A PATTERN RECOGNITION SYSTEM FOR HUMAN AGE IDENTIFICATION

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Abstract: **Identification of human age can be accessed based on their facial characteristics. Each face contains special unique information which can be used in the identification of an individual's age. To identify age of an individual from the input, some of fundamental steps to be performed are pre-processing, feature extraction and a classification technique. In our work, we have used the traditional KNN algorithm as classifier. The inputs are acquired from publically available dataset and by constructing local dataset by capturing faces of individuals' from different orientation and under different illumination using good resolution camera. In our work, the popular GLCM and LBP feature extraction techniques have been adopted. The extracted features are maintained in the feature matrix which will be fed as input to the classifier for identifying person age.**

In this paper, two datasets are considered for our experiments. One is publically available MORPH dataset and another is local dataset constructed by capturing different person's face images using mobile camera. An attempt is made to develop a usable system that will identify the person age based on the face features.

Index Items: **Face images, Features, Feature Descriptors, Classifier, Data sets.**

I. INTRODUCTION

Age identification assures age of a person depending upon their biometric features. Despite the fact that estimation of person's age can be refined by means of different biometric characters, anyway this paper is mainly absorbed on age estimation by utilizing biometric features of a person. To extract discriminative information contained in face pictures, and pattern recognition or to display face appearances and to cluster them in machine learning methods Computer vision is utilized by age identification framework. The computer vision abilities are used as feature vector methods and algorithm to encode the information required for age identification. Separation between distinguished facial markers for example, eyes, noses, and lips are used to extract features and to perform face acknowledgment or classification utilizing Supervised learning systems, for example, Support Vector Machines (SVM), KNN and Decision Trees, grouping learning strategies, Deep Neural Networks [1], machine learning methods can be used. Face recognition is an acknowledged and advance biometric technique utilized by us to discover each other. It is an acknowledgment procedure that assesses facial attributes of an individual.

The face recognition plays its most recent interest for the utilization of newest methods in security, observation and different other business benefits. Individuals look for extra secure strategies to protect their important data. Password validation, card key confirmation, and biometric verification are the most usually utilized validation types. Aging Face discovery will be basic instrument for face recognition framework. It identifies and portions face areas from pictures. It includes different solicitations like, surveillance, frameworks for security control, image recovery by content based methods, video conferencing, and interfaces with human PC. Figure 1 depicts aging effects of a subject. The major portion of the current face identification system take up that the face appearances are promptly accessible for processing. If we don't have normal pictures with simply just faces pictures, we are going to segment only the face image from its original image. And by using appropriate methodologies we will refine the face image so that we could get one suitable image for our work. Using these face image we extract the required features and based on them classification will be performed. At last age of the person will be approximated.

Fig. 1: Example of aging effects of a subject

II. Challenges

Age estimation shares numerous issues experienced in other normal face picture understanding undertakings, for example, face identification, face acknowledgment, demeanour and sexual orientation acknowledgment. Facial appearance disfigurements caused by changed looks, between individual varieties, lighting variety, face introduction and the nearness of occlusions having negatively affect the execution on programmed age estimation. Notwithstanding, when compared with other face picture understanding errands, the issue of age estimation shows extra interesting difficulties that may include are:

1) Constrained between age group varieties: In particular cases differentiates in appearance between neighbouring age groups are irrelevant, causing challenges amid the time spent age estimation. This issue is raised while overseeing grown-up subjects.

2) Diversity of aging variety: Both the rate of aging and sort of age-related effects differ for different individuals. For instance the measure of wrinkles on face might be altogether different for various people having a place with a similar age grouping. Because of the decent variety of aging variety, the utilization of a similar age estimation system for all subjects may not create satisfactory execution. A few components could impact the aging procedure including race, sexual orientation and hereditary attributes. Hence different age estimation methodologies might has been needed for various groupings of subjects.

