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Use of Unmanned Aerial Vehicle Technology in the Protection of Goods of Cultural Interest (GCIs): The Case of the Castle of Cala (Huelva, Spain)

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Abstract: Currently, the use of modern technologies, such as UAVs, allows for a detailed analysis of the protection of Sites of Cultural Interest (BICs) in Spain. Cala Castle in Huelva is selected for this study, which is one of the most important medieval fortifications in the mountainous region and was rehabilitated between 2003 and 2011. After a decade of its architectural rehabilitation, the use of this new UAV technology will allow the creation of a database of the property and its surroundings, made up of a series of 3D models and photogrammetric studies of the territory. This analysis allows us two complementary readings to the original study: on the one hand, to characterize the natural and landscape context of Cala Castle, and on the other, to identify the pre-existence of a series of historic buildings, which have historically articulated this region. The 3D models obtained provide relevant graphic information. The current state of the BIC allows this space to be considered for reactivation as a social space at the regional level. The visuals of the regional environment allow us to identify that the most recent growth has been articulated longitudinally along the N-630 highway, this infrastructure being the backbone of the nucleus. As a pilot test, the beginning of this graphic and visual database (3D) at a regional level will provide a valuable tool for the conservation and registration of built heritage, given that it seeks to incorporate other fortifications that make up Banda Gallega with the aim of defining a sustainable development strategy at county level.

Keywords: three-dimensional modeling; cultural heritage; historical building; drone; photogrammetry; digital imagen; UAV; point cloud

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1. Introduction

1.1. Initiation of the Research and Intervention

The archaeological and architectural research was conducted in 2001 and 2003, respectively (Proyecto de Intervención Arqueológica and Proyecto Básico, respectively), financed by the Consejería de Cultura de la Junta de Andalucía (Figure 1).

The project required archaeological baselines and extensive and complex in situ data acquisition (Figure 2), which proved essential in the analysis of what was then no more than a ruin.

During the whole process of documentation, data acquisition, and study, the criteria of the Krakow Charter of 2000 up to the Charter of the Restoration [1] were taken into account.

Figure 1. Image of the archaeological intervention process.

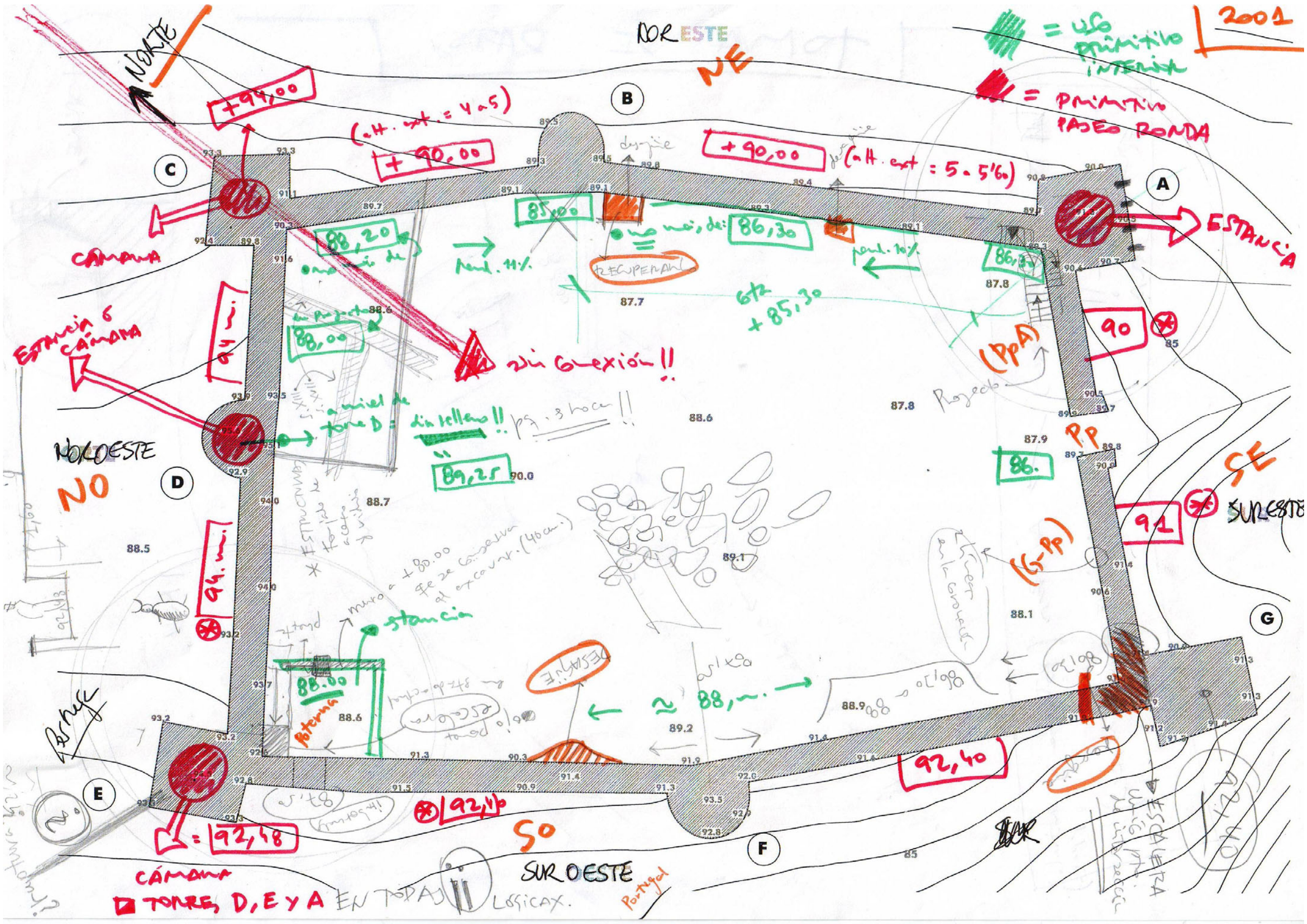

Figure 2. On-site data collection, 2001 (On the plan, the letters A–G indicate the points where the survey was carried out).

