

September 2018

Flipped Classroom

A guide to create virtual tours of panoramic scenes from digital photography of forest ecosystems

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1 Introduction

The project "Flipped Classroom" aims to develop the creation of virtual tours by connecting previously photographed scenes to a digital version of this surrounding which can be experienced in a web-based, interactive way.

Therefore, the project may contribute to digital learning in a vast range of different applications, as well as support the development and evaluation of different management strategies by comparison of forest ecosystems in time and spatial correlation. Furthermore, the implementation of geographic information systems (GIS) and the advancement of forest information technologies (FIT) offer various utilizations of this method. The digital visualization of a geo location within a forest ecosystem may bridge the gap between computerized theoretical concepts and hands-on field work by interlinking the perception of small and big scale management approaches.

The concept is mainly focused on its possible integration into academic knowledge transfer or as an explanatory supplementation within advanced education. The technological process in general is applicable to all types of landscapes and offers a lot more applications than regarded within this tutorial. This focus is set to forest ecosystems and their special demands in terms of successful generation of a useful panoramic scene.

2 Equipment

2.1 Field work:

- Digital reflex camera provided with a large enough memory card (32 GB i.e.)
- Camera lens (10-22mm i.e.)
- Tripod, should provide a water level for adjustment
- Panoramic Head for tripod mount and camera arrangement (Manfrotto i.e.)
- Compass, Global Positioning System (GPS)

2.2 Digital work:

- PTGui panorama-software (<http://www.ptgui.com/>)
- Kolor Panotour virtual tour software (<http://www.kolor.com/panotour/>)
- Any common browser able to provide html5, mobile devices and/or tablets



Fig. 1: Common digital reflex camera by Canon (1: Main device EOS 60D; 2: lens EF-S 10-22mm; 3: Instructions; 4: Charger; 5: Connection cable; 6: Installation CD).

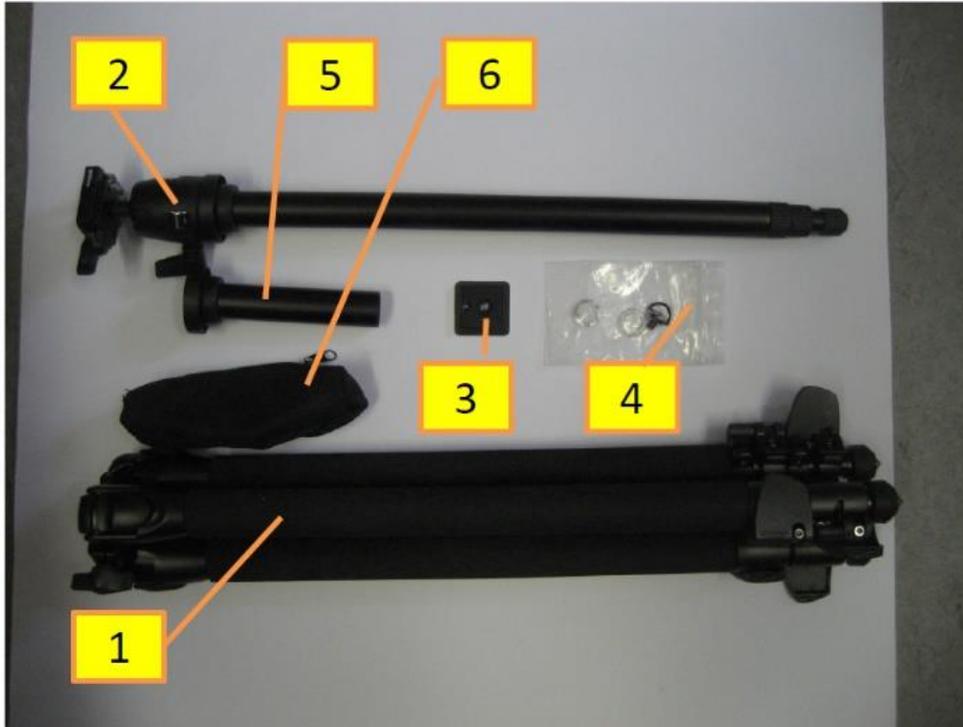


Fig. 2: Common tripod by Cullmann (1: Main device Magnesit 525M; 2: Monopod with ballhead and camera mount; 3: Adapter plate; 4: Screw and two washers; 5: Tripod mount with 6: Bag).

