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Attendance system using ArcFace and Raspberry pi

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Abstract - *Image processing has been on the frontier of Machine Learning development since the development of the initial perceptron. Image processing has seen a lot of widespread applications in domains like self-driving cars, medical imaging, geo-sensing etc. Neural Network is extensively used for the above purposes due to its ability to learn hidden patterns from the data. One such popular neural network used for image related tasks is convolutional neural network (CNN). This project highlights the importance of pre-trained neural networks as well as the significance of Deep Learning used in real life which is implemented using Python programming language and Python libraries. Face Recognition Attendance Systems involve the face detection and classify the person accurately. This paper illustrates a way to solve the traditional attendance methodologies. These ways of attendance monitoring are traditionally very difficult to manage and scale up to multiple users. This inefficiency in the system enables new technologies to be used to accelerate the workflows for the same*

Key Words: Machine Learning, Neural Network ArcFace, Euclidean Distance, SMTP Protocol, Computer Vision

1.INTRODUCTION

Maintenance of attendance is important in all the schools, colleges and organizations for checking the performance of a particular person. At some places attendance is done manually and some have adopted methods of automatic attendance using some biometric techniques.

A biometric system consists of an enrollment process in which unique features of a person are stored. Biometric templates can be of many types like Fingerprints, Eye Iris, Face, Hand Geometry, Signature and voice. The purpose system uses face recognition with a neural network for attendance of students. Modern Face recognition system consists of four steps, in first step face is detected and second step is to alignment of the detected face, third step is to extract features from aligned face using neural network and last step is to verify the person using distance metrics. There are various methods for face detection such as HAAR Cascade Classifier, Histogram of oriented gradients and neural networks. In our system we have used SSD for face detection. After face detection we do face alignment. We have used ArcFace for feature extraction from the aligned face. These extracted features are used to verify the person is present in our database or not. We have used SMTP protocol to send email to students. The Attendance Record is saved in a csv file.

1.1 Literature Survey

Sunaryono D, Siswantoro J, and Anggoro R, 2019. An android based course attendance system using face recognition. Journal of King Saud University-Computer and Information Sciences. This paper mainly revolves around building a production system for the Android operating system that can achieve a high accuracy for attendance system.

Zeng, Wenxian, Qinglin Meng, and Ran Li. "Design of intelligent classroom attendance system based on face recognition." 2019 IEEE 3rd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC). IEEE, 2019 This paper helped us to find new ways to improve the accuracy of the attendance systems using a different ML architecture.

Sutabri, Tata, Ade Kurniawan Pamungkur, and Raymond Erz Saragih. "Automatic Attendance System for University Student Using Face Recognition Based on Deep Learning." International Journal of Machine Learning and Computing 9.5 (2019). This paper proposed a web-based student attendance system that aims towards using facial recognition.

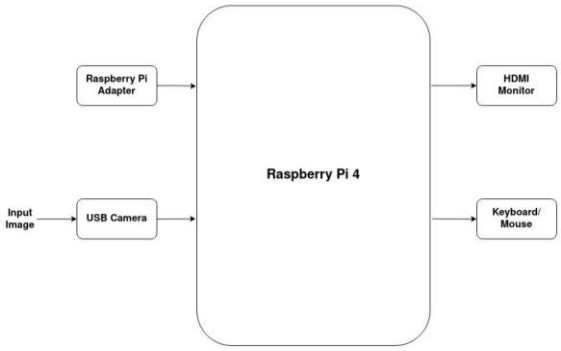
Yang, Hao, and Xiaofeng Han. "Face Recognition Attendance System Based on Real-time Video Processing." IEEE Access (2020). A different resource to explore video processing and thus low latency Facial recognition algorithms for classroom based attendance systems..

Deng, Jiankang, et al. "Arcface: Additive angular margin loss for deep face recognition." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2019. This addresses the elephant in the room where the main challenges in feature learning using Deep Convolutional Neural Networks (DCNNs) for large-scale face recognition is the design of appropriate loss functions that enhance discriminative power. Centre loss penalises the distance between the deep features and their corresponding class centres in the Euclidean space to achieve intra-class compactness.

2. Block Diagram and System Analysis

The system consists of a Raspberry pi, USB camera, monitor, keyboard, mouse and power supply. Raspberry pi is the low cost small size computer that can be plugged with input output devices such as monitor, keyboard, mouse, etc. The power supply provides power to raspberry pi. In raspberry pi we have installed the Raspberian Operating system. We have created a python script for face recognition. After running the python script, input image is taken using a USB camera and appropriate steps for face recognition are performed on the input image. The output is displayed on the monitor. Then the email is sent to the person and attendance is recorded in csv file respectively.

