AECDI : طريقة محسنة لتصنيف صور الاسنان

د. عمار ظاهر ياسين ال عبد العزيز

جامعة الموصل – كلية علوم الحاسوب والرياضيات – قسم علوم الحاسوب

AECDI: An Enhanced Approach For Classifying Dental Images

Dr. Ammar Thaher Yaseen Al Abd Alazeez
University of Mosul – College of Computer Science and Mathmatics - Computer Science Department
ammarthaher@uomosul.edu.iq

Abstract:

The face is the most significant element which is noticeable on first sight for a person. Soft tissue of the face and the basic dentoskeletal tissues characterizes the facial qualities of an individual. Social acknowledgment, mental well-being, and self-esteem of an individual are identified with physical appearance. The view of an alluring face is to a great extent emotional with ethnicity, age, sex, culture, and character impacting normal facial characteristics. Strangely, facial highlights are normally concentrated in profile. Orthodontic finding and treatment arranging are progressively being founded on profiles as opposed to only on Angle's idea of molar relationship. It was perceived that specific skeletal rakish standards, measure of tonicity of the soft tissue, and facial solid stance can impact the examination of the profile.

One of the incredible difficulties in orthodontics is the treatment arranging and the executives of orthognathic careful cases. These cases require a blend of both orthodontics and orthognathic medical procedure to accomplish an even impediment, appropriate capacity, and amicable facial feel. Early analyze of malocclusion is extremely helpful to get appropriate teeth straight. Therefore, in this paper we built up a basic PC supported program that could help arranging teeth impediment. In other word, we snap a photo of individual and group it into one of the three fundamental sorts Class I, Class II, and Class III. This examination gives information which can be utilized in treatment arranging by experts, for example, orthodontists, prosthodontists, plastic specialists, and maxillofacial specialists, who have the capacity to change the soft tissue facial highlights.

Keywords: Image Segmentation Algorithms, Image Analysis, Malaclusion, Straight Teeth**.**

الملخص:

الوجه هو الجزء الاهم من الجسم لانه يحتوي على المظهر الخارجي للانسان. تحليل انسجة الوجه مع تحليل النسيج العظمي للجمجمة يحددان الخصائص المميزة للشخص. القبول المجتمعي والسايكولوجي معروفان جدا للجميع وهما متعلقان بالخصائص الفيزيائية للشخص. مفهوم الاعجاب بالوجه هو خاص جدا لانه متعلق بعدة امور دقيقة منها العرق، العمر، الجنس، الثقافة، والتاثير الشخصي بالتعامل مع الاخرين. ومن الملفت للنظر ان خصائص الوجه هي عادة تدرج في الملف الشخصي للفرد. التشخيص الفمي وخطط العلاج في ازدياد مستمر بالاعتماد على المعلومات الشخصية بدلا من الاعتماد فقط على شكل الاسنان. كان من الواضح في الدراسات السابقة ان هناك بعض المعايير لشكل الجمجمة والتحليل النسيجي والشكل العام للوجه والتي من الممكن ان تؤثر على المعلومات الشخصية للفرد.

من التحديات الصعبة في علم الاسنان هو الخطط العلاجية وادارة الحالات المرضية الخاصة والتي تتطلب تدخلات جراحية. هذه الحالات تتطلب دمج بين علم تقويم الاسنان والتدخلات الجراحية لانجاز التوازن المطلوب في عملية اطباق الاسنان والحصول على وظائف فمية مميزة كالنطق الواضح وكذلك الحصول على التجميل المنسجم للوجه. التشخيص المبكر لحالات الاطباق الفمي غير الصحيح مهم جدا للحصول على اطباق اسنان ميميز. لذلك في هذا البحث قمنا بتطوير برنامج حاسوبي بسيط للمساعدة في تصنيف حالات اطباق الاسنان. بتعبير آخر، في هذا البرنامج نقوم باخذ صورة لشخص ما وتصنيفها الى احد

التصانيف الثلاثة المشهورة Class I , Class II, Class III. هذه الدراسة تقدم معلومات من الممكن ان تستخدم في الخطط العلاجية لاطباء الاسنان واطباء التجميل والتعويضات البلاستيكية وجراحوا الوجه والفكين والذين يملكون القدرة على تغيير خصائص المظهر الخارجي للوجه.

الكلمات المفتاحية: خوارزميات تقطيع الصور، تحليل الصور، حالات اطباق الاسنان غير الصحيحة، تقويم الاسنان.

4- Introduction

Orthodontics is a part of dentistry that treats malocclusion, a condition where the teeth are not accurately situated when the mouth is shut. This outcomes in an ill-advised nibble. An orthodontist has practical experience in making the teeth straight. Treatment may be cosmetic; to improve an individual's appearance, yet it regularly means to improve oral function, too [1].

The accomplishment of an orthodontic treatment is every now and again identified with the improvement picked up in the patient's facial appearance, which incorporates the soft tissue profile. The face is considered as most factor some portion of the body, factors rely on shape, size, highlights or mix of these. Also, since there is significant variety in the soft tissue covering the face, deluding ends can be delivered if finding and treatment arranging depend on dental and skeletal estimations alone [2].

The utilization of Computer-aided diagnosis (CAD) of infection is entrenched in clinical radiology, having been used since the 1980's at the University of Chicago and other clinical places for help with the determination of lung knobs, bosom disease, osteoporosis and other complex radiographic errands. A significant qualification has been made in the clinical network between mechanized PC conclusion versus PC supported finding. The fundamental difference is that in computerized PC finding, the computer does the assessment of the symptomatic material, i.e., radiographs, and arrives at the last conclusion with no human information. In PC supported finding; both a clinical practitioner and a PC assess the radiograph and arrive at a determination independently. Contingent upon the expert's certainty level, the person in question will at that point either make the last determination or utilize the PC's analysis, in the event that it is not quite the same as the professional's [3].

