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An Investigation into the Effects of Ablution on Visage Categorization Using Machine Learning Techniques: A Systematic Review

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Abstract:

Introduction: There is a belief in Islam that performing ablution before each prayer usually enhances the brightness of faces. In line with this assertion, there has not been proper scientific proof in determining facial conditions of Muslims in respect of the ablution effect to the brightness of their faces.

Aims: To examine, investigate, and determine the strengths and weaknesses of the available machine learning algorithms for facial image analysis with respect to the effects of ablution on the human visage.

Materials and Methods: The Google Scholar repository yielded 265 publications, all of which were thoroughly reviewed. After our predetermined inclusion and exclusion criteria were applied, only 48 papers were chosen for analysis in this study.

Results: Results show that LBP, PCA, CNN, and SVM are the most frequently used algorithms for facial image categorization systems, and the accuracy of SVM ranged from 94.5% to 96.83%, and CNN returned an accuracy of 98.3%. Results also show there is a correlation between the size of input data and the accuracy of machine learning algorithms.

Conclusion: This suggests that the Support Vector Machine (SVM) algorithm returned a higher accuracy of 96.83% in classification, especially when used with fewer datasets, and CNN worked robustly on larger datasets with an accuracy of 98.3%.

Keywords: Neurotheology, Visage, Ablution, Hadith, Linear Filtering

All co-authors agreed to have their names listed as authors.

1. INTRODUCTION

Ablution, as a ritual cleansing practice in various religious traditions, can be considered within the context of neurotheology [1]. Neurotheology explores the neural basis of religious and spiritual experiences [2]..
Islam as a whole holds the belief that doing ablution *(wudu')* before performing prayer *(solat)* plays a significant role in cleansing various bodily parts. Without a valid ablution, prayer would not be possible [3]. Ablution *(wudu')* is the Arabic word for purity, grace, and light. Muslims make ablutions before prayers [4]. According to Islamic law, ablution refers to act of washing or rubbing specific parts of the body with clean water to purify them in accordance with Allah's laws and regulations. The Hadith and the Qur'an place emphasis on this directive to conduct ablution before observing any prayer [2]. Allah says that *"When you intend to offer prayer, wash your faces and your hands (fore-arms) up to the elbows, rub (by passing wet hands over) your heads, and (wash) your feet up to ankles." (Qur'an, al-Maidah 5: 6).* There exist a religion believe in Islam, picked from prophet Muhammad's word *(Hadith)* which states that *"Verily, my nation will be called on the Day of Resurrection as brightly radiant from the traces of ablution (wudu'). Whoever among you is able to extend his radiance, let him do so" (Ṣaḥīḥ al-Bukhārī 136, Ṣaḥīḥ Muslim 246).* The assertion from the words of prophet has not been proofed scientifically, therefore, visage of praying Muslims should be scientifically processed and compare to those humans who are not regularly performing ablution [5].
An interdisciplinary field called neuro-theology, commonly referred to as bio-theology, investigates the neurological basis of religion [6]. This could be simply refers to as *"the neuroscience of theological belief".* Despite its one-way character, in which information only flows from scientists (neurologists, psychologists, biologists, etc.) to pragmatic (learning) or education, neuroscience research as a field of study has seen remarkable expansion [7]. The understanding of neurotheology has developed over time, and it could be said that philosophy, cognitive science, neurology, psychology, anthropology, theology, religious studies, religious experience, and religious practice are all included in this multidisciplinary field [8].
A component of image processing called visage processing, often referred to as facial image processing, always takes into account the texture, colour, segmentation, etc. of facial images [9]. Part of the most difficult challenges in human visage recognition is facial image analysis. Identifying faces can be difficult due to the variations in facial appearance brought on by a variety of circumstances, including emotion, partial face occlusion, illumination and long-distance data gathering. [10].
A technique for enhancing facial recognition precision and accuracy by combining the Gabor filter and a deep learning neural network with Stacked Sparse Auto Encoders (SSAE) was introduced by Wael and others in 2018. The efficacy of the proposed hybrid model was evaluated utilising the Extended Yale-B databases and the Olivetti Research Laboratory (OLR) face image datasets [11] [12]. All of the visage datasets used in the experiments have the gray scale image type and have resolutions of 192 x 168 for the Enhanced Yale-B database and 92 × 112 for the OLR database. In comparison to the present state-of-the-art face recognition algorithms for all test scenarios, the study findings demonstrated which suggested that the method increased face identification accuracy by almost 100% for both databases utilized at a much faster feature extraction time. Large and complicated datasets can be explored using the SSAE method with little computational effort. The method also increases recognition accuracy while reducing the false acceptance rate. This suggests that the proposed approach is promising and may improve the effectiveness of face recognition systems. [12].
In the field of image processing, these unique qualities are quite beneficial. In the realm of computer vision, there is a lot of interest in the representation and classification of colour and texture [13]. It is challenging to classify unlabeled images or textures into the appropriate labeled class using a process called texture classification. This work is difficult due of some important elements like scaling, viewpoint variations, and changes in illumination. [14].

