Slide 1

Good morning committee members!

Thank you very much for being here and taking part in my thesis project work and another step for graduation.

My name is Volodymyr Kozyr but you can call me Vova.

My topic if called “A study on data visualization for fishery management”

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I will start with agenda for my presentation.

First, I will go through introduction and goals of the project, why and for whom it is implemented.

Then we will review several papers/projects done in this area so we will understand what is already implemented, which pros and cons these visualizations have and which improvements could be done.

After that I will explain you tasks for the project.

Then we will quickly overview architecture of the implemented system.

And finally, more particular examples of use cases implementation and conclusions.

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Topic -> Fishery data, like data from other domains, deals with observations across time, and across space. Depending on decisions made after analysis it can lead to different economic and environmental consequences. Also, there are many data sources available for fisheries, which I will touch briefly further in my presentation.

Objective -> This work will help people who are domain experts but are not very familiar with data analysis tools. The tool can help fishery management regulate fishery catching in certain Canadian provinces and help decide which policies or fishing quotas for specific fish types should be applied.

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There are different groups of users in the fishery domain  like fishery management companies, environmental policy issuers and simple fishermen etc. All of them need to get different data and analyze it in some way. For example, marine environmentalists analyze data about the quantity of fish in a particular region, they issue quotas  for fishery companies. After that companies analyze the fish stock market, plan, and distribute information to their employees in a way that it is optimized and profitable.

Papers discussed in this chapter are oriented primarily for fishery management, because papers for environmentalists, for example, include more information about biological and ecological perspectives rather than focusing on visualization methods. However, the content is sometimes complicated for readers who are not data analysts or experienced computer users.

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FishCAM2000 is a computer-based integrated information system for fisheries management and marine environmental monitoring. It incorporates visualization of the fishery activity over the same spatial area of interest for a particular type of fish. It has a user-friendly and straightforward interface implemented in Windows Forms.

One important advantage of the system is that it presents complex geodata, which includes the amount of fish caught in the geographical zone on the map instead of the data table, which is a considerable timesaving for users to understand the query output.

Figure on slide shows the output after the user passes seven screens of settings of the query wizard. While entering so many screens of data may suggest a large amount of effort before one obtains any results, this process does allow the system to be as generic as possible but requires a great deal of effort and time from the user.

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Good example of non-fishery visualization tool

IDMVis is a visualization tool that shows multidimensional related data during the day for patients with diabetes. The designed tool helps doctors track the state of patients' important parameters and detect anomalies.  After that, doctors use it as a decision support tool for the treatment of diabetes.

Six clinicians evaluated design decisions positively, the criteria of the evaluation was how well  proposed visualizations help with the decision-making process on daily basis. Also, that detailed visualization convinces doctors to prescribe were more personalized treatment for the patient.

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The same approach of using line graph visualizations can be seen in a more recent annual environmental report on this kind of data. For example, Scottish Sea Fisheries Statistics or 2019 from the Cabinet Secretary for Rural Economic and Tourism provides summary data and more detailed statistics by region.

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The total amount of fish caught is shown in blue, and the value of all landings by Scottish vessels is shown in red. By comparing the blue and red lines, the user can easily and quickly determine the connection between the catch's value and the amount of fish caught in a specific year. For instance, the user can see that despite the tonnage falling since 2017, the value of landings remains constant.

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We can see that the marine industry requires to see overall reports on such parameters as “tonnage” and “value”. From the pie charts, users can determine which type of fish gives which revenue according to tonnage.

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In the next report there are bar charts for two consecutive years presented. This is done mainly to see trends and then to decide if the fishery industry is doing better or worse than the previous year. After comparing values for two years some adjustments in fishery policies could potentially be implemented by ecologists or fishery companies.

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Based on literature review for the project we can stress some fishery domain problems

Determining the optimal amount of catch for each type of fish to reduce environmental damage in a specific region

Predicting which species may also be subject to negative or positive effects (trends)

Establishing quotas (the proper amount of unloading of fish) which will minimize the negative impact on the environment

Analyzing the safety of methods for catching a particular type of fish in each region

And other…

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Analysis of the data presented in a table or text format may take significant amount of time, as was discussed in IDMVis. For example, it is hard to see trends, how values change through the years, as well as comparing data for different provinces and fish type. Another thing that is hard to capture is the correlation between price and quantities of specific types of fish for a certain period.

FishPlots is developed for people who may not be data scientists. The main goal is to make it usable for people with average knowledge about computers. It also will not require any installation steps, because it is a web application that can be accessed just by typing a URL in any modern browsers. Another feature of FishPlots is that it will allow the user to select range, provinces, and any fish type from dropdowns, zoom into details, etc.

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* **Requirement 1. Interactivity**

The main difference between existing static reports and FishPlots is that we allow users to interact with data before producing a visualization. These interactions involve operations like filtering, zooming, and so on.

* **Requirement 2. Data Scaling for Further Analysis**

FishPlots should allow users to discover patterns, trends, and anomalies

* **Requirement 3. Summary and Overall Statistics**

Showing global summarized data.

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The main reason for choosing a web solution for implementing visualizations is that it will be accessible for users without needing the installation of any additional software. Having everything in a web browser is a modern way of viewing and sharing visualizations. The user doesn’t have to do any extra manipulations with a computer system to access visualizations.

FishPlots is implemented in TypeScript (wrapper for JavaScript) from Microsoft. The front-end framework is Angular, one of the most powerful and highly used web engines. The back end is not needed for now as it is a test project. If the data source is changed, there will be minimum code modifications to get/process data.

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As described in the previous chapters, the data layer for FishPlots uses public data provided by DFO Canada. Data is converted from Excel to JSON format, which is suitable for use inside a web browser environment.

The web browser gets data by using HTTP REST request, therefore if the dataset is changed, it can point to any URL that can provide a JSON file with data in a suitable format for FishPlots to use.

Logic part of FishPlots is doing data-transformation from JSON files to a format which is suitable for the library to render and display visuals. It also reacts on user actions and emits events to charts to refresh data if needed and handles switching between charts.

As a framework engine, FishPlots uses TypeScript framework Angular. It is a popular JavaScript-based web framework. For presenting data there is an amCharts4 library included in the project, which allows generation of complex interactive  data visualizations using JavaScript inside a web browser.