Orthodontics, feel, and visual guides for soft tissue forecast have advanced since the mid 1970s from the utilization of acetic acid derivation following paper to PC based line drawings to increasingly present day advances during the 1990s where PCs could adjust tolerant photos trying to foresee careful results. Visual treatment objective (VTO) pictures help the orthodontist to anticipate hard and soft tissue changes that may happen because of medical procedure and can be used to treatment plan orthognathic cases and to speak with patients and specialists. 70% of imminent orthognathic medical procedure patients notice feel as their guideline inspiration, further featuring the significance of soft tissue treatment arranging [4].

It is the specialist's legitimate, moral, and moral duty to educate the patient regarding the dangers versus benefits, choices of disguise versus medical procedure, and treatment versus no treatment. Nonetheless, VTOs may prompt unreasonable patient desires causing disappointment with postsurgical results. This is a substantial worry, as the mistakes of the expectation in two-jaw careful cases are not surely known [4].

Early analyze of malocclusion is valuable to get legitimate teeth straight and help in a sharp decline in the dental sickness rate. On account of the developing availability to clinical imaging, the clinical applications currently have better effect on persistent consideration [5]. Along these lines, in this paper we built up a basic PC supported program that could help characterizing teeth impediment. In other word, we snap a photo of individual and arrange it into one of the three primary sorts Class I, Class II, and Class III to help for additional treatment. We propose the new method depending on image processing and statistical techniques. This technique is based on pre-processing images, dividing the dataset into two groups, training dataset and testing dataset, and classifying the new images. The novelty here is to develop a simple image processing method combining with basic

statistical techniques to diagnosis of dental image classes. This approach was tested on collected datasets and has demonstrated a good performance of detection.

5- Related Work

Soft tissue examination assumes a significant job in orthodontics where it helps in the conclusion, treatment arranging, improve treatment achievement and build up ideal facial congruity. The soft tissues are a main consideration in deciding the outer facial appearance. Peterman *et al.* [4] introduced Dolphin Imaging programming tool that can be used for case introduction and patient instruction and to get patient's educated assent for two-jaw orthognathic careful treatment plans. The VTO programming system could be helpful for net developments and forecasts of two-jaw careful results during treatment arranging yet is questionable for treatment arranging exact developments when estimation run is < 1 mm. Moreover, the lower lip forecast is the least precise in this program for two-jaw careful cases. The utilization of this program must be with alert to forestall ridiculous patient desires and disappointment.

Ben Ali *et al.* [5] proposed a neural network based strategy (DenNN) for order X-ray pictures. In the structure of the paper, the operator under center has a job to characterize biomedical pictures by AI with the aim of finding clinically relevant pathology designs. These characterization tasks depend on dynamic device. In any case, the bury patients inconstancy presents numerous difficulties for the customary order method s. These have generally been designed and parameterized on little datasets or on an unmistakable companion. Also, this methodology requests X-ray pictures which may be not accessible constantly.

Alfarra *et al.* [6] proposed a methodology named (DenSTM) for Malay patients utilizing soft tissue profile. The eleven parameters in Holdaway examination were naturally determined utilizing Planmeca Romexis Cephalometric Analysis Software program once the anatomical focuses have been digitized for every horizontal cephalogram. In spite of the fact that this product is helpful for quiet picture examination, it works with explicit gathering of individuals (Malaysian) and takes long calculation time.

Muhammed *et al.* [7] introduced a strategy for drawing the cephalometric radiograph pictures. The investigation meant to think about the unwavering quality of the two drawing techniques (anatomic point and tangent line strategy). The example comprises of 100 cephalometric radiographs of patients with ordinary impediment and acknowledged facial profile, ten precise estimations along the soft tissue form were estimated by the 2 drawing techniques by 3 orthodontist analysts and dissected measurably to fined means and standard deviation and to be thought about by intra-class connection coefficient. Despite the fact that this strategy could be utilized to distinguish the dental picture class, it relies upon the analysts to check the conclusive outcomes which isn't constantly accessible.

Even though there are numerous techniques for dental specialist picture class recognition, it is as yet important to create exact class location strategy to support dental specialist. The primary impediment of these strategies is that the assessment of the framework was finished utilizing skeletal or X-ray teeth pictures, which are totally not quite the same as normal ones. The issue of the old style approach of dental class picture acknowledgment is that it is extremely hard to construct a decent qualities extractor and that it must be straightened out for each new application.

Our commitment is as per the following: we propose an arrangement of identification and order of dental pictures utilizing straightforward picture handling and measurable methods. This framework can be helpful for dental specialists to order dental pictures into Class I, Class II, and Class III. Fundamentally, the location of dental picture class has been a visual procedure, chiefly dependent on visual-material assessment and radiographic assessment.

6- Problem Description

Facial style in dentistry has increased incredible consideration as of late. The accomplishment of orthodontic treatment is much of the time identified with the improvement picked up in patient's facial appearance, which incorporates soft tissue profile and since there is an impressive varieties in soft tissue covering, deceiving ends can be delivered if conclusion and treatment arranging depends on dental and skeletal estimations alone; in this way, examination of soft tissue profile is compulsory [8].

To evaluate the skeletal examination, the skeletal classes were named the accompanying dependent on [6] (see Figure 1):

- Class I: ANB angle between (2˚- 4˚).
- Class II: ANB angle > (4˚).
- Class III: ANB angle < (2˚).

Where, *A* is the best concavity point on the line between the prosthion and the foremost nasal spine, *B* is the best concavity point on the line between the infradentale (summit of the alveolar bone between the left and right lower first incisors) and pogonion, and *N* is the Nasion, which is the best concavity point in the midline between the nose and the brow on the frontonasal stitch. On the off chance that the ANB point is between 2˚- 4˚ (inside ordinary range), the skeletal example is considered as skeletal Class I. In the event that this point is not exactly ordinary range, it is Class III and on the off chance that it is more than typical, it is Class II skeletal example [6].

