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## Time and Space in Panoramic Photography

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**Abstract**

This article intends to show a usage-hacking case of everyday technology for creating visual narratives. The photographic art project "Panorama Time" is discussed through a techno-cultural perspective and examines the spatial-temporal dimension in panoramic photography, which, in this case, is a digital camera in a mobile phone. The post-media condition and its characteristic of embracing the fusion of different media in one device without specifying any single one is examined in our project through the combination of photographic and cinematographic processes combined in the mobile device. The rolling shutter feature, which is the technological core of digital cameras, enables the strip-photography technique, in our case used in a panoramic technique to deliver a set of concepts: glitch, repetition, frozen frames, and similar. Through deliberate navigation and control, the user breaks the panoramic view, and thus the project's technique presents the distinction between fault and glitch aesthetics. We show examples and demonstrate the process of creating our digital photography art project "Panorama Time". By showing how we hacked the digital artifact, we also discuss insights from several experiments in connection to broader photographic concepts in relation to time and space.

*Keywords:* Digital photography, panorama camera, glitch aesthetics, fault aesthetics, spatial-temporal dimension, post-media condition

**Introduction**

Through the "Panorama Time" project the author discusses how to reach significant and aesthetically appealing, but most importantly "broken" results through hacking the use of our everyday device – a mobile phone camera. In this project, by using the panoramic mode of the digital camera, we try to break the concept of panorama, which might be referred to as an "unbroken" wide view in front of the viewer.

The word panorama originates from the Greek words "pan" meaning all and "(h)órāma" meaning view or sight. Several relevant meanings are in use nowadays: an unobstructed and wide view of an extensive area, an extended pictorial representation, and a continuously passing or changing scene or unfolding of events. Those meanings bring an understanding of the whole range of panoramic features, but they all incorporate a view and scene, which brings time and space dimensions into account.

Photographic panorama images were already famous in the 19th century. During that period, various technologies were developed to create a wide view and experience, sometimes more than

the human eye could observe. Starting with a swing lens camera, a rotating camera, and spherical lenses (Luhmann, 2016), the technologies produced various scanning conditions and results. Nowadays a simple digital camera can reproduce similar effects with pretty simplistic technologies combined with human interaction. The main technological feature of a camera, which is implemented in most of those digital devices, is a rolling shutter that in our case helps to capture a panoramic image and create the effects discussed in this article.

By choosing a panorama mode, which simultaneously combines two mediums in one – still photography and filming – we expect to explore time and space in a particular way. In this application, time passes noticeably on the screen, and the user can control the process by capturing what is relevant to that moment (by freezing the moment) while also working with a time construct, for example, to wait for some scenes to pass without being captured. Some views and action in front of the camera can be missed and deleted from the image, some can be replicated and repeated, so several of the same subjects can appear in the final image. And all this happens in real-time, encountering space and time dimensions, through the documentary approach.

In this project, documentary photography is turned into artistic practice through technological means and an extreme usage-hack. Through learning and knowing the particular device and the program, the user can try to hack its usage. In such practice, it is important to know the conventional usage of the device and, if you want to hack its use, to act according to the use. This features the directions of the process, including the documentary practice in relation to the situation and the technological constraints of the device and the program, and eventually designing the appropriate artifact. This in turn shows how important it is to look after the several techniques to create something substantially new.

In this article, we explore and shape our understanding of digital photography as artistic practice to find new ways of expression and possibilities of tweaking time and space. We practice hacking of digital photography and try new ways to achieve the expressive artistic results. Focusing on both artistic and technological paradigms, we conducted practice-based experiments. Further in the paper, through the photography project "Panorama Time," we discuss and express our understanding of glitch and fault aesthetics.

By hacking new technology and techniques, we explore the different ways in which hacking may act and create new aesthetics, even without knowing the structural components of it or how the hardware and software work. Consequently, we learn how the unknown world unfolds in action, and we may use those discoveries for our aesthetic pursuits.

### Background

According to visual art history, Cubism intentionally breaks the perspective and the view, it tries to create broken three-dimensional forms by depicting the subject from multiple viewpoints. Futurism questions how it is possible to combine time and space in a visual form, how to visualize movement and dynamics in a still image, and futurist artists managed to do so by choosing several perspectives in time and space. The Cubists took multiple viewpoints of the subject pictured at the same time; the Futurists were different from them: they took multiple viewpoint shots of the same subject but from different perspectives in time, so in Futurist artwork the past and the present is presented simultaneously.

