

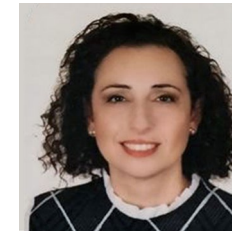
Drone-based SVP utilization for revitalizing under-valued public open spaces: Case of Istanbul

Digital technology interventions become non-separable from contemporary urbanscape. This study discusses drone-based spatial video projection (D-SVP) as a digital alternative to revitalize under-valued public open spaces (UVPOSs). Spatial video projection is a projection-based augmented reality technology that enables the projection of visual content over 3-D objects of any scale. D-SVP is an integrated system suggested by this study where the drone will be supported by data collection and projection devices, which means that D-SVP works for both the data collection and showing at once.



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Keywords:

Drone; Mobile Spatial video projection; Spatial analysis; Space revitalization; Istanbul

1. INTRODUCTION

UVPOSs have become a phenomenon within contemporary urbanscapes. They threaten the quality of life in today's cities. Despite that, they are an opportunity in case of appropriate revitalization (Southworth, 2001; Spandou et al., 2010; Jaszczak, et al., 2021).

UVPOSs emerged due to various circumstances, and thus share differing characteristics. Each UVPOS has its unique features based on its contextual settings. One of UVPOS's challenges is that they are invisible and therefore unknown despite their convenient physical conditions. D-SVP utilization is to identify these spaces and share information about them to improve their visibility based on this information. Identifying the locations of UVPOS and their spatial characteristics is an essential step for their revitalization.

In the rapidly changing contemporary cities, drones allow effective exploring of UVPOS. Istanbul is one of these cities where the old city parts have faced random interventions. Its interwoven urban fabric brings about invisibility for some public open spaces, thus UVPOS (Fig. 1).

D-SVP merges drone "kinetic" and SVP "content" flexibility, leading to immersive spatiality with less equipment. Drones can generate light shows but require a robust number of drones, and this needs more physical space to operate compared with SVP. This is a vital factor for dense cities like Istanbul. SVP also could provide quality light shows with a variety of visual content (Fig. 2).

Photos taken by drones compared to aerial ones give specific detailed information for the scale of UVPOS because drones fly closer to the built-environment than planes and satellites. As in fig. 3, D-SVP allows the creation of such public art but virtually instead of an actual painting (Cureton, 2020).

Drones in architecture and the built environment are also an emergent area of research grown just over the last decade (Corso, 2019; Cureton, 2020). This study aims to identify possible scenarios of applying D-SVP for the purpose of UVPOS revitalization. This is achieved



Fig. 1 - Shows the dense Fabric of Istanbul and one of the UVPOS that is invisible to most of the city inhabitants. Left: Image © 2023 Maxar technologies, Image © 2023 Terrametrics, from, Google Earth, edited by authors; middle and right: photos taken by the author.

