Student attendance system

Introduction

Nowadays, the attendance system is of great significance in enterprises, schools, governments, and other places where personnel management is needed. Attendance through fingerprint recognition requires queuing for identification, which consumes a lot of time. In the case of a finger injury, the accuracy of fingerprint recognition will be greatly reduced. By scanning the ID card for attendance, the identity of the cardholder cannot be verified, which will also produce fraudulent attendance behavior. Checking attendance by mobile phone location is similar to scanning an ID card, which cannot confirm the user's identity, and the location information can also be forged. With the continuous development of machine learning and artificial intelligence technology, the methods of face detection, face recognition, and face landmarks detection have changed greatly. As an important biological feature, the human face has been widely used in the attendance system. The dynamic face recognition technology takes a photo of the current attending students within the classroom building. The user only needs to appear within the scope of video surveillance, and the system can automatically recognize it. Because of its real-time and convenience, this technology has become a hot research direction for the attendance system. An attendance system based on dynamic and multi-face recognition is designed using deep learning approaches. We also designed a user interaction interface for the attendance system. Finally, the attendance system depends on face recognition technology which has basic steps as a pipeline to be followed**[1]**.

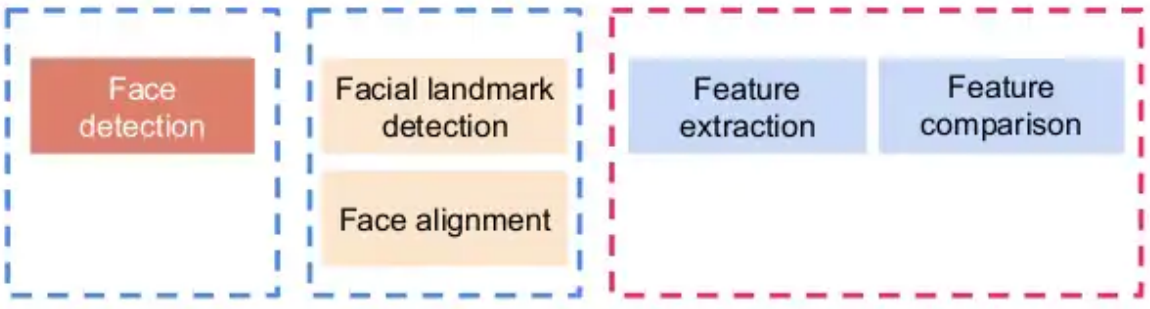

Fig1: face recognition pipeline

What is Face Detection

The first step in face recognition is the detection of the face. Face detection helps identify which parts of an image or video should be focused on to determine age, gender, and emotions using facial expressions. In a facial recognition system, face detection data is required for algorithms that discern which parts of an image or video are needed to generate a faceprint. Face detection applications use algorithms and ML to find human faces within larger images, which often incorporate other non-face objects such as landscapes and other human body parts like feet or hands. Face detection algorithms typically start by searching for human eyes -- one of the easiest features to detect. The algorithm might then attempt to detect eyebrows, the mouth, nose, nostrils, and the iris. Once the algorithm concludes that it has found a facial region, it applies additional tests to confirm that it has detected a face**[2]**.

What is landmark detection

Facial landmark detection algorithms aim to automatically identify the locations of the facial key landmark points on facial images or videos. Those key points are either the dominant points describing the unique location of a facial component (e.g., eye corner) or an interpolated point connecting those dominant points around the facial components and facial contour. Facial landmark detection is challenging for several reasons. First, facial appearance changes significantly across subjects under different facial expressions and head poses. Second, environmental conditions such as illumination would affect the appearance of the faces on the facial images. Third, facial occlusion by other objects or self-occlusion due to extreme head poses would lead to incomplete facial appearance information**[3]**.

What is face recognition

Face recognition is the science that involves the understanding of how faces are recognized by biological systems and how this can be emulated by computer systems. Biological systems employ different types of visual sensors (i.e., eyes), which have been designed by nature to suit a certain environment where the agent lives. Similarly, computer systems employ different visual devices to capture and process faces as best indicated by each particular application. These sensors can be video cameras (e.g., a camcorder), infrared cameras, or among others, 3D scans. Face recognition systems work by capturing an incoming image from a camera device in a two-dimensional or three-dimensional way depending on the characteristics of the device. These ones compare the relevant information of the incoming image signal in real-time in photo or video in a database, being much more reliable and secure than the information obtained in a static image.In this

comparison of faces, it analyses mathematically the incoming image without any margin of error and verifies that the biometric data matches the person **[4]**.

Problem definition

Building an automated attendance system that is reliable, efficient, and which saves time. In recent times, machine learning is enhancing and making human life smart, and hence following or using the same old traditional approaches in daily chores and tasks is like wasting time, energy, and effort for no reason. attendance system which uses face recognition algorithms to record the attendance of the class and manage the class database. The system seeks its application in every classroom to record the attendance of the students smartly and take over the traditional attendance approaches.

System objective

We introduce a system that uses facial recognition technology to record attendance automatically by acquiring images through a high-resolution digital camera. The data acquired is fed to the computer for classification. However, for a machine to be able to identify a person based on their characteristics, it needs to be trained by the use of different algorithms suitable for the purpose. The algorithms defined in the paper are therefore able to recognize faces by means of comparing the test images; acquired on runtime, with the face images stored in the training database, and decisions are made using suitable classifiers. Once the test face matches a stored image, attendance is marked.

The system allows the identification of a person based on some of its main physiological and behavioral characteristics, identifying or verifying people in photographs and videos, a process comprised of detection, alignment, feature extraction, and a recognition task It has 4 steps which are **[5]**:

1. **Face Detection**
2. **Data Gathering**
3. **Data Comparison**
4. **Face Recognition**

Literature survey

In recent times, different techniques, methods, and algorithms have been used to perform facial recognition and increase the accuracy of facial recognition for taking attendance.

In **[6]** presents a novel methodology of taking students' attendance through the face recognition technique. The facial features of the students are extracted via Local Binary Pattern (LBP) and Histogram of Oriented Gradients (HOG). Both LBP and HOG features are combined to create a new feature vector. A classification model is implemented using a Support Vector Machine (SVM) classifier which predicts students based on comparisons made between the features of the query image and the features of the images stored in the student database.

