Project Synopsis
on

A Novel Approach to Measure Student Attentiveness in the Class

Submitted as a part of course curriculum for

Bachelor of Technology
in
Computer Science

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DECLARATION

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled "**A Novel Approach to Measure Student Attentiveness in the Class**" which is submitted by **Nandita Yadav, Kshiteesh Kumar and Kumari Bhavya Chaubey** in partial fulfilment of the requirement for the award of degree B. Tech. in Department of Computer Science of Dr A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

Date:

Supervisor Signature
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Last but not the least, we acknowledge our friends for their contribution to the completion of the project.

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ABSTRACT

In classrooms, it becomes quite difficult for the teacher to make a guess if the students are getting the point the teacher is trying to convey. Besides, nowadays students as well as teachers have started to think that being present in the class means being attentive throughout the whole lecture.

Facial expressions play a crucial role in everyone's day to day lives. An individual is full of emotions, like sad, distressed, happy, angry, etc. The technique of real time facial recognition can be used to detect the emotions as well as attentiveness of a student throughout the whole lecture. The teacher can therefore use this method to identify whether the students were being attentive or is there something that needs to be changed regarding the way of teaching.

Using the three methods of face detection - OpenCV, Media pipe and face recognition, a model that could monitor the attentiveness of students can be implemented. It is a tool that essentially picks up each student’s emotions throughout the whole class and calculates the degree of attentiveness of the student based on multiple parameters. At the end of the class, the teacher gets an auto generated report about their students.

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CHAPTER 01

INTRODUCTION

Over the past years, there have been significant changes seen in the education system of every country. But the thing that remains constant is the question whether students were being attentive for more than 80% of the lecture time. If the student was attentive throughout the whole lecture, it concludes two things - first, the student is able to keep up with the teacher's pace of teaching and is clearly understanding what is being told, and secondly the teacher is good at their job. That is why it has become vital to introduce a system which can monitor student's attentiveness in the lectures and be able to generate a report that can be used for reference.

The program takes images as input and detects faces in them. It eliminates those images with a low resolution of the face, crops the rest, and modifies all images to the same resolution height. It also generates a list of students in a CSV file. Now it trains the cropped images to generate a trained model. With this trained model, it recognizes faces (can recognize multiple faces at a time) from a real-time webcam feed and marks attendance with good accuracy. This program supports three methods of face detection - OpenCV, Mediapipe, and face recognition each having its own advantages. Any of these options can be selected by ourselves.

Also, this program provides many facilities to the user that he/her can change according to their convenience.

PROBLEM STATEMENT

Attendance has always been a major criterion in educational institutions. There has always been a notion that being present means being attentive in the class. But not only being present is must, but also being attentive and clearly understanding what is being taught should be the main goal behind taking attendance.

Nowadays students' sole goal is to only meet the attendance criteria given by respective institutions rather than learning in the classrooms. Besides not always the students are to held accountable for not being able to be attentive. Sometimes there's a gap between the teacher's way of teaching and students' way of understanding, that need to be bridged.

Hence there is a need of attendance monitoring system that monitors the attendance level of every student present in the classroom and gives an auto generated report to the teacher present. This will help the teacher to get an idea about the students who are being attentive and who are not and thus will take steps to increase the participation of students in being attentive.

OBJECTIVE

The sole objective of this project is to ease the pressure on teachers and students, and help create a healthier ecosystem that further promotes progress in education. We have designed a tool that essentially picks up each student's emotions throughout the whole class and calculate the degree of attentiveness of the student basing on multiple parameters. At the end of the class, the teacher gets an autogenerated report about their students.

With the help of this report, teachers shall be able to come up with a counter measure to adjust accordingly by either fixing their teaching patterns or spending extra time with students.

SCOPE

This model shall be used to understand the pace of the class and student's interest. It would also help to identify how influential the instructor's teaching is. This will lead to better monitoring capability and thereby improving the quality of teaching and performance of students.

The teachers would be aware of student's attentiveness in the classroom. This will lead to a better understanding between teachers and students. Students, on the other hand, would try their best to know the factors that are responsible for their lack of attentiveness and will be able to resolve the issue for the better understanding of the topic.

CHAPTER 02

LITERATURE REVIEW

Facial recognition refers to a subset of computer technology that can identify the human faces in digital images. The processing of the image input is divided into two parts: Detection and Recognition. Face detection, which involves detecting human faces within images, is the first and foremost step in face recognition. OpenCV, stands for Open-Source Computer Vision Library, is widely used for the implementation of facial recognition algorithms. Using OpenCV, facial recognition algorithms like Eigenface, Fisherface and LBPH can be implemented.

