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Development of the Green Classroom Environmental System Based on Deep Learning Model

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Abstract

In this digital age development of green classroom makes a great impact on teaching and learning methods. Using less energy we can make an environment-friendly classroom. The proposed model includes two modules 1. The attendance will be automatically recorded 2. The next part of our system is that we will be using safe engineering practices to capture the various emotions students are going through the classroom. This system will help the teacher to get a good idea of the emotions that the student is going in the classroom. The status of the students is recorded and presented to the teacher so they can assess what difficulty students are having inside the class using the framework based on Deep Learning Model. In addition to that participation index of each student in the class environment will be consolidated and presented through Grafana database.

Key words: Deep learning model, classroom Behavior management, Emotion Recognition, Green classroom, MobileNet Image classification, RmNet, Influx Database.

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1 Introduction

Everything around the globe is getting digital. And talking about digital the management in schools and colleges is still old. The attendance is taken manually by the teachers and hence a record is maintained. Due to manual attendance, a lot of face proxies are given by students for their classmates and friends. Also, sometimes students give teachers a really hard time in maintaining the proper attendance record, which is time-consuming and also inefficient. The automated attendance system that uses face recognition technology with the help of a video camera fit inside the classroom, captures the objects (students) present and marks the students present in the dataset. Often students in a class are caught using mobile phones, chit-chatting with their friends, sleeping, etc.

In short not paying attention in the class, resulting in low marks and sometimes even not being able to pass in examinations. It is difficult for a teacher to give personal attention to every student in a class of 40-50 students. A smart classroom system can improve learning efficiency and helps to achieve the learning outcome of every classroom. [7]Also, after the examinations, it is too late for analyzing the student to help him with his grades. For example, if a teacher is explaining some algorithm and a particular student is not able to understand it, this will show on his face with some confused expressions. This can be caught by the feature extraction method using deep learning techniques. Where the students in the class are monitored using a video camera and various algorithms are applied to capture their behavior in a class which is further analyzed using a graphical representation.

Now, if a student is not focusing on the class it will be recorded and the respective teacher will be notified. This will help the professor to pay attention to every student in the class properly and hence the overall result of the class will also improve. The architecture of smart classrooms can be chosen by considering the geographical setting and position of students and the teachers [8].

With the background of learning materials overview of different context aware technical approaches are studied briefly [11].

Based on the Mobile net algorithm and uniting CNN model we develop a system which records the student's attendance and helps us in determining the various emotions student go through.

The remaining of the paper is organized as follows. Section II describes the Literary Review. Section III introduces the framework for smart classroom management. Section IV cumulatively explains dataflow for the model. Section V illustrates the results and further discussion. The conclusion is made in section VI.

2 Literary Review

Chiou C.K et al. improved the performance of a learning system by deploying wireless sensor networks in the classroom. The three subsystems were created to avoid wasting of time by the teachers inside the classroom [1]. The environmental factors such as pressure, the humidity will also influence the listening capability of a student.

In [2] authors reported emphasis on the usage of faster R-CNN which is used in conjunction with Regional Proposal Networks. This addition of the last neural network helps in increasing the speed of processing and gives a faster output. Without Regional Proposal Network, the Selective search algorithm in the R-CNN takes about 2 seconds for each image to be processed. When the additional neural network layer is introduced, the overall processing speed decreases to 198ms. This is a significant boost in the processing output. The majority of the task that it does is bounding boxes around different objects present in an instance of a video. This process is inexpensive to compute and does not require a high-end GPU.To save energy consumption in classroom environments the model is depicted with the help of the internet of things [3].

Mobile Net Architecture is generally used in mobile and embedded vision devices. The major advantages are

(i) Fewer input parameters required.

(ii)Fewer Calculations as Hidden layers are less [4].

RmNet architecture has 3x3 convolution is interchanged with a depth-wise variant. The ReLU activation function is replaced with the RELU activation function. Pre-training is done with datasets for weight distribution.

