Noldus Hub: A dashboard with filtering systems that are adaptive to the user's needs

Gamze Bozkurt
HU University of Applied Sciences
gamze.bozkurt@student.hu.nl
1776984

Sophie Kieftenbelt
HU University of Applied Sciences
sophie.kieftenbelt@student.hu.nl
1695244

Daan den Otter
HU University of Applied Sciences
daan.denotter@student.hu.nl
1665029

Abstract

The main expectancy from a smart interface is the adaptability and ability to react depending on the tasks and the preferences of users. An important aspect of our project is how interfaces can be designed to recognize the objectives and the preferences of the user with a machine learning algorithm. Our prototype is inspired by the data-driven feedback loop which is integrated with the Bayesian Method which predicts the user's preferences. Also, customization of the dashboard by personalized filtering is the other strong point in our design. As the main problem was time efficiency, designing a filtering system could help the user to find the most valuable information without time waste. To test our prototype we did a usability test on five Noldus employees. The Covid-19 pandemic prevented us from testing the prototype on external parties.

KEYWORDS: Human-Computer Interaction, Smart Interface, Content-Based Filtering, Collaborative Filtering, Adaptive Filtering, User Interface Design, Personalized Filters, Bayesian Classifier

Introduction

In the age that we live in, the collection, translation, and visualization of triangulated data are crucial. This is exactly what Noldus Information Technology does. To create efficient data visualizations for Noldus, we designed a dashboard with a Human-Computer Interaction and Machine Learning approach. Our goal was to build an interface with an adaptive information filtering system where data is presented according to the user preferences with smart algorithms.

Interpreting data and getting new insights are parts of the users', User Experience (UX) designers', daily tasks. Noldus' current dashboard is not adaptive and personalized for the user. It is not designed properly from the user's perspective and is therefore not giving them the optimal experience.

The optimal dashboard differs per user, we put a filtering system in the center of our proposal and designed it to adapt to the user's needs. We think that by filtering the data of the participants and giving the user options to filter the data, the analysis will be quicker and easier since it gives a better overview.

To understand the user's needs we interviewed UX designers and created a persona. We focussed on how to help UX designers to show relevant data combinations that simplify and shorten the analysis of their data.

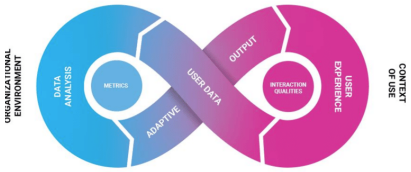

Image 1. Data-driven Feedback Loop

Literature Review

Filtering techniques

There are three well-known filtering techniques in the literature which are, Content-Based Filtering (CBF) and Collaborative Filtering (CF), and User Adaptive Filtering (UAF). CBF learns to recommend items similar to the ones the user liked before (Gemmis, Lops, Musto, Narducci, & Semeraro, 2015), CF suggests items that users with similar tastes liked in the past (Ricci, Rokach, & Shapira, 2015). UAF is a learning process of filtering the incoming data streams in such a way that only relevant data or information are preserved to the user. In recent years, filtering techniques are integrated with models that are driven by artificial intelligence. To better translate the human-computer interaction and create a smart interface, there are some useful machine learning algorithms and adaptive filtering used in recommendation systems.

Personalization in filtering

The personalization happens while it constructs and develops information about users' interests, likes, dislikes regarding the information on the dashboard. Implementing User Adaptive Filtering (UAF) is one of the steps to personalize the interface. In the UAF process, incoming data streams in such a way that only relevant data or information are preserved to the user after recognizing the user. The relevancy of the data is dependent on the changing needs of the user. UAF can serve recurring users better because the interface has been learning the user's behavior without a pause. In other words, UAF can adapt to the user's new interest by constantly updating the user profile from creating new items or letting the user create/delete items (Hand, 2010). There should be a personalized filter selection and repetition of the user behavior to learn the user behavior with a binary decision for each search (Zhang, 2004).

Bayesian Classifier Model

The Bayesian Classifier Method is an alternative machine learning approach in recommendation filters. This method combines data with existing information relating to that data and then utilizes algorithms and models in favor of the user. Bayesian calculates the conditional probability of a user preference to improve the interaction. The main focus of the algorithm is to learn and predict what UX designers prefer by exploiting similar patterns. It is widely used in many companies such as Netflix, Amazon, and Facebook, which collect user data and rely on automated analytics.