2. MATERIAL AND METHODS

This study used a systematic review approach, which included the following: quality assessment, data extraction and synthesis, study design, search strategy, and information sources, as well as study selection and data collection.

2.1 Study Design, Search Method and Information Sources

The following procedures make up the search strategy:
(a) Create search terms by utilizing keywords that are pertinent to the goal of this study;
(b) find substitute terms that have the same meaning as the main keywords used;
(c) find some studies that are pertinent to our review;
(d) create exclusion criteria to filter studies that are not pertinent to this study.
(e) Create the required search term using boolean operators.
In order to find publications about the classification of visage photographs in relation to the effects of ablution on its texture, we used the Google Scholar library.

2.1.1 Study Selection and Data Collection Process

The Preferred Reporting Item for Systematic Reviews and Meta-Analyses (PRISMA) criteria were used in this systematic review of the literature. The PRISMA flow diagram for article selection is displayed in Figure 1.

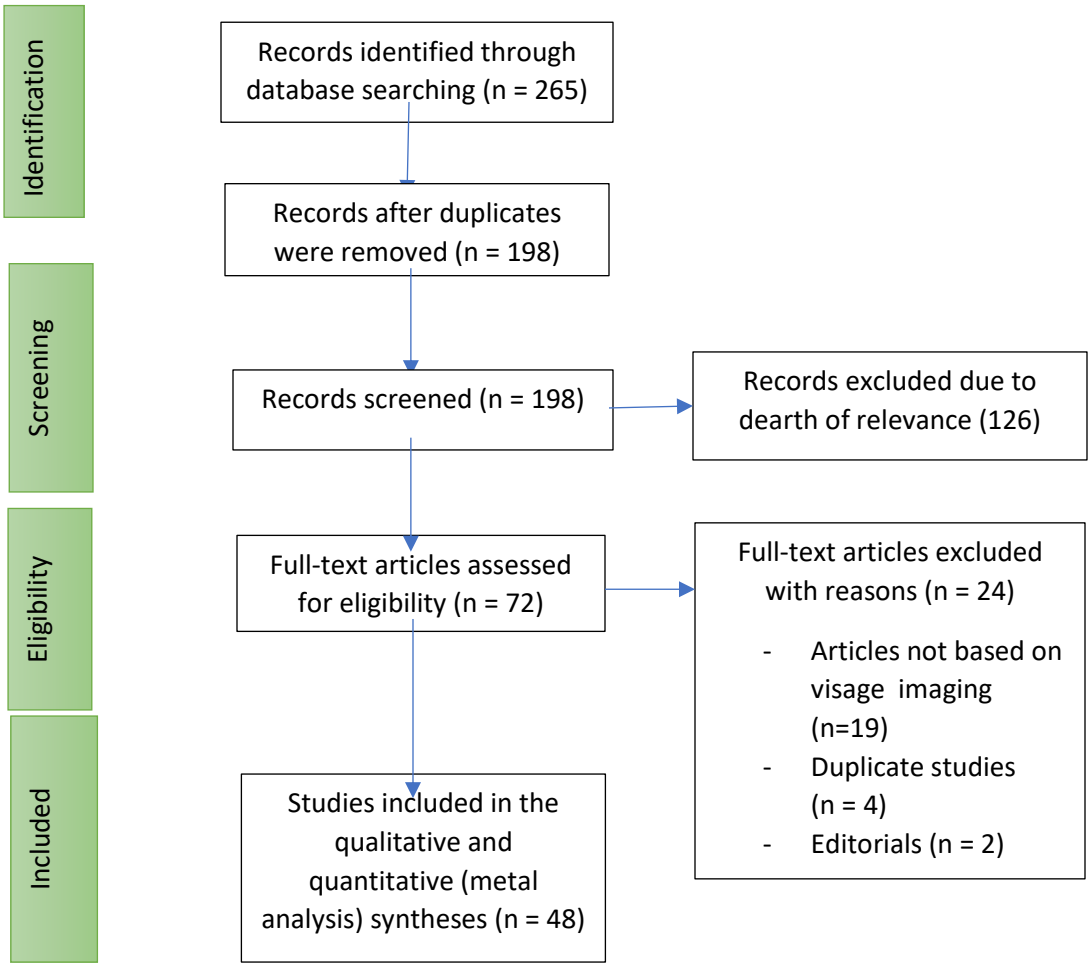

Figure 1: Preferred Reporting Item for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram

2.1.2 Qualifications for Inclusion

Research on several machine learning techniques used in texture classification systems for facial photographs was found and examined. Our research was limited to algorithms for facial skin texture classifications for the purposes of this systematic review. Evaluation metrics, performance, and face image processing are some of the terms that make up our inclusion criteria. The following search terms were used to search through Google scholar for related literature; effects of ablution on human face, facial feature selection algorithms, image processing model, machine learning classification algorithms, metric and

