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Monochromatic Integral Image Identification Based on Adaboost and Viola-Jones Classifier

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ABSTRACT

In every sector, trustworthiness, and authentication played important roles. Technology understanding growth causes an increase in crime. Crime suspects are difficult to distinguish from members of the general population. Face recognition technology may be useful in identifying the perpetrators of a crime. In this study, the viola-Jones algorithm and the LPBH algorithm (Local Pattern Binary Histogram) were used to forecast the occurrence of crimes. The viola-jones algorithm was used to collect the statistics on crime. According to the characteristics of the face, these data were categorized and trained by Adaboost, and the findings were saved in a database. The final step was to determine the criminal suspects by comparing the input data to the previously stored images.

Keywords: *Face identification, Haar characteristics, Local pattern binary histogram(LPBH), Adaboost training and crime prediction*

I. INTRODUCTION

A type of digital image processing known as image recognition is able to recognise and categorise different kinds of people, places, or items in a given digital image. Although people may find it simple to categorise the images, computers find it difficult to distinguish between them. Because pixels—picture components that make up digital images—each have a finite, discrete quantity of numeric representation for their degree of intensity or grey.

Face recognition is a biometric security procedure used to categorise and separate individuals based on their characteristics. Facial recognition is the application of technology to the personal identification or grouping of people in pictures and videos. This system can be used for a variety of real-time applications, primarily those involving security and authentication, such as crowd video surveillance and opening lockers of any kind.

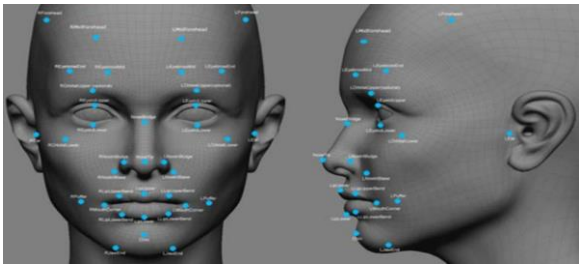

FIG.1 represents a model with nodal points

In general, face recognition works by comparing the input with the data already stored and showing the results whether they match or not. The two sorts of comparison are identification and verification. verification involves comparing two distinct photographs to see if they resemble one another. In identification, each photo is compared to every other photo that was stored in the dataset. Fig.2 represents the following steps. At detection phase, the software searches the provided video or image for the subject's face. Following the identification of a face in the input, the following step is determining the locations of the head, eye, nose, and ear. The face must be facing the camera at least 35 degrees in order to register. In normalization phase, the image must be cropped and rotated in order to store the head and other facial characteristics and map their size, shape, and posture. After the normalization stage was finished, the facial data were translated into a specific code. This strategy makes it simpler to compare the inputs. After all processes were finished, the data were stored as a dataset. The system was then provided with input video or image that needed to be identified. For the fresh photos, the system goes through all the steps again. The result will be provided by comparing the newly processed data with the previously stored data, indicating whether the data were matched or not.

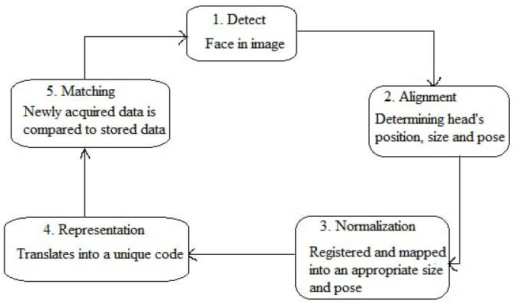

FIG 2: depicts the steps involved in face recognition

The use of fake identifications today raises the crime rate in public places. False identification makes it challenging to distinguish suspects from the general population. Face recognition is extremely important in separating the suspects. Despite the fact that cyber security has developed a tool to identify criminals, this software cannot be used by regular people in public places like malls, theatres, or other gathering places. We therefore require simple and practical software to identify criminals for real-time purposes. The main motive of this paper is to develop practical facial recognition software that can tell suspects apart from the general public. Face identification is made up of face extraction and face detection. The process of finding a face in a gathering of people in a digital image is called face detection. The method of face extraction involves examining the features of the discovered face. The color picture is changed to a black-and-white format. The geometry of the face is then examined using elements such as skin tone, facial shape, eye color, eye socket depth, nose shape, and distance between the eyes. The database that was created using these details will enable comparisons with the incoming data.

