupuncture, doctor Minh is one of the most popular acupuncturists in Ho Chi Minh City, Vietnam. He has a deep knowledge of traditional medicine, as well as understanding of the modern technology applied in medicals. Mmed. Minh is currently also a lecturer of traditional medicine from Ho Chi Minh City Medicine and Pharmacy University.

- **MMed. Van Le Thi Tuong**: is currently a lecturer of traditional medicine at Pham Ngoc Thach University of Medicine, Ho Chi Minh City. She has many years of experience as a lecturer, as well as working as a private acupuncturist in clinics, and especially contributed as a medical supporter for the national basketball team of Ho Chi Minh City.

The two acupuncturists agreed to be involved with the team during the implementation of the project, not only to provide the trustful specialized information and sources to collect data, but also to validate the validity, accuracy and effectiveness of our final product. Although not being the main end-users, since both acupuncturists are also lecturers, they would support the team in distributing the final product among their students at university.

III. RATIONAL FOR THE PROJECT

III.1. NEEDS FOR THE PROJECT

The significance of acupuncture points has made them one of the core ideas of traditional Chinese medicine. Building a data management system, which ensures that the information included within the system is accurate and has been medically verified, has been a long-standing challenge due to the vast amount of data in the industry.

The need for a system to be widely used as a companion for 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. By offering various visualization techniques and reliable data management, this system should increase the effectiveness of learning about and remembering the acupuncture points. This will undoubtedly aid in-field learners, particularly medical university students and inexperienced intern acupuncturists, in their extracurricular study and review when they are unable to access the physical model used in the lectures. Furthermore, using the Covid-19 pandemic as an example, we would all need to be prepared to teach and learn online in case of any emergency situations. Involving a tool like the system of this project will undoubtedly change the game for both the students and the lecturers in terms of how they distribute their lectures.

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 the one who is interested in the field and want to explore and understand more about acupuncture with trustful specialized information.

III.2. FOCUSES OF THE PROJECT

There are currently no digital data management system that was medically verified to be accurate, or approved by the trustful source of the data collected, 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.

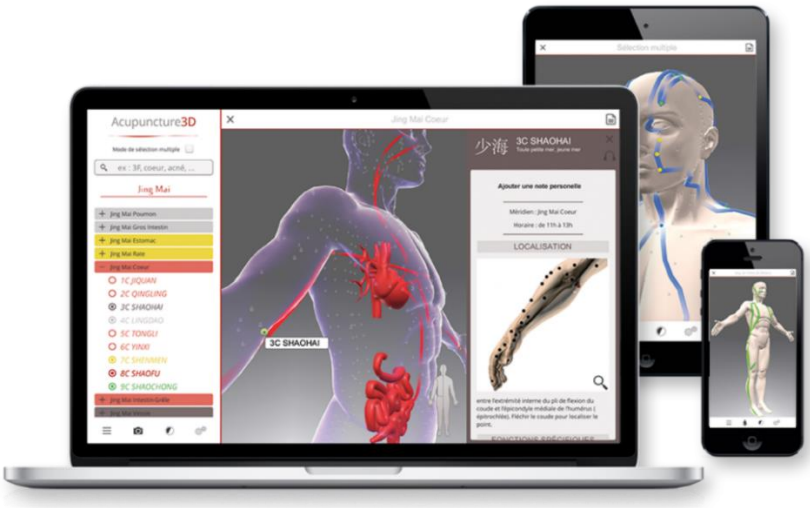

Figure 2 - One of the best existing systems supports studying and upskilling in acupuncture (Coulais, n.d.)

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 plan to collect data from the trustful sources of information suggested by our specialist consultants, or from their shared personal documents, and also from the libraries supported by prestigious medical institutions. We plan to also collect the data from some of the research papers, with the hope that it could provide the team with better guidelines during the modeling step.
- *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 about acupuncture and knowledge involved within the field, such as the locations, functionalities, injection methods of the points, or the important meridians of human body.

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 and collection 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, such as the acupuncture points, the meridians, etc, from trustful sources suggested by the specialist consultants. The final product includes a 3-D model platform for acupuncture exploration and learning, with the acupuncture

points, 14 meridians (including 12 main meridians and 2 extraordinary meridians) 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 research papers and official information sources that are commonly accepted in acupuncture, to be stored as a database for the system to promote exploration and learning about the field.
- A 3-D model website for interacting and understanding acupuncture treatments.
- A 3-D model with different display modes (including external anatomy mode – viewing from the external skin, and the internal anatomy mode – viewing with the muscles and internal organs included) of human body.
- 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.
- 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.
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 the 12 standard meridians and 2 extraordinary meridians (Ren Meridian and Du Meridian) on the 3-D model of human body.
4	The system should allow users to view the acupuncture points marked on the meridians on the 3-D model of human body.
5	The system should allow users to view the information about the meridians by clicking on them on the 3-D model of human body.
6	The system should allow users to view the information about the meridians by clicking on them on the 3-D model of human body.
7	The system should allow users to switch between the viewmode of two different types of 3-D model for human body: external anatomy model and internal anatomy model.
8	The system should allow administrators and authorized users to manage and insert, update the information of acupuncture points and meridians with a dashboard.

9	The system should allow users classified as students to save the acupuncture points or meridians to collections for reviewing.
10	The system should allow users classified as students to attempt quizzes on the acupuncture points and meridians.
11	The system should allow users classified as teachers to add notes to the acupuncture points or meridians, and save into collections for displaying during the lectures.

