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Article

# Proto/Early Renaissance Depictions, Iconographic Analysis and Computerised Face Recognition Connections: 16<sup>th</sup> Century Frescoes of St. Leocadia Church (Chaves, North of Portugal)

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**Abstract:** The content of this paper is a very significant contribution to the heritage regional reconstruction and conservation interventions. The results about the iconographic analysis of the Early-Renaissance frescoes of St. Leocadia Church, in Chaves, in the north-east of Portugal, were presented for the first time. This paper aims to study facial similarity analysis applied to identification of the personages represented in the 1511-1513 mural paintings of the apse of St. Leocadia Church, in Chaves Municipality (North of Portugal) and those ones in the oil paintings by the Proto-Renaissance Portuguese painter Nuno Gonçalves. In this work, it was explored the feasibility of face recognition technologies in answering many ambiguities concerning Manueline stylistic identity and iconography. A proposal was made to identify the characters, fundamental to the meaning of the frescoes. It has been experimentally proved on 7 characters of St. Leocadia Church's paintings, in comparison with the referred old master portraits. It was used an in-house trained deep face recognition model to extract facial features from images of 15th and 16th century portraits to compare their degree of similarity. It was undertaken facial similarity analysis of the faces in the formidable portrait gallery of the 15th century Portuguese society represented in the Panels of St. Vicent, which has been subject of national and international research for 130 years. On the other, in the oil painting of St. Peter and St. Paul and Infanta St. Joana, of the same old master. The iconographic interpretation of the mural paintings of St. Leocadia, based in the deep facial features of the images, is plausible: a catechetical purpose; the ritual practices of royal ancestor worship in royal portrait apses of the churches; the Portuguese maritime expansion and the macro-imperial ideology of D. Manuel I.

**Keywords:** deep learning; face recognition; early renaissance mural paintings; proto-renaissance oil paintings; style modelling

## 1. Introduction

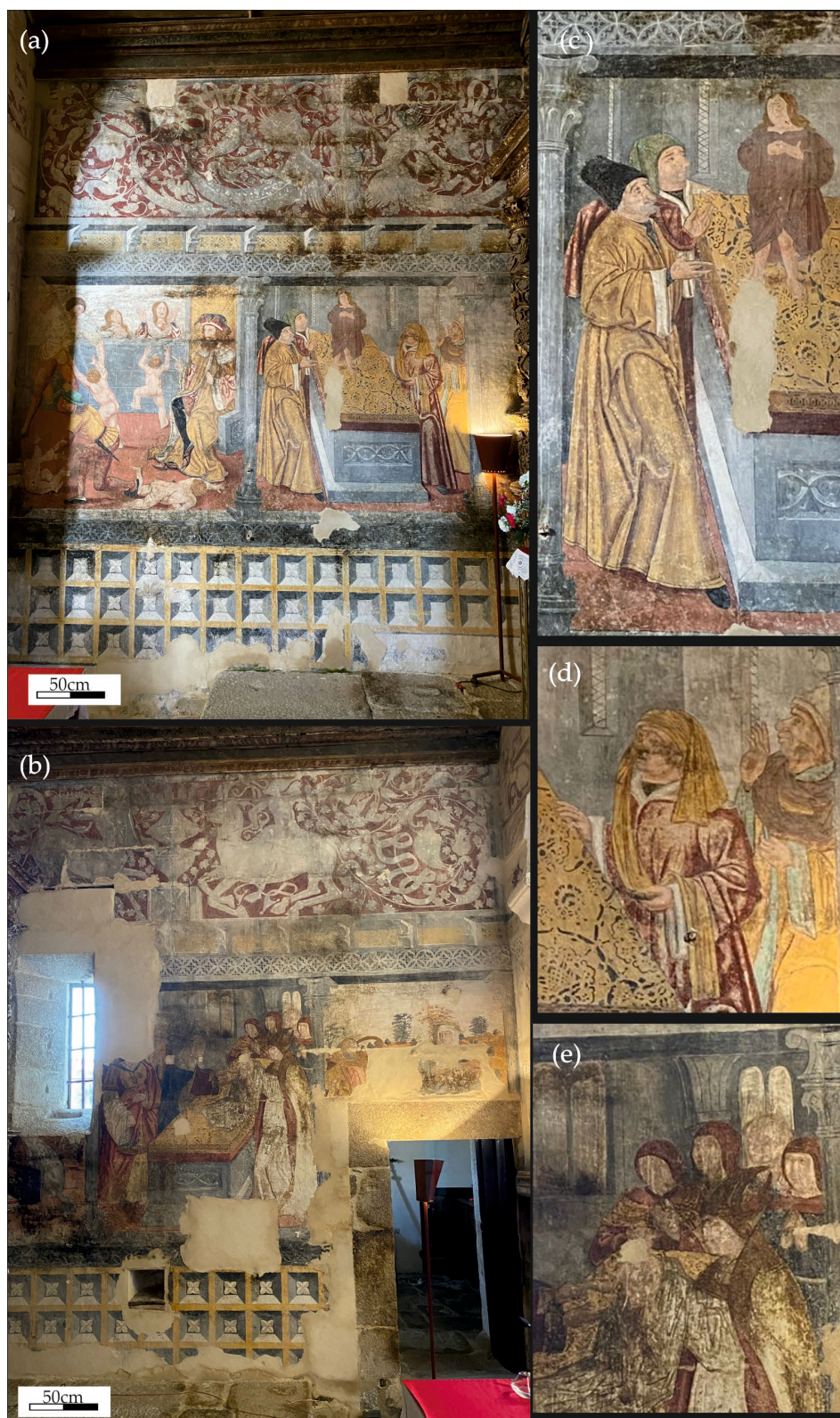
It is important carrying out useful database on the use of different analytical techniques to select the most adequate solutions for restoration interventions of frescoes. The methodology of investigation on works of art, involves the clarification of stylistic problems and knowledge of those instruments and techniques, in order to ensure the reconstruction of any damaged or missing items

[1]. Similarity between faces in portraiture is a source of information for art historical questions about the identity of the characters represented, as well as about the historic-artistic context, in order to understand why a certain person was painted in a certain way [2]. This study presents the results of the research on proto-renaissance and early renaissance portrait art works as the Vincentian panels and other oil paintings of Nuno Gonçalves and the frescoes of the apse of Santa Leocadia Church, using the potential of face recognition technologies. They have played a decisive role in the identification of the represented personages of the frescoes and in the reconstruction of the organization and layout of the images, conveying a certain intentionality to the narrative (which can be recognized depending on the cultural background of the viewer), a common characteristic of the Manueline iconographic program [3–6].

St Leocadia church is in a small site, south of its namesake village in Chaves. It has Romanesque origins, with a longitudinal plan, a nave and an apse. In the 12<sup>th</sup> Century, it was parish seat of the Jurisdiction of Montenegro. It is mentioned in the 13<sup>th</sup> and 14<sup>th</sup> centuries under Chaves and as a rectory and commendation of the House of Bragança [7,8]. Symbolic reasons related to political and religious beliefs of the first quarter of the 16<sup>th</sup> century led to the decoration of its interior (Figures 1,2), based on what was important for King D. Manuel I and to the parishioners of St Leocadia, including their maritime achievements during his reign. Thus, the dignification of the religious space was instituted, while recovering the prestige of the House of Bragança [9]. The building is classified as a Public Interest Site. Between 1996 and 2003, the DGEMN and EPRPS were involved in analysing, conservation and restoration of the interior walls and the frescoes, of the nave and apse [10]. The frescoes of the Church of St. Leocadia are attributed to the Marão mural painting Workshop III, from the first quarter of the 16th century - also active in the Church of St. Marinha in Vila Marim, Chapel of St. Brás in Vila Real, Chapel of Our Lady of Guadalupe in Mouçós, Church of St. Michael of Três Minas, Church of Our Lady of Azinheira in Outeiro Seco, and Church of St. John the Baptist of Cimo in Vila da Castanheira [11].



**Figure 1.** Frescoes of Santa Leocadia Church: (a) (b) Bipartite composition of an Inscription, in Epistle and Gospel sides of Triumphal Arch of the apse; frescoes in the nave: c) *Martyrdom of Saint Sabastian*; d) *Saint Gregory's Mass*; e) *Saint Christobal*; f) *Caravel (ex-voto)*; (g) *Archangel Saint Michael*; (h) *Lamentation over Dead Christ*; (i) *Saint Martha*.



