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Drones, Fire, and VR: 21st-Century Tools for Sustainable Development

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Learning Objectives

- Apply a comprehensive process and workflow to perform reality capture, and prepare recap data to be experienced in VR
- Identify typical data management challenges encountered in photogrammetry/reality capture, and ways to overcome them
- Explain practical lessons and tips for executing drone-based photogrammetry in the field
- Articulate the various use cases where virtual reality can be applied to photogrammetry and feasibility studies

Description

As our global population increases, remote indigenous communities are compelled to develop to accommodate growth and responsible tourism. Technology is now available to support and promote development of remote communities in an environmentally and culturally sustainable manner. Specifically, PHOTOGRAMMETRY and VIRTUAL REALITY enable effective decisions about sensitive development by empowering stakeholders with intuitive, immersive experience of site conditions from new points of view.

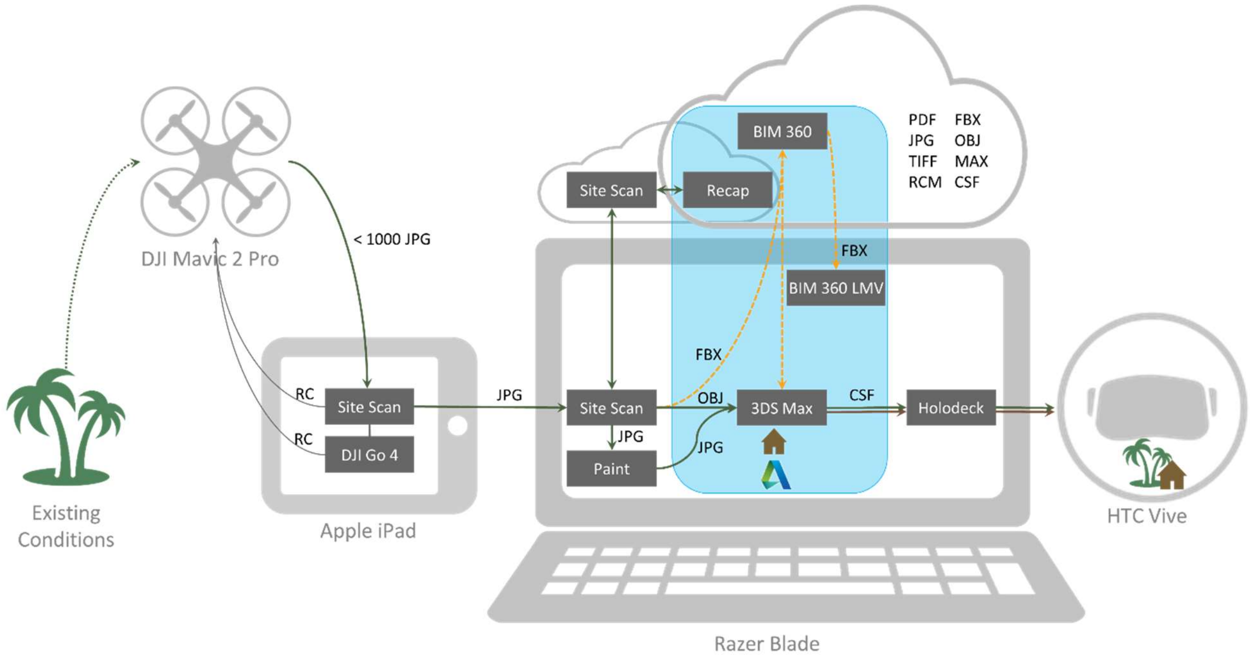
This session will present a recent project on the remote island of Vorovoro, in Fiji, executed as a joint effort between: an indigenous island tribe, a university construction management program, a social enterprise promoting positive social impact, and a global AEC software corporation. The collaborative team created a feasibility study for a dam to retain fresh water on the island, developed new data workflows, and leveraged drones, VR, and cloud-based collaboration platforms with a Forge partner.

Speakers

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.

Tony Lamanna is the Sundt Professor of Alternative Delivery Methods and Sustainable Development and the Program Chair for the Del E Webb School of Construction at Arizona State University. He leads the school into the future in terms of undergraduate and research programs, and strengthening ties with their industry partners. He is also a Senior Sustainability Scientist at the Julie Ann Wrigley Global Institute of Sustainability, the Chief Engineer of a small engineering company. He specializes in repair and retrofit of existing buildings and provides expert testimony and consulting advice on insurance, construction, and personal injury claims. When he's not teaching his students how to be successful in the construction industry, he's making homemade wine, mead, and beer, and serves as a certified beer judge.

Aerial Photogrammetry to Immersive VR 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

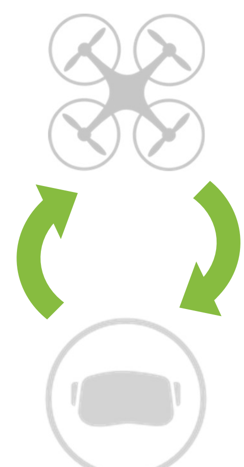
These limits demand a carefully planned work-breakdown structure (WBS). Managing thousands of photos and a thoughtful WBS requires good “digital hygiene” of file management, naming conventions, discipline, and record-keeping. The significance of this effort cannot be overstated.

Practical Tips for Aerial Photogrammetry in the Field

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. Place visual markers for **Ground Control Points**
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 Sustainable Development



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 provide the following sustainable development capabilities:

- Greater accessibility of experience for locals, by extending the experience to people who couldn't or wouldn't hike to remote sites for proposed development
- To support effective decision-making during feasibility studies, by providing a digital model of the existing conditions to support remote measurements and analysis
- To expand outreach to remote project stakeholders or funding sources to better understand the proposed projects by experiencing them
- To support tourism and education
- To provide new vantage points for locals, giving them a clear overview of the proposed site from above to plan development and maintenance