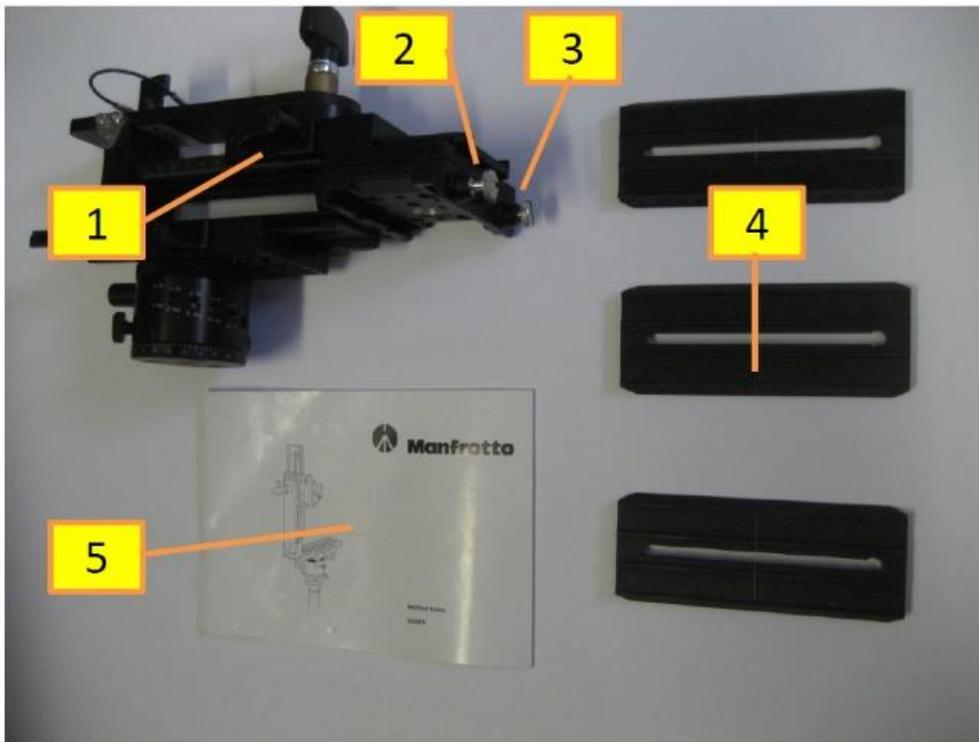


Fig. 3: Panorama head (1: Main device Manfrotto 303 SPH; 2+3: Screws for camera mount; 4: Camera plates; 5: Instructions).

3 Preparation

To achieve useful photographic pictures of any forest ecosystem or stand, a minimum of preparation should be taken care of.

A general understanding of the photo equipment which shall be used should be given under any circumstances. The technical setup of all pictures taken within one panoramic scene should be the same, also the lighting and contrast should be as even as possible along the series of photos taken during the process.

It is recommended to double check the mechanical zoom of the lens and set it as far back as possible, so the camera setup altogether is as wide-angled as possible. If the applicant is not an experienced photographer, the most basic adjustment of the camera settings will suit most conditions, if enough light is given. More sophisticated applicants may try different settings to achieve more evened-out images as a result.

A basic level of experience of handling a digital reflex camera can be achieved already in advance of the field work. Whilst in the forest ecosystem or stand, the applicant should always pay attention to the time of the day and the changing light conditions due to weather and the changing position of the sun. The best results for an easy processing afterwards are achieved by a quick and orderly series of pictures during conditions, as similar as possible.

