

A study on the painting language of Giotto, a pioneer of the renaissance

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Abstract: This article delves into the painting language of Giotto di Bondone, a pioneer of the Renaissance, analyzing his significant position in art history and his influence on subsequent generations. The article begins with an overview of Giotto's life and artistic background, then proceeds to a detailed analysis of his breakthroughs in painting conventions, how he emerged from the influence of Byzantine art, and introduced humanistic spirit. It continues by exploring how Giotto's works extracted figures and objects from life, and his attention to and practice of space and perspective, reflecting his focus on real life and the pursuit of painting realism. Finally, the article deciphers the materials and painting methods of Giotto's tempera works, including the selection and use of supports, grounds, pigments, and medium agents, as well as specific painting steps and techniques. Through these analyses, the article demonstrates how Giotto, with his unique artistic techniques and spirit of innovation, paved the way for the development of art during the Renaissance period.

Keywords: Giotto di Bondone, Renaissance, painting language, humanism, spatial perspective, tempera technique, painting materials, artistic innovation

1. Introduction

Giotto di Bondone (1266-1337) was a renowned painter in Europe at the end of the 13th and the beginning of the 14th century. [1] He was born in Colle di Vespignino, in the Mugello hills near Florence, Italy.

Between the ages of 10 and 14, Giotto entered the workshop of the Florentine painter Cimabue [2] as an apprentice. Cimabue had traveled to Rome and was influenced by the Roman painter Cavallini. Cimabue introduced the Greek technique of egg tempera to Italy, and his works, such as "Madonna and Angels," already had a secular flavor. [3]



Figure 1: Giotto Statue

At the end of the 13th and the beginning of the 14th century, Giotto primarily worked in churches in Italian cities such as Florence, Assisi, Padua, and Rome, engaging in painting creation. He left behind a substantial legacy of frescoes and tempera paintings on wood panels. The two frescoes in the Basilica of San Francesco in Assisi, "Isaac's Blessing of Jacob" and "Esau Before Isaac," created in 1290, are possibly Giotto's earliest works. Additionally, some scholars believe that by 1290, Giotto had already produced the tempera painting "Madonna and Child" in the Church of San Giorgio all a Costa in Florence. Another theory suggests that the tempera painting "Crucifixion" in the Basilica of Santa Maria Novella in Florence was created by Giotto between 1290 and 1300. The works depicting the life of Saint Francis in the Basilica of San Francesco in Assisi were painted by Giotto before 1300.

In 1285, Giotto first traveled to Rome. In 1291, he returned to Rome to work on the Santa Maria Maggiore Basilica. Between 1299 and 1300, the papal court held grand celebrations to mark the beginning of the year 1300 and to bless Pope Boniface VIII (Sant-Jean-de-Lantran), and Giotto painted frescoes for the loggia of St. John Lateran Archbasilica, which unfortunately have mostly been destroyed.

At the beginning of the 14th century, Giotto had become one of the most renowned painters in the Tuscany region. In 1301, Giotto painted frescoes and tempera works for the Church of St. Francis in Rimini, including "The Crucifixion," which has been preserved to this day. In 1304, the Scrovegni family of Padua commissioned Giotto to create frescoes for their private chapel; these frescoes are among Giotto's most representative works. It is said that during his time in Padua, Giotto also met Dante.

In 1310, Giotto was invited by Cardinal Jacopo Stefaneshi to return to Rome once more to paint Dante's "The Boat" on the loggia of St. Peter's Basilica; this work was later repainted by Francesco Berretta in 1628. In 1311, Stefaneshi commissioned another triptych from Giotto for St. Peter's Basilica, which is now housed in the Vatican Museums.

Research suggests that the tempera work "Maestà" housed in the Uffizi Gallery in Florence dates to Giotto's return to Florence between 1310 and 1311. According to historical records, Giotto had become very wealthy from his investments at this time, although he also faced debt litigation. [4]

Historians have found records of Giotto in Florence in the documents from the years 1314, 1318, 1320, 1325, 1326, and 1327. [5] During this period, Giotto completed frescoes and tempera works in several chapels of the Santa Croce Basilica. Most of these works have been destroyed or lost, but some surviving works, such as "The Death of the Virgin," "Crucifixion," and "Madonna and Child," are now housed in museums in Berlin, New York, Munich, Strasbourg, London, and Boston.

