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Attendance and Performance Monitoring System Implementation

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Abstract: ***Attendance Management is very important for every organization. Taking attendance of lot student is very time consuming process. It is difficult to analyze attendance of students how frequently one is skipping classes. And also there will be some proxy attendance of student in traditional system. The possible solution to this problem is to use an automatic attendance system which uses face recognition techniques. This system will mark attendance electronically and recorded attendance will be stored in a database. The preparation of a question paper for the Internal Assessment Exam can be automatically generated with the help of teachers according to RBT levels. The Internal Assessment is very important for students. This system will give individual student reports based on the performance of student in internal assessment, exactly in which type of RBT level the student need to improve themselves.***

Keywords: Attendance Monitoring; deep learning; convolutional neural networks (CNN), MobileNetV1,Machin, Learningpaper setter, Internal Assesment Analysis, RBT(Revised Blooms Taxonomy) can be used;

I. INTRODUCTION

In an educational institute it is a very difficult task to maintain attendance and progress of each student. Each institute has its own methods of taking attendance but most of them used manual attendance sheets. This method required a significant amount of time from the faculty. The problem of proxy attendance can be solved using face recognized attendance system. It utilizes the facial features of students for identification. This system will use face recognition techniques to mark attendance without any intervention of students. There will be some limitations in terms of accuracy.

The setting question paper for internal assessment is a hepatic task for the teachers. Teachers need to select questions to make a question paper according to the RBT level. This process needs to be repeated for every internal assessment. This process can be automated with the help of a teacher. This system will generate a question paper for internal assessment from a question bank given by the teacher according to RBT levels.

RBT stands for Revised Bloom's taxonomy. There are six levels which are: Remembering, Understanding, Applying, Evaluating and Creating according to cognitive objectives. The first level cover basics concepts that can be deals with small degree of reasoning, then the concepts raise the level of knowledge to complex levels.

Machine learning implementations have increased dramatically over the past few years as a result of the development of computational frameworks, particularly Graphical Processing Units (GPU) embedded processors. This growth has led to the advancement of novel methodologies and designs, which has now given rise to a new classification, Deep Learning.

II. LITERATURE SURVEY

1) *Project Titled " Attendance Management System.":* proposes that this article proposes that, they found the solution for an automatic attendance system by using facial recognition. This paper mainly focuses on the methods and techniques required to mark the attendance. This system uses a deeply supervised neural network for recognizing the faces. They have developed a web application interface which is easy for users to understand.
2) Project Titled *" Student Attendance Monitoring System Using Image Processing.":* In this research paper a group of students is captured and also recognized on an individual bias. Once the face recognition is done a model is built to train based on the gender. It is found that the proportionality of hospitalization information collected. If the faces in the images or video don't match with the student images present in the class, then the status of that particular student is marked as absent. They have captured the images through the web camera, and they have used the Haar cascade algorithm.
3) *Project Titled " Prediction Model on Student Performance based on Internal Assessment using Deep Learning ":* This paper compares different methods of classification such as artificial immune recognition system and AdaBoost, to analyze the results of the students.

The maximum accuracy achieved in this study was 95.34%. This project uses the dataset which consists of 10140 student records.

4) *Project Titled " Class Attendance Management System Using Face Recognition.":* This paper proposes a method of developing the attendance management system by using face recognition with controlling the door access. This system uses raspberry pi that runs on a linux operating system installed in a micro SD card. They have used a raspberry pi camera and a screen which are connected to the raspberry pi. The algorithm used in this project is Local Binary Patterns(LBPs). If the input image matches with the trained dataset then the door will open with the help of a servo motor, then the results are stored in the mysql database. This system gives an accuracy of 95% with the dataset consisting of 11 images.
5) *Project Titled " Applying the Revised Bloom's Taxonomy of the Cognitive Domain to Linux System Administration Assessments.":* This paper attempts to merge curriculum development aimed at a higher level of thinking with the outcomes required by the Linux system administration. They have analyzed the students' performance based on the RBT levels to determine the thinking level of the students.
6) *Project Titled " Automated Smart Attendance System Using Face Recognition.":* This paper develops a model for face recognition using LBP (Local Binary Pattern) algorithm. The system will capture the images and will be compared to the images that are stored in the database. The database is updated upon the enrolment of the new students using the automated process. This system marks the attendance if the captured image matches with the images that are present in the database.