3) Dependence on outside variables: Outer parts affect the rate and the aging design grasped by an individual impacting in that way the method of age estimation. Numerous factors that impact aging pattern includes way of life, psychology, health condition and deliberate endeavours to mediate with the aging procedure using anti-aging items or restorative medical procedures**.**

4) Data accessibility: The estimation of age frameworks needs appropriate datasets reasonable for training and testing. Reasonable datasets ought to contain numerous pictures demonstrating a similar subject at various ages covering a wide age extend. Since aging is a kind of facial assortment that can't be controlled particularly by individuals, the grouping of such datasets requires the usage of pictures got previously. Currently there are two open datasets (MORPH and FG-NET) that expect to help experimentation in the area of facial aging. The MORPH database contains simply couple of tests per subject while the FG-NET database contains pictures indicating big non-aging related assortment.

III. LITERATURE SURVEY

Chunlei Peng, Xinbo Gao, et al., [2] in 2015 proposed a work on Heterogeneous Face Recognition (HFR). It is helpful for matching a two face pictures obtained from various sources. This work proposes a new graphical representation on HFR strategy (G-HFR). To speak to heterogeneous picture patches independently, which take the spatial similarity among its Neighbouring picture patches into thought, Markov systems are sent. A coupled representation similitude metric (CRSM) is intended to gauge the likeness between got graphical representations.

Shubhangi G. Rode et al., [3] in 2014 demonstrated significant test to coordinate the infrared face pictures to an optical face pictures. This work proposed a technique to build the introduction of face location and acknowledgment frameworks. Initially it identifies faces after that it perceives the distinguished appearances. In process of identification, it utilized the Gaussian skin shading form with skin shading division, which is joined with the help of AdaBoost calculation.

Jiwen Lu, et al.,[4] in 2014 depicted on simultaneous component feature and dictionary learning (SFDL) strategy for set of picture based face acknowledgment, This work proposes a SFDL technique to learn a discriminative character and word references all the while from basic face pictures so discriminative data can be together misused. Broad trial comes about on four generally utilized face datasets demonstrate that this strategy accomplishes preferable execution over cutting edge picture set based face acknowledgment techniques.

Dong Yi, Zhen Lei, Shengcai Liao and Stan Z. Li et al., in the year 2014 [5] proposed a new structure for acknowledgment of heterogeneous faces. Gabor features in the beginning of some limited facial focuses are separated, and afterward utilize Boltzmann Restricted Machines (RBMs) to take in a mutual representation in the neighbourhood around every facial point to expel the heterogeneity. At last, the common representations of neighbourhood RBMs are associated collectively and prepared by PCA.

Sifei Liu, Dong Yi, ZhenLei, StanZ.Li et al.,[6] in 2012 demonstrated heterogeneous Face Recognition (HFR) alludes acknowledgment of human face pictures caught in the various modalities, e.g. Visual (VIS), close infrared (NIR) and warm infrared (TIR). Albeit various face pictures of a specified individual contrast by the pixel thresholds, the personality of the face ought to be named the same. In this work, they proposed another list of capabilities called the Light Source Invariant Features (LSIFs) that can dispense with refinements of heterogeneities that lie in low recurrence of a picture.

IV. SYSTEM ARCHITECTURE

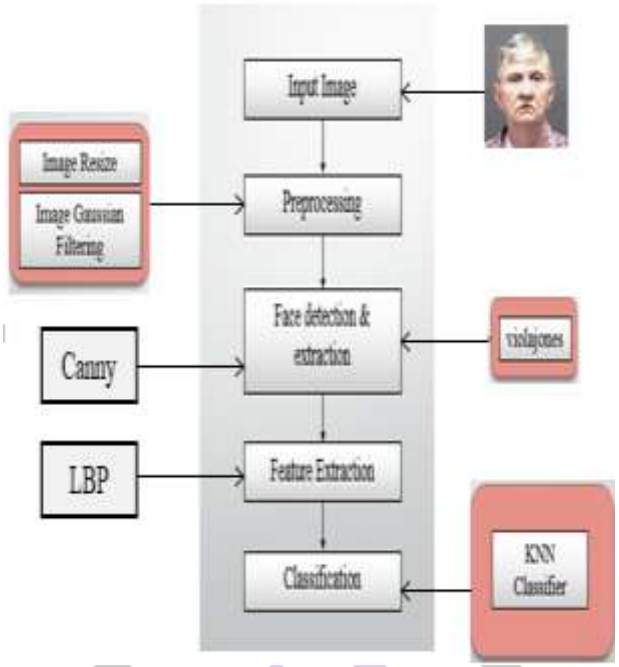


Fig. 2: Architectural diagram for Facial age Identification

The figure 2 depicts the flow diagram for facial age identification. Initially person face image is taken as an input to our system. Then the image is taken out for various pre-processing steps, i.e, image resizing, grey scale conversion and filtering the image by using Gaussian filter. In the next step by using viola jones algorithm, we detect and extract the face from the input image.