performance evaluation. We also based our reviews on only articles published in English language, which are open access publications. Publications that were not published in English language or do not relate to neurotheology or image processing were excluded.

3. RESULTS AND DISCUSSION

3.1 Results of the Literature Searched

An initial list of 265 studies was produced by the preliminary search for the main study. Subsequently, we excluded studies that did not incorporate the main study in their title and abstract, leaving us with a total of 198 studies. Further, we eliminated studies that did not include the main study in their full text and removed any duplicates. The final selection of 48 studies was recorded.
12 studies were on Support Vector Machine (SVM), 8 study applied Convolutional Neural Network (CNN), 4 applied Local Binary Pattern (LBP), 2 used (PCA) 2 combined Local Binary Pattern (LBP) and Support Vector Machine (SVM), 1 Combined Deep Convolutional Neural Networks (DCNN), 2 each for K-Nearest-Neighbors (KNN), Naive Bayes (NB), Decision Tree (DT), and Logistic Regression (LR). Table 1 presents chronological summary of the review articles, while Table 2 states the features of the included research.

Table 1: Chronological Summary of Researched Papers

Year of publication	Number of papers(48)
2009	1
2012	3
2013	2
2014	1
2017	2
2018	6
2019	9
2020	4
2021	9
2022	8
2023	3

Table 2: The location and features of the included studies.

Features	Quantity of Papers = 48
Year of Publication (Median)	***2018 (2014-20123***
Publication's Country:	
United State of America (USA)	4
United Kingdom (UK)	11
Canada	3
China	6
Pakistan	6
Germany	4
Ireland	5
Nigeria	9
Language English	**48**