Historically, glitch aesthetics surface from machines, industrialization and Futurism and their close relationship to technology. As far as the sound of the machine is concerned, Italian Futurist and composer Luigi Russolo (1883-1947) noted in his manifesto *L'Arte dei Rumori* (The Art of Noises) from 1913: "With the invention of machines, noise was born". Machine work, which is not always under rigorous control and in many cases malfunctions, is a great resource for glitch artists. The meaning of this machine work notion extends to all the noises, which might be tuned. Tuning is a

second round and a sort of controlled feature in the phase of post-production, so knowing the parameters of the machine, the artwork could be produced in the controlled settings. Here, the fault feature comes as an unknown malfunctioning condition and a glitch appears as a deliberate function through the design process. Looking from a hacker perspective, new forms of expression originate from the constant acceleration of technological development. Software-driven artists generate glitch aesthetics through data- and pixel-bending techniques by corrupting digital code or physically manipulating electronic devices. Contemporary techniques which thoroughly examine temporal and spatial issues through photographic and digital means are the slit-scan technique and strip-photography, and digital panoramic photography shares some of the qualities with the previously mentioned ones. Artist Jaak Kaevats presented his strip-photography cinematographic project "Street-Scape" at the ISEA2014 – International Symposium on Electronic Art. He visualizes the speed of people passing-by: while some people walking at 5km/h stay in their original proportions he applied distortion on others depending on their speed. The figures get distorted with time and space being interconnected in this technique: the slower passing figures got thicker, and the faster ones – thinner. The background and stationary objects appeared as horizontal lines, stripes. Other great examples of the enhanced selected glitch qualities are the 3D printed sculptures, "Truths Unveiled by Time", which are assembled from scans of moving people captured by a 3D slicing data camera, all produced by Australian artist Daniel Crooks and exhibited at Ars Electronica (Festival for Art, Technology and Society) 2014. In addition to these mentioned, there are impressive previous video works by Crooks, treating time itself as a medium through using the same peripheral, slit-scan, slice and strip photographic techniques. An academic article written by photographer Murat Germen was published at the EVA (Electronic Visualization and the Arts) London 2014 conference on digital aesthetics in mobile photography, with a few hack techniques for various mobile apps. However, the artworks by the artist are of a major interest for photographic hackers with a focus on glitch aesthetics, and they contain characteristics of repetition and non-linearity: broken landscapes, liquid cityscapes; the distorted views are of a high artistic quality, sometimes approaching the surrealist state.

**Encountering Concepts, Techniques and Practices**

In this section we discuss the concepts, techniques and practices involved in the project, like the spatial-temporal dimension, the combination of photographic and filming techniques, storytelling, usage-hacking, documentary and glitch, and how those theoretical, practical and technical qualities support the post-media condition through various combinations and through the practice of "Panorama Time".

**The Spatial-Temporal Dimensions**

By looking at panoramic photography from the techno-cultural perspective we encounter the post-media condition, which unfolds through the spatial-temporal dimensions and by examining its role through the "Panorama Time" project's production settings. So let's start by expanding on the understanding of the medium itself and continue with a deeper look at the insights of the project.

The panorama feature in digital photography is twofold, and takes notions of two mediums into account: one is taking a still image and concerned with capturing a moment; it is an ordinary notion from the photographic perspective; another account is concerned with the technological reason and taking a deeper look into certain delicate aspects of the technique, in particular, that time is involved through not only the exposure time but also through the capturing time like in filming, the capturing of a series of moving images. The second feature is closely examined in our project, so the short time intervals and the changes in the scenes over those periods get enhanced in the still image. Technically, the panoramic camera scans the environment and captures one strip at a time, the strips get caught in different times, and the scanning process gets represented through time and

space. The user, through the speed of moving the camera and the camera movement direction, gets control over the spatial-temporal dimensions. The rolling shutter implemented in most digital mobile cameras plays a crucial role, and it runs in the way strip-photography works: the image capture happens through the rolling slit, the image is taken not as a whole shot of the entire scene at a single instance, but by rapidly scanning the scene. The rolling shutter runs through both temporal and spatial dimensions, in which case the direction of the camera, the movement of the subject and the speed provide implications for creating different effects and distortions.