II. RELATED WORKS

[1]. Manan Shah, Neil Shah and Nandish Bagat(2021) made a computer vision technique and machine learning algorithm to predict and prevent crime. Here ML techniques and computer vision are both used to identify criminal activity. The method used to identify crimes depends on the type of crime. Identification of the motive is required for this, as it will be used to judge the offense. ML algorithms were used to keep crime records and their details. Foreseeing offenses were done using computer vision. Although it produces results with excellent accuracy, this method cannot be used directly in the public domain. Before being put into practice, this must be taught in a division of the megapolis. WEKA open source software is used for the comparation of dangerous crimes from the society and neighbourhood. The software has been trained using different types of machine learning methods to understand about criminal behaviour

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of an individual. By understanding about the criminality behaviour of people it better answer the date, time and place of the crime event.

[2]. Faisal tareque shoban ,Abu ubaida Akash , Muhammad Ibrahim and mohammad shaficel Alam searched a crime prediction with a novel crime dataset using machine learning. In this paper, crime prediction is illegal act that repercussions. Due to over population, property and so many problems Bangladesh had created many crime activities. Understanding development in crime is crucial for law enforcement organization to stop illegal Activity in future life . These entities serve this aim .An organized criminal organization collection must be established .The current research shows this paper unique a crime dataset that includes data on 6574. Crimes that is temporal, physical, weather related and Epidemiological occurrences in Bangladesh. In order to obtain information data recording the data of collection linked to located the weather, we can use that fundamental features to contact that reputable services provides of these collection of data .Instances of Infraction the collection of data from the Bangladesh national surveys were also used to gather people information .The machine learning data collection is created combined in all the collection of information. For that crime to designed a total of 36 features. This using a recently produced. Collection of data ,five controlled machine learning classification techniques are evaluated we also collected exploratory study on different faces of the dataset .The results of this type of study will assist law enforcement departments in prediction and containing law of crime as well as addition to ensuring the best available allocation of money for crime prediction.

[3]. Steven Walczak (2021) developed a patrol managing crime identification technique using neural networks. This paper, related research, including some problem-solving and decision-making, is reviewed. Machine learning is employed in this study, and prediction in particular is useful at handling classification and prediction usage of neural networks and police related esteeming tasks. To give a practical explanation of the usefulness of neural networks to the law enforcement, a neural network that can predict crime location given the crime and the specific day of the week has been constructed. By providing real-time information on crimes, neural network forecast models for crime aid law enforcement personnel in making better decisions. In crimes has 27 different sorts, the time of 16.4%, they are capable of predicting different type of crime that has been be committed, crime or 27.1% of the time ,When same for crime, In 31.2% of cases, the zip code location prediction neural networks can accurately estimate or nearby area.

[4]. Sakib Mahmud, Abdus Sattar and Musfika Nuha (2021) developed the machine learning and data mining for crime detection. To identify, assess and detect Criminal patterns and trends using different collection of data and KNN algorithm. In order to determine the most protected route to a target, the method analyse Bangladesh's crime rate and calculates the changes of Various crimes occuring in differenc location. The author highlight the a various importance of studying crime due to significant adverse effect on Society in many way, involves Safety issues like hijacking, kidnapping and Intimidation. They Make out that individuals - Frequently utilize the mapping service to determine the simplest path to their location, but don't fully understand the Situation through the route, which can result in unpleasant event. the editors combines primary and Secondary data in their studies. To evaluate the previous information and to proceed the crime identification of the path, KNN algorithm is used. The location is finally assigned using the forecast rate. In conclusion, the creator hopes that their approach will help people become conscious of the crime area and Learn the way to get somewhere safely. It is crucial to remember that if you utilize this paper as a location, you must formally reference it in order.

[5]. Sohail Asghar, Wajiha Safat and Saira Gillani (2021) developed a deep learning and machine learning approaches for criminal detection. Here crime and violation are represented as challenges by controlled in the rule of law. By the exact crime identification and later forecasting rage leads to statistical growth in metro cities. The early specific prediction and forecasting of crime is complicated by people

limited in capacity for handling complex details from big data. multiple algorithmic possible and challenges are represented by accurate rate type of crime, location are past Information. In spite of many research efforts a stranger, predictive algorithm is remains necessary to guide police forces for criminal prediction. To complete crime prediction accuracy using deep learning method. Therefore this research applied a multiple kinds of vectors involving various machine learning techniques particularly Naïve Bayes, XGBoost, SVM, MLP, KNN, ARIMA and LSTM. In regards to root mean square error (RMS) and imply standard variation the efficiency of long-short term memory by time series analysis has about ordinary Mistake (MAE), for both data set. The analysis suggests that more than 35 different Kinds of crimes types will occurs, together an annual drop is Chicago's criminal offence and a minor rise for Los Angeles's criminal offence. In also February recognized a lower crime rate than other year on normal. In this coming year, Chicago's total crime rate will likely continue to arise slightly. The ARIMA Models Project a importance decrease in crime and the criminal offence in Los Angeles. In addition the main regions of both cities crime. prediction finding were discovered. overall, these information suggest . From the beginning crime detection, high crime areas, and future developments all helps to police training and planning by provide greater accuracy in prediction than other approach.