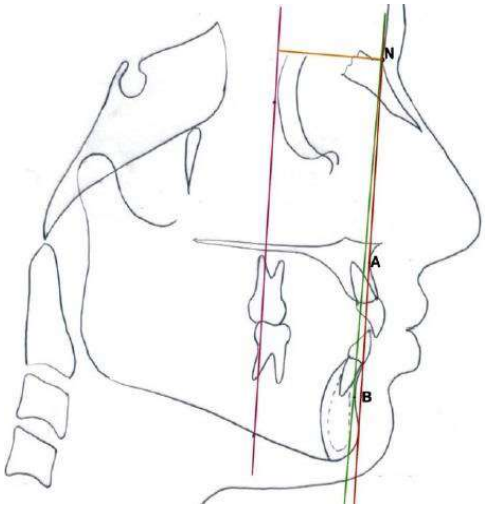


Figure 1: Skeletal class classification

However, this study dependent on skeletal measurements while our study is focus on soft tissue analysis. In other word, there are main three dental image classes Class I (see Figure 2), Class II (see Figure 3), and Class III (see Figure 4) which depend on the outer shape of the face.

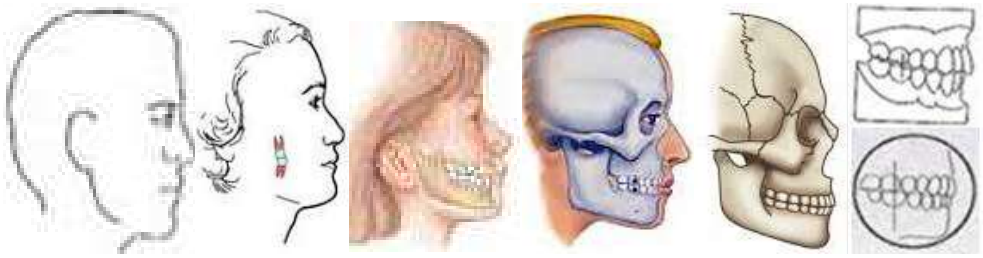


Figure 2: Class I

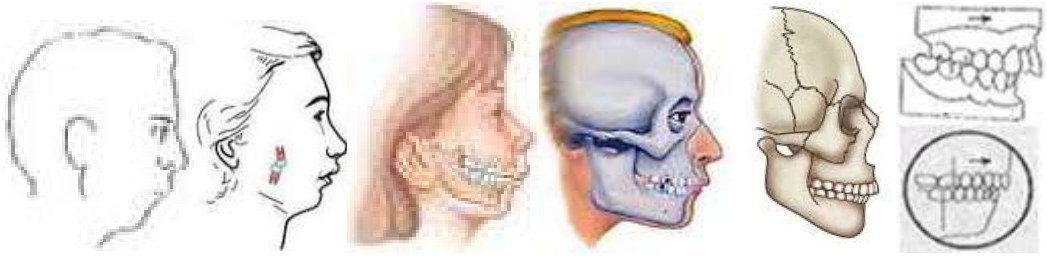


Figure 3: Class II

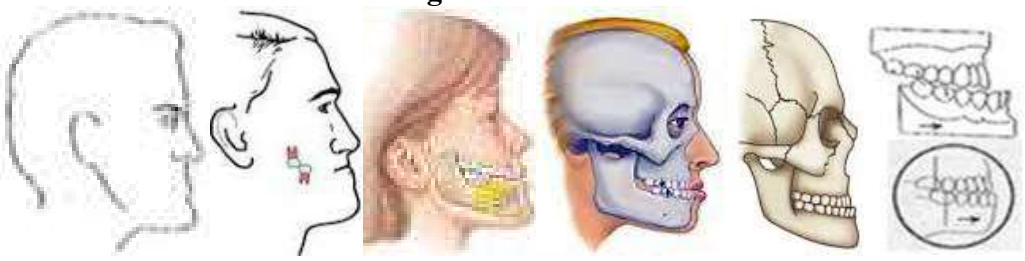


Figure 4: Class III

The accompanying standards were barred from the investigation:

1. Previous or current orthodontic treatment.
2. Missing teeth.
3. Obvious periodontal malady.
4. Evidence of past injury/medical procedure.
5. Facial asymmetry or distortion.
6. Presence of deciduous/held teeth.
7. Presence of any neurotic conditions.
8. Presence of deciduous or over held teeth.

7- AECDI Algorithm

As of late, numerous specialists have been proposed methods utilizing picture preparing plan to take care of arranging dental specialist classes' issue. This investigation is associated with building an arrangement model that consolidates the upsides of statistic methods and image processing methods named AECDI.

Before formally explaining the AECDI method level structure, we might want to acquaint some fundamental information with better encourage its understandability (see Figure 5).

A. Pre-processing for each image:
   1. Read the image.
   2. Resize the image to 200*100 pixels.
   3. Rotate the image to the left side.
   4. Divide the image and take the useful part (lips and chin).
   5. Resize the image to 100*50 pixels.
   6. Remove the noise and enhance the image.
   7. Make it black and white.
   8. Take the outer edge.

B. Identify image groups:
   1. Divide the images of each class into two sets (training set (90% of the images) and testing set (10% of the images)).

C. Training
   1. Take the training set and find minimum, maximum, mean, and standard deviation of each class.

D. Testing

1. Take an image from each training set (Class I, Class II, Class III) and enter it to the program and see the output mean with a threshold (± 2 STD).
2. Take an image from each test set (Class I, Class II, Class III) and enter it to the program and see the output mean with the same threshold.