Ali Mollahosseini *et al.* express RmNet as a collection of images of people in a database. These contain the attributes and various emotion dataset which keeps accounts of almost 1,000,000 individuals. These contain almost 1250 different emotional keywords in various languages. The higher the number of people in the database, the lesser is the chance of getting an error in the output. The database was collected from different websites and almost 500 YouTube clips. This is the highest number of features recorded for individuals in a database. This improves the overall accuracy of Facial and Emotion recognition. The inclusion of CNN with this database makes the result almost 94% accurate. This high rate of accuracy and presence of a large number of datasets makes it suitable use for the model of our system. [5].The CNN model is used to analyze the classroom behaviour of students using the audio collected from the classroom snapshots [6]. Deep architecture such as Facenet can be used for face recognition [9].

Pranav K.B *et al.* developed a system that enhances the accuracy of CNN based face recognition model. By adding the different pooling layers the model is checked with real-time AT & T dataset. [10]

Using CK+ database 8 classes of facial expression are recognized to build CNN based architecture. The architecture has 6 convolution layers which are increased to 12 for better performance [12].To improvise the performance of the Facial Recognition model preprocessing of data should be done. The architecture is based on the VGG16 network using the weighted fusion method. Relu Activation function is used after each layer of convolution. The response time for facial recognition is very less due to fused method via softmax operation [13].A deep belief network [14] based architecture is used for facial recognition using the data collected from various sensors. Video stimuli are used to simulate human emotions.Gupta *et al.* presented ResNet architecture for emotion recognition. In addition to the convolution layer, attention block is introduced in the architecture to increase visibility. This model highly decreases the vanishing gradient problem [15].

3 The Framework for Smart Classroom Management

The Architecture for building the smart classroom management system is shown in figure 1. It includes the MobileNet image classification model for tracking the attendance of the student. The collected data is then stored in an influx database.

The Architecture for building the smart classroom management system is shown in figure 1.The various steps involved in building smart classroom management are explained below:

(i)The input from camera is feed into face reognitition module.It includes the MobileNet image classification model for tracking the attendance of the student.

(ii)The collected data is then stored in the influx database.

(iii)After that to capture the various emotions of the student handmade CNN and RmNet are used.

(ii) At the end with the help of Grafana, analysis is performed for students' behavior.

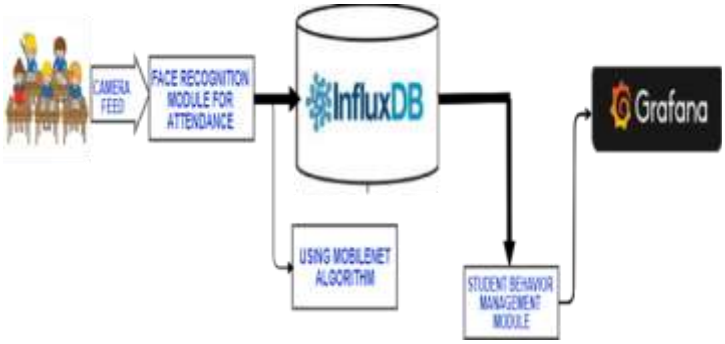

Figure 1: Architectural flow for the proposed model

4 Data Flow Diagram for the Model

The Data Flow Diagram (DFD) provides the flow of data and explains which component performs which process along with the input and output parameters. Here we have two levels of DFD diagrams. The Figure 2 mentioned below is the Level 0 of DFD diagram which explained the attendance portal and interactions between students and teachers. There are three types of users as students, staff and admin where they have interaction with attendance portal. Here every user gave their login credentials to enter into the model. Attendance portal will track the attendance of all the students and staff. When a user login to the model their attendance status gets updated in the portal. These activities are monitored by the administration officer of the particular organisation.