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

Our team and the customer have decided that the finished product would be made available as a website that can be accessed using the most recent versions of various browsers. The final product will be released in two versions, and the following is a thorough description of each one:

Version 1: The website must be styled in accordance with the final product's design and prototype. These are some of the features that will be present in this version:

- The 3-D model of cut-off human body is rendered into the browser's interface.
- The acupuncture points are marked with proper locations on the 3-D model of human body.
- The authentication system should be done successfully for users to sign in and manage their personal information.
- The 3-D model should provide basic interactions for the users, such as spinning, zoom in, zoom out, and users can also click on the acupuncture points to view the related information to that point.

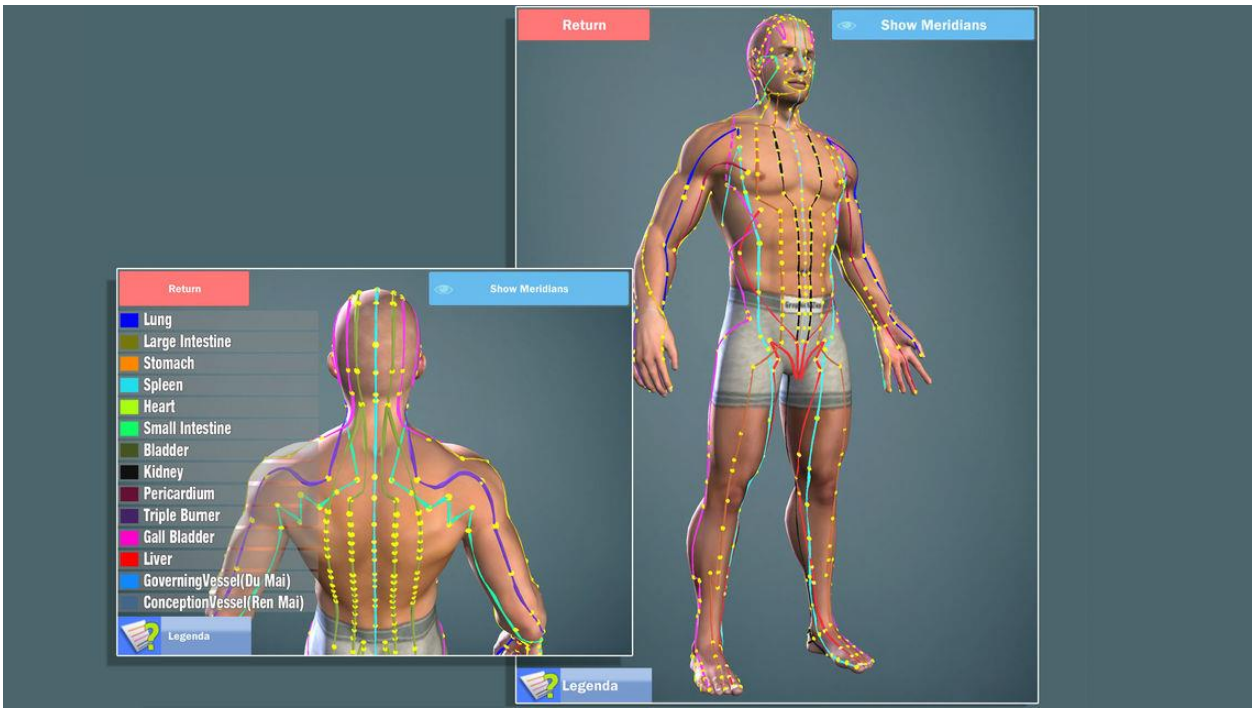

Figure 3 - The first version of the final product is expected to be similar to this

Version 2: All of the expected functionalities for the final system should be completed:

- The meridians of the human body are displayed on the 3-D model, which has been done in version 1.
- The system should provide different viewing mode for the 3-D model, including:
  - External anatomy mode: viewing the acupuncture points and meridians on the 3-D model displayed from the point of view of the outer skin.
  - Internal anatomy mode: viewing the acupuncture points and meridians on the 3-D model displayed from the point of view of the internal muscles and organs.
- The system should provide a dashboard for data management, that allows the authorized users to update, insert the data involved in the system.
- *(If there is still time available)* The system should provide different additional functionalities that support lecturing and reviewing on the 3-D model, such as taking quizzes (locating points and meridians based on provided information), or adding notes, creating collection of points to be displayed, etc.

The initial planning for the architecture design of our final system is as follows:

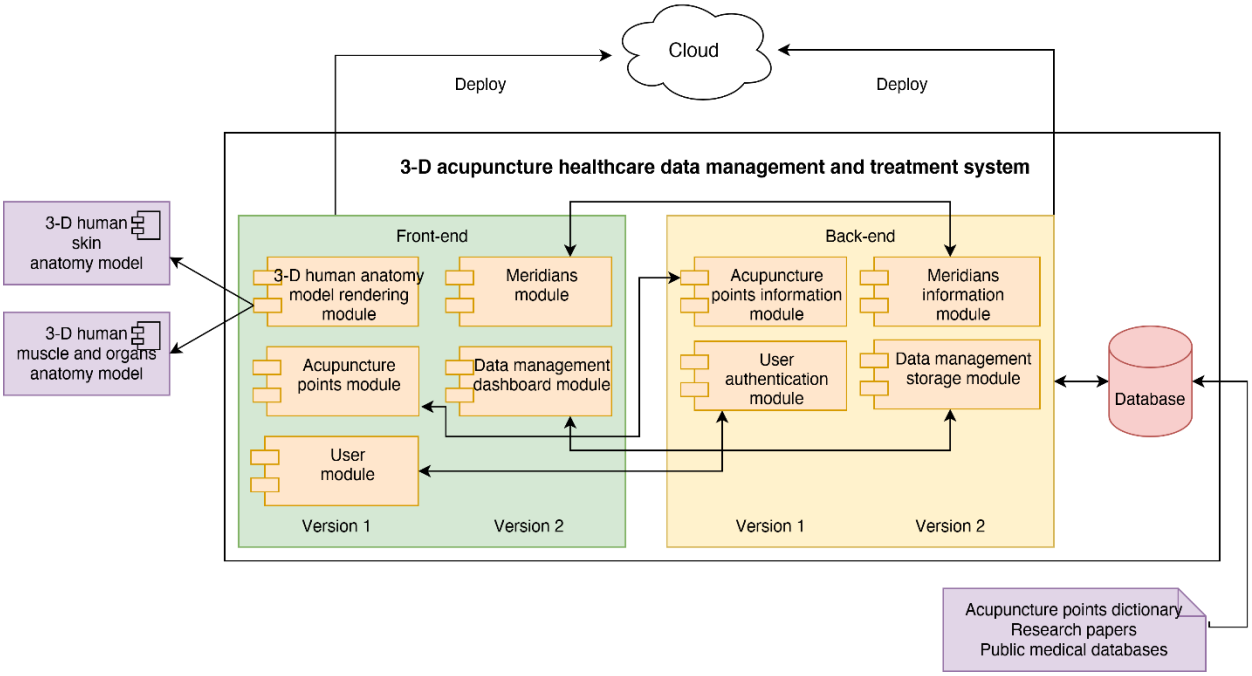

Figure 4 - Architecture design for the final system

Basically describing, the system is divided into 2 parts: the Front-end side and the Back-end side, which will later be deployed into the cloud after completion. A set of different modules and components are defined, including:

Table 5 - Modules and components of the final system

Side	Module / Component	Description
External	Components: 3-D human skin anatomy model + 3-D human muscle and organs anatomy model	The external 3-D models of the human body anatomy, provided in the 3-D model markets. The selected 3-D models would be used as the core model to be rendered for the system (more details would be added to the model). The uses of two models would provide 2 viewing mode for the final 3-D model of the system.
Front-end (Version 1)	Module: 3-D human anatomy model rendering module	The module is responsible for the application of the selected 3-D graphics library to render the 3-D model to the web browser and add the additional acupuncture points and meridians to the model. The module is also responsible for handling different view mode for the 3-D anatomy model of the final system.
	Module: Acupuncture points module	Handle the retrieval of information about the locations and related scientific information of the acupuncture points.

	Module: User module	Handle the basic authentication functionalities for the UI side of the final system.
Front-end (Version 2)	Module: Meridians module	Handle the retrieval of information about the locations and related scientific information of the meridians inside the human body.
	Module: Data management dashboard module	Providing the dashboard interface for authorized and admin users to insert, modify or remove the information stored within the system, ensuring the accuracy of the data from the specialized point of view.
Back-end (Version 1)	Module: Acupuncture points information module	Responsible for providing the locations and scientific information of the acupuncture points for the Front-end side to render the 3-D model and display to the users on purpose.
	Module: User authentication module	Responsible for retrieving information, and handling the authentication for the system.
Back-end (Version 2)	Module: Meridians information module	Responsible for providing the locations and scientific information of the meridians inside the human body for the Front-end side.
	Module: Data dashboard module	Responsible for communicating with the database and provide a data sending and receiving endpoint from the server side, to support the working of the Data management dashboard module in Front-end side.
Database	Component: Database	The core data storage for the complete system: from the data generated within the system to the data collected from research and collection phases, to provide for the modules in handling the tasks of the system.