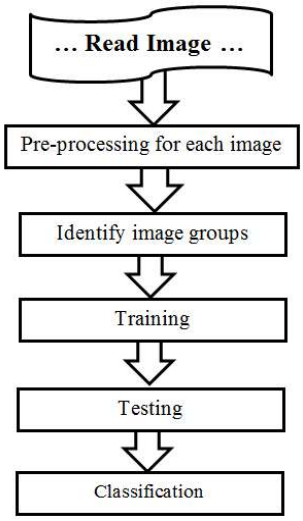


Figure 5: The algorithm steps

A. Image pre-processing

The proposed method for characterizing dental specialist picture gets an image from the asset, places it in a buffer and expels the commotion to plan for next stage, for example parallel pictures that signify closer view and foundation pixels with non-zero and zero qualities, separately.

B. Identification of patient class

Human shapes are commonly separated into three sorts. Naming, the typical chomp (which called Class I), the over stream nibble/prognathism (which called Class II), and the negative over fly chomp/retrognathism (see Figure 2-4 respectively). In this progression we are separating the pictures into those three classes. In order to accomplish this, we reliant on pictures labels. The proposed technique utilizes the classes for training and testing steps.

C. Training

The following phase of investigation distinguishes picture classes, i.e., Class I, Class II, and Class III. This will help set up finding the most significant highlights of each class. The progression incorporate make three groups of areas made out of stable pixels and sets up their relationship with the identified class.

The following step of examination finds picture districts made out of distinguished pixels and sets up their relationship with the perceived classes.

D. Testing

In this stage we are trying pictures of each class to ensure that each picture has a place with one careful class. In spite of the fact that we are relying upon realized picture mark, we explore the right yield picture class from the method.

E. Classification

In order to show that this strategy gives data that may be used for viable area of obscure patient class in sensible conditions, the technique was improved with modules for classes course of action and dynamic. The grouping module is indispensable in order to isolate classes distinguishing to

address from different classes. Various techniques may be utilized for this task, running from direct classifiers subject to neural network [5], to complex models arranged with image features [7].
In the wake of presenting the principle fundamental strides of the method, we are going to introduce the proposed algorithm. Figure 6 sums up the code clarification of the basic AECDI technique. The sources of info (inputs) are pictures and the yields (outputs) are three classes.

AECDI Algorithm:

Inputs:

- *Images.*

Outputs:

- *Three Classes; Class I, Class II, Class III*

Algorithm Steps:

1. $Do\ Pre-processing\ for\ each\ image$
2. $Divide\ the\ images\ into\ three\ groups$
3. $Divide\ the\ image\ groups\ into\ two\ sets\ training\ set\ and\ testing\ se$
3. $Extract\ image\ features\ of\ each\ class\ and\ add\ them\ into\ the\ data$
4. $Examine\ each\ image\ in\ test\ set\ to\ identify\ correct\ class$

$Retrive\ the\ available\ image\ features\ from\ the\ database$

end

Figure 6: Code of the method

8- Evaluation of the Suggested Algorithm

Here, we will assess the adequacy of the proposed technique from the precision and productivity ideas of the methodology. Right off the bat, we will present some correctness rules (Sec. 5.A). At that point, we will introduce the chose datasets that will use for testing (Sec. 5.B). From that point onward, clarify the experimental assessment convention (Sec. 5.C). At that point, we will present the exploratory outcomes (Sec. 5.D) lastly discussion the result of the strategy (Sec. 5.E).

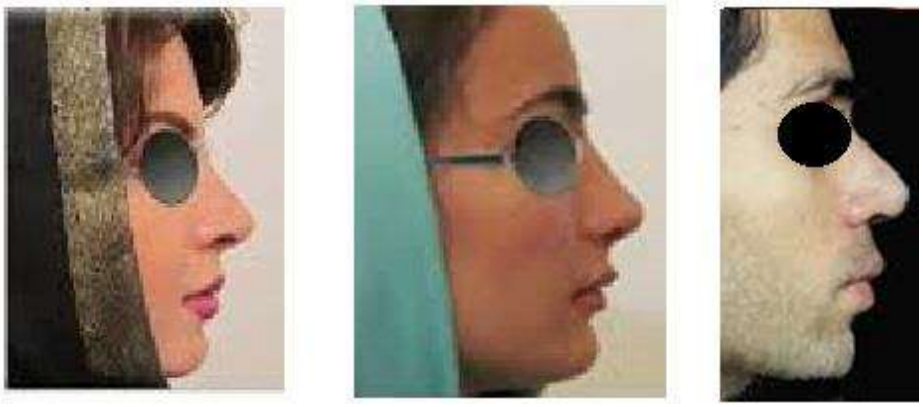
A. Evaluation Criteria

Correctness of the characterization techniques can be assessed by means of fluctuates approaches which found in the literature [9]. This examination choses the administered techniques to survey the exactness of the proposed strategy. We manufacture datasets which contain referred to classes as the ground truth for testing the "*closeness*" of the steady classes results created by the method to the ground truth. The closer the subsequent constant classes to the known classes, the more precise is. Those models including purity and entropy.

Purity was utilized in [10] and entropy in [11]. Purity alludes to the extent of the pictures having a place with a known class that are allocated by a method. The higher the estimation of this parameter (between [0, 1]) is, the better the method is [12]. Entropy mirrors the quantity of the pictures of various classes in the first dataset that are doled out to a class by the method. The estimation of this measure is between [0, $\mathrm{Log}_2 N$] where $N$is the quantity of various classes included. For the most part, the littler estimation of the entropy is, the better the classification method is [13]. The proficiency of a method was estimated by the measure of time in seconds taken for the method in finishing the classification task.
For a given dataset, we split the information into two sections: the training dataset and the testing dataset.

