AS223139

Drones, Machetes, and Virtual Reality: 21st-Century Tools for Historic Preservation

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Learning Objectives

- Understand a comprehensive process and workflow to perform reality capture, and convert and optimize recap data to be experienced in VR and AR experiences
- Identify typical data management challenges encountered in photogrammetry/reality capture, and understand the ways to address them
- Learn practical lessons and tips for executing drone-based photogrammetry in the field
- Understand the various use cases that virtual reality can be applied to photogrammetry and historic preservation

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Description

The climate is changing, and sea level is rising. This will have a catastrophic impact around the globe, especially for those who live on Pacific islands, as entire countries, cultures, and architectural artifacts are wiped off the map. As technology advances and becomes more accessible, we now have tools to mitigate the impacts of climate change. Specifically, PHOTOGRAMMETRY and VIRTUAL REALITY enable us to document artifacts at risk of submersion, to support historic preservation efforts in the face of climate change.
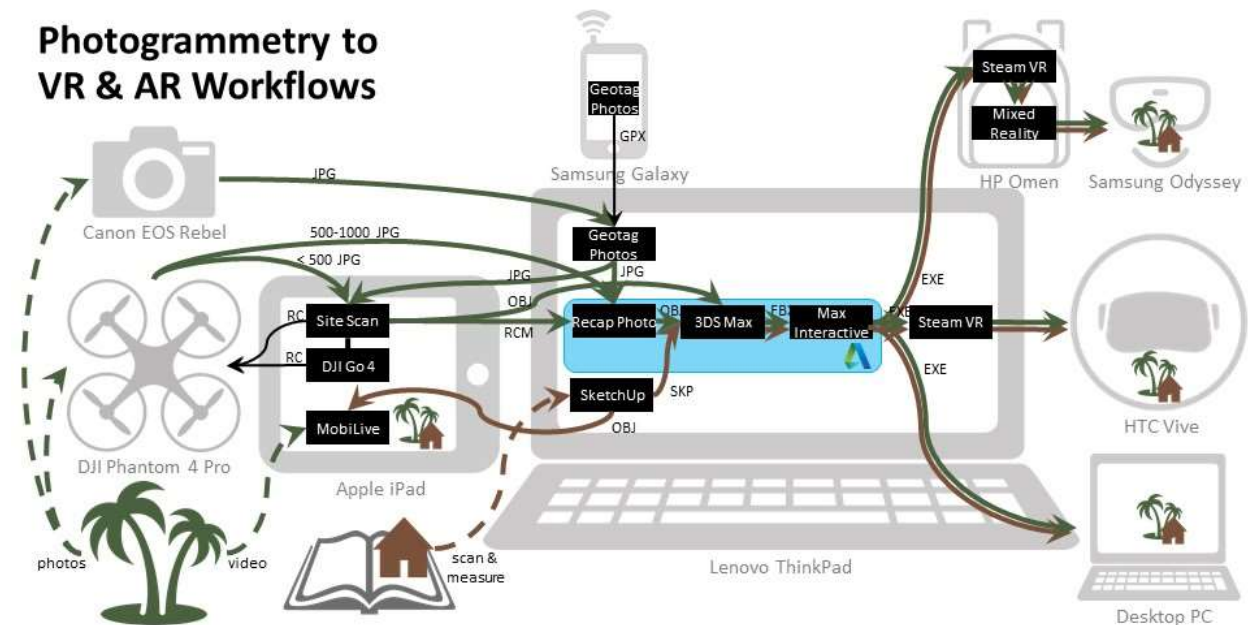
This session will present a recent project documenting archaeological and architectural ruins in Kosrae, Micronesia. The project supported effective decision-making about the preservation of culturally significant artifacts by experiencing them from new points of view. To do this, the project investigated feasibility, developed workflows, and utilized drones, photogrammetry, virtual reality, and augmented reality to historic preservation of cultural artifacts.

