The design of an interactive graphical user interface for a digital twin of the Rhine-Meuse delta

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Salt intrusion from the North Sea into the Rhine-Meuse estuary is becoming an increasingly large problem for locals' access to freshwater. To monitor and take measures against this salt intrusion, meetings involving Rijkswaterstaat, and relevant water boards are conducted. The knowledge institute Deltares is developing a decision-making aid for these meetings, in the shape of a Digital Twin called the Virtual Delta. This Digital Twin allows users to monitor measurements in real-time, create baseline forecasts, and run simulations on salt intrusion management measures. While the back-end developers create calculation models, the development of an interface (front-end) is the goal of this thesis.

This thesis proposes a visual design concept of the Virtual deltas interface. Design requirements were first developed according to research on Digital Twins and Graphical User Interfaces, literature research, and an analysis of and interviews with stakeholders. The research on the concepts of Digital Twins and Graphical User Interfaces resulted in a base level of knowledge to develop the visual design proposal on, while the literature research resulted in design principles used for the substantiation of design decisions.

The needs and wishes of the stakeholders were analysed and divided into returning themes. Whereafter they were developed into the design requirements based on the MoSCoW guidelines, dividing the requirements based on their importance. Where the design requirements allowed for the assessment of the design concept later in the process, the division allowed for the prioritization of the development of certain features over others during the following design phase of the assignment, with must-have requirements being essential to the functionality of the design.

To ensure all developed parts of the interface were in a cohesive proposal, a visual design style was developed first in the design phase. This style focused on the design style, colour schemes, typeface, and spacing and was used as a visual guideline during the generation of ideas.

The next idea generation phase was split into the three necessary parts of the interface, the real-time monitoring screen, the baseline forecasting and simulation creation workflow, and the forecast and simulation assessment workflow. Brainstorming, intermediate assessment, and iteration during this phase resulted in concepts for each part that were combined into a preliminary concept in the conceptualization phase.

The conceptualization started with the merging of the idea generations results into a preliminary concept. This concept was assessed against the design requirements, which allowed for the localization of areas where improvements were necessary. Implementing these improvements

resulted in the final concept presented in Figure 1. This concept proposal met all requirements on the highest tier of importance, and met 81% of all requirements.

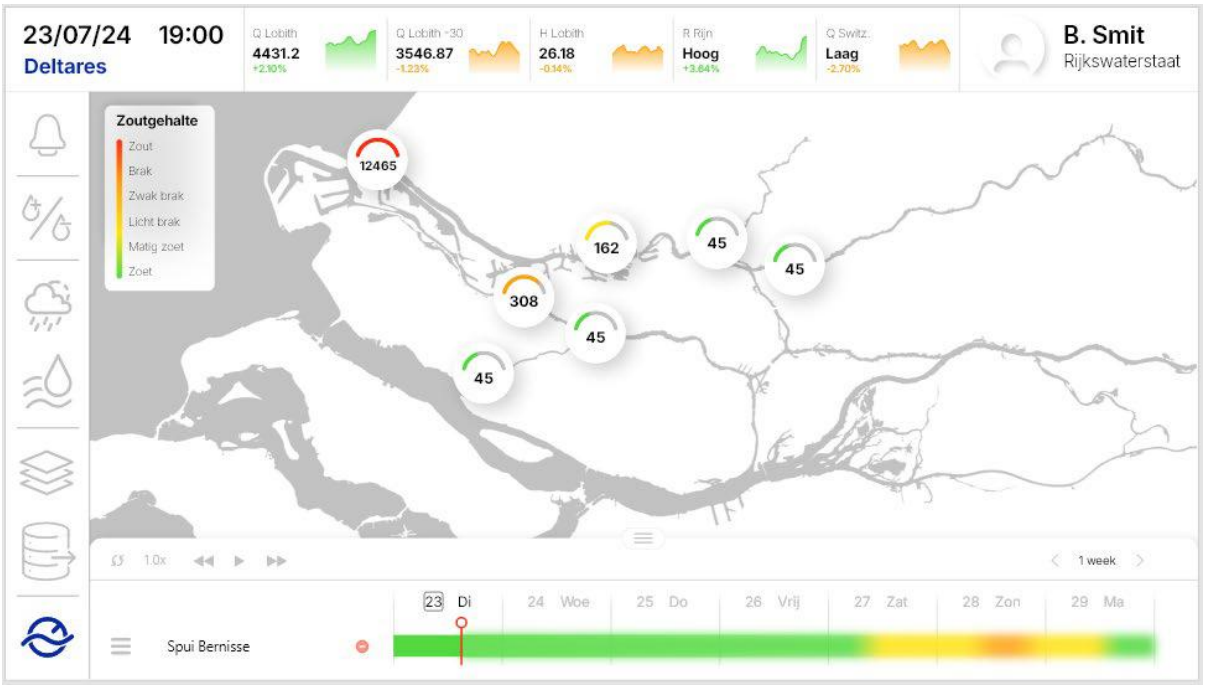

Figure 1 Real-time monitoring interface screen

For testing purposes, a digital prototype was developed based on the final concept proposal. This was achieved using the Adobe Illustrator and XD softwares. The prototype does not have real-time data integration, and was made to test its interactivity. It can be tested at https://edu.nl/rhx8f. Stakeholders and potential users tested the prototype with the guidance of tutorial videos and answered survey questions. These restults showed room for improvement in the visualization of the probability and correctness of predictions, and the satisfaction of users with the cohesiveness of the concept.

This thesis project resulted in the development of a visual design proposal for the interface of the Virtual Delta Digital Twin, and a prototype testable on its interactivity and intuitiveness. Although the design proposal meets all Must-have requirements, extensive usability testing has not been performed and would be necessary to confirm the results discussed in this thesis.

The goal of developing the concept for the interface for the Virtual Delta has been accomplished, as the Must-have requirements have been met. However, development is not complete yet as not every design requirement has been met. Therefore, further research and development is necessary. Especially work regarding the probability of the simulation results is necessary, and usability testing must be performed to ensure a user tested product that integrates into the back-end of the Virtual Delta.