1.2. Pre-Intervention Status

The fortified enclosure was in a state of general ruin (Figure 3).

Figure 3. Initial state, before the architectural intervention.

The walls and the towers lacked both the crowning element and the upper area. The archaeological work suggested the existence of continuous protection on the outside, both on the walkway and on the towers, as it was not possible to document the existence of pinnacles and merlons. There was a great deal of damage to the masonry of the walls and towers, with large cavities and missing material. The main gate did not exist, as the adjoining wall had been destroyed. There were also remains of the two staircases that would have led to the coastal walkway, but they were in a ruinous state.

The castle was heavily infilled inside, with collapsed material, and there was also an accumulation of material from the destruction of the castle's internal structures. The backfill undoubtedly exerted a damaging pressure on the structure from the point of view of stability. The walls and the areas adjacent to the ramparts were severely affected by wild vegetation and accumulated materials. There was also a multitude of parasitic plant sprouts and extensive damage to the walls.

1.3. Justification for the Solution Adopted in the Project

Although the general state of the castle posed numerous problems regarding certain constructive aspects, there was sufficient data to begin the study of its comprehensive restoration, which required the repair of the damage and the valuation of the monumental complex by means of large-scale volumetric recovery, as well as the recovery of those documented elevations.

This is why, in the "Basic Project" of 2004 (Figure 4), the Krakow Charter of 2000 [2] is applied; in this and within the enumeration of the "principles for the conservation and restoration of built heritage", it is established (in its paragraph nº 4) that:

> "Reconstruction in "building style" of entire parts of the building should be avoided. The reconstruction of very limited parts of architectural significance may exceptionally be accepted if it is based on precise and indisputable documentation. If the incorporation of more extensive spatial and functional parts is necessary for the proper use of the building, the language of current architecture must be reflected in them."

On the other hand, in this type of architectural study, there are constructive issues more typical of the scale of the architectural detail, and others more typical of the territorial scale (Figure 5).

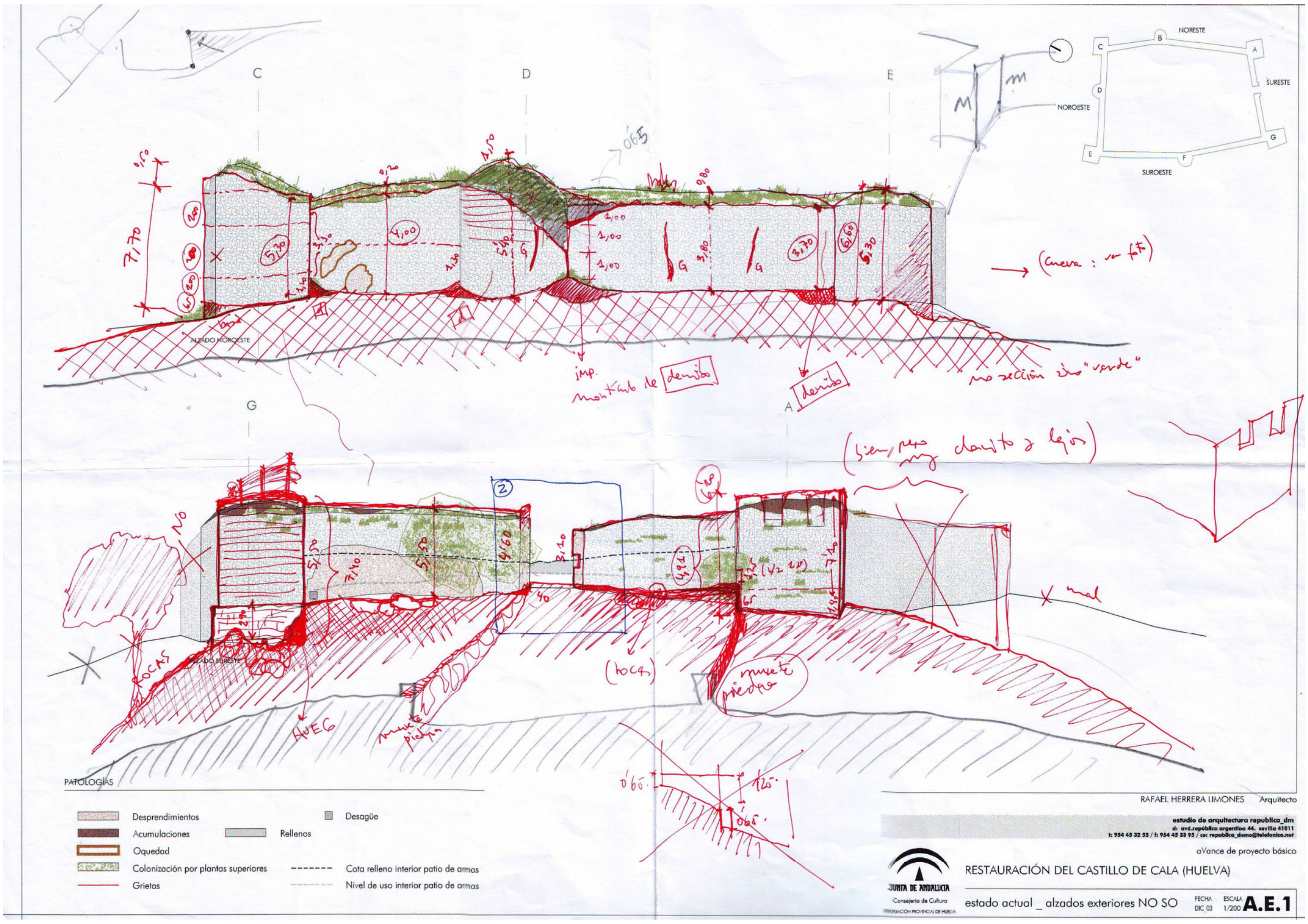

Figure 4. Project plan.