Speaker(s)

Dace Campbell, AIA, LEED AP is a Construction Account Manager in Education at Autodesk and a nationally recognized expert and thought-leader in innovative tools and processes, including Building Information Modeling, Lean Construction, and Integrated Project Delivery. He is a licensed architect with almost 30 years of experience in design, construction, innovation, collaboration, and business consulting, and over 25 years of applied research in virtual reality and augmented reality in AEC. Dace's projects have won four AIA BIM awards, and he is a winner of the 2011 Building Design + Construction "40 under 40" award. His work and writing about BIM, Lean, IPD, and VR and AR have been published internationally, and he is an active member of local and national BIM and Lean communities.

VR Experiences

Virtual Reality (VR) experiences of the historic artifacts on Kosrae can be accessed from: https://tinyurl.com/VirtualKosrae

Photogrammetry to VR & AR Workflows

Data Management Challenges

It is vital to be aware of the minimum and maximum limits for the number of photographs a photogrammetry process will support, as follows:

- **20**: Minimum number of images to process

- **300**: Maximum limit of Recap Photo "object" processing

- **500**: Limit of 3DR Site Scan use of background Recap Photo, above which 3DR uses Pix4D

- **1000**: Maximum limit of Recap Photo "aerial" processing

- **2500**: Maximum limit of images to process by 3DR Site Scan

These limits demand a carefully planned work-breakdown structure (WBS). Managing thousands of photos and a thoughtful WBS requires good "digital hygiene" of file management, naming conventions, discipline, and record-keeping. The significance of this effort cannot be overstated.

Practical Tips for Aerial Photogrammetry in the Field

Based on this project, there are several lessons learned and best practices recommended for executing automated aerial photogrammetry, as follows:
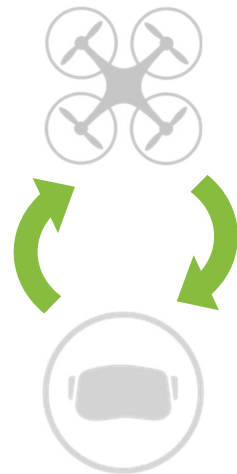
1. Use a spotter to keep the drone in line of sight at all times
2. Start with high-flight at 300' to create a base ortho photo
3. Practice and perfect drone flight patterns, to re-fly final flights automatically
4. Fly all flights at same time of day, for consistent lighting
5. Fly in low wind and in overcast skies or hazy sun to minimize dark shadows and glare
6. Carefully plan flight times to optimize battery use
7. Record flight times and names of photos in areas you plan to delete
8. Measure a known distance on the ground for reference
9. Bring an umbrella to keep your tablet dry and cool/shaded
10. Bring spare cables, adapters, batteries, and propellers

BONUS: Wind is unpredictable, and trees eat drones for breakfast… be flexible and stay alert!

Use Cases for applying VR to Photogrammetry and Historic Preservation

Multiple use cases have been identified for VR in a photogrammetry workflow. The hypothesis that VR would be useful to visualize the final model, *after* photogrammetry was complete, was validated. Additionally, VR was quite useful *during* the photogrammetry process, as follows:

1. To review low-resolution models created from an initial high-flight, to be able to identify areas of interest and plan additional flights to document them
2. To quality-check in-progress models, to be able to identify gaps in the data captured and plan supplementary drone flights and photos to fill those gaps
3. To compare models of an environment processed from photos taken from different flights, whether from different flight patterns, or various times, days, or weather

In this way, photogrammetry and VR are not merely sequential technologies applied in a linear process, but rather mutually beneficial technologies that lend themselves to a reiterative process.

Further, VR (and AR) provide the following historic preservation capabilities:
- Greater accessibility of experience for locals
- To extend experience to people who couldn't or wouldn't hike to remote areas
- To expand outreach: for researchers and historic preservation authorities like UNESCO to understand the intended experience of a managed site
- To connect ex-patriots living abroad to their homeland resources
- To support tourism and education
- To provide new vantage points for land owners, giving them a clear view of artifacts from above to plan maintenance of the ruins