Barometer & Web UI Development

> **Documentation**

i. AUTHORS

@David's Student, @Hendrik Bohling, @C | Christine, @Istabraq Kinda Hussain, @Luca, @Fergan Künler

ℹ️ This Documentation is contributed by multiple authors that were participants of the Hackaton at Hochschule Bremen in 2022.

ii. RELATED WORK

iii. ABSTRACT

Visualization nowadays is used everywhere to visualize large amounts of data. Common in statistics and research, huge amounts of data from table sets are processed and displayed in an easy-to-read and understandable form. The goal is to improve the audiences' knowledge, finding gaps in given data or to gain a different perspective on provided databases to discover new relations. Displaying information in different ways is useful and progress in this sector is interestingly followed by teachers, schools, trainees, or museums. The last one mentioned has problems in transferring their vastly collected artefacts into the web for a wider audience. File sizes of stored scanned items are too large and solutions are needed. We won't address this issue specifically. In terms, this is a low-cost project with the aim to help the Deutsche Schiffahrtsmuseum to bring their attractions online, so they can be explored by a variety of people. Our goal is to achieve this with open-source software and tools that are easily available on the internet. In this paper you will find a well documented product and all the necessities to accomplish such a project as ours. We showcase our created components and display how they changed during the several phases of the project. We divided this presentation in milestones that we accomplished, Additionally we provide solution statements to concerns that appeared in the different phases of our project. At last, you will find conclusion about advantages and disadvantages together with a summary about the project as it states now.

iv. BACKGROUND

i. Mile 1 (Hackaton)

The German Maritime Museum / Leibniz Institute for Maritime History (DSM) organized a two-day hackathon and visualization workshop in cooperation with Faculty 4 (Electrical Engineering and Computer Science) of the Bremen University of Applied Sciences (HSB) and the MAPEX Center for Materials and Processes at the University of Bremen. The hackathon was open to students from Bremen and the surrounding area and took place under the name "Seaman's Gear" on 8.- 9. October at the HSB.

Hackaton participants received a short introduction into Blender, µ-computer-tomography and the possible exhibits we are about to be working with which are the chronometer, sextant, barometer. We chose to work with the barometer.

In this context, this time period is further referred to as Mile 1 in our development work.

i. Given task

The online presentation of visualized technical devices should be made possible using open source applications.

ii. Mile 2 (Project-based work)

As our work got reviewed and presented to members of the DSM, they were happy with our results and further ideas crystallized in a talk afterwards. A small team of the hackathon participants was then commissioned for further tasks. This time period is further referred to as Mile 2 in our development work.

i. Given task

To polish our work from mile 1 making our product ready for an exhibition to the audience and visitors of the DSM. This includes UI-design, model optimisation, web development and project management.

v. KEYWORDS

Visualization, 3D-Modelling, 3D-Animation, Web Development, GLTF, WebGL

vi. DISTRIBUTION

vii. TABLE OF CONTENTS

i. AUTHORS
ii. RELATED WORK
iii. ABSTRACT
iv. BACKGROUND
    i. Mile 1 (Hackaton)
        i. Given task

viii. REFERENCES

Digital Materialities | Hackathon

ii. Mile 2 (Project-based work)
i. Given task
v. KEYWORDS
vi. DISTRIBUTION
vii. TABLE OF CONTENTS
viii. REFERENCES
ix. TOOLS
i. Mile 1
i. Project management
ii. Project-related
ii. Mile 2
i. Project-related
x. PRODUCT SPECIFICATION
i. Mile 1
ii. Mile 2
xi. REQUIREMENT DEFINITION
i. Mile 1
ii. Mile 2
xii. DESIGN
xiii. METHODS
i. µ-computer tomography
xiv. ANIMATION
i. Blender related
ii. Mile 1
i. Animate components
iii. Mile 2
i. Animations implemented into UI
ii. Example of an animation process
xv. COMPONENTS & COMPARISON
i. Mile 0
i. Initial barometer
ii. Case scan
ii. Mile 1
i. The body
ii. The chain
iii. The spring
iv. Insides
iii. Mile 2

