Applying Digital Image Processing in Psychological Assessment: Automating the Interpretation of the Tree-Drawing Test in Psychotherapy

Florentina-Anica PINTEA[1*, 2], Laurențiu Dan LACRĂMĂ[1], Dana RAD[3]

[1]Faculty of Computer Science and Applied Informatics, "Tibiscus" University of Timisoara, Romania

[2]Center for Multidisciplinary Informatics Research, "Tibiscus" University of Timisoara, Romania

[3]Faculty of Educational Sciences, Psychology and Social Work, Center of Research Development and Innovation in Psychology, Aurel Vlaicu University of Arad, Arad, Romania

[*]Corresponding Author

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ABSTRACT

This study investigates the application of digital image processing techniques in the automation of Tree Drawing Test (TDT) interpretation, a tool frequently used in psychological assessment and psychotherapy. The research was conducted within the Multidisciplinary Informatics Research Center at UTT, using an extensive dataset of images from which morphological indicators such as drawing size (M), crown width (PM), and trunk direction were automatically extracted through segmentation and morphological analysis methods implemented in a complete OpenCV-based processing pipeline. The results show high accuracy in recognizing trunk direction (96.04%), as well as a significant correlation between several graphical indicators. The study highlights the potential of automated methods to support psychological evaluation by increasing standardization, reducing inter-evaluator variability, and enabling the future integration of machine learning techniques for the classification of psychological traits. The conclusions support the integration of these approaches into psychotherapeutic practice, with implications for monitoring client progress and developing digital decision-support tools.

Keywords - digital image processing, Tree Drawing Test, psychological assessment, psychotherapy, automation, machine learning, automatic classification

INTRODUCTION

Modern psychological assessment lies at the intersection of traditional, clinically validated methods and emerging digital technologies that promise to increase the objectivity and efficiency of the evaluation process. Drawing-based projective tests remain widely used tools in psychodiagnostics and psychotherapy - particularly in work with children and adolescents, but also in clinical contexts with adults - due to their relatively non-intrusive nature and their ability to facilitate the symbolic expression of emotional content [2].

Extending these approaches to the psychotherapeutic context - where the TDT is used not only for screening but also for monitoring the process of change - raises new methodological and ethical questions: How can automation be integrated into clinical practice without oversimplifying the complexity of interpretation? How can image processing algorithms be calibrated to the specificities of psychotherapeutic work and the concrete needs of clinicians?

The present study aims to address these challenges by exploring the application of digital image processing to the interpretation of the Tree-Drawing Test, with a focus on its practical usefulness in psychotherapy.

A. Context and Significance of the Research

Digital image processing has become an essential tool in the behavioral and psychological sciences, enabling the automation and objectification of psychological test interpretations. The Tree-Drawing Test, frequently used in psychotherapy to assess personality traits and psychological states, can benefit significantly from digital technologies by reducing subjectivity and increasing the efficiency of the analysis process. Automating the interpretation of this test has the potential to provide practitioners with a rapid, precise, and standardized instrument for diagnosis and patient monitoring. [4][12].

Key references introducing the application of digital image processing in psychological assessment and the automation of Tree-Drawing Test interpretation include studies that examine the use of the test for screening depressive disorders, employing objective analysis of tree drawings through image acquisition and recognition methods. These works highlight the diagnostic relevance of various quantitative drawing parameters [1], Studies on the validity and usefulness of the Tree-Drawing Test in emotional diagnosis, including the correlation of tree dimensions and drawing characteristics with psychological traits and mental states such as depression [6], The importance of automation in psychological assessment and the application of digital technologies to achieve standardization and increase efficiency in the interpretation of psychological tests [1], Research highlighting the potential of digital technologies and artificial intelligence in automating the interpretation of psychological tests, as well as the technological impact on the quality of psychological diagnosis [12].

These works represent the fundamental pillars supporting the context, objectives, and methodology of the scientific study on applying digital image processing to the automation of Tree-Drawing Test interpretation in psychotherapy.