3.2 Main Study Results

3.2.1 Table 3. Deduction from a few of the listed studies

S/N	Title of Study	Authors	Year	Methodology	Strength	Weakness	Contribution

1	Research on 3D Face Recognition Method Based on LBP and SVM.	Yongliang Shen, Xia Wang, and Liangliang Shi	2020	The author has employed an LBP and SVM-based method for recognising faces in three dimensions.	Local Binary Pattern combined with the SVM method utilized in this work demonstrated 96.83% recognition accuracy.	The algorithms only worked on small sizes of data.	The LBP's radius, accuracy, speed, and surrounding points' sizes improved the technique
2.	A New Method for Face Recognition Using Convolutional Neural Network	Roman Radil, Patrik Kamencay, Tomas Mizdos, and Miroslav Benco	2017	LBPH, KNN, PCA, and suggested CNN were used to work on Epoch, accuracy, ORL face database.	The best outcomes were obtained by convolutional neural networks. With sophisticated structures, accuracy rates of roughly 98.3% can be attained.	It required large amount of training data before a good result could be achieved.	This work presents an overall demonstration of the recognition accuracy utilising the suggested CNN, PCA, LBPH, and KNN
3.	Skin lesion classification of dermoscopic images using machine learning and convolutional neural network	Rajeswari Chengoden, Bhuvaneshwari Shetty, Roshan Fernandes, Anisha P. Rodrigues, Sweta Bhattacharya, and Kurva Lakshmanna	2022	The suggested study uses CNN and machine learning techniques to categorize the photos of skin lesions.	According to the findings, the customized CNN outperformed the suggested machine learning methods with an accuracy of 95.18%. This implies that for the HAM10000 data set, the suggested CNN performs better in terms of classification.	It required large amount of training data before a good result could be achieved.	To categorize the photos of skin lesions.
4.	Automatic classification of human facial features based on their appearance	Mariano Alcañiz, Valery Naranjo, Jose A. Diego-Mas, and Felix Fuentes-Hurtado	2019	This process helps create facial feature taxonomies and addresses the challenges of categorizing characteristics based on assessments from human observers. For lips, nostrils, and eyes, taxonomies	Every subset of facial traits was subjected to the Eigenfaces technique. In order to streamline the ensuing clustering procedure, an equal number of eigenfaces were chosen for every subset, keeping	Accuracy is low, compare to other machine learning algorithms.	The method for automatically classifying facial characteristics based on their overall look is presented in this work using a computer.

				derived from this process are displayed [15].	in mind that the explained variances consistently accounted for 85% or more of the variances.		
5.	Association between scripture memorization and brain atrophy using magnetic resonance imaging	Irfan Ullah, Benjamin Segun Aribisala, Hammad Omer, and Mukaila Alade Rahman	2021	Volumes of the cerebrospinal fluid, white matter, and grey matter were measured. The brain tissue volumes of those who memorised the full Quran and those who only memorised a portion were compared to the control group using one-way ANOVA in SPSS.	The findings demonstrated that, in comparison to individuals who had not memorized scripture, those who had done so had more brain tissue intact. Age did not significantly differ across the three groups ($p>0.50$). Compared to the control group, the group that learned the Quran by heart had greater quantities of white and gray matter. These results imply that memorizing scripture can improve brain health by keeping our minds active.	The process was not performed using machine algorithms but analysis of MRI.	The research used magnetic resonance imaging techniques to study the relationship between brain tissue and scripture memorization.
6.	Classification Algorithms Research on Facial Expression Recognition	Jun Ou	2022	Using Visual C++, which classifies the emotion of a face expression using a KNN and employs wavelets to extract facial information. PCA is used to choose the features for facial	According to experimental data, the suggested technique performs exceptionally well when used with a face expression recognition system.	The accuracy of the result was very low.	Created a technique for automatically recognizing facial expressions

				representation. The characterization of the facial expression is classified using the KNN.			
7.	Deep face recognition using imperfect facial data.	Hassan Ugail and Ali Elmahmudi .	2019	They employed most recent architecture based on convolutional neural networks in conjunction with using the VGG-Face model that has been trained, which enables us to extract features for machine learning. Next, assess the recognition rates using two classifiers: the linear support vector machine and the cosine similarity.	The findings indicate that while individual facial features, such as the eyes, nose, and cheeks, have low identification rates, when these features are shown as probes in combination, recognition rates rise rapidly.	The algorithm required large number of trained data to achieve a better result.	Developed a computer-based face recognition system using probes made of incomplete facial data.
8.	A New Concept to be Reckoned with: Neurotheology	Alexandru-Corneliu Arion	2015	By claiming that spiritual experiences are somehow created by the brain, writers who adhere to a materialist ontology and a reductive theory of the mind not only argue for neural correlates of spiritual experience but also want to completely eradicate spirituality. The author examines several areas of the "neuroscience	The frontal lobes, parietal lobes, and limbic systems of the patients with Alzheimer's and Parkinson's disease all displayed similar elevated activity, the researchers discovered. Despite the fact that different individuals have interpreted the data differently, it is evident that prayer and meditation appear to have	The research work was limited to analysis of the effects of meditation and spirituality.	The study at the nexus of psychology, religion and spirituality, and neuroscience serves as a focus for the paper's discussion of one of the most prominent manifestations of the long-standing confrontation between science and religion.