The results of the experiment have shown that the proposed system works efficiently well in almost all lighting conditions. It recognizes the faces of the students accurately and updates the attendance status. It also recognizes the faces even in the presence of spectacles. The combining of LBP and HOG features has increased the accuracy of face recognition way better than other methods. The implemented system also preserves the wastage of time and the proxy data entries that often take place in the case of manual attendance marking.

In **[7]** presents a methodology for recognizing the human face based on the features derived from the image. The proposed methodology is implemented in two stages. The first stage detects the human face in an image using a viola-Jones algorithm. In the next stage, the detected face in the image is recognized using a fusion of Principal Component Analysis and Feed Forward Neural Network. The performance of the proposed method is compared with existing methods. Better accuracy in recognition is realized with the proposed method. The proposed methodology uses Bio ID-Face-Database as a standard image database. The accuracy of face detection and recognition of the proposed method is compared with the existing methods. With the PCA algorithm, an image identification of 72% is realized and with the ANN algorithm, an image identification of 92% is achieved.

In **[8]** aspires to present the comparison of two face recognition techniques Haar Cascade and Local Binary Pattern edified for the classification. As a result, the accuracy of Haar Cascade is more than the Local Binary Pattern but the execution time in Haar Cascade is more than Local Binary Pattern. The execution is performed on both Haar cascade and LBP classifier by using a number of images. As a result, the Haar cascade has more accuracy than the LBP classifier but the time taken by the LBP classifier is less than the Haar cascade classifier compared to other researchers. The Haar cascade classifier detects more faces than the LBP classifier in an image.

In **[9]** AdaBoost face detection algorithm is used to obtain a single face area image, and the principal component analysis (PCA) algorithm is used to realize the class attendance system. However, the PCA algorithm is sensitive to light, age, expression and other conditions, which cannot guarantee the consistency of extracted face feature information, and the recognition effect is poor.

In **[10]** introduces the important basic model MTCNN at first. It is one of the hottest models used most widely recently for its high precision and outstanding real-time performance among the state-of-art algorithms for face detection. Then, the first basic application of portrait classification is researched based on MTCNN and FaceNet. Its direction is one of the most classical and popular areas in nowadays AI visual research and is also the base of many other industrial branches. In addition to the discussion of the basic models, several practical methods are also advised to improve the precision. At last, an interesting and creative research target of Beauty Judgement is discussed based on the portrait classification model. Deep study reveals many brand new difficulties of the topic. Then solutions and suggestions are proposed with detailed analysis from multi-angles, and the general algorithm with six steps is presented and compared with the portrait classification.

Jing Zhou et al.**[11]** designed and implemented an intelligent classroom roll call system based on face recognition, which uses face recognition technology to realize the function of students' regular attendance in class. Compared with fingerprint recognition and iris recognition, the system uses face information as the basis of attendance, which has the advantages of easy access, friendliness, and easy discrimination. However, there are some problems in this system, such as low accuracy of multi-face detection, high rate of face recognition error, and the corresponding features extracted are easily affected by the attitude, light, and expression.

After a long time of experiments to choose the best classification and detection algorithms from the literature survey and based on the following comparisons. We used Multi-task Cascaded Convolutional Networks (MTCNN) which are an effective method to detect faces, identify the position of the face in the picture and mark five landmarks through deep Convolutional Neural Network (CNN) **Table 1**. FaceNet is a technology of face recognition, which is also based on CNN technology, exhibiting high accuracy **Table 2**.

Algorithm	Creator	year	Dataset	Method/ Backbone	Accuracy
LBP	Silva	2015	CMU-PIE	based on a local binary operator Over CNN	94.74%
viola-Jones	Paul Viola and Michael Jones	2001	MIT-CMU	Based on classifiers cascades	93.24%
AdaBoost	Yoav Freund and Robert Schapire	2003	Titanic dataset	Ensemble Method in Machine Learning	88.88%
Haar Cascade	Alfred Haar	1909	ImageNet dataset	ResNet-50 backbone as baseline	96.24%

MTCNN**[23]**	G. J. Edwards, and C. J. Taylor	2001	WIDER-FACE dataset	FaceNet and pre-trained ImageNet	98.9%
R-CNN **[20]**	Shaoqing	2007	PASCAL VOC	based on CNN detector	66.0%
Fast R-CNN **[20]**	Ross Girshick	2007	PASCAL VOC	based on CNN detector	70.0%
Faster R-CNN **[20]**	Ross Girshick	2007	PASCAL VOC	based on CNN detector	73.2%
Mask R-CNN **[20]**	Ross Girshick	2007	MS COCO dataset	based on CNN detector	78.2%
YOLO **[22]**	Jason Brownlee	2007	PASCAL VOC	Based on classifier adopts	63.4%
SSD513 **[22]**	Sik-Ho Tsang	2007	MSCOCO test-dev	Single Shot Detector	76.8%
YOLOv2**[22]**	Jason Brownlee	2007	DSSDD	Based on K-means clustering	78.6%
YOLOv3**[22]**	Jason Brownlee	2007	MS COCO	Based on multi-label classification	61.1%

Table 1 . face recognition algorithms survey.

Algorithm	Creator	year	Dataset	Method/ Backbone	Accuracy
FaceNet **[13]**	Google	2015	Labeled Faces in the Wild	Deep convolutional network	99.63%
DeepID3 **[13]**	The Chinese University of Hong Kong	2015	Labeled Faces in the Wild		99.53%
SphereFace **[14]**	Georgia Institute of Technology	2017	Labeled Faces in the Wild	PyTorch framework	99.42%

Dlib **[15]**	Davis E. King	2009	Labeled Faces in the Wild	ResNet-10	99.38%
VGG-Face **[16]**	The University of Oxford	2015	YouTube Faces DB	ResNet 50	97.40%
DeepFace **[17]**	Facebook	2014	Labeled Faces in the Wild		97.35%
OpenFace **[18]**	Carnegie Mellon University	2016	Labeled Faces in the Wild	PyTorch deep learning framework	92.92%
ArcFace **[19]**	Imperial College London		large-scale image and video database	MobileFaceNet	99.40%

Table 2 . face recognition algorithms survey.

