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HEALTHCARE

3D Replicators Aren't Just for Star Trek Anymore



Robert Plant, Associate Professor, School of Business Administration, University of Miami
6/26/2013
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Recently developed technologies can capture more accurate physical measurements of objects. A byproduct of this is the creation of big data sets. These techniques and technologies have enabled great strides to be made in metrology, the science of measurement. Scanning technologies have been central to this.

3D scanning

3D scanning of large objects has become increasingly possible. For example, scientists from Downland Partnership Ltd. recently scanned the HMS Victory, Admiral Nelson's flagship from the Battle of Trafalgar. This came in response to the request from the National Museum of the Royal Navy to create a 3D model of "every structurally significant part of the ship." The goal was to gain an understanding of the ship's structural components, its strengths, and its weaknesses to help conservators develop a wood replacement strategy.

Working in conjunction with the Ministry of Defense, Fenton Holloway Ltd., and BAE Systems, Downland used HDR Spheron cameras and Leica HDS6000 systems to collect sub-millimeter information. The £65,000 system can measure up to 50,000 points per second at a density of 1mm. Taking 850 scans of the ship created 90 billion measurements and helped produce a model at a level of detail unobtainable by hand.

The data set created for the Victory is an example of point cloud data -- in essence, a 3D coordinate (x, y, and z) model of an object's surfaces. These data sets allow surfaces to be represented and used in CAD and other models, such as surface reconstructions, 3D meshing, and structural tests. Data captured in these models can be used in many ways. For example, it can be archived for comparison with subsequent scans, allowing users to identify any changes over time. Users can also create fly-through models that visualize a journey through things such as factories or ships.

3D medical scanning

One of the leading applications of 3D modeling has been medicine. In 1989, the National Library of Medicine created the Visible Human Project. Anatomical images were collected from the cadaver of a male volunteer. Axial MRI images of the head and neck and longitudinal sections of the remainder of the body were taken at 4mm intervals. The data set is approximately 15Gb and is complemented by a set of photographs, each 32Mb in size and 4,096 x 2,700 pixels in resolution. A female volunteer's cadaver was digitized in 1995 at 0.33mm intervals, producing 5,189 images and a data set approximately 40Gb in size. This data set was spaced in the z plane at the same size as the x-y slices (0.33mm) to allow medical researchers and developers to work with cubic voxels.



The NLM says on its website that it created this project "to serve as a set of common public domain data for testing medical imaging algorithms, and to serve as a test bed and model for the construction of network accessible image libraries."

Other big data medical projects include:

- The 3DAnatomicalHuman project, whose goal is "developing realistic functional three-dimensional models for the human musculoskeletal system"
GE's Data Visualization project, in which meta data is collected on the type of scan and the time of the scan
Microsoft's Inner Eye medical image analysis project, which attempts to connect advances in machine learning, computer vision, and medicine to automate the analysis of medical scans

3D printing

With advances in input systems, 3D scanning, and the creation of increasingly detailed data capture sets, the output possibilities now have to be considered, primarily in the form of 3D printing. Most 3D printing solutions are small-scale ones, but their complexity and scale will increase dramatically in the near future. One of the largest printers in the world is the D-Shape, a device invented by Enrico Dini that

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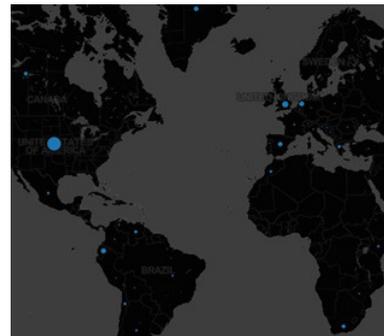


Tableau visualizes global tweets focusing on a cure for Malaria. Explore this data here.

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prints 5-10mm layers to create small habitable structures. Dini has investigated the possibility of using the machine with moon dust to create buildings on the moon. More near-term applications could include recreating objects such as the HMS Victory. Data scans would act not only as mechanisms for preserving the past, but also as the basis for recreating it.

