Real-time Data Visualization Stimuli

Business Case and Draft Plan

(Team 3)

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1. Business Case

1.1 Executive summary

The project aims to enhance VPN Laboratory's software by developing a real-time data visualization function to display neuron activity, improving research efficiency and accuracy. We will automate processes and streamline the research process to be twice as fast and effective as before. Our feasible timeline includes building, developing, and integrating the functions.

1.2 Project Motivation

Artificial vision has seen remarkable advancements in recent years; however, it continues to grapple with accuracy issues, particularly in detecting occlusions and working in unstructured environments, necessitating vast amounts of training data, and being constrained to structured environments. These limitations create challenges for autonomous vehicles to adapt to unforeseen circumstances, such as inclement weather conditions like snow or heavy rain (McDermid 2020).

The VPN Laboratory, a renowned institution at the forefront of artificial vision research, has been praised by the Wall Street Journal (2010) for their breakthroughs in visual processing, computer vision algorithms, deep learning, and signal processing. Their cutting-edge work holds great promise for the development of innovative algorithms capable of overcoming the existing limitations in the field.

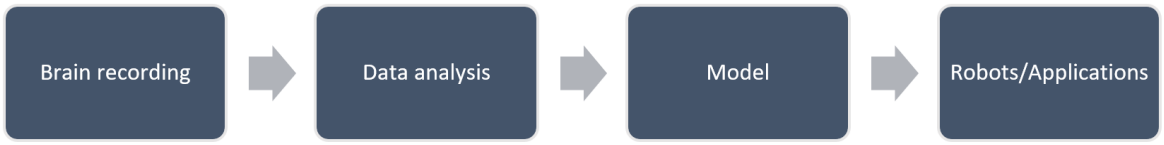

Figure 1. VPN Lab research working flow.

VPN Lab has an existing software to record the data from dragonflies' neurons. However, they have encountered some limitations during the data gathering and analysing process.

Our project is driven by the motivation to overcome the existing limitations of the VPN Laboratory's artificial vision development, specifically in terms of data collection and analysis process to enhance the efficiency and accuracy of the development. By refining the data collection and analysis procedures, we can significantly improve the overall development. This breakthrough will be instrumental in addressing the current constraints of artificial vision systems.

Ultimately, our project aspires to contribute to the evolution of advanced autonomous driving technology, ensuring greater safety and reliability for all users and to pave the way for more

accurate and adaptable artificial vision, empowering autonomous vehicles to thrive in even the most unpredictable environments.

1.3 Project Description

Over the course of this semester, our team will embark on a project to enhance the VPN laboratory's software. Specifically, we'll be developing a real-time data visualization function as an extension of the current graphical user interface.

The purpose of this function is to display the activity of the neurons in a heatmap format in real time, indicating whether the dragonfly's two eyes are in active or inhibitory mode. By having access to this information in real-time, scientists will be able to make more informed decisions about which eye to use in their experiments, potentially saving hours of wasted effort.

To achieve this goal, we will utilize our programming expertise in languages such as MATLAB and Java to create a more efficient and responsive software. Our team aims to automate the software, reducing the needs for manually loading and searching files. The result will be a streamlined research process that is twice as fast and effective as before.

1.4 Benefits

The real-time data visualization stimuli offer numerous benefits to the VPN Laboratory's research.

- Allowing scientists to avoid experiments on the wrong eye, effectively doubling research processes and reducing manual work, allowing scientist to quickly pinpoint where in the eye to conduct experiments to increase efficiency and accuracy in data gathering and analysis.
- Providing real-time data, enabling faster decisions and informed conclusions, and offering real-time data visualization for comprehensive neural activity view to Identify patterns and trends not otherwise evident.
- Enhancing autonomous driving technology through optimized data gathering and analysis and improving artificial vision system accuracy and reliability, ensuring safer autonomous driving, and also giving VPN Laboratory a competitive edge with real-time data visualization tool to attract funding and bolsters reputation in artificial vision research.

1.5 Goals

Our objective is to meet the project goals within the desired timeframe. The following are the goals we aim to achieve:

- Develop a real-time data visualization function on a GUI extension of the existing software to assist scientists in enhancing the efficiency and accuracy of their data analysis process.
- Develop an integrated software solution that minimizes manual operations, guarantees seamless functions, and improves the software's efficiency and responsiveness.

1.6 Future Directions

With only a single semester to achieve the goals outlined above, we must prioritize our efforts. However, if we are given more time, we could implement potential enhancements that have been identified for the project.

- Simplifying the GUI interface
- Adding a capturing monitor information function.

These enhancements can save time, reduce errors, and promote data collection efficiency, ultimately contributing to the success of the project and advancing artificial vision systems.

