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Research Article

Analysis of Emotional Authenticity Displayed by Film Actors Using Image Processing Techniques

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ABSTRACT

This study analyzes a social phenomenon using technical methods to uncover the underlying reasons for the researched phenomenon. This study investigates the authenticity of facial expressions and emotional cues of well-known film actors in Turkish comedy cinema films. For the study, 480 video data samples related to the actors were collected from the social media platform YouTube. The videos were categorized into smile, surprise, and anger, with 120 samples analyzed for each category. The Kaggle database containing facial expressions of smile, surprise, and anger from regular individuals was utilized to compare the images.

The Local Binary Pattern (LBP) feature extraction technique was employed to extract features from the images. Machine learning models were then constructed using the extracted features. Based on the classification results, the accuracy values were 99.37% for the smile category, 97.19% for the surprise category, and 97.81% for the anger category.

The analysis results show that the emotional expressions of film actors and normal individuals differ. This study aims to develop a unique perspective by highlighting the distinctive characteristics of renowned actors through their emotional expressions.

1. INTRODUCTION

When people encounter any image, they can make a wide range of interpretations based on their experiences. Therefore, an image represents the meaning created by thousands of words coming together. From a computer's perspective, computers, despite lacking prior knowledge, can effectively identify and present the features that contribute to forming visual content through their semantic understanding capabilities. Thus, they are capable of efficiently detecting the features present within images. The features that constitute images are known to be color, texture, and size. Many images are formed based on these fundamental features [1].

Image processing is the process of using computer assistance to clean up noise or unwanted features in an image [2]. Image processing is also a technique that enables the manipulation of images obtained from different sources. Image processing can serve different purposes, such as object detection, object recognition, or enhancing image quality. For images to be comprehensible by computers, they need to be digitized. The digitization of images is achieved through the use of colors, a feature that constitutes images [3]. This allows images to be transferred into software languages and subjected to various types of research.

Image processing is widely applied in various fields such as defense, medicine, geographic information systems, robotics, and autonomous vehicles [4]. There are also studies that can identify individuals based on their handwriting style using image processing techniques [5]. The acquisition of images through cameras can stem from different sources. The remarkable advancement of technology in our present day has brought forth numerous diverse sources for accessing images. One of the most significant sources is social media channels. Social media platforms host an enormous amount of image data. Moreover, access to this data has become more convenient. It's known that platforms like YouTube contain millions of videos. Each of these videos comprises multiple images coming together to form moving visuals. The data obtained from these sources has given rise to various research opportunities.

YouTube hosts numerous films that feature important figures in the cinema industry. These iconic films continue to be watched by millions of users even today and are freely available for viewers on YouTube. What accounts for the repeated viewing of films by Kemal Sunal, a prominent figure in Turkish cinema? This phenomenon stems from the ability to authentically present the character's words, expressions, and behaviors in the films to the audience [6]. In other popular

Turkish cinema films, one can observe that other actors have successfully achieved this, winning the audience's affection. The skillful use of gestures and facial expressions by the characters in the films aims to create genuine behavior, inviting the viewers to become part of the movie experience [7]. Analyzing whether these expressions are unique to these actors can be accomplished through image processing techniques.

Feature extraction techniques play a crucial role in image processing, and they are particularly important for various applications such as person recognition and more. Feature extraction is the process of obtaining the most relevant information in the original data. It can also be seen as a specialized form of dimensionality reduction. This allows the acquired information to be represented in a lower-dimensional space. In other words, when data is raw, it can be of very high dimensionality. Feature vectors are defined as representations of the data that are more compact by selecting features with higher information content from the data. Transforming input data into a representation that summarizes information is generally referred to as feature extraction [8]. This process is vital for enabling various image processing applications related to person recognition and beyond.

Feature extraction can be categorized into different types based on applying different approaches. The most commonly used features in image processing are spectral, geometric, and structural. Processing an image's pixel matrix involves the use of spectral features. This allows each pixel within the image to be numerically represented in terms of color values and color changes. One of the advantages of leveraging spectral features is the ability to obtain features regardless of the image's size. The most fundamental type of spectral feature involves color space, which can be used to examine the distribution of colors on an image [9].