Furthermore, as during any kind of field work, the equipment relies on certain factors to work orderly. Any electronic devices should have its battery fully charged and each piece of equipment be tested in advance. A trained applicant may still need a certain amount of time for logistical transport and setup at the desired position of all the equipment under sometimes rough conditions. It is of high priority to evaluate and recheck the chosen position before taking the shots to ensure a clear field of view, as well as the absence of any disturbing equipment, people or vehicles which are not supposed to be included in the panorama.

In larger projects where there are several applications of the method to be taken care of, a general familiarity of the area is of high importance. Only by knowing about distinct features, landmarks and targeted information which shall be shown in the result, the applicant is able to avoid errors and focus on the outcome.

4 Step 1 (field work)

During the field work with the photographic equipment, some rules of common sense with expensive material may be recalled, ensuring it to be orderly handled.

Since a forest environment can be tricky to track through, the rules of careful approach which apply to the personal body may be expanded onto the equipment. After the first setup of the tripod, it is recommended not to dismantle everything, if the next desired location is within reasonable walking distance. It may be advisable to dismount the camera, in any case, it is of high importance to always apply the protection cover of the lens.

When positioning the tripod on the forest ground, the close surrounding should be clear of any logs which may cause falling or tripping during the picture shooting. Each leg of the tripod must be stable and undisturbed during the whole process. Equipment, backpacks and people around the applicant should be always kept as far behind the current field of view as possible.

During the shooting of the pictures the applicant may keep his or her attention to the weather conditions. Drastic changes like dark clouds or heavy winds which may change within a short period of time can be avoided if the time spent is reasonable. As an alternative some levels of photo-manipulation within the used programs may compensate for these differences during the shooting. More experienced applicant may find it useful to rework the pictures in a more sophisticated program such as Adobe Photoshop i.e., but it is not mandatory for decent results when the primary shot is already well prepared in general.

In dependency of the applicant's preferences as well as in relation to the available memory space, technical computer performance and programs to be used, the applicant should decide also about the format in which the camera saves the images taken. It is recommended to use the highest resolution and save the images in a .jpg and a RAW file format to ensure the workability of these images with as many options as possible.

For an orderly and easy handling of the equipment, the applicant should ensure his free movement all around the tripod after setup. A level stand of the camera is mandatory, the panorama head needs to have all screws tightened. The plates for adjustment should be readable, the rotation of the circular hinge should be set to the desired degree interval at which a picture is taken of the series. By dividing 360° by the amount of degrees for a photo shot, the applicant will determine the number of photos per rotation. To achieve a fluent and fitting panorama, an amount of 36 pictures (therefore a degree interval of 10°) has been proven to be fully sufficient.

The camera is usually positioned upright. To compensate the length of the lens it may be attached in a way that the entry point of the lens is positioned as exactly at the center of rotation as possible. The various settings of the camera allow an experienced applicant to achieve great results under nearly any circumstances. Inexperienced applicants should in general mainly ensure not to change any settings during the process and to capture as much of the environment as possible. After the rotation on the horizontal level has been complied, a second rotation with an upwards angle of 45° ensures the full capture of the trees crowns. The upwards angle may be adjusted, if the crowns are of further distance or

another type of landscape is photographed. It should be kept in mind that the upwards angle determines the amount of sky being captured. If there is a low amount of contrast and lines in a scenic environment, the used software will not as easy be able to arrange the panoramic images. If it is of high importance to capture the conditions of the ground, it may on the other hand be advisable to take a third rotation of photos, set to a downwards angle of 45°. The applicant should keep in mind that a high number of pictures also leads to a high amount of data processing and not necessarily to better panoramic results. Many overlapping images can disturb the correlation calculation and lead to blurry and disturbed results which will have to be manually reworked.

At the beginning of each scene the applicant should take a photo which functions as a "marker picture" and indicates the beginning of a new series. This will ease the sorting of the pictures by far. Ideally this starting picture is aligned towards North, so the later arrangement of the position of the scene within the tour is easily reconstructed.



Fig. 4: Position of camera and panorama head after assembly.

