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Neural Network based Anti-Spoofing Attendance System

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Abstract: ***Attendance systems are an integral part of a school system. It has traditionally been served by manual processes and the habit of roll-call. Over the last few years various entities and institutions are incorporating face recognition based automatic attendance systems. These advancements help the students and teachers not to waste time during class hours. But one of the reasons it's not implemented at a large scale is that most systems are not fool proof. Various degrees of research have been done to find fool-proof face recognition systems. In this paper we use a deep learning approach to maximise efficiency and present an attendance system that detects and rejects spoofing attempts. We primarily use a deep neural network to detect the authenticity of a person in the class and then update the database to mark that student's attendance. In this paper we will observe the current methods used to achieve this and architect a solution using deep neural networks.***
Keywords: Face Recognition, Face Liveness, Anti-spoofing, Attendance system, Neural Network

I. INTRODUCTION

Every classroom in the world needs an attendance system. It will be of great use if the system is automated and built to detect spoofing attempts. Current systems are not widely used, they lack accessibility and are not easy to use. They are also susceptible to imposter attacks and students tricking the system by spoofing the input image to the system. For instance, current systems can be fooled by holding a picture of a student in front of the camera among other methods. Therefore, it is important to implement a face liveness detection algorithm in the system so that it detects spoofing attempts and registers attendance only if there is a real person in the frame of the input image. Attendance systems that incorporate face recognition methods generally have 3 modules. The first being a camera unit that takes a picture of the classroom. The second is the unit that processes the input image and the third is a user interface where the attendance of the students can be monitored and tracked. In this proposed system, the solution is independent of the initial/first unit. Any manufacturer's camera unit can be used, but the picture taken in sent to a cloud hosted web application. This application pre-processes the image, detects individual faces in the classroom image, validates the authenticity of the image by running the proposed anti-spoofing algorithms against it and then marks/updates attendance for the respective students.

II. RELATED WORKS

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A. Automatic Attendance Marking using Face Recognition and SMS Alert using IoT [1]

This paper uses a basic system wherein the image captured is initially passed through a saturation filter, this helps detect faces in the image. Each face is demarcated and cropped into a separate image object. Each of which is converted into a vector form. This vector is compared with each registered student data in the database. The comparison is done by finding the Euclidean distance between these two eigenvectors. If the least distance is lesser than the threshold of 0, the image is said to be matched and that respective student is marked attendance. While this method seems simple and easy it lacks the necessary efficiency in challenging circumstances. For example, it achieves only a 76% accuracy if a student has a beard. It also does not have any provisions to detect and reject spoofing attempts and hence the system is unreliable. The method also uses every pixel in the entire face as a means to detect similarity wherein the better alternative is to implement feature engineering techniques and match similarities based on certain facial features.

B. Automated Attendance Systems Using Face Recognition by K-Means Algorithms

This paper proposes a method of using K-means algorithm to identify clusters of image features and then use support vector machines to classify if the student is present in the student image database and then mark the attendance respectively. The paper suggests a 8 step process of creating a database of student picture, feature engineering is performed on this acquired dataset, they also use the Gabor transform to denoise the input, then the extracted features are clustered using K-means algorithm then a SVM

classifier is used to find the face of any particular student, this is also the same method used in a test scenario to detect a particular student. While the paper is based on using SVM to predict a student's face, it is not efficient at scale. In the circumstances where we have a large number of students, the prediction accuracy is lower.

C. Automated Attendance System using Haarcascade : A Face Recognition Approach

This paper proposes a tried and tested approach of using Haarcascade algorithm to detect faces in an image and then matches it to a registered face image in the database so as to mark the respective student's attendance. This paper also surveys other papers that intend to make a biometric face based attendance system. Some of them are Automated Attendance Management System using Face Recognition By Mrunmayee Shirodkar ,Varun Sinha, Urvi Jain, Bhushan Nemade which uses facial feature detection algorithm like Haar cascade, ada boost and contrast analysis to detect faces and Local Binary Patterns to match detected faces to student faces in the database..