Methodology

In this document, a real time attendance taking system is implemented using deep learning approaches to detect the faces of each student from a video stream and then recognize the faces by cross-referencing the detected faces with the ones stored in the system. This system also has the ability to detect and recognize multiple people on the screen automatically in real-time from the video stream.

For both detecting and recognizing faces, Deep convolutional neural network (DCNN) models are used. Multitasking Cascading Convolutional Networks (MTCNN) is used for face detection and alignment, followed by FaceNet and Inception-ResNet-v1 modals to extract face features and create embeddings and stored it into the database to be compared later by binary classification for face verification and matching.

Convolutional neural network (CNN)

A convolutional neural network (CNN) is a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data.

Convolutional neural networks are composed of multiple layers of artificial neurons. Artificial neurons, a rough imitation of their biological counterparts, are mathematical functions that calculate the weighted sum of multiple inputs and output an activation value. When you input an image in a ConvNet, each layer generates several activation functions that are passed onto the next layer**[24]**.

Residual Network (ResNet)

Deep Residual Network (ResNet) is an Artificial Neural Network that is created with the aim of overcoming the problem of lower accuracy when creating a plain ANN with a deeper layer than a shallower ANN [10]. In other words, the purpose of the Deep Residual Network is to make ANN with deeper layers with high accuracy [9]. The concept of the Deep Residual Network is to make ANN that can update the weight to a shallower layer (reduce degradation gradient). The concept is implemented using a "shortcut connection". The concept of a residual network is shown in Fig. 2

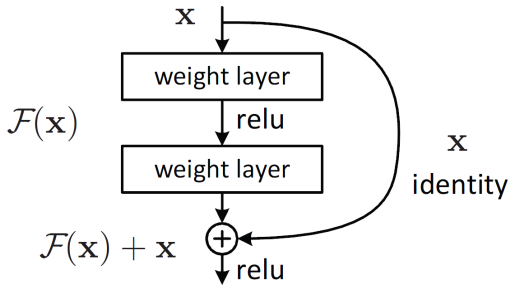

Fig.2 Residual learning: a building block

Inception-ResNet-v1 is one of the ResNet pre-trained models which is a convolutional neural network that is trained on more than a million images from the ImageNet database. The network is 572 layers deep and can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals. As a result, the network has learned rich feature representations for a wide range of images **[31]**.

Multitasking Cascading Convolutional Networks (MTCNN)

Multitasking Cascading Convolutional Networks (MTCNN) is a framework developed as a face detection and face alignment solution. The process consists of three stages of convolutional networks capable of recognizing faces and prominent locations such as the eyes, nose, and mouth.

In the first stage, a shallow CNN is used to quickly produce filter windows. The second stage optimizes the proposed filter windows through a more complex CNN. Finally, the third stage uses a third CNN, one more complex than the other, to improve the result and output the positions of the facial features**[28]**.

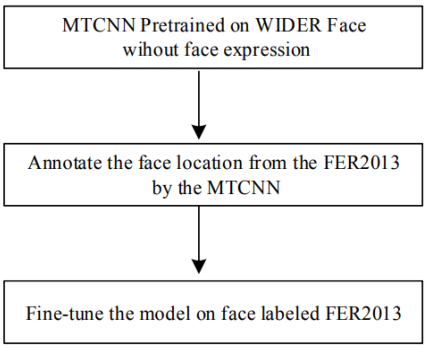

Fig.3 MTCNN training procedure

MTCNN is mainly based on 3 separate CNN models: P-Net, R-Net, and O-Net.

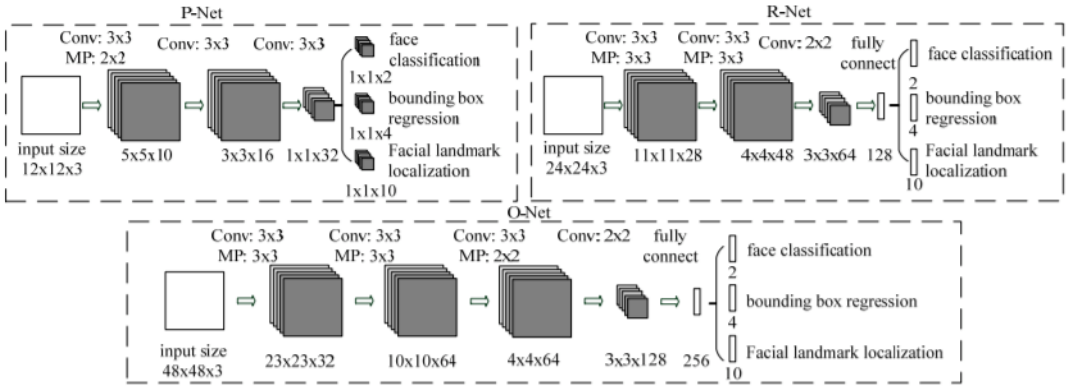

Fig.4 MTCNN Structure

- **The Proposal Network (P-Net):** This first stage is a fully convolutional network (FCN). The difference between a CNN and an FCN is that a fully convolutional network does not use a dense layer as part of the architecture. This Proposal Network is used to obtain candidate windows and their bounding box regression vectors **[31]**.
- **The Refine Network (R-Net):** All candidates from the P-Net are fed into the Refine Network. Notice that this network is a CNN, not an FCN like the one before since there is a dense layer at the last stage of the network architecture. The R-Net further reduces the number of candidates, performs calibration with bounding box regression, and employs non-maximum suppression (NMS) to merge overlapping candidates **[31]**.

  The R-Net outputs whether the input is a face or not, a 4 element vector which is the bounding box for the face, and a 10 element vector for facial landmark localization.

- **The Output Network (O-Net):** This stage is similar to the R-Net, but this Output Network aims to describe the face in more detail and output the five facial landmarks' positions for eyes, nose, and mouth **[31]**.

Binary classification

It is a process or task of classification, in which a given data is being classified into two classes. It's basically a kind of prediction about which of two groups the thing belongs to.

Let us suppose, two emails are sent to you, one is sent by an insurance company that keeps sending their ads, and the other is from your bank regarding your credit card bill. The email service provider will classify the two emails, the first one will be sent to the spam folder and the second one will be kept in the primary one**[28]**.