**Figure 2.** Frescoes of the apse of St. Leocadia Church: (a) on Gospel wall, *Slaughter of Innocents* (175 x 175 cm) and *Jesus among Doctors* (175 x 175 cm); (b) on Epistle wall, *Jesus Presentation in the Temple* (175 x 175 cm) and *Flight into Egypt* (175 x 175 cm); it is proposed a comparative visual analysis between the characters in the St Leocadia frescoes and those in the Vincentian Panels: (c) Estevão de Aguiar and Jew Rabi, of the Vincentine *Panels of the Friars and of the Relic*; (d) Friar João Alvares of the *Panel of the Relic*; (e) Archbishop, D. Alvaro Vaz de Almada, D. Jaime and D. Pedro Contestable, of the Vincentine *Panel of the Archbishop*.

## 2. Literature Review

### 2.1. State-of-art of Face Recognition

State-of-the-art of face recognition systems leads to the conclusion that have recently become important for analyzing works of portraiture and provide quantitative information to art historians, making it easier to identify and compare the face similarities of the represented characters. Srinivasan and *alli*, in 2013, explore the potential of face recognition technologies for answering many of the ambiguities concerning identity of the subject in some portraits and in understanding artists' styles. It was used the Portrait Feature Space (PFS) to quantitative measures of similarities between Renaissance portrait pairs known to represent same/different sitters. Through statistical hypothesis tests were analyze uncertain portraits against known identities and explain the significance of the results from an art historian's perspective [12]. Gupta and *alli*, in 2018, developed significant improvement over baselines and state-of-art methods on several examples which are identified by art historians as being very controversial. It was used the deep Siamese Convolutional Neural Networks (CNN) to provide a measure of similarity between a pair of portraits. To overcome limited training data issue, it was employed CNN based style-transfer technique that creates new images by recasting an art style to other images, keeping original image content unchanged [13]. In 2019, two research projects have been carried out on this subject. Chokkadi and *alli*, considered sketch recognition one of the most important areas that have been adopted by the agencies of law administration in current trends of forensic science. This research, based on CNNs, basically focuses on deep learning techniques used in face recognition and matching and includes automatic composite sketch recognition technique etc. [14]. Elmahmudi and Ugail, explored the question that surrounds the idea of face recognition using partial facial data, by applying novel experiments to test the performance of machine learning using manipulations on face images such as rotation and zooming, as training and recognition cues. In particular, were studied the rate of recognition subject to the various parts of the face such as the eyes, mouth, nose and the cheek. And also, the effect of face recognition subject to facial rotation as well as to zooming out of the facial images. These experiments are based on using the state-of-the-art CNNs based architecture along with the pre-trained VGG-Face model through which were extract features for machine learning. There were ran experiments on two publicly available datasets namely, the controlled Brazilian FEI and the uncontrolled LFW dataset. The results show that individual parts of the face such as the eyes, nose and the cheeks have low recognition rates though the rate of recognition quickly goes up when individual parts of the face in combined form are presented as probes [15]. Hsiao et *alli*, in 2021, suggested the importance of part-based information in face recognition in addition to whole-face information. Here, was examined the face recognition through the Eye Movement analysis with Hidden Markov Models (EMHMM) approach. The results suggested that artists' advantage in face processing is specific to tasks similar to their drawing experience such as face matching and may be related to their better ability in extracting identity-invariant information between two faces rather than more eyes-focused eye movement patterns [16]. In 2022, there were developed some research on this same subject. Ugail et *alli*, used an in-house trained deep face recognition model to extract facial features from images of 16<sup>th</sup> and 17<sup>th</sup> century portraits to compare their degree of similarity. Taking the well VGG deep learning model as the basis, for enhanced facial similarity analysis, it was providing particular attention to the effects from prominent parts of the face, such as the eyes, nose and mouth features [17]. Marco and *alli*, used Face Recognition (FR) for accessing the trustworthiness of critical decisions. It was proposed a model pointing to increase the transparency of verification decisions: an approach to estimate the uncertainty of face comparison scores and introduce a confidence measure of the system's decision to provide insights into the verification decision. The experimental campaign was proven on three face recognition models on two datasets [18]. This year there are several very interesting research papers on the same subject. Hangaragi, Tripty and Neelima, dedicated their research work in applications such as recognizing the people in particular areas namely stores and banks, identifying people in a particular database (police database), or to control people's entry into restricted areas or grant access to ATMs or computers. The proposed model can detect and recognize

the face using Face mesh. The model can handle non-frontal images of males and females of all ages and races. The Labeled wild face (LWF) dataset images and images captured in real-time are used to train the deep neural network of the model. The face landmarks of the test image which match with the face landmarks of the training images the model gives the name of the person. Almost perfect accuracy is achieved for face recognition by the proposed model [19]. Grace Zhong, in her paper of 2023, makes a study of similarity between faces in portraiture which is informative for art historians: art historical questions involving the sitter's identity, as well for setting a painting in its historical context to understand why someone was depicted a certain way. The studied royal portraits were from Song dynasty, China. It was demonstrated the usefulness of computer vision-based quantitative metrics in complementing existing rich subjective evaluations. Working with the portrait set and L2 distances generated by OpenFace support, was possible to accept the hypothesis that 2 emperors of Song Dynasty were identified in surrounding posthumous portraiture, despite confounding factors in the clouds of memory. This research shows the promise of using computer vision-based techniques as complements to subjective analyses in exploring old painted portrait faces [20].

## 2.2. Initial Considerations on the Frescoes Iconographic Interpretation

The cultural effervescence of the Florentine "spring" at the beginning of the Quattrocento inspired the new style, which was introduced during the reign of D. Manuel I, in St. Leocadia Church. In keeping with the architectural trends of the time, the apse medieval stonework is covered by mural paintings in the form of triptychs. On the back wall, the Apostles St. Peter and St. Paul are depicted on each side of the Sta Leocadia statue. On the side walls there are several depictions of moments in the life of Our Lady and Jesus (until his adolescence), typical of religious worship and object of devotion. It's interesting to note that the frescoes of St Leocadia are contemporary with China's Ming Dynasty, when the Neo-Confucian scholars-officials had strict views on the use of royal portraits posthumously produced for the reverence of descendants. These portraits were used to provoke an intense psychological and emotional reaction to intimidate the observers. When the collective portrait represented a lineage of the royal family, then it was intended to affirm a royal heritage and status on the part of the descendants [21]. Deceased relatives of D. Manuel and others were identified among the many characters in the frescoes of Saint Leocadia, similar to those depicted in the Panels of St. Vincent. It might have been intended as a way to mark their presence in the religious space, when evoked during divine services [22], as well as using the chancel for audiences for infantes, dukes, prelates and clerics. They are depicted in "memory niches", or observation balconies [23–26], which rest on a low wall covered with a painting simulating quadrangular modules, in a Renaissance diamond point. The structure of columns and architraves of the "loggie" in greyish stone frame the frescoes of *St. Peter*, *St. Paul* (Figure 5), *The Visitation*, *Annunciation to the Shepherds*, *The Presentation of the Child Jesus in the Temple*, *Flight into Egypt*, *The Massacre of the Innocents*, *Jesus among the Doctors* (Figure 2), in a series of spatial cubes projected in depth, delineating the modular space. The architectural setting is topped by a red and gray frieze of profane fantasy figures, whose decorative elements are a synthesis of various influences of the time. On the one hand, they are related to the mosaics of Pella (Ancient Greece), from the 6<sup>th</sup> century a. C.. On the other hand, they could be related to Raphael's paintings in the Patio de San Damaso, in the Vatican Palace, inspired by the grotesque decoration of the Domus Aurea. We are also reminded of the sculptural frieze by João de Castilho, from the Convent of Christ, with exotic decoration linked to the sea; or the bicolored Indian bedspreads from the 16<sup>th</sup> century, or they are even reminiscent of the 16<sup>th</sup> century red velvets embroidered with silver silk from Trás-os-Montes region; or the Indo-Portuguese Cinquecento boxes in red lacquered wood with silver decoration, based on Greco-Roman mythology [27–29]. We see a centaur with a spear and a shield, mermaids, dolphins, crustaceans, molluscs, griffins, and beings with winged heads (Le Condottiere). One of these is mounted on a horse, wielding a spear in the direction of a centauries throwing a sabre. On both sides there is a Florentine amphora (the Holy Grail); branches with flowers and ivy leaves that are intertwined with ribbons; a heron, a falcon, an oriole, doves, greyhounds, a wild boar; all, in a charming decoration, painted in silver, on a velvet

scarlet background, suggesting the passion of Christ. These frescoes reflect the grandiose intentions of King Manuel I.