5 Step 2 (digital work)

After transferring the pictures on the computer, two different programs will be used to achieve the final virtual tours. First, a panoramic scene will be created by using PTGui. Following this, the Panotour software will combine the created scenes and implement visual spots to include further information and interactive elements into the developing tour. Both programs can be used as a free trial, for results in high resolution without any watermarks, only the Pro-version of these programs offer the necessary abilities.

5.1 PTGui

To create toe panoramic image in PTGui, the applicant can easily load all the images belonging to one scene into the program at once. The included metadata will already align them by the time, at which the picture was taken. The automatic function of PTGui "Align images" will generate the control points within the series which are used to determine the amount of overlap. If necessary, the setting of lens and camera can be adjusted but the program should already be able to determine these settings itself. Also, any control point may be readjusted by the user, as well as new control points set and arranged. To run an automatic optimization of the amount of control points used, the included "Optimizer" usually creates decent results.

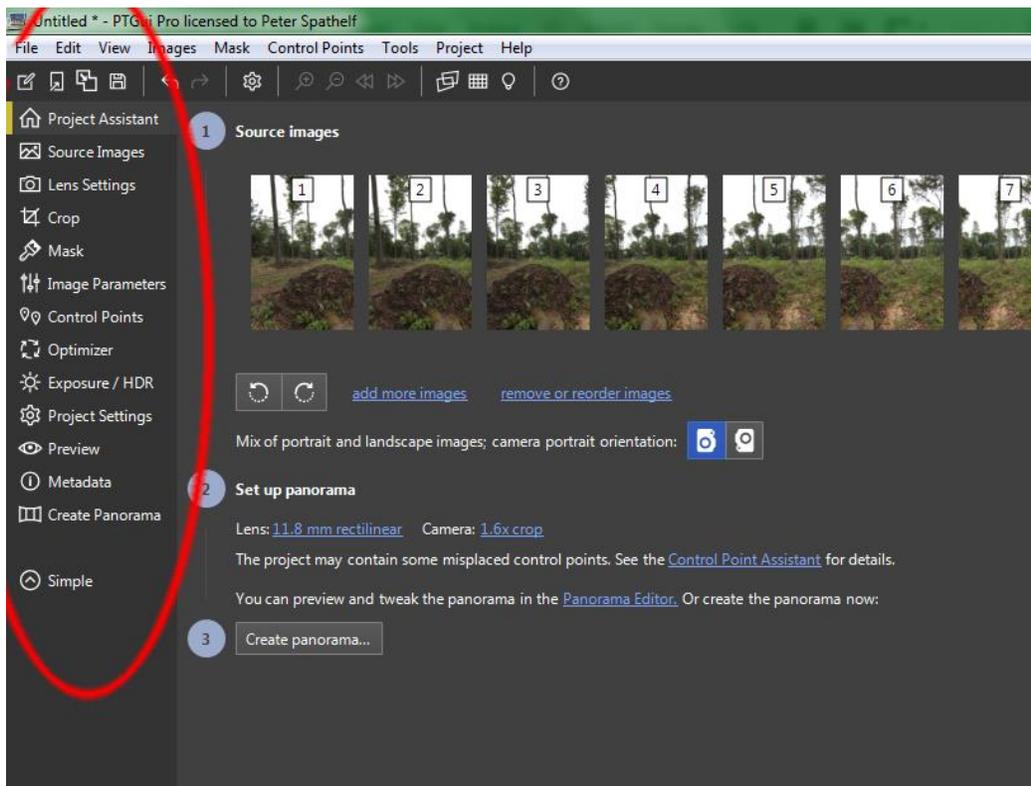


Fig. 5: In PTGui, all important editors and functions are aligned to the left area of the screen.

Another feature of high importance within the PTGui software is the "Mask" feature. To reduce blurry parts in the panorama or erase unwanted elements like equipment or accidental shots of people, the masking feature uses a very intuitive way to allow the user to prioritize certain photos within the overlapping combination of shots. A high improvement of the panoramic scenes can thus be already achieved after a brief period of training.