After extracting a face from an input image, face segmentation is done by using crop function on detected face of input image. By using canny edge detection algorithm, we represent the detected face edges. And finally extract the pixel features by using local binary pattern (LBP) algorithm. Using a KNN classifier we classify the pixel features and represent the age group to which, given input image belongs. Following steps involves in estimation of person age.

Input: The face images are taken as input to the system. These images are in .jpg or .png format. And image dataset are collected from MORPH database.

Pre-processing: The collected input images are subjected to pre-processing. In the Pre-processing step, filtering, resizes implementation and contrast enhancements are performed.

Face Detection & Extraction: In this step, we will detect the face region and that region will be extracted/ segmented from the input.

Feature extraction: In the feature extraction process, various features will be identified and determined.

Classification: In this step, appropriate Classifier will be used to recognize the age of the person.

1) PRE-PROCESSING

a) Gaussian filter: Filtering by using Gaussian is used to blur pictures and remove commotion and detail. The power range of Gaussian is believed to be a fair model for multipath portions with long deferments in UHF correspondences [7]. It is also proposed as a model for the aeronautical channel [8]. A range of Gaussian Doppler is moreover shown once in a while of the ANSI J-STD-008 reference channel models for PCS applications, for both outside (remote circle) and inside (private, office) [9]. The power range of standardized Gaussian Doppler depicts analytically by equation (1):

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-x^2}{2\sigma^2}} \quad (1)$$

Where σ represents standard deviation of the distribution, and mean of 0.

b) RGB to Grey scale conversion

The input image taken for finding person age may be of colour or grey scale one. Colour image can be either converted to grey scale image or else we can use it directly to recognize the person's age. In this work the GLCM feature descriptor requires grey scale image to identify person's age. When we want to convert the colour image to grey scale we use rgb2grey (RGB) conversion functionality, which convert real nature RGB picture to the grey scale force picture. This function eliminates the hue and saturates the information while holding the luminance. In the event that we have Parallel Computing Toolbox introduced, rgb2grey can play out this transformation on a GPU.

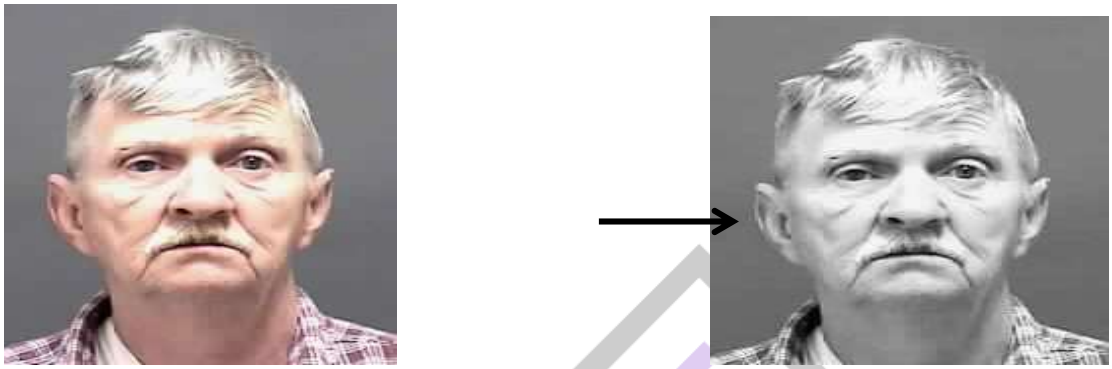


Fig. 3: RGB to Grey scale Conversion

2) FACE DETECTION AND SEGMENTATION

Viola-Jones algorithm is used for detecting the face objects. This algorithm ought to be fit for working in an unconstrained situation implying that it should identify every obvious face in any possible picture. The individuals' faces, noses area, eyes portion, mouth part, or abdominal area are detected by using cascade object identifier which interns utilizes Viola-Jones algorithm. Input picture to a face detection algorithm is appeared in Figure 4. This image has a relatively low contrast, and person's full image. Since pretty much the face picture is frontal upright and only the expected face will be identified by this algorithm. The algorithm used here creates an object indicator framework which distinguishes objects utilizing the Viola-Jones calculation. The kind of object identified is controlled by the model property. As a matter of course, the identifier is designed to recognize faces.

