3D-Visualization of Utility Lines in the Browser Using Augmented Reality on Tablets

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Introduction: Locating underground utilities, such as water pipes (sewer lines), is challenging because they are typically hidden and visible only on 2D plans. And many have difficulty to perceive them in 3D. This project aims to solve this problem by enabling the 3D visualization of these utilities in the real world environment using augmented reality (AR). Although there are solutions for this purpose, they require native applications and specialized hardware. In contrast, this project focuses on the development of a web application that is easy to use and works with off-the-shelf tablets and a low-cost, high-accuracy GNSS (GPS) devices such as ArduSimple's RTK Handheld Surveyor Kit.

Approach: The project started with an exploration of existing technologies, followed by the development of a prototype to test their feasibility. The next step was to implement the actual application using the best performing technologies from the prototype. Specifically, the WebXR API was chosen to create AR experiences in a browser on the web. Blender with the BlenderBIM add-on is used to convert building data (IFC 4.3) as input into a web-friendly format (glTF). The Vue.js JavaScript framework is used for the frontend and Python Flask for the backend.

Result: The application is designed to visualize water utilities based on the user's location and the models. The colors of the pipes (lines) correspond to the colors defined in the IFC data. During implementation, an educational model was used for testing purposes. A field test in Stäfa further assessed the application. These tests were crucial to evaluate the feasability and usability of this application. One of the challenges was to align the virtual utility lines with the real world. This is difficult due to the limited accuracy of mobile device compasses, which are easily affected by nearby magnetic fields. There are still challenges to overcome, such as reducing the optical illusion of manholes that seem to be too high, or inconsistencies in the IFC data. Extensions include other utilities and terrain integration. This project has laid the groundwork for AR and 3D visualization of utilities.

Example screenshot from the task definition showcasing another augmented reality solution by vGIS using a native app
https://www.directionsmag.com/pressrelease/7197

Screenshot of the web-app with an educational model on the OST campus Rapperswil displaying different types of pipes
Own presentment

Screenshot from Stäfa showing waste water pipes; the manholes seem to be above the ground, but it's an optical illusion
Own presentment