Digital repository displays 3D models of museums, buildings a

Project aims to collaborate with the conservation and the study of the historical and cultural patrimony of the State of Rio Grande do Sul and, with the aid of 3D printing, make the works accessible to people with visual impairment

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One of the techniques used for scanning is the portable structured light scanner - Photo: press release

The Laçador, the former facade of the Chemistry Institute, now transformed into the Cultural Center, a taxidermied green turtle, a pillar reminiscent of the old gradis that surrounded the blocks that form the UFRGS Campus Center and the dessert plates set from the old Confectionery Rocco are some of the items available in the 3D repository of the Laboratory of Design and Selection of Materials of UFRGS. Developed from the digitization of pieces of museums, public monuments and historic buildings, the site is part of a project dedicated to the conservation and study of historical and cultural heritage, as well as to the accessibility of people with disability to those collections, only made possible due to the 3D printing of scanned models. The work that originated the repository began about ten years ago. It started with pieces from the Porto Alegre Museum José Joaquim Felizardo. In 2011, the Statue of the Laçador was digitalized. Porto Alegre's official symbol, the monument of more than 4 meters in height (not counting the 2.2 meters of the pedestal) demanded the use of a basket truck, provided by the city's Department of Culture and took about 12 hours of work to capture images with a 3D scanner. In 2012, from a project funded by FAPERGS, the group expanded its work with street heritage, including sculptures, details and facades of historic buildings.

According to Fabio Pinto da Silva, the coordinator of the study and faculty member of the UFRGS' Department of Design and Graphic Expression, the initial motivation came from the perception that the digitization of the patrimony was a common practice in the main museums of the world. "In Brazil there were no such works being produced, but we had conditions to do the same thing that had been doing abroad, depending only on adequate financing. So, because we had already been working on digitization (our digitization was more focused on products in general, in the areas of design and engineering), we realized that we also had the technology to contribute in the area of historical patrimony," he says.

The applications of this work are diverse. 3D models, in addition to being available to anyone with internet access, allow the works to be analyzed from different angles and viewpoints that are difficult to obtain from the original pieces. Manipulating the digital version of the Laçador, for instance, one can see how careful with the observer's perspective sculptor Antônio Caringi used to be. The artist increased the upper body of the sculpture, which gained rather broad shoulders, since it was designed to be viewed by observers from a lower position.

From 3D printing, the project can also enable disabled people to access artworks. "Another thing that motivated this heritage study was precisely the idea of making the tactile replicas so that blind or vision-impaired people could touch and have access to them," says Silva. In addition, several replicas from the collection hosted the Museum of Porto Alegre José Joaquim Felizardo, produced by our research group, ended by being donated back to that institution, which now uses them in guided visits with visually impaired people.

"Generally, museum pieces are placed inside a glass vial. They cannot be touched, and even visitors with perfect eyesight are often unable to see them in perspective. So the idea of the replica comes very much in favor of a patrimonial education, of allowing people to see the pieces from richer perspectives, to have a tactile experience with the items," adds the teacher.

Digital models can also be useful for the preservation and replication of works in cases of theft or disasters that can cause the loss of pieces. Of course, one can never really replace the original article, but there are ways to anticipate and minimize the losses. It was the risk of theft of the Monument in Homage to Bento Gonçalves, for example, that led the city of Porto Alegre to contact the research group in 2016. The piece was composed of two bronze plates, each one with approximately 1.5 meter by 1 meter. With a wave of bronze thefts in the city, one of them had already been stolen when the researchers were contacted. "The city hall asked us to do the digitizing work, as the piece was in a situation of vulnerability and it could be stolen at any moment. We then digitized the piece, and unfortunately, what we most feared did happen. The plate was stolen, and only our digital model was left," reports Silva.

Scanning Techniques

Currently, in the Laboratory of Design and Material Selection, four technologies are used for digitization. The first is a very accurate laser scanner (in the hundredths of a millimeter), used with small objects such as museum pieces, which need to be taken to the laboratory.

The second technology is the handheld scanner, which operates with structured light. It has a precision of approximately 1 or 2 tenths of a millimeter, and with it you can go to the field to scan elements of facades and monuments as big as the Laçador. Because it works with white light measurement, this technique must necessarily be used at night time. For entire facades, buildings and bigger monuments, a long-range laser scanner is used, which captures objects within a radius of 80 meters.

Finally, the fourth technique is called photogrammetry and consists of scanning from photographs. You take a series of photos of specific positions and within pre-established distances. This technique can be used with objects of all sizes – from microscopic objects to large items. This is the technology that Google uses to reproduce models of cities. "It is a process that, when rigorously controlled, can build high precision models; and if done loosely and faster, it can build less accurate models," explains Silva.

The techniques do not need to be used separately. A combination of two or three is often used. The choice depends on factors such as the characteristics of the item to be scanned, the accuracy that one wishes to achieve and time availability. "For example, in the Chemistry Building, that combined strategy was adopted. We made it with a long-range scanner, picking up the whole facade of the building. Then we went up there and with the light scanner structured on the statue to do a particular part with more details", says the professor.

By the end of the process, the data is processed and treated in specific software. Two types of files are then generated for each object – one of a higher resolution, containing all information from the scan, directed to registration, creation of replicas or restorations; for availability and visualization in the online repository, simplified, lower resolution versions are generated.

Ongoing projects

At the moment, the group is keeping a partnership through a community outreach project with the Museum of Natural Sciences, linked to the Center for Coastal, Limnological and Marine Studies (Ceclimar) of UFRGS. A taxidermied green turtle and a magellanic penguin are already in the repository.

Studies are also underway on the different ways of reproducing tactile replicas with 3D printers, the possibilities of the various materials that can be used, the textures from the process and their impact on people's tactile sensitivity. Another ongoing project, part of Guilherme Resende's doctorate, involves the insertion of 3D models in virtual reality environments, allowing the manipulation of digital objects and monuments and a greater immersion from the public with the aid of specific glasses and motion capture devices.

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