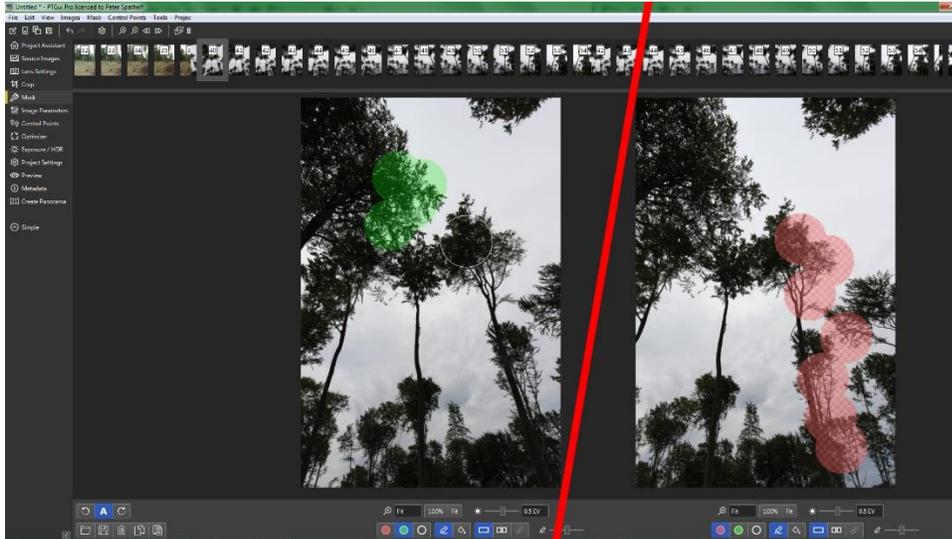


Fig. 6: The "Mask"-function within PTGui improves the generated panoramic scenes.

Additional tools for improving the image quality can be found among the menu of the program. Also, the geo location of the scene can be implemented into the metadata of the result. A well sorted and easy to understand collection of tutorials for the usage of PTGui can be found at their website (<https://www.ptgui.com/examples/>). To follow this part of the working process, within the "Panoramas"-folder of this project there are two different PTGui-projects saved in the "Marteloskop"-folder.

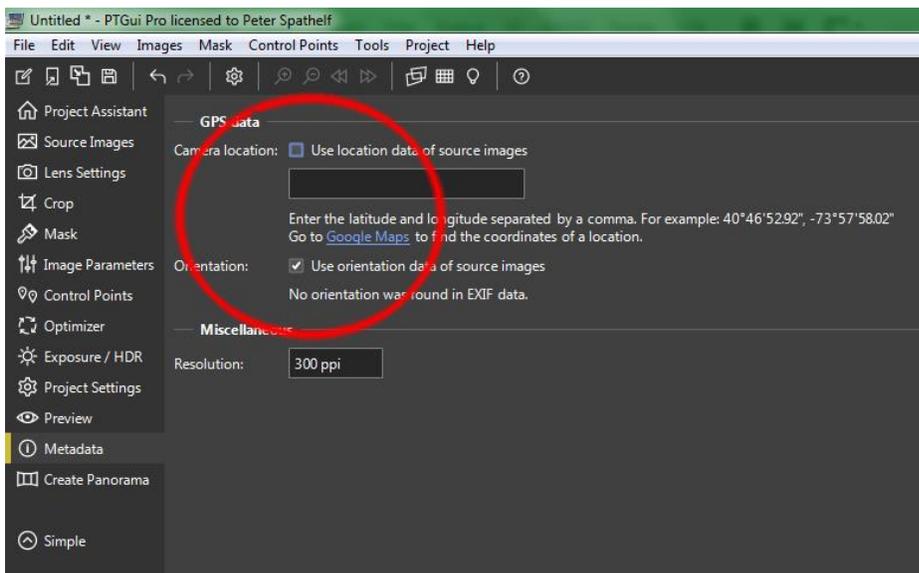


Fig. 7: The included metadata of the generated panorama allows the integration within other applications.

