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Intelligent Human Age Estimation System

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The estimate of age from face images needs a considerable amount of information from input image. Extracting those characteristics is highly important due to the fact that the efficiency of a system of age estimation will be highly dependent on the obtained features quality. A considerable amount of studying the estimation of age was proceeding in the direction of extracting aging features. In this work a proposed system for age estimation is used to classify the face image to different classes (three age classes were suggested), the face image is preprocessed to keep only valuable information within the system. The resulted image will extract to feature using Linear Discriminant Analysis LDA feature extraction which will later be optimized using hybrid feature optimization algorithms (FIREFLY-Bat) the resulted features are classified using the J48 and a decision table classification algorithms and the results show that the suggested system has given precision 90.45% and MAE by 1.14 with J48 classifier and attained a precision 87.05% and MAE by 7.57 with a Decision Table classifier.

Keywords: Age estimation, Viola jones, LDA, Firefly algorithm, Bat algorithm, J48, Decision Table

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يتطلب تقدير العمر من صور الوجوه كمية كبيرة من المعلومات من الصورة المُدخلة. ويُعد استخراج هذه الخصائص بالغ الأهمية، نظرًا لأن

كفاءة نظام تقدير العمر تعتمد بشكل كبير على جودة السمات المُستقاة. وقد اتجهت دراسات تقدير العمر بشكل كبير نحو استخراج سمات الشيخوخة. في هذا العمل، يُستخدم نظام مقترح لتقدير العمر لتصنيف صور الوجوه إلى فئات مختلفة (اقتُرحت ثلاث فئات عمرية)، وتُعالَج صورة الوجه مسبقًا للاحتفاظ بالمعلومات القيّمة فقط داخل النظام. سيتم استخراج الصورة الناتجة باستخدام تحليل التمييز الخطي(LDA) ، والذي سيتم تحسينه لاحقًا باستخدام خوارزميات تحسين الميزات الهجينة .(FIREFLY-Bat) صُنفت الميزات الناتجة باستخدام خوارزمية J48 وخوارزمية تصنيف جدول القرار. وتُظهر النتائج أن النظام المقترح قد حقق دقة 90.45% ومتوسط خطأ تقديري (MAE) بنسبة 1.14 باستخدام مصنفJ48 ، ودقة 87.05% ومتوسط خطأ تقديري (MAE) بنسبة 7.57 باستخدام مصنف جدول القرار.

الكلمات المفتاحية: تقدير العمر، فيولا جونز، LDA، خوارزمية Firefly، خوارزميةBat ، J48، جدول القرار

1. INTRODUCTION

In the past few decades, the age estimation of humans from visible data like video data and still images is one of the interesting researches because of many prospective applications like the development of intelligent human-machine interfaces and refinement of safety and protection in various sections as convey, security, and medicine [1]. The estimation of age using numerical facial image analysis may be implemented in a wide range of potential implementations like developing intelligent human-machine interfaces and improving the protection and safety of young people in a variety of certain sectors such as medicine, transport, business, banks, and so on [2]. It may be highly beneficial for developed video monitoring, business intelligence, demographic statistics gathering, enhancement of search in large databases, and patron profiling. The attribute of the age may as well be utilized in verifying faces and enriching tools which are utilized in the investigations of the police. Generally, automatic age estimate by the machine is beneficial in applications in which the goal is determining a person is without recognizing him [3].

2. RELATED WORKS

Several researchers and methods have been reported in human face recognition [4] and the human age estimation field. For human age estimation, X. Wang, R. Li, and et al, proposed a new method for feature learning which has been based on Convolution Sparse Coding CSC which is capable of automatically learning the characterization of aging signatures. They have verified that the learning method is capable of extracting localized subtle features of aging such as the Convolutional Neural Networks (CNN). In addition to that, they have employed the pooling of standard deviation (STD) for summarizing the feature of aging. Ultimately, the obtained features have been fed to a discriminative manifold framework of learning for obtaining low-dimensional representations which are more discriminative and additionally enhance computational efficiency [5]. The method uses the FG-NET database [6] and the MAE value was 4.01.