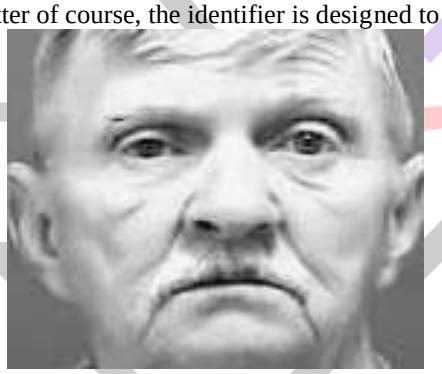


Fig. 4: Face image detection and segmentation

3) EDGE DETECTION

Canny Edge Detection method find out the edges via observing local maxima of gradient of the input picture. It calculates the gradient using Gaussian channel auxiliary. The canny methodology utilizes two edges to perceive solid as well as weak edges. It joins edges which are weak in the yield just in case they are related with strong edges. Accordingly, the technique is more robust to noise and more likely to recognize true weak edges.

Canny technique chooses the User-characterized edge check box to characterize the low and high limit thresholds. It utilizes the threshold source factor which is used to determine how one should enter the limit thresholds. In the event that we select specify by means of exchange, the parameter of threshold that is low and high is shows up in the discourse box. Here if the entered value is less than the lower threshold then it is represented as a weak edge. If the entered value is higher than lower threshold and lesser than higher threshold then it will be represented as strong edge. Figure 5 depicts input image whose edge is detected by canny method.

Fig. 5: Edge Detection using Canny

V. FEATURE EXTRACTION

The essential LBP administrator had been presented by Ojala et al. [10] as a spatial element descriptor, in light of local image patch structure. To figure feature extraction methods, the LBP approach first takes a symmetric neighbourhood in the region of every pixel and edge the neighbouring pixels grey value at the grey value of the pixel in centre circular fashion. The local neighbourhood differences i.e. threshold output includes 2 sorts of data: sign and its magnitude. Sign part gives the essential difference data, i.e. the surrounded pixels are greater or littler compare to inside pixel threshold. Be that as it may, extent data, gives the measure of the distinction, i.e., sum by which the surrounded pixels are greater or littler compare to inside pixel threshold. To accomplish grey level invariance, the LBP approach utilizes just the indication of nearby neighbourhood contrasts for binarization. Thus, a binary feature vector is made by assigning a value 1. By any chance the surrounded pixel is more higher when compared to the inside pixel or else value 0 is assigned. Formally, the LBP feature vector is characterized as condition (2):

$$V = v\left(S\left(g_0 - g_c\right), S(g_1 - g_c), \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots S(g_{p-1} - g_c)\right) \quad (2)$$

Where g_c is the value of grey pixel in the centre that is g_n, and (n = 0……p-1) the pixels grey value which is surrounded in circular fashion having radius R. P is aggregate numeral of surrounded pixel in a nearby picture patch. As binomial factor increases Binary feature vector is also increase and then added-up to change into a code that signifies the spatial structure of the local image texture as appeared in Eq. (2)

$$LBP_{P,R} = \sum_{n=0}^{P-1} S\left(g_n - g_c\right)2n$$

$$S(x) = \begin{cases} 1, x \geq 0 \\ 0, x < 0 \end{cases} \quad (3)$$

Where, s(x) is a function which indicates the sign of local neighbouring pixel differences, i.e., $(g_n - g_c)$ it is equal to zero when negative argument is there otherwise one. Coordinates of the adjacent pixels (g_n) are given by $\left(-R\sin\left(\frac{2\pi n}{p}\right), R\cos\left(\frac{2\pi n}{p}\right)\right)$, by taking central pixel coordinates (g_c) as (0,0). Fig. 4.4 depicts basic computational method of LBP approach.