IV.5. KEY MILESTONES

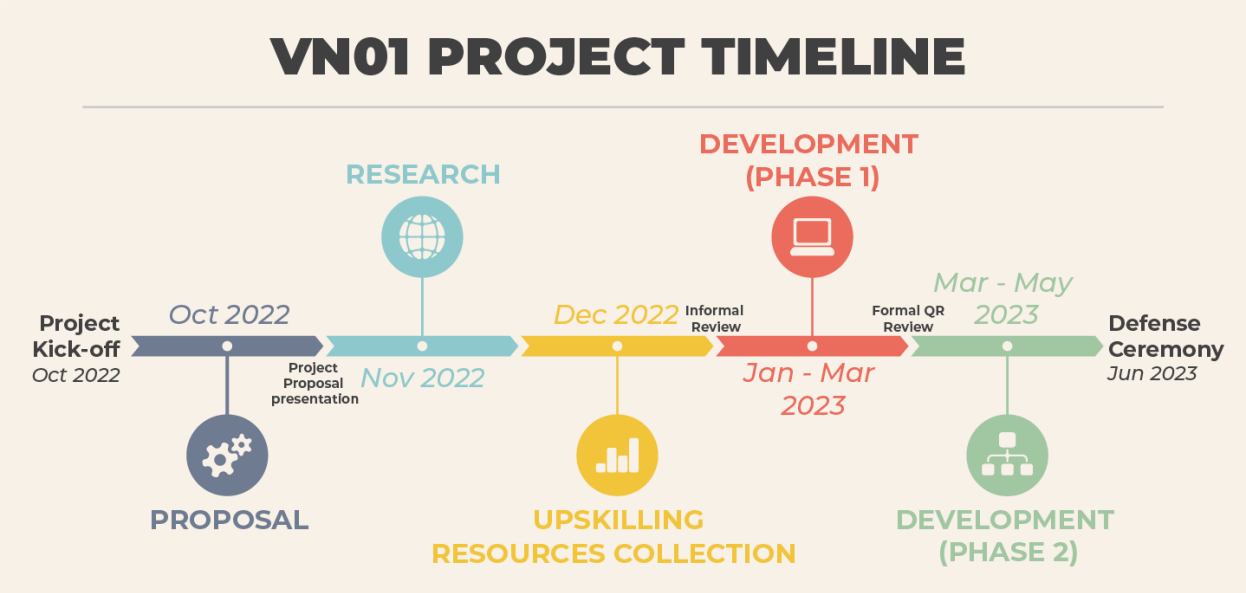

Figure 5 - Project timeline

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 6 - Project's key phases and milestones

Phase	Description	Milestone	Planned Schedule
Proposal	Deliver the Project Proposal document for the project, and evaluate the feasibility of the project	Project Proposal Presentation *(early November 2022)*	October 2022
Research	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
Upskilling & Resources Collection	Related data would be collected to be used later for the final system. Acquire the required skills for implementation of the project: data collection skills and techniques, 3-D development skills, etc.	Report on skill improvement and data selected *(at the end of December 2022)* Informal QR Review *(January 2023)*	December 2022
Development (phase 1)	Build the first version of the system with basic interactive features and the rendering of the 3-D model.	Formal Midterm Review *(mid-March 2023)*	January – early March 2023

Development (phase 2)	Develop the final project with all defined requirements.	Defense Ceremony *(at the beginning of June 2023)*	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 6 - 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.

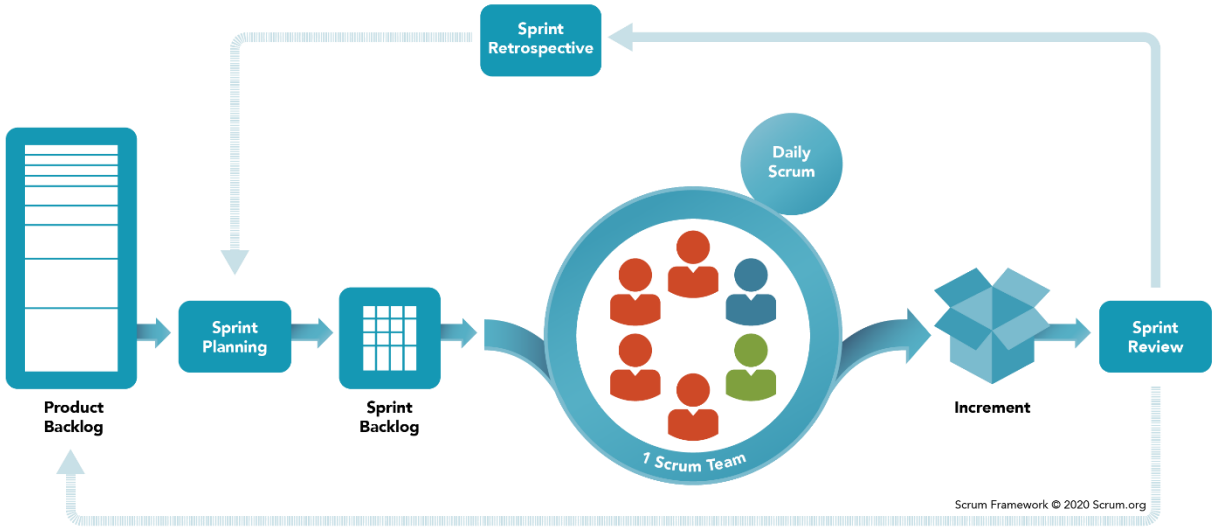

Figure 7 - Scrum Framework

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 7 - Team members' roles assigned based on prior experience

Member	Prior experience	Assigned role
Chuong Pham Dinh	Completed the testing documentation for the project, and performed acceptance testing and integration testing for the projects from earlier classes.	Quality Engineer
Nhan Nguyen Cao	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
Tan Le Tran Ba	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
Trang Ho Ngoc Thao	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.

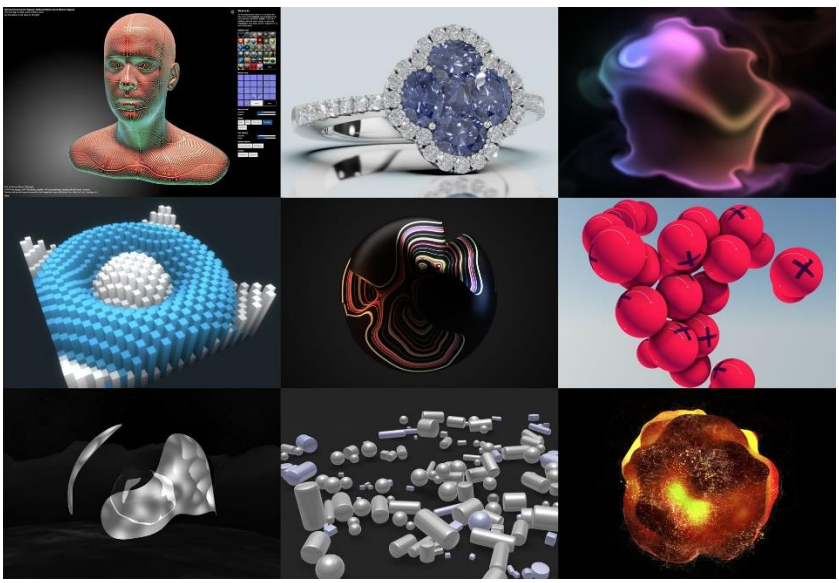

Figure 8 - Some demo projects built using Three.js library

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.