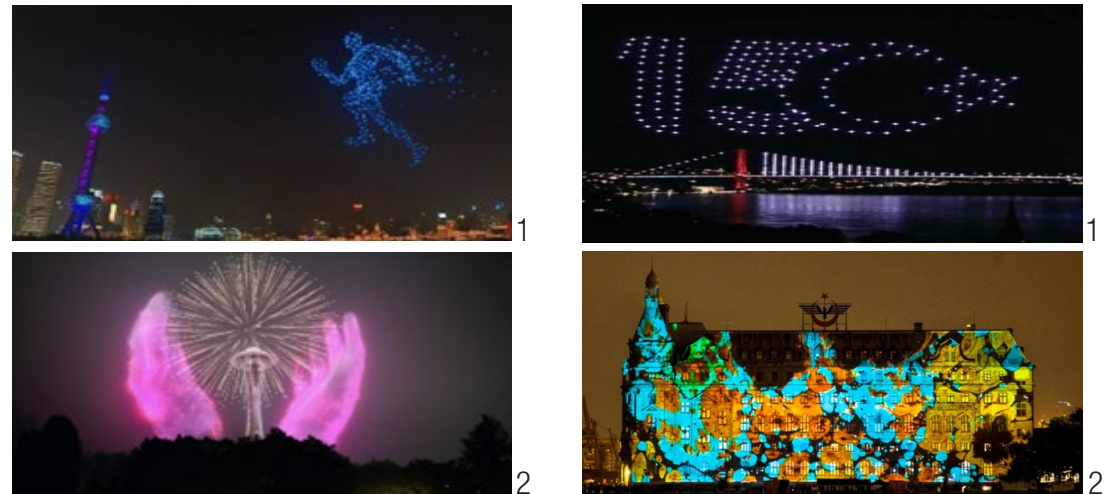


Fig. 2a - Shows two different installations using the technologies of drones and SVP. 1) 2020 new year celebration drone show in Shanghai. The show was conducted by using more than 2000 drones. © 2018 CGTN © 2023 - AV Magazine, from, <https://news.cgtn.com/news/2020-01-04/Drone-light-shows-take-flight-replacing-fireworks-MVrecgnWUE/index.html>; 2) 2021 new year celebrations SVP show in Seattle. This show is considered the first to apply "sky mapping" technology, from, <https://www.avinteractive.com/news/projection/max-in10city-joined-forces-modern-enterprises-virtual-sky-mapping-show-seen-around-world-05-01-2021/>.

Fig. 2b - Shows drones and SVP installations in Istanbul. 1) Drones light show in the annual celebrations National event in July 2020, from, <http://www.haber32.com.tr/genel/istanbul-bogazi-nda-drone-lar-la-15-temmuz-gosterisi-h144648.html>; 2) " Monolithic", "Yekpare" in Turkish, a SVP installation in the celebrations of Istanbul European Capital of Culture - 2010. The first SVP took place in the city, from, <https://csismn.com/YEKPARE>.

by investigating drone applications and by locating the suggested system of D-SVP within them. Then, review different cases of drone-based public art installations and relate them with the D-SVP system suggested by this study. These are configured to explore the capacities of D-SVP concerning UVPOS revitalization in the form of possible scenarios.

2. DRONE APPLICATIONS

Nowadays, drones have several applications in various fields, including military, games, film, media, architecture, engineering, and construction. Drones started to impact the operations and the appearance of today's urban landscape. This occurred either by the infrastructure that is needed for the drone to operate or by the applications that the drones provide. The infrastructure required, such as the hover space (space needed for flying drones) and take-off and landing ports, are not within the domain of this research. The applications that drone currently provide could be classified into three main categories which are, data collection, operation assistant, and activity creation tool (Vergouw, et al., 2016).

2.1. DRONE FOR COLLECTING DATA

This includes collecting data about the built environment for journalism and military purposes. This study focuses more on the field of urban development and the urban built environment. Within the field of architecture, engineering, and construction (AEC) including landscape architecture and urban design for pre, during, and post-construction of the project. The drone's dominant role is to capture still and video images, while these data are then used to create digital models and monitor operation sites in an efficient time and cost manner (Corso, 2019; Cureton, 2020). These collected data by drones assist in creating 3D virtual spaces, which facilitate the creation of and integration with virtual reality (VR) and augmented reality (AR) environments. Supported by other technologies of AI, IoT, and GPS, drones help us to understand and navigate urban landscapes. In the case of this study, the collected data regarding the locations and characteristics of the UVPOS will then assist in creating suitable SVP installations for each space (Corso, 2019; Cureton, 2020).