System implementation

The proposed system is generated using a web application. We have used the flask framework and SQLite database. Different stages of the application are presented next.

System architecture

The proposed system's architecture based on flexibility is shown in Fig.5 below

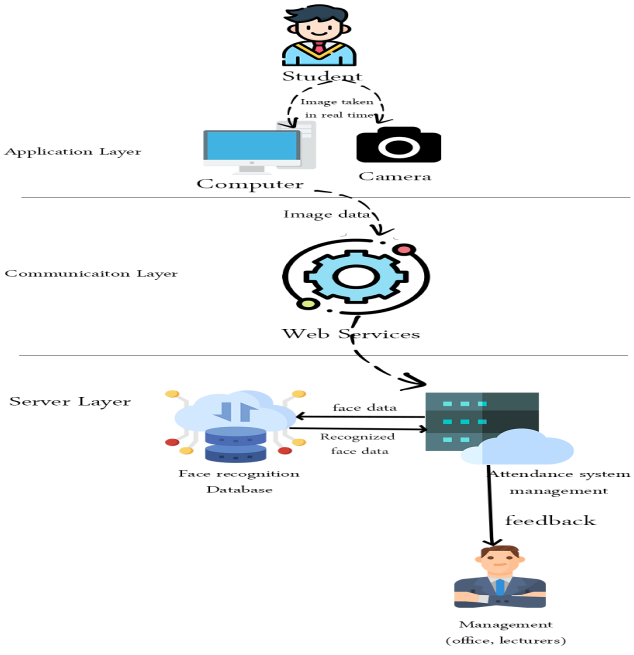

Fig 5. System architecture

The system consists of three layers: Application Layer, Communication Layer, and Server Layer **[33]**.

1. **Application Layer:** In the application layer, there are the input devices whether it can be a built-in laptop camera or an isolated camera connected to the computer. The purpose of this layer is to capture the images in real-time to be sent next to the cloud server for face detection and recognition processing. The results are saved into a database together with all the reachable data **[33]**.

2. **Communication Layer:** RESTful web services are used to communicate between the applications and server layers. Requests are sent by the POST method. Each request is sent with a unique ID of the authorized user of the session. Due to its flexibility and fast performance, JSON is used as the data format for web services response. With this abstract web service layer, the system can easily be used for a new item in the application layer, such as web pages or a new mobile operating system **[33]**.

3. **Server Layer:** The server layer is responsible for handling the requests and sending the results to the client. Face detection and recognition algorithms are performed in this layer and more than 10 different web services are created for handling different requests from web applications. The attendance is taken in real-time processing to compare with pre-trained saved face encodings from the database. The attendance is taken once for each unique person, and it can be recorded again after two hours from the latest attended time **[33]**.

System pipeline

The proposed methodology for face recognition is based on deep learning algorithms. Fig.6 describes the proposed system block diagram.

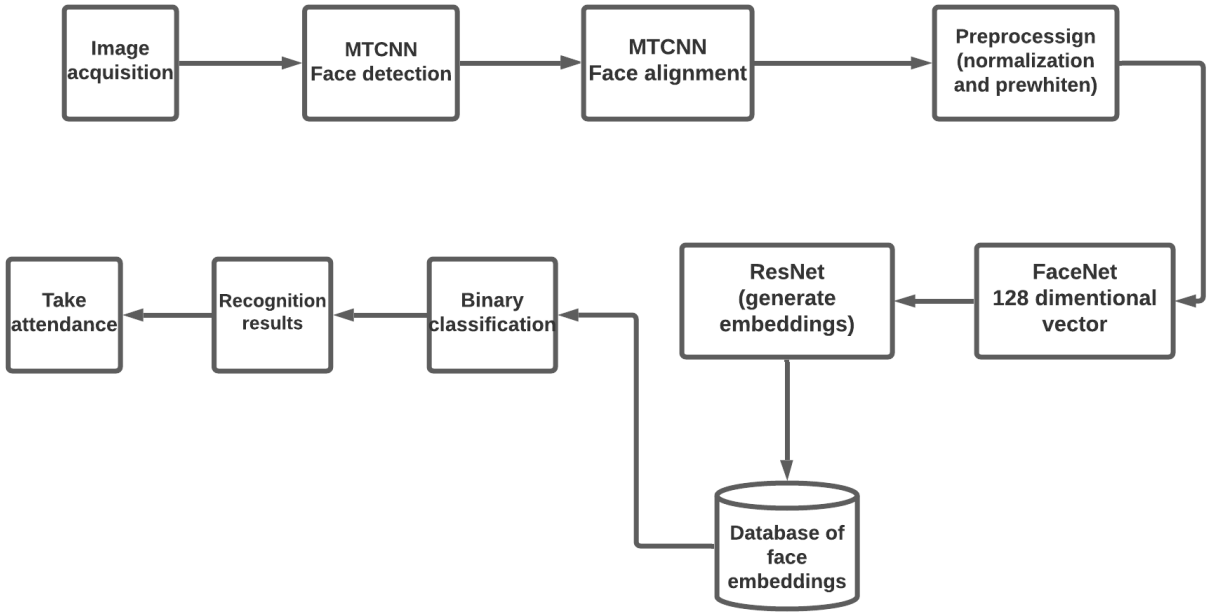

Fig.6 System pipeline

1- Image acquisition

The data for Deep Learning is a key input to models that comprehend from such data and learn the features for future prediction. Although, various aspects come during the deep learning model development, without which various crucial tasks cannot be accomplished. In other words, data is the backbone of entire model development without that it is not possible to train a machine that learns from humans and predicts for humans.

So, the biggest challenge that faces this project is to apply attendance functionalities with just one image for the unique person and recognize him in many cases or conditions. The images acquired from the data/images folder that you can put a student image and attached with his code into this folder, and the system will apply training techniques for it and save it into the database **[28]**.