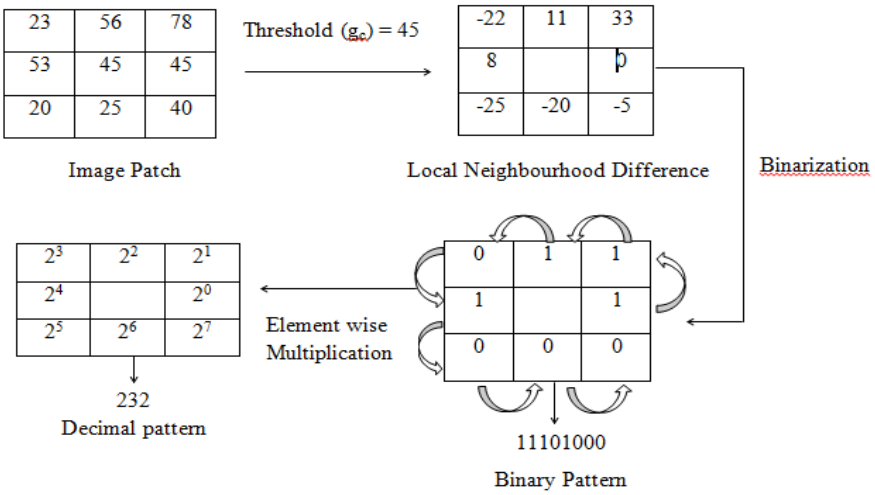
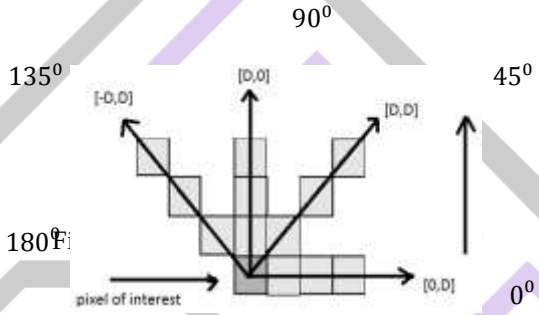


Fig. 6: Example showing LBP computation

VI. GREY LEVEL CO-OCCURRENCE MATRIX (GLCM)

In statistical texture analysis, the texture features are calculated from the distribution of experiential blends of intensities at distinguished areas in respect to each other in the picture. They are classified into 1st order, 2nd order and furthermore higher-order measurements as indicated by the quantity of intensity points (pixels) in every combination. The GLCM methodology gives a strategy for isolating 2nd request quantifiable features of surface. This methodology can be used in various different solicitations, 3rd and higher demand surfaces will study the associations between more than three pixels. All though they are theoretically possible anyway not typically executed because of count time and also understanding trouble.

The quantity of lines and segments is equivalent to the quantity of grey levels represent by G, in the picture. Grid component P (i, j | Δx, Δy) explains relative recurrence by which 2 pixels, isolated by pixel separate (Δx, Δy), happen inside a given neighbourhood, with two intensities one is 'i' another one is 'j. Second order values of probability statistical changes among grey levels 'i', 'j' in specific relocation remove d and at a specific edge (ɵ) in the grid component P (i, j | d, ɵ). Utilizing a substantial numerous force G levels infers putting away great deal of impermanent information, i.e. a G × G grid for every blend of (Δx, Δy) or (d, ɵ).
GLCM framework detailing will clarified with the case delineated as for four diverse levels of grey. One pixel offset is utilized here (Reference pixel and neighbour). If adequately enormous window is there, greater offset can be achieved. The left side cell in upper region will be stacked with the conditions blend (0,0) happens, i.e. how many time within the image with (neighbour pixel) grey level 0 flips to the other grey level pixel of another side with 0(reference pixel).
GLCM direction analysis is depicted as shown in figure 4.6. Here θ is considered in following ways, horizontalθ as (0°), front diagonal θ as (45°), vertical θ as (90°) and back diagonal θ as (135°).



Grey level co-event framework is defined to acquire measurable statistical texture features. Various texture features might be removed from the GLCM. Haralick [11] characterizes 14 features estimated from likelihood network to extract the attributes of surface measurements pictures. Be that as it may, in this work just five second request includes to be specific precise second minute, differentiate, entropy, Local Homogeneity, Inverse Difference Moment (IDM) are figured. These five measures give high segregation precision.