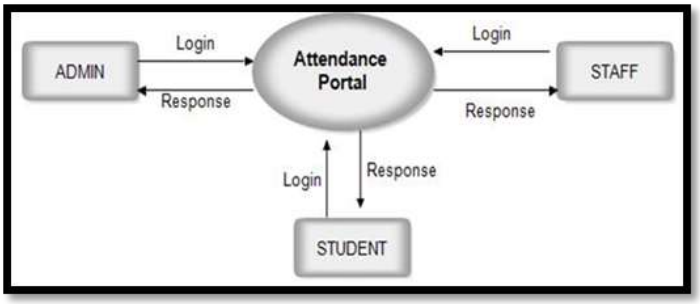

Figure 2: Level 0 of DFD Diagram

The level 1 of DFD diagram shows the flow of emotion recognition through the capturing of various facial images. Figure 3 describes Emotion detection that can be used for calculating participation index.

The detection of emotion done with help of deep learning technique. At first, various facial images are given as an input then it is processed. Processing of image is done to get the information of the facial expression. After image processing the next step is categorised into three, they are face detection, lip, eye mapping and face point detection. The face detection is the technique used in varies applications to fine the key features of the face and to detect the human face in digital images. Lip, eye, mouth mapping that helps to detect the nose, eye, skin etc with the help of an algorithm. Face point detection is used to fine the location where the nose, eyes are actually located. Then data flows to particle filter which gives the minimal extend of image structure. From this information obtained the system get trained and the analysis is done. finally, we detect the emotions with the images given as input.

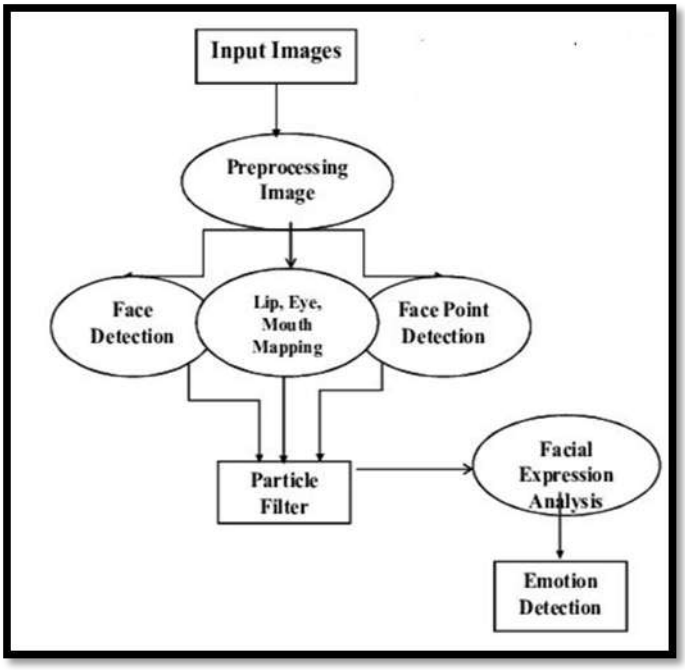

Figure 3: Level 1 of DFD Diagram

5 Results and Discussion

In fig: 4 Students are identified from the uploaded sample video. Influx database is used to store the captured images for further use.

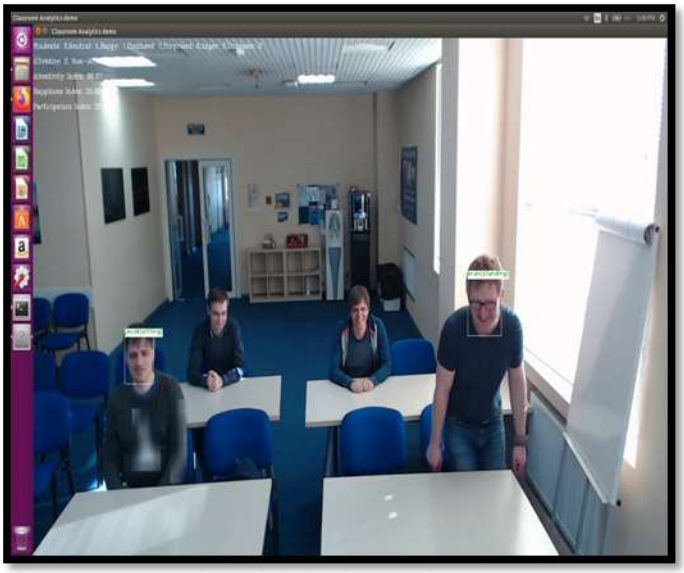

Figure 4: Identifying Students from Sample Video

When a student is dreamy or distracted from the class the model captures him through RmNet and CNN model. [Fig 5]