Deutsches Schiffahrtsmuseum

HSB Fakultät 4

MAPEX Center for Materials and Processes

i. Case
ii. Barometer
iii. Insides
iv. Textures
xvii. WEB-APP-USER-INTERFACE
i. Mile 1
i. GUI
ii. Mile 2
i. GUI
ii. Optimized for different screen sizes
xviii. CODE
ii. Mile 1
i. Basic setup
ii. Load model
iii. Play the animation
iii. Mile 2
i. New application architecture
ii. Entry point
iii. Scene component
ii. Dashboard component
xix. BAROMETER
i. Description
ii. Technique
iii. Details
xxi. PROBLEMS & OPTIONS & SOLUTIONS
iii. App architecture
xxii. TESTINGS
i. White-box & black-box testing
i. Mile 1
ii. Mile 2
xxiii. CONCLUSION

ix. TOOLS

i. Mile 1

i. Project management

- Notion
- Gdrive
- Github

ii. Project-related

- Blender
- three.js
- JavaScript

▼ Node.js + Webpack

Setup

```
# Install dependencies (only the first time)
npm install

# Run the local server at localhost:8080
npm run dev

# Build for production in the dist/ directory
npm run build
```

ii. Mile 2

i. Project-related

- + Figma
- + tailwind.css
- + DRACO Compression

x. PRODUCT SPECIFICATION

i. Mile 1

The requirements for this mile are to create a functional product. We are able to clean up barometer meshes and animate different parts of it from given raw data. Which was shaped into multiple undefinable objects beforehand, we refer that time period as Mile 0, as it was a rough scan provided from the DSM with a lot of glued polygons and undifferentiated parts of the barometer. So the tasks given are: (1) to analyse its mechanism and (2) to figure out which parts have to be reworked to be able to animate them properly. An additional feature idea from one of the participants is that we can link the barometers' animation to real world weather data. This will be possible through a weather API. However, this feature was not implemented yet due to the team size. and short-timed nature of the hackathon.

ii. Mile 2

To make our product ready for exhibition it implies tasks like creating and improving a more appealing user interface, differ and organise our previously made animations from Mile 1 as well as creating new ones which complete the portfolio. Lastly, we are to implement a mode which functions similar to an x-ray vision and allows to take a look inside the barometer.

xi. REQUIREMENT DEFINITION

i. Mile 1

The main goal for mile 1 is to realise a barometer and its mechanics based on given raw data which consists of a sticked together polygonic mass. Several component parts will be extracted from that mass. To do so we have to first understand the mechanic of the barometer. We can then choose which parts of that mass we need to refine some proper components from. Animations will later be added for such individual components. Afterwards these components will be attached to one another as a union. Doing so in a logical and useful way so in the end a complete barometer exists.

ii. Mile 2

In mile 1 the focus considering animation lied on crafting and animating components. In mile 2 this process shifts into the direction of animating the barometer in its whole. The main goal in this mile is to create a web-application which showcases the barometer functionality in a visual appealing and detailed manner at an exhibition for the DSM and its visitors. Users shall be able to play several animations on the barometer, rotating it, and be able to toggle different views on it. In the animation section of this documentation, the different possible animations are mentioned. As a possible view, an x-ray-vision on the barometer shall be implemented additionally.

xii. DESIGN

The preparatory work for the digitization of the barometer was created on the 3D modeling program Dragonfly.

// TODO: screenshot here from initial data

Complications arose, which is why digitization continued on Blender 3D. Here we did our modelling tasks and were able to present and refine components in more detail.

xiii. METHODS

i. µ-computer tomography

The method that was used to scan the barometer artifact from the museum which we received our raw data from.

- X-ray tube consists of an object placed on a rotatable sample holder and a detector panel.
- Creates projections (2D), which then stitched together to 3D object. Dragonfly software is then used to create the mesh from image stack.

xiv. ANIMATION

i. Blender related

In Blender 3D you can not only record objects in the room but also add a movement and thus create an animation. For example, the spring created must be able to expand and pull together again. It is possible by setting the "screw" values higher or lower in the "Modifier Window". So you set a maximum and a minimum, these points are recorded in the lower "Frame menu", e.g. the minimum value 1 is for seconds and the maximum value is 10 seconds. Blender 3D then adjusts the movement and projects the desired animation.

ii. Mile 1

i. Animate components

In mile 1 several objects were extracted from the given polygon mass. They have been partly combined and crafted into several components that seemed to have a logical relation for us. You can find these in section xv. Components.

iii. Mile 2

i. Animations implemented into UI

In mile 2 several animations were refurbished and updated to fit the needs for an appropiate user experience and to assure they can be played smoothly inside the updated UI. Though many were planned the actual implementation consits of the **bold marked** animations that are listed and descripted below. The animation steps are sorted from left to right inside the UI. Multiple different sets of animations made of combining these steps to our liking can be implemented in the future as a playlist. For now we stay with one default set and it’s main purpose is to display the technical aspect. For a smooth experience to the audience of the exhibition and possible online presentation we decided to show how the barometers case is removed and the insides taken out.