The feature extraction stage is not sufficient for detecting the investigated phenomenon. The obtained features are separated into their classes, and the prediction process takes place using machine learning or deep learning algorithms. Machine learning can be utilized for various problems, including face recognition or detecting facial expressions. Humans are emotional beings who reflect their emotions to others using facial expressions. Facial expressions are classified as binary (positive and negative), ternary (positive, neutral, negative), or 7-category (happy, sad, angry, disgust, fear, surprise, and neutral) within the scope of studies [10].

Facial expressions play a significant role in people's relationships with others. It is stated that facial expressions greatly influence viewers. Researchers have suggested that people's innate characteristics shape their emotions, and they demonstrate this through facial expressions. Facial expressions arise from sudden changes in the face due to the contraction of facial muscles, eyebrows, and lips. These changes reflect human emotions. Since the degree of muscle contraction in each person's face differs, some individuals can exhibit better or worse emotions [11].

In light of this information, extracting and analyzing the features of an image using image processing techniques is quite feasible. As previously mentioned, old Turkish films hold a unique place for the audience. Using images of veteran actors who appeared in these films, the actors' facial expressions can be separated into features using image processing techniques. Additionally, the actors' facial expressions are classified to depict different emotional states (smile, surprise, anger). This would allow us to examine the uniqueness of the on-screen images portrayed by these talented actors.

2. RELATED WORK

Numerous studies related to image processing can be found when reviewing the literature. The studies analyzing emotion using image processing techniques have been reviewed in the first stage. When examining recent emotion analysis studies, it is observed that the focus is primarily on publicly shared datasets. Researchers have utilized these datasets to distinguish human emotions using classifier algorithms and have attempted to improve their performance. In one such study, [10] attempted to predict emotions using the FER-213 and CK+ datasets shared as open-source on the Kaggle website. They employed a CNN algorithm with tuned parameters as the classifier. The same classifier was utilized to categorize human faces into three categories (positive, neutral, negative) and seven categories (happy, angry, sad, disgust, fear, surprise, neutral) within the same dataset. The CNN algorithm exhibited better performance in the emotion class containing three categories. In a similar study, [11] conducted their research on different datasets shared as open-source. They attempted to detect seven different emotional states (happiness, sadness, surprise, disgust, anger, fear, neutral) using both traditional machine learning algorithms and deep learning algorithms. They employed a Histogram of Oriented Gradients (HOG) as the feature extraction method during the image processing stage. The analysis results indicated that deep learning algorithms like CNN provided better results across three different datasets compared to classical machine learning algorithms. Consequently, they attempted to identify performance differences between algorithms through emotion analysis. Another study aimed at more accurately detecting emotional states by combining different classification models. In this study by [12], they attempted to predict seven different emotions (happy, surprise, sad, disgust, anger, fear, and neutral). As a result, they found that combined classifiers performed better for positive and neutral emotional states, while singular classifiers performed better for emotions like anger and sadness. This study demonstrates that the classifier with higher performance for the investigated emotional state can be utilized for emotion prediction.

It is also possible to come across practical studies conducted on emotion analysis. From such studies, [13] claimed in their research that people's negative emotional states affect their driving behaviors. They attempted to detect seven different emotional states (happy, sad, neutral, angry, disgusted, surprised, and afraid) by capturing facial images of drivers at certain moments. They used CNN and derivative algorithms during the feature extraction stage from the images and successfully distinguished emotions with 96.63% accuracy. Thus, they aimed to develop a system capable of detecting drivers' negative emotional states and alerting them accordingly.

Emotion analysis is conducted using image processing techniques, with studies directly focusing on the human face. In a study by [14], they attempted to calculate the charisma score of the human face. They aimed to determine the visual attractiveness of celebrities by using both celebrities and non-celebrities. They utilized a dataset consisting of 6000 images of celebrities and 6000 images of non-celebrities. By employing the ResNet-50 deep learning algorithm, they

achieved a performance score of 95.92%. Regarding facial features, they found that factors such as disproportionate face width, baby face shape, and thin chin are distant from celebrity charisma. At the same time, larger eyes and darker skin tones are closer to celebrity charisma.