The Tree-Drawing Test (TDT, Baum Test), developed by Karl Koch, is one of the most widely used projective drawing tests for assessing personality, adaptive resources, and potential psychopathological vulnerabilities [16]. The Tree Drawing Test (TDT) is used in the assessment of children with learning difficulties, in the screening of emotional disorders, and also in psychotherapeutic contexts, where the drawing becomes a starting point for exploring relationships, self-image, and unconscious dynamics in Guo et al. [7], Santillo, G., et al [15], Liu et al [9].

In parallel with the development of psychodiagnostics, advances in image processing and artificial intelligence have opened the possibility for partially automating the analysis of projective tests. Recent studies have demonstrated that images generated from the TDT can be segmented, processed, and analyzed automatically to extract relevant morphological features (such as trunk size, crown shape, or page positioning), with the potential to support psychologists in formulating faster and more coherent interpretations. In [13] we presented a segmentation method for tree drawings made on paper for use in psychological testing.

The specialized literature highlights that the TDT is used both in the diagnosis of mental disorders (for example, in studies examining morphological differences between the drawings of patients with schizophrenia and those of healthy individuals) and in recent research aimed at screening cognitive disorders or suicide risk. [10] [14] [16]. For example, the test has been included in digital early-screening protocols for dementia, as well as in machine learning models designed to detect suicidal ideation based on automatically extracted features from tree drawings.

At the same time, traditional projective interpretation is highly dependent on the psychologist's experience, subject to inter-evaluator variability, and time-consuming - particularly in largescale screening contexts or in overcrowded healthcare services [2]. Automating certain stages of the analysis -particularly those involving quantitative measurements and preliminary classifications - can contribute to:

1. increasing the consistency and reproducibility of interpretations, reducing the time required for processing,
2. facilitating the use of the TDT as a standardized complementary tool in psychotherapy (for initial assessment and progress monitoring).

Previous contributions in the direction of automated processing of Tree-Drawing Test images - from automatic segmentation of the drawings to the pre-classification of images based on morphological features - demonstrate the technical feasibility of this approach and provide a solid foundation for extending it to clinical and psychotherapeutic settings [3].

In this context, it becomes relevant to explore how modern image processing techniques can be integrated into a workflow specific to psychotherapy, in a way that generates useful quantitative indicators while still leaving room for the qualitative and relational interpretation that is essential in clinical practice.

B. Objectives of the Study

This study aims to investigate the application of digital image processing techniques in psychological assessment through the automated interpretation of the Tree-Drawing Test. The primary objective is to develop and validate an automated model capable of analyzing the characteristics of the tree drawing (such as size, trunk shape, branches, and details) in order to support psychotherapeutic diagnosis. Additionally, the study seeks to evaluate the impact of this automation on the quality and speed of psychological interpretation [1].

Building on previous research, this study proposes the development and adaptation of a complete digital image processing pipeline for drawings generated through the Tree-Drawing Test. This workflow will integrate essential stages such as image acquisition, preprocessing (binarization, noise filtering, contrast adjustment), segmentation of the drawing's main structures (trunk, crown, and possibly roots), and the extraction of morphological and spatial features that are psychologically relevant. These efforts were built upon earlier work in the field, particularly studies that have demonstrated the feasibility of automated analysis of TDT images (Pintea at all, 2013 - Automatic Pre-processing of Images for Tree Drawing Test; Pintea & Toma, 2013 - Automatic Segmentation of Tree Drawings for Psychological Tests).

Furthermore, the research aims to establish a rigorous set of quantitative indicators - such as the tree's total height, the trunk-to-crown ratio, crown width, the drawing's position on the page, degree of symmetry, and line density - that can be correlated with clinical criteria traditionally used in the psychological interpretation of the Tree-Drawing Test. The identification of these indicators will be based on specialized literature as well as consultations with experts in projective psychodiagnostics.

Another major objective is to evaluate the concordance between the interpretations formulated by psychologists or psychotherapists, and the classifications automatically generated by the image analysis algorithms. This step is essential for determining the extent to which the proposed system can function as a valid decision-support tool in psychotherapeutic practice - for example, for the rapid identification of drawings with potential clinical risk or for detecting relevant changes between therapy sessions.