Figure 5. Post-intervention photo, 2012.

This double scale, macro, and micro, shows the difficulty of interventions on heritage assets. In short, the lines of action that are specified (already in the 2008 Execution Project) are, with respect to the general volumetry, the following:

- Recovery of the three sections of walls (located in the N.W., S.W., and S.E.) facing the population, which constitute the collective memory of its past: the ethnographic atavism of the citizens (Figure 6). This operation will be developed by means of a constructive language that allows a double reading of the BIC:

(a) From the point of view of their integration into the environment–territory–landscape, the materials used, textures, and general tones shall not differ from the pre-existing ones.
(b) From the point of view of the authenticity and integrity of the building, the different languages can be clearly differentiated so that no undesirable mimicry effects occur, even over the years.

- The section of wall between towers A and C (facing N.E.) is considered to have its "back turned" to the town that protects the castle and "facing" the hillside with the steepest slope and most distant perspective and, on the other hand, with the aim of achieving the originality of the existing historical remains and thus having a spatial recovery with different materials to the pre-existing ones and conserving the state of "ruin" (obviously after appropriate structural–constructive consolidation) according to archaeological criteria. This action is reflected in the incorporation of a footbridge (Figure 7), thus allowing continuity in the coastal walkway at its original heights (according to the hypotheses of use) and recovering the pre-existing virtual volumetry.

Having made the previous contextualization, it is important to point out that the use of recent technologies does not imply the eradication of traditional studies in the analysis of the territory and its associated historical properties. For this reason, the general objective of this research work seeks to highlight the importance of incorporating the use of innovative technologies such as multirotor UAVs in the collection of data associated with a historical and heritage asset, in this case, taking as a case study the Castle of Cala (Huelva, Spain).

From the analysis conducted, the aim is to build a database at the regional level, which will be composed of a series of 3D models and photogrammetric studies of the territory. In a first phase, this tool will be the basis for recording data necessary for the conservation and registration of the built heritage that is part of the Galician Band, together with its natural environment. The above will streamline the obtaining of data for the development of sustainable strategies at the regional level.

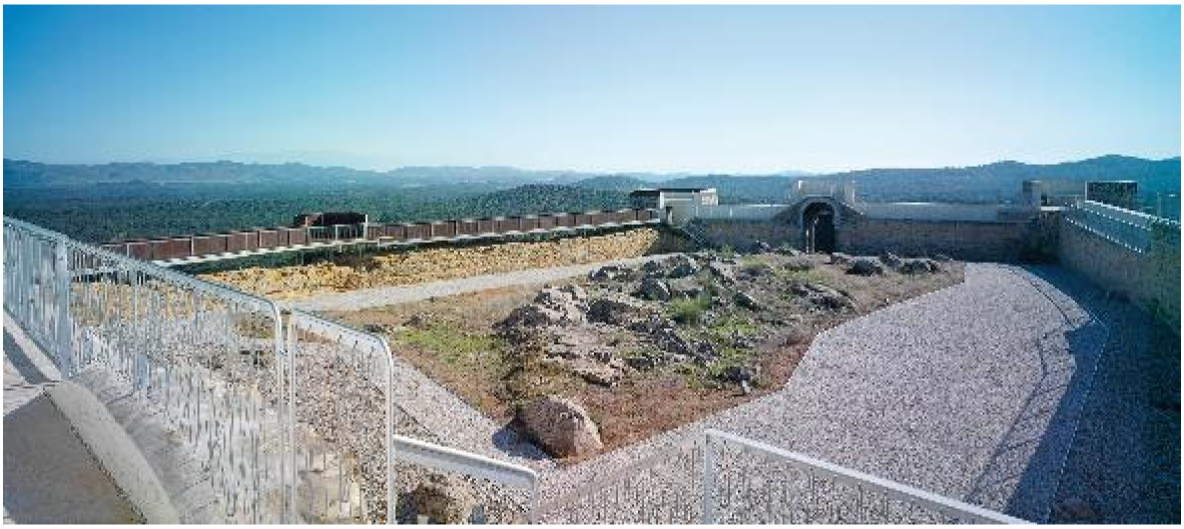

Figure 6. View of the parade ground: after the intervention, 2012.

Figure 7. Photograph of the catwalk, 2012.

1.4. Use of Innovative Tools in the Conservation and Protection of Heritage

Currently, BIM technology and GISs (Geographic Information Systems) are tools that are used in the development of research in architecture, engineering, urban planning, and construction, as well as in archaeology and the rehabilitation of buildings [3,4].

BIM (Building Information Modeling) refers to a set of working methodologies and tools characterized by the use of information in a coordinated, coherent, computable, and continuous way [5]. In this case, various methodologies associated with architecture and engineering, allow the important development of big data applied in the construction of buildings, as well as in their rehabilitation [6,7]. BIM databases may or may not be made up of a variety of comprehensive information such as spreadsheets, photographs, cartography, images and raster, etc., which must be processed to drive project management as required [8].