Between 1328 (or 1329) and 1333, Giotto worked for King Robert of Anjou of Naples. Unfortunately, no works from this period have survived. Also destroyed were the frescoes that Giotto painted in 1333 [6] for the Church of Santa Croce at the invitation of Milanese lord Azzone Visconti. The tempera on wood work "Madonna and Child with Angels and Saints," signed by Giotto, and the "Coronation of the Virgin" in Santa Croce Basilica, are believed to be works from Giotto's workshop before 1337.

In 1334, Giotto was appointed as the artistic director of the Florence Cathedral and also served as an architect for the city and the castle. During this time, he conceived the idea of building the Florence bell tower. Giotto passed away in Florence on January 8, 1337, with the bell tower having only one story built, and his fresco "The Last Judgment" for the Bargello chapel was only partially completed with a few portraits. Giotto lived a brilliant and rich life, and his reputation became even more illustrious after his death, being hailed as a master of his time. In his memory, the Florence bell tower was named "Giotto's Bell Tower" three years after his death. In 1390, Cennino d' Andrea Cennini appraised Giotto by saying, "Giotto brought his painting out of the Orthodox style and towards the 'modern'." Giorgio Vasari believed that Giotto "revived beautiful painting. Giotto's artworks not only continued the spiritual expression but also focused on humanity and humanistic spirit, and in terms of form, language, and technical exploration, his works were a typical representative that bridged the past and the future."

2. Giotto's artistic creation as a link between the past and the future

2.1. Breaking through established painting conventions

Medieval Italian art was deeply influenced by Byzantine art. Byzantine art had a fixed and unified style and norms, and the depictions of Christ, saints, and other objects in artworks also followed fixed standard

patterns. They believed that the divine was sacred, advocating for the "absolute and eternal spirit" of the gods, and that the images of the divine should remain stable and unified through eternity. During the Byzantine era, the same drawing could be used to create many paintings, each completed according to certain specifications or patterns. Giotto's teacher Cimabue, Duccio of Siena, and other painters of Giotto's time often used the same composition or shapes in their works.

At that time, the expression of the artist's personal emotions and artistic viewpoints was not important in painting creation. The painter had no self-awareness throughout the entire process, only needing to concern themselves with how to make a line more vivid or when it was appropriate to display a bright color block. After more than a hundred years of iconoclasm, around the 9th century, the issue of how to represent the image of the divine was raised again. Christianity, in designing new images of the divine, linked the relationship between humans and gods, believing that since gods created humans in their own image, humans could also come to know and approach the divine through their creations. This theory connected the relationship between humans and the divine. Humans could be like gods because they possess divinity, reflecting and understanding the divine through human creation.

The tempera work "The Descent of the Holy Spirit," housed in the National Gallery in London, depicts the scene of the Holy Spirit's light shining down from above using a flat perspective. The saints in the painting are concentrated in the middle of the image, with the figures of the five saints in the front row mostly blocked by buildings, revealing only their heads and shoulders. The foreground consists of full-body figures in various dynamic poses. The clothing textures, facial features, and halos of the saints create a dense formal sense, contrasting with the straight and simple lines of the buildings; the more relaxed and soft lines of the figures contrast with the more resolute lines of the architectural decorations, forming a rhythmic contrast of rigid and soft, square and round; the horizontal composition of the saints in the middle of the image and the horizontal lines of the buildings create an organic structure that interweaves horizontal and vertical forms, achieving perfect unity through contrast.