Finally, the study aims to explore the practical applicability of digital indicators in the psychotherapeutic environment. The analysis will focus on how these indicators can be integrated into the initial assessment, client feedback, and the monitoring of progress throughout the therapeutic intervention, with the goal of complementing - rather than replacing - traditional clinical interpretation.

C. Research Questions and Hypotheses

Based on the formulated objectives, this research aims to investigate how digital image processing can contribute to the automation and standardization of Tree-Drawing Test interpretation in the psychotherapeutic context. A central aspect is the analysis of the extent to which automatically generated results can be correlated with evaluations performed by psychologists, particularly regarding the identification of personality traits and emotional indicators reflected in the drawing.

In this sense, the study seeks to determine whether preprocessing, segmentation, and feature-extraction algorithms can provide interpretations that are comparable in relevance and consistency to those formulated by human specialists, enabling automated analysis to become a viable support tool in psychotherapeutic practice.

The working hypothesis of the research is that automating the interpretation of the Tree-Drawing Test, through the integration of modern digital image processing techniques, will significantly reduce the time required for analysis while maintaining - or even improving - the accuracy and consistency of psychological evaluations, thus offering a more standardized and reproducible framework for projective interpretation [6][8].

To what extent do the features automatically extracted from TDT images correlate with the scores and categories used by psychologists in the interpretation of the test?

- **Hypothesis 1:** There are significant correlations between the automatically computed morphological indicators (e.g., tree height/ page height ratio, trunk-to-crown ratio, crown asymmetry) and the clinical scores or global impressions formulated by human evaluators [13].

Can an image-processing-based system perform a clinically useful pre-classification of drawings (e.g., within normal limits vs. potentially problematic/ requires further investigation) to support the psychotherapist's decision-making?

- **Hypothesis 2:** The preprocessing and classification algorithm achieves acceptable accuracy levels (e.g., >70%) in differentiating drawings considered *normative* by experts from those identified as having psychopathological content or signs of vulnerability [11] [13].

How can automatically generated information be integrated into the psychotherapeutic process without diminishing the richness of projective interpretation?

- **Hypothesis 3:** Psychotherapists perceive digital indicators as particularly useful for supporting and documenting clinical hypotheses, monitoring change between sessions, and facilitating communication with other specialists (psychiatrists, physicians, multidisciplinary teams), provided that the feedback generated by the system is presented in a form that is easy to understand and integrate into case conceptualization [10].

METHODOLOGY

The study was conducted at the Faculty of Computer Science and Applied Informatics and at the Center for Multidisciplinary Informatics Research, Tibiscus University of Timișoara, Romania. All statistical analyses were performed using RStudio.

The methodology examines the use of digital image processing and analysis techniques to extract the essential characteristics of the tree drawing. This includes image capture, the application of filters and segmentation algorithms to identify structural elements (trunk, branches, foliage), and the use of machine learning models for psychological classification and interpretation. The results obtained will be compared with manual evaluations conducted by psychotherapists in order to validate the system [5][12].

The proposed research employs a mixed quantitative–qualitative design, structured across several complementary stages. In the first stage, data collection involves obtaining TDT drawings produced in both psychological assessment contexts and psychotherapeutic processes, including children and adolescents referred for evaluation, as well as adults in therapy. For each participant, basic demographic data - such as age and gender - will be recorded, along with relevant clinical information (diagnosis, reason for referral, or stage of the therapeutic process), all collected in compliance with ethical standards and informed consent procedures.

In the next stage, the drawings will be digitized through scanning or photographing under standardized conditions, ensuring adequate resolution and controlled lighting, after which they will be converted into digital format. Preprocessing procedures will then be applied to these images, including grayscale conversion, binarization, noise filtering, contrast correction, and compensation for any page tilt. The main segments of the drawing - the trunk, the crown, and, where applicable, the roots - will be identified using segmentation techniques based on intensity profiles, projection histograms, or other robust algorithms described in the specialized literature dedicated to the Tree-Drawing Test.

