

VIRTUAL REALITY MODELING OF THE CRREL PERMAFROST TUNNEL,

ALASKA

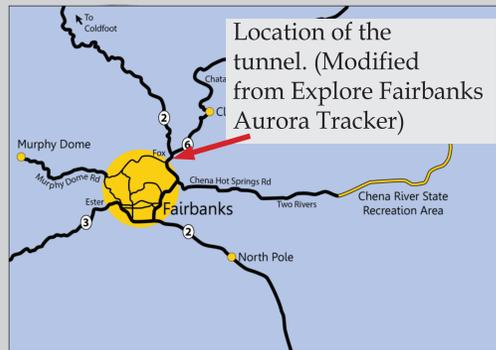


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Background

As of today, few real, small-scale locations have been modeled for Virtual Reality (VR). One location, perfect for modeling, is the Permafrost Tunnel between Fairbanks and Fox, Alaska. The Tunnel was originally made between 1963 and 1969 by the Army Corps of Engineers as a bunker and storage experiment. Since then, the tunnel has been used extensively for permafrost, biology, geology, climate, mining, and engineering research. It is currently owned by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL). We set out to develop a useable VR model of the Permafrost Tunnel for educational use. We used a 360-degree camera, Agisoft Metashape, and the Unity game engine to generate a useable model. Upon completion, students from around the world and people with disabilities or illnesses will have access to the Permafrost Tunnel.



Methods

To photograph the tunnel, we used a GoPro Fusion 360-degree camera (right). By moving the camera horizontally between 50cm and 75cm for each photo, a total overlap of over 9 photos for almost any given area was obtained. After four visits and 810 photos, we created the full model from smaller sections using Agisoft Metashape. Merging different tunnel sections (8 in total) reduced computer load and maximized model quality. After finalizing the model, the Unity game engine (unity.com) along with the SteamVR plugin were used to create the VR experience. We used the premade materials and scripts included in those programs to make the experience interactive.



The early setup we had to use in order to insure good lighting and photo resolution



Illustrated goggle view of the tunnel
 Photo: (Shelby Lum / Alaska Dispatch News)



VR Goggles

VIRTUAL REALITY

Outcomes



A textured mesh (left) and an early version of the tunnel in Unity (right).

We have created a virtual model of the Permafrost Tunnel using about 800 spherical photos. We have shown that it is possible to create a model using a 360-degree camera with the computing strength of a laptop. Taking the photos took about 12 hours while processing time clocked in at over 100 hours. During testing, users felt that the feel of the tunnel was right while the dust and smell were thankfully left out. The model is available for testing here.

Discussion

The main problem faced while taking photos was low and variable light. While we did have smaller lights to add to what is currently in the tunnel, more would be needed in the future to improve upon the model. Nevertheless, the end product has about 97% coverage with the remaining 3% of the tunnel appearing as holes due to surfaces being too smooth or dark for Metashape to recognize. A faster, more powerful computer would cut down on processing time and could result in a higher resolution model.



Variable lighting, dust, and smooth surfaces in the tunnel

Conclusion

We have managed to create a Virtual Reality experience of a real location. Once fully complete, this model will be made available to the wider public. Teachers and professors can soon guide tours through the tunnel using VR headsets or a computer and streaming services. Virtual Reality is a versatile tool that can be used on phones as well as computers so students can follow along on whatever medium they have and revisit the tunnel at will. This model and outreach have the potential to interest many more students in arctic and climate research.



The \$16 Google Cardboard is affordable and works with any smartphone

Acknowledgements

- This project is based on work supported by the National Science Foundation under Grant No. 1423550
- Matthew Strum (P.I.)
- Chris Maio
- Support from Alaska EPSCoR NSF award #OIA-1757348 and the state of Alaska.
- University of Alaska Fairbanks
- U.S. Army CRREL
- UAF Geophysical Institute
- Unity Technologies
- Agisoft
- URSA



This project is part of Hot Times in Cold Places: Permafrost During Climate Change. Visit the website at www.permafrosttunnel.org or scan this QR code.