The fresco "The Descent of the Holy Spirit" (Life of Christ) in the Scrovegni Chapel in Padua [7] is a work on the same subject as the tempera work "The Descent of the Holy Spirit" housed in the National Gallery in London, but in this piece, Giotto employed a different composition. This fresco is positioned above the viewer's eye level, and Giotto used a flat perspective with a slight upward view to portray the theme. The saints in the painting are placed within Gothic architecture, allowing the viewer to see the entire building: front, sides, and roof. Twelve saints are seated on stools, with the heads and backs of the five saints in the foreground fully depicted. The columns of the building and the vertical trends of each saint form the main vertical form of the image, contrasting with the horizontal composition of the saints and the horizontal lines of the buildings and stools to create a crisscrossing structure of the image. Giotto used different compositional arrangements, figure modeling, and formal treatments to express the same thematic content, conveying his understanding of religion and demonstrating his unique artistic sensibilities and talents through the use of modeling, composition, space, and rhythm in painting.



Figure 2: Giotto's Descent of the Holy Spirit (Life of Christ) fresco in the Scrovegni Chapel, Padua.

The tempera on wood painting "Meeting of St. Francis and Christ" housed in the Louvre in Paris features the work "Establishment of the Rule" in the lower central part of the painting. Giotto arranges the figures in an indoor setting, allowing viewers to see the front, left, and right walls of the room, as well as the ceiling and floor. Guided by the lines of architectural perspective, the viewer's gaze is directed to the figures of Pope Innocent III and St. Francis at the bottom of the painting. Pope Innocent III formally recognizes the new Franciscan Order and establishes their rules. St. Francis, leading his friars, kneels before the Pope to receive his blessing. St. Francis and his companions are depicted in dark colors, with the interplay of clothing textures and detailed head depictions creating a dense focal area of the painting. The figures around the Pope are rendered in lighter colors with simpler clothing patterns, forming a rhythmic contrast and variation in density and lightness with St. Francis and his companions. The red color on the Pope contrasts sharply with the lighter colors of the figures around him in terms of color purity. The Pope's red also contrasts with the dark colors on St. Francis and his friars in terms of color and hue, making him the undisputed center of the painting.

The fresco "Establishment of the Rule" in the Bardi Chapel of the Basilica of Santa Croce in Florence [8] is a work by Giotto between 1319 and 1328. This piece portrays Pope Innocent III accepting the kneeling of St. Francis and allowing the establishment of their rules from a flat perspective. The artist not only depicts the five sides of the interior where the figures are located—above, below, left, right, and behind—but also the exterior facade of the building facing the viewer, adding a sense of space and depth to the image. In the painting, apart from St. Francis, the other friars are arranged in three rows, kneeling before the Pope. St. Francis and two other friars, who are closer to the viewer, are depicted in lighter colors, while the ten friars further away are rendered in darker shades. This light-to-dark arrangement from the foreground to the background enhances the spatial layers of the image and strengthens the rhythmic contrast of black and white. The vivid and specific lines of the figures' clothing and the detailed depictions of their faces form a tight focal area that echoes the square structure on the ceiling of the building in terms of perspective. The figures in white clothing around the Pope set off his red-robed figure, making him appear more noble and dignified.

The fresco "Lamentation of Christ" in the Upper Church of the Basilica of San Francesco in Assisi [9], created by Giotto between 1290 and 1295, marks one of his earliest independent works. Giotto structured the scene into three spatial levels: the foreground, middle ground, and background. In the foreground, the Virgin Mary, Jesus, and surrounding figures form a horizontal trend. The darker tones around Jesus contrast with his lighter central figure, which is the focal point of the painting. The middle ground, with figures and rocks, creates a vertical trend. The interplay of horizontal and vertical forms, along with the angels in the background, establishes a structural relationship of points, lines, and planes. The relatively lighter tones of the middle and background contrast with the darker foreground, producing a spatial rhythm of primary and secondary, strong and weak elements. The expressions and movements of the figures are vividly portrayed, with looks of mourning and compassion. Although this fresco is from Giotto's early period, it already demonstrates his unique attention to the emotions of the figures and the organization of the composition, creating a picture filled with humanistic care. In this regard, Giotto's work of this period already shows distinctive features compared to the works of painters before him.