Subsequently, relevant quantitative features will be extracted from the segmented images, such as overall dimensions (height and width), the trunk-to-crown ratio, the proportion between the tree's height and the page height, the position of the center of gravity on the vertical and horizontal axes, the degree of approximate symmetry, and line density. Based on projective literature and psychodiagnostics guidelines, these features will be associated with specific psychological indicators - such as rigidity or flexibility, emotional stability or instability, adaptive resources or insecurity - indicators that will be established and validated in collaboration with psychotherapy experts.

An essential stage of the study consists of the human evaluation of the drawings and its comparison with the automatically generated results. A group of psychologists and psychotherapists experienced in the use of the TDT will analyze each drawing using a standardized scoring sheet and will formulate an overall clinical impression.

The concordance between human evaluations and automated classifications will be statistically assessed using appropriate coefficients, such as the Kappa coefficient, Pearson or Spearman correlations, and ROC analyses, to estimate the accuracy and clinical relevance of the automated system.

In addition to other indicators such as the presence/absence of roots and the presence/absence of elements within the tree crown, the analysis also included two central parameters: M (drawing size) and PM (crown width), computed for all images in the database - a total of 152 drawings. After data cleaning procedures (removal of incomplete files, distorted images, or cases for which robust segmentation was not possible), number the cases remained with valid values for both variables.

For each image, the values of M and PM were automatically extracted following the structural segmentation of the drawing. Subsequently, these values were included in statistical correlation and classification analyses to evaluate the specific contribution of each indicator to predicting psychological scores and overall clinical impressions.

Pearson and Spearman correlations. The ordinal coded values (a = 1, b = 2, c = 3, etc., using the first letter when combinations such as a,b or c,e appeared) were used to estimate the relationship between drawing size and crown width:

Pearson correlation between M and PM:

$r = -0{,}385(p \approx 8{,}47 \times 10^{-6})$

This indicates a statistically significant negative linear association: as the category associated with drawing size increases (larger drawings), the coded categories for crown width tend, on average, to be lower, and vice versa. The automated analysis thus detects a real and significant association between the two indicators.

Spearman correlation (for ordinal variables, based on ranks**)**:

$\rho = -0{,}017(p \approx 0{,}85)$

The result suggests that, at the level of rank ordering, the relationship between M and PM is not a robust monotonic one, likely due to the highly unbalanced distributions across categories (e.g., many g values for PM and many a/b values for M).

Kappa = –0.01

Interpretation: The indicators M and PM do not measure the same underlying dimension; therefore, the agreement between their categories is zero, which is normal and expected. The automated analysis confirms that there is no conceptual overlap between drawing size and crown width.

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Exploratory ROC Analysis

To illustrate methodologically the possibility of using ROC analyses on these data, we constructed an artificial binary criterion solely as an example:

1. we defined large drawing = 1 if **M ≥ c** (i.e., **M_num ≥ 3**, corresponding to categories c/g) etc.),
2. small drawing = 0 for values **a** and **b** on M.

We used **PM_num** (the numerically coded crown width) as the "predictor score" and plotted the ROC curve for this constructed criterion. The result:

AUC ≈ 0,50, practically equal to chance level.

This shows that, under this artificial operationalization, crown width (PM) does not discriminate between *large* and *small* drawings as defined by M. However, it is important to emphasize that:

- this ROC does not reflect a real clinical criterion (it is not pathological vs. non-pathological),

- but merely illustrates how the numerical indicators extracted from the drawing can be used to test their discriminative ability with respect to a binary label, once a clinical criterion is available (e.g., elevated emotional risk, presence of a diagnosis, case considered severe by the psychotherapist, etc.).

In the final stage, the quantitative results and the ways in which they can support clinical interpretation will be discussed with the psychotherapists involved in the study, with the aim of identifying practical ways of integrating digital indicators into routine practice. Through focus-group discussions and semi-structured interviews, clinicians' perceptions will be documented regarding the advantages, limitations, and potential risks of introducing automation into the interpretation of the Tree-Drawing Test, as well as the conditions necessary for an effective and ethical use of these technologies in psychotherapy. [9].