Finally, this technology provides a model of the building and its environment, based on the information extracted from the big data, to manage the construction of the building, its maintenance, or rehabilitation [9–11].

Several authors agree that a GIS facilitates the management, manipulation, and analysis of spatially referenced data, through which complex planning and management problems can be solved [3,12].

The GIS constitutes a database with geographic information, which is associated with a graphic identifier of a digital map [3], resulting in the generation of maps, reports, graphs, etc. [13] multiplying the analytical variables focused on territorial analysis [14]. Currently, research into the efficient operationalization of BIM and GISs has been increasing exponentially due to the possibilities of both technological tools [15,16]. Linked to the use of BIM and GIS technologies, the application of information obtained from UAVs has become of great interest [9,17]. UAVs intensively generate large amounts of points and information, resulting in the generation of point clouds that can vary in their properties, depending on the number of returns and/or the density of the vegetation or urban plan [17,18].

It is important to note that the versatility of the system allows working and defining the flight paths of the UAVs (Pix4D Capture in free version for programming the flight path), and the procedure can also be carried out in reverse; the flight path is designed within the programme, and the region of interest is indicated, defining the maximum altimetry required according to the type of flight path information [17].

The different typology of existing drones leads to the choice of a specific type as the most suitable for the recognition and observation of an asset of cultural interest. Specifically, the multirotor drone is presented as the most suitable. The possibilities offered by this type of UAV are clearly more advantageous than those of a fixed-wing UAV, for example. However, if the area to be studied is larger than one hectare or if the terrain is very uneven or requires observation from a high altitude, the fixed-wing UAV is the most suitable. Currently, most of the cultural assets to be studied are buildings or remains of small cities. In this sense, the predominant and most widely used typology is the multirotor UAV.

In the field of inspection [19] and observation, the use of UAVs is becoming more common, as well as in activities related to public safety [20,21]; territory mapping with different applications [22–24], such as agriculture [25] and mining [26]; or in inspections of public works or power lines [27].

In the field of cultural property registration, photogrammetry [28,29], which allows 3D models to be obtained, stands out. This new application of UAVs and data processing makes the use of these new technologies possible, concluding in an application to the study of archaeological [30] and heritage properties [31]. Thus, throughout this article, the use of UAVs applied to territorial analysis is shown, focusing on the territorial analysis of a heritage property, such as the Castle of Cala.

For the methodological development of the analysis of the Castle of Cala, it is convenient to specify the main characteristics, advantages, and disadvantages of the several types of UAVs (Table 1), to establish the relevance of the use of the multirotor UAV in the 3D survey of our case study.

Table 1. Typology of UAVs.

	Features	
Fixed wing	Aircraft	It is based on the fixed-wing principle for lift. May or may not have any propulsion system such as propellers or turbines.
Rotating wing	Helicopter	Its lift principle is based on rotating wings. The difference with multirotors is that it consists of a single sustaining rotor, which implies the existence of an anti-rotor.
	Multirotor	Like the helicopter, the multirotor bases its lift on the principle of rotating wings. The difference is that there is more than one rotor, making the anti-rotor unnecessary.
	Advantages	
Fixed wing	Aircraft	Greater autonomy. They can achieve higher travel speeds.
Rotating wing	Helicopter	It allows stationary flights. It has total freedom of movement in all three axes.
	Multirotor	Greater stability. Greater mechanical simplicity compared to the helicopter.
	Disadvantages	
Fixed wing	Aircraft	It does not allow stationary flights. Slow speed on course changes.
Rotating wing	Helicopter	Less autonomy. Increased mechanical complexity, greater likelihood of breakdowns, and higher maintenance costs.
	Multirotor	Reduced range compared to fixed-wing aircraft. Increased mechanical complexity compared to fixed-wing aircraft

The creation of a 3D digital model applied to heritage elements through the use of UAVs can have different objectives, although the main one is to provide essential information in the development of urban policies, as well as in land use planning [32,33]. As for the analysis of historic buildings, the creation of 3D digital models provides digital documentation [34–36] for the perfect conservation and reconstruction of heritage and for the support of educational programs [37], as well as for those aimed at the dissemination of heritage [38,39].

Although UAVs are presented as a complement to the use of LIDAR technology [31,40], on occasions, as in the case of the analysis of Cala Castle, they offer better results [24,41,42] since when we analyze a heritage element associated with the territory, these elements are often located in places that are difficult to access [43].

From its landscape aspect, due to the historical importance of the territory where the Castle of Cala is located and the role of Fortaleza in the regional territory, it is mentioned that in 2000, the Council of Europe adopted the European Landscape Convention (henceforth ELC) which warned of the need to integrate the landscape and its values in urban policies, as well as in cultural, environmental, agricultural, social, and economic policies [44–48]. In this sense, the Government of Spain, in 2012, approved the National Plan for Cultural Landscapes (PNPC), where this concept was defined as "the result of the interaction between people and the natural environment over time, whose expression is a territory perceived and valued for its cultural qualities, the product of a process, and a corner stone of a community's identity" [49].

2. Case Study: The Castle of Cala

2.1. Andalusian Defensive Architecture

According to the P.A.D.A. (Plan for Andalusian Defensive Architecture), belonging to the General Directorate of Cultural Heritage of the Department of Culture of the Andalusian Regional Government, the defensive architecture of the Andalusian Autonomous Community constitutes a heritage of exceptional quality, due to "its historical condition as a frontier between kingdoms and civilizations" [50]. In addition, and since a multitude of landmarks still survive in the Andalusian landscape, it can be seen how towers, castles, walls, etc., are witnesses to a jurisdictional and logical reality of implantation in the physical environment.