The fresco "Lamentation of Christ" (Life of Christ) in the Scrovegni Chapel [10] in Padua was painted by Giotto between 1302 and 1305, during which time his composition and figure portrayal had become more refined. In this work, Giotto employed a different composition from the "Lamentation of Christ" in the Upper Church of the Basilica of San Francesco in Assisi. The figures in the foreground are arranged around Jesus, with the two closest figures positioned with their backs to the viewer. The three figures on either side of Jesus are depicted in semi-profile. These five figures form the first circle around Jesus, with the remaining figures forming a second circle to the left of Jesus, mostly in standing positions. All figures' dynamic trends converge towards Jesus, with different postures expressing mourning emotions in their own ways, each distinctive yet interconnected. The middle ground of the painting features rocks and trees, with angels placed in the background. From this painting, we can sense Giotto's sensitive grasp of human emotions and his superb ability to portray thematic content.



Figure 3: Giotto's "Meeting of St. Francis and Jesus" tempera on wood, housed in the Louvre Museum, Paris.

In Giotto's works, he consciously used different compositions, different hues of colors, and different formal structures to organize the relationships and layout of the figures in the paintings for the same thematic content. Achieving this was not an easy task for painters at the time who were accustomed to using standardized compositions to represent the same thematic content. It required the painter to have a deep and unique understanding of the content expressed, a genuine concern for humanity, and a highly sensitive intuition and exceptional talent in art. Giotto possessed these advantages; he was not satisfied with the existing painting conventions and, through continuous exploration and effort, inherited the existing painting conventions while also making breakthroughs on this basis.

2.2. The depiction of people and objects in Giotto's works is derived from life

St. Francis of Assisi, full name Francesco Bernardone, was born in 1181 in Assisi, Italy, and died in 1226, about 40 years before Giotto was born. Giotto and St. Francis can be considered as contemporaries. Therefore, when depicting the life and stories of St. Francis, Giotto was portraying content that was relatively familiar to him.

The tempera on wood painting "St. Francis Meeting Jesus" housed in the Louvre in Paris depicts the scene after Jesus was crucified, where the marks of the crucifixion are projected onto St. Francis through light. In the painting, St. Francis is kneeling on one knee, leaning slightly backward, with his weight on his right leg, in a natural pose. The figure's clothing is simple, and the treatment of the clothing folds in relation to the body structure and movement is fitting. Below this painting are three smaller paintings depicting "Pope Innocent III's Dream," "The Establishment of the Rule," and "St. Francis Preaching to the Birds." In "The Establishment of the Rule," St. Francis is kneeling with both knees on the ground, holding the rule and looking up at the Pope. The friars behind him, like St. Francis, are dressed in simple clothing and devoutly kneel in pursuit of St. Francis. In "St. Francis Preaching to the Birds," St. Francis leans forward, his head slightly lowered towards the flock of birds, with his hands raised to different heights as he preaches to them, in a realistic and fitting posture. The birds in the painting, some resting on the ground and others in the process of flying towards the ground, seem to be attracted by St. Francis's speech and are listening attentively. These birds are vividly depicted, and the friar behind St. Francis leans slightly backward, his right hand raised, conveying his surprise at seeing the birds listening intently to St. Francis's preaching.

through his body language. The depiction of the characters' expressions, gestures, and clothing is simple and vivid. Giotto's portrayal of St. Francis, this holy figure, is also very cordial and humble, full of humanity, and not so mysteriously aloof. It makes the viewer feel that he is a saint, yet also like an elder in the secular world, approachable and endearing.

The characters in Giotto's works are drawn from life, and many of the buildings in his works are also based on reality. Giotto's works demonstrate that he was an artist adept at using the structure of buildings to divide the composition, combine the relationships between figures, and organize the overall structure of the painting. Through the composition and layout of painting language, Giotto presents narrative stories in a visual form, selecting appropriate buildings based on the thematic content and the overall atmosphere surrounding these contents. The Gothic architecture in the fresco "The Descent of the Holy Spirit" in the Scrovegni Chapel in Padua is inherently very beautiful. The seven columns of the building divide the composition into six rectangular spaces, and Giotto arranged the twelve disciples in groups of two to three in five of these spaces. The clever combination of the building's structure and the layout of the painting not only makes the work more artistic but also more realistic. This compositional method transforms the originally narrative storytelling into vivid visual images.