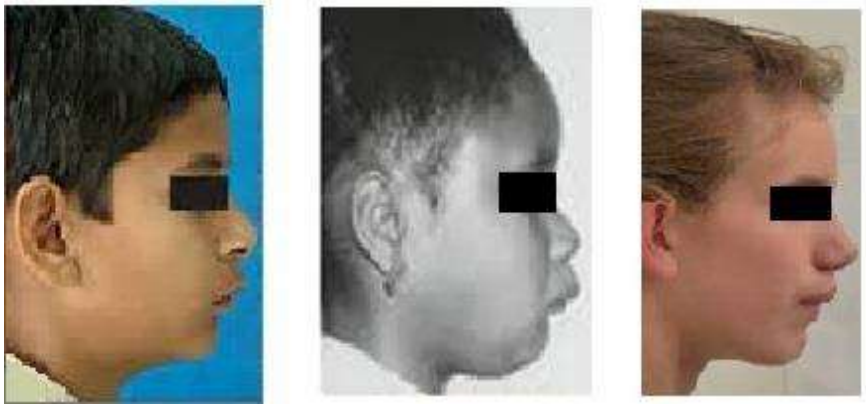
B. Dataset Used

All the investigations have finished with chosen datasets. In subtleties, we made three datasets everyone has 50 images and has a place with a particular class. DS1 contains images of Class I (Figure 7 contains a portion of this class), DS2 contains images of Class II (Figure 8 contains a portion of this class), and DS3 contains images of Class III (Figure 9 contains a portion of this class). We concurred that there are a few downsides of the chose datasets. They didn't have a wide range of features. In future work, this technique will assess on increasingly entangled datasets.



(a) (b) (c)

Figure 7: Images of Class I in DS1



(a) (b) (c)

Figure 8: Images of Class II in DS2

(a) (b) (c)

Figure 9: Images of Class III in DS3

C. Empirical Evaluation Protocol

To test the exhibition of the proposed method AECDI and contrast it with the two existing methods (DenNN and DenSTM), we divided each dataset (DS1, DS2, and DS3) into two gatherings: the training set (80%, i.e. it contains 40 images) and testing set (20%, i.e. it contains 10 images). This is on the grounds that the current methods treat the info images along these lines. For fairness we have made the proposed method to be tried utilizing a similar convention. The experiments were replay 100 times, and the average was considered.

We applied AECDI algorithm to selected datasets. As mentioned in Section 4, we read the original image, segment it to take useful part, change it to gray image, enhance the image, identify the borders, and change it to the black and white image. Figure 10 shows the steps that we applied for images of Class I. Figure 11 shows the steps that we applied for images of Class II. Figure 12 shows the steps that we applied for images of Class III.