III. PROPOSED SOLUTION

The system not only recognizes student's faces but also generates questions paper for internal assessment and gives an analyzed report of individual students about their internal assessment performance. Moreover, the system will be built as a webapp. So, the attendance and internal assessment marks can be access by the student and teachers. Here, the face recognition will be done by implementation of one of the Convolutional neural network algorithms which is MobileNetV1 implemented using FaceApi.js.

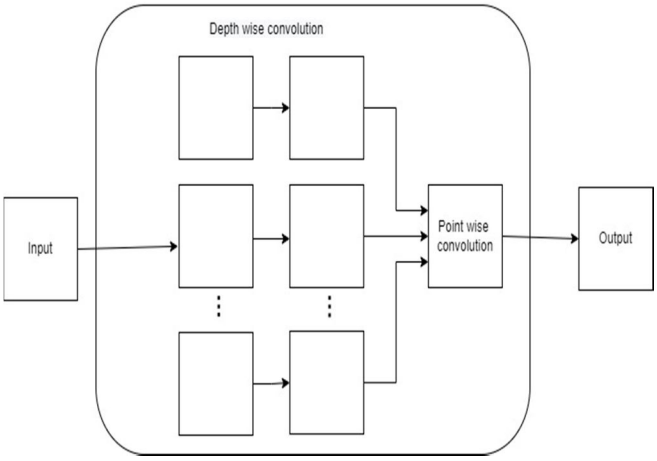

Fig 1: Depth wise separable Convolution

MobileNets used depth-wise separable convolutions. We present two straightforward global hyper-parameters that effectively balance latency and accuracy. Based on the limitations of the problem, these hyper-parameters enable the model builder to select the appropriately sized model for their application. Then, using a variety of applications and use cases, including object identification, fine-grained classification, face attributes, and extensive geo-localization, we show how successful MobileNets is.

FaceApi.js is a modern deep learning based JavaScript face recognition toolkit that offers a high level API to carry out tasks including age prediction, gender prediction, face expression prediction, face detection, facial landmark detection, and face identification.

Next module is the Internal Assessment question paper generator. First teacher will add all important questions into the database with their RBT levels. And then the system will generate a question paper accordingly.

And our last Module of our system is the "Student Performance Analyzer". Initially teachers will add the marks of internal assessment with question number which they have attended. The system will use a create report. Which tells students where he/she needs to improve themselves.

A. Data Set and Framework

@inproceedings{yang2016wider,
Author :- Yang, Shuo and Luo, Ping and Loy, Chen Change and Tang, Xiaoou,
Booktitle :- IEEE Conference on Computer Vision and Pattern Recognition,
Title = {WIDER FACE: A Face Detection Benchmark},
Year = {2016}}

Dataset utilized is taken from WIDER FACE, which is publicly accessible dataset which is benchmark dataset . With a high degree of heterogeneity in scale, position, and occlusion as seen in the example photos, we selected 32,203 images and classified 393,703 faces. The 61 event classes used to structure the WIDER FACE dataset. We choose 40 percent, 10 percent, and 50 percent of the data for training, validation, and testing sets respectively for each event class at random.

Fig 2. Dataset

There was a total of 32,301 image records. The information was partitioned into training data, validation data, and testing data. It was partitioned so that the preparation information included all the types of heterogeneity like scale, pose, occlusion, expression, makeup and illumination.

B. Face-Required api.js's Pre-trained Models for Face Recognition

Face detection, face alignment, feature extraction, and feature matching are all steps in the face recognition process. As a result, we need three essential pre-trained models for tasks including face detection, facial landmark detection, and feature extraction.
In terms of face detection, the API offers three pre-trained face detection models: MTCNN, SSD MobileNet V1, and Tiny Face. Since SSD MobileNet V1 is substantially more effective and powerful than the other models, we chose it above the others. The "weights" portion of the face-api repository contains many weight files for pre-trained models.

Task	Model Weight File Name	Metadata File Name	Size	Purpose
Face Detection	ssd_mobilenetv1_model-shard1, ssd_mobilenetv1_model-shard2	ssd_mobilenetv1_model-weights_manifest.json	5.4MB	Find the location of faces and mark with bounding boxes
Facial Landmark Detection	face_landmark_68_tiny_model-shard1	face_landmark_68_tiny_model-weights_manifest.json	80KB	Find 68 landmark points for face alignment pre-processing
Feature Extraction	face_recognition_model-shard1, face recognition_model-shard2	face_recognition_model-weights_manifest.json	6.2MB	Extract 128 normalized feature vectors from ROI

Fig.3: Pre-trained Models Description.