Time in the panorama is seen as a linear construct and with our usage-hack technique we try to break that linearity, creating new narratives from the situation and through a fault or distortion, which adds and supplements the narrative with its qualities.

**Photography and Filming**

It is interesting to investigate the technique itself, where the post-media condition through using several media in one device is apparent – here a photograph – a still image – and a filming technique meet each other on equal rights and through combining features from both practices come into a whole one. In this way time and space get tweaked both ways through temporal and spatial dimensions. The artist is supposed to think of two mediums and two dimensions encountered in the creative process. Both time and a moment are crucial in this technique. Here the "decisive moment", the popular Henri Cartier-Bresson's approach to photography in which a scene is stopped and depicted at a certain point of high visual drama, is enriched by cinematographic temporality, but the final image is a photographic still and the temporal dimension is frozen over a period of time.

Because a moment, to a great degree, is involved in the photographic process, we find that improvisation and chance play a significant role in this process, most importantly in relation to documentary practice. However, some types of professional photography, such as advertising, are turning away from the fortuitous moment and mainly working with pre-constructed and designed sets for scenes, deliberately eliminating chance, which is one of the most recognizable natural attributes of the documentary.

**Extreme Usage-hack**

The technological feature of the rolling shutter in mobile phone cameras directly influences the imagery and the qualities of the glitch. By using the panorama mode, the unorthodox use of the camera produces apparent distortions, which are inappropriate for the correct use and conventional linear-view, but we take advantage of such an approach and try to enhance those distortions for our artistic pursuits and storytelling. In our work, the natural distortions and digital glitches sometimes appear as uncontrolled features, for example, when the stitching of frames gets picked up on the movement of a moving object and the algorithm starts adding those stitches automatically. So, this happens when the rolling shutter and the stitching algorithm pick up on the moving object and the movement of the object gets interpreted as camera movement.

The interaction with the device and the constraints appearing from the limitations of the hardware and software creates possibilities to learn the already established use and logics, and adapt the affordances of the tool. Of course, it becomes an extreme use of the tool and the interaction is playing with the limits of the program. In most cases the program crashes instantly, but fortunately, at the same time saving the latest imagery on the phone. So by crashing the algorithm we still can extract the last saved image and find the important crashing moment in the resulting photograph, which might be an unfinished and shorter version of the panorama. In this way we learn what triggers the crash not just from the interaction perspective and what movement we had lately produced, but also from the frozen crash moment resulting in the final image.

**Photography and Glitch**

The synthesis of the two matched different techniques, first of all, digital photography, and secondly the glitch, in creating the respective outcomes is a core feature in this project. Even though

the abstract image could be easily produced with the extreme use of the panoramic camera, the focus in this project is to tell a story through some aspects of figuration and through real life situations, incorporating documentary photography and the principles of storytelling. The acts of deletion and repetition of the object or parts of it in the image are those qualities, which take priority in storytelling and combine time and space in the visual narrative.

As the technique used in "Panorama Time" does not contain just completely abstract glitch experiments, but is also concerned with documentation and a natural view, it combines layers of abstraction in the visual storytelling. The features of glitch and layers of abstraction contribute to storytelling as, for example, the repetition adds its qualities to the image and changes the initial story to an imaginative one.

**The Characteristics of the Glitch and the Fault**

The aesthetic qualities of the glitch and glitch practices could be seen from its usage perspective, according to Rosa Menkman. "Glitch-alike" tendencies refer to deliberate, planned, created, designed and artificial results, and depend on the intentional decisions of the user. In other words, in the "glitch-alike" glitch practices are taken into account from the start and the outcome is planned with all the glitch qualities and consequences. However, the other, more passive glitch approach by Menkman is referred to as "pure glitch" with accidental, coincidental, appropriated, found and real practices, and it does not depend on prior intentional decisions of the user, but instead all glitch are created instantaneously.