Regarding the automatic recognition of trunk direction, the system was evaluated on a set of 152 digitized images. The results indicate very high performance for cases in which the trunk shows a clear inclination. Thus, for the category *left inclination*, the system achieved a recognition rate of 100%, and for the category *right inclination*, the same perfect performance was obtained, with 100% accuracy.

For the images in which the trunk does not display a significant inclination - the *no inclination* category - the system achieved a recognition rate of 88.14%, a high value but slightly lower than the results obtained for pronounced inclinations. This difference is understandable, as the absence of a dominant direction involves greater variability in the trunk's contours and, consequently, increased difficulty for the algorithm in establishing an exact classification.

Overall, the total recognition rate for trunk direction is 96.04%, confirming that the digital processing methods applied in this study are robust and effective in extracting the main structural direction from Tree-Drawing Test images.

The confusion matrix for trunk direction is presented in Table 1. For the interpretive category's *inclination to the left* and *inclination to the right (*to see Fig.1*)*, the automatic evaluation algorithm performed very well. However, for trees that the psychologist interpreted as having a non-inclined trunk, the algorithm encountered several difficulties, as some trunks show directional oscillations from the base toward the top of the trunk.

TABLE I. Confusion matrix for trunk-direction classification

Direcţia trunchiului	a. Înclinare spre stânga	b.Înclinare spre dreapta	- Neînclinare
a. Înclinare spre stânga	100	0	0
b. Înclinare spre dreapta	0	100	0
- Neînclinare	5.08	6.78	88.14

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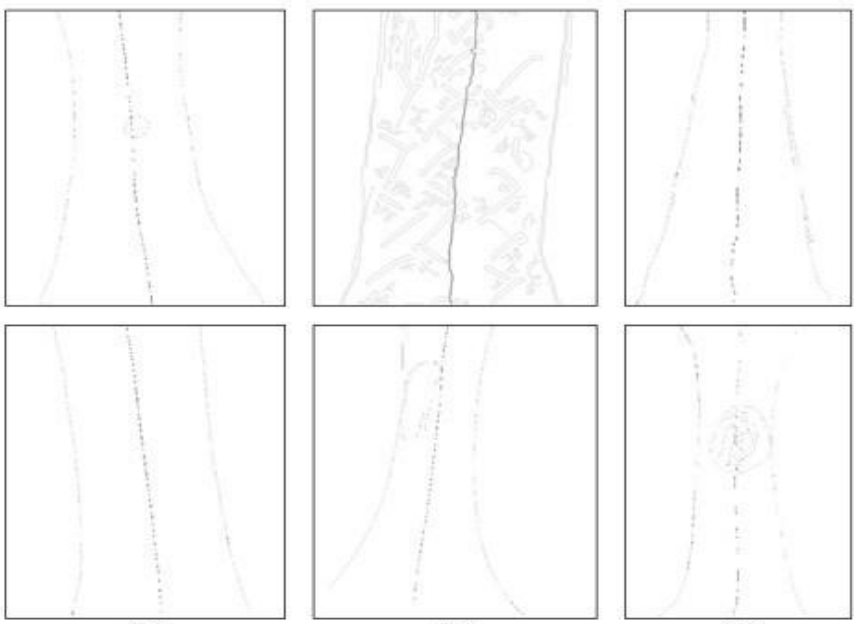

Figure 1. Experimental results for trunk direction The recognition rate for the *No inclination* category is only 88.14%, however, overall, the recognition rate for trunk direction is 96.04%.

To address the issue of directional oscillation in tree trunks, the automatic evaluation method was improved, and the results for the "No inclination" indicator increased from 52 trees to 56 trees. The recognition rate for the non-inclined trunk category increased from 88.14% to 94.91%, and the overall recognition rate for trunk direction increased from 96.04% to 98.30%.

