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Biometric Attendance Management System

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Abstract: *Taking attendance is a long process and takes lot of effort and time, especially if it involves huge number of students. It is also problematic when an exam is held and causes a lot of disturbance. Moreover, the attendance sheet is subjected to damage and loss while being passed on between different students or teaching staff. And when the number of students enrolled in a certain course is huge, the lecturers tend to call the names of students randomly which is not fair student evaluation process either. This process could be easy and effective with a small number of students but on the other hand dealing with the records of a large number of students often leads to human error. Human face detection by computer systems has become a major field of interest. Face detection algorithms are used in a wide range of applications, such as security control, video retrieving, biometric signal processing, human computer interface, face recognitions and image database management. The system should be built to be used for a prolonged period of time anywhere in the university campus where attendance would be tracked and saved in excel sheets for efficiency and accuracy. Techniques like Haar Cascade Classifiers which is a face detection classifier and LBPH Facial Recognition process were used. With the help of the following techniques, this has been successfully implemented for maintaining the attendance record. The main motive behind developing this system is to eliminate all the drawbacks which were associated with manual attendance system, which was successfully eliminated.*

Keywords: *biometric, attendance, machine, learning, facial, recognition*

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I. Introduction

In many Institutions and Organizations, the attendance is a very important factor to maintain the record of lectures, salary and work hours etc [13]. Most of the institutes and organizations follow the manual method using old paper and file method and some of them have shifted to biometric technique. The current method that colleges use is that the professor passes a sheet or make roll calls and mark the attendance of the students and this sheet further goes to the admin department with updates the final excel sheet. This process is quite hectic and time consuming. Also, for professors or employees at institutes or organizations the biometric system serves one at a time. So, why not shift to an automated attendance system which works on face recognition technique [10-11]? Be it a class room or entry gates it will mark the attendance of the students, professors, employees, etc [12]. This can also be used in payment techniques, for access and security, identifying criminals and people, for advertising and marketing, and even for healthcare.

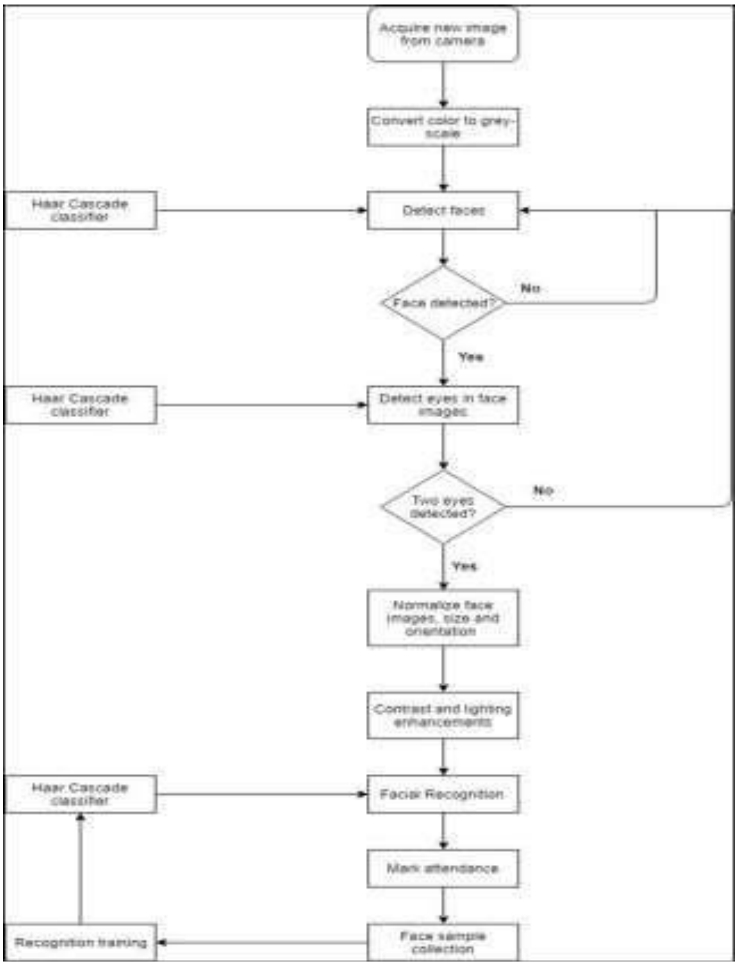

Figure 1. Flowchart of system architecture

II. Literature Survey

The research paper "A Real-time Face Recognition System Based on the Improved LBPH Algorithm" carried out by XueMei Zhao [2] was the main motivation behind this. Documents related to OpenCv [16] were read and various videos were watched and referred to understand the approaches to solve the problem. The main aim in referring the websites was to understand the techniques and select an appropriate and viable method for the project.