D. Face Liveness Detection Based on Texture and Frequency Analyses Gahyun Kim, Sungmin Eum, Jae Kyu Suhr, Dong Ik Kim, Kang Ryoung Park and Jaihie Kim

Like many papers in this domain, this approach is to use texture and frequency analysis to detect face liveness in a picture. This paper demonstrates this method in the context of a liveness detector for any image which in our context is an attendance system. It basically uses a 2D discrete Fourier transform on a facial image so as to get a frequency of the features which are then divided into different groups with each representing a region in the frequency band. After this step of feature engineering it uses Local Binary Patterns to identify texture patterns that help classify if the picture in consideration is spoofed or otherwise

E. Face Recognition with Liveness Detection using Eye and Mouth Movement Avinash Kumar Singh, Piyush Joshi, G. C. Nandi

This paper also uses the Paul Viola and Michael Jones proposed Haar cascade to detect faces and perform feature engineering on the detected facial images. To detect liveness and prevent spoofing it take a movement-based approach. Specific tasks are given to the user such as particular eye and mouth movements so as to validate the authenticity of the person in the picture. The algorithm searches in the eye and mouth regions to find if the features are as expected according to the given task such as opening and closing the respective person's eye or mouth. While this approach might intend to help detect and discard face images, it is not completely fool proof. Various imposter attacks that mimic eye and mouth movements can be used to trick the system and hence rendering it ineffective.

III.PROPOSED METHODOLOGY

The solution this paper suggests is building an attendance system that is designed to detect spoofing attacks by using neural networks to predict if a particular student is really in the classroom or not. The overall workflow of the solution is given in the below figure

A. Face recognition-Based attendance System Workflow

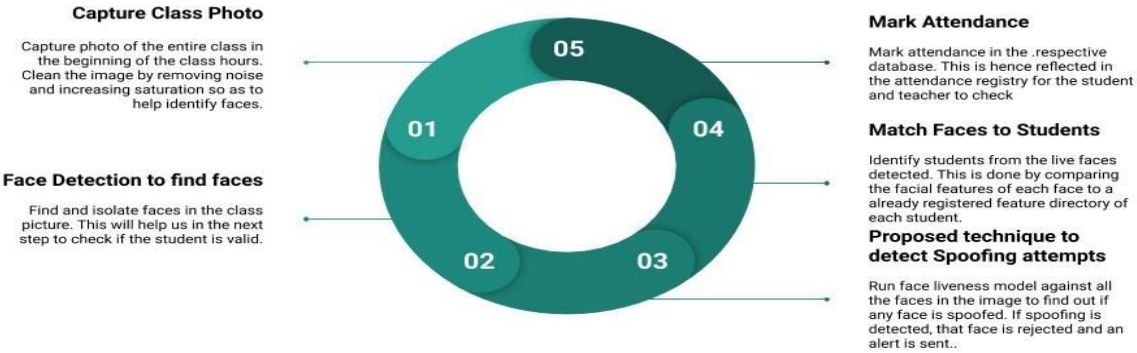

Fig. 1 Five step architectural workflow of the proposed attendance system

The above workflow depicts how the system will take attendance automatically. This is achieved by following a five step process, starting with taking the picture of the class from a handheld device or fixed camera installed in the classroom and then validating if the detected faces are genuine to eventually marking attendance to the students in the classroom.

The neural network model used to detect if a picture is spoofed or not is built using python machine learning libraries. It is trained and tested on a dataset of real and spoofed images. The overall structure of the model is given in the figure below