Participants' Quotes

"I would like to a dashboard which is scannable and shows me where to make an action in my project"

"Dashboard should depict the data according to the data type and viewer type also viewers have options to determine the data sets"

"I prefer to have an option for checking not only behavior trends of many users but also individual's data"

"It would be interesting to have the possibility to dive into the results of a specific user"

The Bayesian method is applied with collaborative filtering and content-based filtering. In CF, it is based on two aspects (Miyahara & Pazzani, 2002). One is UX designer-based collaborative filtering, which makes predictions based on the users' similarities and provides automated insights from the projects. In the collaborative filtering, the similarity between users' acceptance or rejection of the summarized insights is driven by the positive or negative reactions of the UX designers.

In short, a user preference model is constructed for the individual based on the user's item selections in the menu and clicks. The second one is item-based collaborative filtering, which makes predictions based on the commonly selected items' similarities in the filtering selection.

The data-driven feedback loop is well integrated with the Bayesian method since the user reactions toward the automated insights are collected and saved during the user experience. There is a continuous prediction of providing insights to the user by the user as in the feedback loop (Smits, Turnhout, Hekman, & Nguyen, 2020).

Exploratory Research

Interview

Most qualitative research gives insights into the views of interviewees, which are transcribed and analyzed to disclose the user's needs, therefore we conducted semi-structured synchronous interviews with ten UX designers who had more than 3 years of experience. Our primary goal was to learn what UX designers mostly desire to have in their dashboards and what they needed to be efficient when they were visualizing data. The UX designers' thoughts, ideas, and perceptions were the primary data of our project.

Key takeaways

- Decisions of UX designers might not be taken based on a single data point.
- If the user has multiple filters to select at once, he or she can narrow down or add features to the search to be able to interpret the data efficiently.
- Design decisions for filters will depend on the metrics, required insights, observant information, errors, significant numbers or volumes, and the type of user.
- Filter behavior of the user depends on the project therefore there should be selections of preferences.
- Interactive filtering can be applied when the dashboard reacts to the user's selection and refreshes the page every time.

Design Process

According to Lotte Boersma, there is no feature in their current dashboard in which their clients can filter the information and results of the participants. This feature would make the analysis of the data easier. The interviewee responded that they want a scannable dashboard, the dashboard should depict the data, and they prefer an option for checking different variables. This is why we created a prototype dashboard with a pre-filtering option. It gives the clients of Noldus based on their project already filtered data to make the analyses easier.

Researching

We interviewed several UX designers to get some insights into their needs regarding a dashboard. We also spoke with Lotte Boersma from Noldus about what they are missing in their dashboard and what they would like to see. The conclusion that the filtering system is needed and desired by the clients was quickly made.

The research started with writing down all the data combinations we thought are relevant on post-it notes as you

can see in image 2.

We wanted to use the CBF approaches which recommend items to users that are similar to the ones they liked in the past and UAF which is a process that filters incoming data streams in such a way that only relevant data or information are preserved to the user. However, we also were interested in the CF technique which suggests items to users based on the preferences of similar users. After investigating how to make the filters smarter, we decided to integrate the filters with a machine learning algorithm called Bayesian Classifier Method.

The first designs were basic designs in which we wanted to visualize our idea of the UAF system integrated into a dashboard.

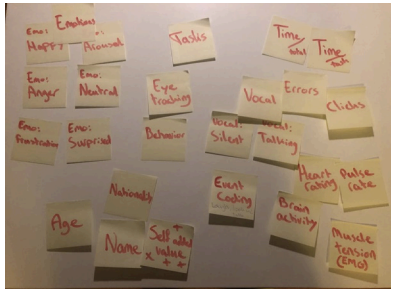

Image 2. The post-it notes with the variables from the early design process.

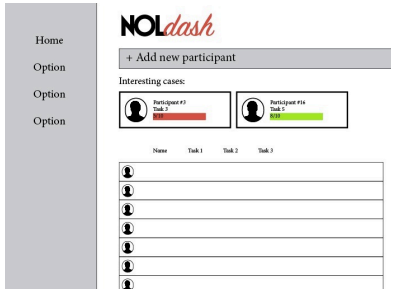

Image 3. The first design with UAF.

Core concept
The Noldus Hub is a dashboard with a smart interface that's based on an algorithm that serves automated data sets according to the past behavior of the users.