In another study, [15] mentioned that aging human faces is an inevitable consequence of human structure and characteristics. This phenomenon holds significant importance in biometric systems as they developed a new method capable of predicting age from facial images. Their dataset included photos of 1002 individuals aged between 0 and 69 and 1046 individuals aged between 18 and 93. They obtained features using a combination of the Local Binary Pattern (LBP) and Binary Similarity-Independent Features (BSIF) techniques for feature extraction. For classification, they employed the Support Vector Regression (SVR) algorithm. Using the developed model, they estimated the age of the provided image data. As a result, they achieved prediction accuracy ranging from 82% to 83%. In a different study, [16] highlighted that individuals have been recognized throughout history based on their inclusion in different ethnic groups. Exploiting these ethnic differences, they performed ethnic origin classification using facial images, as human faces exhibit diverse characteristics. They conducted the study using the Convolutional Neural Network (CNN) algorithm, a deep learning technique widely used in various face recognition applications. They obtained a dataset of 3105 images with different ages and ethnicities from sources like Google, Facebook, and others. The acquired images were selected in various sizes and resolutions. They used 3052 images for the training and 53 for the testing phases. Since each original image had different dimensions, all images were standardized to a size of 64x64. Utilizing the CNN algorithm, they managed to create a model that achieved an accuracy of 84.91%.

In another area of application for image processing techniques, [17] emphasized the significant importance of classifying malicious viruses in the field of cybersecurity. Departing from the traditional approach of virus identification, they aimed to classify viruses using binary images of the viruses. They obtained their dataset from a source containing 12,000 binary virus images of 32 different types. They applied the Local Binary Pattern (LBP) feature extraction technique to these images. Through training models using the K-Nearest Neighbors (KNN) classification algorithm, they achieved a prediction accuracy of 85.93%. Moreover, using the Support Vector Machine (SVM) algorithm, they reached a prediction accuracy of 87.88% for the models they created.

The related literature shows that image-processing techniques have been applied in various interdisciplinary studies. Simultaneously, the literature review demonstrates the existence of studies utilizing image processing techniques for both emotion analysis and extracting the characteristic features of the human face. Past research indicates that investigation into emotional authenticity has not been the focus. Therefore, the relationship between human emotion and the uniqueness of facial characteristics is considered an open topic for investigation.

In this study, image-processing techniques have been implemented in the cinema industry to contribute a novel perspective to the literature by applying image-processing techniques and exploring the authenticity of emotions.

3. METHODOLOGY

The data for this study was obtained from old Turkish films on the social media platform YouTube. The study focuses on determining the authenticity of emotions displayed by actors in Turkish films using image processing techniques. For analysis, images of four veteran film actors who had appeared in comedy films, namely Kemal Sunal, Şener Şen, Münir Özkul, and Adile Naşit, were utilized. Images were collected from various films for each actor, capturing their emotional expressions [18]. These emotional states consist of smiles, surprise, and anger. For each actor, there are 40 images depicting each of these emotions, resulting in 120 images representing four different emotional states. 480 emotion-related images were used for analysis across the four actors. As shown in Figure 1, only the part of the film frame that displays the emotional expression was cropped and used as data. The study aims to determine the authenticity of emotional expressions by seasoned actors. To enable comparison, a database of images containing smiles, surprise, and anger expressions from different individuals was obtained from the Kaggle website [19][20].