Also, "Face Description with local binary patterns" by Ahonen [1] helped understand the concepts of binary patterns and also the applications of facial recognition.

"Multiresolution gray-scale and rotation invariant texture classification with local binary patterns." By Ojala [3] made it easier to understand the concepts of Haar Cascade Classifiers and Local binary patterns histogram (LBPH).

III. Design

Human face detection by computer systems has become a major field of interest. Face detection algorithms are used in a wide range of applications, such as security control, video retrieving, biometric signal processing, human computer interface, face recognitions and image database management

[9]. However, it is difficult to develop a complete robust face detector due to various light conditions, face sizes, and face orientations [7]. Face recognition system includes four main parts: information acquisition module, feature extraction module, classification module and training classifier database module [15]. The image information collected by the information acquisition module will be used as a test sample for analysis. In the feature extraction module, a series of salient features which can represent human identity information are extracted and analysed [14]. In the classification module, the classifier trained by database is used to classify the test samples to determine the identity information of the samples. The following techniques were used for design:

A. Face Detection Classifier (Haar Cascade)

A computer program that decides whether an image is a positive image (face image) or negative image (non-face image) is called a classifier. A classifier is trained on hundreds of thousands of face and non-face images to learn how to classify a new image correctly. OpenCV provides us with two pre-trained and ready to be used for face detection classifiers:

To run a classifier, the knowledge files need to be loaded first, as if it had no knowledge, just like a newly born baby.

Each file starts with the name of the classifier it belongs to. For example, a Haar cascade classifier starts off as haarcascade_frontalface_alt.xml.

The Haar Cascade Classifier is a machine learning based approach, an algorithm created by Paul Viola and Michael Jones; which are trained from many positive images (with faces) and negatives images (without faces). [5]

It starts by extracting Haar features from each image as shown by the windows below:

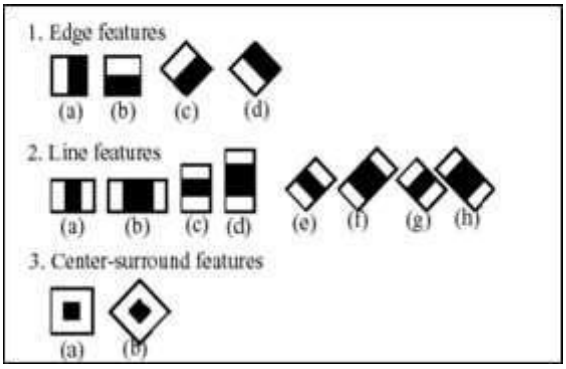

Figure 2. Haar Cascade Classifier

Each window is placed on the picture to calculate a single feature. This feature is a single value obtained by subtracting the sum of pixels under the white part of the window from the sum of the pixels under the black part of the window.

Now, all possible sizes of each window are placed on all possible locations of each image to calculate plenty of features.