The Hub presents the user with a better overview of the data selection by using filtering systems. It allows the user to personalize the dashboard to their needs. You can add graphs to the homepage which will show the average data of these variables. This way, users can organize the results that apply to them. If you want more in-depth information about these variables you can click on the graph to get more insights.

The dashboard gives users the option for not only checking behavioral trends of many users but also individual data. This is based on one of our key takeaways from the interviews. The individual data can be filtered on the "Participants" page. It's not only possible to filter on the variables, but also within the variables. Think about choosing a maximum age of 29, the system will deselect all participants above the age of 29. This is possible with all variables.

The system collects all the choices and preferences of users. The machine learning algorithm Bayesian Classifier Method recommends the user's new filtering options in the menu.

UAF is implemented in the personalized messages that the system gives the user at the top of the home screen. The messages contain new insights automatically predicted by the system. They are about outstanding data, for example, when there was a very high average heart rate, or a certain participant scored very low in comparison with the others.

The system serves recurring users better because the interface learns the user's behavior without a pause, as stated in the literature review. To make this happen, it contains a personalized filter selection and it needs continuous feedback from the user. The system can do this by asking the user if the messages are useful. Mostly, clients of Noldus are existing customers therefore if their interest drifts or changes, UAF adapts to the users accordingly.

Before we started the user tests we asked Joep de Wildt, an UX designer at ABN AMRO Netherlands, for constructive feedback on the prototype. We used his expertise in design to optimize the prototype before conducting the user test. He provided us with insightful feedback and we included this in creating the prototype for testing.

Scenario
We painted a scenario of a client and visualized this based on our prototype. The client's name is Herman, a UX designer at the website Etsy.com (Appendix 1.1). He saw that a lot of customers are going everywhere on the website and many customers do not go to the checkout page eventually. He decided to test the website based on two tasks: The customers had to find coasters with the filtering system of Etsy.com and eventually go to the check out page. Facial recognition can identify the emotions of the participants during these tasks.

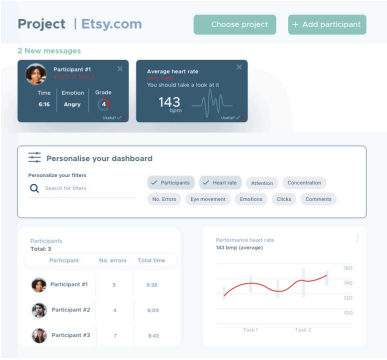

Image 4. Final dashboard - Homepage.

Image 5. Final dashboard - "Participants" page.

Herman's scenario (appendix 1.2) starts with him going to the login page of the dashboard, he can get access to a general project page in which he can find his project. He chooses his project: Etsy.com He wants to see the emotions the participants had regarding their tasks. Herman is sent to a page with an overview of all emotions of the participants. At the top of the page, he sees that there is one participant that took far longer to finish the tasks in comparison to the other participants. He clicks on the participant and sees all the data from the participant regarding the test.

User Testing

To test our prototype we were brought in contact with five Noldus employees. We created five steps the participants had to go through to see if the design, navigation, and purpose of the prototype is efficient. After taking all steps we asked the participants several questions to come to a conclusion.

The user testing took place through MS teams. At first, we introduced the user scenario to the participants and then asked them to take the following steps:

- Can you add the filter "emotions" to the dashboard?
- Can you add a comment to a specific point in the graph of participant 1?
- Can you sort all participants on the number of errors?
- Please go to the general page and tell us what you see and how you would interpret it?

Some of the questions we asked after the participant took the steps mentioned above were:

- Could you grade every page on a scale from 1 to 10?
- How did you experience these steps?
- What would you add, delete or want to see differently regarding this dashboard?

User testing results

Overall the participants reacted positively towards the interface of the prototype. The participants were enthusiastic about the filtering system of the prototype.

However, step 2 was perceived as the most difficult step to perform, due to a malfunction in the prototype it was unclear about how to navigate to the right page. Four of the participants also mentioned that the "2 new insights", a feature that is displayed at the top of the home page, were very confusing since it was not clear what those 2 new insights were. This caused a lot of confusion during user testing.

All participants were enthusiastic about the personalization of the participants. However, the button "filters" on the side of the page that made the filter options pop up was not received as well. Participants mentioned it fell off the page and it felt like it is not part of the page. They suggested placing it above the graphs or with a "plus" button next to the graphs.

