POSSIBLE USE OF GIGAPAN FOR DOCUMENTING CULTURAL HERITAGE SITES

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Abstract:

GigaPan EPIC Pro is a new version of the GigaPan Systems intended especially for digital DSLR cameras. It creates multi-gigapixel panoramas with incredible depth and clarity. This paper deals with testing and possible use of the GigaPan EPIC Pro. Capturing images is based on automatic rotation of a DSLR camera placed on the GigaPan EPIC Pro. Before capturing, it is necessary to set up the camera and the GigaPan so as to adjust the focus and exposure, define the field of view, time per picture, overlap, etc. The final panorama is then influenced by this setting. The individual images are aligned and blended in the GigaPan Stitch software. The stitched panorama can be uploaded to the GigaPan.com where it can be explored, zoomed in and out, and snapshots can be taken there. The panorama can also be shared in the Google Earth or placed on the website. GigaPan EPIC Pro provides high resolution panoramas with minimal distortion – unlike the fisheye lens known for its distorted appearance. GigaPan enables creating both large and 360° panoramas and it can be used in different environments, i.e. both outdoors and indoors. Therefore, it is suitable for documentation of buildings and their interiors. One of possible use of the GigaPan is creating 360° panoramas as part of a virtual museum, enabling visitors to explore the museum in great detail.

1. INTRODUCTION

Progress in digital photography has resulted in new technology in the form of a robotic head which allows automatic capturing of panoramic images. These robotic devices facilitate the photographer's work which he previously had to do alone. The combination of a robotic head and high quality camera enables capturing more than hundreds of photos, and after stitching the images we obtain a highly detailed panoramic view. The advantage of such a view is that it allows us to look at a wider part of the captured area. 360° panoramas are a modern and efficient form of space presentation suitable for creating virtual tours of museums, castles and other places of interest. This article will discuss the technology of the GigaPan device and its testing.

2. GIGAPAN EPIC PRO

GigaPan EPIC Pro is a unique robotic camera mount invented by the GigaPan Systems Company. This new model is especially intended for DSLR cameras with shorter or longer focal length. The range of motion of the robotic head is 360° in horizontal direction with a -65° /+90° tilt. To ensure a steady series of images, it is necessary to mount the GigaPan on a stable tripod and before capturing level this device using the bubble level.
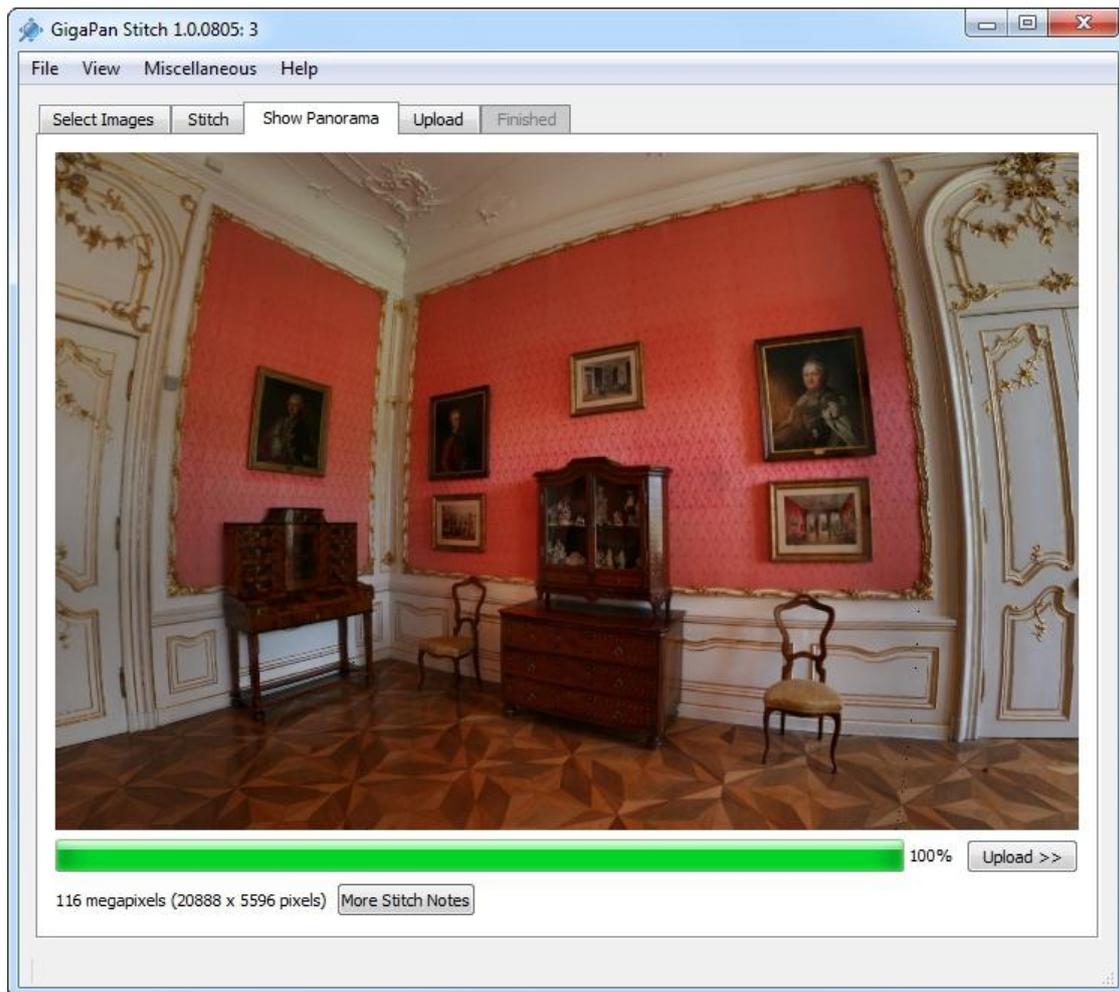
Figure 1: GigaPan EPIC Pro