In our project case, where documentary photography takes a major role and where the glitch appears through real situations and in real-time, the above glitch characterization by Menkman cannot be directly applied. In the process of creating a panoramic glitch, the mobile application's program behavior should be learned and appreciated, so deliberate and planned "glitch-alike" tendencies can be found in the device itself the user is hacking: an attempt to derive the photograph from the technological means is the stance here. However, those tendencies cannot be found in the real situations where the photograph is taken from. It is important to mention, that working with documentary settings and without staging the scene and knowing what exactly comes next means that the improvisation is a spontaneous performance without preparation. The user does not know what is actually going on and what will come next, so Menkman's "pure glitch" with accidental and coincidental modes is apparent and happening through the constant change. The user improvises in making decisions about when and what to film, when to stop or let it go, and what to freeze as a "decisive moment". This performative improvisation supports the freedom of the artist to simultaneously create the photograph by following the scene in real-time and together encounter the device's or program's glitches.

In our research, we label a passive and accidental glitch approach that results from malfunctioning or error – *fault aesthetics*, so it could be a printer's physical distortion or when a photograph became a corrupted file through the physical act of removing a USB stick from the laptop. *Glitch aesthetics* results from more of a conscious act and from controlled settings, where the user knows what the process is, including both material conditions and technologies, and the user's artistry, ability and skills.

Iman Moradi (2004) describes visual glitch characteristics as follows: fragmentation, repetition, linearity and complexity. Most of those characteristics are contained in our project, however, we argue that non-linearity is more apparent and important than linearity, and in our case, we aim to break the linear view and linear way of thinking, both from time and space perspectives. If linearity is not that important in our work of glitch experiments, we argue that fragmentation and repetition come strongly through in our practice. In the examples below, we show that fragmentation comes through the freezing of time and by that we mean that some frames and parts of the scenery get

removed from the final image, or we add and repeat certain parts of the scenery and create repetition of the same object. The importance of time and space and its combination with live documenting in the project is essential: the capture of the same object or repetition happens in different time (Deleuze, 1968). In our "Panorama Time" case, we are not duplicating the same object exactly, but the repetition happens live in real-time, so the next captured similar frame in a panoramic photograph is actually different as it is taken later in time; the object is repeated with a slight difference over time and that difference is noticeable and, most importantly, is controllable.

This controlled repetition in real-time settings and in documentaries, which, according to the second case of Deleuzian repetition, contains evolutionary qualities and is evolving, is directly relevant to our project. Deleuze's first case of repetition is emphasized as revolving and static, while the second is dynamic. This dynamic way of repetition is not the machinic, the machines do not produce the difference, and they build upon the identical information and get exactly the same repeated results as in mass-production. Looking from the Deleuzian perspective on repetition we discover that evolving repetition has a transgressive nature, "Repetition is a transgression" (Deleuze, 1968). The evolving nature of the repetition with its transgressive aspect supports a discussion on the control aspect in "Panorama Time" as a non-linear approach.

The critical view on the machinic is discussed by Broeckmann (2010) – taking it as a productive assemblage of forces, not just referring to machines as technical apparatuses. From the start, by choosing to work with already established techniques and technology, the artist picks up on its limitations, restrictions and instabilities. "Panorama Time" closely relates to the machinic notion and to its four conditions described by Broeckmann: material conditions, human interaction, processual restrictions, and technical instabilities. Through the given material conditions of the device and the algorithmic program, a mobile panorama camera provides curtain characteristics to work with, so the user gets to know the device and its conventional use, the digital properties of the image, and the interaction through the features of the physical and digital. The use of those material conditions depends on the user, in our case, the extreme hack of the use of the device and the program supplement the artistic pursuits. There are also the human interaction concerns with the use of the device and the program, the combination of its well-known conventional use and of the unorthodox use was made through the extreme use of it. The processual restrictions relate to the program and its algorithm, which in our case was functioning pretty well, but the general limitations like the lens angle, the length of the panoramic photograph, the sensitivity of the algorithm in the stitching and of crashing, the thickness of the frames and other parameters were set in the program in advance. We find those limitations intriguing and embrace them as a potential resource for our hacking activity. So the technical instabilities were adopted for the creative purposes, for example, the algorithm was constantly crashing if used too harshly. But at the same time, using the wrong direction of the camera, so not following the train's movement, but the opposite one, forcing the stitching direction to the contrary, still produced the pursued image.