One of the participants mentioned that we do have a filtering system, but they can not actually filter the variables. This means you can add the filter "Age", but you can not filter it for example filters on different age categories.

The participants valued the section in which you can add comments, which makes analyzing more practical. However, one of the participants mentioned that he missed the observer's notes, in his opinion that could sometimes be more valuable in comparison to just a graph.

We took all the above-mentioned observations and added or adjusted them in our final prototype.

Discussion

Noldus Hub (appendix, 1.3) gives users the ability to easier analyze the data and give them a better overview of all outstanding data due to the filtering system. After the interviews with the experts, it became clear that there was a need for a better overview of the data. Lotte Boersma, our Noldus contact, provided us with the information that there is no filtering system although clients have expressed a need for this feature. Based on these findings we created a solution with a prototype which due to machine learning gives the desired insight to analyze the information quicker.

The user tests showed that the participants were enthusiastic regarding the design of the prototype and the provided filtering system. However, the navigation of the system was for participants the biggest obstacle they faced during the test. This however was due to a malfunction in the prototype at the time of the test. Although they were positive about the design they showed concern about the filter button on the right side of the page. This would not be noticeable enough for the users. The user test provided us with a lot of new insights. This is why a lot of the design flaws are directly inspired by the target audience.

Limitations

Due to the current Covid-19 pandemic, the government announced a lockdown. This lockdown prevented us from doing the test physically with the participants. This is why we had to do it online which limited us in testing our prototype.

We used Noldus employees as participants for the user test. Unfortunately, due to the short time we had for the research and the pandemic, we were not able to host external participants for the user test. Moreover, we need to make further innovations in data visualization since we could not invest time in every aspect of the entire interface design.

The prototype is mainly focused on the filtering system. However, this is only one feature of a good platform. The visualization of the data could be added to this platform to make it a more wholesome platform. However, we researched the visualization before focussing on the filtering system. We found it difficult to find good and relevant literature reviews regarding visualizing data and AI-driven design. Here is certainly room to fill up a gap or build upon the current literature.

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Appendix

1.1 Persona

Herman Hendriks

"Good design is about process, not product"

Age: 42
Work: UX designer, Etsy.com
Location: Utrecht, The Netherlands

Personality

Introvert	Extrovert
Thinking	Feeling
Sensing	Intuition
Judging	Perceiving

Creative | Go-Getter | Pragmatic

Goals

- Improve the usability of Etsy.com.
- Creating an interface customers desire.
- Introduce user-focuses mentality and methods into traditional company landscape.

Frustrations

- Regarding datasets retrieved from the research:
- It is not personalized
- It is not significant
- It is not summarized
- It is time-consuming to analyze

Bio

Herman is employed as a UX designer for the website Etsy.com. According to him, there are many website visitors that put items in their shopping basket but do not check out. He also found out that website visitors go across the whole website and leave right after. This makes Herman believe that the visitors can not find what they are looking for.
He wants to test the filtering system of Etsy.com and the check out page by using facial recognition while the participants do their tasks.

Motivation

Incentive
Fear
Growth
Power
Social

Preferred Channels

Traditional Ads
Online & Social Media
Referral
Guerrilla Efforts & PR

1.2 User scenario

LOG IN PAGE

Herman logs in on the NoiDash dashboard to see the results or progress of the research he hired Noldus to conduct

PROJECT PAGE

On the project page Herman can find a progress bar, to see how far along the research is. On the left he can find the navigation menu to different parts of the dataset. In the centre of the page he can find prefiltered general data where he can click on to see more in depth information. On the right he can adjust the filters a he likes. Herman wants to see more information regarding the emotions of the participants. He clicks on the left graph.

Emotions

Here Herman gets an overview of all the emotions the participants experienced during the tasks. Underneath he can find the two tasks the participants had to do, the time duration of the tasks and a score he gave before starting the research. He clicks on participant 1 for more information.

Participant 1

Herman can find all data of participant 1 on this page. It also includes notes from the observes during the research. He choose participant 4 because the grade she scored at the second task was below average. The participant was mostly angry during this task. He noticed that she could not find the right button. He can take this in consideration during his analyses.

1.3 Prototype

https://xd.adobe.com/view/5bd0b7fb-3bf1-4f61-9f69-37e10052ed6b-0e83/

1.4 Prototype - video

https://youtu.be/BHRYgiEggk0