Ayad R. Abbas and Asaad R. Kareem [7], they proposed a system for intelligent age estimation from facial images by applying the machine learning technique using the J48 classifier on the FG_NET database. The proposed work consists of three stages, the first stage is image preprocessing, the second stage is the data mining process, and the third stage includes two phases, estimation, and evaluation. The MAE value is equal to 1.48.

S. Taheri and Ö. Toygar [8], they used 2-level fusion scores and features by using score-level and feature-level methods of fusion. The feature-level fusion of texture-based and biologically inspired approaches has been integrated into the suggested approach, and their combination has been merged with the appearance-based approach with the use of score-level fusion. The obtained experimental results which have been implemented on publicly available FG-NET dataset

have proven the efficiency of the presented approach and the value of the mean absolute error was equal to 4.06.

3. THEORETICAL BACKGROUND

3.1 Viola-Jones Algorithm

Viola-Jones algorithm is a popular algorithm for face detection. Viola-Jones algorithm has four steps haar feature, an integral image, Adaboost classifier learning, and Cascading Classifiers. This method improved speed and accuracy in real-time and training rates [9].

3.2 Linear Discriminant Analysis (LDA) Algorithm

LDA is a popular technique used for dimensionality reduction and classification, it provides class reparability by drawing a decision region among the various classes. LDA tries to maximize the ratio of the between-class variance and the within-class variance [10].

3.3 Firefly Algorithm and Bat algorithm

Firefly algorithm classified as a swarm approach and it which based on the flashing patterns and conduct of fireflies. Firefly is formulated by Xin-She Yang with the presumption [11]:

1. Unisexual are all the fireflies, that is why every firefly is attracted to others.
2. Brightness has immediate proportionality with attractiveness, and for pair of two fireflies, the one with less brightness will be attracted to the greater brightness and with the rise in the distance, there is a reduction in the distance.
3. If no brighter firefly is found than the given one, a motion will be random.

Bat algorithm, suggested by Yang, is a meta-heuristic algorithm inspired by charming capabilities of bats like trying to imitative the behavior of hunted for their prey and discriminating various types of insects even in the darkness. The bat algorithm operates based on the echolocation ability that makes them charming [12].

3.4 J48 Algorithm

This J48 classifier is supervised technique will take the strongest feature as a root node and two others as (branch and leaf) nodes, the classification process start by dividing the entire features to many subsets which are used to build the decision tree inclemently, top-down nature of this algorithm to work with greedy search through all the possible features branches [13].

3.5 Decision Table

This is a precise approach for the numerical predictions from the decision trees and it's an ordered group of rules of the "If-Then" type, which can potentially be of a higher level of compactness and as a result more comprehensible compared to decision trees. Selecting for exploring decision tables due to the fact that they are less complicated and less compute-intensive compared to decision tree-based approaches [14].

4. DATASET

The proposed system uses the FG-NET dataset which is shown in Table 1. The data used in this research is grouped into three classes i.e the features are extracted for each class consolidates since it has a similar number of features each class has its very own age scope which is shown in Table 2. The estimation of age will insinuate to the results of every order procedure done which will specify to which class this information has belonged.

Table (1). The dataset summarization

Element	Details
No. of faces images	890
No. of persons	82 different individuals
Age scope	3 years to 50 years

Table (2). The Classes summarization

Class Number	Age Scope
Class 1	3-7 and 26-30 years
Class 2	8-13, 14-19 and 20-25 years.
Class 3	31- 40 and 41-50 years

5. PROPOSED SYSTEM

Age estimated system is a new defies for investigators such a system aim to guess the age of the system user via image by extracting features and classify it for an estimate of the age of the human-based on these features. In this part of research a flowchart, algorithms and detailed about the proposed system is provided. As shown in Fig.1, the proposed system consists of many phases which are:

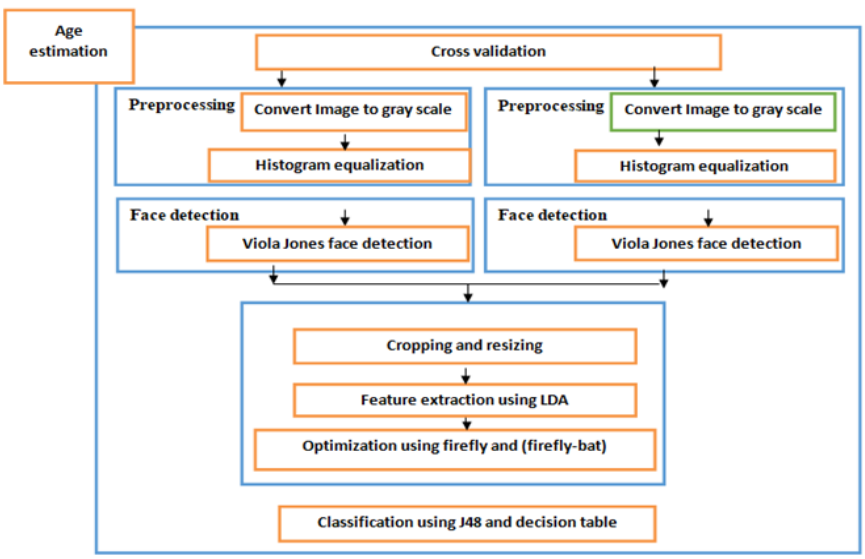
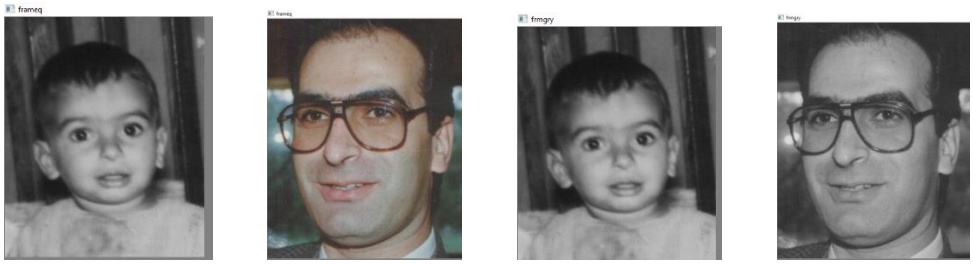


Fig.1. Age estimation system architecture

(A) Pre-processing phase

Preprocessing is enhancing the image data which overcomes the reluctant distortions or improving certain features of the image that are of high importance for additional processing and is used to reduce the amount of data to be processed and to remove the noise that may affect the extraction of features later. In this research, a simple RGB to grayscale converter is used and histogram equalization. Fig. 2 shows the original image and the grayscale image, and Fig. 3 shows the image after applying histogram equalization.



(a) (b) (c) (d)

Fig.2. (a,b) Original face image, (c,d) Grayscale image

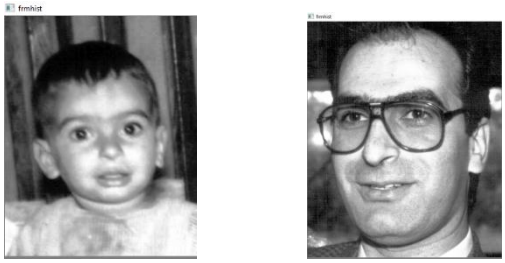


Fig.3.Histogram equalization

(B) Face detection phase

The first step in this stage is face detection which aimed to extract the region of interest (human face) in the proposed system. In this phase, the Viola-Jones algorithm is used for face detection operation. The images are cropped and resized to unique the whole data used in the system. The elimination of weak data is done via extract the correlated data using feature extraction algorithms. In this step, the LDA algorithm for feature extraction was applied. The result of applying the

Viola-Jones face detection algorithm is shown in Fig. 4 and the crop resizing image is shown in Fig. 5.

