# AUGMENTED REALITY TOOL FOR COMMUNICATING COMPLEX GEOLOGICAL CONDITIONS, ENGINEERING DESIGNS, AND HAZARDS

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ABSTRACT

Complex geological conditions, engineering designs, and risk management strategies for geohazards are often difficult to communicate, and consequently difficult to understand for non-specialists. These complex datasets, prepared by technical specialists, are typically presented in reports, presentations and 2D drawings. The people receiving this information must then interpret and form their own mental 3D model of the real-world conditions, proposed designs, or risks. Effective communication requires technical specialists to prepare information in a clear and easily understandable manner. Those receiving this information are required to correctly interpret how the 2D representations translate into reality, which is of course 3D.  A new augmented reality applied earth science visualization system has been developed to help bridge this gap and promote more effective communication.

The augmented reality applied earth science system includes proprietary software for generating 3D holographic models, coupled with an augmented reality holographic visualization tool. GIS software is used to merge topographic data (LiDAR, UAV photogrammetry, etc.), engineering designs (e.g. Civil3D surfaces), imagery, and vector datasets (feature labels, etc.) into a single GIS workspace. The augmented reality applied earth science system creates 3D holographic projections from this data, which are then exported and deployed onto a holographic headset. A user can then use the headset to view a 3D holographic table top model of the scenes created at a true 1 horizontal: 1 depth: 1 vertical scale.

An immersive view has been developed to allow users to move through a landscape in a virtual tour of the project site, with visualizations that are to scale, and represent the natural environment or potential future conditions. A user can jump from a table top model to the immersive view, allowing the user to interact with a site from different viewpoints. The ability to visualize a site from different perspectives and scales helps users to gain a deeper understanding of a project site (Figure 1).


Figure 1. An immersive view of a mine site with a table top model of the same location from a bird's eye view point.

Another key development is the ability to connect multiple holographic headsets wirelessly so that multiple users can view and interact with the same scene simultaneously (Figure 2). This augmented reality applied earth science tool allows a presenter, such as a technical expert, to guide other users, such as stakeholders or clients, through a project site. Applications for this include client or stakeholder meeting and public engagement sessions. This allows the other users to see exactly what the presenter sees without having the need to interpret and visualize the complex technical information. This can help to mitigate the risk of miscommunication between the technical specialists and those receiving the information, and minimize the likelihood of incorrect interpretations impacting the decision-making process.


Figure 2. Boardroom presentation connecting multiple users to visualize the same scenario using holographic headsets.

The augmented reality applied earth science system has been used in several real-world applications. One example was during an advisory board meeting for a hydroelectric project. Visualizations of key scenarios during the construction were presented by combining existing topography with 3D design work and overlaying a number of water level scenarios on the model. The effect of shoreline erosion following reservoir filling to 100 years of reservoir operation was demonstrated at a location with a variety of existing infrastructure. Users commented the ability to see and communicate geohazards were powerful for those who did not have a technical background or understanding to visualize the complex earth science concepts of the site.

The power of 3D visualization was also realized when a slope failure occurred on a mine site. A UAV photogrammetry point cloud was used to generate a DEM of site conditions with the current orthophoto draped on the topography. Using the augmented reality applied earth science system, a table top model was generated within an hour, and the model was deployed to a holographic headset as a 3D holographic model for the mining company's internal use within a day. Multiple parties were able to view the slide and make informed decisions on the information without the time and expense of having to fly everyone out to site.

The augmented reality visualization tool was used for a project where linear infrastructure crossed many geohazards. A railway company contracted models to be built along three of their most congested sites to evaluate the utility of the models. They realized the benefit of being able to see the sites they would be working at before heading into the field, identifying most narrow and vulnerable sections on the tracks, and to facilitating conversations for route planning and material placement. These are a few of the examples of how visual communication aids in focusing planning.

Augmented reality allows people to interact with applied earth science data and control their experience, which facilitates the development of a deeper understanding of 3D environments and their changes over time. The ability to visualize a site in 3D on a boardroom table can help to identify, anticipate, and mitigate challenges earlier in a project life cycle. Visualization of 3D models allows stakeholders to have a better understanding of how man-made structures and their geological setting influence landscapes, groundwater, and geohazard conditions. With the help of augmented reality, technical language barriers are lessened in the field of applied earth science. Holographic visualization creates space for more confident decision making.