2.2 Hardware



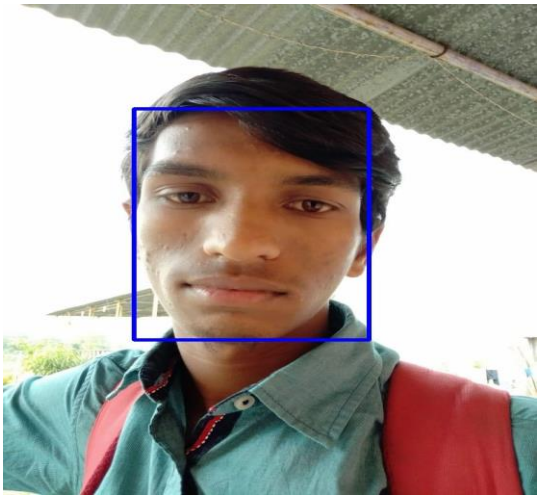
We have used a Raspberry Pi 4 4GB RAM along with the power brick as the compute equipment. Hosting machine learning models on ARM based embedded systems requires decent compute equipment. For the camera module, we have used a USB camera. The HDMI Display along with a Micro Hdmi Cable is used to monitor the output. Also a Heat Sink to dissipate heat and finally a SD Card to store the Operating System for Raspberry pi.

2.3 Software

Python 3, Opencv, Tensorflow , Scikit-Learn, Numpy, Pandas, Email, Smtplib, Datetime

3. Steps for Face Recognition

3.1 Face Detection



Face detection is the task of locating and localizing one or more faces in an image. Locating a face means finding the coordinate of the face in the image. Localizing means to draw a bounding box around the faces. We perform face detection on the input image. We have used SSD for face detection. It is a challenging task given the dynamic nature of faces. For a given image, a face detection algorithm will give zero or more bounding boxes containing faces. Detected face are given as input to the next stage

3.2 Face Alignment

In Face Alignment we rotate the detected face by some angle such that the center of both the eyes should be horizontally aligned. This angle is based on the position of the eyes. If the left eye is above the right eye then we rotate the image in anti-clockwise direction. If the right

eye is above the left eye then we rotate the image in a clockwise direction.

3.3 Feature Extraction

In Face Representation we feed in aligned face to our CNN model. In this stage we get an embedding vector as an output .We will use the CNN model to get the features from the face. Different CNN models have different input and output shapes .For example, Google Facenet expects 160 x 160 x 3 shape input and gives 128 dimensional vector as output. On the other hand, ArcFace has 112 x 112 x 3 shape input and output shape is 512 dimensional array. Based on these representations we can decide if two faces are similar or not. We have used ArcFace for our purpose.

3.4 Face Verification

Face verification is the task of comparing one face to another face and determining that the person is the same or not. Different Face Verification Techniques are Probability, Euclidean Distance, L2-Norm Euclidean Distance and Cosine Similarity. For our purpose we have used L2-Norm Euclidean Distance

4. Algorithm

Step 1: Take input image from camera.

Step 2: Face Detection.

Step 3: Face alignment.

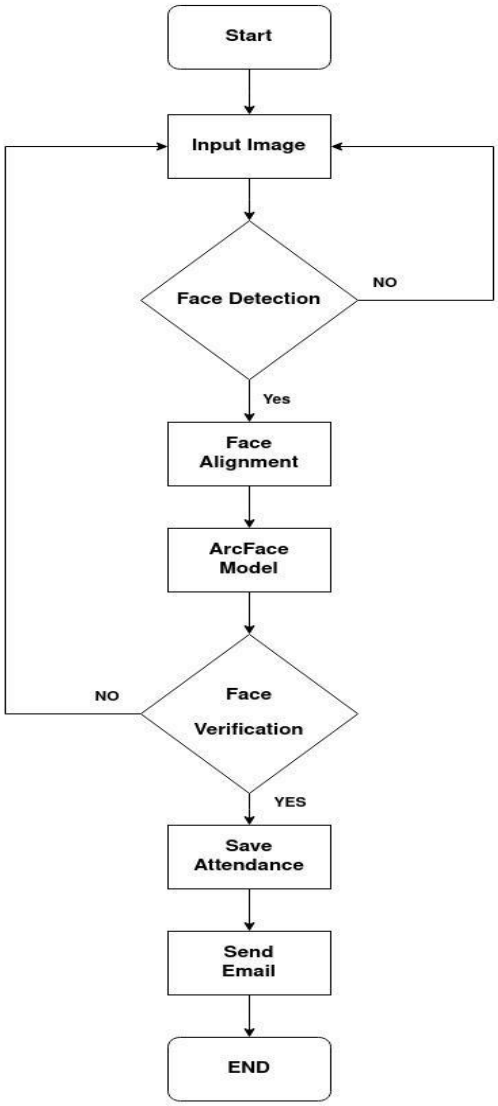
Step 4: Resizing and scaling down the detected face.