This is also the aim of researchers in the medical domain. Dr. Anthony Atala has been working on a 3D printer that uses living cells to produce a [transplantable kidney](#). Atala says these capabilities are at least 10 years away, but 3D scanning and printing offer immense promise within the medical field and open up whole new areas of research and hope for patents around the world.

The replicator from the starship Enterprise is certainly on its way, and it won't just replicate Earl Grey tea for Captain Picard. Home and industrial replicators based on big data scans will open up endless possibilities for us all.

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PAGE 1 / 2 > >



Mike Lata, User Rank: Blogger
7/1/2013 | 1:29:10 PM

Re: Enormous opportunity

I think both 3D printing and 3D scanning have a lot of potential and room for growth. I really hope that the medical field can improve in the way they detect cancers before its too late and cure them. I am very sad right. Now because my grandmother is dying from lung cancer that went (metasized) to her brain and it seems they didnt detect it went to her brain before it was too late. I also had a good family friend pass away due to doctors not scanning him correctly or detecting a cancer when they should have.



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legalcio, User Rank: Exabyte Executive
7/1/2013 | 8:56:35 AM

Re: Enormous opportunity

Ultimately kiran large companies are looking for reliable partners to be part of the supply chain. As long as due diligence is conducted regarding quality and on time delivery there's no reason a small shop can't be as valuable a partner as a large shop.



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kiran, User Rank: Petabyte Pathfinder
6/30/2013 | 3:42:38 AM

Re: Enormous opportunity

@legalcio - Excellent idea about small startups getting into 3D printing. Do you think big industries can entrust these companies with their projects given their infant existence?



Also, 3D scans will definitely aid diagnoses by a huge margin. Good job!

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kiran, User Rank: Petabyte Pathfinder
6/30/2013 | 3:38:54 AM

Re: Medical Privacy

@Saul - The same legislation will apply, don't you think? Since you're essentially sharing the same kind of data, only more tangible.



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kiran, User Rank: Petabyte Pathfinder
6/30/2013 | 3:36:53 AM

Re: 3D replication

@Robert - Great article. I'd like to know what level of sophistication can we expect from 3D printing in the field of medicine.



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AlphaEdge, User Rank: Exabyte Executive
6/27/2013 | 1:00:04 PM

Re: 3D replication

However, sometimes I am puzzled by some of the posts here as I am having a difficult time to envision the connection between the topic and Big Data. Meanwhile, it seems it is so remote for Big Data to have some impact on some of the industries.



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Ariella, User Rank: Blogger
6/27/2013 | 12:56:39 PM

Re: 3D replication

@Robert you mention, "More near-term applications could include recreating objects such as the HMS Victory. Data scans would act not only as mechanisms for preserving the past, but also as the basis for recreating it." Having recently stopped in at an antique car show, I wonder if someone has thought of 3D printing replicas of classic cars. There are specialists who work on restoring antique cars, but I'd imagine the cost must be very high, as it looks like the process entails taking everything apart, cleaning, repainting, and then putting it back together. There is even a "replicars" industry. Those are not genuine, though they still don't come cheap.



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AlphaEdge, User Rank: Exabyte Executive
6/27/2013 | 12:29:12 PM

Re: Medical Privacy

Went to a big data skeptics meetup in NYC. Interesting comments on data privacy issues. It is indeed would be a problem in the future.

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Saul Sherry, User Rank: Blogger
6/27/2013 | 11:32:05 AM

Medical Privacy

I wonder where the legislature will come down on the sharing of 3D scans etc... in addition to Doctor notes they would make a massively mineable data set looking for issue correlations.

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James M. Connolly, User Rank: Blogger
6/27/2013 | 9:59:01 AM

Under the radar

@Robert. Great blog. Thanks for putting 3D imaging and printing into perspective. It's funny how we hear about some of these projects, and then think, "That's neat." But we never really think about how far these technologies have come. Your blog pulled it all together. Thanks.

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