A system consisting of a Raspberry Pi Zero, Raspberry Pi Camera Module, Capacitive touch sensor and an OLED display can be used for facial recognition. These components are to be connected to the Raspberry Pi Zero. Firstly, the capacitive touch sensor is used to give input which causes the camera module to capture an image. The HAAR Cascade classifier is used in detecting any faces, if present in the image. In this Machine Learning based approach, the cascade function is trained from a lot of positive (images of faces) and negative (images without faces) images. The Local Binary Pattern Histogram (LBPH) algorithm is used for the purpose of facial recognition from the system's face database. The output is displayed on an OLED display. Under the ideal conditions (ideal lighting and the distance of 1m between the camera and individual), the percentage of face detection was found to be 80% and accuracy of facial recognition was also 80%.

Facial expression recognition has 3 major stages: face detection, feature extraction and classification. The 6 major facial expressions: anger, disgust, fear, happiness, sadness and surprise, can be detected through machines. Face detection or pre-processing that involves removing all noise from images and resizing the images, is the foremost step. Second step is feature extraction which basically extracts all major information of images and the last step is Classification that groups the images based on the features they belong to.

There are two methods of Facial Expression Recognition: (1) Feature Based and (2) Model Based. Some methods of feature extraction technique are: i) Histogram of Oriented

Gradient, ii) Geometric Features, iii) Local Binary Pattern, iv) Gabor Filter Texture, and v) Hybrid Features.

Histogram of Oriented Gradient (HOG) counts the number of occurrences of the gradient oriented localized portion of an image. It is used where object shape matters. Geometric Features are used to solve visual related problems. It searches out a group of representative options of geometric kind to represent an Associate in Nursing object by grouping geometric options from pictures and learning them by mistreating economical machine learning strategies. Local Binary Pattern (LBP) labels the components of a picture by thresholding the neighborhood of every pixel and considering the resulting binary range. LBP uses 3x3 pixel containing grey scale values. Gabor Filter Texture (GFT) uses the linear filter for texture analysis.

Learner's facial expressions play a vital role in detecting whether the learner is able to understand what is being conveyed. If a machine wants to intelligently recognize student emotions, it must be able to find feature vectors that that machine can calculate. A three-dimensional space model in which the X-axis denotes the happy-unhappy dimension, Y-Axis represents the attention and rejection dimension, which indicates the learner's emotional change from disgust to interest and the Z-axis represents the awake dimension, indicating the learner's emotional change from sleep to tension, was drawn.

The study of learner emotions was as follows:(1) When the learner is quite interested in the current teaching content, his body will lean forward involuntarily during the learning process. As a result, the area of the face becomes larger. When the learner is not interested in the current teaching process, he would lean back during the learning process. As a result, the area of the face becomes smaller. (2) When the learner is in a tensed state, his eyes will widen, indicating the learning state is focused. When students are sleeping, the eyes would be closed. (3) When students are in a happy mood, the corners of their mouths would rise.