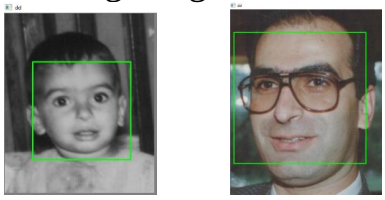


Fig.4. Viola-Jones face detection

Fig.5.Cropped and resized image

(C) Feature optimization phase

The number of obtained features from the previous step is huge and it needs to be reduced, this can be done by applying such techniques based on swarm algorithm. In this system, we using the hybrid optimization (Firefly - Bat) algorithm.

(D) Classifications phase

The age decade is classified into different classes; These classes represent the age periods. The features belong to a certain age period will be classified in the system by using machine learning classification algorithms, and the used algorithm here is, J48 and Decision Table classifiers. Finally, age estimation which is the prediction of human age is done according to the classification step which will verify the age group of each person.

6. SYSTEM EXPERIMENTAL RESULTS

First scenario: After selection the features in the features selection phase, the LDA algorithm is applied for feature extraction in the face detection phase, and hybrid technique (firefly and bat) algorithms are

used for feature selection in the feature optimization phase. While for classification, the J48 algorithm is used in the classification phase. The results of this scenario are shown in Table 3.

Table (3). (LDA-HYBRID- J48)

	(0-7)(26-30)	(31-40)(41-50)	(8-13)(14-19)(20-25)
True Positive Rate	95.81395348837209	78.125	95.59902200488997
True Negative Rate	99.54655454282	99.0758423079068	99.74755109842
Precision	95.86257947867452	79.67881944444444	95.80134474327629
Recall	95.81395348837209	78.125	95.59902200488997
F-Measure	95.80796240493702	78.13283025454078	95.60039981760937
Mean Absolute Error	0.83720930230232	2.09722222222	0.48899755501
Root Mean Squared Error	9.14991421	13.8744369	6.99283601
Total Number of Instances	215.0	96.0	409.0
Correct	206.0	75.0	391.0
Incorrect	9.0	21.0	18.0

Second scenario: After selection the features in the features selection phase, the LDA algorithm is applied for feature extraction in the face detection phase, and hybrid technique (firefly and bat) algorithms are used for feature selection in the feature optimization phase. While for

classification, the Decision Table algorithm is used in the classification phase. The results of this scenario are shown in Table 4.

Table (4). (LDA – HYBRID – Decision Table)

	(0-7)(26-30)	(31-40)(41-50)	(8-13)(14-19)(20-25)
True Positive Rate	84.651162790697	81.25	97.799511002444
True Negative Rate	97.41425189033	98.34292208229	99.84483867368
Precision	87.07597328323605	76.23766447368422	97.84268314769537
Recall	84.65116279069768	81.25	97.7995110024449
F-Measure	84.3935278086204	77.4022289550874	97.80254251516345
Mean Absolute Error	9.52849963505	8.14445052950	5.03799852674
Root Mean Squared Error	18.1928970	18.8364221	11.4897594
Total Number of Instances	215.0	96.0	409.0
Correct	182.0	78.0	400.0
Incorrect	33.0	18.0	9.0

According to Tables (3,4), and Figures (6,7,8,9,10,11), the first scenario is giving the best results than second scenario.