The buildings in "The People Present Gifts to St. Francis" in the Upper Church of the Basilica of San Francesco in Assisi are taken from the civic hall and the Temple of Minerva in the town hall square of Assisi at that time. These architectural forms in Giotto's works possess the unique style of the period's architecture: a combination of traditional Italian styles with Gothic elements. He rearranged real buildings in the composition according to the needs of the work, or directly used real buildings to form the structure of the painting. Whether it is the portrayal of people or objects, Giotto valued the refinement from reality in his creations. In his works, he focused on a human perspective in both character design and emotional expression, caring for real-life feelings. His religious-themed works are not aloof like those of painters before him, but close to real life, human emotions, and the concerns of "citizens," embodying the spirit of humanism.

2.3. Attention to and practice of spatial relationships

Giotto sought to approach reality and life in his creations, striving for visual authenticity to immerse viewers in his works. For Giotto, the spatial relationships within his art—such as the space and volume of figures and objects within the painting, their relationship to the environment, and the relationship between the artwork and its surroundings—were of paramount importance. The shift from two-dimensional to three-dimensional representation was not only a change in painting technique but also a transformation in conceptual understanding: bringing painting closer to humanity, reality, and the embodiment of the humanistic spirit. Giotto made significant contributions in this regard and paved new directions and ideas for artists who followed him.

To enhance the spatial and volumetric relationships of figures and objects in his paintings, Giotto focused on exploring light and shadow as well as contour. The fresco "The Kiss of Judas" in the Scrovegni Chapel, created between 1302 and 1305, shows a light source coming from the upper right of the composition. Giotto defined the illuminated and shadowed sides of each figure with clarity. Judas's back, waist, and hips are in the lighted area, which is also the brightest part of the painting. His left hand hangs down towards his feet, covering the robe of Jesus and placing it in the shadowed area. The distinct division of light and shadow makes the figures appear more realistic and three-dimensional. Giotto also paid special attention to the transition areas—the gray areas—between the dark and light parts. In the painting, the area under Judas's arms and from his hips to his feet is in the gray area. The gray area constructs an intermediate zone between the dark and light parts, and with its transition and connection, the figures become more substantial, natural, and real. Giotto's use of light and shadow to treat the figure of Judas makes him the undeniable visual center of the composition, capturing the viewer's attention. The tempera on wood work "Stefaneschi Triptych" [11], housed in the Vatican Gallery in Rome, is one of Giotto's important representative works. The figure in the white robe at the lower left corner of the central panel is the donor, Stefaneshi. Giotto's treatment of Stefaneshi's outline is relaxed and confident. The left outline of Stefaneshi follows the parts of his white robe that cling to his neck, back, and hips, and Giotto handles it with certainty. The upper part of Stefaneshi's right outline shows the shoulder and chest areas that are farther from the

viewer, and Giotto softens it by blending the dark tones of the background figures with the gray areas on the white robe; the lower part of the right outline shows the relationship between the draped robe and the kneeling legs, and Giotto strengthens it by contrasting it with the light color of the steps. These variations in the solidity and strength of the figure's outline depict Stefaneshi as a three-dimensional figure with a sense of presence in real space. From this work, it is evident that Giotto was able to handle the spatial and volumetric relationships of figures with relative initiative.