The first experiments of our project "Panorama Time" began a few years ago and, by increasingly engaging in this activity, the artist started adapting the technology and creating experiments related to real and documentary situations. Several photographic series were produced. Those series might be seen as personal travel diaries, as most of them were created while traveling. This also raises questions around memory issues as bringing distorted images home could relate to a different type of remembering. But let us first discuss those instances from the production side.

**The "Panorama Time" Experiments**
In this section, we want to show the most successful glitch experiments with the panorama camera on the iPhone. First, however, we introduce the mobile panorama camera features. The main action of capturing a panoramic image with such a handy device is to pan the camera by following the

landscape. Pan the camera to the side (left or right) and the iPhone camera app will stitch together multiple images into a single photograph. The thickness of the lines of stitches is originally narrow, but those could be also controlled through the speed of the movement. A final panoramic image will be long, covering a wide field of view. The iPhone supports a 240º panorama in one shot. It is a digital process, and the final result is generated by a camera app by using a video-like stream of successive frames and stitching them together.

**Rational Break**

The very first experiments with the panorama camera were conducted several years ago and were based on trying to hack the technique and technology by using it in some weird ways. The aim was to create the most extreme images and reach the limits of manipulation of the app. Various radical motions like spinning, rotating, shaking, and following the landscape line were tested. As the software was constantly crashing, the artist had to refine the movements and find an intuitive relation with the app. Despite the sensitive software, and the struggle with the extreme usage-hack, a few images were saved and collected.

**Variable Horizons**

The second discovery in hacking the mobile panoramic camera was trying to simulate the movement of the camera so that the software would get the signal of a moving camera (to trigger the movement sensor), but the actual camera would stay still and focus at the same point. All types of shaking the camera were investigated to fake the movement, to trick and trigger the camera to start its software move without actual camera movement. By shaking the camera up and down, the device receives an input like the camera moving and the image automatically starts moving forward, while software collects the upcoming bits in frames and stacks them together into one image.

The cursor starts moving forwards and stitches the upcoming parts of the image, at the same time repeating the scene: the movement of the panorama camera is hacked without actually moving the camera itself to the side. For example, as a result, several of the same towers appear side by side. However, from the camera movement we get a natural distorting glitch – not a straight line and level of the horizon, see Figure 1.



Figure 1. Khalifa City, project Panorama Time, experiment Varianble Horizons.

**Vertical Scan**

Disadvantages of the photographic technique related to the work of a rolling shutter were applied in most of our experiments. In such cases, the image is captured not by taking a snapshot of the entire scene at once, but rather by rapidly scanning across the scene. The use of the rolling shutter is nicely applicable for vertical panoramic photography, as the shutter's capturing strip gets horizontal and produces other impressive effects. In the rotating propeller example, the algorithm starts picking on the rotation of the wings and automatically stitches the frames, so no movement of the camera is needed to extend and replicate the image. The examples below show a rotating propeller, passers-by and passing cars (see all vertical pictures in Figure 2 below).



Figure 2. The fragmented traces of people and cars, Vertical Scan experiment.

### Linear Space

The most significant results were gained after continued experimenting with movement: at this time keeping the camera still, but creating movement from mounting the camera on wheels. The camera was stably placed on the side of a moving car's window. So, there was a movement of the camera in space, but not proceeded by the user's hand. The iPhone panorama camera is built for rotary movement; thus, the camera becomes the centre of the photograph – and we know that such a view is the most natural and pleasant for the human eye. So, in this experiment, the camera movement was based on steady linear movement (along the image scene and picture plane) instead of revolving the camera on the axis. It results in a straightening up the circular movement of the user and a flattening of the image.

### Insights from "Linear Space"

We want to share some findings in the connection to time and space. Basically, the panorama software stacks vertical frames-strips over time, and, during that process, many activities in front of the camera happen, some of them being caught by the camera, some of them missed, some repeated.



Figure 3. Concept Cars, project Panorama Time, experiment Linear Space.

- The distance between point-of-focus erases closer objects or replicates the farther ones, for example, the background clouds. If the focus is far, closer objects will be deleted. Farther objects move more slowly and closer objects move faster, an aspect, which is seen in Figure 3.

- The speed of the moving camera will impact the photograph and the thickness of the stacking lines: the image will stack more details inside (the camera will stack a longer distance) or the opposite.

