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Case ref. Number: 0210-03/2023
Case assigned by: Roi S.
Mode of receipt: Online request / website form
To, Mr. [HIDDEN]
Address: Not-disclosed

1 Description of the Documents:

The content of this report is made by **Aithenticate.art** based on the documents described below.

1. RGB Photo *Q1.png* of resolution 3024×4022, provided by the customer and showing a Coca-Cola "Coke" red can with white thin diagonal stripes, autographed using a black marker. Refer to Figure 1 for the reproduction and Section 2.1 for a description.
2. RGB Photos *Q2.png* and *Q2.png* of resolution 3024×4022, provided by the customer and showing details of the front cover and reverse side of an autographed invitation to the exhibition holding place on June 28th 1987 in the Casino Knokke. Refer to Figure 3 for the reproduction and Section 2.2 for a description.
3. RGB Photos *Q4.png*, *Q5.png*, *Q6.png*, *Q7.png*, *Q8.png*, *Q9.png* of resolution 3024×4022, provided by the customer and showing different signed drawings. Refer to Figures 4, 5, 6, 7, 8 and 9 for the reproduction and Section 2.3 for a description.
4. RGB png images of items, drawings, documents and cards with verified authentic autographs from Keith Haring, dated at the same time period (1985-1988). The signatures are labeled "*Admitted Signatures*", and include 25 verified authentic autographs from the Haring Foundation's catalogue raisonné.
5. RGB png images of *skilled forgeries*. The *skilled forgeries* used for validation are made by Aithenticate.art subject the same requirements as the *Admitted Signatures*. The selected 15 signatures are made with similar medium and extracted using the same technique as with **Q1-Q9**.

1.1 Assignment

1. To prove that the area of inscription of the signatures **Q1, Q3-Q9** are free of alterations, by using digital inspection and comparison techniques.
2. To find out whether the A.I. model determines that the Questioned Signature **Q1** and the *Admitted Signatures* have been handwritten by the same person, and compare the feature vector curves.
3. To perform a description and study of the artwork (if any) the signature is an integral part of, and verify the corresponding authenticity tells, conceptually, in form and size.
4. To use our database of verified authentic signatures, perform a **graphological description** of the questioned signatures, and verify the authenticity tells.

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1.2 Declaration of Standards

For this work, we are working subject of two international standards:

1. Scientific Working Group for Forensic Document Examination (SWGDOC)'s **Standard for Examination of Handwritten Items** for examinations and comparisons involving handwritten items and related procedures using side by side comparison methods.
2. **ANSI/ASB Standard 35: Standard for the Examination of Documents for Alterations** to ensure that there is no alteration of the document by physical, chemical, electronic, or mechanical means, or a combination thereof.

2 Description of the autographed items

In this section we describe the presented items and collect all the information that can be useful for the authentication process.

2.1 Autographed soda can

The red Coke can design with diagonal thin white stripes and the white and blue "Coke" underline logo has been used by Coca-Cola periodically over the years. This design was first introduced in 1987 and was used until 1998. It was then reintroduced in 2011 as part of Coca-Cola's "Share a Coke" campaign and has been used periodically since then for various promotions and limited edition cans.

The signature is hand-written on the top of the can cylindrical barrel. We conducted a digital examination and chromatic analysis of the can colors, and they resemble the ones of the claimed time period (1988). The can also shows a dancing figure drawing on the bottom of the cylindrical barrel.



K. Haring 88

(a) Signed drawing with Q1. (b) Unwrapped area of inscription. (c) Distortion corrected Q1.

Figure 1: Digital unwrapping and distortion correction for the texture on the soda can. The drawing medium is a black marker pen, and the signature reads "K. Haring 88".