Specifically, within the P.A.D.A., a number of objectives are prioritized, including:

- Registering properties for computer processing using GIS-type applications, thus allowing databases to be associated with cartographic documentation and systematizing data processing.
- To carry out conservation and restoration actions applying a methodology based on knowledge, through research processes and previous studies, and in the adaptation of projects to the characteristics and circumstances of each building.

2.2. Location and Territorial Articulation

The Castle of Cala is located in the province of Huelva, at the western end of the Sierra Morena and in the low mountain ranges [51,52]. The heritage density of this region is notable for important constructions, including a series of fortified elements (towers and castles), which are representative of 13th century military architecture. Historically, it belongs to the Banda Gallega (part of the defensive system of the Kingdom of Seville against possible Portuguese attacks). Between the castles of Cala, Real de la Jara, and Santa Olalla de Cala, a triangular visual control was established, which was strategic, given its proximity to the territories of the Order of Santiago [53], and the crossing of the Vía de la Plata was of vital importance for its regional consolidation.

The fortress stands on a 650 m. high hill, with a small plateau at its summit. The surrounding landscape corresponds to a meadow, and at its feet, the fertile plain of the river Cala stretches out. The complex is small in size and totally isolated from the town, and was probably used to house a small military garrison [52,54,55].

Cala Castle is irregular in outline but tends to be rectangular in shape. It is an enclosure enclosed by a wall of varying width, ranging from 1.93 to 2.16 m. It has a quadrangular tower at each corner and intermediate semicircular towers on three sides (Figure 8). It has a convex shape on the two longest sides, with the intermediate towers predominating, but the sides have a rectilinear layout between the towers [56,57].

Figure 8. Northeast elevation, before the rehabilitation of the BIC, year 2000.

There is a main gate located to the south, bounded by two perpendicular walls and a probable continuous machicolation, with two arches (semicircular and pointed) and a barrel vault; there is also a secondary gate (postern) located to the west, with an internal semicircular arch and an external pointed arch of granite ashlars framed by a rectangular slump, Between the arches, there is a barrel vault of granite ashlars, with "levelling" of courses of brick.

There are two interior staircases, attached to the walls: one near the main doorway attached to the SE side, which ascends in a NE direction, landing at the corner formed by the sides and the tower, and another, next to the postern, which is attached to the NW side of the wall and ascends in a SW direction.

The walls are built with two walls of faced masonry, with the intervening cavity filled with earth, clay, stones, and lime mortar. The sides of the walls are built on the rocky outcrop. In any case, the construction system is similar to that of other mountain fortresses such as Encinasola, Torres, Cortegana, Cumbres de San Bartolomé, Cumbres Mayores, and Santa Olalla.

The orography, as well as the course of the water have been especially important and have marked the territory. These characteristics have defined communications throughout history, as well as the location of populations in the territory [54,58]. The fortifications and their location are reflected in the cartography produced during the 17th, 18th, and 19th centuries [59–61]. The characterization of the territory presents a clear east–west arrangement, where the topography of the Hercynian folds orders them in a northeast–southeast direction towards the eastern end (Figure 9).

The Christian repopulation from the second half of the 13th century onwards had a large Galician–Leonese component; the Christian conquest assigned this territory to the land of Seville, creating from the 14th century onwards the so-called Banda Gallega [62,63]. Its historical definition defines it as the design of a border defence system made up of castles and fortifications [64] against Portugal in its wars with Castile [65,66]. The concentration of a rural population was the basis for the ruins of the current castles such as those of Cumbres Mayores, Cala, Santa Olalla de Cala, Cumbres de Enmedio, or Cumbres de San Bartolomé [57].

The fortifications are an example of defensive architecture, typical of this territory, such as the Castle of Cala. Its first traces date back to the Islamic period, during the Christian conquest; the Islamic enclosures were built at the end of the 13th century, and in the defensive programme against the kingdom of Portugal, the fortifications and towers of the so-called Banda Gallega stand out.

The historical importance of this group of Andalusian fortifications is still valid; therefore, the castles of the Banda Gallega have been catalogued as an Asset of Cultural Interest (BIC).

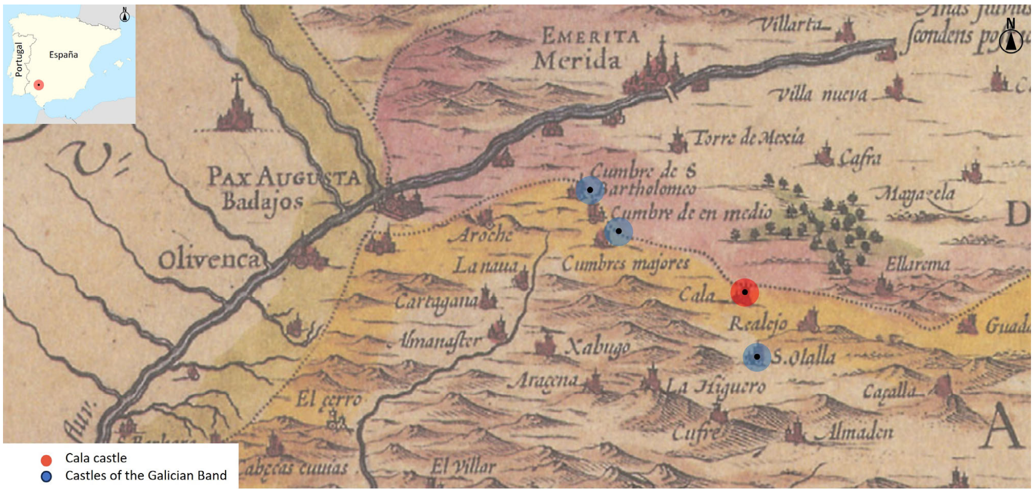

Figure 9. Location of Cala Castle in cartography from the 17th century.

