Interactive Data Science to Help Tackle Climate Change

Individual Project
CM3203 – 40 Credits

Cardiff University
School of Computer Science and Informatics

Author: Sam Winkworth

Supervisor: Charith Perera

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1 Project Description

Like many other locations on Earth, the Kinabatangan Forest and its wildlife are under threat from climate change and poaching activities. Protecting such Malaysian forests from damaging activities, such as poaching, will have a positive effect on the wildlife and the forest, that we rely on for natural resources [2]. Climate change is having a profound impact on the planet. The changes are reflected in higher temperatures, precipitation patterns, increased risk of draught, rising ocean levels, and increased frequency of bad weather [1]. Comparing the seasonal rainfall trend in 1961-1990 with 1998-2007, Sabah has observed an increase of more than 10% [1]. This project looks to make an impact on wildlife conservation activities, support the mitigation of climate change and fight against poaching activities in the Kinabatangan forest and river. Situated in Borneo, home to one of the oldest rainforests in the world.

Monitoring climate change provides users with information they need for effective planning and operations to respond to climate variations [3]. Furthermore, monitoring an area allows users to observe patterns or trends, that in turn, gives users a better understanding of how the area has changed over time. Data science techniques can tell a story of this change. Developing an interactive data science app using a range of data, for example, satellite and weather data, would help researchers understand the change. The application would contain a map to visualise the data that can be configured by the user, depending on the type of data they want to view and the time period. This way, a user can easily see the impacts of climate change on the Kinabatangan forest. Furthermore, using a map would also present the opportunity of showing animal locations that would help in the fight against poaching by informing security forces. Python, along with the relevant datasets, would be suitable for developing this interactive application.

The aims of the project are to tell a story of how the area of the Kinabatangan forest and river has changed over time, to help researchers understand this change. The drivers for this change are the climate and wildlife. To tell this story, the user should interact with an application that is intuitive to use, therefore, when developing the application, the zero overhead principle should be employed. Furthermore, the project should aid in the fight against poaching in this area by allowing security forces use the application to view animal locations/hotspots to position themselves in way that can capture or deter poachers. To achieve this, open data will need to be collected along with GPS animal collar data which can be acquired from the Danau Girang Field Centre. Lastly, the overall aim of this project is to support climate change mitigation and make an impact on wildlife conservation activities by raising awareness of the impact these factors are having on this area.

These figures show the area this project will be focusing on to display the change over time.

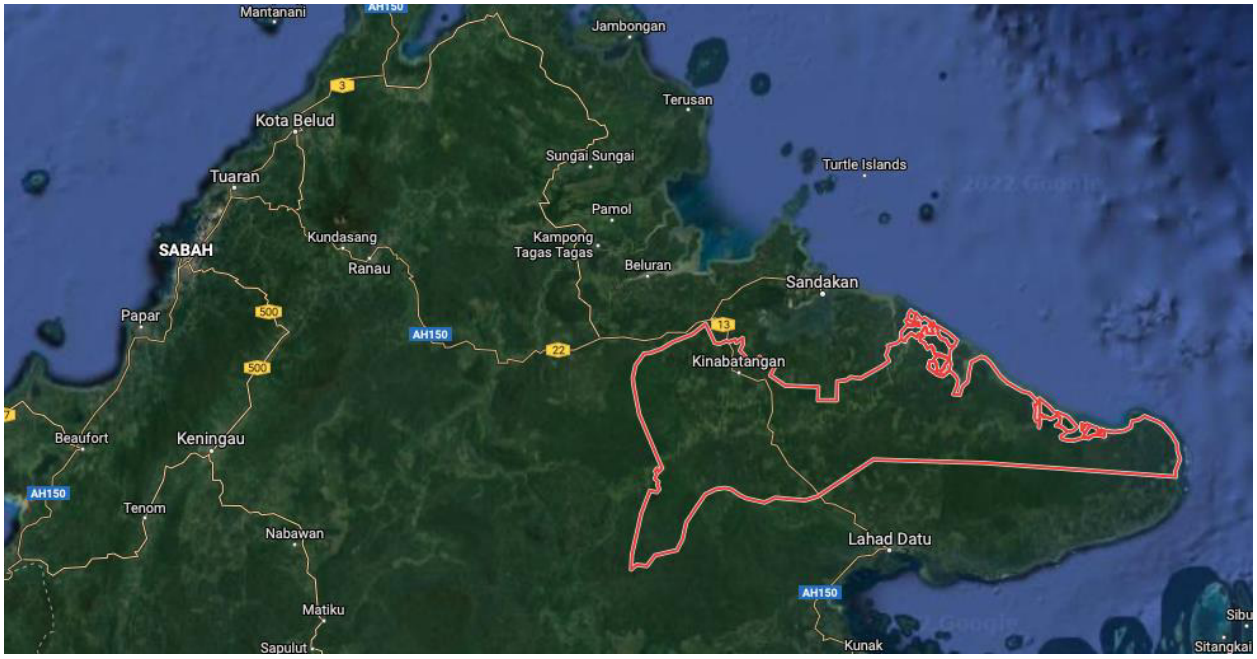

Figure 1 [1]