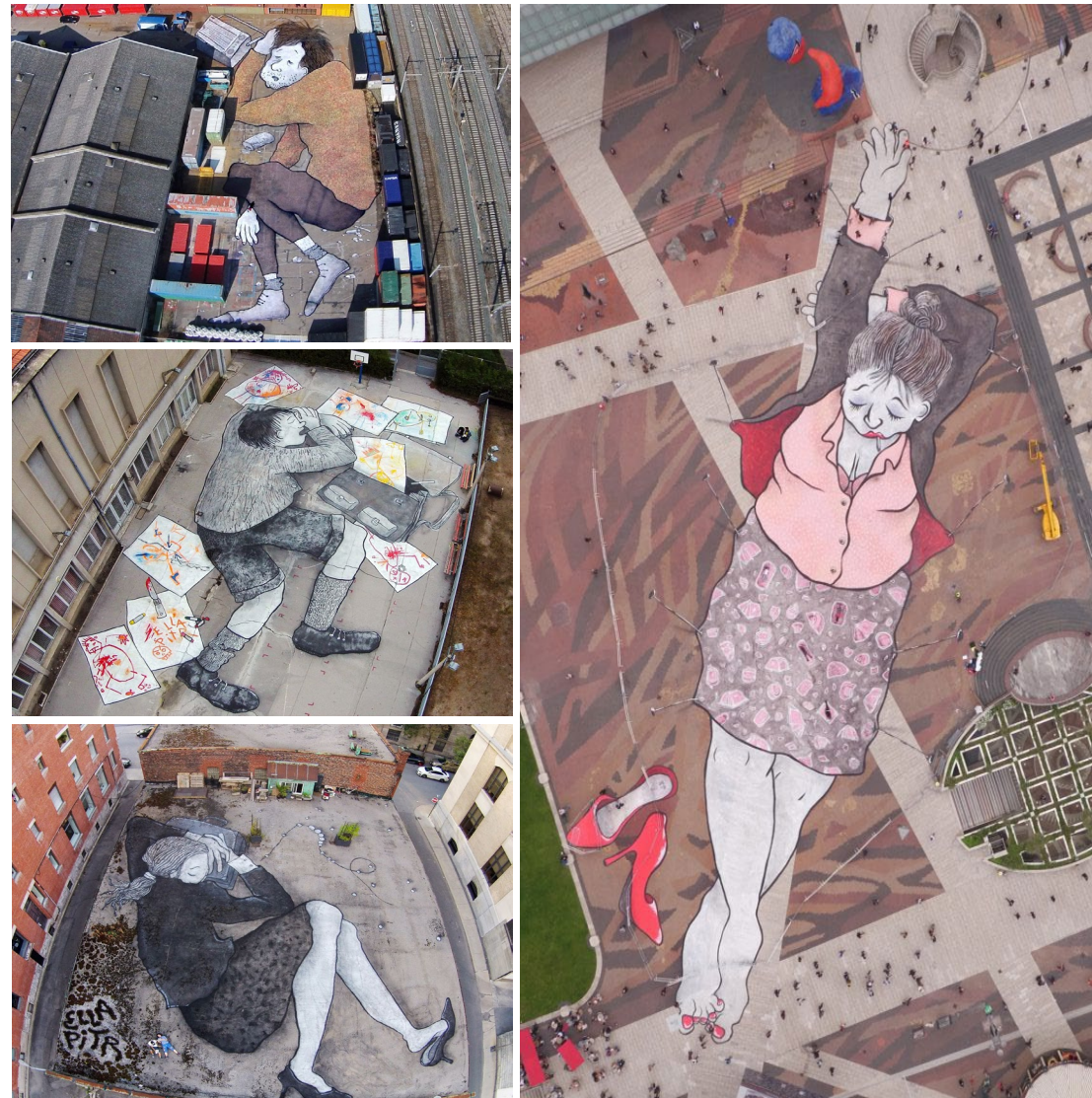


Fig. 3 - Shows public art installations (ELLA & PITR ©). Images of the installations taken by drones, such detailed and quality photos are possible when taken by drones. Left: From, <https://tonworld.com/streetart/ella/>; right: © STREETARTNEWS.NET, from, <https://streetartnews.net/tag/ella-pitr>.

2.2. DRONE AS AN OPERATION ASSISTANT

Drones started to take an active role in the field of agriculture. They have several roles in seed throwing for planting, crop irrigation, and delivering goods (Fig. 4) (Cureton 2020). In this study, the suggested D-SVP system, the drone will hold a projector connected to a channel for audio-visual input.

2.3. DRONE-BASED ACTIVITY

Beyond the purpose-driven utilization of drones, they are started to be used nowadays for entertainment purposes. These related activities deal with drones as a main component of the event. These events could be considered as at their beginnings, and they are going to increase, while today's most common drone-based activities are drone races and drone light shows. In relation to that, this study focuses on drone activities in creating public art installations (Um, 2019; Cureton, 2020).

2.4. DRONES FOR PUBLIC ART INSTALLATIONS

Drones participate in the process of public art created in two ways, drone light shows and drones as assistant tools to create public art. The drone's light shows currently appear as an alternative to the fireworks shows (Fig. 5a, b). The drones also assist in creating public art as applied by the architect Carlo Ratti who draws a giant canvas by using drones carrying paintings tanks of various colors (Tucker, 2017) (Fig. 5c). The suggested model of this study is expected to have the effect of drones in creating light shows but with a decreased amount of drones and accordingly the physical space needed for the show operations.