5.2 Panotour

The second step is to combine the created panoramic scenes which are saved as a .jpg file in a desirable resolution to a virtual tour. By using the program of Panotour which may need more time to fully comprehend, the created files can be interlinked. For a fluently working result, panoramas with a resolution of 3600 pixels in width have been proven to work sufficiently, the generated images of the tour for mobile devices or tablets are automatically scaled down in relation to the original file. The design of interactive elements is generated by different editorial views which can be confusing for inexperienced users. The virtual tour can be complemented with various elements for orientation, open source or Google online map projection and another web content. Most of the presets for elements to be included in the tour are ready to use and work in any tour to full satisfaction. Anyhow, a distinctive, personal style for the elements will lead to a higher intuitive access for users. Also, a well-made implementation of interactive elements without creating an overloaded tour or panorama is of higher desirability than a hard to comprehend, overstuffed experience of the scenes or tour in general.

The two main editors of the Panotour software are the "Tour" and the "Style"-area. The first allows the user to place the interactive icons within the panorama. Some elements such as the interactive map or a control bar are on a fixed position and will not be shown in the Tour-area of the program. Any type of icon or element of the tour can be designed and modified in the Style-area, also the icons or elements with a fixed position can be arranged in this editor.

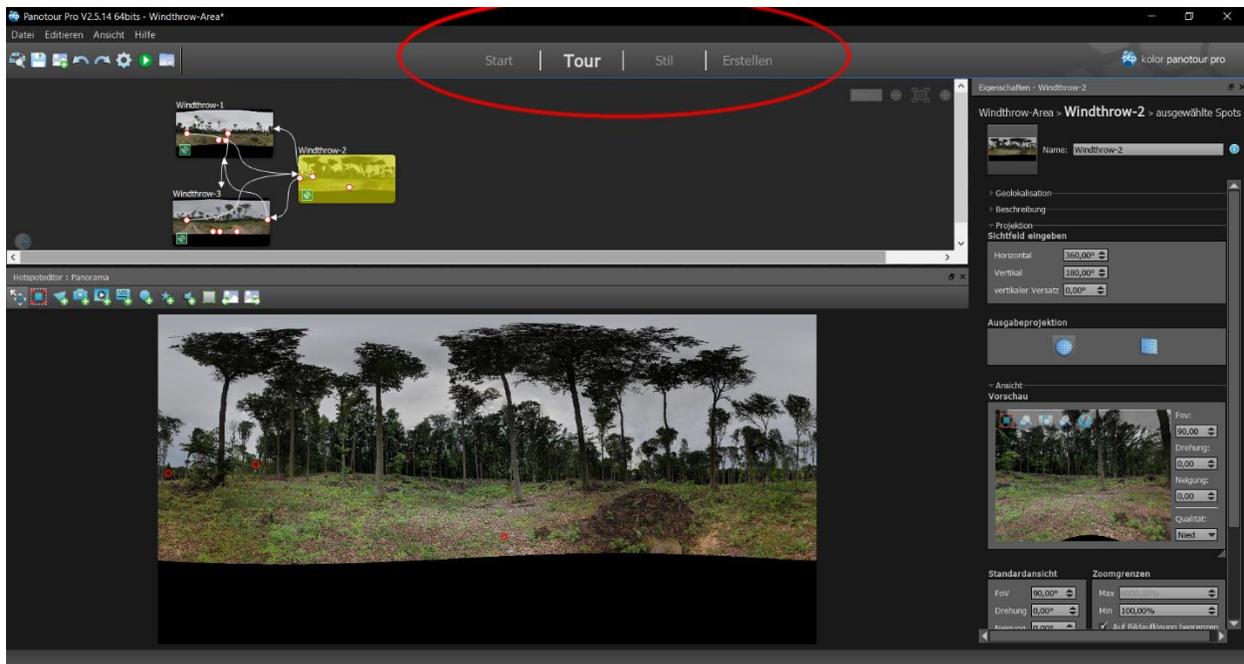


Fig. 8: Within Panotour, all editors are aligned on the top area of the program.