### 3. Materials and Methods

A working method, logical, deductive, or inductive reasoning was followed, always rigorous, avoiding the arbitrariness of character and symbol identifications.

#### 3.1. Iconographic Analysis

During the research around the conservation of the Romanesque churches in the region of Trás-os-Montes, new and unexpected issues of interpretation of the iconography emerged, which highlighted the importance of studying the frescoes found in the St. Leocadia church. One of the main objectives of the study was to establish a correlation between the St Vincent Panels (1464-1467) and the frescoes found in the apse (1511-1513) of this church. In addition to the biblical connotation, there were specific features of Manueline interventions. One aspect which deserved a more in-depth analysis was the important role played by symbols and icons in the storytelling and originality of the Manueline style. Great care was taken in the organization and layout of the images, conveying a certain intentionality to the narrative, which can be recognized depending on the cultural background of the viewer, a common characteristic of the Manueline iconological program. The present study used a methodology based on reviewing the iconographic analysis and reading the iconology of the frescoes based on new research and artistic discoveries, previously unknown until recently. A bibliographic study was carried out beforehand, collecting numerous documents. In a second phase, a database was created with the frescoes found in the churches in the Districts of Vila Real and Bragança, based on the work of Caetano (2001) [20] and Fernandes (2012) [30]. The study included a thematic, stylistic and chronological analysis of the frescoes. More knowledge was obtained concerning the patron of the paintings in the apse. The trends found in the first Renaissance period in Europe were also analysed in order to better understand their meaning and to better place them in time and space. Through direct observation and "in loco" analysis it was possible to perform a comparative visual analysis of the personages depicted in the frescoes of the apse of the church and those found in the St. Vincent panels, enabling us to identify them. The link between the Avis dynasty and the new demands for religious worship was established, as well as imported technical and aesthetic novelties found in the Manueline interventions. Finally, a descriptive study of the church and its respective frescoes was carried out, including the location of the paintings, their distribution, size and analysis of their stylistic, iconographic and iconological influences.

#### 3.2. Deep Face Recognition Model

The deep face recognition model used in this work has been inspired by the model developed by researchers at the Visual Geometry Group (VGG) - which is a convolutional neural network (CNN) based deep learning. In this paper, it was used an in-house trained deep face recognition model, just like the one proposed by Ugail, Edwards, Benoy and Brooke [17]. This method extracted facial features from images of 15<sup>th</sup> century portraits of Nuno Gonçalves and the characters of the 16<sup>th</sup> century frescoes of the Church of St. Leocadia, to compare their degree of similarity. It was evaluated the similarity between the faces in the oil paintings of seven characters of Vicentine Panels and other paintings of the old master and those ones of the frescoes of the apse of the church. In Figure 3, are the example seven pairs of images, used for training and testing of facial feature specific models. The used method for Face Recognition Model is specified in the Experimental Campaign.



**Figure 3.** – Selected images for training and testing of facial feature specific models. FR-70\_ASP\_E vs D: Franciscan friar vs *St. Peter*; SP\_VEL\_E vs D: *St. Paul* vs *St. Paul*; R\_SV2\_E vs D: Queen Elizabeth vs *St. Elizabeth of Visitation*; DP\_PF\_E vs D: Infante D. Pedro vs *Annunciation to the Shepherds*; FR\_79\_FRC\_E vs D: Franciscan friar vs *St. Joseph of Flight into Egypt*; FR\_70\_SL\_E vs D: Saint Joan Princess vs *Our Lady of Flight into Egypt*; and DD\_CH\_E vs D: King D. Duarte vs the man with chaperon of the *Slaughter of the Innocents*.

## 4. Results

The acquisition of new knowledge about the famous Panels of São Vicente made it possible to create a database on the author of the polyptych, the date of execution, where the work was destined and, also, unveil some mysteries regarding the identification of the characters represented there. From the study of the paintings of Santa Leocádia, an intrinsic meaning or content was learned, underlying the beginning of the 16th century in Portugal, its religious and philosophical convictions. Images, stories and allegories are manifestations of these underlying principles, which we interpret as symbolic. The pre-iconographic description of biblical scenes allowed the identification of similarities between the characters and stories in the frescoes and those on the panels, giving these scenes a new allegorical meaning. The iconographic analysis allowed an intentional reading according to the historical sources from the time of the Portuguese Kings, D. Afonso V, D. João II and D. Manuel I. This research could thus, by engaging in the game of identifications, offer an attempt at interpretation. It is recognized that the task is not easy and the results of this study cannot arrive at a solution that could be imposed. It is only offering conjunctures here. In this work, it was used a deep face recognition model to extract facial features from the personages of old portrait gallery and of the frescoes, to compare their degree of similarity.

### 4.1. Background

#### 4.1.1. Historical-Political-Artistic Framework

D. João I starts a new world which had risen with the illustrious generation (15<sup>th</sup> century). This is followed by the regency period of Infante D. Pedro, characterized by a fracture in Portuguese society, culminating in the Battle of Alfarrobeira (1449). During this period, a “new” nobility emerges, with the intention of affirming itself, and which defeats the centralizing politics of the real power in

this battle [31]. During the reign of D. Afonso V, the art of Nuno Gonçalves (the royal painter), represented the maximum exponent of Portuguese art, whose roots are in the North of the country and Galicia. There was an autonomous Portuguese school, although not alien to foreign influences, characterized by a brilliant power of representation of the human figure, of psychological portraiture and in the scope of the technical domain. This Portuguese school of painting precedes the Flemish influence in Portugal (before the arrival of Jan van Eyck, to Portugal, in 1428). The São Vicente Panels, painted by Nuno Gonçalves, represent an artistic level comparable to that of Spain, France, Italy and Flanders [32].

Maritime exploits regained momentum with D. João II, who initiated the policy of expansion in the Atlantic. The relationship between Portugal and other kingdoms in the Peninsula is strengthened. It is the *Portuguese Golden Age*. A change in governance takes place with D. Manuel, with commerce and navigation being restructured (where the House of India stands out), and with power being influenced by a new vision of expansion and missionary work. Some changes are also observed in the Church, with administrative and doctrine restructurings. With the weakening of the Roman Catholic Church, combined with the pontifical favouritism towards the Portuguese Crown, D. Manuel increasingly had a more significant leadership role in the Church. In 1501, this king was granted the right to nominate bishops by “presentation” and to also oversee the process of their resignation. During this time, Afonso de Albuquerque conquers Malaca (1511), Diogo de Azambuja, Safim, D. Jaime, Duque de Bragança, the fortresses of Azamor (1513) and Jorge Álvares made the first contact on southern China, on Tamão island (now Hong Kong) near Guangzhou (1513). A modern State was being built, combined with peace in Europe and maritime expansion, while at the same time the king freed himself from his obligations to the nobles. Maritime commerce allowed Portugal to become richer and to prosper. In the field of the arts, painting left the sacred to be profaned, while classical forms were reborn and reinterpreted [33]. During the reign of D. Manuel, the Flemish influence on Portuguese painting emerges from commercial and artistic relationships (painting workshops) with Brussels, Bruges and Antwerp. The Flemish Book of Hours is particularly relevant to the iconographic programme of the frescoes found in the St. Leocadia church. There seems to be similarities between the Altarpiece of the Guild of Antwerp Carpenters (1511), by Matsys, as well as the *Panels of Saint Vicent*, painted by Nuno Gonçalves and the frescoes in the apse of the same church [34]. The first work depicts St. John the Baptist and St. John Evangelist. The fact is explained by the association between St. John the Baptist and St. John Evangelist, frequently found in the iconography of the Middle Ages and of the Renaissance. This was interpreted as St John the Baptist being the link between the Old and New Testament, while St John Evangelist, the royal eagle, represented the New Testament. In the *Panels of Saint Vincent*, the holy deacon, appear doubly repeated in the center of the frieze in an act of veneration. In the frescoes of the apse of St. Leocadia, the symbolic narrative is depicted according to the dualist principle in theology. During the Iron Age this dualism represented the warrior vs the druid, strength vs traditional wisdom [35].