C. Face Recognition Utility Function Preparation

For the image acquisition, we used faceapi.fetchImage(blob) function to pass the image data into the API.

```
// fetch image to api
let img = await faceapi.fetchImage(blob);
```

Image Acquisition

D. Set SsdMobilenetv1 Option for Face Detection

To discriminate between the positive and negative classes, we need to set a score threshold for the face identification test.

```
let scoreThreshold = 0.8;
const OPTION = new faceapi.SsdMobilenetv1Options({
  inputSize,
  scoreThreshold,
});
```

Face Detection SSDMobileNetV1 Option

E. Steps Overall

```
faceapi.fetchImage(blob)-> faceapi.detectAllFaces(img,
SSDMobileNetV1Option).withFaceLandmarksuseTinyM
odel=true).withFaceDescriiptors()
```

F. Face Registration Process

We have provided two alternatives for users to upload via a webcam or from a disk for the Face Registration Module. After getting the video frame, users can store the data to database.

We must convert the Feature Vectors to a string before saving them in the database so they may be retrieved more easily because they are of the Float32Array Datatype. The dataset gallery will be refreshed, and the notification "Add Face Photo Success" will appear following a successful upload.

G. Face registration steps

1) Image Acquisition.
2) Generate Feature Vector from Detected Face.
3) Store the Feature Vector.

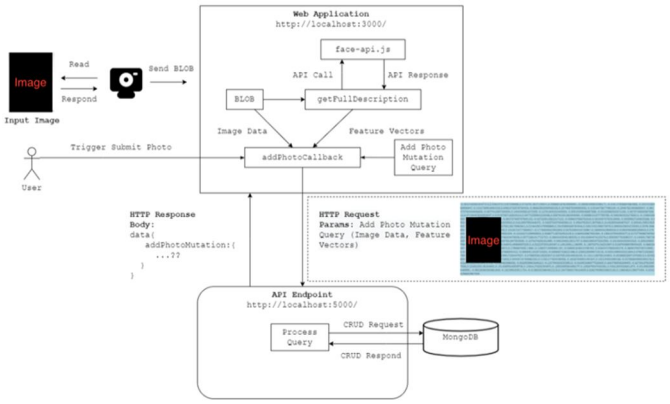

Fig 4: Face Registration Process.

H. Face Matching Process

Using React, we created a reference from the chosen webcam useRef(). The current frame's BLOB value is returned by React.useRef().webcam.current.getScreenshot(). The feature vectors are then obtained by using the utility function for face recognition called getFullDescriptions. No vector is produced is no face matched.

When the client get data vector we need to convert string into to Float32Array datatype. faceapi. Label Face Descriptors (Face_ID, List_of_Feature_Vectors) is used to be passed to the faceapi. FaceMatcher (labelledDescriptors, matchingthreshold) to find the best match using Euclidean Distance (L2) algorithm.

2 possible cases for determining the threshold value:

1) The higher the threshold, the more result is obtained but if the threshold is too loose (>0.6), it may prone to false positive case for unknown dataset.
2) The lower the threshold, the less result is obtained but if the threshold is to strict (<0.3), it may prone to false negative case for known dataset.

I. Steps For Face Matching

1) Fetching Dataset.
2) Label Dataset.
3) Image Acquisition
4) Generate Feature Vector from Detected Face.
5) Compute L2 Distance.
6) Obtain Face ID.
7) Save the transaction.