2.2 Invitation to the exhibition of the "Casino Knokke 87" mural

Our customer presents pictures Q1.png and Q2.png, showing an autographed invitation to Keith Haring's exhibition held at the casino in Knokke on June 28th, 1987. Haring's "Casino Knokke 87" is a famous mural painted on the casino's ceiling. The mural features playful figures, vibrant colors, and Haring's bold outlines. It is considered a masterpiece and a significant work in Haring's career.

The mural was created during a two-week residency at the casino, where Haring had complete creative freedom. Today, the mural is a tourist attraction and a testament to Haring's legacy in contemporary art.

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The item our customer has is an autographed invitation to the exhibition, not a reproduction of the mural. The invitation features a front cover image representing the mural, however it is a separate artwork that must be evaluated based on its own unique qualities and historical significance. One telltale sign of differentiation is the differences in colors, which could be due to variations in printing processes or intentional design choices. The dolphin's eye is also different in the invitation, appearing in the same color as the rest of the dolphin. The colors in the invitation appear more yellow than orange compared to the mural and other reproductions. This could be due to printing processes or materials used.

It's important to note that the signature at the bottom of the invitation cover is printed, rather than handwritten as in the original poster. The printed signature is a close replica of Haring's original signature.

Evaluating the invitation based on its own merits as a unique and valuable item, we gain a deeper understanding of the artwork and its place in art history.

2.2.1 Reproduction quality of the invitation cover

On the top images of Figure 2 we appreciate a well preserved invitation to the exhibition, from now on **Q2**. In order to highlight the color match of **Q2** and a verified authentic invitation cover, and the contrast with the colors of a reproduction, we plotted the separate main colors on the second row of Figure 2. We have also measured the line thickness on both prints. The differences in colors and line thickness between **Q2** (a) and the verified authentic invitation (b) may be due to variations in printing quality or color calibration, and are not a necessary indication of a forged invitation card. We did not observe large color inconsistencies between both invitation covers. And as we expected, we did observe differences between the invitations and the mural reproduction (c). Therefore, the conclusion of the chromaticity study is that there are no relevant mismatches between the colors of the present invitation and a verified authentic original invitation.

It's important to note that the signature at the bottom of the invitation cover is printed, rather than handwritten as in the original poster. The printed signature is a close replica of Haring's original signature. Overall, the cover of the invitation is a reproduction of "Casino Knokke 87" that captures the essence of the original artwork.