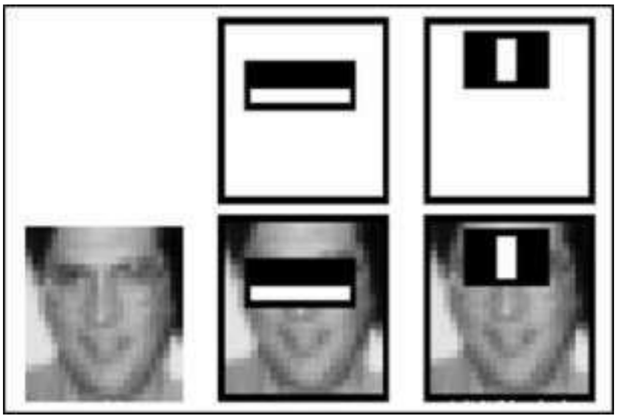

Figure 3. Face detection using Haar Cascade

For example, in above image, two features are being extracted. The first one focuses on the property that the region of the eyes is often darker than the area of the nose and cheeks. The second feature relies on the property that the eyes are darker than the bridge of the nose. But among all these features calculated, most of them are irrelevant. For example, when used on the cheek, the windows become irrelevant because none of these areas are darker or lighter than other regions on the cheeks, all sectors here are the same. Hence, irrelevant features are discarded and only the relevant ones are kept with a fancy technique called Adaboost [17]. AdaBoost is a training process for face detection, which selects only those features known to improve the classification (face/non-face) accuracy of the classifier. In the end, the algorithm considers the fact that generally: most of the region in an image is a non-face region. Considering this, it's a better idea to have a simple method to check if a window is a non-face region, and if it's not, discard it right away and don't process it again. Hence the area where a face is mainly focused.

B. Local Binary Patterns Histogram (LBPH)

Local Binary Patterns (LBP) is a type of visual descriptor used for classification in computer vision [4]. LBP was first described in 1994 and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with the Histogram of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. [4-8]

Eigenfaces and Fisherfaces recognizers are both affected by light and, in real life, perfect light conditions cannot be guaranteed [6]. LBPH face recognizer is an improvement to overcome this drawback.

The idea with LBPH is not to look at the image as a whole, but instead, try to find its local structure by comparing each pixel to the neighbouring pixels.

In the LBPH Face Recognizer Process, a 3×3 window is taken and moved across one image. At each move (each local part of the picture), compare the pixel at the centre, with its surrounding pixels. Denote the neighbours with intensity value less than or equal to the centre pixel by 1 and the rest by 0.

After reading these 0/1 values under the 3×3 window in a clockwise order, a binary pattern like 11100011 that is local to a particular area of the picture is obtained. After repeating this process on the whole image, a list of local binary patterns will be generated.

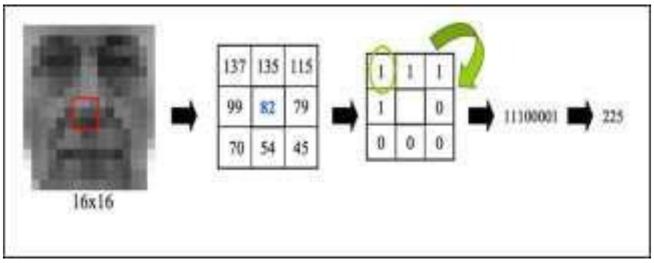

Figure 4. Understanding LBPH

Now, after a list of local binary patterns is obtained, the binary pattern is converted into a decimal number using binary to decimal conversion (as shown in above image) and then a histogram of all of those decimal values is made. A sample histogram looks like this:

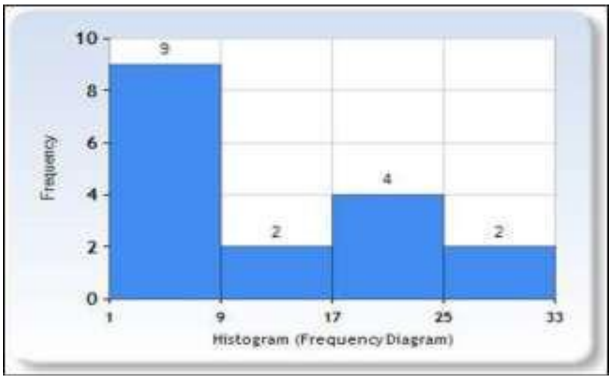

Figure 5. LBPH Histogram

In the end, one histogram for each face in the training data set is obtained. That means that if there were 100 images in the training data set then LBPH will extract 100 histograms after training and store them for later recognition. Remember, the algorithm also keeps track of which histogram belongs to which person.

Later during recognition the process is as follows:

1. Feed a new image to the recognizer for face recognition.
2. The recognizer generates a histogram for that new picture.
3. It then compares that histogram with the histograms it already has.
4. Finally, it finds the best match and returns the person label associated with that best match.