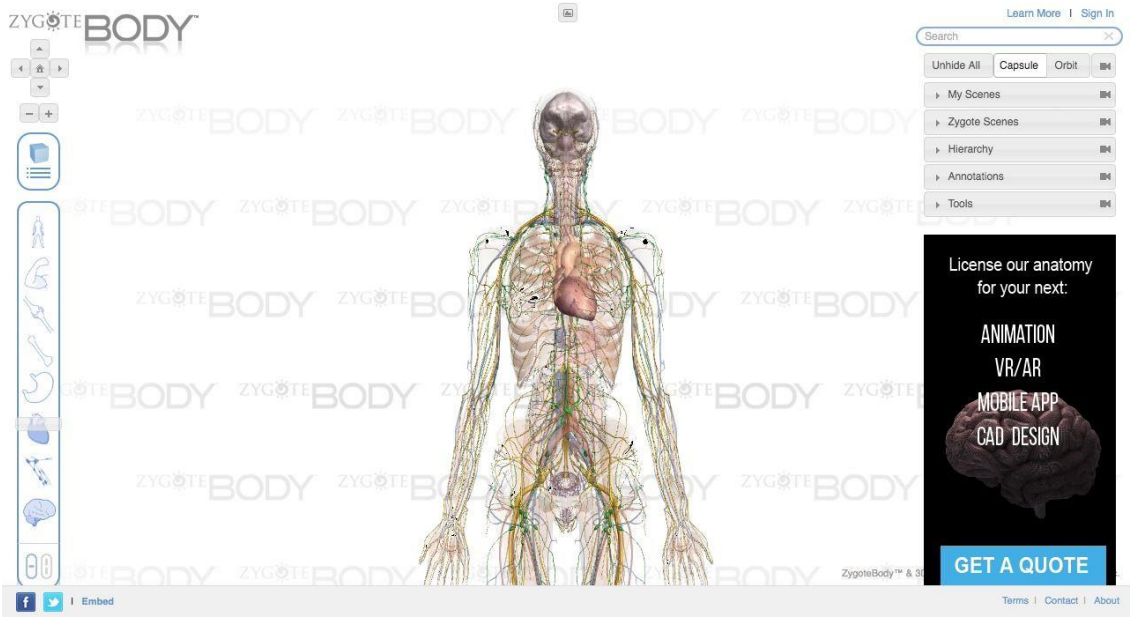

Figure 9 - An existing medical project built using Three.js library

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 2nd Development phase, Sprint can last longer (3 weeks) to handle more complex tasks of the project.

Table 8 - Project's Work Breakdown Structure

Task ID	Task	Predecessor	Estimation (man-days)
1	**Proposal**		
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
2	**Research**		
2.1	**Market and technical research**		
2.1.1	Perform technical research for the 3-D model to implement	-	5
2.1.2	Perform market research for similar product	-	5
2.2	**Specialized requirements**		
2.2.1	Interview the acupuncturists to discuss for scope of usage and requirements	-	2
2.2.2	Analyze the requirements + plan for stakeholders	2.2.1	3
2.2.3	Interview with the medical university students to get the requirements	2.2.2	2
2.2.4	Analyze the requirements from the medical students	2.2.3	3
2.2.5	Sum up the final set of functional requirements	2.2.2, 2.2.4	2
2.3	**Sum up the research results**		
2.3.1	Define the work flow for implementation the project from research's results	2.1.1, 2.1.2	3
2.3.2	Explore different choices for platform of the project, that supports rendering 3-D	-	7
2.3.3	Define the framework and libraries to use for the project that support 3-D rendering	2.3.2	3
3	**Upskilling and Resources collection**		
3.1	**Upskill technical skills**		
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
3.2	**Resources collection**		

3.2.1	Collect images for the human anatomy 3-D model	-	5
3.2.2	Collect data about 14 meridians to use from suggested books	-	5
3.2.3	Collect data about the 60 important acupuncture points from books	-	5
3.2.4	Collect data about the 301 supportive acupuncture points from books	-	10
4	**Development (phase 1)**		
4.1	Design the prototype for the final system	-	4
4.2	**Front-end**		
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 and meridians marking function on the model	3.2.2, 4.1	10
4.2.3	Build the authentication system	4.1	5
4.2	**Back-end**		
4.2.1	Build the authentication server	-	8
4.2.2	Design the structure for database	-	5
4.2.3	Fill up acupoints and meridians for the database	3.2.2	7
4.3	**Testing**		
4.4.1	Test the 3-D human body anatomy model	4.2.1	5
4.4.2	Test the display and information displayed of the acupuncture points and meridians	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
5	**Development (phase 2)**		
5.1	**Front-end**		
5.1.1	Build the search functionality	3.2.2, 4.2.1, 4.2.2	5
5.1.2	Build the dashboard data management system	3.2.2, 3.2.3, 3.2.4	5
5.1.3	Build the quiz functionality	3.2.2, 3.2.3, 3.2.4, 4.2.1, 4.2.2	5
5.1.4	Integrate the anatomy view mode for the 3-D model	4.2.1, 4.2.2	5
5.2	**Back-end**		
5.2.1	Build the handling of search by query functionality	3.2.2	5
5.2.2	Build the data management server	3.2.2, 3.2.3, 3.2.4	5