DISCUSSION

A. Interpretation of the Results in Relation to Specialized Literature

The results obtained in this study align with the trends reflected in current literature on the use of automated image processing in psychological assessment. The high recognition rate for trunk direction confirms observations reported in previous research (Pintea & Toma, 2013; Guo et al., 2024), which indicate that clearly defined structural characteristics - such as the general orientation of shapes - are easier to detect using algorithms based on morphological analysis and principal axis estimation of objects within the image.

The negative correlation identified between tree size (M) and crown width (PM) may be interpreted in light of the traditional psychodynamic conceptualization of the Tree-Drawing Test, according to which the expansion of the trunk or central structure may correspond to a different level of internal organization compared to the development of the upper parts of the tree (Koch, 1952; Santillo, 2025). However, the absence of a consistent ordinal relationship suggests that these two dimensions capture different aspects of graphic expressiveness.

The ROC results, which do not indicate a discriminative capacity between "large drawings" and "small drawings," are consistent with literature emphasizing the need for robust and well-defined clinical criteria for predictive evaluation (Liu et al., 2025). They confirm that the morphological indicators of the Tree-Drawing Test can be useful as descriptors but require integration into a coherent clinical framework to achieve diagnostic value.

B. Limitations of the Study

This study presents several limitations that should be taken into account when interpreting the results. First, the correlations, as most values are concentrated in the upper range of the scale (g, h, f). Second, the data includes inter-evaluator variability in the letter-based coding, which may introduce additional noise into the automation process.

Another limitation is the absence of standardized clinical criterion. The ROC analyses were conducted only exploratorily, through the artificial construction of a binary label. For true diagnostic validation, independently validated clinical labels are required.

Lastly, projective interpretation always involves a subjective component, and current algorithms can capture only the evident morphological characteristics - not the symbolic content, psychodynamic meanings, or the relational context in which the drawing is produced.

C. Practical Implications for Psychotherapy and Diagnosis

Even with the limitations mentioned, the results suggest that automatic image processing can have significant practical value in psychotherapy and psychological assessment. The algorithms can be used to:

1. **Rapid screening** of relevant graphic characteristics (e.g., trunk direction, overall size, presence/absence of roots, presence/absence of elements in the crown, tree placement on the page, dimensions),
2. **Monitoring therapeutic progress** by enabling objective comparison of drawings produced at different time intervals,
3. **Reducing inter-evaluator** variability by providing standardized measurements,
4. **Supporting clinical interpretation**, especially in contexts with high data volume (schools, busy clinics, prevention programs).

Although the algorithms cannot replace the psychotherapist's expertise, they can provide a quantitative framework that complements qualitative evaluation, facilitating the integration of information in a more coherent and reproducible manner.

D. Future Research Directions

The study opens several promising avenues for future research. First, it is necessary to expand the database by including more diverse sets of images originating from different clinical contexts and associated diagnoses, in order to enable robust predictive analyses. The introduction of standardized clinical labels (e.g., anxiety, depression, developmental disorders) would allow for a genuine evaluation of the algorithms' ability to discriminate between psychological profiles.

Second, it would be useful to integrate modern deep learning techniques - particularly convolutional neural networks (CNNs) - for the automatic segmentation and classification of drawing elements. Such approaches could overcome the limitations of traditional morphological methods by capturing complex structures and stylistic variations. Another important direction involves the development of algorithms dedicated to dynamic analysis, capable of comparing a client's evolution over time using sequential models.

Finally, continuous reflection on ethical aspects is necessary: the use of algorithms in psychological assessment must be transparent, explainable, and responsible, integrated into professional practice in order to avoid mechanical interpretations or those detached from the therapeutic context.

A natural direction for further development of this work is the integration of machine learning techniques for the automatic classification of psychological traits based on the already processed images. Instead of interpreting morphological indicators (such as drawing size, crown width, trunk direction, page position, symmetry, or line density) exclusively through predefined rules, these features can be used as input variables in a supervised learning model trained to predict clinical labels or projective categories defined by experts (e.g., levels of anxiety, rigidity, emotional lability, adaptive resources).