3. Methodology

Given the objective of this research, in which the analysis deals with the current situation of Cala Castle, a DJITMMAVICTM 2 Pro multirotor UAV was used. Furthermore, this UAV was considered due to the interest in surveying the castle through photogrammetry, which allowed us to produce a 3D reconstruction of Cala Castle and its territorial surroundings.

With regards to its characteristics, the work tool has omnidirectional vision systems and an infrared detection system, and a fully stabilized 3-axis gimbal with a camera with a 1st CMOS sensor (jointly developed by DJI and Hasselblad) that shoots 4K video and allows 20-megapixel photos to be obtained. It also offers DJI signature technologies such as obstacle sensing and intelligent flight modes like hyperlapse, activetrackTM 2.0, quickshot, panorama, and an advanced pilot assistance system. The Mavic 2 Pro boasts a maximum flight speed of 72 km/h and a maximum flight time of 31 min.

To take the images, the multirotor UAV was equipped with a non-metric camera with a 1/2.3″ CMOS sensor [67] and a 24–48 mm lens (35 mm format equivalent).

Subsequently, this set of images taken at different positions in the study area were processed using the 3D reconstruction software: Agisoft PhotoScan [68–70]. From this software, a Digital Orthophoto Map (DOM) and Digital Elevation Model (DEM) were automatically structured, with surveys that allowed us to obtain a 3D model of the Castillo de Cala and part of the territorial envelope where it is located.

Agisoft PhotoScan allows 3D models to be obtained automatically without the use of control points. This software allows the initial images to be arbitrary [71] and to be taken at any angle and position, as long as there is a minimum overlap of 70% between them. If this method of 3D model reconstruction is compared with that used by a 3D laser scanner, this method is very efficient and good results are obtained at a low cost [72], taking into account that the objective of this experimental model will be to obtain a photogrammetric reconstruction, where a high precision in terms of the coordinates of the points is not necessary [72].

For the development of this pilot experience, two analyses of the case study were considered. These studies were developed in two types of UAV flight. On the one hand, a first broad and general reconnaissance was carried out to contextualize the castle with respect to its urban and territorial environment, in order to determine, therefore, what visual impact the visitor has; and on the other hand, a second reconnaissance was carried out covering a smaller area of the urban and territorial environment, in order to be able to document the castle in more detail.

3.1. General Reconnaissance: Flight No. 1

A data collection flight was made with a trajectory from the castle to the population centre, inspecting an approximate area of 341,544 m^2 (Table 2). In order to cover this route, the images were taken by positioning the camera at an angle of 90° with respect to the ground line.

Table 2. Details of Flight No. 1.

UAV	Multirotor-DJI Mavic 2
Date	27 June 2020
Type	Grid
Flight time	16 min
Dimensions	399 m × 856 m
Number of images	315
Overlap	80–70%
Camera angle	90°
Altitude	115 m
Path	8011 m

The objective of this first data collection was to obtain a Digital Elevation Model (DEM) to determine the visual impact of the castle on its surroundings. To do this, the software was used, and the images obtained from the UAV were positioned consecutively, looking for common points in each shot, which is why it is important to have a 70% overlap between them.

Subsequently, high-quality, smoothly filtered depth maps and a very dense point cloud of more than 72 million points were generated. With the processing of these data, the DEM was obtained from the elaboration of the high-quality mesh model. To conclude this section, it should be noted that the DEM was processed with an error of 6.3 m (Figure 10), which is considered acceptable considering the purpose of this research, as well as the extent of the mapped area (Figure 10).

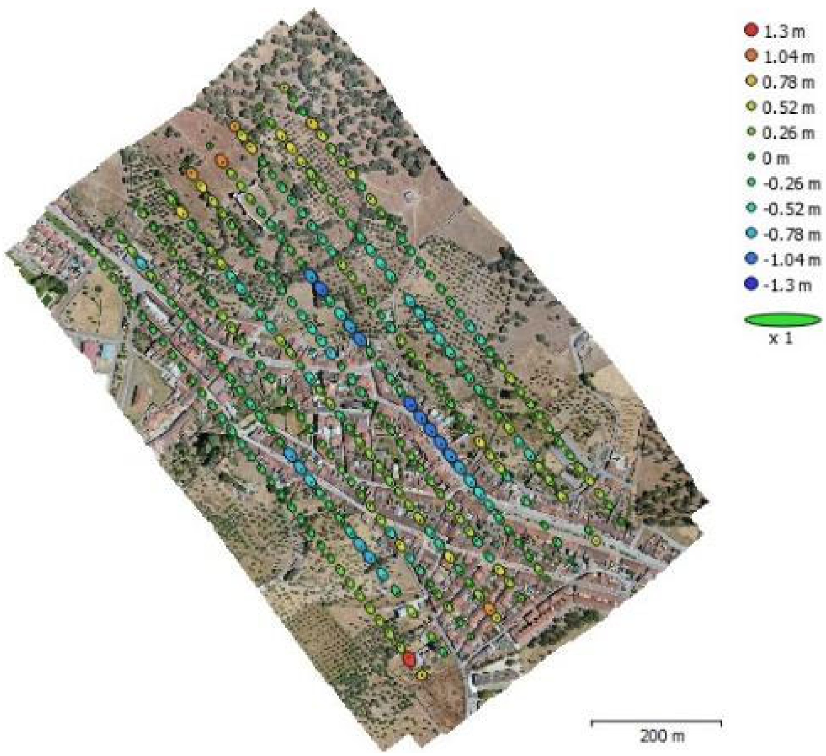

Figure 10. Camera positions and error estimators. The color indicates the error in Z, while the size and shape of the ellipse represent the error in XY.