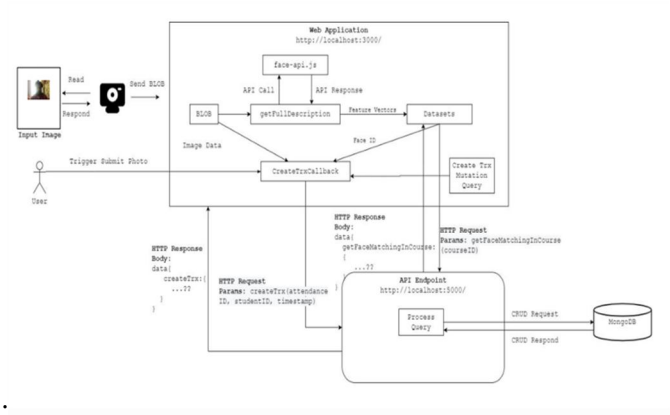

Fig 5: Face Matching Module

J. Paper Generator Module

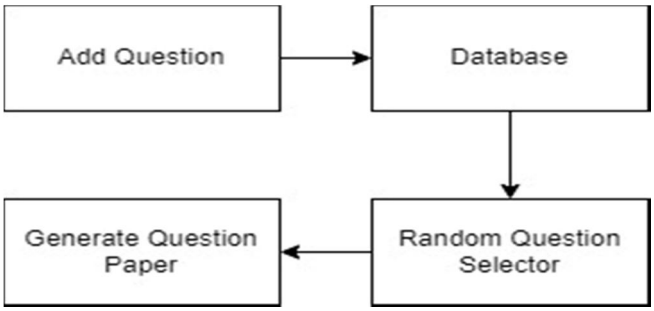

Fig 6: Question Paper Generation Flow

K. Performance Report Generation Flow

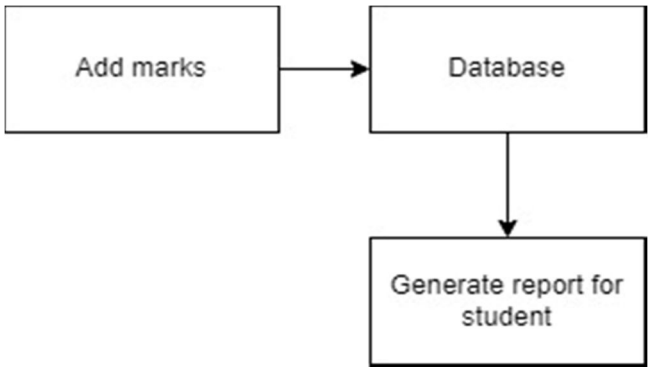

Fig 7: Report Generation Flow

The Performance report is generated based on the Internal
Assessment Performance and the question attempted from a generated question paper which contains all the information about the q uestion i.e., weightage of marks, RBT Level, & so on.

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IV. PROBLEM FORMULATION

The Evaluation of this model has been done with assistance of different metrics. The API uses Euclidean Distance to calculate the degree of similarity between feature vectors that have been discovered and those in our dataset throughout the matching process.

To distinguish between the positive and negative classes, a matching threshold will be established. We utilized a fairly strict matching threshold to reduce False Positives, which occur when the system recognizes a discovered face among the incorrect dataset users (0.45).

Cases for determining the threshold value:

1) The more results that are obtained, the higher the threshold, but if the threshold is set too loosely (>0.6), it may result in false positive cases for unknown datasets.

2) The less results that are obtained, the lower the threshold must be, however if it is set too low (0.3), it may result in false negative cases for known datasets.

Depending on your use case, you can experiment and adjust the matching threshold between 0.45 and 0.6 to get more results of recognition.

$$d(\mathbf{p},\mathbf{q}) = d(\mathbf{q},\mathbf{p}) = \sqrt{(q_1-p_1)^2+(q_2-p_2)^2+\cdots+(q_n-p_n)^2}$$
$$= \sqrt{\sum_{i=1}^{n}(q_i-p_i)^2}.$$

Euclidean Distance Formula

Returned shortest distance with Face ID/Label

```
export const matchingThreshold = 0.45;
```

Matching Threshold (The face with the shortest distance below the matching threshold will labelled as the respective Face ID, otherwise the face will be regarded as "Unknown")

According to the face-api.js documentation, the word "facial descriptors" is used in API functions to refer to feature vectors. The feature extraction model mimics the architecture of FaceNet by having a ResNet-34-like topology and returning 128D feature vectors.

Storing Feature Vectors During Face Registration

We stored these feature vectors into our database from Float32Array to string datatype.

Fetching Feature Vectors During Face Matching

We will extract these feature vectors from our database, and convert them into Float32Array datatype from string.

V. CONCLUSION

As a part of the proposed system, a system has been formulated in such a way so as to foster self-reflection of the performance phase on a per topic basis. This system marks the attendance electronically and the records will be stored in the database. Internal assessments are important for students, this system will automatically generate the question papers based on the RBT levels. This system will also generate individual student reports based on the RBT levels through which student performance can be analyzed and improved.