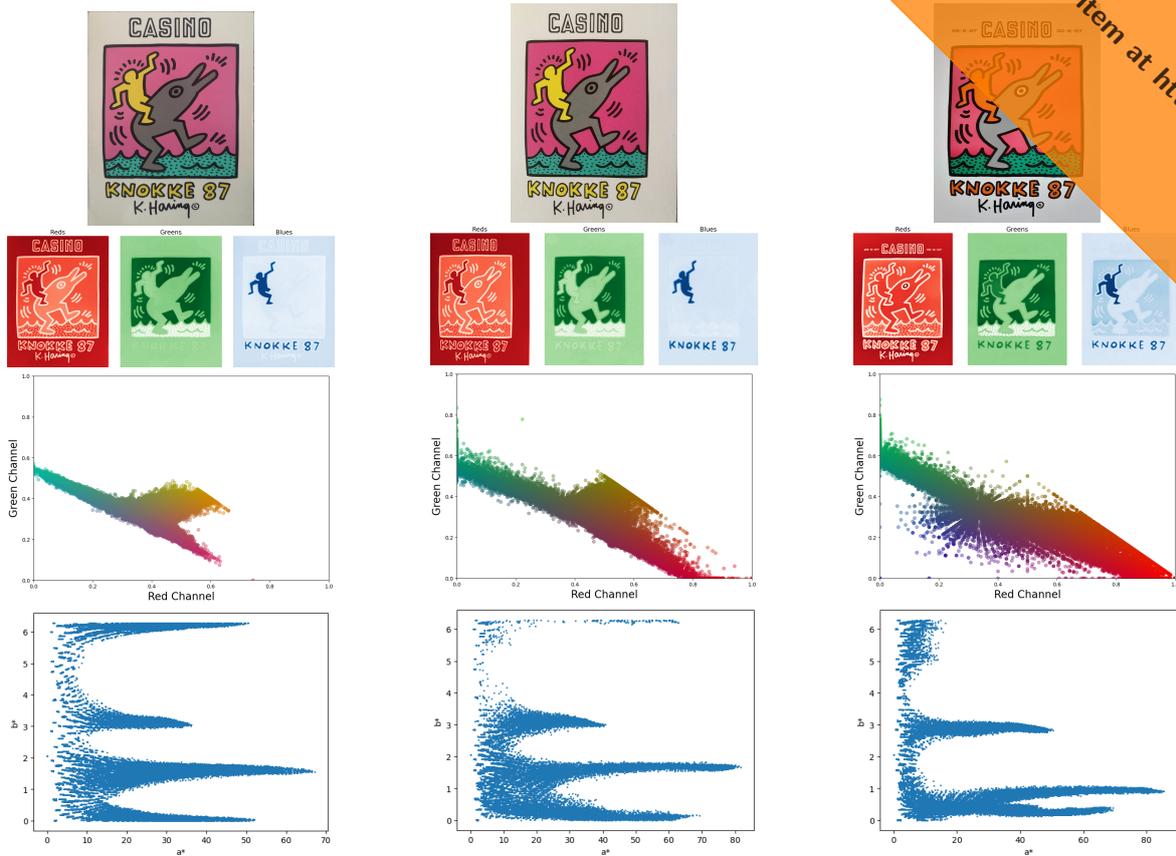
Chromaticity space plots represent colors in terms of their hue and saturation, and can be useful for analyzing color consistency across an image or for identifying color casts. These plots can be used to find color inconsistencies on printed low quality imitations. However, they may not provide enough information to determine the age or authenticity of a printed document by comparison.

2.2.2 Autographed reverse side of the invitation

Keith Haring signed many invitations for exhibitions during his career. It was a common practice for artists to sign exhibition invitations as a way to promote their shows and gain recognition. Haring was known for his prolific output and active participation in the art world, so it is likely that he signed many invitations throughout his career. However, the exact number is not known.

The first row of Figure 3 (b) shows the verso of an authentic invitation for the June 28th 1987 exhibition, which includes a signature made using a black marker pen. On the same figure, (a) shows the **Q3** signature on an invitation. We did not observe differences on both documents apart from the handwritten signature. Before studying the signature, we cannot determine whether the presented invitation card is authentic or a very good reproduction of the original invitation.

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(a) Invitation cover, labeled **Q2**. (b) Verified authentic invitation. (c) Reproduction of original mural.

Figure 2: Comparison of the invitation cover (**Q2**) with a verified authentic sample and a reproduction of the mural poster. The second row shows the decomposition of the three basic colors, and the bottom plots the chromaticity plots.



(a) Autographed reverse of the card. (b) Verified authentic invitation. (c) Extracted **Q3**.

Figure 3: a) Authentic invitation to the June 28th 1987 exhibition in the Casino Knokke, b) Questioned Signature labeled **Q3**, handwritten on the right hand side of the invitation. c) Extracted questioned signature **Q3**.

2.3 Collection of signed drawings

Keith Haring was a famous American artist known for his bold and expressive drawings, many of which he created using pens on paper. He was known to use a variety of drawing tools, but the medium he used the most was the black marker pen. He preferred using this tool because it allowed him to create

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bold, thick lines with a consistent quality. The black marker pen also dried quickly, which enabled him to work fast and efficiently. Haring's use of this tool is evident in many of his iconic works, such as his subway drawings, murals, and other pieces on paper.

Overall, Keith Haring's pen drawings on paper are characterized by their boldness, energy, and playfulness, and continue to inspire artists and art lovers around the world.