3.2. Detailed Reconnaissance: Flight No. 2

The work carried out sought to document the castle, so its survey area was limited to a smaller perimeter than the previous flight, considering an area of 12,750 m^2 (Table 3). For this purpose, a double-mesh route was made, i.e., the multirotor UAV makes two meshes perpendicular to each other, taking the images at an angle of 70° and focusing on the central point of the mesh.

Table 3. Details of Flight No. 2.

UAV	Multirotor-DJI Mavic 2
Date	27 June 2020
Type	Double Grid
Flight time	14 min
Dimensions	102 m × 125 m
Number of images	330
Overlap	80–70%
Camera angle	70°
Altitude	30 m
Path	2169 m

The objective of this second data collection was to obtain a 3D Digital Model, which would allow the documentation of this heritage building. To do this, following the same process as before, the images obtained from the UAV were aligned to subsequently generate depth maps with high quality, soft filtering, and a dense point cloud, generated from more than 72 million points. From this point cloud, a mesh was created (Figure 11), which, in turn, allowed the creation of a tessellation model.

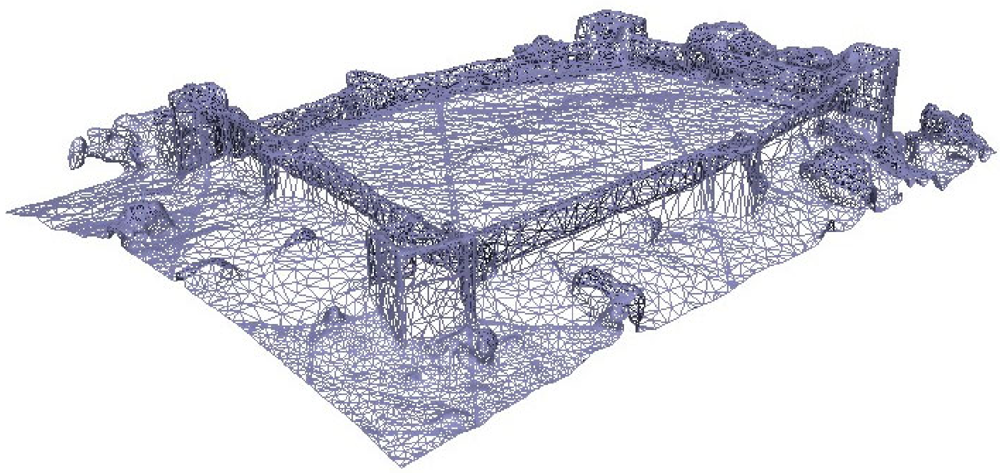

Figure 11. Image of the generated mesh.

It is important to note that this model was processed with an error of 0.97 m (Figure 12), which is considered a sufficient error because the purpose of creating the model is not applied for specific measurements but for visual documentation of the current state of the BIC.

Figure 12. Camera positions and error estimators. The color indicates the error in Z, while the size and shape of the ellipse represent the error in XY.

4. Results

4.1. Digital Elevation Model

The process explained above allows corroboration of the Digital Elevation Model (Figure 13) developed.

The first reading of the photogrammetric analysis allows us to refer to the surface of the territory that was covered with the first flight (341,544 m^2); the DEM has allowed us to identify a series of territorial elements that today continue to form part of the county identity to which the Castle of Cala belongs (Figure 14).

Topographically, the DEM shows that there is a considerable slope between the castle (UAV take-off point) and the current urban centre, with a distance of 93 m between both points. This height has allowed, throughout various historical processes, a complete view of the natural boundaries that delimit the region. At the same time, small valleys of the holm oak forest of the Dehesa de San Francisco can be identified, which allows livestock farming activities to be maintained.

The resolution of the DEM makes it possible to identify the permanence and continuity in the use and layout of the old historical roads. The old silver road towards the castles of Cumbres, as well as part of the 13.4 km [72] of transhumant paths (livestock trails) in the municipality of Cala are also identified. With the historical background of these paths, their continuity makes them properties that intrinsically carry with them an important heritage load at a regional level.