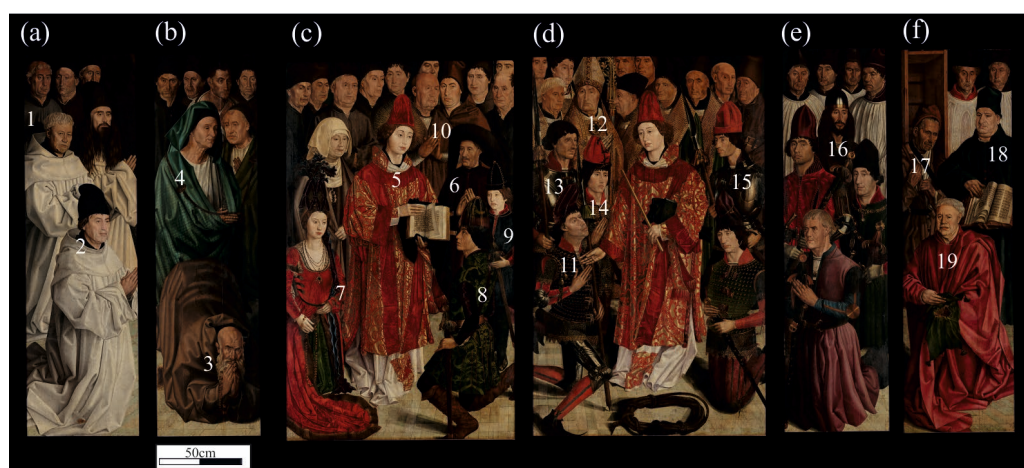
The frescoes found in the apse of St Leocadia church were made during the diocese of D. Fernando de Meneses Coutinho, during the period in which the church was attached to him (1511-1513). It was later reintegrated under the patronage of D. Jaime (1513), Duke of Bragança, by D. Manuel I. They depict several historical scenes from the life of Our Lady and Jesus Christ. The influence of the painting by Nuno Gonçalves should be highlighted, via D. Fernando Meneses Coutinho, who meddled in the circles of power of the Avis Dynasty. He was designated as head chaplain of Paço da Ribeira in 1514, during the reign of D. Manuel, a position he held while bishop of Lamego [36].

#### 4.1.2. Oil paintings of Nuno Gonçalves

In the main chapel of the Cathedral of Lisbon, there has been, since the end of the 15th century, a large painting altarpiece dedicated to St. Vincent. The altarpiece was still, in 1545 and 1567, in its same place [37]. Following Vítor Serrão, the “Panels of St. Vicent” is a «great gratulatory *ex-voto* to Saint Vincent Martir, deacon-patron of the City (of Lisbon), the Kingdom and the Conquests of North Africa, through a set of altarpiece panels where the court, nobles and canons of the Chapter of the

Cathedral, friars, of two or three religious orders, people in trades and public administration, fishermen, merchants, and manual labour» are represented. These panels (*Panel of the Friars*, *Panel of the Fishermen*, *Panel of the Prince*, *Panel of the Archbishop*, *Panel of the Knights*, and *Panel of the Relic*) they were part of the altarpiece of the main chapel of the Lisbon Cathedral, where was the original altar of Saint Vincent with the venerated tomb, where rest the relics of the Saint. The panels were made around 1460-1470, according to the historical documentation references and the characteristics of the style, technique and compositional elements, which laboratory examinations confirmed. The painter who led the project was Nuno Gonçalves, an artist highly praised by Francisco de Holanda, and who worked as royal painter for D. Afonso V since 1450 [38]. The six *Panels of Saint Vicent*, considered one of the most important and famous paintings in Europe of the Quattrocento, represents the glorification of the Infante Santo by St. Vincent (the holy deacon, appear doubly repeated in the center of the frieze in an act of veneration), before the high nobility of the House of Avis and the entire Portuguese society during the reign of D. Afonso V [39] (Figure 4). More than a simple meeting of the court of D. Afonso V, the panels give us the idea of a unique and determined will around a maritime enterprise, guided by the ideal of the Crusade. In the opinion of some authors, the main theme of the panels is the rehabilitation of the memory of the captivity of D. Fernando, after failing to conquer Tangier in 1437 [40], as well as of Infante D. Pedro, who felt at the Battle of Alfarrobeira. Godinho's historical approach, that despite not having been followed, would be the one which would best coincide with the date given by the dendrochronology of the panels, in 2001 [41]. For him, the Saint Vicent reference is made to an event of January 1446, perhaps even of the 22<sup>nd</sup>, the date of the feast at Saint Vicent, when D. Pedro, Duke of Coimbra, abandoned the regency, and his nephew and future son-in-law D. Afonso V came of age [42]. The same theme (the battle of Afarrobeira) can be found in the frescoes of the apse of the St Leocadia church and in the fresco at the Paços de Audiência de Monsaraz, from 1496-1513 [43], which symbolically illustrated both divine and human justice.

As a result of the call for a combination of efforts, on the part of researchers, with a view to clarifying the identification of the characters in the Panels, this study outlines a proposal for interpreting the meaning of the work in the light of the frescoes of Sta. Leocádia, in context of the Dynastic Crisis and Renaissance in Portugal, in the 15<sup>th</sup> and 16<sup>th</sup> centuries. Based on the work of P. Freitas and M.J. Gonçalves [44], the identification of some characters from the Vincentian panels is presented, whose features resemble the characters from the frescoes in the church of Santa Leocádia. There were identified the following characters (Figure 4).



**Figure 4.** Panels of Saint Vicent, 1460-1470: (a) Panel of the Friars (207,2 x 64,2 cm); (b) Panel of the Fisherman (207 x 60 cm); (c) Panel of the Prince or Panel of the Infant (206,4 x 128 cm); (d) Panel of the Archbishop (206,4 x 128 cm); (e) Panel of the Knights (206,6 x 60,4 cm); (f) Panel of the Relic (206,5 x 63,1 cm). MNAA, <http://www.museudearteantiga.pt>; Character identification [44]: 1- John Vicent; 2 – Estêvão de Aguiar; 3 - Simon Peter; 4 - St John the Evangelist; 5 - St Vincent; 6 – King D. Duarte; 7 - Queen Isabel; 8 – King D. Afonso V; 9 - Prince John; 10 – 1st Duke of Bragança; 11 - Infante D. Pedro;

12 - Archbishop of Lisbon; 13 - Álvaro Vaz de Almada, 14 - D. Jaime; 15 - Constable Pedro; 16 - Infante D. Fernando; 17 - Beggar; 18 - Jewish rabbi; 19 - Friar João Alvares.