2.3.1 Signatures under drawings

Figures 4 to 9 show a collection of signed drawings, made using marker pens and charcoal, and the corresponding extracted signature.



(a) Signed drawing with Q4.



(b) Extracted Q4 signature.

Figure 4: Signature under a drawing, which appears to be made with a brown marker pen, and reading "K. Haring 86 ⊕".

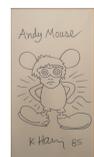


(a) Signed drawing with Q5.



(b) Extracted Q5.

Figure 5: Signature under a drawing of a barking dog, made using a red marker pen, and reading "K. Haring ⊕".



(a) Signed drawing with Q6.



(b) Extracted Q6.

Figure 6: Signature under a drawing, which appears to be made with charcoal, and reading "K. Haring 85".



(a) Signed drawing with Q7.



(b) Extracted Q7.

Figure 7: Signature under a drawing of a barking dog, made on black marker pen, and reading "K. Haring 88 ⊕".



(a) Signed drawing with Q8.



(b) Extracted Q8.

Figure 8: Signature under a dancing figure drawing, made on black marker pen, and reading "K. Haring".



(a) Signed drawing with Q9.



(b) Extracted Q9.

Figure 9: Signature on marker pen of a crawling radiant baby, made on black marker pen, and reading "K. Haring 88 ⊕".

3 Authenticity Cues apart from the Signature

Keith Haring's signature is an integral part of his art, but it is often positioned in such a way that it does not distract from the overall composition. Haring's signature is usually small in comparison to the rest of the artwork, and it is often located in the lower right corner of the work.

Haring's signature is typically written in a cursive, flowing script that is similar to his drawing style. This helps to integrate the signature into the artwork and make it feel like a natural extension of the drawing. Haring saw his signature as an important part of his identity as an artist, and he wanted it to be recognizable and memorable.

Although Haring's signature may not be the most eye-catching element of his artwork, it is still an important part of his legacy. Regarding any study of the authenticity of a piece, the signature is the most important part to consider in this case. At the end of the signature, Haring often writes the year and his signature circled cross icon.

In this section we will go through the item description, provenance, the included art concepts, and how they relate to both the signature and the authenticity of the works.

3.1 Recurring art concepts and authenticity

The recurring art concepts, like the radiant child, barking dog and dancing figures are closely associated with Keith Haring's authentic artistic style and vision. They are both motifs that are unique to Haring's work and are easily recognizable as his own.

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BASED AUTHENTICATION

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Q1	Q3	Q4	Q5	Q6	Q7
Q8	Q9				
S1	S2	S3	S4	S5	S6
S7	S8	S9			

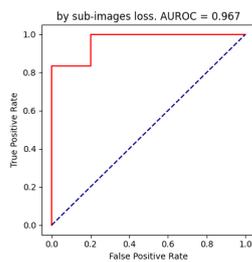
Figure 10: On the first and second tables, the Questioned Signatures Q1, Q3-Q9. On the third and fourth table, some of the verified authentic signatures by Keith Haring used in this study (S1-S9).

The diagram of the neural networks is shown on Figure 13. On Figures 11 and 12 we can see the classification ROC curve, the features vector curves and heatmaps.

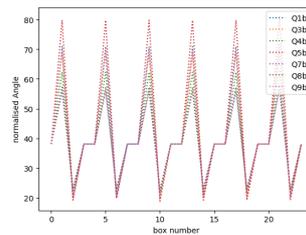
Our A.I. model correctly classified all the Admitted Signatures in the experiment run except one, and classified all the *Questioned Signatures* as **non-authentic**, with an accuracy on the control samples used in the experiment greater than 96%. Therefore, the verdict of the A.I. is:



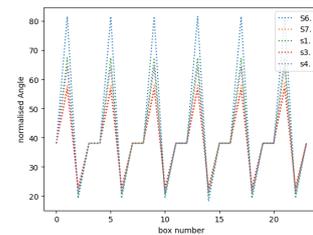
The A.I. model classified all the *Questioned Signatures*, labeled Q1, Q3-Q9, as **NON-AUTHENTIC** with a classification accuracy greater than 96%.