Figure 5: Identification of Students Not Focusing the Class

Finally, the teacher can analyze the participation index of each student with the help of an interactive visualization tool Grafana. [Fig 6]

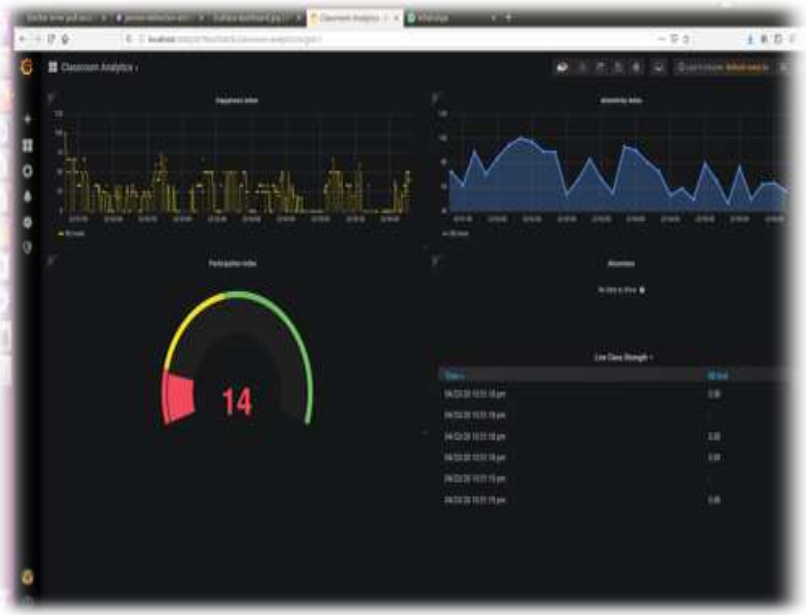

Figure 6: Grafana Showing Participation Index

6 Conclusion

With advancements in technology, the accuracy of the algorithm will grow. These algorithms used would become obsolete so newer algorithms would need to replace the old ones. Moreover, with better GPU and higher processor, the overall time to get an accurate result can be reduced drastically. As more datasets for facial records are made, better would be the chances of getting an accurate result. This can too be changed for future purposes. The classroom management behavior system helps in increasing the functionality between teacher and student. As time goes on, better methods for monitoring the students can be achieved like implementing a camera inside the classroom at different angles for only a limited number of students. This means that a particular camera will monitor only a handful of students, therefore increasing the accuracy.

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Biographies

Vasudha Bajaj is a graduate student within the Information Technology program at the SRM Institute of Science and Technology.Currently she is working as a Frontend Developer in an e-commerce company. Her research includes Deep learning and data analytics.

S.Sindhu is an Assistant Professor at SRM Institute of science and Technology since 2015. She obtained her M.tech degree in Computer science and engineering from G.K.M Engineering college, Anna University in 2011 and currently pursuing her Ph.D. in SRM institute of science and Technology.She has 10+ years of teaching experience in the field of computer science.Her Research interest includes Data Analytics,IoT and Deep Learning.

Anuj Kataruka is a graduate student within the Information Technology program at the SRM Institute of Science and Technology.Currently he is looking forward in developing his career as a Software Development Engineer.His research includes Deep learning and data analytics.

Roodra Pratap Kanwar is a graduate student within the Information Technology program at the SRM Institute of Science and Technology. He always had a knack towards Data Science and its counterparts. This is a budding field and learning from it to hone his skills is what he desires.

Sajal Agarwal is a graduate student within the Information Technology program at the SRM Institute of Science and Technology. His current plan is to gain professional work experience in the field of Technology and later apply for a Master's Degree in the field of Business Administration.