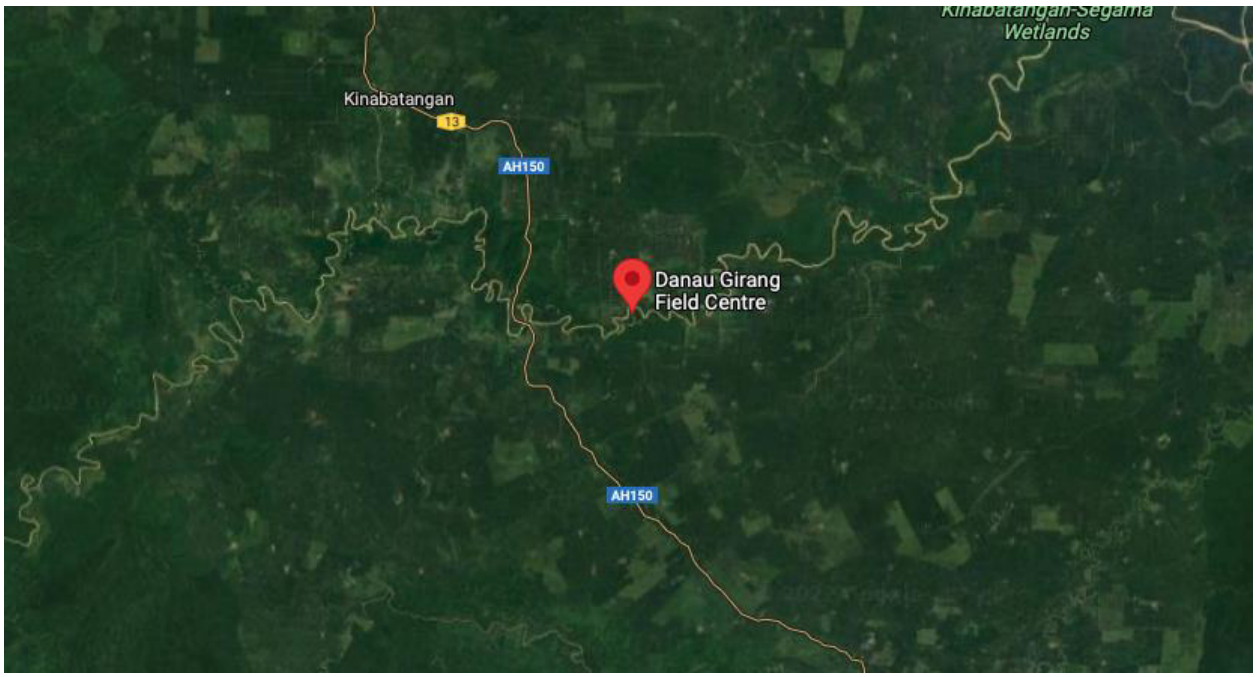

Figure 2 [1]

2 Project Aims and Objectives

The aims of this project are tailored towards making an impact on wildlife conservation activities, supporting the mitigation of climate change, and fighting against poaching activities. The objectives will specify how the aims will be achieved.

Aims:

- Use data science techniques to help researchers understand how the Kinabatangan forest, river and surrounding area of Sabah has changed over time.
- Help security forces see animal locations so they can better protect them from poachers.
- Raise awareness on the impact of climate change on the Kinabatangan forest, river, and surrounding area of Sabah.

Objectives:

- Investigate current interactive data science techniques, such as data visualisation, to acquire a list of key functionalities and gain knowledge of user interfaces for this application to derive its components and design.
- Research the Kinabatangan forest, river, and surrounding area of Sabah to give context to the application.
- Investigate the effects of climate change and poaching in this area and how security forces can be assisted in the fight against poaching.
- Gather fake and real data to tell a story of climate and wildlife change along with animal locations to help fight poaching.
- Develop a Graphical User Interface (GUI) in Python to for users to interact with the application to observe the change over time in this area.

  A low-risk approach for the interactive application would be to use a 2D choropleth map which can filter between different data sets and have a time filter to display the chosen time period. To implement this type of map, I would likely require various Python libraries, such as, pandas, geopandas and bokeh.

  To improve user experience, a 3D interactive map could be utilised instead which would slightly increase the risk due to increased complexity. To create this type of map, Python libraries pydeck, pandas, and ipywidgets would be used.