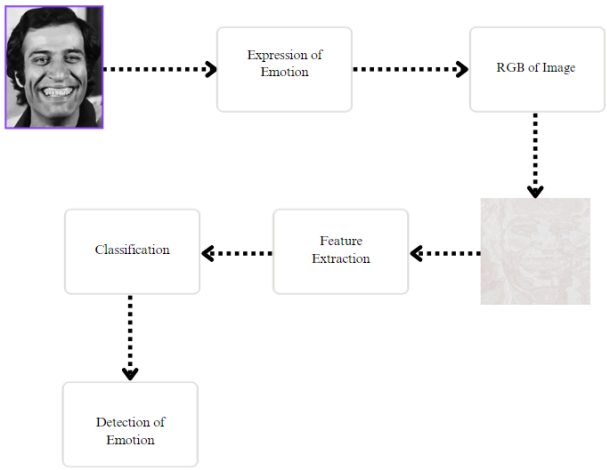

Figure 1. The Process of Detecting Emotion Expression from Image

3.1. Data Preprocessing

The data obtained undergoes several preprocessing steps for use in subsequent stages [21]. Initially, images are cropped from the film frames to include only the relevant facial expressions of the actors. As shown in Figure 1, once the facial expression image is obtained, it is converted into grayscale. In image processing and machine learning processes, images need to be transformed into a numerical format. Converting the image to grayscale yields the form seen in Figure 1, containing RGB numerical values of the image. Since each image may have different dimensions, all images are standardized to a consistent size. This size is 50x50 to reduce computation time during the machine learning phase. Standardized images then proceed to the feature extraction stage to obtain their characteristics.

3.2. Feature Extraction

There are various methods for extracting features from images. In this study, the features of the images were obtained using the Local Binary Pattern (LBP) method. LBP, a popular technique among feature extraction methods, initially emerged

for texture classification. The discovery of different application areas has also become commonly used in fields such as facial expression detection, face recognition, and fingerprint recognition [22]. The LBP method is applied to each pixel within an image. The LBP method considers the relationship between each pixel and its surrounding neighbor pixels. This relationship is based on whether the pixel is greater or smaller than its neighboring pixel. This results in a binary structure in binary notation, where the pixel is represented as 1 if greater and 0 if smaller. These binary values are combined from left to right to obtain a new value in decimal notation [23].

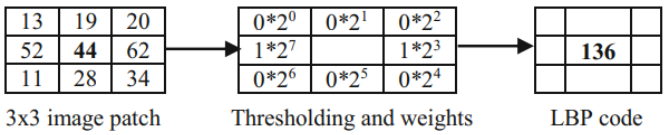

Figure 2. LBP Technique [24]

Following this approach, local LBP histograms were computed. The calculated local histograms form the feature vector. A machine learning model was constructed with the created feature vector, and the introduced images to the model were classified using multiple classification algorithms.

3.3. Classification Algorithms

3.3.1. HistGradientBoostingClassifier

It is an adaptation of the GradientBoosting classifier algorithm. Unlike the GradientBoosting algorithm, this algorithm offers a histogram-based approach. As a result, it learns faster and uses less memory than the GradientBoosting algorithm does [25].

3.3.2. LinearSVC

Support Vector Machines (SVM) is a machine learning algorithm for regression analysis and data classification. It is applied to datasets with two or more classes. LinearSVC is an adapted version of Support Vector Classification (SVC). LinearSVC aims to maximize the margin between classes, which it achieves by trying to find a linear hyperplane [26].

3.3.3. AdaBoostClassifier

Adaboost aims to create a stronger classifier by combining weak classifiers, such as decision trees. This process is applied on top of a base classifier. It focuses on reducing the error in the new classifier by increasing the weights of the points where the previous classifier has made mistakes [27].

3.4. Performance Evaluation Metric

In binary classification problems, the degree of separation between the two classes can be observed in the Confusion Matrix table. In the Confusion Matrix table, tp and tn represent the correctly classified data, while fp and fn indicate the misclassified data in the classification outcome [28].