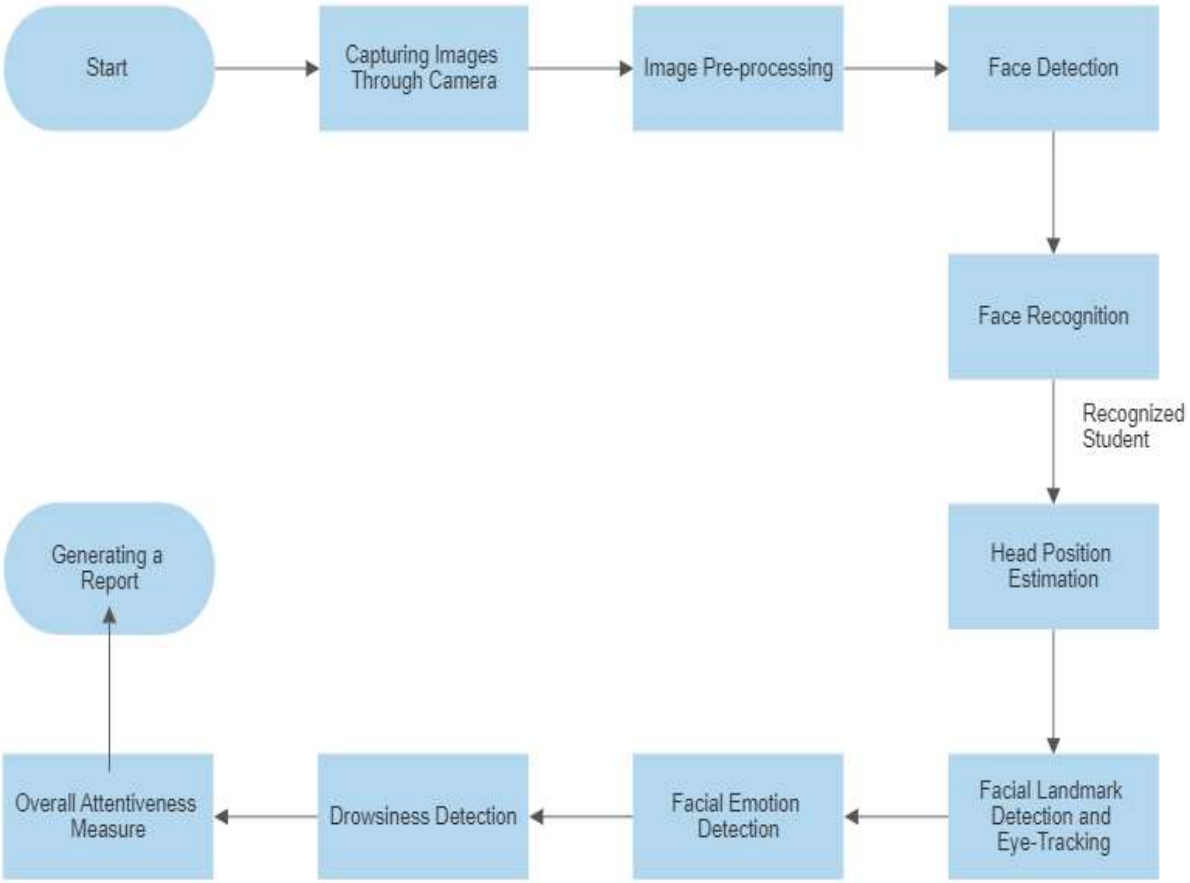
Besides facial expression, posture-based evaluation models are quite used. The human body can be used to detect an individual's presence of mind with the help of their posture. Five postures were identified for a classroom environment and labelled: Attentive, Head rested on the hand, leaning back, Writing and Not looking at the screen. In order to preprocess the image data, Open Pose is used as a preprocessing model for the data. OpenPose is a real-time multi-person system, built as a Caffe model, that jointly detects

human body, hand, facial, and foot key-points on the images. CNN is used to train the model for attentivity. It helps to classify an image into one of the five classes discussed. But in a live lecture session, the model will be fed with a stream of images and hence, is prone to constantly changing postures, which may not always be consistent. In order to solve this problem, Frame Average Sampling is used. This method allows minimization of false alerts due to outliers, in a live environment. Each frame results in a respective output. However, the consistency in neighboring frames may suggest otherwise. In such cases, the output of that frame can be overridden by the output of the consistent neighboring frames. This can be done by averaging the outputs of the current frame and a batch of the previous frames, to normalize the actual output of the current frame. Since the model's last layer has a SoftMax activation, it results in an N-dimensional probability vector (where N is the number of classes). The frame sampling is thus performed over the N-dimensional vector and not the resultant class index, which can consider probabilities of indices which are marginally less than the maximum. The preprocessed images resulted in precise data with only the relevant features extracted for the training process. Consequently, training the model for 20 epochs with a batch size of 8, resulted in a highly accurate and lossless model, with an accuracy of 99.82%.