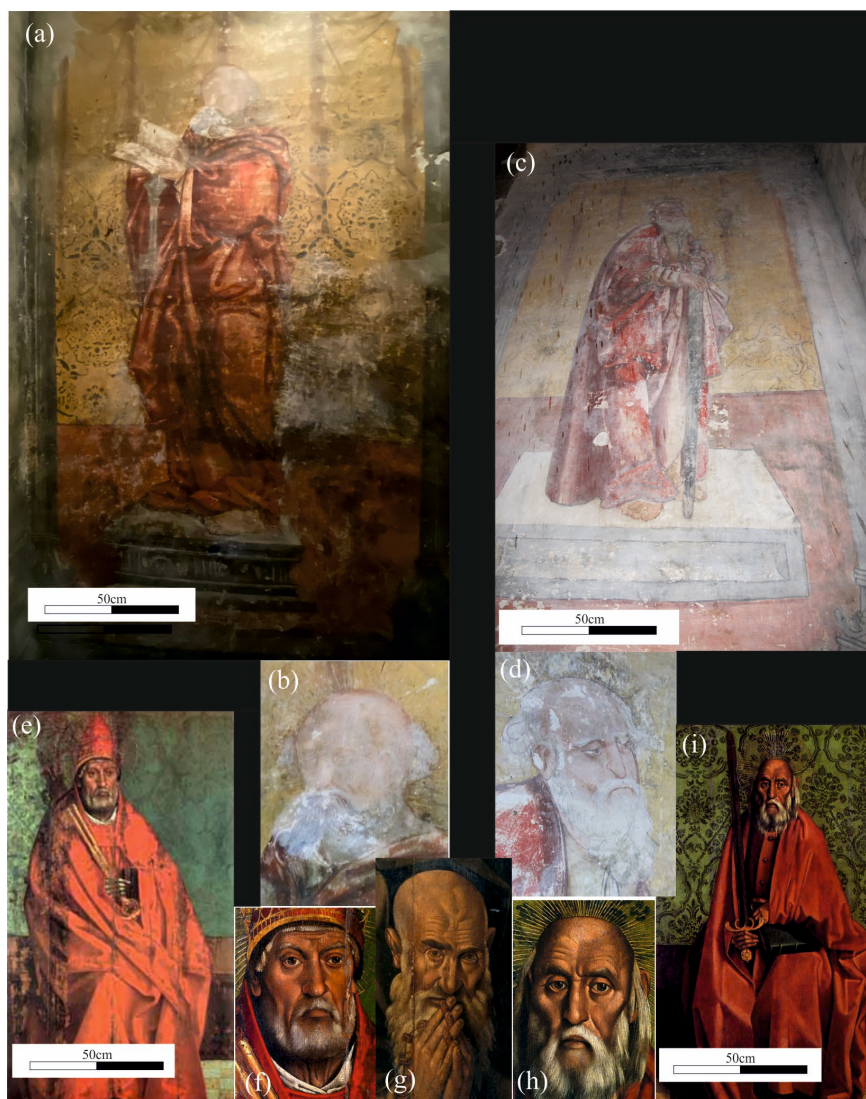
In the *Panel of Friars* - 1- Master John Vicent, founder of the Order of St John the Evangelist [45]; 2 - D. Estêvão de Aguiar of the Cistercian Order (according to some historians), the Abbot of the Monastery of Alcobaça (1431-1446) [46,47], who took a stand in favour of the Duke of Coimbra. In the *Panel of the Fisherman* - 3 - Simon Peter, as Armando de Sousa Gomes identified the Franciscan friar [45]; 4 - St John the Evangelist, as the character who stands immediately behind the kneeling Franciscan (St. Peter) was identified by A. Gomes [45]. In the *Panel of the Prince* - 5 - St Vincent; 6 - King D. Duarte, father of D. Afonso V, was identified by D. Markl, following Paviot [48]. His brother, Prince Ferdinand, was held captive in Tangier after an unsuccessful military expedition and later died in Fez in 1443. The Infante Santo had been abandoned by his relatives and the victim of a disastrous national policy, King Duarte did not want to accept the ransom conditions, which required the return of Ceuta in exchange for his brother. Prince Ferdinand had been sacrificed like an innocent. Duarte and Henry the Navigator were accused of this crime against their brother [49]; 7 - Queen Isabel, Isabel/Elisabeth of Portugal [45], daughter of the Infante Regent D. Pedro de Portugal (1st Duke of Coimbra), wife and cousin of D. Afonso V, and mother of D. João II; After giving birth in May to prince D. João II, the queen died in December at the age of twenty-three: there was talk of poisoning. She was, also, mother of Princess Saint Joan; 8 - King D. Afonso V [45], the king; 9 - Prince John, future King John II; 10 - D. Afonso, 1st Duke of Bragança [50]. In the *Panel of the Archbishop*, 11 - Infante D. Pedro, Duke of Coimbra (which was son of D. João I, uncle and father-in-law of D. Afonso V, Regent of the Kingdom until the age of majority of his nephew); 12 - D. Afonso de Nogueira, Archbishop of Lisbon [51]; 13 - D. Álvaro Vaz de Almada, he took part in the taking of Ceuta, was in Tangier, was captain-general of the royal fleet, mayor-general of the castle of Lisbon, Count of Avranches in Normadia, having died in battle in Alfarrobeira; 14 - Future Cardinal D. Jaime, the youngest son of D. Pedro; 15 - Constable Pedro, future King of Aragon [52], the eldest son of D. Pedro. In the *Panel of Knights* - 16 - Infante D. Fernando (Holy Infant). In the *Panel of the Relic*, 17 - Figure of a beggar, symbolising Infante Santo's spirit of almsgiving and charity; 18 - Jewish rabbi, and is dressed in black, with a radiant six-pointed red star on his chest, holds a book open, showing that the pages turn from left to right, which the painter knew but not knowing Hebrew letters [53]; 19 - Friar João Alvares, in the red attire of a notary from Paço da Ribeira, who wrote the *Chronica dos Feytos, Vida e Morte do Infante Santo D. Fernando que Morreu em Fez* [54]. He was prior of the palace and chronicler of the Holy Infant. According to the opinion of some authors, Friar João Alvares was at the service of the Infante Santo, D. Fernando, as clerk of the Chamber and accompanied him on the tragic expedition to Tangier in 1437 and then during his captivity in Fez. João Alvares was rescued by Infante D. Pedro, five years after his death. He later returned to North Africa to bring the relics of the Infante Santo, which currently lie in the Monastery of Batalha [55-57]. In Vincentian Panels, he is showing the relic of Saint Anthony that the Duke of Coimbra brought from Padua [58].

The panels representing *St. Peter* and *St. Paul* (1465-1490) undoubtedly belong to the same workshop of Nuno Gonçalves and could have been part of the predella of a large altarpiece (Figure 4). The magnificent painting of *Santa Joana Princesa* (Figure 8 (c)), kept in the Aveiro Museum, could perhaps date back to 1471, or shortly before. It was painted by an anonymous author, which followed the principles of the Portuguese school of the royal painter Nuno Gonçalves. His own physiognomic features are similar to those of his family, particularly those of his brother, the future king D. João II, as they appear to us in the *Panel of the Infant* [44]. Infanta Santa Joana was daughter of King D. Afonso V and Queen D. Isabel of Portugal and sister of D. João II. The Infanta firmly announced her choice of religious life, expressing it after the arrival of her father from the capture of Africa, a period during which she exercised, in fact, the regency of the kingdom. Santa Joan Princess care, in the Monastery of Jesus of Aveiro, the illegitimate son of D. João II, D. Jorge de Lencastre. The devout aunt took great care in eloquent and pious education of her nephew [59].

#### 4.1.3. The Frescoes from the apse

In the Epistle side and Gospel side of Triumphal Arch of the apse of St. Leocadia Church, there is a bipartite composition of an Inscription, which indicates that the commissioner of the frescoes was D. Fernando de Menezes Coutinho, in 1511-1513 (Figure 1 (a) (b)). It has 2 shields, one on each side of the opening to the nave - enlarged - and the inscription must be read continuously, without interruption in its 5 lines of text. "Esta obra ma[ndou] // fazer o egregio senhor // dom fernão [couti] // // nho do conce[lho] dellrey e abade // de Santa mar... // maria de moreiras e samta loca[ia] // locaia e adaia[m] // ...m de coimbra e protonotairo [da] See apostollica. -" 2 lines below, in the right corner, "[tr]as dom".

The frescoes of the back wall of the apse depict (Figure 5), on a damask background, *St. Peter* on the left, holding the Gospels and the key to the Church, with *St Paul* on the right, wielding a sword. If we compare the Apostles of St. Leocadia with those painted between 1465 and 1490, by Nuno Gonçalves [60], the resemblance is remarkable. On the other hand, *St. Peter* has, also, some features of the old Franciscan, in the *Panel of Fishers*. It is interesting to note that in 1927, Armando de Sousa Gomes identified this Franciscan friar with Simon Peter [45].



**Figure 5.** Frescoes of the back wall of the apse of St. Leocadia Church: (a), (b) *St. Peter* (175 x 148 cm) and (c), (d) *St. Paul* (175 x 148 cm); Oil painting of Nuno Gonçalves: (e), (f) *St. Peter*, 1450-1490 (135,8 x 80,3 cm); (g) Old Franciscan of the *Panel of Fisherman* 1470 (207 x 60 cm); (h), (i) *St. Paul*, 1450-1490 (137 x 84 cm).