For a basic tour without too many icons or elements included, it is recommended to arrange the different panoramic images in a logical constellation towards each other in the top area of the Tour-editor. An icon positioned within the panoramas which will lead towards the next scene, should be

included in any panorama, thus all panoramic scenes are interlinked to each other and allow to start at the beginning after the final scene. To show the geographical position of each scene, the open source software of OpenStreetMap can be implemented without any further knowledge, other than the geo location. An exact positioning of the view within the scene may be achieved by the compass settings. Further icons may be positioned within the scenes to include information about the project, reasons why this geo location has been chosen or other important content of choice.

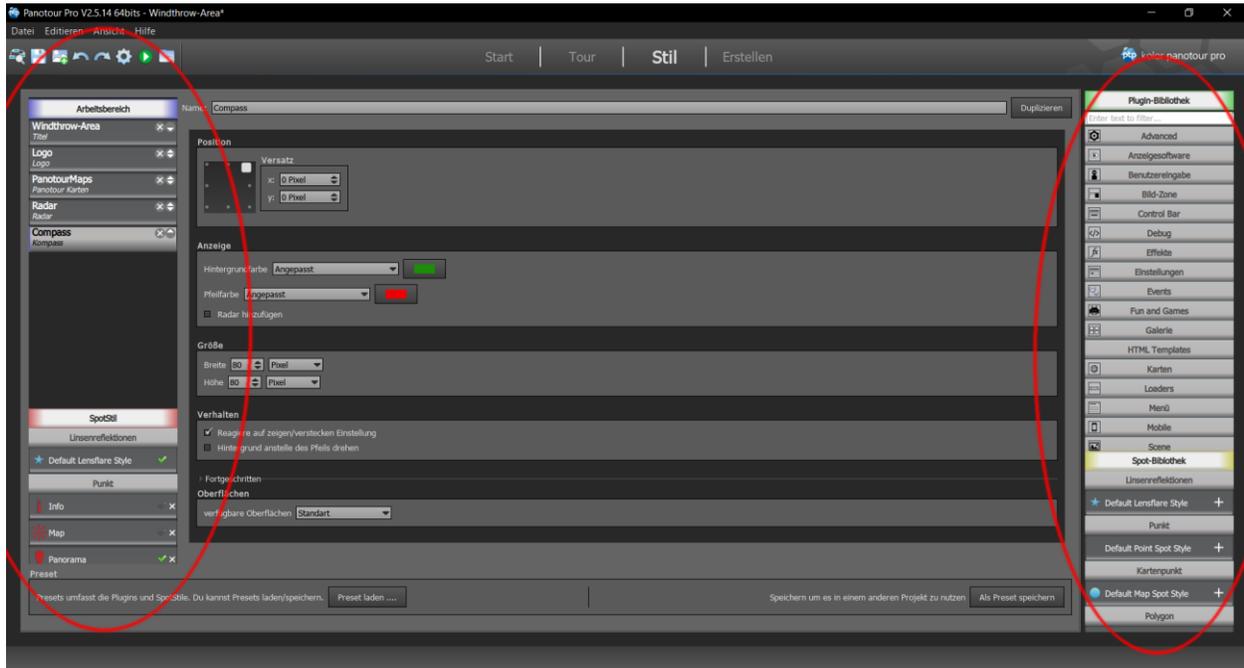


Fig. 9: The "Style"-editor allows the overall modification of all interactive elements of the tour - the catalogue of options is found on the right and after integration into the tour editable on the left.

The working process with the Panotour software has been conducted in the "Panoramas"-folder of this project for each geo location. The projects annexed with the adjunct "_small" have a reduced image size to be suitable for web-content. For a local application within advanced learning methods, the higher resolution will be more suitable. The geo location of the BWI-Comparison includes both saved project files of the PTGui and the Panotour software to allow the striving applicant to practice his or her skills to a sophisticated level of experience at any step of the described working process.