				of enlightenment," including the brain [16]	a special biochemical impact on the brain.		
9.	Supervised Learning Methods for Skin Segmentation Based on Pixel Color Classification	Farou Zakarya and Taan Ahmad	2021	K-Nearest-Neighbors (KNN), Decision Trees (DT), Support Vector Machines (SVM), Naive Bayes (NB), and Logistic Regression (LR) are being contrasted. Data was transformed from RGB to YCbCr color space, which improved the classification of skin from non-skin [17].	After multiple studies, it was determined that KNN is the most preferred model due to its stable performance, even with established comparison criteria.	The best machine learning algorithm was not clearly stated. The strength and weakness of these algorithms were not stated as well.	An analysis of five popular supervised learning algorithms for the color-based segmentation of skin in images
10.	Colour and Texture Identification Using Image Segmentation	Nida Rehman, Poonam Sinha	2014	The suggested approach efficiently recovers the object contour by automatically merging the first mean shift segmentation-segmented regions. It then compares the resulting mask with test database image sets based on texture and color [18].	The simulated outcomes demonstrate that the suggested strategy can successfully match face image sets with the mask and create the mask from the face image in a dependable manner.	Machine learning algorithms were not involved in the work. Low accuracy was recorded too.	This study presents the Mean shift with region merging technique for picture segmentation. In order to do this, a set of face photos must be compared using a face image database in order to make recognition decisions.
11.	Skin Characterizations by Using Contact Capacitive Imaging and High-Resolution Ultrasound	Andrey Chirikhin, Francesco Bianconi, Sabina Dewsbury-Ennis, Elena Chirikhina, and Perry Xiao	2021	Used transfer learning to train Deep Learning Neural Networks for picture classification [19].	According to the findings, the cheek, eye corner, and under-eye areas have the most water content, while the lips and nose have the	The result achieved was low in accuracy.	Investigated the water content of the skin at several skin areas using machine learning techniques for high-resolution ultrasound

	Imaging with Machine Learning Algorithms				lowest. The classification has an accuracy of up to 83.8%.		imaging and contact capacitance imaging.
12.	A Hybrid Method of Enhancing Accuracy of Facial Recognition System Using Gabor Filter and Stacked Sparse Autoencoders Deep Neural Network	Harprith Kaur Rajinder Singh, Opeyemi Lateef Usman, Ravie Chandren Muniyandi, and Abdullah Ghanim Jaber	2021	The study suggested a technique that combines a Gabor filter with a stacked sparse autoencoders (SSAE) deep neural network to improve face recognition accuracy and precision.	When compared to the state-of-the-art face recognition algorithms now in use, experimental results demonstrate that the suggested method improved face identification accuracy for the two databases studied by over 100% at a much quicker feature extraction time for all test instances.	Using fewer datasets pose a potential bad result.	Created a facial recognition tool that can recognize faces accurately even in the absence of substantial training data samples.

3.2.2 Types of Visage Categorization Machine Learning Algorithms

3.2.2.1 Convolution Neural Network

Owing to its ability to identify patterns in images, a convolutional neural network (CNN) is a type of artificial neural network that is mostly used for image recognition and processing [20]. A regularized kind of feed-forward neural network, the convolutional neural network (CNN) uses filter (or kernel) optimization to teach itself feature engineering [21] [22]. In early neural networks, backpropagation is protected against shrinking and increasing gradients by using regularized weights over fewer connections [23].

3.2.2.2 Local Binary Patterns

One of the best texture descriptors is known as local binary patterns (LBP) [35]. LBP was first introduced by Ojala et al. and is used to represent the local features, also known as the focal points, of an image [24]. The center pixel of the window used by the standard LBP operator is thought of as a threshold; if the adjoining pixel's value is less than the threshold value, the pixel value is labeled as 0, otherwise it is 1 [25].

3.2.2.3 Principal Component Analysis

One common dimensionality reduction method used in machine learning applications is Principal Component Analysis (PCA) [26]. By transforming a large number of variables, PCA reduces their information into a smaller number of variables [27]. Linearly linked variables become uncorrelated when the transformation is applied in this manner. Information can be compressed if it is possible to lessen the redundancy of the information, as correlation indicates [28].

3.2.2.4 K-Nearest Neighbour

A data science methodology called KNN (K-Nearest Neighbours) is used to find the approximate neighbors who are closest to the input data [29]. Any format may be used for the input data (in our example, photos).