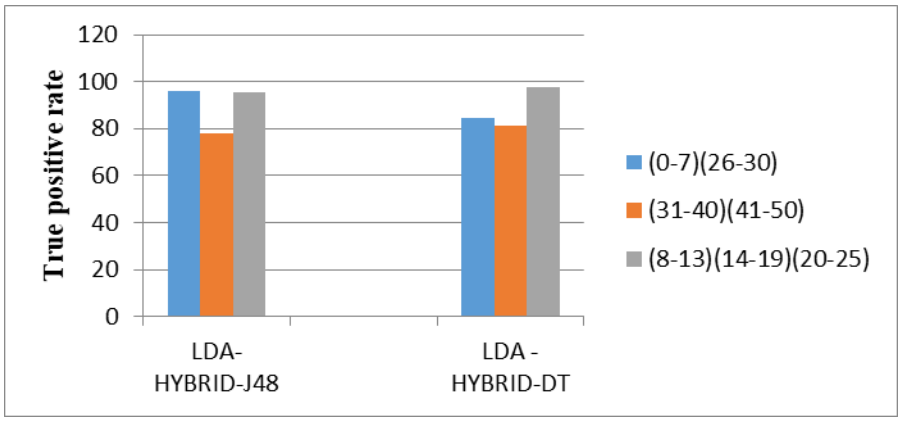


Fig.6.True Positive Rate of the two scenarios

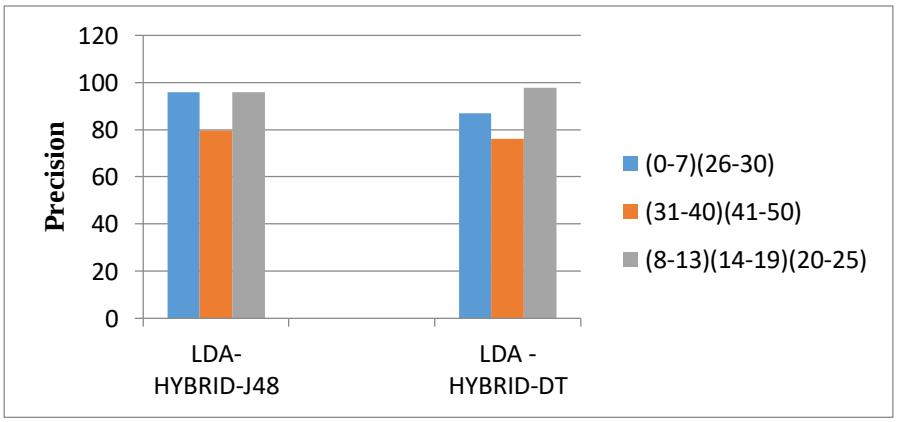


Fig.7.The precision of the two scenarios

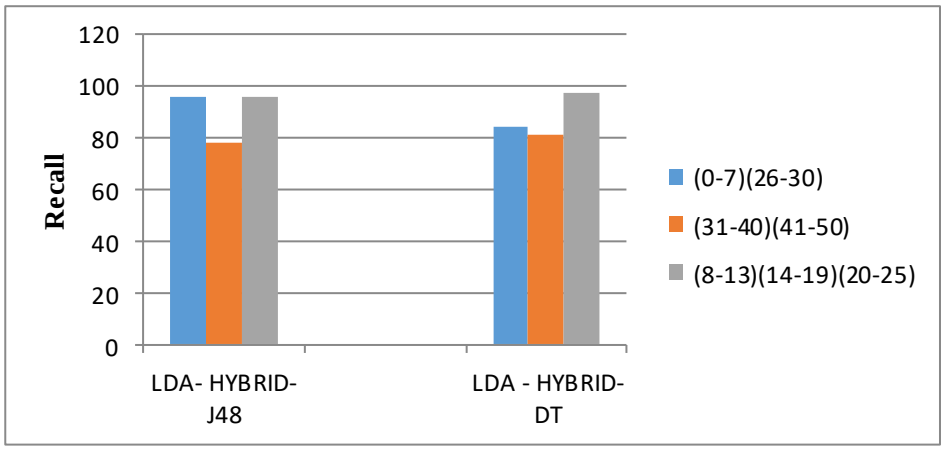


Fig.8.The Recall of the two scenarios

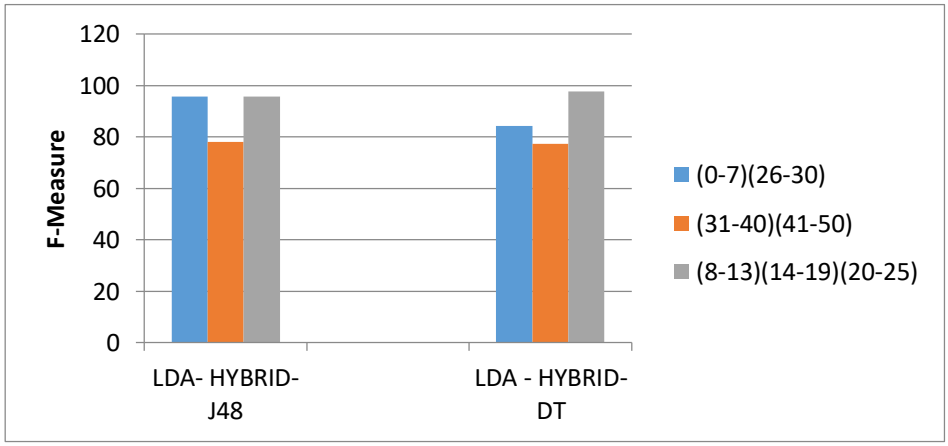


Fig.9.F-Measure of the two scenarios

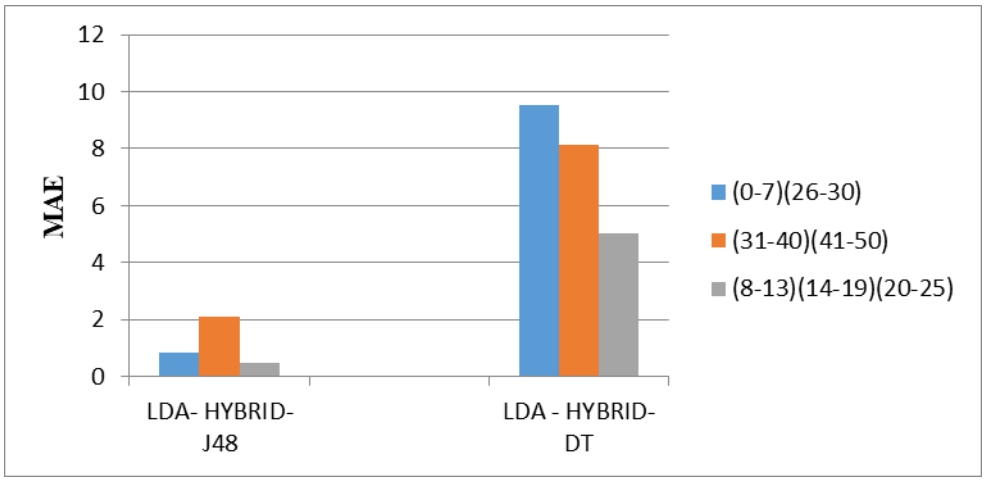


Fig.10.Mean Absolute Error of the two scenarios

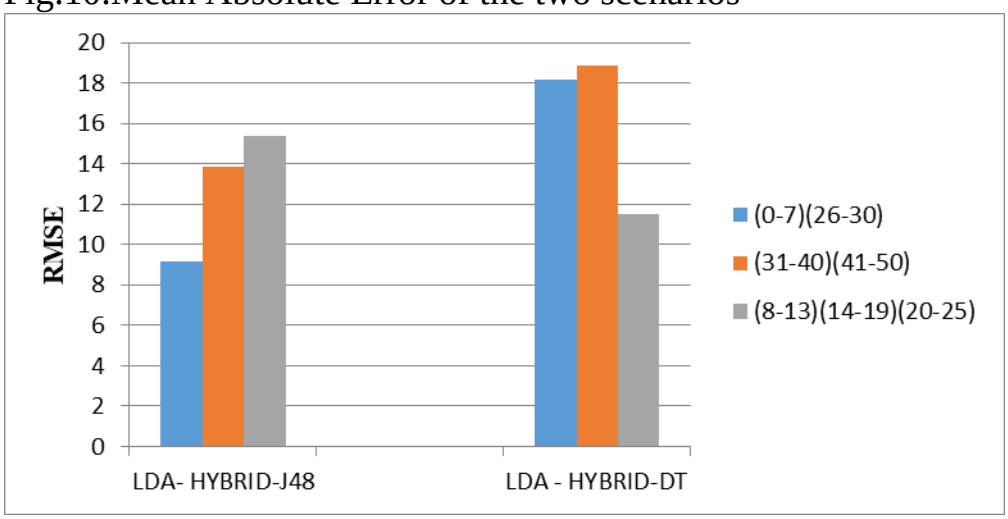


Fig.11.Root Mean Squared Error of the two scenarios

7. CONCLUSIONS

Age estimation technicality needs to be accurate to estimate and predict the age of persons. The scenario of using LDA with hybrid (Firefly-Bat) and J48 algorithms gives the best results than the other scenario of using LDA with hybrid (Firefly-Bat) and Decision Table as shown in tables results of the proposed system are affected by many factors.

REFERENCES

1. M. M. Dehshibi and A. Bastanfard, "A new algorithm for age recognition from facial images", *Signal Processing*, vol. 90, no. 8, 2010, pp. 2431–2444.

2. S. N. Kohail, "Using artificial neural network for human age estimation based on facial images", *International Conference on Innovations in Information Technology (IIT)*, 2012, pp. 215–219.