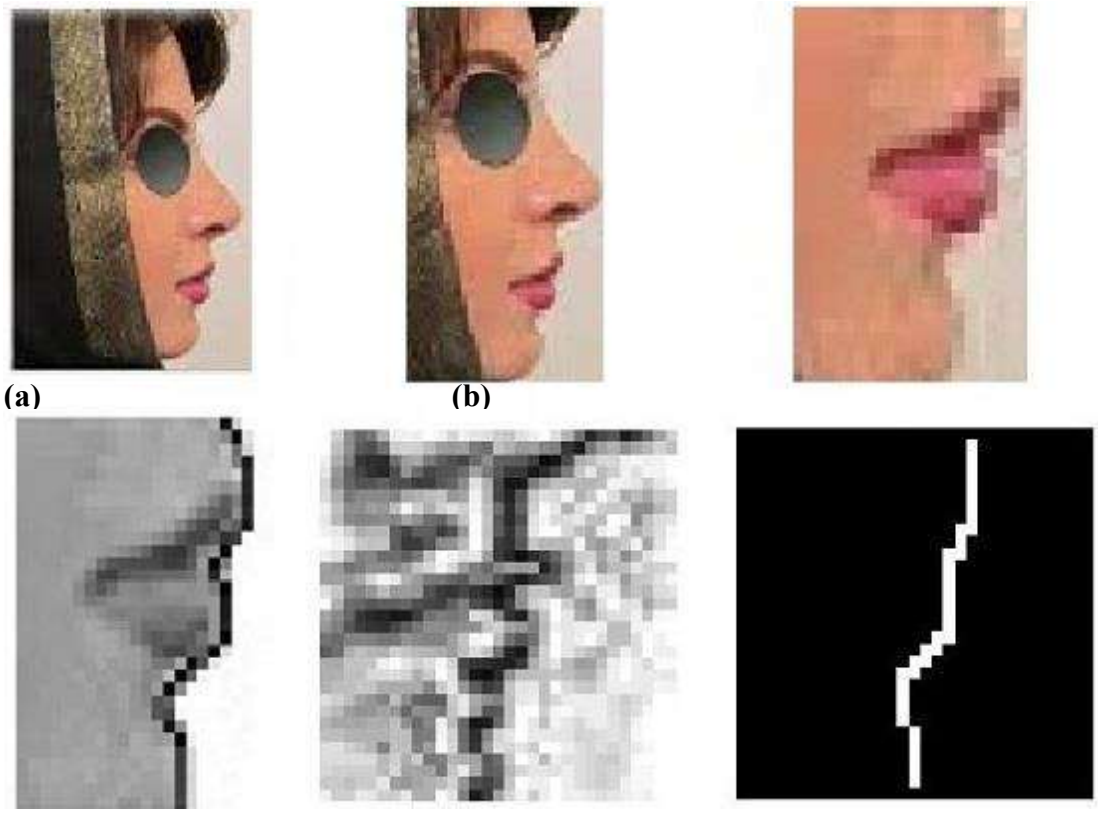


Figure 10: Algorithm steps in DS1

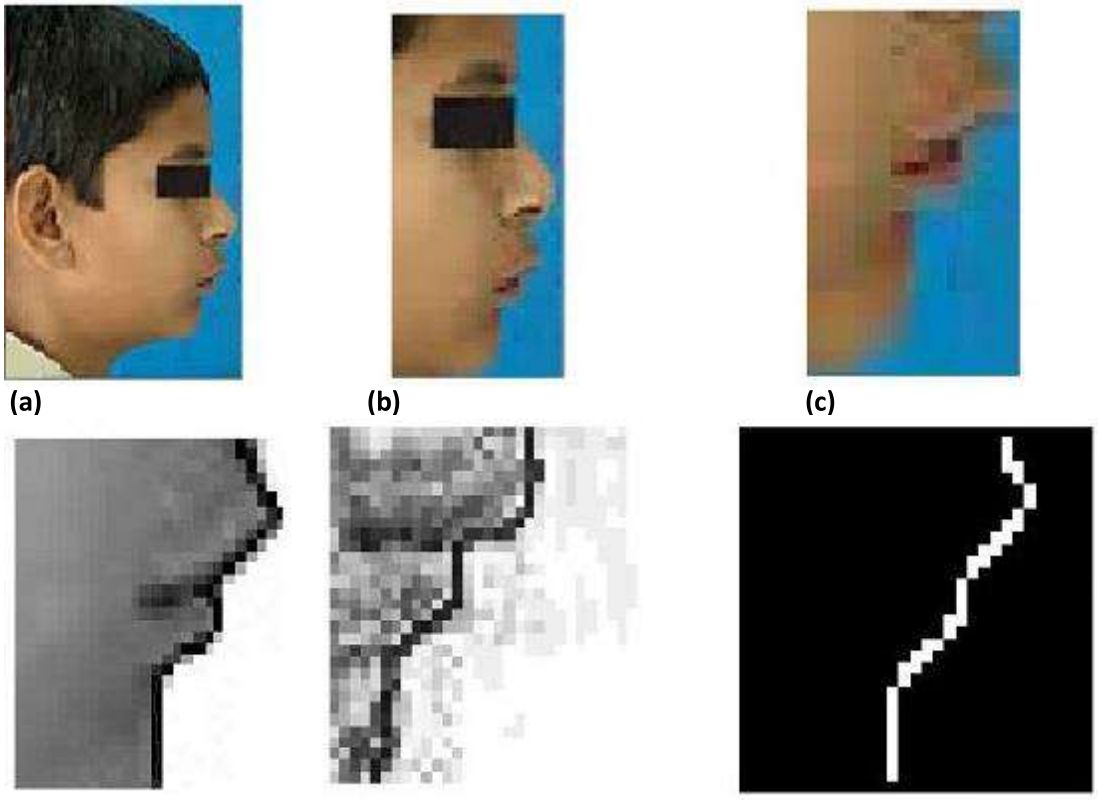


Figure 11: Algorithm steps in DS2

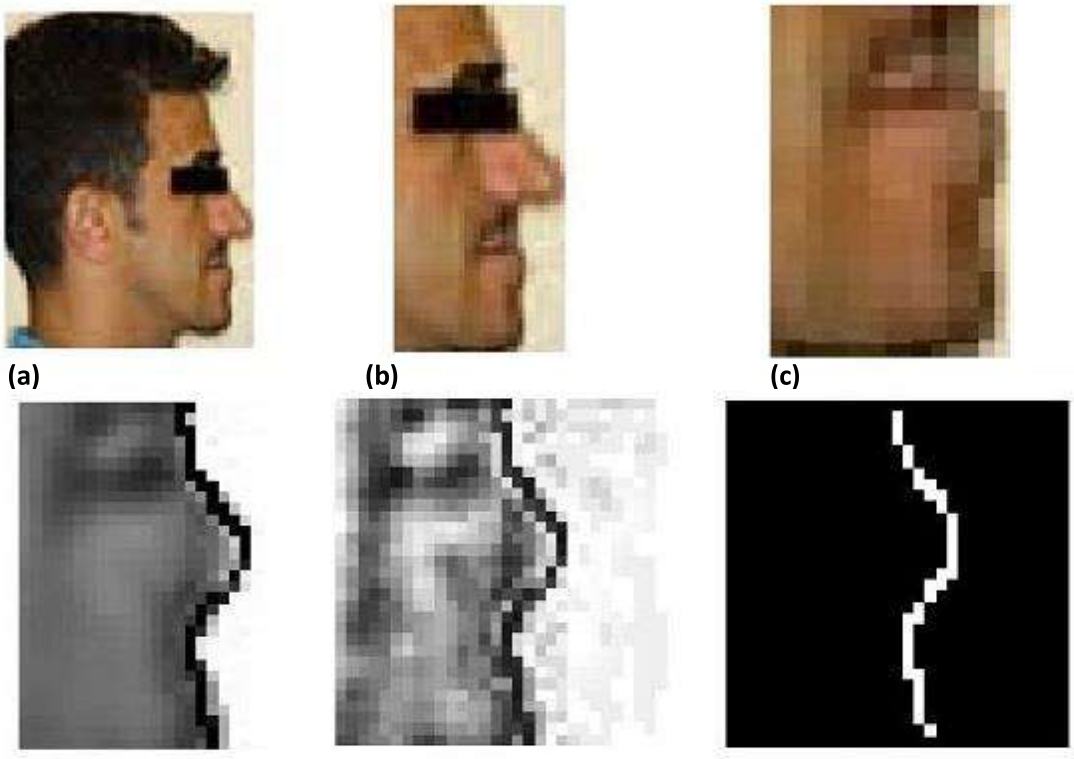


Figure 12: Algorithm steps in DS3

After we applied the AECDI algorithm to the selected datasets, we identified the values of minimum, maximum, mean, and standard deviation of each class. The mean value of Class I is 29.1578 with STD

value 1.1670, the mean value of Class II is 44.6030 with STD value 1.3705, and the mean value of Class III is 36.0525 with STD value 1.7975 (Table 1 summarizes the output values). The output values were used to identify each class. In other word, when we take an image from test dataset, calculate the summation of ones of final output black/white image, and compare it with benchmark table.