III. EXISTING SYSTEM

Guessing a crime consists of collecting details, evaluating them, and demonstrating the collected information. Identification of an illegal act needs knowledge about all the department's disciplines. The collected crime information can be used to identify any individual or provide the details required by departmental authorities to verify the fraud, abuse, and neglect. The previous method depended on fingerprint analysis, biological samples, signatures, handwriting, footprint, video, and photographs of an individual. Identification of a criminal using images of a person includes minute details like eyes, cheeks, nose, ears, and mouth. When an individual was identified as a criminal and the image in the database was 4-5 years old, it would not detect it. In image identification, it is challenging to identify a criminal in a video of more than 10 people. Therefore, in the former approach, it is difficult to identify an individual in crowded areas with an old data set.

Disadvantages

In face detection, because of poor lighting and low-quality images, an individual's nodal points do not match the data due to indistinct camera angles.

2. Image identification algorithms strive to identify a person as the same person. This means that the system needs new or current images of the person. When older images of a human were given, they were not detected accurately. so the system was unable to verify the face of an individual.

When there are too many people in an image or video, the software system has a challenging time analysing or differentiating the individuals' faces and features.

IV. METHODOLOGY

Phases of recognition

1.Haar-Cascade

The Haar cascade algorithm is beneficial for human face detection. It is also known as "viola Jones algorithm" and it is not only used in face identification but also used to detect various inflexible structures. This algorithm was composed of four main processes, which make it more applicable and practical for face identification. The processes are computing Haar features, generating Integral Images, performing Adaboost training and executing cascade Classifiers. Once undergoing all these processes, any software system can be able to detect a person's face. Haar cascade classifier is an algorithm used to detect objects in an image or video. It is the most effective and widely used algorithm for face identification. In object detection, Haar cascade characteristics uses Haar like characteristics in various forms to detect objects in a picture. The Haar characteristics are used to classify the various objects in a picture by extracting the characteristics of that picture.

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Generally these Haar characteristics are trained to detect only one object in an picture. Several of them can be used in parallel for example detecting face and eyes together.

FIG 3: positive image and negative image

Negative pictures and positive pictures are used to train a Haar classifier which is shown in Fig.3. Essentially positive image that contain a face and negative image do not contain any face instead it contain objects. For training a Haar classifier, rotating the aperture of multiple geometrical figures for extracting single value characteristic. The quantities of the pixel intensities are subtracted under the white geometrical figure from the black geometrical figure for calculation purpose and commonly these characteristics have separate values. The calculation looks more pathetic for a 24x24 context and it will generate 180,000 characteristics. Therefore integral image method is devised and that computes this with four array references. Boosting algorithm is then used to determine the important information of the features.

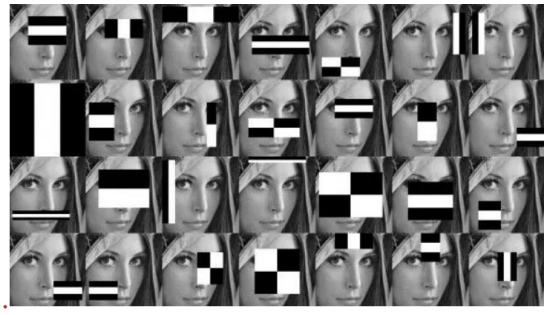

FIG 4: represents the steps taking place in face recognition.

2. Face identification

For human face identification, Haar features are used by the Haar cascade classifier. There are three steps in calculating the Haar features. The first step is to gather the Haar characteristics. These aspects can be helpful in identifying the edge or line characteristics in the image or an unexpected difference in the intensity of the pixel. For large images, it is complicated to use these characteristics. Integral images are used here to produce the reduced number of operations. It also improves the speed of the computation processes of these Haar characteristics.