	Actual Positive Class	**Actual Negative Class**
Predicted Positive Class	True positive (*tp*)	False negative (*fn*)
Predicted Negative Class	False positive (*fp*)	True negative (*tn*)

Figure 3. Confusion Matrix Binary Classification [28]

In Figure 3, evaluation metrics are used to assess the performance of the classifier algorithm. Accuracy indicates the ratio of correctly predicted emotional expressions of actor and normal classes within the total dataset. Accuracy is the most commonly preferred evaluation metric in binary or multiclass classification problems [28].

$$\text{Accuracy (acc)} = \frac{tp+tn}{tp+fp+tn+fn} \quad (1)$$

Precision is a ratio that shows how accurately the samples predicted as a player class is predicted due to classification.

$$\text{Precision (p)} = \frac{tp}{tp+fp} \quad (2)$$

Recall is a ratio that shows how successfully the instances belonging to the actual player class are predicted.

$$\text{Recall (r)} = \frac{tp}{tp+fn} \quad (3)$$

F-Measure, or F-score, is the harmonic mean of Recall and Precision values. It provides a balanced assessment of both Recall and Precision in a classification setting [29].

$$\text{F-Measure (FM)} = \frac{2*p*r}{p+r} \quad (4)$$

4. EXPERIMENTS

The confusion matrix for each emotion expression after the classification process is shown in Figure 4.

TABLE 1
RESULTS OF EMOTION OF SMILE

Method	Accuracy	F-Score	Recall	Precision
ensemble.HistGradientBoostingClassifier	0.9937	0.9938	0.9938	0.9938
XGBoost	0.9937	0.9937	0.9938	0.9941
ensemble.RandomForestClassifier	0.9906	0.9906	0.9906	0.9915
ensemble.GradientBoostingClassifier	0.9875	0.9875	0.9875	0.9886
naiveBayes.BernoulliNB	0.9875	0.9875	0.9875	0.9886
ensemble.AdaBoostClassifier	0.9844	0.9843	0.9844	0.9856
linear_model.LogisticRegressionCV	0.9844	0.9843	0.9844	0.9862
linear_model.LogisticRegression	0.9844	0.9843	0.9844	0.9862
neural_network.MLPClassifier	0.9813	0.9810	0.9813	0.9841
ensemble.VotingClassifier	0.9813	0.9810	0.9813	0.9841

Based on the classification results in Tables 1, 2, and 3, the highest accuracy value for the "smile" category is calculated as 99.37% with the HistGradientBoostingClassifier. For the "surprise" category, the highest accuracy is 97.19% with the LinearSVC, and for the "anger" category, the highest accuracy is 97.81% with the AdaBoostClassifier. The lowest performances for the algorithms are determined as follows: VotingClassifier with an accuracy of 98.37%, SGDClassifier with an accuracy of 94.38%, and BaggingClassifier with an accuracy of 95.31%.

TABLE 2
RESULTS OF EMOTION OF SUPRISE

Method	Accuracy	F-Score	Recall	Precision
svm.LinearSVC	0.9719	0.9718	0.9719	0.9737
linear_model.LogisticRegression	0.9719	0.9718	0.9719	0.9741

linear_model.LogisticRegressionCV	0.9656	0.9656	0.9656	0.9671
linear_model.PassiveAggressiveClassifier	0.9594	0.9593	0.9594	0.9620
neural_network.MLPClassifier	0.9594	0.9593	0.9594	0.9619
linear_model.Perceptron	0.9563	0.9561	0.9563	0.9590
ensemble.AdaBoostClassifier	0.9469	0.9466	0.9469	0.9512
ensemble.BaggingClassifier	0.9438	0.9436	0.9438	0.9467
svm.SVC	0.9438	0.9436	0.9438	0.9467
linear_model.SGDClassifier	0.9438	0.9434	0.9438	0.9491

TABLE 3
RESULTS OF EMOTION OF ANGRY

Method	Accuracy	F-Score	Recall	Precision
ensemble.AdaBoostClassifier	0.9781	0.9781	0.9781	0.9797
linear_model.LogisticRegressionCV	0.9750	0.9750	0.9750	0.9761
neural_network.MLPClassifier	0.9750	0.9750	0.9750	0.9761
svm.LinearSVC	0.9688	0.9687	0.9688	0.9702
linear_model.LogisticRegression	0.9688	0.9687	0.9688	0.9705
ensemble.HistGradientBoostingClassifier	0.9688	0.9687	0.9688	0.9705
XGBoost	0.9656	0.9655	0.9656	0.9683
ensemble.RandomForestClassifier	0.9594	0.9593	0.9594	0.9619
linear_model.PassiveAggressiveClassifier	0.9563	0.9559	0.9563	0.9622
ensemble.BaggingClassifier	0.9531	0.9530	0.9531	0.9570