  On either type of map, there are some key, low-risk, features that should be on the application. These being a timeline slider (to demonstrate the change over time), a key for the type of data being visualised, a filter to switch between different types of data, and a text box to add context to the visualisation. Higher-risk features could also be implemented into the application, but once again, this will increase complexity. The features would include, showing custom locations and boundaries on the map (e.g., Kinabatangan Wildlife sanctuary), ability to zoom in and out of the map, and for the user to click on specific location to show them more information about area/animal.
- Test the developed application to ensure it is working as designed and get feedback from other users.
- Thoroughly evaluate the application against its purpose and other existing applications that have interactive map features. Also evaluate possible future improvements.
  - Evaluating the ease of use for the user, referring to the no overhead principle whereby they do not need training to use the application.
  - Evaluate the accuracy of the data visualisation.
  - Evaluate how easy the data visualisation is to understand.

3 Work Plan

To develop the interactive application and produce the final report, I will be using an agile software development methodology. The weekly time plan is an initial plan but may change during development due to unforeseen circumstances.

Deliverables for the final report:

- Final Report
- All source code
- Supporting documents (e.g., video demonstrations of application)

Supervisor meetings: Supervisor meetings will take place weekly, but in some occurrences, they may take place bi-weekly where an agreement has been made due to extended tasks.

Weekly time plan:

- Week 1 (31/01/2022)
    - Write the initial plan for the project, including a project description, its aims and objectives and a work plan.
    - Initial meeting with project supervisor along with other students working in collaboration with Cardiff University's Danau Girang Field Centre (DGFC).
    - Begin researching interactive map applications to gain an understanding of the key requirements and UI.

- Week 2 (07/02/2022)
    - Further research interactive data science Python applications and determine required software and libraries to install on personal computer.
    - Research background information on the Kinabatangan forest and river, along with the climate and wildlife aspect, to add context to the application.
    - Set up data and code repositories (e.g., GitLab) to store the source code and datasets.
    - Find real and fake datasets that can be used in the application and store them in respective repositories.
    - Investigate ethical approval for when user testing later in the development stage.

- Week 3 (14/02/2022)
    - Create an application design (front and back end) and list required system functionalities.
    - Process the data and carry out any data manipulation that is required.
    - Submit required documentation for ethics approval.

- Week 4 (21/02/2022)
    - Begin developing the back and front end of the application.

- Week 5 (28/02/2022)
    - Continue developing application, iterating through designs if unforeseen problems arise.

- Week 6 (07/03/2022) – Week 9
    - Ongoing application development
        - Trail implementing higher risk features to app
        - Bug fixes

    - Application testing
        - Get users to test different iterations of the application so key issues can be raised during development.
    - Structure the final report and gradually begin writing it.

- Easter (04/04/2022)
    - Use allocated time if needed to catch up on application development the final report.

- Week 10 (25/04/2022)
    - Write final report.

- Week 11 (02/05/2022)
    - Continue writing final report.

- Week 12 (09/05/2022)
    - Finalise the final report.
    - Collate submission documents and source code and perform a recorded demonstration on how the application works.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Easter	Week 10	Week 11	Week 12
Initial Report										X			
Research interactive data science techniques.										X			
Research area, with climate and wildlife aspect, to add context.										X			
Ethics Approval										X			
Application Design										X			
Application Development										X			
Application Testing										X			
Bug Fixes										X			
Evaluation										X			
Final Report Writing and supporting documents.										X			

Risk	Probability of Occurrence	Impact on Project	Mitigation Response
Illness	Medium	Medium	- Inform supervisor if I am unwell for an extended period - Buffer time allocated over Easter catch up on development. - Apply for extenuation circumstances if necessary.
Loss of Data	Low	High	- Regularly back up data to repositories. - Use cloud storage (e.g., One Drive) to back up final report and supporting documents.
Incomplete project	Low	High	- Regular meetings with supervisor to check on progress and discuss any issues. - Adapt work plan if necessary.
Insufficient number of users to test the application.	Medium	Medium	- Remind those that agreed to the test to finish the test. - Use school mailbox to share test with as many applicants as possible.

References

[1] Google Maps, “Google Maps,” Google Maps, 2021. https://www.google.co.uk/maps.

[2] H.A. Rahman, “CLIMATE CHANGE SCENARIOS IN MALAYSIA: ENGAGING THE PUBLIC”, International Journal of Malay-Nusantara Studies, vol. 1, pp. 55-77, Nov 2018

[3] WWF, “MEDIA RELEASE WWF-Malaysia applauds anti-poaching efforts and calls for the establishment of a wildlife crime unit,” 2020. Accessed: Feb. 03, 2022. [Online]. Available: https://wwfmy.awsassets.panda.org/downloads/media_release___wwf_malaysia_calls_for_the_establishment_of_a_wildlife_crime_unit__23.pdf.

[4] X. L. Wang, T. C. Peterson, J. Lawrimore, M. Brunet-India, R. Cerveny, C. Donlon, F. Driouech, W. A. Wan Hassan, R. Hollermann, M. D. Schwartz, Z. Zhang, “Monitoring the Earth’s climate”, Adapting to climate variability and change, vol. 57 (2), pp. 109-113, April 2008.