Ancient Wonders Captured in 3-D

Part 1

I'd like to start with a short story. It's about a little boy whose father was a history buff and who used to **take him by the hand**[1] to visit the ruins of an ancient metropolis on the outskirts of their camp. They would always stop by to visit these huge winged bulls that used to guard the gates of that ancient metropolis, and the boy used to be scared of these winged bulls, but at the same time they excited him. And the dad used to use those bulls to tell the boy stories about that civilization and their work.

Let's **fast-forward**[2] to the San Francisco Bay Area many decades later, where I started a technology company that brought the world its first 3D laser scanning system. Let me show you how it works.

[Video] *Female Voice: Long-range laser scanning works by sending out a pulse that's a laser beam of light. The system measures the beam's time of flight, recording the time it takes for the light to hit a surface and make its return. With two mirrors, the scanner calculates the beam's horizontal and vertical angles, giving accurate x, y, and z coordinates. The point is then recorded into a 3D visualization program. All of this happens in seconds.*

You can see here, these systems are extremely fast. They collect millions of points at a time with very high accuracy and very high resolution. A **surveyor**[3] with traditional survey tools would **be hard-pressed to**[4] produce maybe 500 points in a whole day. These **babies**[5] would be producing something like ten thousand points a second. So, as you can imagine, this was **a paradigm shift**[6] in the survey and construction as well as in reality-capture industry.

Approximately ten years ago, my wife and I started a foundation to do good, and right about that time, the magnificent Bamiyan Buddhas, hundred and eighty foot tall in Afghanistan, were blown up by the Taliban. They were gone in an instant. And unfortunately, there was no detailed documentation of these Buddhas. This clearly devastated me, and I couldn't help but wonder about the fate of my old friends, the winged bulls, and the fate of the many, many heritage sites all over the world. Both my wife and I were so touched by this that we decided to expand the mission of our foundation to include digital heritage preservation of world sites. We called the project CyArk, which stands for Cyber Archive.

Part 2

To date[7], with the help of a global network of partners, we've completed close to fifty projects. Let me show you some of them: Chichen Itza, Rapa Nui—and what you're seeing here are the cloud of points—Babylon, Rosslyn Chapel, Pompeii, and our latest project, Mt. Rushmore, which happened to be one of our most challenging projects. As you see here, we had to develop a special rig to bring the scanner up close and personal. The results of our work in the field are used to

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[1] When you "take someone by the hand" you hold their hand and lead them.

[2] Students also heard TED speaker Diana Laufenberg use the term "fast-forward" to move a story ahead in Unit 2.

[3] A "surveyor" has the job of measuring three-dimensional points between distances. It is a common job in the construction industry.

[4] When someone "is hard-pressed" to do something, that person is going to face difficulties accomplishing it, likely because of not having enough time or money.

[5] The term "baby" is used colloquially sometimes to refer to machines, especially impressive ones.

[6] A "paradigm shift" completely changes the way something has been done up until that point.

[7] The phrase "to date" means "up until the present time."

produce media and **deliverables⁸** to be used by conservators and researchers. We also produce media for dissemination to the public—free through the CyArk website. These would be used for education, cultural tourism, etc.

What you're looking at in here is a 3D viewer that we developed that would allow the display and manipulation of [the] cloud of points in real time, cutting sections through them and extracting dimensions. This happens to be the cloud of points for **Tikal⁹**. In here you see a traditional 2D architectural engineering drawing that's used for preservation, and of course we tell the stories through fly-throughs. And here, this is a **fly-through¹⁰** the cloud of points of Tikal, and here you see it rendered and photo-textured with the photography that we take of the site. And so this is not a video. This is actual 3D points with two- to three-millimeter accuracy. And of course the data can be used to develop 3D models that are very accurate and very detailed. And here you're looking at a model that's extracted from the cloud of points for Stirling Castle. It's used for studies, for visualization, as well as for education.

And finally, we produce mobile apps that include narrated virtual tools. The more I got involved in the heritage field, the more it became clear to me that we are losing the sites and the stories faster than we can physically preserve them. Of course, earthquakes and all the natural phenomena—floods, tornadoes, etc.—**take their toll¹¹**. However, what occurred to me was human-caused destruction, which was not only causing a significant portion of the destruction, but actually it was accelerating. This includes arson, urban sprawl, acid rain, not to mention terrorism and wars. It was getting more and more apparent that we're **fighting a losing battle¹²**. We're losing our sites and the stories, and basically we're losing a piece—and a significant piece—of our collective memory. Imagine us as a human race not knowing where we came from.

[. . .] Let me close with another short story. Two years ago, we were approached by a partner of ours to digitally preserve an important heritage site, a UNESCO heritage site in Uganda, the Royal Kasubi Tombs. The work was done successfully in the field, and the data was archived and publicly disseminated through the CyArk website. Last March, we received very sad news. The Royal Tombs had been destroyed by suspected arson. A few days later, we received a call: "Is the data available and can it be used for reconstruction?" Our answer, of course, was yes.

Let me leave you with a final thought. Our heritage is much more than our collective memory—it's our collective treasure. We owe it to our children, our grandchildren, and the generations we will never meet to keep it safe and to pass it along. Thank you.

This is an edited version of Kacyra's 2011 TED Talk.
To watch the full talk, visit TED.com.

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⁸ A "deliverable" is a general term used to describe a product to be provided.

⁹ Tikal is a Mayan ruin in Guatemala.

¹⁰ A "fly-through" usually refers to a computer simulated experience that lets you view a site from above, as though you are flying through it.

¹¹ When something "takes its toll," it means that it creates a negative impact.

¹² The expression "fighting a losing battle" is used when it seems that success is impossible because the obstacles to overcome are too strong or too many.