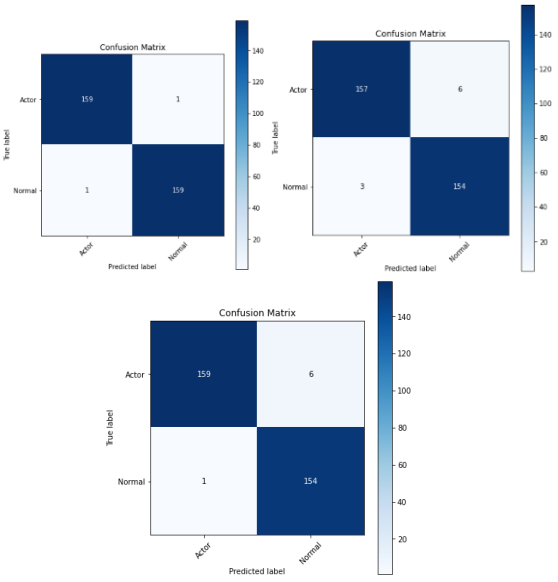

Figure 4. Confusion Matrix (Emotion of Smile, Surprised and Angry, respectively)

5. DISCUSSION

This study aims to analyze a social phenomenon using technical methods to uncover the underlying reasons behind the investigated phenomenon. The research examines the uniqueness of facial expressions and emotional states of renowned film actors in Turkish comedy movies. The analysis confirms that the actors' expressions significantly differ from those of regular individuals. Tables 1, 2, and 3 present the results obtained through machine learning. The algorithm with the highest accuracy rate for the "smile" category is the "HistGradientBoosting" with an accuracy of 99.37%. For the "surprise" category, the highest accuracy is achieved by the "LinearSVC" with 97.19%, and for the "anger" category, the "AdaBoostClassifier" performs the best with an accuracy of 97.81%.

A similar previous study by [14] attempted to identify the features that distinguish the facial characteristics of celebrities. They constructed their datasets from facial images of both celebrities and non-celebrities. Similar to this study, the ResNet-50 algorithm they used accurately classified celebrities and non-celebrities with a success rate of 95.92%. Other image processing studies have also achieved good results using similar algorithms. From these studies, [30] developed a machine-learning model using AdaboostClassifier on 355 brain images to differentiate brain tumors. Their model achieved 100% accuracy using 155 test images. In another study, [31] developed a machine-learning model to distinguish diseased leaves from leaf images. Similarly, they used LBP and HOG techniques for feature extraction and employed multiple algorithms for classification. The HistGradientBoosting algorithm yielded the highest accuracy of 89.11% among the tested algorithms. Another study by [32] focused on predicting seven different facial expressions from the KDEF_RaFD dataset. Their model achieved the highest F-score using the LinearSVC algorithm. These reviewed studies demonstrate that comparable performance results can be obtained using the machine learning algorithms employed in this study. Although the topics investigated in image processing vary, the results sought to be achieved are similar. Studies demonstrating the distinct facial characteristics of celebrities also support this research.

In this study, the emotional expressions of four master actors in comedy films were obtained, focusing on happiness, surprise, and anger. The data collection phase posed challenges in obtaining emotional expression data related to the actors. Therefore, analysis was conducted using three emotional expressions and four cinema actors. This limitation could be considered in the study. In future studies, the diversity of emotional expressions and the number of actors can be expanded to conduct further analyses.