(a) ROC curve.



(b) Features vector curves for *Questioned Signatures*.



(c) Features vector curves for *Admitted Signatures*.

Figure 11: a) The AUC score obtained with our test samples is 0.97, which is very high. The features vector curves for the *Questioned Signatures* (b) and some *Admitted Signatures* (c).

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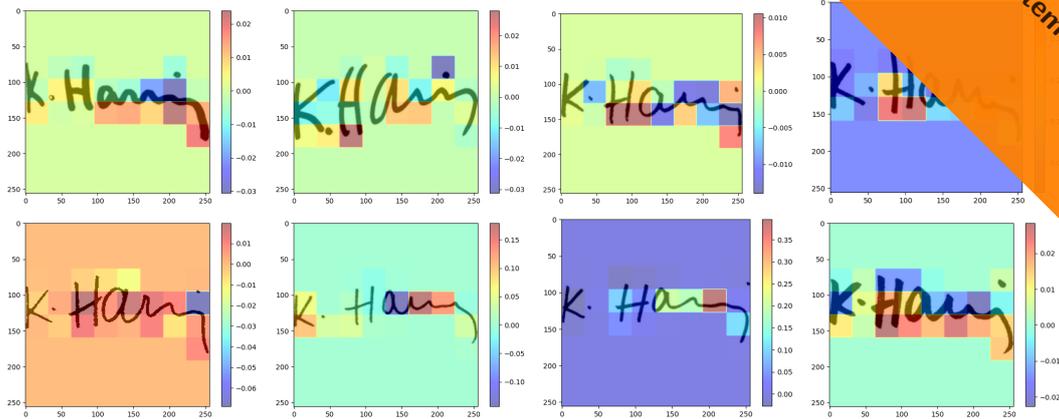


Figure 12: a) The heatmap for **Q1**, **Q3-Q9** highlighting the regions that were used by the AI to classify the signatures as non-authentic.



Figure 12: Heatmap on the signature: According to the A.I. model, the strokes in **Q1** that the A.I. used to classify the signatures as non-authentic are located all along the signature. However, the regions which are resourced the most by the A.I. for the verdict are the ones highlighted in red. We observed that these regions are recurrent across several signatures, like the bottom half of the H and the decorative tail "g". We describe these features in detail in Section 2.



Figure 11: Features Vector curves of the signatures: The curves on these plots characterize the signatures attending to the response to filters on corresponding regions. All the curves feature the same pattern, meaning that the extraction technique digital images have been extracted homogeneously, and adding on the validity of the present digital processing and comparisons.

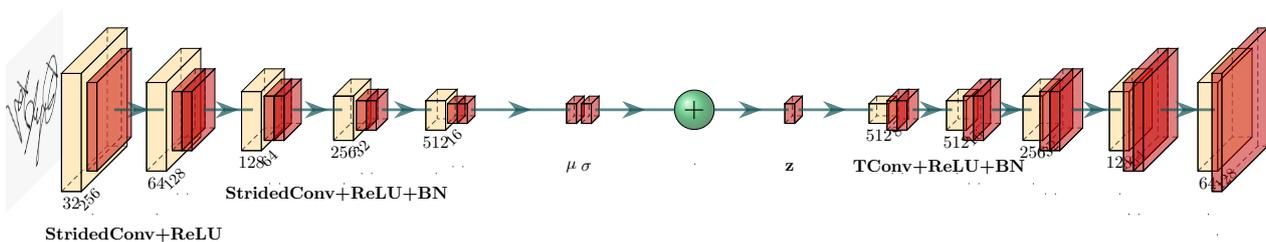


Figure 13: A diagram of the architecture for our AI model for Signature Authentication.