Byzantine period paintings focused more on the division of planes, emphasizing the aesthetic sense of numbers and geometry. Mr. Haiying Dai, a French-based painter, wrote in his article "Tracing the Origins of Tempera Art": "From the works, one can see that Byzantine art is a flat, impersonal, and stylized embodiment of divinity." The works of this period no longer pursued a sense of reality. "The entire universe is a relationship of numbers, and in the exploration of the structure of numbers, one hopes to find the secrets of the universe or the most perfect laws of the universe. The golden ratio is the absolute perfect embodiment of this numerical proportion. This theory in Christian art is the study of lines." Lines are used to compose and divide the picture, "we can fully appreciate 'the eternal absolute spirit of God' and the perfect laws of numerical proportions." Numbers and geometry divide the two-dimensional picture into a divine plane shape, conveying the spirit of God.

Giotto's works inherited the advantages of Byzantine art and constructed his understanding of three-dimensional space into the picture. From the tempera on wood painting "The Descent of the Holy Spirit," housed in the National Gallery in London, it can be seen that Giotto has put his thoughts on the spatial relationship between figures and the environment into practice in his work. The walls of the building in the painting divide the picture into two spaces, front and back. The three figures closest to the viewer are in the foreground space, and the twelve disciples are in the middle ground space, with Giotto setting the walls and windows of the building as the background of the picture. The figures in the foreground are treated with a more obvious light and shadow relationship; the figures in the middle ground are relatively concentrated, forming a dense, warm, and heavy area; the background is treated relatively sparsely and brightly. The interplay of light and shadow, density, and warmth and coolness in different spatial levels makes the twelve disciples in the middle ground the visual center. The spatial setting of near, middle, and far makes the relationship between the figures and the spatial environment natural and realistic, giving the picture a sense of three-dimensional depth.

Giotto placed great emphasis on the relationship between his works and the spatial environment in which they were situated. Unlike the spatial concepts found in ancient Greek and Roman paintings, which were not continued during the medieval period, medieval painters often viewed painting as a two-dimensional decorative and filling element for blank walls. When Giotto designed the frescoes for the Basilica of San Francesco in Assisi, he attempted to create a three-dimensional spatial sensation on the two-dimensional walls, integrating the work with the existing space of the building to create a more Three-dimensional perspective.

Giotto's research and practice with space had a significant impact on the painting community of his time and influenced the whole of Italy. For instance, the work of the 14th-century Flemish painter Jan Van Eyck [13] was deeply influenced and inspired by Giotto's work.

2.4. Attention to and practice of perspective

Giotto approached biblical themes with a humanistic spirit, using real-life experiences to portray religious content. To convey the authenticity of scenes, he not only explored spatial aspects but also made significant efforts in studying the perspective relationships within his paintings.

The tempera on wood work "Stefaneschi Triptych" housed in the Vatican Gallery in Rome demonstrates a layered perspective concept in the central panel of the triptych's rear screen. The perspective lines of the geometric decorations on the ground in the painting lead the viewer's gaze into the picture, directing it towards the central figure, Saint Peter. Kneeling before Saint Peter, holding the Bible, is a monk dressed in a dark robe, and on the other side, dressed in white and holding a model of a painting screen, is the donor of the triptych, Stefaneshi, who looks up at Saint Peter. Angels and saints on either side of Saint Peter focus their gaze on him. The lines of sight between Saint Peter and the surrounding figures form a second layer of perspective in the painting. The kneeling Stefaneshi and the monk represent the foreground figures, while

Saint Peter seated in the center with two standing saints on either side are in the middle ground, and the two standing angels are in the background. The spatial arrangement of the figures in the foreground, middle, and background creates a third layer of perspective. These empirical perspective arrangements serve to emphasize the focus of the painting, highlight the theme, and enhance the expressiveness of the scene.

In the fresco "Renunciation of Property" in the Bardi Chapel of the Basilica of Santa Croce in Florence, Giotto intentionally depicted the buildings in the painting as slanted. Since this mural is painted on a high wall, viewers on the ground must look up to view the work. The buildings in the painting appear reasonable and fitting from this perspective. Giotto used perspective to sensibly integrate the mural with the structure of the building it occupies, immersing the viewer in the scene.



Figure 4: Giotto's "Renunciation of Worldly Goods" fresco in the Bardi Chapel of the Basilica of Santa Croce, Florence.