Table 1: Summarization of output classes of AECDI method

	Minimum	Maximum	Mean	Standard Deviation
Class I	27	31	29.1578	1.1670
Class II	40	46	44.6030	1.3705
Class III	33	38	36.0525	1.7975

MATLAB software was used to investigate the results of each algorithm.

D. Experimental Results

- ***Purity***

Figure 13 shows the subtleties of comparison results between the known classes and the yield classes from the DenNN, DenSTM, and AECDI methods individually. AECDI has the most noteworthy purity. This is the aftereffect of the rigid classifying methodology conveyed and the new procedure of preprocessing images. DenSTM additionally has great immaculateness by using the Holdaway rules and Planmeca Romexis Cephalometric Analysis Software. DenNN has the more unfortunate immaculateness in view of its procedure of using of neural network in order images.

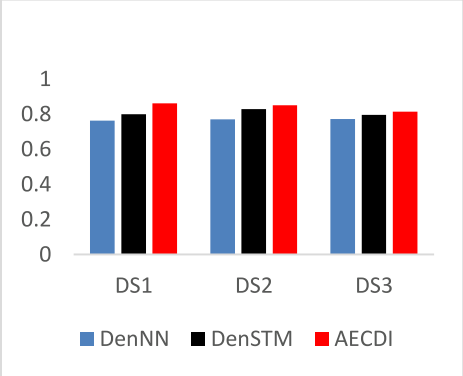


Figure 13: The purity measurement.

- ***Entropy***

As appeared by Figure 14, AECDI has the most minimal entropy since it relies upon basic statistic estimations and very careful threshold. DenSTM has the second most reduced level in view of applying Planmeca Romexis Cephalometric Analysis Software lead to blunder arranging a few images. DenNN has the third level in light of the fact that the arbitrary number of hidden layers in neural network lead to mistake arranging a few images.

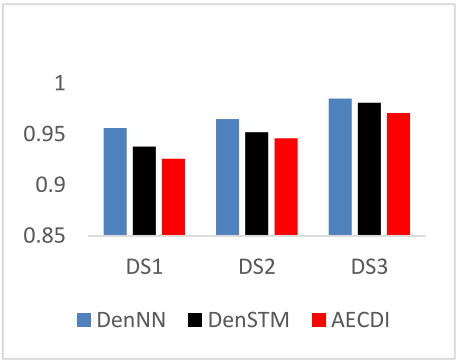


Figure 14: The entropy measurement

Efficiency Evaluation

- ***Execution Time***

Execution time is the extent of the proportion of time in seconds that continue for the technique in completing the classification task. Concerning usage time, the AECDI strategy has the less execution time sought after by DenNN and DenSTM individually (see Figure 15).

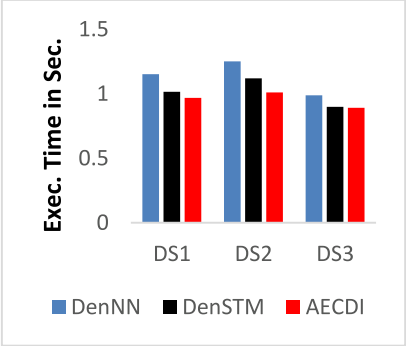


Figure 15: The efficiency measurement

After getting these output results we could approve that AECDI method is faster than DenSTM and DenNN.

E. Discussion

An individual's capacity to perceive a wonderful face is intrinsic, however making an interpretation of this into characterized treatment objectives is problematic. Perceiving magnificence isn't drilled nor is it troublesome. The impression of magnificence is an individual inclination with social predisposition. Rules administering why a face is excellent are not comprehended nor are required for anybody to state that a face is delightful. Artists and wellbeing experts have endeavored to characterize and reproduce a perfect. They perceive excellence, yet target guidelines are troublesome, regardless of ceaseless endeavors to explain this idea. As wellbeing experts have expanded their capacity to change faces, the need to comprehend what is and isn't excellent has heightened. Truly, orthodontics has included facial congruity as one of its significant objectives alongside occlusal greatness. Edward Hartley [14] recommended that if teeth were put in ideal impediment, great facial congruity would result. The facial skeleton and its overlying soft tissue decide facial congruity and equalization. It is the structure of the overlying soft tissues and their relative extents that give the visual effect of the face [14].

Safeguarding of facial engaging quality is an essential objective of orthodontic treatment. Treatment arranging requires information on the parameters and regularizing information that assists with setting up objectives and foresee the snags that should be arranged. As soft tissue standards fill

in as a rule in figuring change it has been recommended that certain cephalometric principles relating teeth to cranial or facial bones could guarantee great facial structure whenever clung to as a treatment objective. The fulfilment of facial soft tissue proportionality is one of the important objectives in the treatment of dentofacial deformations and can be accomplished with appropriately arranged and executed orthognathic medical procedure strategies. Accordingly the point of this examination is to compute the standards with the goal that the soft tissue cephalometric estimations of different parameters could be separated in order to manage the orthodontist towards a superior analysis and treatment arranging of dentofacial deformations.

The joined consequences of all analyses demonstrate that the proposed method gives information on preparing dataset which, in the wake of utilizing the classification, prompts fruitful discovery pictures. Contrasted with other late methodologies with distinguish image classes, e.g., [5] [6] [7] the method introduced in this paper is moderately straightforward, both thoughtfully and computationally. It doesn't require complex calculations, for example, online learning, probabilistic models, conduct displaying, and so forth. The method utilizes fundamental numerical and statistic tasks for displaying the image classes and the necessary number of methods relies upon image content. Therefore, this method is easy to execute in a working framework, for instance in an installed framework inside the versatile applications. Regarding computational unpredictability, the most tedious stage is the pre-preparing.