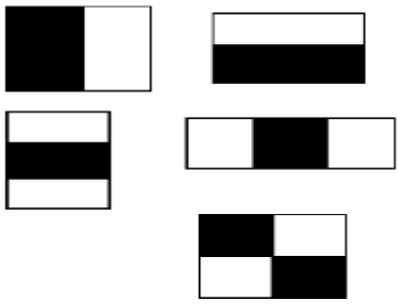

FIG 5: general types of Haar characteristics

3. LPBH Algorithm

Using a local binary pattern technique, the front and side faces of people were recognised. This approach is based on the image's pixel value. Groups of pixels make create a digital image. The image was cut up into several little squares. The term "pixel" refers to a single square. The pixels in the image's width and height must be multiplied to determine the total number of pixels.

Basic process of LPBH algorithm:

This algorithm consists of three steps,

- Creating binary value
- Generating histogram
- Comparison

Creating binary value

Initially, binary values for images were made through examining their matrices. If there are 3 rows and 3 columns of pixels in the image, there were a total of 9 pixels. Each pixel has a unique value. To create a binary value, the value of the

middle pixel was chosen. Then, the values of each pixel in the image were compared to the chosen centre value. When the number is higher than or equal to the centre number then the result will be '1'; otherwise, the result will be '0'. In this manner, 0s and 1s were substituted for all values surrounding the central value. Binary values were taken in the following order: top left corner of the first column, final row, value of the last column, right in the last row, and upward in the first column. In other words, the flow must have the shape of a circle centred on the value. Convert the binary value you created for the image to a decimal value that should be between 0 and 255. Both lighter and darker images will benefit from this algorithm's strength. The value will be greater for the brighter image and lower for the darker image.

Generating histogram

Each pixel in an image is made up of numerous pixels, making up the entire image. By using the condition mentioned above, each pixel was given a binary value. The pixel's colour information is represented by the binary value. Based on these data, a graph was made to illustrate the squares that includes a count of the repetition of each colour. The name "histogram" refers to this graph representation.

Comparison

The edge and corner information of a picture can be found by comparing the histogram. The colour information for facial features is contained in this histogram.

4. Adaboost Training

Adaboost (adaptive boosting) is a machine-learning technique used as an ensemble method. The most familiar evaluator employed with Adaboost was decision trees. It selects the best characteristics of human features and gradually trains the classifier to detect the human face. It creates an object and gives equal weight to each data point. The object is classified into weak classifiers and strong classifiers. More weight is implemented for the weak classifier. By converting a large number of weak learners into strong learners, this boosting algorithm would improve the identification power. It needs training data to have a destination variable.

In bagging, multiple samples are taken from the training data. To create a simple predictive model, combine the results of individual trees. Each and every bootstrap sample does not depend on others, thus this method runs in parallel. For any demographic model, boosting algorithm can be applied. They do not contain any bootstrap samplers. Boosting algorithm working is done by predefined orderly manner. To create a strong classifier, all the trees are matched on the changed version of the earlier records and at the end combined together. Decision stump is used to separate the records into two parts. A coherent classifier is given to the records is also called as decision stump. In the first loop, the classifier will get separated into two parts and rightly classified class will be given small mass. In the second loop from the classifier classes more mass will be given to the rightly classified class by providing further decision stump that fits the weak classifier on the record. Then it will alter the mass to the next loop which is third loop. In the third loop more mass will be given to the wrongly classified class by a decision stump.

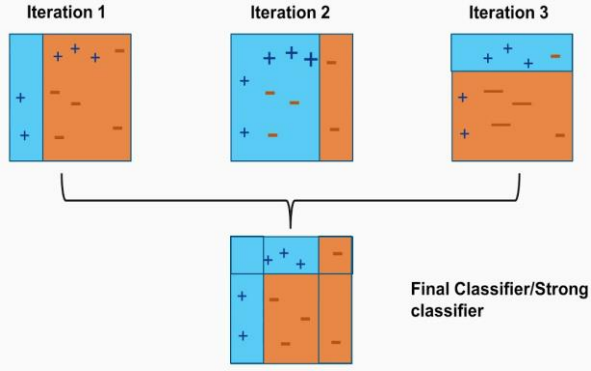

FIG 6: Working principle of adaboost classifier

Examine the minus symbols in fig. 6 to determine whose weights have been increased. Once each iteration is complete, weights which are generated automatically for each classifier are added to all previous iterations. In order to create a powerful classifier that correctly predicts the classes, add each iteration based on weight. The data are fitted to a classifier, and the overall errors

are computed. The classifier for the final additive model evaluation should contain the weight calculation errors. The larger weight assigned to the model will be more accurately detected by the innate sense. The weights assigned to each observation will then be revised. In this case, the erroneously classified observation will carry more weight. Figure 7 illustrates how weights were modified from the original iteration to the most recent iteration. First, a decision tree classifier and an adaboost classifier are imported in order to implement this technique in python. A base estimator that is fitted to the entire dataset by a decision stump in adaboost that fits some of the cloned organizer on the similar dataset.