How does GigaPan work? First the camera has to be set up under the current lighting conditions – ISO, exposure time, aperture value, white balance… After the camera has been set it can be mounted to the camera mounting plate, fastened to the GigaPan camera rail and the electronic trigger cable can be connected. Settings directly in the GigaPan EPIC Pro are the next step. It is necessary to set up the field of view which differs for each lens and camera bodies. Therefore, the field of view must be set up every time they are changed or the focal length is zoomed. This is followed by setting the time per picture (depending on the camera), picture overlap (recommended min. 30%), pictures order, etc. This device offers many more configuration options, but this is not the topic of this article (for more information see the GigaPan EPIC Pro user guide [2]). After the configuration everything is ready for panorama capturing. The EPIC Pro requires pointing the camera to the upper left corner of the scene and then to the lower right corner. After finishing these settings, the total number of pictures and amount of time are automatically calculated and displayed. Then the EPIC Pro starts capturing individual images. This process can be suspended any time and it is possible to return to a certain point of shooting.

3. GIGAPAN STITCH SOFTWARE

Once the individual images have been captured, we need some photo stitching software. For this purpose the GigaPan Systems created the GigaPan Stitch software. The first step in the panorama creating process is to add all *.JPG images and sorting them into the appropriate number of columns and rows. It is important to follow the numerical and alphabetical order of the images. Otherwise, the images do not consist of a sequence and the software does not sort the images in the proper order. It is also important to check whether all images for the panorama are loaded. The next step is to save the project as *.gigapan. Then the software starts automatically to stitch the individual images using the identical points in the overlapping area. The speed of the stitching process can be seen in the progress bar. In approximately the middle of this process the stitched panorama is already available for exploring by clicking on it and dragging it, zooming in and out. The final panorama can be exported to a TIFF or Adobe RAW format or uploaded to GigaPan.com. The interface of the GigaPan Stitch software is shown in Figure 2. The disadvantage of this software is that it does not provide the opportunity to enter the stitching process. We cannot influence the panorama by editing it or adding identical points. Such a function would be particularly suited for stitching images with little variety of surfaces such as concrete walls, plasters of buildings, blank or patterned walls, etc. In these cases the automatic assignment of points often fails. This leads to the discontinuity mainly in the vertical connections. To influence the stitching process, it is necessary to choose some other software, either commercial (i.e. Autopano Giga or PTGui) or open source (i.e. Hugin). Another disadvantage of this software is that there is no opportunity to finally edit brightness, change contrast, and crop the final image. On the other hand, it should be noted that this software works fairly quickly and gives good results for panoramas showing scenes without regular linear shapes, for example panoramas of landscape. The outcome of using GigaPan EPIC Pro technology is a gigapixel panorama which enables zooming into unbelievable detail. This is its the main advantage against the common panorama. As well as that the resulting panorama has minimal distortion against the panorama obtained with a fisheye lens.

Figure 2: Interface of the GigaPan Stitch software

4. GIGAPAN TESTING

The GigaPan EPIC Pro was bought for the Laboratory of Photogrammetry at the end of the year 2010. Since the laboratory has not owned a similar device before, it was necessary to test it and get acquainted with the functions this device offers.

The first testing took place in the new premises of the Faculty of Architecture, CTU in Prague. For testing the following DSLR cameras were chosen – Canon Ultrasonic EOS 20D and Sony Alpha 200. Their settings are given in the table below.

Camera:	Canon EOS 20D	Sony Alpha 200
Focal length	22mm	40mm
Overlap	40, 50, 60%	40%

Table 1: Cameras settings

The main aim of the tests was trying out the new device for shooting interiors in the form of a 360° panorama. They took place in one of the atriums in the building of the Faculty of Architecture. The result can be seen in the next figure.