3. R. Arroyo, J. J. Yebes, L. M. Bergasa, I. G. Daza, and J. Almazán, "Expert video-surveillance system for real-time detection of suspicious behaviors in shopping malls", *Expert Systems with Applications*, vol. 42, no. 21, 2015, pp. 7991–8005.

4. J. M. AL-Tuwaijari, S. I. Mohammed, "Performance Evaluation of Face Image Recognition Based Voila–Joins with SVM", *Iraqi Journal of Information Technology*. V.9 N.3. 2019.

5. X. Wang, R. Li, Y. Zhou, and C. Kambhamettu, "A Study of Convolutional Sparse Feature Learning for Human Age Estimate", *12th IEEE International Conference on Automatic Face & Gesture Recognition (FG)*, 2017, pp. 566–572.

6. Fg-net. The Fg-net Aging Database. Available from: http://wwwprima. inrialpes.fr/FGnet/html/benchmarks.html. [Accessed 19th Aug 2019].

7. A. R. Abbas, and A. R. Kareem "Intelligent Age Estimation From Facial Images Using Machine Learning Techniques", *Iraqi Journal of Science*, vol. 59, no. 2A, 2018.

8. S. Taheri and Ö. Toygar, "Integrating Feature Extractors for the Estimation of Human Facial Age", *Applied Artificial Intelligence*, vol. 33, no. 5, 2019, pp. 379–398.