2. Draft Plan

2.1 Schedule

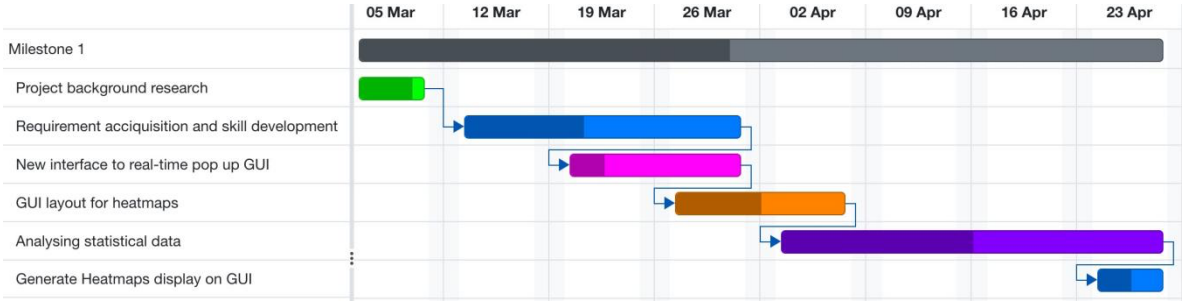

Figure 2. Gantt chart for milestone 1

Milestone 1	Activities	Projected Outputs
Develop a real-time data visualization function on a GUI extension of the existing software.	Project background research. The project background prepared us when we encounter biological terminologies used in codes and comments.	Project background documentation
	Requirement acquisition and skill development. Studying required programming tools and source code is essential for us to understand what client needs in an academic way and how we can exact the plans to achieve the goals for this project. Necessary parts of the algorithm can be withdrawn from this process and establish the foundation of the code development process.	Pitch presentation
	New interface to real-time pop-up GUI. Create a button on the existing interface to real-time visualisation GUI, which provides a choice for the client whether to fast access or not under different scenarios.	New interface

	GUI layout for heatmaps. The heatmap layout will be created on the new GUI extension. There will be two heatmaps in total, each representing a visualization of objects from different directions. The size of the heatmap will be adjusted according to the existing GUI, with a length and width proportion of 2:1.	Heatmaps layout
	Analysing statistical data. Read raw data and convert to spikes line chart, extract heatmap function to convert line chart to heatmap.	Heatmaps creation
	Generate heatmaps display on GUI. Heap-map will be generated by algorithms in source code, then displayed on the pop-up GUI created. Therefore, neural activities can be seen in real-time, and insignificant data generation can be stopped immediately to save resources.	Real-time data visualisation

2.2 Scrum Team

2.2.1 Product Owner

Lin Cen Lin Jia Yi, the product owner, shapes and prioritizes the dynamic product backlog by closely connecting with stakeholders to understand their needs, keeping the team focused on the most important priorities.

2.2.2 Scrum Master

Members in our team take turns as Scrum Master to ensure adherence to agile processes. We effectively manage meetings and ceremonies like daily stand-ups and sprint retrospectives and collaborate to overcome obstacles towards achieving our objectives.

Sprint	Team member
1	Lin Cen Lin Jia Yi
2	Yueran Wu
3	Shengbin Wu
4	Haoxian Wu

2.2.3 Development Team

The team members are responsible for building and testing the product, working together to complete tasks during each sprint. They are a self-organizing, cross-functional group with diverse skills, capable of accomplishing work independently.

2.2.4 Stakeholders

Bernard Evans, the project supervisor, and Steven Wiederman, a scientist, collaborate with esteemed professors and tutors. The team members provide valuable insights and may even benefit as end-users. External stakeholders, such as students, faculty, employers, competing universities, and the local community, have a range of interests, from learning impact to competitiveness and the local economy. Active engagement with them is vital for project success.

2.3 Communication Plan

Description	Frequency	Method	Participants
Daily Stand-ups	Daily	Online zoom / WeChat	Core team
weekly meetings	Weekly	In person	Core team
Project document	As needed	Google drive	Core team
Sprint Retrospectives	Once 3 weeks	In person	Core team
Backlog Grooming	As needed	GitHub wiki	Core team
Client Meeting	Weekly	In person / Emails	Clients / Supervisor/ Core team

The primary communication methods for team members during this project include daily stand-ups and in-person meetings. Stand-ups provide updates on the working process and removal of potential obstacles, while in-person meetings supplement the expressiveness of stand-ups. Client meetings will be followed by a team meeting to prioritize tasks, and sprint retrospective meetings will be held to reflect on the current process and set goals for the next sprint.

Team members will use Google Drive to collaboratively edit text and presentation documents. Project documents, including timesheets, meeting minutes, agendas, requirements, presentations, and source code, will be stored on the GitHub wiki for review by team members and supervisors.

Task tracking will be based on GitHub, where team members will be assigned tasks with specific deadlines. Team members will move cards between the "To do," "In progress," and "Done" columns to monitor the status of project tasks.

Reference

Pannett, R. (2015). Scientists Tap Dragonfly Vision to Build a Better Bionic Eye. Wall Street Journal. [online] 5 Oct. Available at: https://www.wsj.com/articles/scientists-tap-dragonfly-vision-to-build-a-better-bionic-eye-1444055235.

McDermid, J. (n.d.). *Autonomous cars: five reasons they still aren't on our roads.* [online] The Conversation. Available at: https://theconversation.com/autonomous-cars-five-reasons-they-still-arent-on-our-roads-143316#:~:text=A%20fully%20autonomous%20car%20needs.