6. CONCLUSION

The analysis of this study revolves around the unique nature of emotional expressions displayed by master actors in Turkish films using image processing and machine learning techniques. The study attempted to demonstrate the distinctiveness of famous actors' emotional states compared to existing similar studies. Being the first study to evaluate the subject from this perspective indicates its originality. The study aims to uncover whether the emotional expressions of these actors are distinctive and contribute to their enduring popularity and have resonance with audiences even today. The emotional expressions of regular individuals and actors were utilized to achieve this analysis. The findings suggest that machine learning models effectively differentiate between the emotional expressions of regular individuals and those of actors. This outcome implies that the gestures and facial expressions of master actors are indeed unique to them. The immense popularity of films featuring these master actors can be attributed to this uniqueness. Furthermore, emerging actors in the film industry can be evaluated using this approach, providing insight into how closely their expressions align with those of veteran actors. In future research, an application can be designed for this system, enabling artificial intelligence to serve as a decision-support element in actor selection within the film industry. The study also provides opportunities for future research. The analysis phase of the study was conducted

using traditional machine learning algorithms with a limited data set. Subsequent studies could expand the data set and test the findings using deep learning algorithms to enhance the research. Additionally, the study used only images of Turkish film actors for analysis. Future research could broaden the scope of the investigation by using images of renowned actors from different countries worldwide to make the findings more generalizable.

REFERENCES

[1] D. Ping Tian, "A review on image feature extraction and representation techniques" International Journal of Multimedia and Ubiquitous Engineering, vol. 8, no. 4, pp. 385-396, 2013.

[2] B. Chitradevi and P. Srimathi, "An overview on image processing techniques" International Journal of Innovative Research in Computer and Communication Engineering, vol. 2, no. 11, pp. 6466-6472, 2014.

[3] A. Eldem, H. Eldem, and A. Palali, "Görüntü işleme teknikleriyle yüz algılama sistemi geliştirme" Bitlis Eren Üniversitesi Fen Bilimleri Dergisi, vol. 6, no. 2, pp. 44-48, 2017.

[4] S. Solak and U. Altınışık, "Görüntü işleme teknikleri ve kümeleme yöntemleri kullanılarak fındık meyvesinin tespit ve sınıflandırılması" Sakarya University Journal of Science, vol. 22, no. 1, pp. 56-65, 2018.

[5] S. Agduk and E. Aydemir, "Classification of Handwritten Text Signatures by Person and Gender: A Comparative Study of Transfer Learning Methods" Acta Informatica Pragensia, vol. 2022, no. 3, pp. 324-347, 2022.

[6] A. K. Sunal, TV ve sinemada Kemal Sunal güldürüsü. Marmara Universitesi (Turkey), 1998.

[7] Z. OKRAY and C. A. MEVLANA, "Selvi Boylum Al Yazmalım Filminin Göstergebilimsel Yöntem Bilimiyle Analizi" Uluslararası Beşeri Bilimler ve Eğitim Dergisi, vol. 5, no. 12, pp. 1216-1244, 2019.

[8] G. Kumar and P. K. Bhatia, "A detailed review of feature extraction in image processing systems" in 2014 Fourth international conference on advanced computing & communication technologies, 2014: IEEE, pp. 5-12.

[9] M. Kunaver and J. Tasic, "Image feature extraction-an overview" in EUROCON 2005-The International Conference on" Computer as a Tool", 2005, vol. 1: IEEE, pp. 183-186.

[10] Meena, G., et al. (2023). "Identifying emotions from facial expressions using a deep convolutional neural network-based approach." Multimedia Tools and Applications: 1-22.

[11] Aksoy, O. E. and S. Güney (2022). "Sentiment analysis from face expressions based on image processing using deep learning methods." Journal of Advanced Research in Natural and Applied Sciences 8(4): 736-752.

[12] Moung, E. G., et al. (2022). "Ensemble-based face expression recognition approach for image sentiment analysis." Int. J. Electr. Comput. Eng 12(3): 2588-2600.

[13] Gite, S., et al. (2024). "Real-Time Driver Sentiment Analysis Using Hybrid Deep Learning Algorithm." International Journal of Intelligent Systems and Applications in Engineering 12(6s): 735-748.