5.2.3	Handle the storage of quiz results and questions (Back-end)	3.2.2, 3.2.3, 3.2.4	5
5.3	**Testing**		
5.3.1	Test the search functionality	5.1.1, 5.2.1	5
5.3.2	Test the acupuncture data management system	5.1.2, 5.2.2	5
5.3.3	Test the quiz functionality	5.1.3, 5.2.3	5
5.3.4	Test the anatomy view mode	5.1.4	5
5.4	**Deployment**		
5.4.1	Deploy the Front-end side of the system	4.2, 5.1	2
5.4.2	Deploy the Back-end side of the system	4.3, 5.2	3
5.4.3	Perform integration testing	5.4.1, 5.4.2	5
5.4.4	Perform user testing with the medical university students	5.4.1, 5.4.2	5
5.4.5	Complete the final testing document	4.4.4, 5.3.1, 5.3.2	8

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 9 - 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, Adobe XD
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.

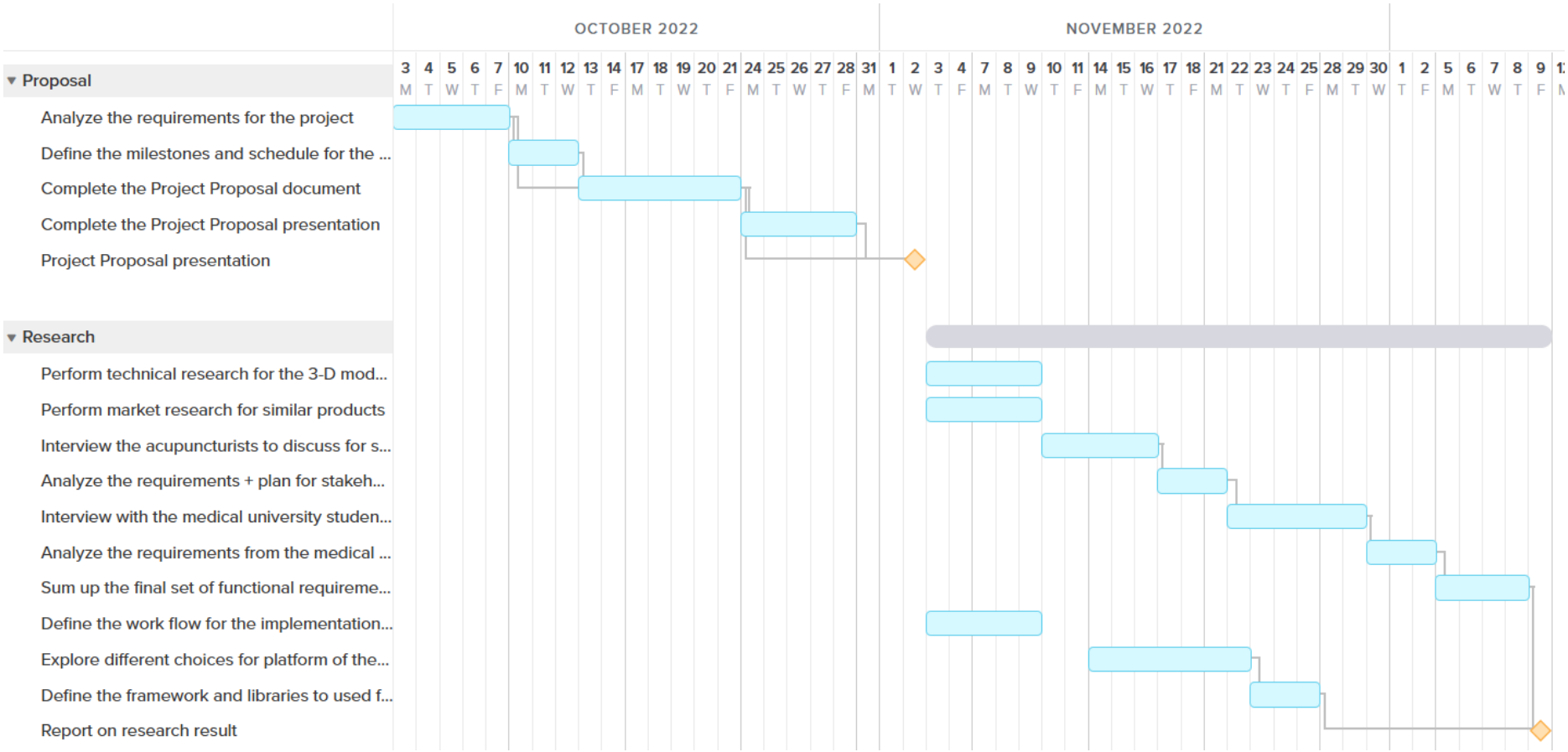

Figure 10 - Gantt Chart for Proposal and Research phases

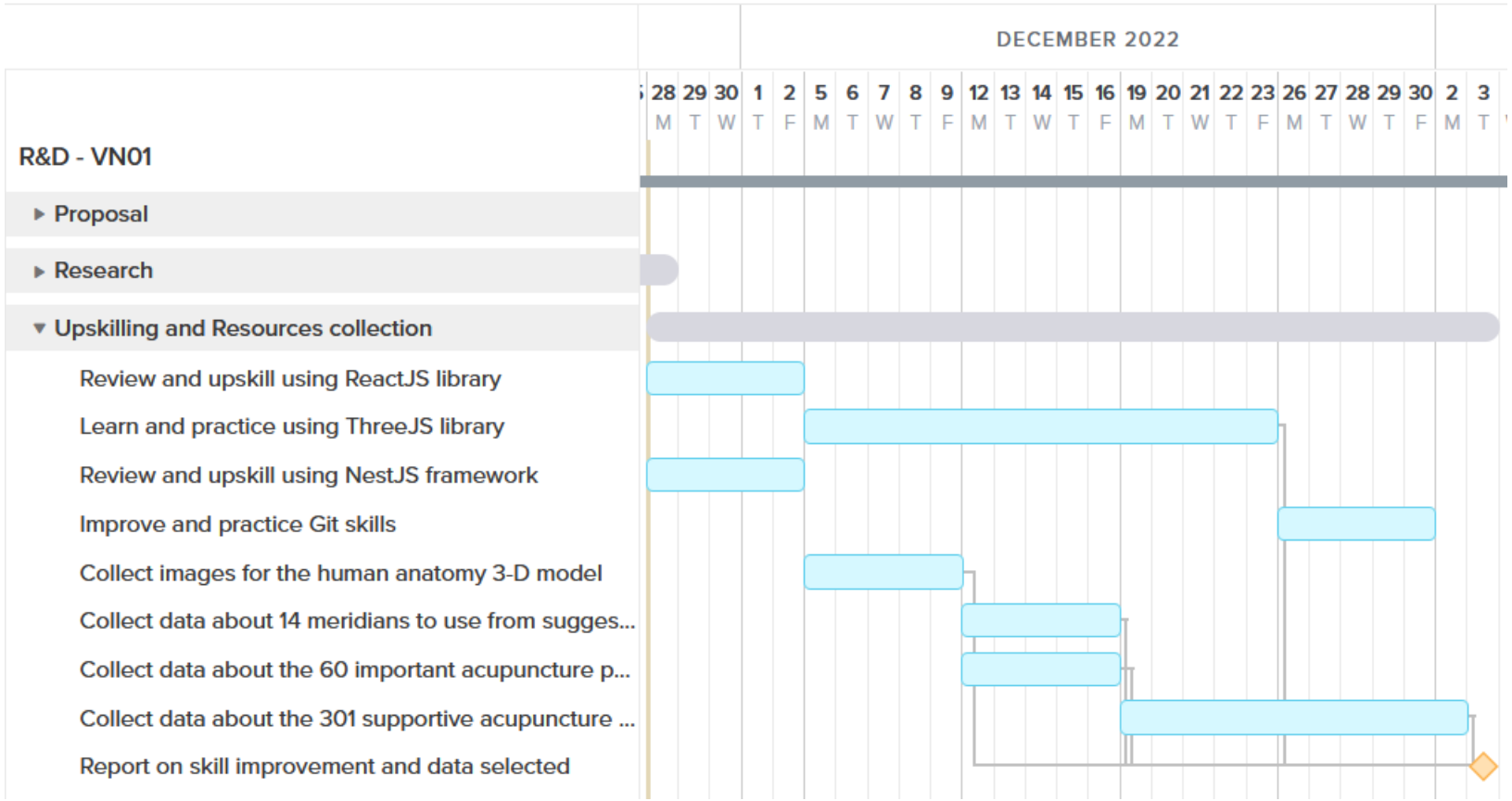

Figure 11 - Gantt Chart for Upskilling and Resources collection phase

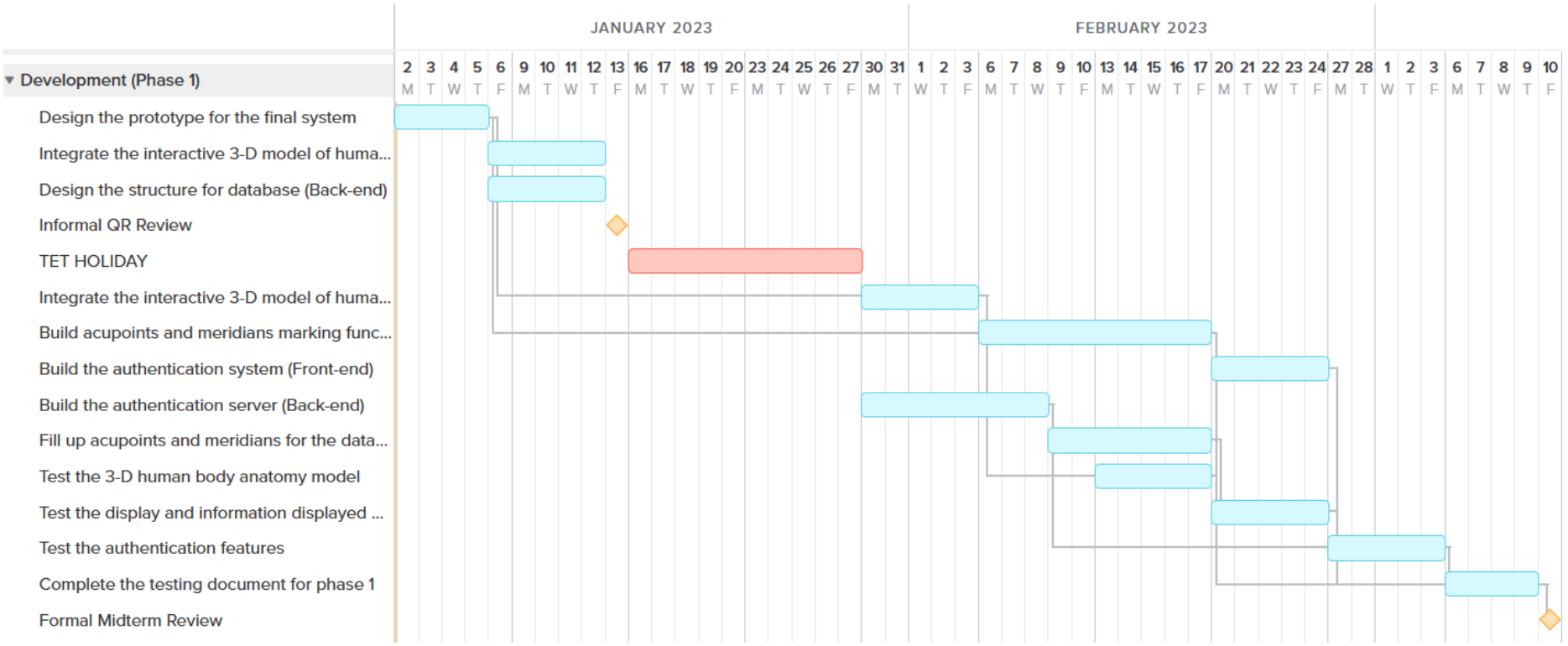

Figure 12 - Gantt Chart for Development (phase 1)

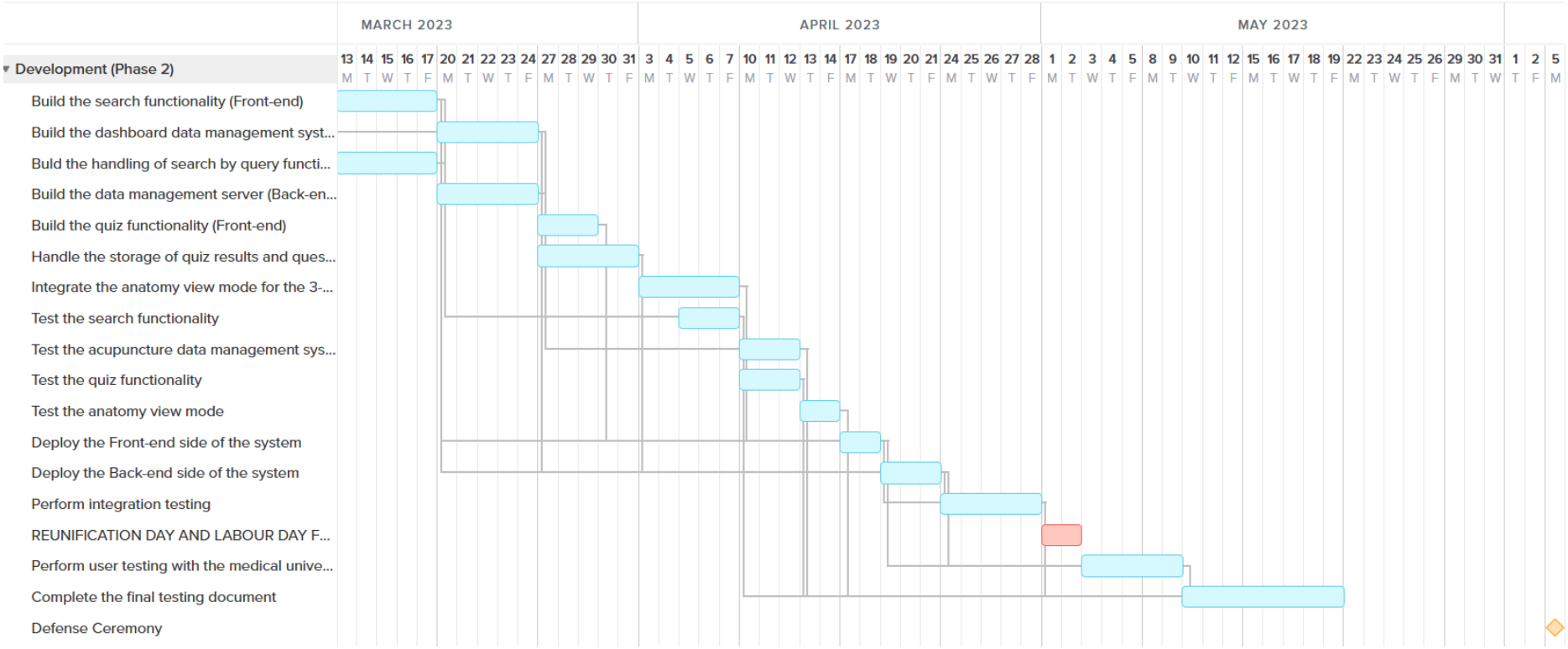

Figure 13 - Gantt Chart for Development (Phase 2), up to the Defense Ceremony

VI.2. PROJECT RISKS

Table 10 - 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 Continous 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 11 - 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 12 - 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 (3rd 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
Interview and experience acupuncture treatment for further information collection	10$ / treatment of 1 hour	800$ (4 team members + supervisor, each target 5 acupuncturists and participate in 4 treatment for each, one of which lasts for about 1 hour)
Total		**12,097$**

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.

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