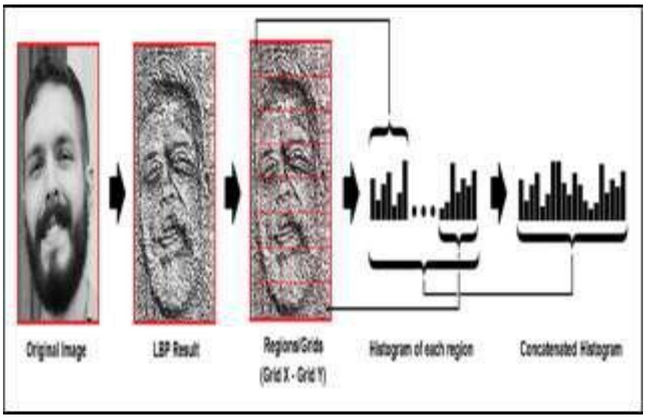

Figure 6. LBPH Operation

C. Software Requirements

The project is based on computer vision concepts and the following are required. [18]
Required code dependencies:

1. OpenCV 3.2.0
2. Python v3.6
3. Numpy
4. Pandas

D. Hardware Requirements

The face detection and recognition system require a webcam. The camera requires necessary driver installed within the operating system. Also, it requires 1 USB port on the PC. Camera's visual must run smoothly without any error and delay more than 4sec to get the image of the user.

This requirement is dependent on many aspects of the user pc. Minimum requirements for running are:

1. GPU: Intel HD Graphics
2. CPU: Intel Celeron
3. Camera: Minimum 2MP Camera
4. USB port: 1x USB 2.0 or better port
5. Operating system: Windows XP or better
6. Processing: Core 2 with processing speed 2.0GHz
7. Memory: 2GB RAM, 50 GB Hard Disk.

IV. Implementation

This project is basically implemented using OpenCV (Open Source Computer Vision) and Python 3.6 – tkinter for GUI interface.
The following diagram is the system architecture and steps for implementation:

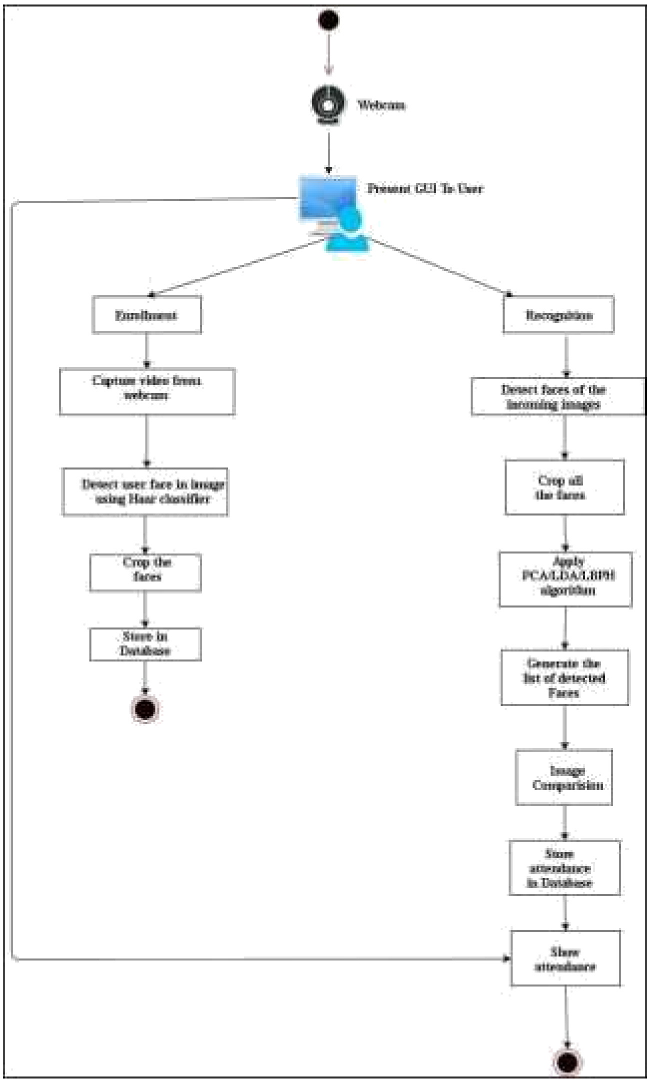

Figure 7. System architecture

V. Result

The screenshots below shows the GUI of the software and the different options available to a user.