9. N. Hazim, S. Sameer, W. Esam, and M. Abdul, "Face Detection and Recognition Using Viola-Jones with PCA-LDA and Square Euclidean Distance", *International Journal of Advanced Computer Science and Applications (IJACSA)*, vol. 7, no. 5, 2016, pp. 371–377.

10. C. N. Li, Y. H. Shao, and N. Y. Deng, "Robust L1-norm two-dimensional linear discriminant analysis", Neural Networks, vol. 65, 2015, pp. 92–104.

11. I. Fister, X. Yang, D. Fister, and I. F. Jr, “Firefly Algorithm: A Brief Review of the Expanding Literature”, *Springer International Publishing Switzerland*, vol. 516, 2014, pp. 1–26.

12. P. Shrivastava, A. Shukla, P. Vepakomma, N. Bhansali, and K. Verma, “A survey of nature-inspired algorithms for feature selection to identify Parkinson’s disease”, *Computer Methods and Programs in Biomedicine*, vol. 139, 2016, pp. 171–179.

13. J.R. Quinlan, Induction of Decision Trees, *Research and Development in Expert Systems XV*, vol. 1, 1986, pp. 15–26.

14. S. Kalmegh, “Comparative Analysis of the WEKA Classifiers Rules Conjunctiverule & Decisiontable on Indian News Dataset by Using Different Test Mode”, *International Journal of Engineering Science Invention (IJESI)*, vol. 7, no. 2, 2018, pp. 1–9.