- Faster or slower objects (e.g., the direction, speed of the cars passing by) in relation to the moving camera will be influenced, deleted or repeated several times.

- Turning the camera (the car) to inner angle stops the app and turning the camera to outer angle gives more space in the image, i.e. the width of the stitched frames gets larger.

- One single reflection might be captured repeatedly in the entire image; the shooting should happen straight in front of the reflective object like a mirror. It can be either external light (the sun) or the reflection of the photographer on the reflective surface. The repeated reflection of the sun on buildings is clearly seen in Figure 5.

- The feature of the flattening of the perspective occurs, that is, all artifacts look flat if directed perpendicularly up front to the camera, because of the spreading of the angle in a line, not revolving the camera on an axis and making the viewing from one point, but moving along the picture plane (see Figures 4 and 5). The flattening distortion happens because the capturing strip is always in the centre of the image, so no perspective is applicable. The buildings in Figure 5 get straightened on the vertical axis of perspective, so no skew of vertical lines gets applied; all the lines become ideally vertical and parallel to each other. As a result, the buildings look like they have been taken from

afar, as they lose all the parameters of perspective and get flattened in relation to the picture plane. This image could be compared to a photograph taken with a strong zoom, however, in the real situation the buildings were very close to the photographer.

- The broken perspective, which makes it possible to see hidden walls, which are behind the object, is an effect of capturing the artifact from several sides. Intentionally moving the stationary station point, manipulating and changing the picture plane, for example, from the start of the session the façade of a building might be set upright to the lens (as the initial picture plane), but by moving the camera to encircle the building the sidewall can be turned and straightened up along the façade. So in turn both the façade and the sidewall get straightened up to the picture plane.

Combining several of these techniques and insights in future work would increase the chances for better results. In addition, by sharing the production process, the artist opens up the project for others to continue explorations.

In our work, we find it intriguing the way results appear. The first experiments were made by accident; the artist has to somehow capture the moment and that particular glitch unintentionally. It just happens. It is to some extent an appropriation of the technical fault, malfunctioning or error, for your artistic pursuits. We call this *fault aesthetics*. *Glitch aesthetics* is related to design and craft practices in another way, where the artist focuses on a particular technique known in advance, and by knowing the scenario, the scene and the view. So it is important how chance is involved in the process that also involves a passive or an active approach towards the glitch practices.

### Discussion

In this work, we got engaged in creating visual narratives in our daily lives, to the extent that the glitch becomes an important instrument for creating new stories and meanings. The technique is highly relevant to the interaction with technology through the usage-hacking of everyday technologies. In a way, our work looks to open up such usage-hacking and unorthodox uses of everyday technology; it also opens up a particular design space through several proposed directions. We tried to emphasize some of the qualities of the specificity of the technique, which appear in relation to capturing a passing time and space, through the use of the panoramic camera and in combination with several other practices, like documentary and glitch.

Through working with "Panorama Time" and the proposed technique, the usage-hacking approach turns the photographic view into a broken panorama. We show how we can draw on such practices to inspire creativity and artistic processes from the hacking of everyday technology. Firstly, the process is important in regard to creating substantial outcomes. Secondly, both the process and the results become inspirations for the users in creating their own projects and new techniques. And most importantly the project emphasizes the temporal and spatial dimensions through which panoramic cameras and the proposed technique could be approached and experienced. The focus on pursuing the medium with an emphasis on the temporal-spatial dimension brings questions about the appearance of several media in one technique and device. In this case the fusion of different media, the combination of photographic and cinematographic processes, and the easy crossing of boundaries between several media in the panoramic app and mobile device manifest the main characteristics of the post-media condition in the "Panorama Time" project.

### Author's Biography

Vygandas "Vegas" Šimbelis is an artist and researcher. Interdisciplinarity is the overarching approach for the artist and it implies various significant artistic, scientific and technological resources. By projecting subjective and critical views on current issues, the artist focuses on the conceptual values of the art world by examining common aspects of societal, political, and cultural discourses.

Šimbelis' work is grounded in visual, conceptual and media art paradigms, with a strong recent focus on the intersection of contemporary art and the technological aspects of new media. Now he is affiliated with the Royal Institute of Technology (KTH) in Stockholm, Sweden, and the Mobile Life Research Centre in Kista, Sweden.

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