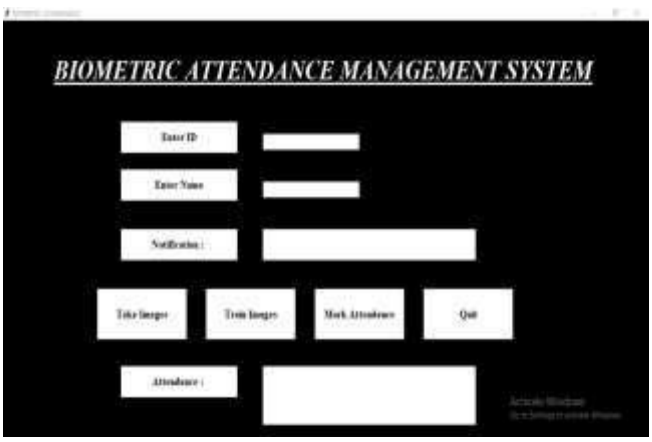

Figure 8. GUI Screenshot

When a new user enters his/her name and clicks on 'Take Images', it clicks 60-80 snaps of the user to train, and adds the new user's name in the database as shown below.

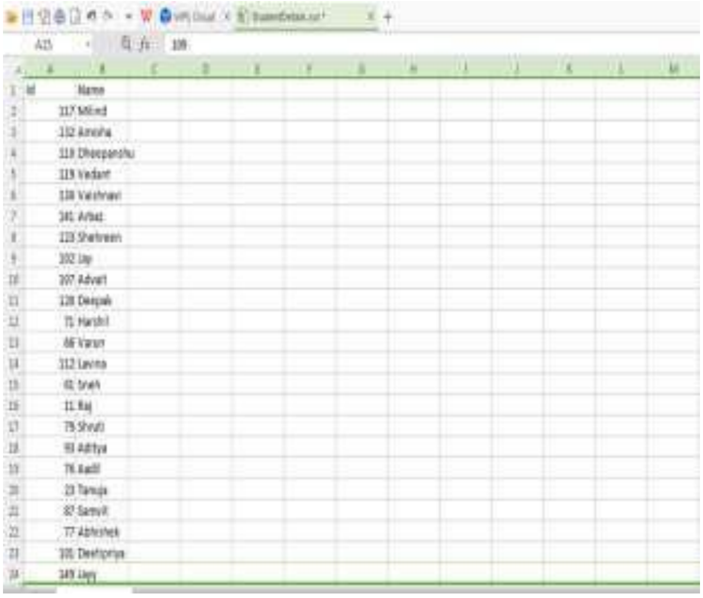

Figure 9. User Database Screenshot

After 'Train Images' is clicked on, the notification that the images are trained is received, and on clicking 'Mark Attendance', the camera opens and detects the faces if they are trained earlier, as shown below.

Figure 10. Face recognition in use

Once the faces are detected, the user's attendance is marked in an excel sheet which provides details such as Name, ID, Date and Time.