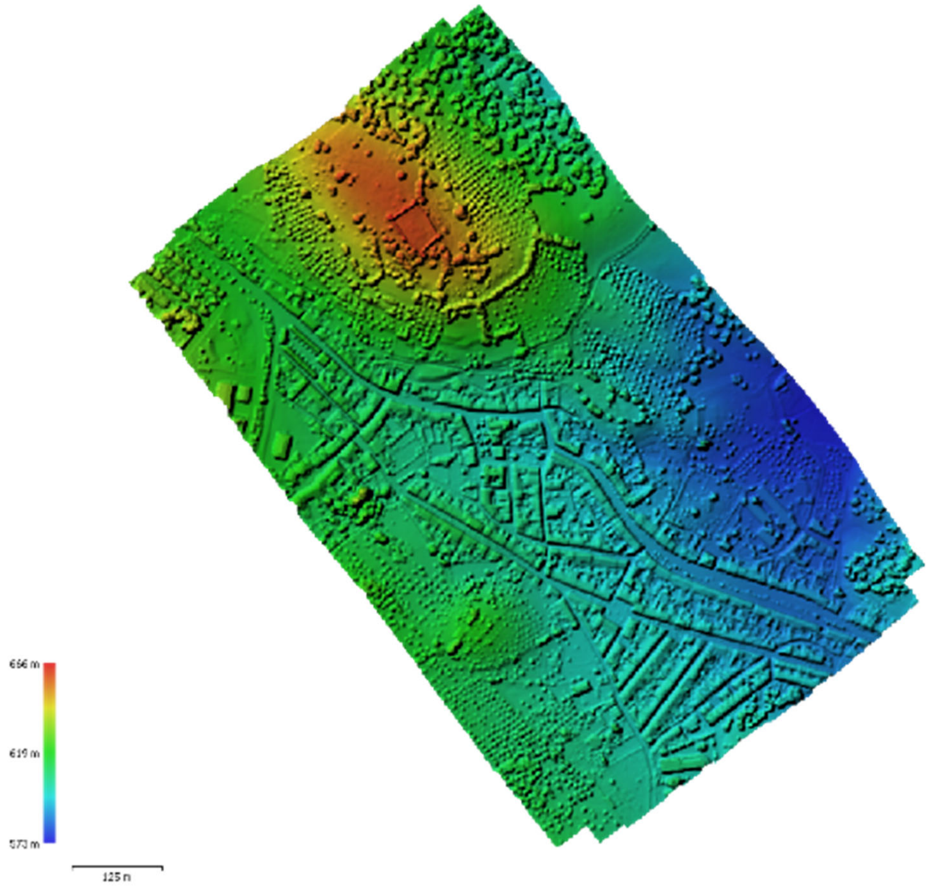

Figure 13. Digital Elevation Model (DEM).

Figure 14. General survey of the territory.

4.2. Three-Dimensional Model of Cala Castle

The processing and treatment of the aerial images allows us to obtain, in addition to the 3D model, a series of images (Figure 15) that allow us to document and carry out technical tasks related to the dissemination of heritage (Figure 16), with great quality and breadth and a high level of detail.

Figure 15. South elevation; image obtained from the photogrammetric process, 2020.

Figure 16. West elevation; image obtained from the photogrammetric process, 2020.

On the other hand, the 3D models provide graphic information on the current state of the BIC (Figure 17). Therefore, the use of UAVs is presented as part of new technologies applied to the analysis of heritage buildings (Figure 18), and is a complementary methodology to a series of rigorous scientific studies prior to the rehabilitation of this fortress (photographic survey, mapping of the current situation of the building, sampling, topographic survey) allowing the development of various studies in different periods of time and with different objectives.

Figure 17. Southwest elevation; image obtained from the photogrammetric process, 2020.

Figure 18. East elevation; obtained from the photogrammetric process, 2020.

Today, the use of UAVs in the field of heritage analysis allows the generation of 3D models and complements the collection of information on historical and heritage properties, with the aim of establishing strategies focused on the maintenance, conservation, and enhancement of the fortresses of the defensive strip of Galicia (Figure 19).

Figure 19. Northwest elevation; image obtained from the photogrammetric process, 2020.

In the research work carried out for Cala Castle, the creation of the 3D model allowed us to study the current situation of both the building and the territory where it is located. For this reason, the work carried out constitutes a part of the database of heritage interest, which will later be continued with the castle of Cumbres Mayores (rehabilitated and in use) and the castle of Cumbres de San Bartolomé, studying its importance from the point of view of sustainability, which will again constitute future research work through the application of UAV technologies.

For this reason, it is considered that for this database to have a use and application, not only in the academic, scientific, and governmental sphere, the local society must be involved and consider it as part of the generation of information about the property, so that the collaborative strategies around the heritage properties are "local bottom up", which can later be transferred to the county level.

5. Conclusions

The research work conducted supports the hypotheses on the suitability of modifying what already exists, as opposed to the production of new built elements. As a result of the 3D survey of the building, it is possible to appreciate the situation in which the refurbishment was conducted more than a decade ago. At the same time, the walkways are in perfect condition. In addition, the members of the team made a physical tour. Due to the lack of maintenance, and because of their location outside, the boxes containing the electrical installations must be checked by a technician.

To construct the relief under which this asset of cultural interest is located, the use of photogrammetry was necessary to obtain the 3D models. Regarding the survey of the surroundings of the castle, it can be recognized that the view that dominates the region is still preserved, a historical value that gave a hierarchy to the Castle of Cala with respect to the rest of the buildings in the region. While the photogrammetric survey allows us to recognize that the territory still preserves remains and traces of the continuity of traditional activities such as agriculture, this can be identified through the natural exploitation of the pastures for pigs, sheep, and goats, without forgetting that the cork industry is a determining factor in local economic development.

Firstly, it should be noted that, compared to the use of traditional surveys, the data collection time was reduced. For the dimensions of the Castle of Cala, it is shown that the use of UAVs is more practical than the use of LIDAR technology, as the use of UAVs allowed access to the surroundings of the Castle of Cala in a more agile way. As there is no maintenance, nature has once again covered the marked paths to access the castle and the surrounding area.

As a result of the work conducted, it can be affirmed that the use of innovative technologies such as UAVs is contributing to the recovery of built properties that form part of Spain's heritage. With this first phase as a pilot experience conducted in the Castle of Cala, it is identified that the construction of a database at a regional level represents an opportunity to record specific data for each property analyzed.

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