(a) Angular Second Moment (ASM)

$$\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} P_{ij}^{\,2}$$

The Homogeneity of an image is measured by ASM. A uniform sight or a view will contain only two or three dim or grey levels, giving GLCM with a couple yet tolerably high estimations of P(i, j). In this way, number of blocks will be high.

(b) Contrast

$$\sum_{i,j=0}^{N-1} P_{ij}\,(i-j)^{2} \qquad (4)$$

This measure of difference or neighbourhood power variety will support commitments from P(i, j) which is far from corner to corner, i.e. $i \neq j$.

(c) Entropy

$$\sum_{i,j=0}^{N-1} -\ln(P_{ij})P_{ij} \qquad (5)$$

The no uniform views have the low first entropy request, but devours high entropy for a homogeneous scene.

(d) Local Homogeneity, Inverse Difference Moment (IDM)

$$\sum_{i,j=0}^{N-1} \frac{P_{ij}}{1+(i-j)^2} \quad (6)$$

IDM is influenced by the picture homogeneity like local homogeneity. Due to weighting factor that is (1+(i−j)*2)- 1. IDM will have little responsibilities on or after inhomogeneous zones (i≠ j). The inhomogeneous pictures will have low IDM edge result, and a decently advanced impetus meant for homogeneous pictures.

VII. CLASSIFICATION

In this work we are utilizing K-Nearest Neighbour (KNN) as the classifier device. The k-nearest neighbours is depicted as non-parametric procedure, and is meant to classification and regression [12]. In the two cases, the input value involves k closest training samples in features space. Based on whether k-NN is used for classifying sample or backslides, the yield relies. A sample is belonging to the group to which it has got maximum votes. In the event having k = 1, sample is assigned to the class of that its nearest neighbour. The k-NN calculation is least difficult among the entire machine learning calculations.

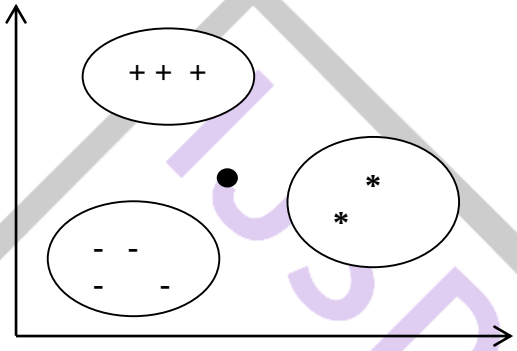


Fig. 8: Example data set

The figure 8 depicts example data set. Here '+' corresponding to class 1, '*'corresponds to class 2 and '–' corresponds to class 3. The black circle in the centre represents test pattern. KNN classifies this test pattern to the class of its closest neighbour in the feature space. In this work there are 41 standard data are selected from MORPH database and 21 images are taken as local datasets. These images include different age groups up to 70 years. We have trained these data sets up to age group of 62, so there will be 62 classes. Test image is selected and the features are extracted by using feature descriptor mention under feature extraction section. Then the test pattern is assigned to the class which has got similar or approximate features as test pattern.

VIII. CONCLUSION AND FUTURE SCOPE

This section summarizes and concludes the contributions made by our paper. A system is developed to identify person age based on feature extracted from the face using MORPH dataset and local dataset. After loading input images pre-processing is done and then texture features are extracted. The extracted features value is given to KNN to classify the facial images based on pixel features.

Conclusion

1. The proposed age recognition system had already been converted as a mobile application. But it may not be efficient for face images with different angle. But our work gives solution to this problem.
2. The proposed system can be used in the forensic science, which helps to identify a person age.

Future Scope

1. The proposed system for age recognition yields a recognition accuracy of more than 95% when we took local image datasets, this may not guarantee that it will yield the same recognition accuracy for other datasets. So future enhancement can be undertaken to get the same recognition accuracy as local datasets.
2.. The user can further adopt other texture feature extraction technologies like Local Ternary pattern (LTP), grey level different method (GLDM) which may produce still better recognition accuracy compared to our work.
3. Further the proposed work can be enhanced by using more number of datasets. Recognition accuracy increases with increase in number of datasets.
4. The work which described in this paper yield good results, when more efficient classifiers like Naïve Bayes, SVM, Decision Tree are used.

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