Figure 3: Testing in the Faculty of Architecture

Then the device was transferred outside, to the front of the building, and the creation of an outdoor panorama was tried. In this case it was not a 360° panorama.


Figure 4: Outdoor panorama of the Faculty of Architecture

Another object where the functionality of this device was tested was the Chateau Slatiňany. The visit to this chateau was made possible thanks to Ing. Jaroslav Bušta, warden of the chateau. Out of the number of rooms in the chateau the pink salon was especially suitable for testing due to its good lighting conditions and a reasonable quantity of mobiliary located mainly along the walls of the room. This salon was captured with the two cameras mentioned above with the following settings – Canon with 22mm focal length and 45% overlap, Sony with 32mm focal length and 40% overlap. The final panorama is displayed in Figure 5.

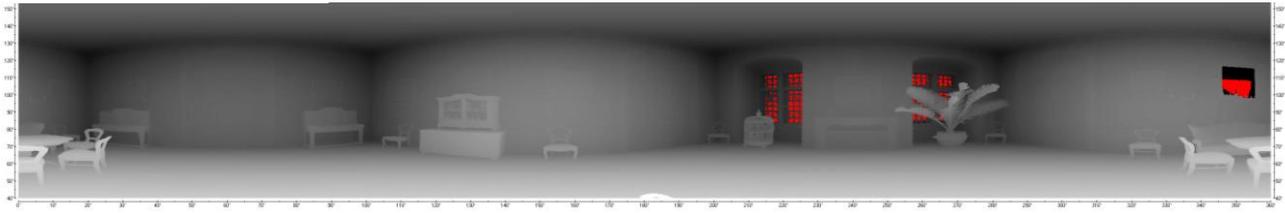**Figure 5:** Pink salon of the Chateau Slatiňany

After the GigaPan testing, the room was documented with laser scanning technology (panoramic Callidus 3D laser scanner CP 3200) from the same station. The results are in the figure below.
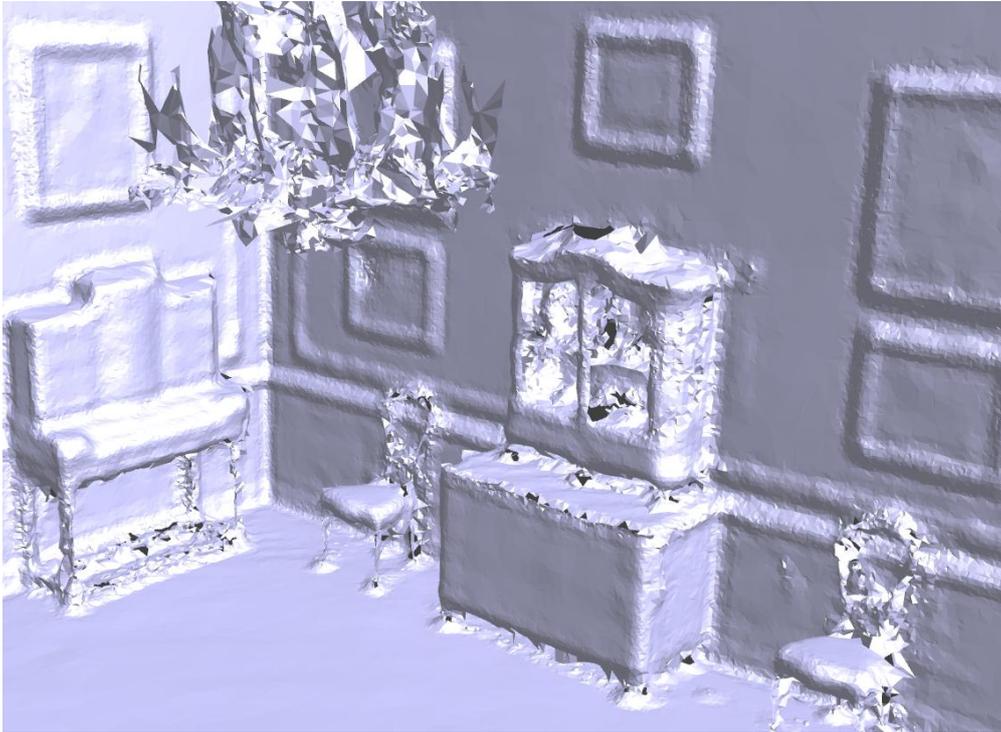
Figure 6: Comparing with laser scanning (Callidus CP3200) ; the view from inside

Figure 7: The view on room from outside (Callidus CP3200)

Figure 8: Results of laser scanning (distance image) and partial photos for point cloud rendering (Callidus CP3200)

4.1 Troubleshooting during testing

During the shooting process and also in the post-processing problems may occur. The following paragraphs describe the ones detected during testing.