3. DRONE-BASED SPATIAL VIDEO PROJECTION

The suggested D-SVP model of this study is operating to data collection targeting the potential UVPOS, operation assistant as drone holds projector and as activity creator. At the same time, the D-SVP system will project digital art installations in the discovered UVPOS for the process of revitalizing UVPOS.



Fig. 4 - Shows various applications of drones in the field of agriculture and for delivering goods. Top left: © 2023 by ZenaDrone Inc, from, <https://www.zenadrone.com/zenadrone-1000-in-smart-farming/>; top right: from, <https://charisuas.com/using-drones-in-the-fight-against-malaria-in-rwanda/>; bottom left: © 2016 Forestry Bureau, from, <https://www.forest.gov.tw/0000014/0064004#lg=1&slide=0.>; bottom right: CC0, from, <https://www.rawpixel.com/image/5912255/image-public-domain-technology-camera>.



Fig. 5 - Shows various public art installations where drones play a vital role on. a) Copyright Sky Elements, LLC 2021, from, <https://skyelementsdrone.com/case-study/sxsw-halo-drone-show-2022/>; b) (Preetam Choudhury / CC BY-SA 4.0) "Drone100" performed by Ars Electronica Futurelab for Intel, in 2015, from, <https://medium.com/swlh/drone-light-shows-better-in-every-way-than-fireworks-e21cc084279>; c) image ©Designboom, from, <https://www.designboom.com/technology/carlo-ratti-associati-paint-by-drone-05-02-2017/>.

The merge between the two technologies of drones and spatial video projection was previously discussed by Darbar et al. (2019). They discussed drone-SVP as a mid-air interactive user interface display that provides 2D widgets to enrich the interactive experience of SVP (Fig. 6).

Considering the drone applications conducted by Rodrigo Lebrun, 2012. Lebrun uses drones to record activities, and share them online and in messages on the event field (Fig. 7). This study focuses on UVPOS instead of protest activities, while the process is similar (Cureton, 2020).

D-SVP suggested in this study, is an integrated system, that identifies spaces, investigates their spatial characteristics, and digitally archives this information to process them using appropriate software, for instance, GIS for spatial analysis and Madmapper for SVP show preparation.

4. D-SVP FOR UVPOS REVITALIZATION AND SUGGESTED SCENARIOS

The urban landscape dynamics, including the public open spaces, get more complex and challenging over time. Drones and SVP, in the context of this study, provide a potential alternative to the revitalization of UVPOS (Cureton, 2020). The suggested D-SVP system by this study holds possible advantages and limitations for the intended purpose of revitalizing UVPOS, and they are summarized below:

4.1. ADVANTAGES

- The system provides a better understanding of the UVPOS and projects a digital installation on them to revitalize them by enhancing their visibility. (Cureton, 2020).
- SVP is an effective tool for the creation of digital public art. As public art and digital public art are discussed as potential place-making tools (Gasparini, 2017; Gomez, 2019; Matthews & Gadaloff, 2022).

- The shared experience that SVP provides gives this

<http://disegnarecon.univaq.it>



Fig. 6 - Shows a system that merges between the drone and SVP to create an interactive user interface display. From, Darbar et al., 2019.



Fig. 7 - Shows drones for the protest 2012 event by Rodrigo Lebrun. From, <http://brn.org/Critical-Speculative-Design/Drones-for-protest>.

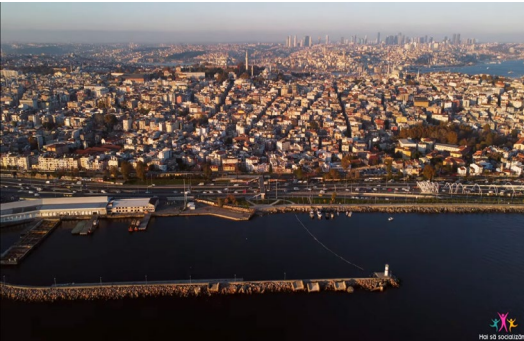


Fig. 8 - Shows various drone-taken aerial photos of the city of Istanbul and shows its dense urban fabric. Top and middle: Haisa socializam!, from, <https://www.youtube.com/watch?v=7Ji4fuglFYy>; bottom: CCO Kamusal Alan, from, <https://pxhere.com/tr/photo/518245>.