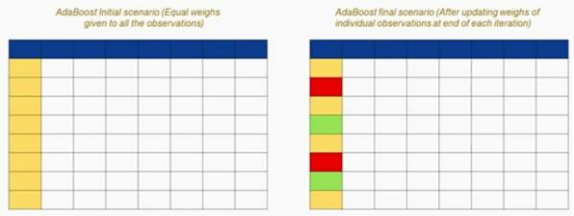

FIG 7: comparison of initial iteration with the last iteration

Calculation of the adaboost mechanism:

Create examined mass Mc = 1/N

With s=1 to S:

To train the dataset, place the organizer Ls(y)

Calculate:

$$errs = \sum_{t=1}^{N} Mc\ I(zt \neq Ls(yt)) / \sum_{t=1}^{N} Mc$$

Calculate:

$$ds = \log (1- errs/errs)$$

Group:

$$Mc < -Mc * \exp[ds * I(zt \neq Ls(yt))], t=1,2,\ldots\ldots,N$$

Final:

$$L(y)\text{-}signi[\sum_{s=1}^{S} dsLs(y)]$$

V. PROPOSED METHOD

The proposed system is divided into three main processes. The foremost process includes organising and training the dataset. The middle part consists of real-time face detection. And the final process consists of the comparison of crime record image and the captured present image of a person then it will provide the result as criminal detected or no criminal detected. The video and image data were collected from the crime records, and it was trained. In another part, the video or image data is fetched using a CCTV camera or web camera and is further processed for the training process. The Haar cascade algorithm is used for feature extraction to detect models in an image. Implementing the Haar cascade model is done with OpenCV and Python code. A minimum of six images and the details about an individual can be given as input. Fig.9 shows that the RGB image is turned into grayscale images to make the process easier. It trains the dataset based on the adaboost algorithm, which produces a strong classifier out of a combination of weak ones. The LBPH (local binary pattern histogram) algorithm is used to recognise both the front and side faces of a person. The local binary pattern operator is strong against monotonic image transformations.

FIG 9 Grayscale images

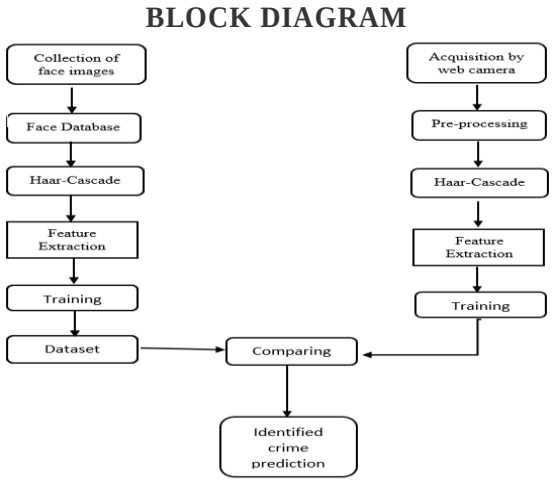

FIG 10: Block diagram

Advantages

By using this proposed system, even when a low-quality image is given, it will detect and predict the result accurately.

Even though there will be a group of people in an airport, railway station, or plaza, it will be possible to identify the face of a person in the video or image input.

If a person's old image were given to train the dataset, it would be able to verify the face of an individual in the present.

VI. RESULT

The face recognition has been achieved by using Haar-Cascade algorithm. The crime suspects records were stored in dataset. With these record crime suspects has been detected. If the human face which was captured using web camera or CCTV matches with the stored crime record, then it indicates human face with red color box and displays as detected crime with their details. Suppose the human face does not matches with the crime records then it indicates human face with green color box 'no record found' message as a pop-up box.

FIG 11: Crime detected

The fig.11 indicates the detected crime suspects in the digital image or video and shows their details by clicking on the suspect name which is given inside the yellow coloured rectangle.

FIG 12: Crime not detected

The Fig.12 indicates no crime record found in the dataset.

VI. CONCLUSION

Nowadays crime rate increases as the knowledge of technology increases. Identifying crime suspects in a public place is one of the major tasks. This paper gives a solution to differentiate crime suspects from common people through face recognition. By using the Haar-cascade algorithm human face was detected on basis of their feature. This application can be used in every public area and crimes can be prevented. By utilizing this application, the verification of a person has become simple, since crime records were gathered previously and stored it in the dataset. The forthcoming work is to enhance the exactness of the human face identification and prediction even in a more crowded area and send an alert message to the police department.

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