The significant guarantee of the AECDI technique is the ease and high adaptable structure. This comprise of the primary elements of the technique: pre-prcessing picture, distinguish classes, recognize preparing and testing pictures, and save images in a database. All procedure were designated as capacities which implies we could simultaniosly improve each capacity separated without altering the general principle structure of the technique.

There were propostions of more upgrades of each function inside the algorithm. Right off the bat, we realize that using separate functions prompt moderate procedure to deside classes. In this way, we could supplant those procedures by one function, for example, utilizing computational topology to distinguish the classes. AI strategies and fuzzy based approches could be consider to deliver more effecint functions to create blended last classes.

9- Conclusion And Future Work

Soft tissue profile is right now one of the most critical areas of enthusiasm for the choice of orthodontic treatment. Principally via lateral cephalometric radiograph, soft tissue profile is concentrated broadly in orthodontics, under the conviction that the soft tissue layout generally oversees the style of the face. The facial soft tissues are viewed as a powerful structure that can create alongside or free of their skeletal base.

The principle favorable position of distinguishing teeth picture classes is to keep away from careful intercession and consequently diminish the horribleness of the medical procedure. The planning of early treatment is essential for a fruitful result. A few examinations have detailed that treatment ought to be done in patients under 10 years old to improve the orthopedic impact.

This examination inferred that the statistic strategy is as solid as the anatomic point technique and those two could be utilized in cephalometric soft tissue investigation.

Classifying teeth image classes is a significant advance during the time spent unattended teeth image identification. Such image must be recognized in the image streams with high exactness so as to give vital information to the choice module. The proposed method takes care of the issue of classifying teeth image location via preparing the module and testing the new image. This method was structured such that makes it simple to execute it in the system for online occasion location and portable applications.

Future work will focus on refreshing the strategy. On account of the technique is adaptable, those refreshing contemplations can manages the significant elements of the strategy. Right off the

bat, we will explore the topology method to introduce progressively modern rendition of the pre-preparing step. Furthermore, we will research hybridizing diverse classifying methods, as neural network based, swarm-based, and genetic based techniques to test the particularity of AECDI strategy. Thirdly, we will examine using learning methodology as input to improve the pre-preparing step and improve arranging functions that have been utilized. At long last, conveyed approaches may have embodied to deliver increasingly precise, right, and bona fide new type of the AECDI strategy.

10- References

[1] Medicalnewstoday, "www.medicalnewstoday.com/articles/249482.php," *medicalnewstoday*, 2018. [Online]. Available: https://www.medicalnewstoday.com/articles/249482.php. [Accessed: 01-Feb-2020].

[2] A. M. Shafi, F. Naseem, A. Khan, and A. G. Khan, "A Soft Tissue Cephalometric Analysis for Pakistani Adult Using Holdaway ' s Analysis," vol. 25, no. 1, pp. 51–53, 2018.

[3] A. P. Publication, "A Review of Dental Caries Detection Technologies," 2015.

[4] R. J. Peterman, S. Jiang, R. Johe, and P. M. Mukherjee, "Accuracy of Dolphin visual treatment objective (VTO) prediction software on class III patients treated with maxillary advancement and mandibular setback," *Prog. Orthod.*, 2016.

[5] R. Ben Ali, R. Ejbali, and M. Zaied, "Detection and Classification of Dental Caries in X-ray Images Using Deep Neural Networks," no. c, pp. 223–227, 2016.

[6] A. F. Kamaruddin, "SOFT TISSUE CEPHALOMETRIC ANALYSIS OF MALAY ORTHODONTIC PATIENTS," vol. 9, no. 4, pp. 157–165, 2018.

[7] S. A. Mohammed, J. E. Saloom, and H. M. Hussien, "Quantifying the Soft Tissue Profile by Two Different Methods in Iraqi Adults : A Comparative Study," pp. 15–21, 2019.

[8] P. J. Khot, M. Agrawal, J. Agrawal, L. Nanjannawar, V. Kagi, and M. Khot, "Evaluation of Soft Tissue Cephalometric Norms for Maharashtrian Population Using Holdaway Analysis," vol. 5, no. 11, pp. 29–33, 2018.

[9] H. Kremer *et al.*, "An effective evaluation measure for clustering on evolving data streams," *Proc. 17th ACM SIGKDD Int. Conf. Knowl. Discov. Data Min. - KDD '11*, no. February 2016, pp. 868–876, 2011.

[10] F. Cao, M. Ester, W. Qian, and A. Zhou, "Density-based clustering over an evolving data stream with noise," *Proc. Sixth SIAM Int. Conf. Data Min.*, vol. 2006, pp. 328–339, 2006.

[11] Y. Zhao and G. Karypis, "Technical Report Criterion Functions for Document Clustering: Experiments and Analysis," *Univ. Minnesota, Dep. Comput. Sci. / Army HPC Res. Center/ Tech. Rep.*, pp. 1–30, 2001.

[12] J. Silva, E. Faria, R. Barros, E. Hruschka, and A. Carvalho, "Data Stream Clustering : A Survey," *ACM Comput. Surv.*, pp. 1–37, 2013.

[13] H. L. Nguyen, Y. K. Woon, and W. K. Ng, "A survey on data stream clustering and classification," *Knowl. Inf. Syst. Springer*, pp. 535–569, 2015.

[14] S. Upadhyay, A. Sharma, and D. Phor, "Assessment of Arnett ' s Soft Tissue Norms For Himachali Population Using Digital Tracing Method : A Cephalometric Study Abstract :," vol. 17, no. 10, pp. 83–90, 2018.