B. Proposed anti-spoofing Techniques

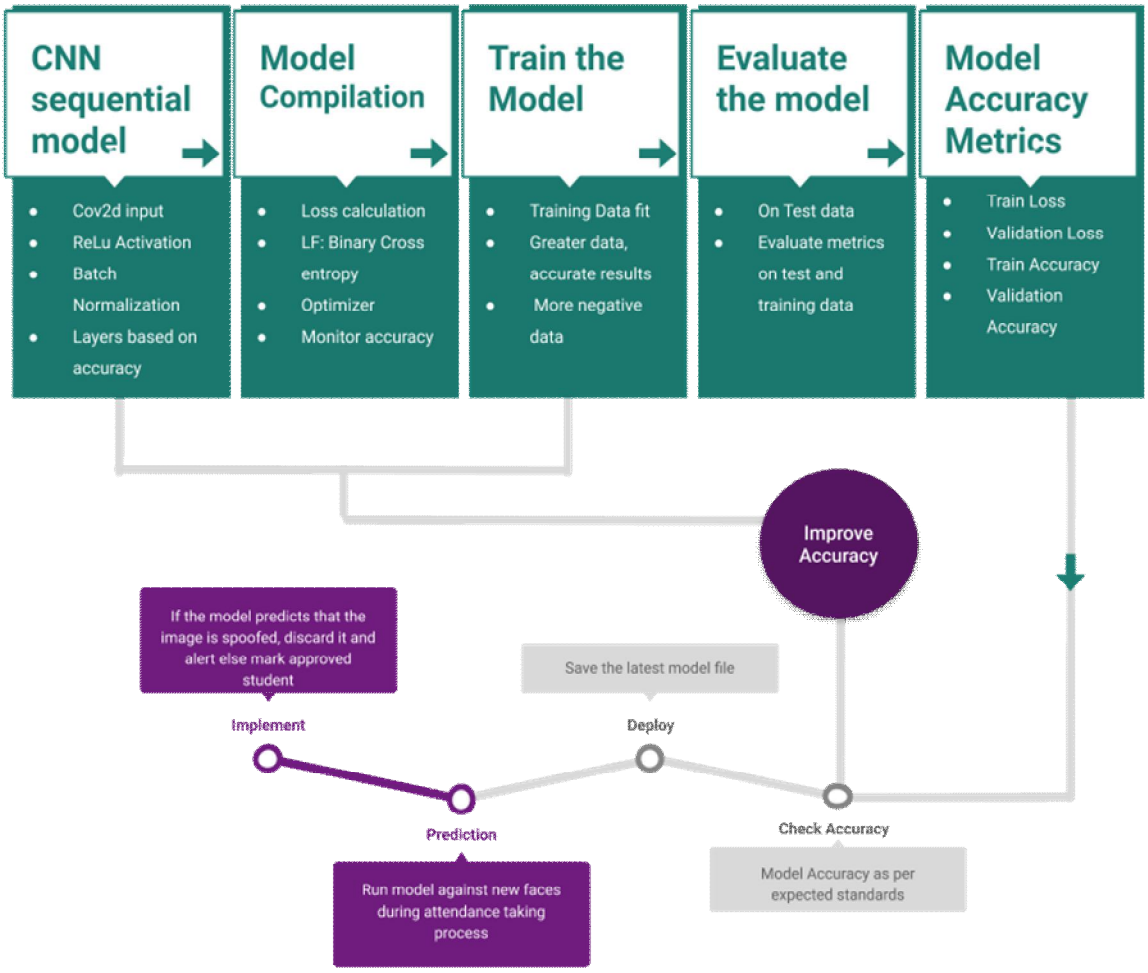

Fig. 2 Neural Network model to detect spoofing attempts

We first define a linear Neural Network, there are few hidden layers with different nodes. The model used is similar to VGG architecture neural networks. This basically starts with a stack of convolutional and pooling layers and ends with fully connected and soft-max layers.

Before training the model, we configure the learning process in the model compilation step. In this step we primarily specify an optimiser, a loss function and a list of metrics that we want to track in the model training process. The optimiser used is RMSprop and used for full batch optimization. Since our model is primarily a binary classification model i.e we intend to check if the face is authentic or spoofed, so we use the binary cross entropy loss function. We track the accuracy rate through the training process.

We then train the model with the training data which is 75% of the dataset in consideration. After which we evaluate its accuracy with the remaining 25% data. If the accuracy is within a specified threshold, we accept the model else we retrain it with more layers and more data if possible. If the model is good, we deploy it for use by the attendance system as shown in the figure.