Figure 2: Animations planned and realised for different time periods

Steps	**Mile 1**	**Mile 2**
1	Open case	**Open Case**
2	Rotation	**Remove Case**
3	Moving Pointer	**Lift Barometer**
4	Show animated inside components mechanism working	Lifting Barometer (using animation from Step 3 - mile 2)

		and let case disappear (using animation from Step 2 - mile 2)
5		**Reverse Lift Barometer** | Lie The Barometer back on the ground (using animation from Step 3 - mile 2)
6		**Measuring |** Show animated inside components mechanism working , Spin the arrow on the dial face

ℹ️ Reverse animation for each step shall be available in the future by pressing the same button for a 2nd time. Right now Step 5 - mile 2 is the only reversed animation we have available and brought to use. Here the reversing process is done inside the web-application and not inside blender.

ii. Example of an animation process

Keyframes were created in the timeline editor to animate the different components parts with Transforms (Rotation, Movement, Scale). Selecting attributes for Transforms records changes chosen attributes values of an object/component with each frame. Blender is recording these accordingly from a defined Keyframe A to Keyframe B in the timeline. The case and lifting animations of the Barometer were done within 100 Frames and the animation of the inside parts were done with 200 Frames. The change in the amount of frames was done to put some focus on the inside parts and how they move in the Lifting position. However this won’t matter for the milestone 2 development goal because animations here will be looped in different positions of the Barometer inside the web-application with the threejs framwork.

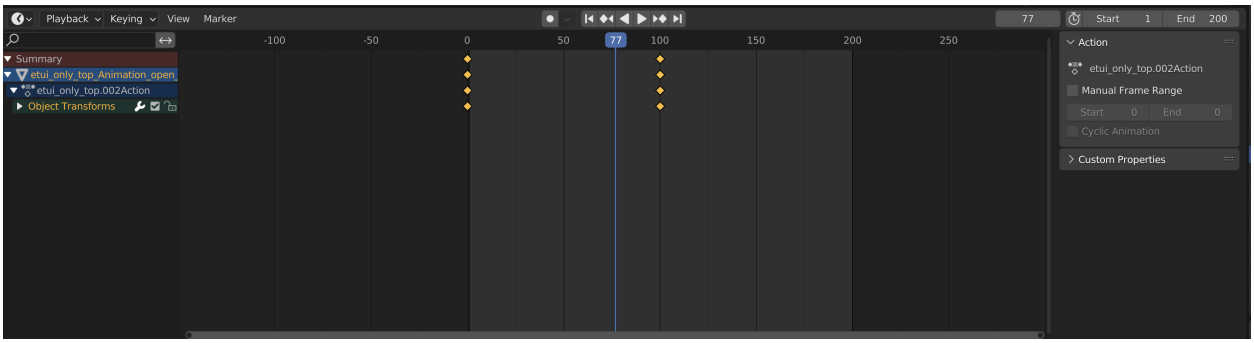

Figure 3: Blender timeline editor

xv. COMPONENTS & COMPARISON

To show you the components we crafted and a comparison on how the barometer artifact changed during the project we collected several examples during the different stages of development to showcase them here.

i. Mile 0

i. Initial barometer

> Was scanned and been delivered as raw data by the DSM which actually came as a polygonmass where objects happened to be badly distinguishable.

Figure 4: Barometer case closed

Figure 5: Barometer front showing clockface

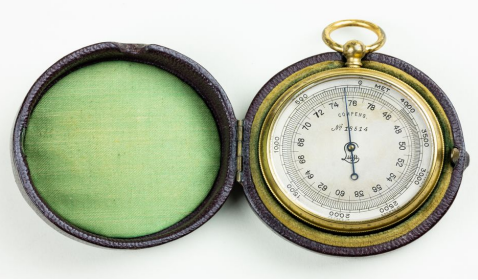

Figure 6: Barometer case open

ii. Case scan

Figure 7: Case open, polygonic white

Figure 8: Case open, polygonic white, top view

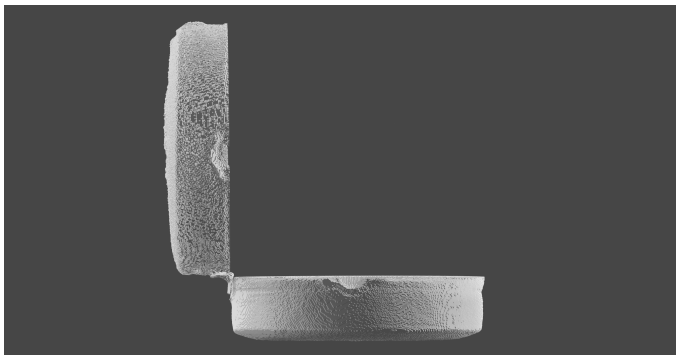

Figure 9: Case open, polygonic white, side view

ii. Mile 1

> 1. Component parts haven been extracted from mass and formed into different logical units.
> 2. Textures were roughly added as it seemed fit.
> 3. We cut out the clockface from Figure 8 or 9 and were able to use it for the models texture inside blender.

i. The body

> Using the original scan from the DSM as reference, we were able to build a body that had all the original features of the initial case.