

360-DEGREE PHOTOS IN THE VIRTUAL MATHEMATICS LABORATORY

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Abstract: Here are reviewed 360-degree photos supporting the educational process, available in the Virtual Mathematics Laboratory, developed at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences. Some options for using different scale 360-degree photos, captured from different levels, in STEAM education are described. Different software and technical devices, such as GO PRO camera and drone, were used for the creation and image processing. The presented examples of educational resources, containing 360-degree photos, can be used directly from the Virtual Mathematics Laboratory, with middle-class virtual reality glasses, or through a higher-class glasses using computer software.

Keywords: 360-degree photos, STEAM, digital competence, drone, GoPro, education, interactive technologies

1. INTRODUCTION

The Virtual Mathematics Laboratory, developed at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences [8], supports resources of a diverse nature - dynamic files, sites with STEAM education topics, teaching aids, scientific articles, presentations, posters, video materials, materials for augmented and virtual reality [7]. With the development of information and communication technologies, the range of resources suitable for creation and use as educational materials has expanded [3], [12]. For example, the resources maintained in the Virtual Mathematics Laboratory for: conducting research and formulating hypotheses [4] resources for organizing a check and self-check [5], topics from the already past editions of the online competition "VIVA Mathematics with a computer" [11]. The use of 360-degree photos and videos continues to be developed and implemented in training. For example, in the creation of author's spaces or in training for professions that require orientation in limited, hard-to-reach places, to which the learner does not always have permission or the opportunity to reach [1], [2], [13], [14], [15], [16], [17], [18]. Here we will look at the 360-degree photos found in the Virtual Mathematics Laboratory.

2. METHODS

In the public space, this type of photos is found under different names - VR photo, 360-degree photo, photosphere or spherical photo, interactive panorama or immersive panorama. Here we will use the term 360-degree photo. The 360-degree photos available in the Virtual Mathematics Laboratory are a resource that helps:

- the observation of objects and spaces from our surrounding work environment, everyday life and nature;
- immersion in the atmosphere of a selected space in a given time period;
- solving tasks and formulating new ones;
- the development of the eyesight;
- the organization of the learning process in classes in mathematics, information technology, visual arts and others;
- the development of the observer's mathematical and digital competence.

The specific examples that we will look at were shot with a GOPRO MAX 360 camera and a DJI Mini 2 drone. The image processing was done using the specialized softwares– GoPro Quik [10] and DJI Fly [9].

3. EXPERIMENTAL

3.1. 360-DEGREE PHOTOS WITH THE GO PRO CAMERA IN THE VIRTUAL MATHEMATICS LABORATORY

Specialized software for processing 360-degree photos and videos from the GO PRO camera enables their presentation in a different view and scale. For example, in the resources for two topics in the "STEAM" section, Panoramic views of a kindergarten and an education room can be observed. The partial distortion of the 360-degree photo provides an opportunity to develop the eyesight and practice the measurement of distances and objects (Fig. 1).



Figure 1. Panoramic view of a 360-degree photo of a kindergarten
<https://cabinet.bg/index.php?contenttype=viewarticle&id=322> and education cabinet
<https://cabinet.bg/index.php?contenttype=viewarticle&id=323>

The format of the 360-degree photos allows viewing from multiple angles, both with the gyro function on and off (Fig. 2).



Figure 2. Spherical view of a 360-degree photo with the gyroscope turned on

Through the 360-degree photos, the virtual reality (VR) function can also be used for complete immersion in the atmosphere of the studied object. One such view is shown in fig. 3. In such a mode, each picture can be observed through a mobile phone placed in a low- or middle-class virtual reality glasses, or through a higher-class glasses using computer software.



Figure 3. Virtual reality (VR) mode of a 360-degree photo

For exploring the overall picture or focusing on a specific artistic element of it, the Virtual Mathematics Laboratory has several STEAM topics exploring the Bishop's Basilica of Philippopolis [6]. They are a suitable aid for studying mosaics, counting, building compositions and creating a work of art in this style (Fig. 4).

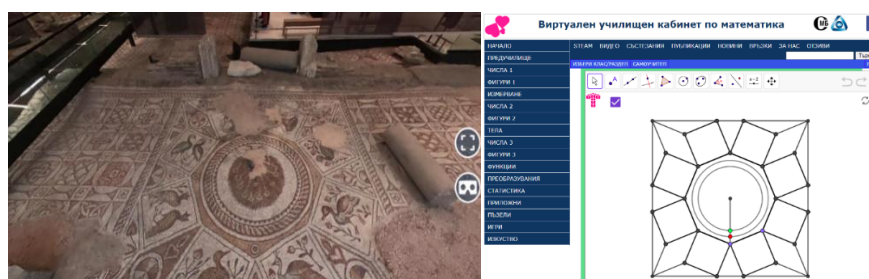


Figure 4. Exploration of artistic elements and compositions from a 360-degree photo of the Bishop's Basilica of Philippopolis

<https://cabinet.bg/index.php?contenttype=viewarticle&id=328>

When viewing some objects, it is appropriate to use shots from close and far distances. Resources including several scales of 360 photos are available in the "Swamp Snowdrop and Nivalin" topic. In fig. 5 are presented 360-degree photos of the site from ground level and from a camera mounted on a tree branch.