Such a model could begin with classical classifiers, such as logistic regression, SVMs, or decision trees, which

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Gradient Boosting) could improve performance by combining multiple classifiers. In parallel, the original or preprocessed images (e.g., binarized and normalized) may be used directly in a convolutional neural network (CNN) architecture capable of automatically learning relevant visual features without relying strictly on manually defined indicators.

The key to such an approach lies in the rigorous definition of the ground truth: psychological and clinical labels assigned by experienced psychologists and psychotherapists based on a comprehensive evaluation (not only the drawing but also the clinical interview and other assessment tools). Using these labels, the dataset can be divided into training, validation, and testing sets, enabling an objective evaluation of model performance using standard indicators (accuracy, sensitivity, specificity, AUCROC, F1-score).

Furthermore, for such a system to be useful in practice, it must be not only performant but also explainable. The models can be supplemented with explainable AI techniques (e.g., feature importance analysis, visual relevance maps) that show the psychotherapist which graphic characteristics contributed to a particular classification. In this way, *machine learning* would not replace clinical interpretation but would provide an additional layer of evidence, helping to structure and verify the hypotheses formulated during psychotherapy.

CONCLUSIONS

A. Summary of the Main Findings

The study demonstrated that digital image processing techniques applied to Tree-Drawing Test images can achieve high performance in identifying morphological characteristics relevant to psychological assessment. The algorithms showed exceptional accuracy in recognizing trunk direction, with an overall recognition rate of 96.04%, achieving perfect performance for images inclined to the left or right and a high rate for the non-inclined category. The analysis of the relationship between the indicators M (drawing size) and PM (crown width) revealed a significant negative linear correlation, suggesting a consistent structural relationship that may be useful in projective interpretation.

At the same time, the results show that these indicators measure distinct dimensions of graphic expressiveness, a finding confirmed by the low value of Cohen's Kappa coefficient. The ROC analyses indicated that, in the absence of a well-defined clinical criterion, the predictive capacity of the morphological indicators is limited - a conclusion fully consistent with the specialized literature.

Overall, the study confirms that automating image processing can represent a valuable tool in supporting psychological assessment, particularly by increasing measurement accuracy, reducing inter-evaluator variability, and improving the efficiency of the analysis process.

B. Contribution to the Field

This research brings several relevant contributions to the field of technology-assisted psychological assessment:

1. **Demonstrates the feasibility** of automating the interpretation of the Tree-Drawing Test using digital image processing algorithms applied to an extensive dataset.
2. **Provides a complete methodological framework -** from image acquisition to the extraction and analysis of indicators - that can be used or expanded in future studies.
3. **Integrates traditional projective indicators** into quantitative analysis, contributing to the objectification of projective test interpretation.
4. **Validates the automatic recognition** of major structural elements (such as trunk direction) with very high accuracy, demonstrating the potential of algorithms to support psychotherapists and psychologists in initial evaluation and clinical progress monitoring.
5. **Opens the discussion** regarding the use of artificial intelligence in psychology, emphasizing both its potential and the need for rigorous ethical and methodological grounding.

Through these contributions, the study aligns with current trends of integrating technology into clinical psychology and psychotherapy, offering a replicable and extensible model.

C. Recommendations for Future Research

The present study focused on several essential morphological indicators (e.g., drawing size, crown width, trunk direction). Future research should include the automatic analysis of instrument pressure (line thickness) as well as the detection of line fragmentation, trembling, or inconsistency. These features may provide a deeper level of automated psychodynamic interpretation.

A promising direction for future work is the integration of machine learning algorithms - such as convolutional neural networks and hybrid models - with clinically validated rules from the projective literature. To assess the usefulness of the Tree Drawing Test in psychotherapy itself, future studies should examine the evolution of drawings over time and evaluate graphic changes across sessions. For psychotherapists to trust such systems, future AI tools should incorporate visualizations of the relevant areas detected by the algorithms, natural-language explanations for the system's recommendations, and clear justifications for its classifications (e.g., right leaning trunk → outward orientation). Such features would ensure transparency and accountability in the clinical use of AI.

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