Step 5: Face representation using Arcface.

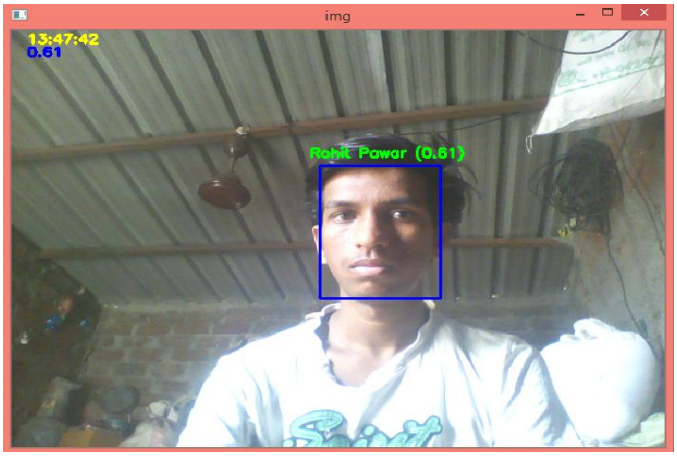
Step 7: Face verification.

Step 8: Mark Attendance According & Send Email

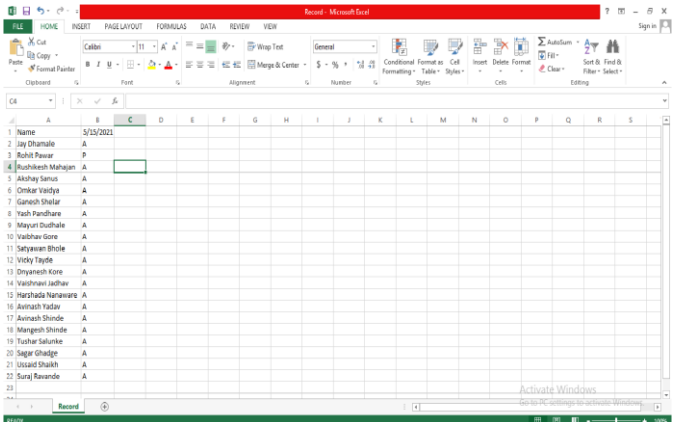
5. Flow Chart



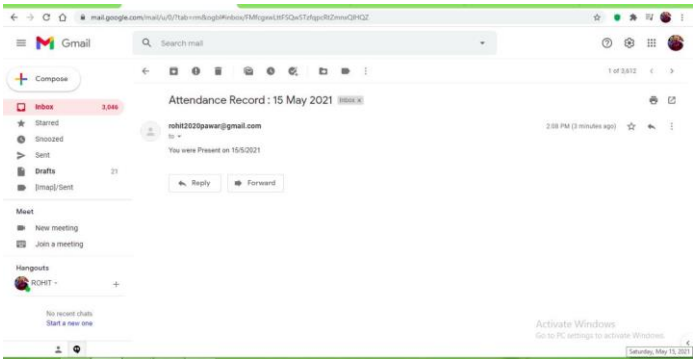
6. Results



Recognised Person present in database



A master record of the attendance table



Auto Generated Email based on the attendance metrics

7. Acknowledgement

For implementation of such a system, we would like to acknowledge a few contributions. We would like to thank Mr. Deng, Jiankang for making significant contributions to ArcFace which has been the backbone of this implementation. We would also like to acknowledge the efforts of Prof. Poonam Yewale for her expert guidance and appreciation followed by support for the work done here with.

8. Conclusion

In this system we have implemented face recognition based attendance system using pretrained neural network ArcFace. The above system can be used in School and Colleges for Attendance purpose. It saves time and effort, especially when the number of students in a classroom are more. This system also establishes a scalable methodology for efficient Attendance monitoring in high throughput workloads for the same.

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