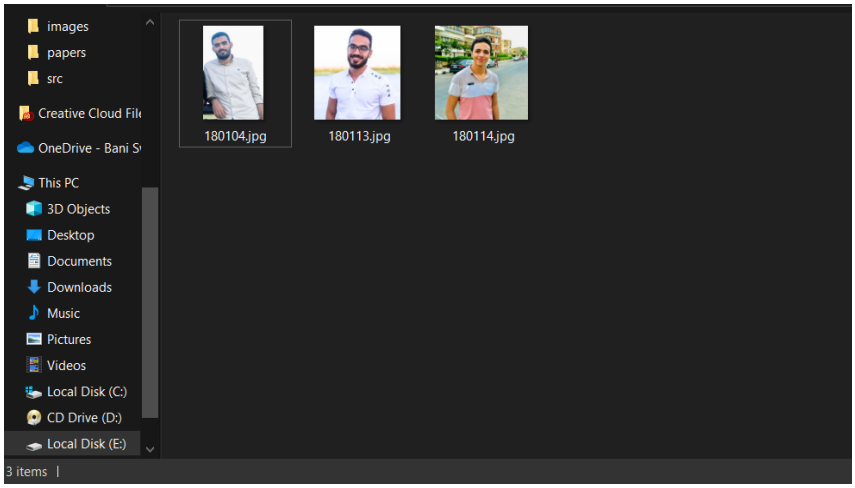

Fig.7 Data acquisition example for students

2- Face detection

MTCNN uses three convolutional networks (RNet, ONet, PNet) to detect faces on both live camera and image. It outputs the bounding boxes to mark the face and generates facial landmarks to be used as input to do face alignment. The MTCNN feature descriptor mainly includes three parts: face/non-face classifier, bounding box regression, and landmark location. There are three stages to be done in face detection with MTCNN. In stage one, images/live camera inputs are passed into the program which automatically creates multiple scaled copies of the image. The copies are then fed into P-Net which is the first convolutional network in MTCNN. At the end of stage one, P-Net outputs bounding boxes with high confidence after removing highly overlapped boxes by using Non-Maximum Suppression (NMS). In stage two, out-of-bound bounding boxes are padded and all the bounding boxes resulting from P-Net are passed to the second convolutional network (R-Net). Again, bounding boxes with low confidence are deleted and NMS is employed to remove highly overlapped bounding boxes. Stage three is similar to stage two, except that stage three has a more complicated convolutional network (O-Net) whose output is more precise. We will talk about them in more detail in the following words **[28]**.

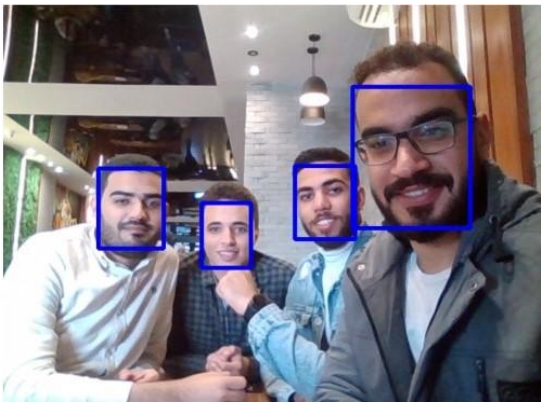

Fig.8 Detecting faces

3- Face Alignment

Align the face in a way that is as closely centered as possible using landmarks from MTCNN in step 2. In this step, we create a class to do face alignment after getting landmarks from MTCNN. The average positions of face points are extracted from Dlib open source code which is a commonly used aspect ratio for 5 landmarks. This class is called when doing face recognition and inputting face features into the database for both camera mode and picture mode.

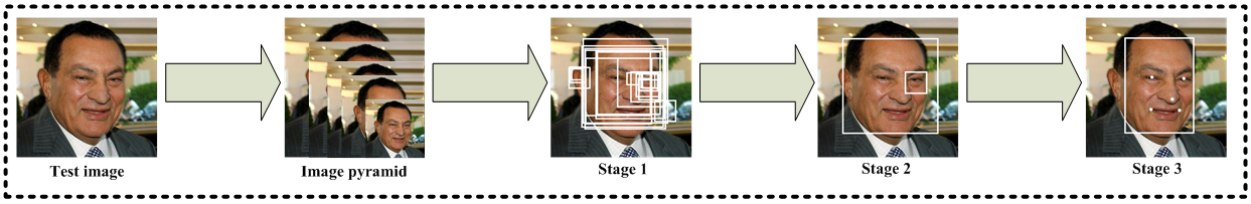

Fig.9 Face Alignment process

4- Image preprocessing

The processing steps have been done into two techniques: Image normalization, and image prewhitening.

The purpose is to do image normalization with the L2 normalization technique to normalize the input and also overcome the problem of vanishing gradient and exploding gradient. The max-pooling layer is used to reduce the dimensionality of the input and the dropout layer is used to avoid the overfitting problem. Using image prewhitening to subtracts the average and normalizes the range of the pixel values of input images. It makes training a lot easier **[28]**.

5- Face feature generation

Pre-trained models of FaceNet are used to generate Embedding in 128-Dimensional/512-Dimensional vectors for each transformed image as the face feature. We tried three different model weights including one 128D and two 512D pre-trained weights. The two 512D weights are generated using FaceNet Inception Resnet V1 architecture on CASIA-WebFace and VGGFace2 training dataset. Details for the Face detection and alignment by MTCNN Calculate distance from the existing user and report the closest user or unknown if the distance is higher than threshold Face features by FaceNet in 128 / 512-Dimensional vector 128D model weights are missing, we only know it is trained on the FaceNet Inception Resnet V1 architecture. The CASIA-WebFace dataset consists of 453 453 images over 10 575 identities after face detection. According to the author of the models, the best performing model has been trained on the VGGFace2 dataset consisting of ~3.3M faces and ~9000 classes. Therefore, we implement all three pre-trained weights for camera mode, but only implement weights trained on VGGFace2 for image mode.

Finally, the generated embeddings for each face will be stored in the students' database to be compared with the incoming real-time camera **[28]**.

6- Binary classification

We used a binary classification technique for a facial recognition network to allow access to one person and to determine either if matched or not.

Internally compare() function is used to compute the Euclidean distance between the face in the image and all faces in the dataset. If the current image is matched with the 60% threshold with the existing dataset, it will move to attendance marking. Internally compare() function is used to compute the Euclidean distance between the face in the image and all faces in the dataset **[28]**.