In order to compare photographs, they must first be converted into vectors in a multidimensional plane. A three-dimensional image can be processed using KNN by first being converted into a single-dimensional vector, which is then fed into the KNN algorithm [30].

23.2.2.5 Extreme Learning Machine
A single layer of hidden nodes makes up the Extreme Learning Machine (ELM) technique, which is basically a single feed forward neural network with randomly set weights between inputs and hidden nodes [31]. Extreme learning machines are feed forward neural networks with one or more layers of hidden nodes for feature learning, classification, regression, clustering, sparse approximation, compression, and regression where the parameters of the hidden nodes (and not just the weights connecting inputs to hidden nodes) must be adjusted. These hidden nodes may be randomly assigned and never changed (i.e., random projections with nonlinear transforms) or they may be inherited from their predecessors in an unchanged state. Like learning a linear model, output weights of hidden nodes are usually learned in a single step [32].

3.2.2.6 Support Vector Machine (SVM)
Regression and classification issues in machine learning are addressed by supervised learning techniques like support vector machines [33]. SVMs are particularly good at solving binary classification problems, which involve splitting a data set's objects into two groups [34]. Applications of Support Vector Machines (SVMs) include handwriting recognition, web pages, email classification, face detection, intrusion detection, and gene classification [35]. SVMs are used in machine learning for this reason, among others. It is capable of handling regression and classification on both linear and non-linear data [36].

Table 4: Machine Learning Algorithms included in this study

Machine Learning Algorithms	**Number of Studies**
Support Vector Machine (SVM)	12
Convolutional Neural Network (CNN)	8
Local Binary Pattern (LBP)	4
Principal Components Analysis (PCA)	3
Deep Convolutional Neural Networks (DCNN)	1
K-Nearest-Neighbors (KNN)	3
Naive Bayes (NB)	2
Decision Tree (DT)	3
Extreme Learning Machine (ELM)	2
Logistic Regression (LR)	3
LBP, SVM	2
PCA, LR	1
PCA, CNN	1
Random Forest (RF)	3

3.3 Study-Based General Deduction

The purpose of this study is to evaluate current machine learning techniques for facial image classification and to determine their strengths and weaknesses. The outcome demonstrates that most algorithms used to classify visages returned high accuracy depends on size of input data. Though Local Binary Pattern (LBP), Principal Component Analysis (PCA), Convolutional Neural Network (CNN) and Support Vector Machine (SVM) are the most frequently used algorithms for facial image categorization system and the accuracy of SVM ranged from 94% to 96% and CNN returned accuracy of 98.3%. Results also show there is correlation between the size of input data and result accuracy in Machine Learning algorithms. All these algorithms are using the traditional evaluation metrics to determine the accuracy, precision, recall, F1-Score and ROC, except the PCA which a preprocessing tool.
SVM posed to be a good algorithm in high dimensional spaces with respect to its versatility to different kernel functions for different decision boundaries. Though it lacks good performance on a very large

dataset. LBP is very simple and computationally efficient in texture categorization, though with limited discriminative in very large datasets. CNN is more advanced algorithm and can take care of deficiencies identified in LBP. This suggests that the Support Vector Machine algorithm produced a better level of accuracy of 96.83% in classification, especially when used with fewer datasets and CNN performed better on larger datasets with an accuracy of 98.3%.
This study's strength is that it employed a methodical approach to find all prior research on the classification of facial images using both machine learning and deep learning methods. This enables us to conduct the study using a set of well selected search phrases. Additionally, the inclusion and exclusion criteria were determined using a standard method. This made it possible for us to save and examine only the pertinent materials. This study's utilization of the Google Scholar repository is another asset. This has the advantage of ensuring that all relevant papers are linked because Google Scholar is linked to all other sources.

4. CONCLUSION

This study carried out a systematic review of the classification of facial images. We discovered that the Support Vector Machine (SVM) algorithm produced greater accuracy of (96.83%), which is supported by the majority of studies and is higher than other machine learning algorithms in classification, especially when used with fewer datasets. It was also discovered that CNN and LBP algorithms performed better in the area of feature extraction from the visages. CNN worked robustly on larger datasets with an accuracy of 98.3%.
To facilitate the creation of new models by hybridizing these algorithms to increase accuracy, we recommend additional research in this area.

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