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Fig. 9 - Shows various drone light shows in the sky of Istanbul and specifically above the phosphorus. Top: Hyundai Türkiye, from, <https://www.youtube.com/watch?v=HeJ4dqQHFQ0>; middle: from, https://pbs.twimg.com/media/Ec_llrjXyAEdvUD.png; bottom: Hyundai Türkiye, from, <https://www.youtube.com/watch?v=HeJ4dqQHFQ0>.

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technology advantage over other mixed reality technologies, while others need a head-mounted display or individual display to process (Rasker et al., 1998). This shared experience feature is also offered by the drone light show but it needs a more complex operating system and space.

- The D-SVP system provides an alternative to the common drone light shows (Eloy, 2021). The common drone shows demand for a robust amount of drones which is a challenge for dense cities, while such an amount of drones occupy a large area of the city hoover space and may cause safety issues (Cureton, 2020).

4.2. LIMITATIONS

- Within the research of this study, it was investigated that there is no ready-to-use D-SVP system. Accordingly, there is a need to prepare it manually.

- The system may provide low to medium visual quality of the SVP installations if compared to the manual SVP installations. This refers to the mobile nature of the system and the limited electrical power which will depend on a movable power supply.

- In the current state of available technologies, the D-SVP system suggested by this study to perform efficiently may be time- and cost-consuming.

- Whether for drones or SVP, it was investigated that there is a lack of interdisciplinary research and practice in relation to urban public open spaces development and revitalization.

4.3. D-SVP and ISTANBUL

- In dense cities like Istanbul, drone eyes can reach invisible public open spaces (Fig. 8). This provides a better understanding of the unrecognized hidden and invisible public open spaces in the city.

- It is noticeable that most of the drone's light shows in Istanbul took place over the Bosphorus Strait, which is one of the most important features of the city. But it is expected that besides the importance of the strait for the city, the show was conducted there because it

is an empty area (no buildings or people) (Fig. 9). In other words, safety issues caused by the operation of the robust number of drones avoided by implementing them in an empty space such as the Bosphorus Strait. The D-SVP model offers more flexibility in this regard, while the hoover space needed for the SVP installations by using the D-SVP model is less than the hoover space needed for the drone's light show. This broadens the possibilities of implementing drone based shows in more spaces even in the dense areas of the city.

4.4. SUGGESTED SCENARIOS

The discussion of this study explored the potential and applications of drones and related them to the D-SVP system that is suggested by this study as a tool for revitalizing the UVPOS. Considering the advantages and disadvantages of the suggested D-SVP model, the capacities of the system are explored in relation to UVPOS revitalization in the form of a set of possible scenarios that are based on:

- 1- Scale in relation to city (micro and meso). D-SVP system could operate in an integrated network of city spaces or individual spaces.
- 2- Setting of the D-SVP system. The system improves site visibility, from location to outside or vice versa.
- 3- Operating method of the system. This includes drones as displays, drones as projector holders, or hybrid systems.

4.5. RECOMMENDED STRATEGIES

- Generating decision support tools that focus on the interplay between the right scale, place, and time.
- Developing management procedures to integrate them into the existing city dynamics.
- Conducting interdisciplinary studies to improve the capacities of the system for the purpose of enhancing spatial experiences.

CONCLUSION:

Drones hold a promising future for various fields of application. The suggested D-SVP model is a potential alternative for the revitalization of UVPOS. The currently available technologies may provide limited possibilities for this model. However, drones, as well as projection technologies, are developing hastily. This study provides a base for future research and practice. It also gives a comprehensive insight into the D-SVP integrated system that merges the technologies of drone and spatial video projection for the purpose of UVPOS revitalization. Istanbul, as a coastal megacity, is featured by its historical, multicultural, and touristic significance. Scenarios discovered by this study are not only for the benefit of Istanbul but other cities worldwide. This study recommends further practice-based research to examine the D-SVP model suggested in this study.

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Declaration of Interest: None.

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