The wall on the Gospel side, next to the old NE angle, with the back wall, represents the fundamental artistic trends of the national Renaissance (Grão Vasco and Nuno Gonçalves), as well as

the Flemish (Rogier Van der Weiden) and German ones (Jakob and Hans Srub). These were characterized by their classicism and noble realism, bringing life to the dialogue between St. Elizabeth and the Virgin of the *Visitation* (Figure 6), although Our Lady has been partially covered by the baroque altarpiece. There are similarities between the face of St. Elisabeth, mother of St John the Baptist (Figure 6 (a), (b)) and Isabel/Elisabeth of Portugal [61], mother of D. João II, who is portrayed in one of the panels of S. Vicente, the "*Panel of the Infante*", kneeling at the feet of the Saint [62]. Though her figure seems fragile, her presence is strong. D. Pedro, the Constable, brother of Queen D. Isabel, describes his sister as an example of perfection and virtuosity [63].



**Figure 6.** *Visitation* Fresco (175 x 175 cm) on Gospel wall of St Leocadia Church: (a)(b) St. Elizabete; (c) Oil painting of Nuno Gonçalves: Isabel de Portugal of the *Panel of the Infante*.

The wall on the Epistle side, next to the angle with the back wall, depicts the group of the *Annunciation to the Shepherds* (Figure 7 (a)), where two main artistic tendencies can be observed: from the Flemish and Spanish Late Gothic (Illumination of the *Book of Hours of D. Duarte*, 1401-1433, by an artist of Bruges [64]; Oil, 1470-1500, Soumaya Museum, Mexico City), with a strict depiction of one of the shepherds with bagpipes, a common musical instrument in the Northeast of Portugal; and also from the beginning of the national Renaissance, given the similarity between the pose and the countenance of the shepherd of the *Annunciation* and the Infante D. Pedro. He was a well-built and thin figure, with a long and angular face, light eyes, curly and reddish hair), kneeling at the feet of the Saint Vincent with the military command baton (D. Pedro had been an office of marshal in Portugal) and over the hart (rope) of justice, in a prominent place, as depicted in the *Panel of the Archbishop* by Nuno Gonçalves (Figures 7 (a)(b)(c)). The infant D. Pedro had a particular devotion to the Archangel Saint Michael (hence its motto of the scales) and, on the other hand, he donated the house of Saint Eloi in Lisbon to the clerics of the order and rule of St. John the Evangelist [65]. It is interesting to note that, in the South wall of the nave of the church, there is a fresco of the archangel St. Michael, with scales; on the other hand, there must be an association of the Angel of the *Annunciation* in the apse with St. John the Evangelist. To A. S. Gomes, in the upper left corner of 15<sup>th</sup> century *Panel of the Friars*, is Master John Vicent, founder of the Order of St. John the Evangelist. In the *Panel of the Fishers*, and according to the same author, the character who stands immediately behind the kneeling Franciscan (St. Peter) is identified as St. John the Evangelist [45]. In the fresco, the symbolic relationship is established between Infante D. Pedro and Master John Vicent. It is not possible to identify the personality of the other pastor from the fresco in the church, which has been partially destroyed by the high altar. The similarity between the face of the angel of the *Annunciation to the Shepherds* and the right side of S. Vicente's face of the *Panel of the Infante* is also proposed mentioning (Figure 7 (a)(c)). The hair has the same color and cut; the eyes are brown; the upper eyelids are larger and rounder; the left eyebrow is wider, the right is lighter; the mouth is lippy, the chin dimple is placed just under the lower lip (slightly indented). However, while Saint Vicent in his left hand holds the text of the Gospel of St. John/Mass of the Holy Spirit [66], the angel of the fresco holds a phylactery, which reads "ALEG (...)". This is an excerpt taken from the Book of Isaiah (the prophet Isaiah announced the coming of the Savior and of a king called Manuel), Lk 2:14: "The army

of Angels rejoices because eternal salvation has appeared to human race.” In the right Vicentine panel, a coiled rope is thrown to the ground. This is a rare attribute of the saint, linked to a miracle that occurred to the Portuguese sailors who went to look for his body in Valencia [67]. In the fresco of St Leocadia, the rope gave way to a shadow of concentric dark brushstrokes, and the shepherd with bagpipe, is kneeling by the riverbank.



**Figure 7.** Fresco of the Epistle wall of the apse of St. Leocadia Church: (a) *Annunciation to the Shepherds* (175 x 175 cm); Oil Painting by Nuno Gonçalves: (b) *Panel of the Archbishop*; (c) *The Angel of Annunciation*, in detail.

In the continuity of this mural painting on the wall of the apse on the Epistle side, it displays the *Jesus' Presentation in the Temple* (Figure 2(b)) (the Presentation of Jesus and the Purification of the Virgin was held forty days after Jesus' birth in Bethlehem) which shows Germanic Renaissance influences, as can be seen from the engraving by Wolgemut from 1490 and the oil painting by Holbein from 1500. Here, we can see the Archbishop of Lisbon in 1459, identified as D. Afonso de Nogueira

from the Panels of St. Vincent. By observing the fresco of the Church, despite its poor state of repair, there are three supporters of the Infant D. Pedro that can be found behind the Archbishop (as in the Vicentine Pannels): D. Jaime, his youngest son; D. Álvaro Vaz de Almada, his “brother in arms”; and D. Pedro, the Constable, his eldest son (Figure 2 (e)).

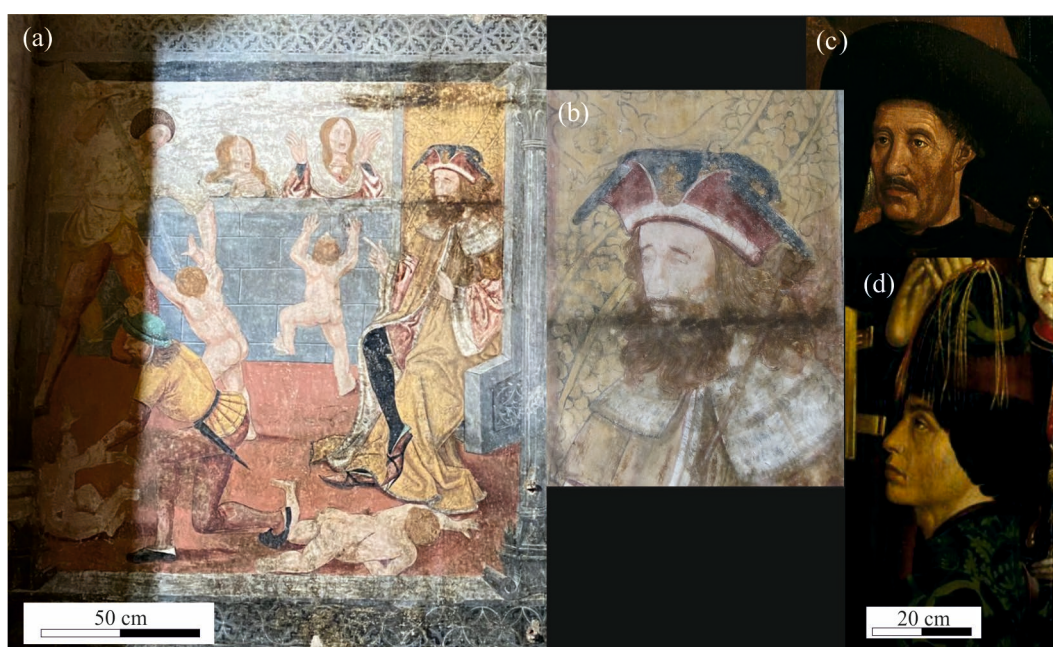
On the same wall on the Epistle side of the apse, over the gap that opens onto the sacristy, there is a commemoration of *Flight into Egypt*, occurred some two years after the birth of Jesus (Figure 8 (b)). In this painting, which is now barely noticeable due to its poor condition, St. Joseph appears to be wearing the clothing of a pilgrim. Our Lady carries the baby Jesus on her lap, transported by a donkey and pulled by St. Joseph with a rope. This painting was influenced by the French Gothic style and an engraving by Wolgeman, from 1491. The face of St. Joseph of St Leocadia is identical to that of the Franciscan kneeling with his elbows on the ground praying a rosary, which is depicted in the “*Panel of Fishermen*”, from the panels of St. Vincent. He has the same expression of suffering. Our Lady’s face is similar to that one of *Infanta Saint Joan*, painted by Nuno Gonçalves, in 1472-1475 (Figure 8 (c)) [68,69]. In the *Memorial of the Monastery*, soror Margarida Pinheira or soror Catarina Pinheira, wrote in which is a true biography: “a very sharp face and body, a very graceful forehead, very beautiful green eyes, a medium and good-looking nose, a thick and rebellious mouth, a round face, a very beautiful throat and hands, more than one could find and see in no other woman, tall and large with a straight body, very fit and elegant, the figure is a representation of a great lady and state.” [70].