7- Attendance marking

Once the faces are identified with the image stored in the database, python generates roll numbers of present students and returns that, when data is returned, the system generates an attendance table which includes the name, roll number, date, day, and time. You can access the attendances for each student on the attendance page **[28]**.

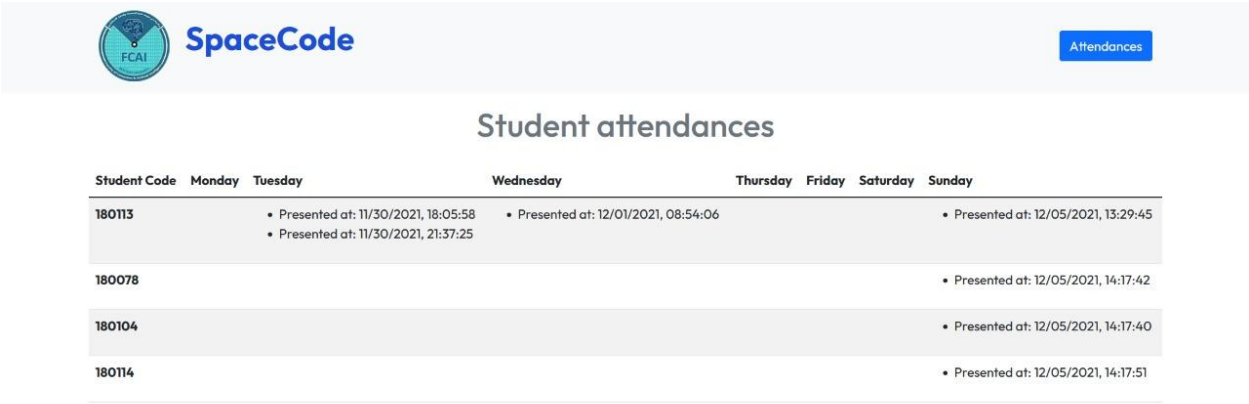

Fig.10 Attendances list

Software requirements

These are the essential software requirements that are necessary to build and deploy the Deep Learning model and the web application. The windows10 operating system with intel i7 8th processor having 16GB RAM is used and the installation on the programming language and the important libraries that are used to develop the project are addressed below:

1- Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python supports modules and packages, which encourages program modularity and code. Python 3 is used to develop the project. The detailed explanation of the python 3 installation procedure can be accessed through the official documentation of python at (https://docs.python.org/3/using/index.html) **[34]**.

2- TensorFlow

TensorFlow is an open-source library for numerical computation and large-scale machine learning. TensorFlow bundles together a slew of machine learning and deep learning models and algorithms and makes them useful by way of a common metaphor. It uses Python to provide a convenient front-end API for building applications with the framework, while executing those applications in high-performance C++.

The TensorFlow 2.7.0 version is used throughout the project. Here is the official site for installation instructions (https://www.tensorflow.org/install/) **[35]**.

3- Keras

Keras is one of the leading high-level neural network APIs. It is written in Python and supports multiple back-end neural network computation engines. The Keras 2.7.0 version is used throughout the project to develop the deep learning models. The installation instructions can be accessed using the link (https://keras.io/#installation) **[35]**.

4- Database

We used SQLite which is a C-language library that implements a small, fast, self-contained, high-reliability, full-featured, SQL database engine. SQLite is the most used database engine in the world. SQLite is built into all mobile phones and most computers and comes bundled inside countless other applications that people use every day. The official download link (https://www.sqlite.org/download.html) **[36]**.

5- OpenCV

Opencv is an open-source library that is very useful for computer vision applications such as video analysis, CCTV footage analysis, and image analysis. OpenCV is written by C++ and has more than 2,500 optimized algorithms. When we create applications for computer vision that we don't want to build from scratch we can use this library to start focusing on real-world problems. There are many companies using this library today such as Google, Amazon, Microsoft, and Toyota. Many researchers and developers contribute. We can easily install it in any OS like Windows, Ubuntu and macOS. Here is the official site for installation instructions (https://docs.opencv.org/4.x/d5/de5/tutorial_py_setup_in_windows.html) **[37]**.

6- Flask

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. Version 2.0.2 is used in the project. The official documentation at (https://flask.palletsprojects.com/en/2.0.x/) **[38]**

7- ORM (SQLAlchemy)

We use sqlalchemy as an object-relational mapper (ORM) with flask and sqlite. SQLAlchemy is the Python SQL toolkit and Object Relational Mapper that gives application developers the full power and flexibility of SQL. It provides the data mapper pattern, where classes can be mapped to the database in open-ended, multiple ways - allowing the object model and database schema to develop in a cleanly decoupled way from the beginning. The official download link using pip (https://pypi.org/project/Flask-SQLAlchemy/) **[38]**.

GUI Development

The application graphical user interface (GUI) was developed into two pages, one for real-time camera observation for taking student attendances, and the other for attendance records.