IV. CONCLUSIONS

This paper suggests an approach of using neural network techniques to build an anti-spoofing facial attendance system that will help classrooms around the world to have a reliable and foolproof method of automatically taking attendance. This will improve efficiency and will generate more teaching time. The anti-spoofing model can also be trained at regular intervals so that its accuracy is increased over time. Unlike other papers in this domain which use models like SVM and PCA, we suggest a neural network approach that will greatly improve efficiency and make the system easier and relevant at scale.

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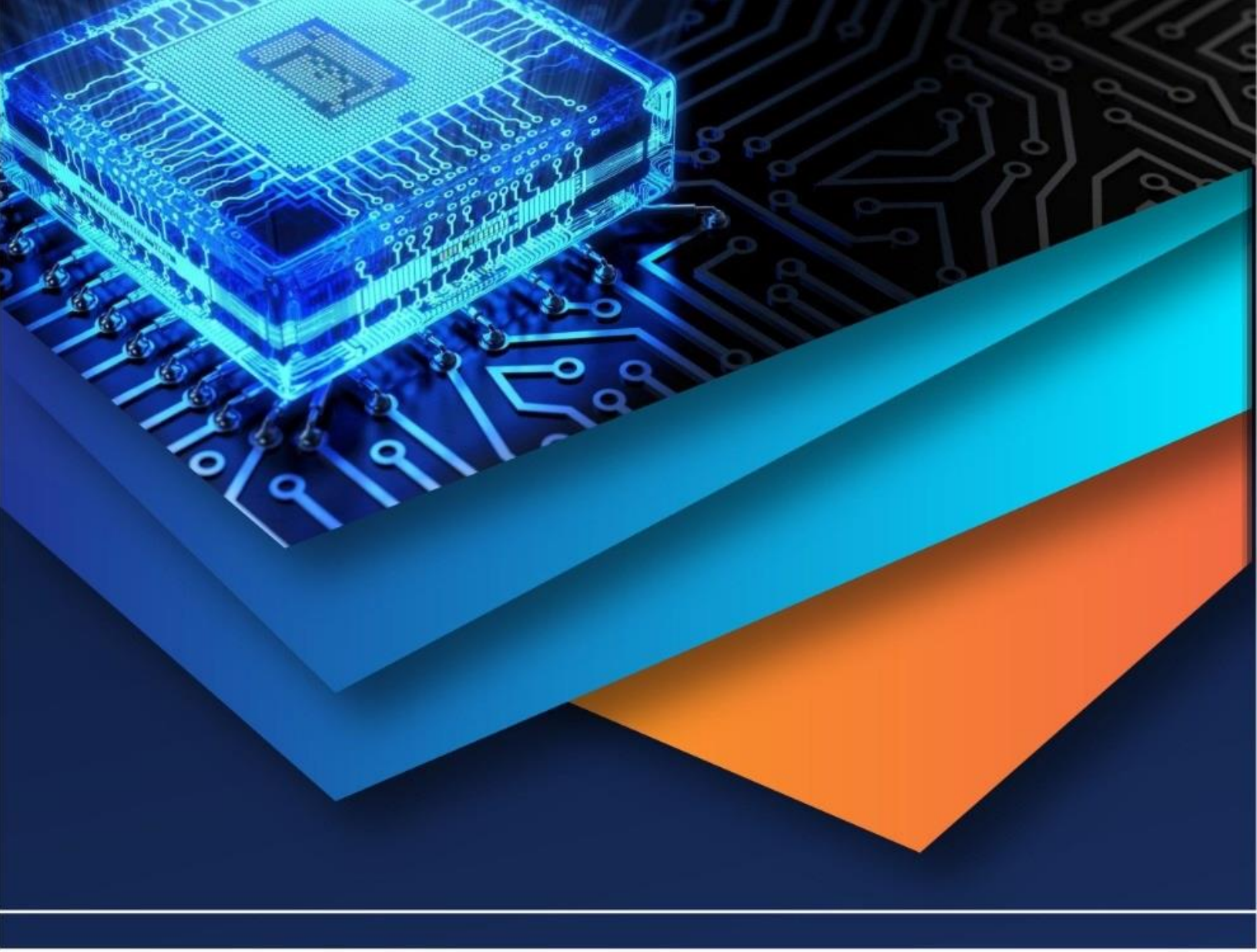

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