The polyptych "Baroncelli Polyptych," also known as "The Coronation of the Virgin," is a tempera on wood housed in the Bardi Chapel of the Basilica of Santa Croce in Florence. The work is composed of five sections, with the central panel depicting the scene of Jesus crowning the Virgin Mary. On either side, the figures are arranged compactly and orderly, with angels playing music on their knees in the foreground, followed by rows of saints with golden halos, all looking solemn and gazing towards the central scene of the coronation. The characters in the painting are vivid and distinct, yet they maintain a sense of unity and harmony. This work successfully conveys a grand atmosphere in its depiction of a large scene with multiple figures, and its use of perspective seems to share a commonality with the scattered perspective method often found in traditional Chinese painting.



Figure 5: Giotto, Baroncelli Polyptych (Coronation of the Virgin), tempera on wood, Basilica of Santa Croce, Florence.

3. Analysis of materials and painting techniques in Giotto's tempera works

3.1. Support, ground, pigments, and mediums

The support for Giotto's tempera works typically consists of naturally air-dried, aged wood, chosen for its suitable moisture content and resistance to warping. For larger-scale works, a glue made from a mixture of lime and dried cheese is often used to bond or adhere several planks of wood together. The process of creating a polyptych is more complex, usually beginning with pasting or nailing sculpted elements into pre-designed positions, followed by preliminary shaping with a plane and chisel, and then roughly carving out the various decorative elements required. The entire framework is then assembled and glued together with cheese lime glue. Areas where nails have been used can be covered with tin foil to prevent rusting that could discolor the ground. A backing is also attached to the back of the wood panel to prevent warping and

deformation. The key to making this backing is to adhere long, narrow wood strips to the back of the panel in the direction of the wood's grain, and these long strips must have appropriate grooves cut into them. Shorter wood strips are then inserted horizontally into the grooves without glue, acting like a sturdy, lightweight spring to prevent the panel from bending or warping.

Before applying the ground, the entire wooden panel is coated with a layer of glue, which is left to air dry naturally for a day and a night, after which linen strips or parchment strips are applied to the wood. Cennini recorded Giotto's method of preparing the ground: the linen strips are first soaked with hot glue, and then a thin layer of starch, sugar, and plaster is applied with a spatula to fill in the gaps. [15] Because after applying the linen or parchment strips, if the wood panel cracks, the strips can protect the panel, preventing further cracking or breaking, thus serving to protect the ground.

The ground can be applied to linen strips or parchment paper, or it can be applied after the wood panel has been carved. The ground is typically made from materials such as chalk, plaster, or similar substances, and a glue solution is used as a binder. Many layers of the ground are applied, and once it dries, the next step can be proceeded with. The surface of the support with the ground applied becomes very smooth and has good water absorption. After sanding, the ground is as flat and white as ivory, being hard, uniform, and elastic, which is an ideal material for tempera painting production, including steps such as coloring and gilding.

For grinding pigments, slabs and grinding tools made of porphyry can be used. Porphyry and granite are more commonly used materials for grinding tools, and marble can also be used as a slab. Small blocks of stone for grinding tools can be specially processed by stonemasons. The steps for making pigments are as follows: first, grind the pigments with water to refine them, then mix in an appropriate amount of egg yolk and the juice of fig branches, which can be diluted with water as needed when painting. The mixture of egg yolk and fig branch juice can be used as a binder for grinding pigments and also as a medium for the pigments. The creamy fig juice can dilute the egg yolk and also has a preservative effect. The proportion of egg yolk in the juice mixture should not be too thick, as Cennini also mentioned that using too much egg yolk in painting is dangerous.