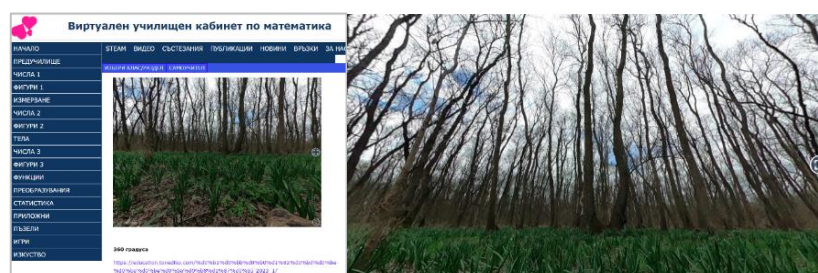


Figure 5. 360-degree ground-level and tree-branch photo of a marsh snowdrop site

<https://cabinet.bg/index.php?contenttype=viewarticle&id=453>

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3.2. 360-DEGREE DRONE PHOTOS IN THE VIRTUAL MATHEMATICS LABORATORY

In the following figure 6, another 360-degree photo of the same area with snowdrops taken by a drone is presented.



Figure 6. 360-degree drone photo of the Swamp Snowdrop deposit
<https://cabinet.bg/index.php?contenttype=viewarticle&id=453>

From the drone footage, elements of the earth's surface cannot be seen in detail, but the surrounding environment can be observed. The wider range of imaging allows inferences to be made about key parameters regarding the cultivation of the specific plant species. The footage is also suitable for use when studying methods for counting tree stands in a forest area.

In the Virtual Mathematics Laboratory, there are special tasks for the development of eyesight, using drone photos (Fig. 7).

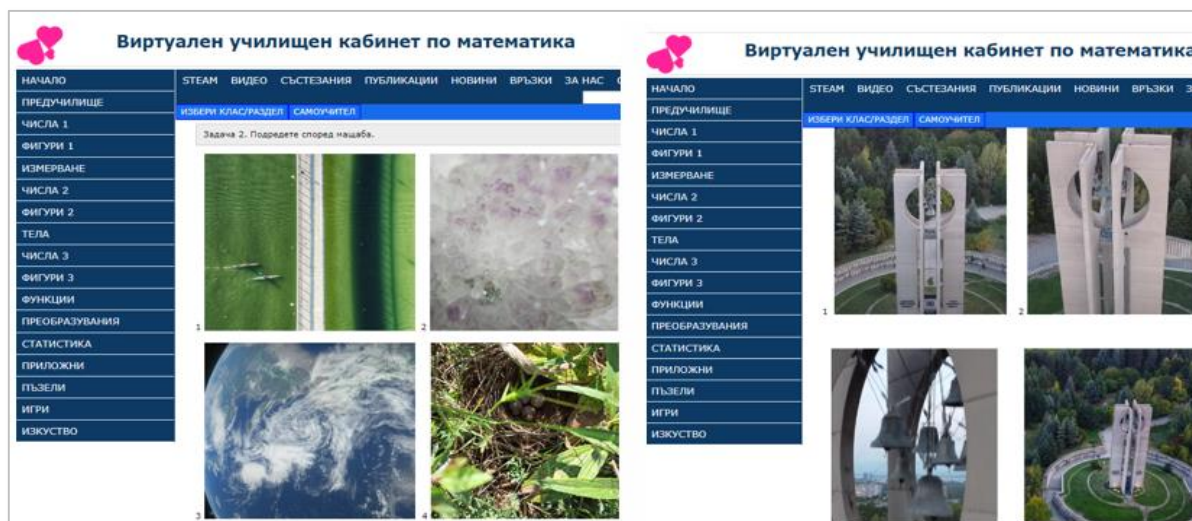


Figure 7. Tasks for the development of the eyesight
<https://cabinet.bg/index.php?contenttype=viewarticle&id=346>

Solving these tasks contributes to the realization of other goals, for example, focusing attention on specific objects, on rules for the use of an unmanned robotic systems, for example, on height and location restrictions.



4. CONCLUSION

The 360-degree photos and videos available in the Virtual Mathematics Laboratory are a STEAM resource suitable for use at various levels of school education. The format of the photos allows them to be explored through multiple technical devices, including virtual reality (VR). The reviewed resources can be used in the training of: specialists dealing with unmanned aerial vehicles; for filming and creating educational resources with specialized equipment (360-degree camera, drone); to create and programmatically support software solutions, including 360-degree photos and videos and others.

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