Unfocused camera

One of the problems that appeared during capturing was the camera unfocused in certain parts of the room, especially in the dull or poorly lighted areas. Thus, problems occurred during capturing white ceilings, wallpapers, and concrete walls in the building of the Faculty of Architecture. Due to different distances of objects in the room, the camera was set up with an autofocus. However, this setting fails in the cases mentioned above and this leads to the skipping of images, and consequently, the panorama cannot be created.

Therefore it is necessary to check the device set up with autofocus, and in the case of unsuccessful focus interrupt the capturing process, switch to manual focus and add the losing image. Another option is to set the camera with a manual focus instead of an autofocus, but this is suitable for capturing objects placed at the same distance.

Badly stitched panorama

After all images have been captured, the process of their stitching follows in the GigaPan Stitch software. As mentioned above, this process cannot be influenced, and so the result depends only on the quality of the process of capturing images.

As can be seen in the example, the stitched panorama contained errors in the form of discontinued vertical and horizontal lines mainly in the dark and dull areas. We can guess that the software could not find a sufficient number of identical points. However, this error is due to an imprecise position of the camera or the lens on the GigaPan device.
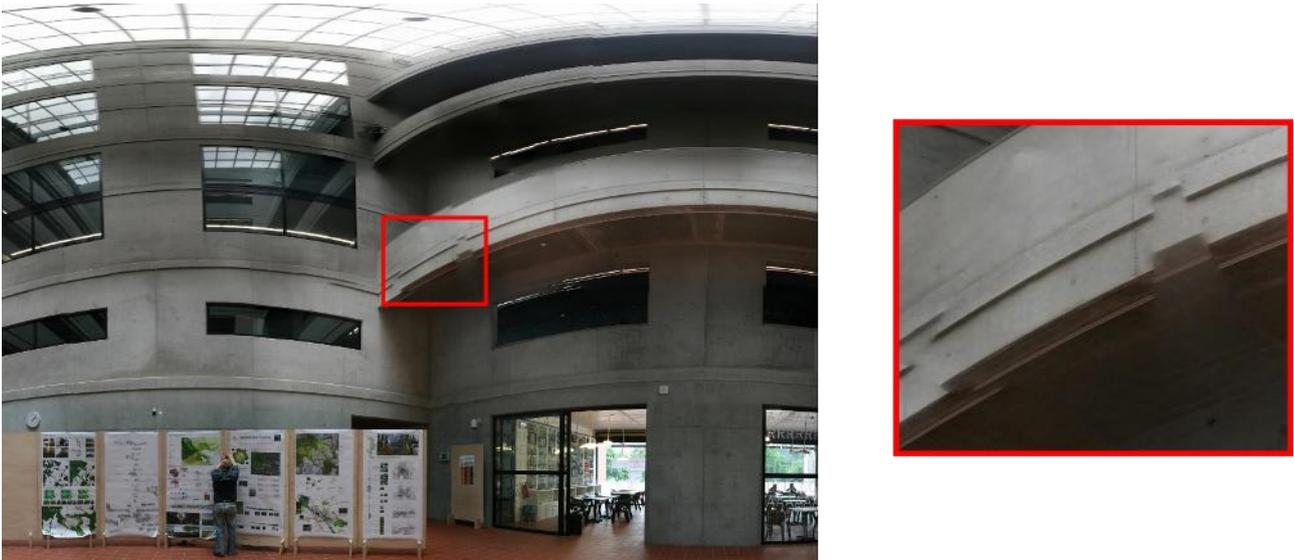
Figure 9: Example of badly stitched panorama

This problem can be solved by finding the exact position of the camera's optical center over the axis of rotation of the device. The optical center differs for every camera or lens and its location is searched experimentally, so it is a time-consuming operation.

5. CONCLUSION

The GigaPan Epic Pro is not a professional device for precision measurements. This is reflected in its mainly plastic construction and its possibilities of setting. The optical center of the camera can be mounted and set up with millimetre precision. However, it is not known where the exact center really is.

That is why the following research will be focused on identifying the optical center of the cameras. It is expected that this will require more testing. The first research step will include mathematical derivation of its location and tests to determine if the stitched panoramas are suitable for detection of spatial information.

The next step will include tests of capturing HDR images with the *Exposure Bracketing* function also provided by this device. It is suitable for panoramas covering a very large horizontal field of view with areas with a different amount of light, eg. a room with windows.

Our future research will deal with searching for an application which could allow browsing through the panorama on own website instead of uploading to GigaPan.com. This could also result in creating a virtual tour of a museum or heritage site from the individual 360° panoramas.

6. REFERENCES

[1] GigaPan : *GigaPan EPIC Pro*, [online], http://www.gigapansystems.com, 2011-30-05
[2] GigaPan Systems: *Manual*, [online], http://gigapansystems.com/introduction.html, 2011-30-05.