[14] Feng, X. F., et al. (2021). "An AI method to score celebrity visual potential from human faces." Shunyuan and Liu, Xiao and Srinivasan, Kannan and Lamberton, Cait Poynor, An AI Method to Score Celebrity Visual Potential from Human Faces (May 1, 2021).

[15] S. E. Bekhouche, A. Ouafi, A. Taleb-Ahmed, A. Hadid, and A. Benlamoudi, "Facial age estimation using bsif and lbp" arXiv preprint arXiv:1601.01876, 2016.

[16] T. I. Baig *et al.*, "Classification of human face: Asian and non-Asian people" in *2019 International Conference on Innovative Computing (ICIC)*, 2019: IEEE, pp. 1-6.

[17] J.-S. Luo and D. C.-T. Lo, "Binary malware image classification using machine learning with local binary pattern" in 2017 IEEE International Conference on Big Data (Big Data), 2017: IEEE, pp. 4664-4667.

[18] Arslan, B., & Aydemir, E. (2023). Turkish Cinema Faces– Data set. Kaggle. https://www.kaggle.com/datasets/147e6c63e2bcb13f22ebbad54601e9a59c1556d85ed1251fdb6b9c6ecfc94f3d

[19] Chazzer (2022). Smiling or Not– Data set. Kaggle. https://www.kaggle.com/datasets/chazzer/smiling-or-not-face-data?resource=download

[20] Vaidya (2020). Natural Human Face Images for Emotion Recognition – Data set. Kaggle. https://www.kaggle.com/datasets/sudarshanvaidya/random-images-for-face-emotion-recognition

[21] Dalgın, G. T., & Daş, R. Sinema verilerinin Neo4j çizge veritabanı ile modellenmesi ve analizi. Dicle Üniversitesi Mühendislik Fakültesi Mühendislik Dergisi, 15(1), 1-13.

[22] P. Kral and L. Lenc, "LBP features for breast cancer detection" in 2016 IEEE international conference on image processing (ICIP), 2016: IEEE, pp. 2643-2647.

[23] A. Gunay and V. V. Nabiyev, "Automatic age classification with LBP" in 2008 23rd international symposium on computer and information sciences, 2008: IEEE, pp. 1-4.

[24] Karanwal, S. and M. Diwakar (2023). "Triangle and orthogonal local binary pattern for face recognition." Multimedia Tools and Applications 82(23): 36179-36205.

[25] Brownlee, J. (2020, April 27). Histogram-Based Gradient Boosting Ensembles in Python**.** https://machinelearningmastery.com/histogram-based-gradient-boosting-ensembles/

[26] C.-C. Chang and C.-J. Lin, "LIBSVM: a library for support vector machines" ACM transactions on intelligent systems and technology (TIST), vol. 2, no. 3, pp. 1-27, 2011.

[27] Y. Freund and R. E. Schapire, "A desicion-theoretic generalization of on-line learning and an application to boosting" in European conference on computational learning theory, 1995: Springer, pp. 23-37.

[28] M. Hossin and M. N. Sulaiman, "A review on evaluation metrics for data classification evaluations" International journal of data mining & knowledge management process, vol. 5, no. 2, p. 1, 2015.

[29] H. Dalianis and H. Dalianis, "Evaluation metrics and evaluation" Clinical Text Mining: secondary use of electronic patient records, pp. 45-53, 2018.

[30] R. Sonavane and P. Sonar, "Classification and segmentation of brain tumor using Adaboost classifier" in 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC), 2016: IEEE, pp. 396-403.

[31] M. B. Devi and K. Amarendra, "Machine Learning-Based Application to Detect Pepper Leaf Diseases Using HistGradientBoosting Classifier with Fused HOG and LBP Features" in Smart Technologies in Data Science and Communication: Proceedings of SMART-DSC 2021, 2021: Springer, pp. 359-369.

[32] N. V. Smirnov and A. S. Chernyshov, "Emotion recognition from facial images" in 2022 International Russian Automation Conference (RusAutoCon), 2022: IEEE, pp. 116-121.

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