1- Home page screen

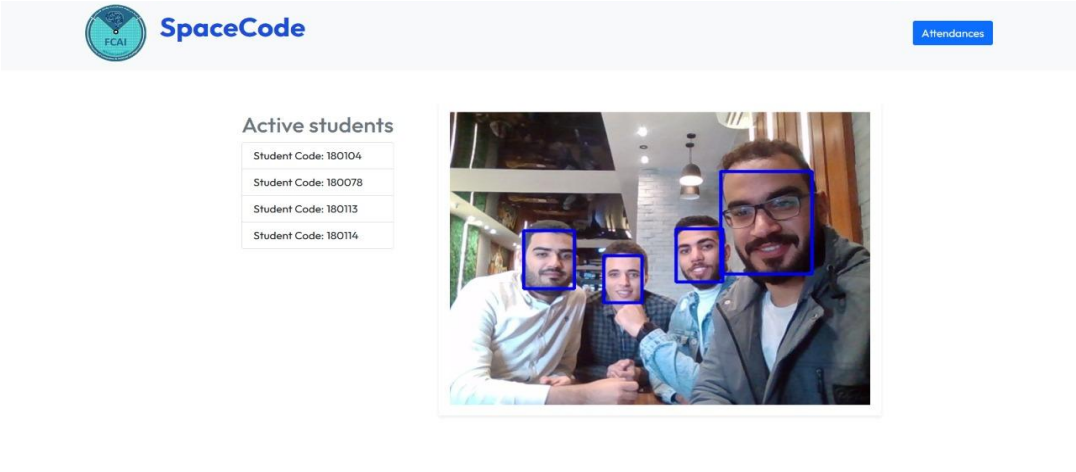

Fig.11 Real time camera processing into home screen

2- Attendance records screen

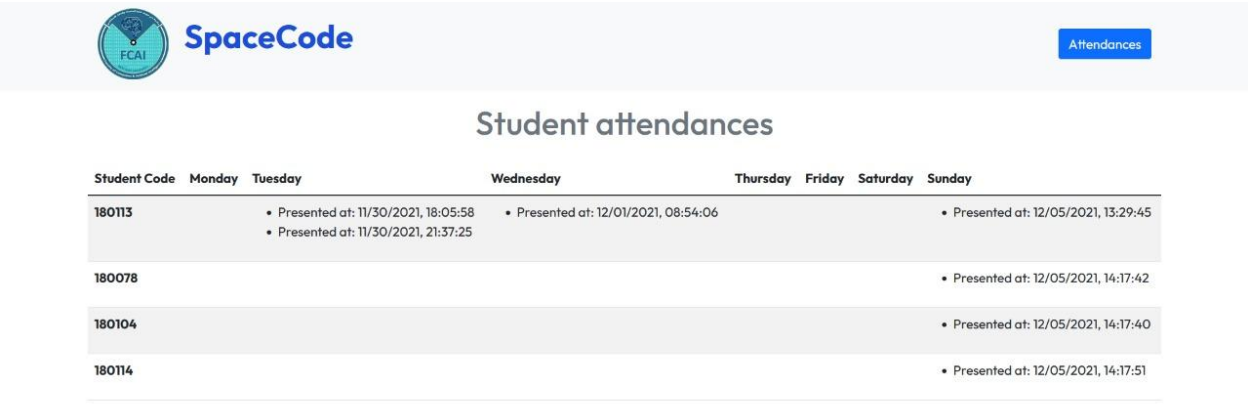

Fig.12 Attendance screen

Experimental results

In order to demonstrate the efficiency of our modal, we have carried out a test on Labeled Faces in the Wild (flw) dataset which contains 13,000 images for 1680 unique people. To have a meaningful representation of the anchor positive distances of faces, it needs to be ensured that a minimal number of examples of any one identity is present in each mini-batch.

The system achieved an accuracy of 97.5% and 0.0545% loss for 20 epochs as shown in the following figures.

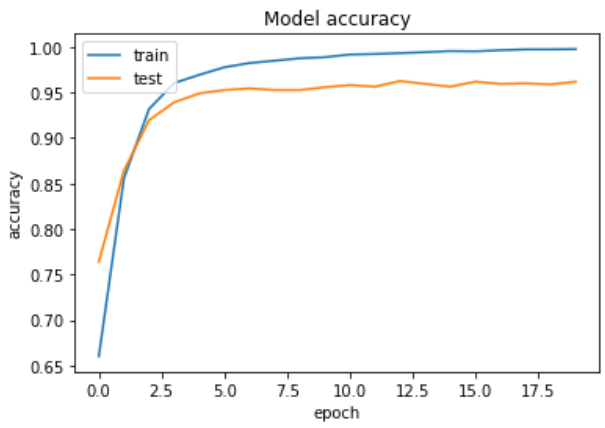

Fig.13 Model accuracy on flw dataset

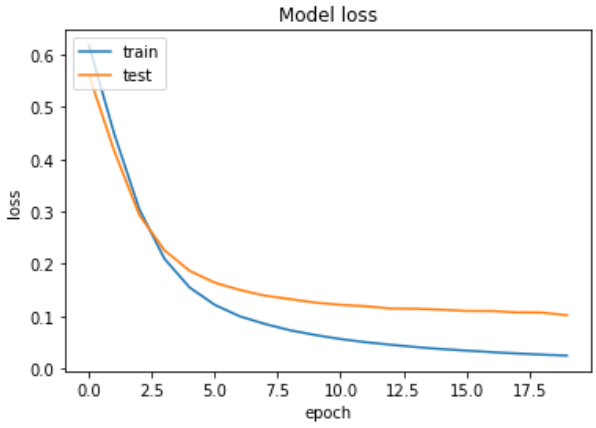

Fig.14 Model learning rate

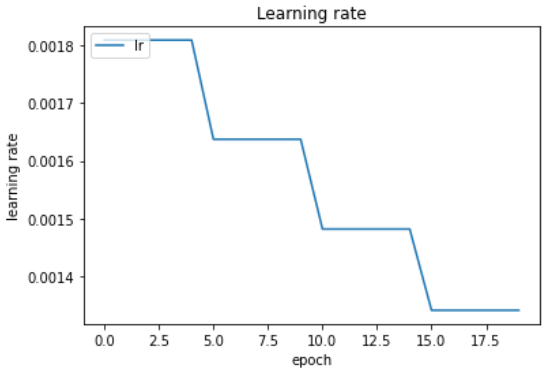

Fig.15 Model learning rate

Conclusion

In this document, We proposed a student attendance system using deep facial recognition. Face detection and recognition are performed by convolutional neural network models MTCNN and FaceNet, also we will make use of Inception ResNetV1 pre-trained model in our project to extract feces features before classifying these features using CNN. The main feature of face recognition, regardless of the high accuracy in recognizing faces, is that we need only one picture for every student to enable our model from recognizing the student. Based on the results, it can be concluded that proposed architecture presents a good solution for managing the attendance of students in classrooms.

