Blogpost: indoor 3D data

We experience the real world in 3D. This third dimension has often given troubles when translating the real world to data. Visualising something in 2D, after all, is easier to do. However, only showing data in 2D also means often information gets lost, and thus, people are actively finding ways to incorporate the third dimension as well. And with digitalization on the rise, it seems we are getting closer and closer to finding good ways of showing data in 3D. For the outdoors, large-scale projects have already been happening across the world, but indoor 3D data is a lot harder to come by, despite a lot of our lives taking place inside buildings.

This loss of information can have bad consequences in certain situations, for example when one needs to navigate through a building while under considerable time constraints. As a case study, we focused on the emergency situation of a fire. In case of a fire, it's of utmost important that someone trapped in the building in question, or a firefighter trying to find their way through the building, can quickly see the route they need to take. This calls for a focus on pathfinding and visualization, making

Upon CGI's request, we, a group of 5 students from Wageningen University, have taken it upon ourselves to investigate the world of indoor 3D data. During the past few weeks, we have gone through the process of collecting the data, creating a model, implementing a pathfinding algorithm; all culminating into an indoor 3D navigational app. As a starting point, we focused our research on the Gaia building within the Wageningen campus. Further below, we will give you some inside information on the process and a sneak preview of the final app.

Data collection

After some deliberation, we decided to try three different ways of creating a 3D-model of one of the buildings on our university campus. The first method was photogrammetry, taking multiple pictures of a place or object and using those to recreate the thing in question in 3D. Even though the results were by no means bad, simply creating a single room already took over a thousand pictures, making it far too time-consuming.

The second method was a tool called a Zebedee, a handheld laser scanner. With the Zebedee we acquired a point cloud, which we converted into a full model using a program called Meshlab. We managed to get a model of the building which was recognizable, but looked more like a dungeon from a videogame than our university building. We later found out that the Zebedee tool is not particularly well-suited for large buildings. It could work if the measurement is done thoroughly enough and on the right level of detail, but due to time constraints and limited access to the building due to the Corona situation, we eventually found that unfeasible as well.

Visualisation

Eventually, we found a way to extrude a model directly from the architectural floor plans of the building. Despite not being the flashiest way of creating a 3D model, it was by far the quickest and most reliable method considering our time and resources, as it included all walls, stairs and doors. After some cleaning up, this led to the model as seen in the final product below.

This model would become the basis for our eventual app. We looked into good ways to show the model in the app, considering the limited time we had. An important point was the way the walls were incorporated into the model: we imported these as separate objects, allowing the user to let the walls appear and disappear at will, as well as show different floors separately.

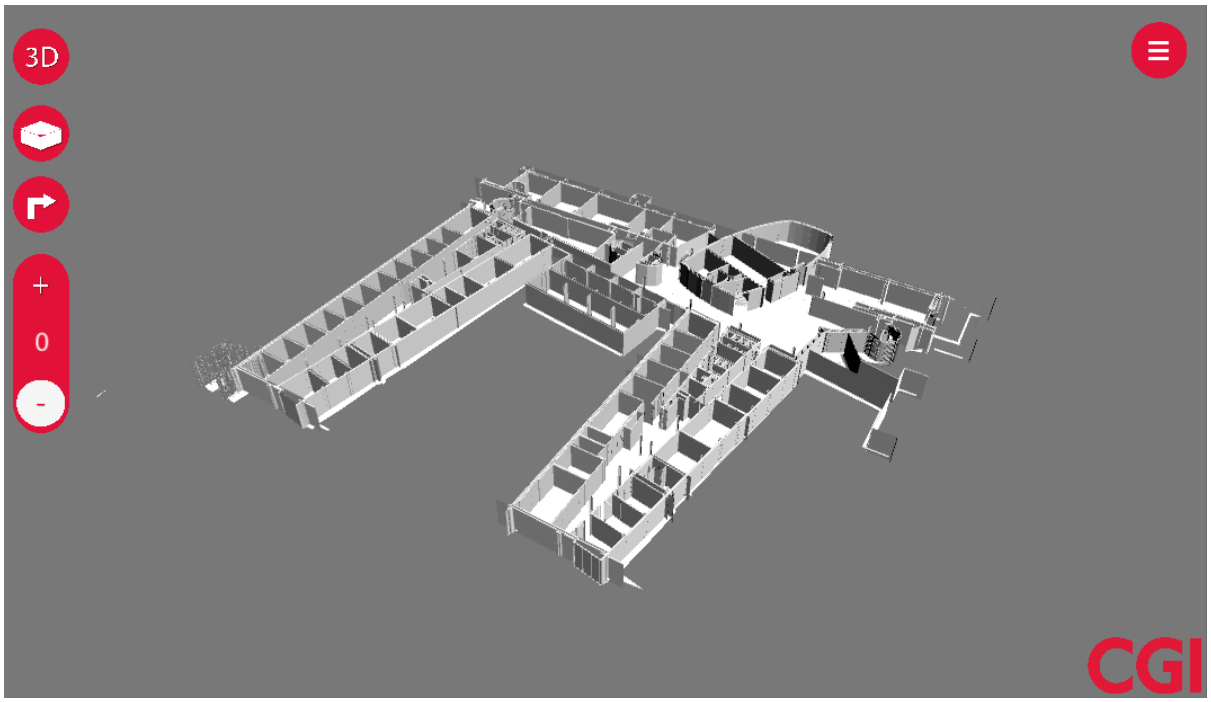
Our next step was conducting an interview with the fire brigade responsible for Wageningen and its surrounding area, we learned about what could be useful, and have tried to incorporate this as much as possible in the final product.

Pathfinding

Now, creating a model by itself is already quite interesting. However, you want a model for a specific purpose. We decided to focus on one important application: the usage of 3D models in crisis situations, and specifically in case of a fire. In such a situation, both for the victims and the firefighters in question, being able to navigate through a building efficiently is extremely important. 2D maps do not always enable a good sense of navigation within a building. Therefore, we focused on implementing an A-star algorithm within the 3D model. Our iteration of the algorithm allows the user to dynamically find the shortest route to the selected destination, ensuring safe paths around potentially disastrous obstructions.

The final product

The final product is an app that guides the user within an indoor environment. Below are some screenshots from the app. Right now, the only building available in the app is Gaia on the Wageningen University campus. However, the vision is that eventually, there will be more buildings, and the user can simply select the building they want.



The future

Although we are proud of our results, we're aware that there are a lot of additional steps that could've been taken did we have more time. One interesting option we came across came from a student team in Delft, which was doing research similar to ours. Their research focused on real-time data collection, which fills in some gaps in our own project. Combining the two could lead to very interesting results, incorporating real time data. Although, as mentioned before, time did not allow

us to do this combining during the project, this is definitely something interesting to look into for the future.

What we created is rather small, thanks to our limited resources, time constraints and our own limitations. However, it's part of something that has a lot of potential. There are ways to create good indoor 3D models, which, if given the time necessary, can serve a plethora of purposes - both in emergency situations, like we focused on, and in a lot of other fields. We learnt a lot during this project, and we're all very excited to see how indoor 3D data will evolve from here. Then maybe at some point, the app could actually be a reality. And in the meantime, it can be found at https://simmer.io/@Rinus50schild/indoor-mapping-firefighters.