6 Publication

The editor "Build" within the Panotour software shows the options of the result. The different ways in which the .html files are viewed, are subject to the desired way of publication. An internal File Transfer Protocol (FTP) allows the direct upload to a previously acquired web space but the same step may be conducted within another FTP-client such as the open source software FileZilla (<https://filezilla-project.org/>).

In general, it is recommended to build the tour with the highest quality of .jpg-files possible to ensure a useful content of visual information. The various options of generating the tour are well explained by the official Panotour website, including many tutorials ([http://www.kolor.com/wiki-en/action/view/Panotour Documentation](http://www.kolor.com/wiki-en/action/view/Panotour_Documentation)).

Besides the various possibilities to integrate the virtual tour within a fully sophisticated concept of any homepage, it already works to simply upload the final .html-file plus its connected folder (recognizable by its name, annexed with the adjunct *[Name of the .html-file]data*). The link leading towards that uploaded .html-file will, if all its connected data is in the same online-folder, show its content in any browser with flash or html5 abilities, mobile device and tablet. The integration in a closed frame or other interactive content, such as websites or Facebook, is also well explained among the Panotour tutorial-website (see above).

7 Additional Information

The technical aspect of good photography is explained in a very well organized and explained lesson by Prof. Dr. Jan-Peter Mund, which is to be found in the "Metainfo"-folder of this project. The method, which is used by the PTGui software, of control points and image stitching, is explained in the lessons and advanced learning content about Unmanned Aerial Vehicles (UAV), found in the same folder.

The tutorials of PTGui and Panotour are already rich material to school every interested user towards a decent level of ability to handle each program accordingly. The interested user will notice the vast field of additional information already available on the common video platform of YouTube (<https://www.youtube.com/>) very helpful and complementary to the provided content of PTGui and Panotour.

The method and subject of virtual accessible panoramic scenes is growing and the creation of a virtual version of a real-world environment has since the beginning of the Google Street View project been boosted everywhere around the world. Therefore, it is most likely that more of these concepts become common practice and will be included in any transparent project which aims at knowledge transfer within modern learning solutions. The development of more tools and accessories to ease this process is to be expected in the upcoming future.

8 Editorial

Generating the virtual tours for the "Flipped Classroom" project offered the chance to dive into the subject of transparent and accessible knowledge transfer. It has shown to be easy to comprehend, fluently working on many different devices and resulting in reactions of astonishment of participating users who are unfamiliar with these methods when introduced to the subject.

The general understanding of forest ecosystems and their functionality may be supported by this method in an extensive array of possibilities. The sophisticated applicant may create a widespread network of connected tours which can over time be of great value for comparison of different subjects within the working field of conservation, forest ecosystem management and economically orientated forest stands.

The authors offer any interested applicant to get in contact and exchange knowledge and ideas about these methods in the upcoming future. The chances within the concept are of value in many aspects, reaching further than possibly perceivable by now, especially in relation to the booming industry of virtual realities. If the general acceptance of the importance of forest ecosystems can be supported, it may be by transferring these ecosystems into a format of modern-day communication and experience. If the digital experience of forests improves the understanding of their ecosystem functions and how necessary they are, it should not be left undone to extend the development of these concepts, although the combination may seem contradictory at first hand.

9 Appendix

- PTGui: "PTGui is panoramic image stitching software for Windows and macOS. Originally started as a Graphical User Interface for Panorama Tools (hence the name), PTGui has evolved into a full featured, industry leading photo stitching application." - <https://www.ptgui.com/> - September 2018
- Panotour: "Explore the world in a virtual tour. Create virtual tours of next generation. With Panotour, you can now show the world around you to your friends, clients or to the mass public." – <http://www.kolor.com/2011/07/13/panotour-1-6-rc2-virtual-tour-software/> - September 2018
- Final uploaded versions of the created virtual tours within this project:
http://twistedminds.com.de/HNEE/FlippedClassroom/Marteloskop_small.html
http://twistedminds.com.de/HNEE/FlippedClassroom/Windthrow_small.html
http://twistedminds.com.de/HNEE/FlippedClassroom/BWI-Comparison_small.html

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