References

[1] Samridhi Dev, Tushar Patnaik "Student Attendance System using Face Recognition" in 2020 doi:10.1109/ICOSEC49089.2020.9215441

[2] Lewis, Michael B; Ellis, Hadyn D (2003), "How we detect a face: A survey of psychological evidence", International Journal of Imaging Systems and Technology,

[3] Yue Wu , Qiang Ji 2019 "Facial Landmark Detection: A Literature Survey" DOI:10.1007/s11263-018-1097-z

[4] Aleix M. Martinez "Face Recognition, Overview" 2009 https://doi.org/10.1007/978-0-387-73003-5_84

[5] Maulana Dimas Iffandi, Rangga Nata Adiningrat, Jeremia Rizki Pandapota, Jihad Fahri Ramadhan, Bayu Kanigoro, Edy Irwansyah "Attendance System with Face Recognition" in 2020 https://doi.org/10.1007/978-3-030-63319-6_69

[6] Manjunath K. Patgar, Soumya Patil ,Rajashekhar B. Shettar “A Face Recognition Based Automatic Attendance Management System by Combining LBP and HOG Features” in 21 December 2018

[7] Dr. S. Ravishankar, Narayan T. Deshpande “Face Detection and Recognition using Viola-Jones algorithm and Fusion of PCA and ANN” in 10, Number 5 (2017)

[8] Anirudha BShetty, Bhoomika, DeekshaJeevan, RebeiroRamyashree “Facial recognition using Haar cascade and LBP classifiers” in November2021

[9] Shi Yuexiang, Cai Zixing, Wang Xuewu, B. Benhabib. Face recognition technology based on Improved PCA algorithm and Fisher linear discrimination [J]. Minicomputer system, 2006

[10] Juan Du “High-Precision Portrait Classification Based on MTCNN and Its Application on Similarity Judgement” in 2020

[11] Jing Zhou, Quan Wei, Tang Jie, Yan Han. Intelligent classroom roll call system based on face recognition [J]. Software engineering, 2017

[12] Florian Schroff, Dmitry Kalenichenko, James Philbin “FaceNet: A Unified Embedding for Face Recognition and Clustering” in 2015

[13] Yi Sun, Ding Liang, Xiaogang Wang, Xiaoou Tang “DeepID3: Face Recognition with Very Deep Neural Networks in 3 Feb 2015

[14] Weiyang Liu, Yandong Wen, Zhiding Yu, Ming Li, Bhiksha Raj, Le Song “SphereFace: Deep Hypersphere Embedding for Face Recognition” in 2017

[15] Davis E. King “Dlib-ml: A Machine Learning Toolkit“ in 1 Jan 2009

[16] O. M. Parkhi, A. Vedaldi, A. Zisserman “ Deep Face Recognition” in 1 Jan 2015

[17] Yaniv Taigman, Ming Yang, Marc’ Aurelio Ranzato, Lior Wolf”DeepFace: Closing the Gap to Human-Level Performance in Face Verification” in 2014

[18] Brandon Amos, Bartosz Ludwiczuk, Mahadev Satyanarayanan “OpenFace: A general-purpose face recognition library with mobile applications” in Jan 2016

[19] Jiankang Deng, Jia Guo, Niannan Xue, Stefanos Zafeiriou “ArcFace: Additive Angular Margin Loss for Deep Face Recognition” in 2019.

[20] Kamya DesaiEmail, Siddhanth ParikhEmail, Kundan, PatelPramod Bide, Sunil Ghane "Survey of Object Detection Algorithms and Techniques" in 2020 https://doi.org/10.1007/978-981-15-1632-0_23

[21] Paul Viola, Michael Jones, "Rapid Object Detection using a Boosted Cascade of Simple Features",ACCEPTED CONFERENCE ON COMPUTER VISION AND PATTERN RECOGNITION 2001

[22] L. Jiao et al., "A Survey of Deep Learning-Based Object Detection," in IEEE Access, vol. 7, pp. 128837-128868, 2019, doi: 10.1109/ACCESS.2019.2939201.

[23] T. F. Cootes, G. J. Edwards, and C. J. Taylor, "Active appearance models," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23, no. 6, pp. 681-685, 2001.

[24] Radhika C. Damale, Prof.Bageshree.V.Pathak " Face Recognition Based Attendance System Using Machine Learning Algorithms" Proceedings of the Second International Conference on Intelligent Computing and Control Systems (ICICCS 2018).

[25] Angelo G. Menezes, Jo˜ao M. D. da C. S´a, Eduardo Llapa, Carlos A. Estombelo-Montesco "Automatic Attendance Management System based on Deep One-Shot Learning" Proceedings of the IWSSIP 2020.

[26] Soumitra Chowdhury, Sudipta Nath, Ashim Dey and Annesha Das " Development of an Automatic Class Attendance System using CNN-based Face Recognition " Emerging Technology in Computing, Communication and Electronics (ETCCE) 2020.

[27] Tarik Hachad, Abdelalim Sadiq, Fadoua Ghanimi " Student's attendance management using deep facial recognition " IEEE 2nd International Conference on Electronics, Control, Optimization and Computer Science (ICECOCS) 2020.

[28] Shizhen Huang, Haonan Luo " Attendance System Based on Dynamic Face Recognition " International Conference on Communications, Information System and Computer Engineering (CISCE) 2020.

[30] Jaehoon (Paul) Jeong, Minho Kim, Yeonghyeon Lee, and Patrick Lingga " IAAS: IoT-Based Automatic Attendance System with Photo Face Recognition in Smart Campus " IEEE Xplore 2021.

[31] Syam Kakarlay, Priyaranjan Gangulaz, M.Sai Rahulx, C. Sai Charan Singh and T. Hitendra Sarma "Smart Attendance Management System Based on Face Recognition Using CNN " IEEE-HYDCON 2020.

[32] Sanyukta Santosh Pawaskar, Ashwini Mandar Chavan " Face Recognition based Class Management and Attendance System " IEEE Bombay Section Signature Conference (IBSSC) 2020.

[33] Abdulsalam O. Alzahrani, and Mohammed J. F. Alenazi " Designing a Network Intrusion Detection System Based on Machine Learning for Software Defined Networks" in 2021 doi:10.3390/fi13050111

[34] Ashwin Pajankar "Introduction to Python" in 2021 DOI:10.1007/978-1-4842-7854-3_1

[35] Mehdi Ghayoumi "TensorFlow and Keras Fundamentals" in 2021 DOI:10.1201/9781003025818-3

[36] John Measey "Literature Databases" in 2021 DOI:10.1201/9781003212560-15

[37] Jeff Cicolani "An Introduction to OpenCV" in 2021 DOI:10.1007/978-1-4842-6891-9_9

[38] Kunal Relan "Building REST APIs with Flask" in 2019 DOI:10.1007/978-1-4842-5022-8