**Figure 8.** Fresco of the Epistle wall of the apse of St. Leocadia Church: (a) *Flight into Egypt*; (b) St. Joseph; (d) Our Lady. Oil Painting by Nuno Gonçalves: (c) Franciscan of the *Panel of Fisherman*; (e) *Santa Joana Princesa* (portrait of Saint Joan Princess, 1472-1475, oil painting on oak wood, 60 x 40 cm) <http://www.matriznet.dgpc.pt/>.

On the wall on the Gospel side, next to the triumphal arch, the fresco depicts *The Slaughter of the Innocents* (Figure 9(a)), based on another engraving by Michael Wolgemut, from 1491. It reflects the influence of the Late Gothic (late 15<sup>th</sup> - early 16<sup>th</sup> centuries) mural painting with the same theme, in the Gospel wall of the apse of the Cathedral of Our Lady of the Assumption in Mondoñedo, Lugo Province, Galicia. The three-quarter face of the character who embodies King Herod matches the three-quarter face and profile of two figures of the “*Panel of Infant*” by Nuno Gonçalves, which have been identified as the Kings D. Duarte and D. Afonso V (Figures 9(b)(c)). The King Herod is remembered for his cruelty, including the murder of three of his own sons. D. Duarte, King of Portugal, was also unwilling to accept the ransom conditions, which required the return of Ceuta in exchange for the surrender of his brother, Infant D. Ferdinand. The death of Prince Ferdinand was a collective sacrifice, and he was sacrificed like an innocent man. In the Vicentine panel, D. Duarte is the iconic man wearing a chaperon. Just as King Herod ordered the execution of the new-borns in Bethlehem for fear of losing the throne to the “King of the Jews”, D. Afonso V, King of Portugal, and son of D. Duarte, is associated with the idea of being a “Bad Judge” [71,72], particularly for letting himself be negatively influenced by his uncle, the Count of Barcelos, who later became the first Duke of Bragança, D. Afonso, half-brother of Infante D. Pedro. Therefore, the king was convinced that his

uncle and father-in-law, Pedro, intended to usurp the throne. As a result, the armies of D. Afonso V confronted those of D. Pedro in the Battle of Alfarrobeira in 1449, where the latter died in combat. The other personage who is found on the top left corner of the fresco identifies himself with, according to some authors, D. Afonso, 1<sup>st</sup> Duke of Bragança of the “*Panel of the Infant*”. While the Duke of Bragança in the St. Leocadia fresco is depicted with the age he would have been at the time of the Battle of Alfarrobeira, 72 years old, in the Vicentine panel he must have been the age he was at the end of his life. With this fresco, D. Manuel’s intention was to demonstrate that he considered D. Afonso V not to have the profile to be a fair king, unlike him. Unlike the Italian *aesthetic* Renaissance, the Manueline Renaissance was essentially *ethical*. Diogo Lopes Rebelo, master of D. Manuel, prior of Clermont and professor of Theology in Navarre, defended justice, as the virtue very necessary to the king: «Justice and mercy appropriate to the king in relation to his subjects, distinguishing two axial effects in justice: the first is not to harm anyone and the second is to prevent usurping what belongs to others. The opposite constitutes injustice. In this way, it is up to the king to minister justice, always asking God for it and exercising it with diligence and mercy: the king uses justice, mixing it with mercy, clemency, and kindness, and tends more towards salvation than condemnation. » [73,74]. After the death of D. João II and the restoration of the House and Dukedom of Bragança, in 1496, by letter of donation from King D. Manuel I, D. Jaime inherited the Dukedom.



**Figure 9.** Fresco of the Gospel wall of the apse of St. Leocadia Church: (a) (b) Slaughter of the Innocents; Oil Painting by Nuno Gonçalves, *Panel of the Infant*: (c) King D. Duarte; (d) King D. Afonso V. .

Still on the same wall of the apse, close to the high altar, the mural depicts *Jesus among the Doctors* (Figure 2 (a)). Not only does the Renaissance influence of Durer (1506) prevail here, but also the inspiration of the painting of Matsys (1509-1511) and of the French School of the 16th century, as well as the iconography and symbolism of the polyptych of St. Vincent Outside the Walls. Jesus, a teenager, attracts all the doctors of the Temple with his intelligent questions. In the images that illustrate this scene, several similar details can be observed, such as the central and highest position of Jesus, with long blond hair, gesturing with his hands while talking to the doctors in awe of that child. A correlation of similarity is made to the teenager, the future king D. João II from the *Panel of the Infante*. Although we can't recognise the facial features of Jesus of Santa Leocadia, we can identify some similarities between the two teenagers, such as their height and the gesture of their left hand. Among the characters who surround Jesus in the fresco of St. Leocadia, others are also recognizable, such as the figure of the Cistercian of the *Panel of Friars*, D. Estevão de Aguiar (in a black cap) (Figure 2(c)). Behind him, is a personage in a green cap, which seems to correspond to the Jew of vicentine

*Panel of the Relic*, who also has a green hat. We also see the figure of the *Panel of the Relic*, identified as João Alvares (Figure 2 (d)), in the red attire, is holding a closed book in his left hand, is located on the right side, next to Jesus, as he was one of the supporters of the Regency of D. Pedro. Behind this, there is “the pilgrim”, who is in front of an open coffin in the *Panel of the Relic*. The “pilgrim” symbolizes the various routes that the remains of Infante D. Pedro had to follow until they were laid to rest in his tomb in the Monastery of Aljubarrota.

#### 4.2. Experimental Campaign

It is proposed a method for computerized face recognition using the facial data. There were taken measurements of specific facial features.

The methodology of the experimental campaign consisted of:

- a) Digitising the images;
- b) Resizing the images so that the faces had the same size and proportion for each pair;
- c) Associate a rectangle with the approximate dimensions of the two faces (pairs of images);
- d) Draw a vector to calculate the distances and anatomical features described above;
- e) Calculate the ratios between variables;
- f) Create an XY representation of the points measured for each pair of images, using X for the image of the St Vincent Panels and Y for the image of the church fresco;
- g) Fit a linear regression equation without a constant to each pair of values (pairs of images);
- h) calculate the coefficient of determination associated with each equation.