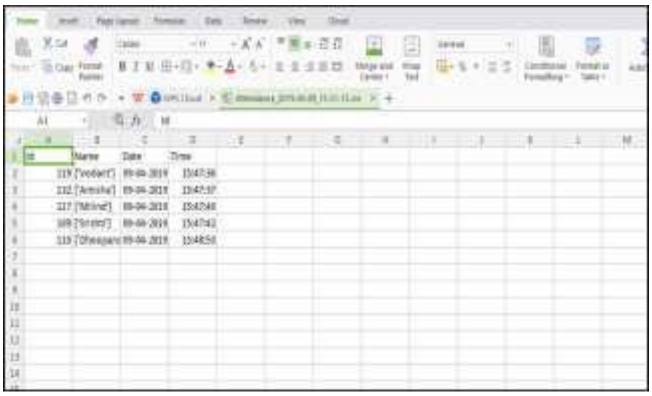

Figure 11. Excel sheet showing attendance being taken

VI. Conclusion

This has been successfully implemented for maintaining the attendance record. The main motive behind developing this system is to eliminate all the drawbacks which were associated with manual attendance system. The drawbacks ranging from wastage of time and paper, till the proxy issues arising in a class, are eliminated. The system has recognition accuracy of about 75%. The number of faces that were used for testing in the LBPH (Local Binary Pattern Histogram) affects the model accuracy and it can be increased by supplying more and a variable input. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance can be far more accurate. The face detection system which uses Haar-Adaboost Classifiers [17] which had a detection rate of 95% and a false detect ratio of 1 in 14000 inputs. The face detection and recognition system was robust enough to achieve good recognition accuracy as the LBPH algorithm is shielded from monotonic greyscale transformations and it performs best in a controlled environment. Facial recognition is part of computer vision and computer vision is on the rise from this decade. The outreach of computer vision is immense and its possibilities are endless. With this being said the most suitable real-world applications for face detection and recognition systems are for mug-shot matching and surveillance.

References

[1]. Ahonen, Timo, Abdenour Hadid, and Matti Pietikainen. "Face description with local binary patterns: Application to face recognition." IEEE transactions on pattern analysis and machine intelligence 28.12 (2006): 2037–2041.

[2]. XueMei Zhao, Cheng Bing Wei. "A Real-time Face Recognition System Based on the Improved LBPH Algorithm". IEEE transactions on lbph recognizer for face recognition (2017).

[3]. Ojala, Timo, Matti Pietikainen, and Topi Maenpaa. "Multiresolution gray-scale and rotation invariant texture classification with local binary patterns." IEEE Transactions on pattern analysis and machine intelligence24.7 (2002): 971–987.

[4]. Ahonen, Timo, Abdenour Hadid, and Matti Pietikäinen. "Face recognition with local binary patterns." Computer vision-eccv 2004 (2004): 469–481.

[5]. X. Zhao, W. Zhang, G. Evangelopoulos, D. Huang, S. Shah, Y. Wang, I. Kakadiaris, L. Chen, "Benchmarking Asymmetric 3D2D Face Recognition Systems", Pattern Analysis and Machine Intelligence, pp. 218-233, 2013.

[6]. E. Rekha, P. Ramaprasad, "An efficient automated attendance management system based on Eigen Face recognition", 7th International Conference on Cloud Computing Data Science & Engineering - Confluence, pp. 605-608, 2017.

[7]. V. Mohanraj, V. Vaidehi, S. Vasuhi, R. Kumar, "A Novel Approach for Face Recognition under Varying Illumination Conditions", International Journal of Intelligent Information Technologies, pp. 218-233, 2018.

[8]. J. Khorsheed, K. Yurtkan, "Analysis of Local Binary Patterns for face recognition under varying facial expressions", 24th Signal Processing and Communication Application Conference (SIU), pp. 2085-2088, 2016.

[9]. K. H. Pun, Y. S. Moon, C. C. Tsang, C. T. Chow, S. M. Chan, "A face recognition embedded system", Biometric Technology for Human Identification, vol. 5779, no. 2, pp. 390, 2005.

[10]. A. Ahmedi, S. Nandyal, An Automatic Attendance System Using Image processing, pp. 1-8, 2015.

[11]. J. Joseph, K. P. Zacharia, "Automatic Attendance Management System Using Face Recognition", International Journal of Science and Research (IJSR), vol. 2, no. 11, pp. 327-330, 2013.

[12]. J. Kanti, A. Papola, Smart Attendance using Face Recognition with Percentage Analyzer, vol. 3, no. 6, pp. 7321-7324, 2014.

[13]. Y. Kawaguchi, "Face Recognition-based Lecture Attendance System", The 3rd AEARU, October 2005.

[14]. N. Kar, M. K. Debbarma, A. Saha, D. R. Pal, "Study of Implementing Automated Attendance System Using Face Recognition Technique", International Journal of Computer and Communication Engineering, vol. 1, no. 2, pp. 100-103, 2012.

[15]. T. A. P. K. K. L. P. M. L. M. P. A. W. G. D. P. J. G. Roshan-Tharanga, S. M. S. C. Samarakoon, "Smart attendance using real time face recognition, " 2013.

[16]. LBPH

[17]. OpenCV:https://docs.opencv.org/2.4/modules/contrib/doc/facerec/facerec_tutorial.html#local-binary-patterns-histograms

[18]. https://hub.packtpub.com/implementing-face-detection-using-haar-cascades-adaboost-algorithm/

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