The preparation of a question paper for the Internal Assessment Exam can be automatically generated with the help of teachers according to RBT levels. The Internal Assessment is very important for students. This system will give individual student reports based on the RBT levels of students' performance in the internal assessment exam and can be analyzed, exactly in which type of RBT level the student need to improve themselves.

Based on the provided training and testing datasets, the model's accuracy in predicting the precise output ranges from 85% to 95%. The algorithms employed were CNN (Convolutional Neural Network), KNN (K-Nearest Neighbor), and MobileNetV1. The Attendance Management System created utilising the CNN algorithm was shown to be the most accurate, efficient, and rapid after comprehensive comparison and analysis.

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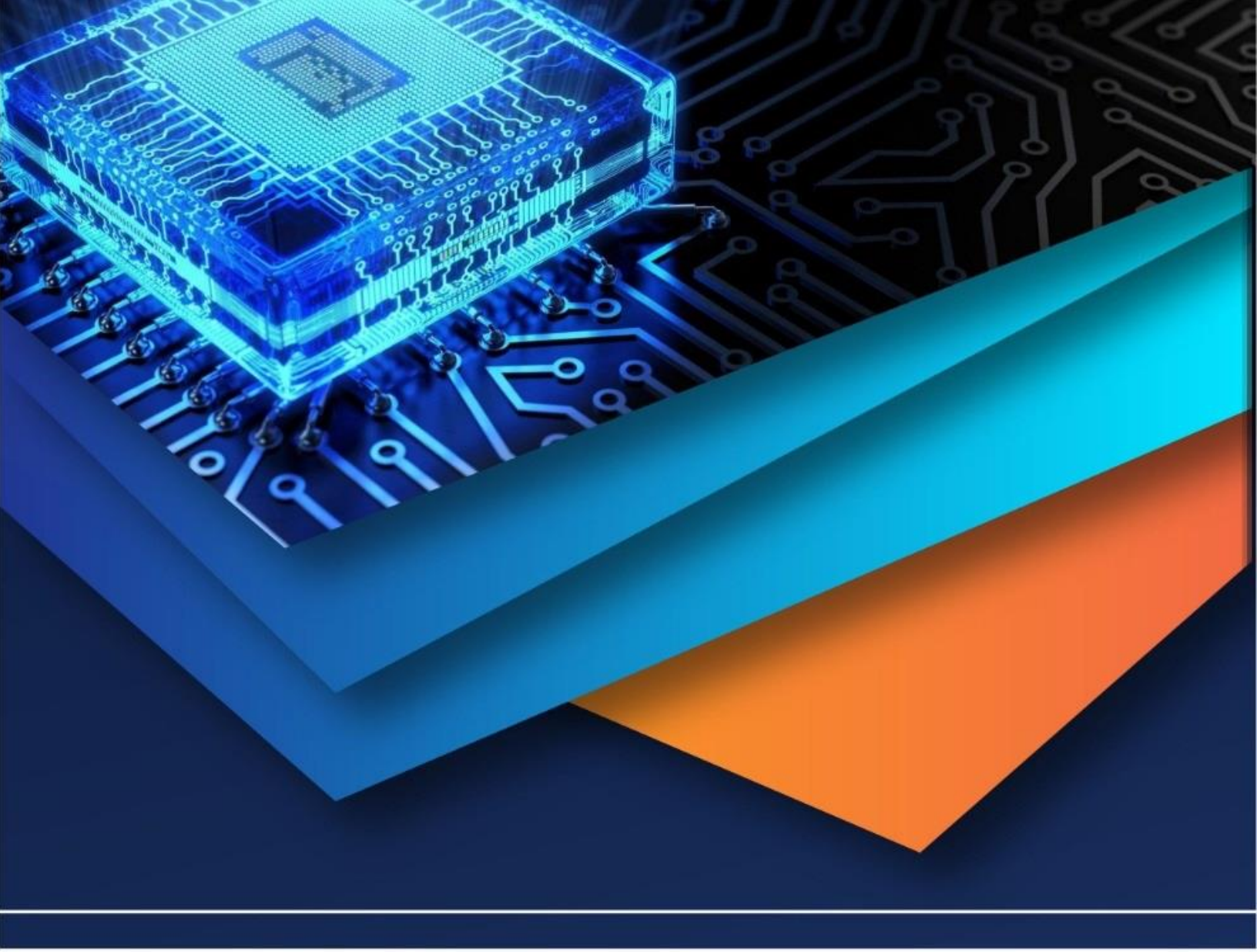

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