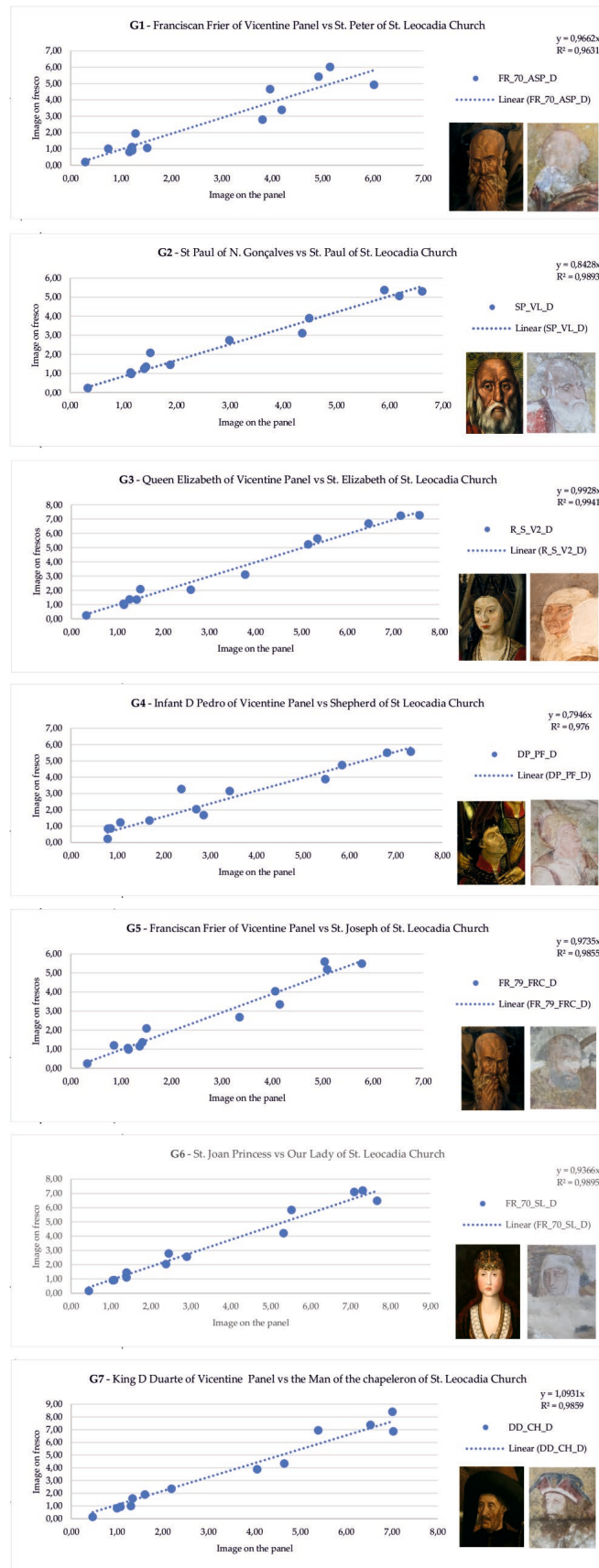
The Table 1 shows the linear relationship between the original measurements and the ratios for each pair of images: the ratio distance between the corners of the eyes and distance between the middle of the eyebrow and the tip of the nose; the ratio distance between the corners of the eyes and distance between the middle of the eyebrow and the top of the mouth; ratio distance between the corner of the eye and the corner of the mouth and mouth length; ratio distance between the middle of the eyebrow and the base of the eye Inter-pupillary distance.

**Table 1.** Facial features original measurements. Calculation of the ratios.

Image Code	Original Measurements		Ratios		All Values	
	E	D	E	D	E	D
FR_70_ASP	1	0,912	1	0,702	1	0,946
SP_VL	1	0,983	1	0,914	1	0,984
R_S_V2	1	0,989	1	0,914	1	0,992
DP_PF	1	0,981	1	0,978	1	0,963
FR_79_FRC	1	0,966	1	0,914	1	0,977
FR_70_SL	1	0,975	1	0,993	1	0,985
DD_CH	1	0,963	1	0,961	1	0,983

**Legend:** FR-70\_ASP\_E vs D: Franciscan friar vs *St. Peter*; SP\_VEL\_E vs D: St. Paul vs *St. Paul*; R\_SV2\_E vs D: Queen Elizabeth vs St. Elizabeth of *Visitation*; DP\_PF\_E vs D: Infante D. Pedro vs *Annunciation to the Shepherds*; FR\_79\_FRC\_E vs D: Franciscan friar vs St. Joseph of *Flight into Egypt*; FR\_70\_SL\_E vs D: Saint Joan Princess vs Our Lady of *Flight into Egypt*; and DD\_CH\_E vs D: King D. Duarte vs the man with chaperon of the *Slaughter of the Innocents*.

The graphs in Figure 10, show how: the degree of influence of the selected parts of the face in recognizing the similarities between the image on the Nuno Gonçalves oil painting and on the image of the fresco of the Church of St. Leocadia; facial features specific models make the facial recognition process possible. The graphs represent the compute percentage similarities between two given images of seven known individuals.



**Figure 10.** – Graphs expressing linear regression equation without constant for each pair of values (image pairs): G1 - Franciscan friar vs *St. Peter*; G2 - Paul vs *St. Paul*; G3 - Queen Elizabeth vs *St. Elizabeth* of *Visitation*; G4 - D: Infante D. Pedro vs *Annunciation to the Shepherds*; G5 - Franciscan friar

vs St. Joseph of *Flight into Egypt*; G6 - Saint Joan Princess vs Our Lady of *Flight into Egypt*; G7 - King D. Duarte vs the man with chaperon of the *Slaughter of the Innocents*.

## 5. Discussion

The iconographic interpretation of those frescoes aims to understand the function and meanings of painting royal, court, nobles, canons, friars, people in public administration, fishermen, and «manual labour» characters. It was necessary to explore the reasons behind the Manueline state's commission for those portraits and development of rituals for their royal ancestor worship throughout the Avis dynasty. It was examined the correlation between the collective portraits of St Vincent Panels (1460-1470) and the characters of the frescoes of St. Leocadia, in the light of the ritual practices in the religious space, when evoked during divine services. The subject matter of the paintings expressed the royal family's hope for the eternal life of their ancestors and for prosperity and regeneration of the nation. The figures are represented using three-quarter view traditionally used for images of Jesus, Our Lady, saints and virtuous men and women. The frescoes presented them as royal figures, some ones possessing the moral authority appropriate to ruling what they regarded as the justice state in the world, contrasting with other ones, which carried out a clumsy politics that immolated innocents on the altar of the nation, or which are considered "bad judges". St. Leocadia Church with these frescoes, turned a memorial site of the natural parents of the king D. Manuel. He used the power of images to elevate the status of their low-ranking natural parents and their own royal authority. The images of kings and princes as saints or the family of Jesus, signify humility, wisdom, and obligation of Christian filial piety. St. Leocadia Church, in this way, was transformed into an official space with the objective of reinforce the royal legitimacy and authority.

An experimental campaign was carried out, through a direct facial comparison between pairs of images, of Nuno Gonçalves oil paintings and frescoes of the Church of St. Leocadia: Franciscan friar vs *St. Peter*; *St. Paul* vs *St. Paul*; Queen Elizabete vs *St. Elizabete of Visitation*; Infante D. Pedro vs *Annunciation to the Shepherds*; Franciscan friar vs *St. Joseph of Flight into Egypt*; Saint Joan Princess vs *Our Lady of Flight into Egypt*; King D. Duarte vs the man with chaperon of the *Slaughter of the Innocents*. It comes out a match between 96% and 99%, which means they are considered practically identical. In the facial recognition programme exercise, a match superior to 75% is considered an identity, and therefore there is a strong probability that there was an important influence of the old master's painting models on the frescoes of 1511-1513 in the Church of St Leocadia.

## 6. Conclusions

The iconological interpretation of the frescoes of St. Leocadia, especially in the apse, was aided by the fact that they are based on historical events. Literary sources, archive research and international artistic studies all contributed to invaluable information about the Manueline style. The European and Ultramarine influence in the iconography and materials used in these frescoes is noticeable, though the symbolic significance of the "St Vincent Panels" was decisive. It seems as if the Portuguese painters learned from external practices, though they adapted them to Portuguese traditions. The iconological programme creates a rearrangement of the architectural space, which was typical of the first Renaissance, obeying criteria with a catechetical purpose, while carrying a sense and meaning of redemptive salvation, alluding to maritime exploration at the same time. The entire world of symbolic values reflects the socio-economic-political-religious context that characterized Portugal at the time. It also reflects the macro-imperial ideology of D. Manuel, who identified himself with the Emmanuel of Isaiah's prophecies.

The results about the iconographic analysis of the Early-Renaissance frescoes of St. Leocadia, presented for the first time, will contribute to a better understanding of the history present in the Portuguese Chroniclers of the 15<sup>th</sup> and 16<sup>th</sup> centuries and its relationship with the representation at the Panels of Saint Vincent. At the same time, in light of the results garnered throughout the study of the Manueline frescoes in the Church of St Leocadia it was possible to propose that are essentially part of an *ethical* Renaissance, different of the Italian *aesthetic* Renaissance.

The forensic facial comparison study conducted in this study, on Proto and Early Renaissance paintings, proposed that the characters painted in the frescoes of St. Leocadia Church (1511-1513) were the posthumously produced models of Nuno Gonçalves, the royal painter of D. Afonso V. Deep learning based facial recognition analysis are useful as an additional tool in works of art with historical importance.

This research is a valuable contribution to the conservation of cultural heritage. It is also important for teachers of conservation and restoration of historical and artistic works, and in the development of reconstruction and heritage conservation interventions.

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