3.2. Painting steps and techniques

First, a gray-green color is mixed from black, white, ochre, and green to draw a clear and precise sketch on the ground. A thinner layer of Verona green is applied over the colored ground, covering the entire white ground to establish the overall tone of the painting. The highlights are first modeled with white, then the Verona green is used to glaze the entire painting, followed by further white modeling. This process is repeated several times to establish the initial overall relationships within the scene. During this process, the relationships between figures, clothing, architecture, and background gradually emerge. Afterwards, details such as skin tones and facial features are rendered to refine the overall relationships. Skin color is typically represented using the "three-tone method," which employs three shades of a specific color. A mixture of iron oxide and white can be used to represent skin color, with varying amounts of white creating different shades of red. A small amount of white mixed with iron oxide for the light areas, an equal amount for the mid-tones, and a larger amount for the dark areas. Meanwhile, the dark areas always reveal the transparent green from the colored ground, creating a richly layered visual gray that contrasts beautifully with the slightly reddish highlights. At this point, the dark, middle, and light areas of the painting exhibit different variations of light and warmth, forming a harmonious pictorial relationship. Finally, red is applied to areas such as lips and cheeks, and black and Indian red are used to draw eyebrows, pupils, and wrinkles. The clothing and accessories of the figures are also treated using the three-tone method. Doerner, in his book "The Materials and Techniques of Painting," describes the specific painting method: "Start with the red of the lips and cheeks, which should be very bright. Since the darkest skin tones must be lighter, they should be half as dark. Then blend various colors and apply them in multiple layers continuously. Finally, use a color close to pure white for the highlights, and use reddish black or pure black for the deepest darks." [16]

4. Conclusion

In conclusion, Giotto di Bondone's pioneering approach to painting during the Renaissance was a transformative moment in the history of art. His innovative techniques in perspective, spatial representation,

and the use of light and shadow not only broke away from the rigid conventions of Byzantine art but also laid the groundwork for future generations of artists. Giotto's attention to human emotion, his detailed observation of the natural world, and his mastery of tempera painting techniques have left an indelible mark on the world of art. Through his works, Giotto captured the essence of humanity and the divine, creating a legacy that continues to inspire and influence artists to this day. His contributions to the development of Western art are undeniable, and his influence can be seen as a bridge between the medieval period and the flourishing of the Renaissance.

5. References

- [1] Cennino d Andrea Cennini. *The Craftsman's Handbook*[M]. Translated by Daniel V. Thompson. Jr. New York: Dover Publications, 1960.
- [2] J Deborah Howard. *Venice & The East: The Impact of the Islamic World on Venetian Architecture 1100-1500* [M]. London: Yale University Press. 2000.
- [3] Lauren Arnold. *Princely gifts and Papal treasures: The Franciscan Mission to China and Its Influence on the Art of the West: 1250—1350*[M]. University of San Francisco.1999.
- [4] Max Doerner. *The Materials and Techniques of Painting* [M]. Translated by Yang Hong tai and Yang Hongyan. Beijing: Tsinghua University Press, 2006.
- [5] Zhang Yuan, Zhao Yang. *Musings on Art Materials—Knots and Solutions in Painting Applications* [M]. Beijing: Higher Education Press, 2005.
- [6] Zhang Yuan, Ma Lu. *Materials and Expression—A Track or Follow of the Material Expression Studio of the Oil Painting Department at the Central Academy of Fine Arts* [M]. Harbin: Heilongjiang Fine Arts Publishing House, 2000.
- [7] Pang Tao. *Research on Painting Materials* [M]. Beijing: China Overseas Chinese Publishing House, 1995.
- [8] Pan Shi Xun. *Evolution of 300 European Traditional Painting Techniques* [M]. Nanning: Guangxi Fine Arts Publishing House, 1996.
- [9] The Teaching and Research Office of Foreign Art History, School of Humanities, Central Academy of Fine Arts. *A Brief History of Foreign Art* [M]. Beijing: China Youth Press, 2007.
- [10] Zhang Gan. *A Concise Compilation of Foreign Art History* [M]. Beijing: Higher Education Press, 2008.
- [11] He Zheng Guang. *Giotto* [M]. Shijiazhuang: Hebei Education Publishing House, 2005.
- [12] Xu Huai qi. *A History of Early Christianity* [M]. Shanghai: East China Normal University Press, 1988.