CHAPTER 03

PROPOSED METHODOLOGY

FLOWCHART

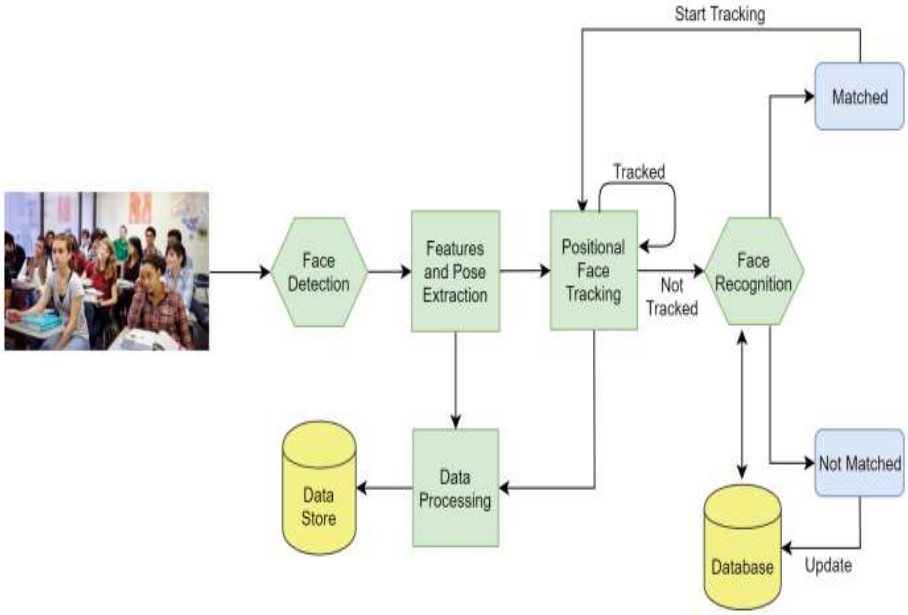


EXPLANATION

1. The camera would first capture the images of the students present in the class.
2. Image preprocessing, that aims at improving the image data by suppressing unwilling distortions or enhancing some image features important for further processing, will be done.
3. The next step would be face detection. Face detection means to identify human faces in the image dataset.
4. Following face detection is face recognition which involves a method of identifying or verifying the identity of an individual using their face.
5. After that the head posture estimation would be done. The angle of the face can all influence the decision-making process of whether they are focused on class or not. This can be achieved using the Head Pose Estimator.
6. Facial landmarks detection or facial key points detection has several uses in computer vision like face alignment, drowsiness detection, and Snapchat filters, to name a few.
7. Next step is eye-tracking. Eye-tracking also helps to measure the distraction level of the student if the student is looking away for more than a threshold level of time.
8. The second most important factor in finding out a student's attentiveness level is to capture their emotions during the online class.
9. With the help of Drowsiness Detection, we can detect students' level of drowsiness, and we can use this as one of the factors to determine the student's attentiveness.
10. The Overall Attentiveness Calculation of a student is the mean of all the above parameters (Head position, Eye tracking, Emotion Detection, and Drowsiness Estimation), excluding facial recognition which is just for authentication purposes.

ALGORITHM PROPOSED

1. The program would take student pictures as input and detect faces in them.
2. It would eliminate those images with a low resolution of the face, crop the rest, and modify all images to the same resolution height.
3. It will generate a list of students in a csv file.
4. Now it would train the cropped images to generate a trained model.
5. With this trained model, it would recognize faces (can recognize multiple faces at a time) from a real time webcam feed and would mark the attendance with good accuracy.



Workflow of the proposed model

SOFTWARE AND HARDWARE REQUIREMENTS

- **SOFTWARE REQUIREMENTS:**
    1. Visual Studio Code
    2. Python and its libraries

- **HARDWARE REQUIREMENTS:**
    1. Camera Module
    2. Laptop

CHAPTER 04

TECHNOLOGY USED

Machine Learning and Deep Learning will be used in the completion of this project.

Deep Learning is a subset of Machine Learning where the artificial neural network and the recurrent neural network come in relation. The algorithms are created exactly just like machine learning but it consists of many more levels of algorithms. All these networks of the algorithm are together called the artificial neural network. In much simpler terms, it replicates just like the human brain as all the neural networks are connected in the brain, which exactly is the concept of deep learning. It solves all the complex problems with the help of algorithms and its process.

OpenCV and Convolutional Neural Networks are to be used for this system.

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. It was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

Deep learning approach using convolutional neural networks can be used to understand the human emotions.

CHAPTER 05

CONCLUSION

After successfully executing the model and the different factors, our output will be a report that needs to be presented to the teachers. It shall contain all the information about the factors for each student, displayed in various forms of graphs for easier understanding.

The report generated by this system shall be used to understand the pace of the class, student's interest, how influential the instructor's teaching is, better monitoring capability and thereby improving the quality of teaching and performance of students. The output will be in the form of a chart report. The emotions and attentiveness level of students displayed in the report would be normalized mean values recorded for the whole duration of the class.

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KIET GROUP OF INSTITUTIONS

MINI PROJECT

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APPROVAL OF TITLE BY GUIDE

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