5 Signature description

This Section goes through a comparative description of the Questioned Signatures with the verified authentic samples.

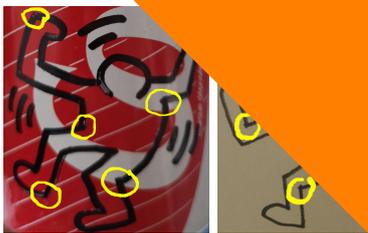
On Section 3 it is mentioned that Haring's signature is an integral part of the artwork, and it is commonly acceptable to reference the relation between drawing and signature, their relative

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(a) Discontinuities on the stroke

Figure 14: Authenticity tells and inconsistencies
are not authentic pieces.

4. Upon close examination of the dancing figures drawing on **Q5**, it can be observed that the fluidity typically seen in Haring's drawings is lacking. A notable difference can be seen in the motion lines, which are drawn perpendicular to the figures, as opposed to Haring's characteristic

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questioned signature.

1. An inter-se comparison of the questioned signature shows a very inconsistent writing pose with very inconsistent slant, pressure, speed, and direction across signatures. This marks the work of many artists.
2. The basic handwriting description of the questioned signature shows consistent high tier penmanship. It is evident that the signature is written in a consistent style, and many features are always repeated. This suggests a high level of graphological comparison for authentication.
3. The direction of the strokes in most of the *Questioned Signatures* are not the same as in *Admitted Signatures*. For instance, on Q4-Q9 **the crossing - in the capital H** is slanted to the left, whereas this line is slanted to the right on most of the verified authentic signatures. In other

SIGNATURE DESCRIPTION

and the baseline on the signature we can easily identify an authentic signature

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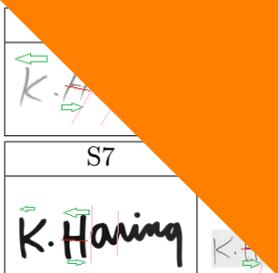


Figure 16: The effects described in the text. The green arrows show the right slant in the H. Using green arrows, the effect on the vertical lines. In blue, the effect on the vertical lines. In blue, the effect on the text.

5. The right slant on the Haring's writing is consistent. However, **Q5**, **Q6** and **Q7** are clearly slanted. The red color lines depicting the slant of the "a" letter, the capitals K and H, and the arcades.
6. The decorative tail "g" on Q6 is finished tilted to the right. The "g" is tilted to the left. Haring used to feature a consistent baseline when writing the signature. In order to visualize the baseline you have to visualize it like it has an unique direction as a whole.

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6 Conclusion

The present report goes through the study of the *Questioned Signatures*, the appearance of the artworks, conceptual motifs and artistic transformation created with it. It follows with the authenticity tells related to the signatures, and the results of the A.I. based authentication. The report is closed with the authenticity tells of the drawings, the graphology of the signatures, and what they may or may not have in common with verified authentic examples made by Keith Haring during the corresponding time period.

The main subject of study in this report is the collection of autographs, most of them which are handwritten below drawings using the same medium. Both drawing and signature are being part of an integral artwork. These artworks are undoubtedly aesthetically pleasing and have a decorative value. They showcase Haring's bold and energetic style and are sure to add a touch of color and creativity to any space. However, the authenticity of the signatures and drawings cannot be determined without adding a clear evidence of authenticity apart from the artwork itself.

The verdict of the A.I. model is that all Questioned Signatures are classified as non-authentic, or not made by Keith Haring, with an accuracy on the control samples used in the experiment greater than 96% .

Our analysis of the drawings and graphological characterization of the signatures in Section 5 includes a thoughtful description. We have found several authenticity tells which support the result of the A.I. for both the drawings and the signatures.

7 Disclaimer / Legal note

The present report by Aithenticate.art is the result of the digital analysis and description of the images of the signatures submitted by the customer, using mathematical models. This analysis has been done with Diligence and Good Faith, but Aithenticate.art

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