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# Multi-Model Biometric Authentication System for Smart Attendance

**K.RaviTeja, Brahmananda S H, Swasthika Jain T J**

***Abstract*: To increase the success rate in academics, attendance is an essential aspect for every student in schools and degree colleges. In olden days, this attendance is manually taken by teachers with pen and paper method, which consumes more amount of time in their busy management scheduling era. To make this attendance taking more comfortable and more accurate, a multi model biometric system for attendance monitoring system is proposed using a Raspberry Pi single-board computer. The camera and biometric device which is connected to the system gathers Information regarding the students by recognizing their faces and their fingerprint simultaneously. If both of them match with the student details stored in the database, then the system will be sending an alert about the student presence in the class. The student details which is stored into the database is collected from the students initially. By using these details like images and fingerprints the system is trained by using a Convolutional Neural Network (CNN) Machine Learning Algorithm.***

***Keyword*: Attendance Monitoring, Raspberry Pi, Machine Learning, Database, CNN Algorithm.**

## I. INTRODUCTION

Attendance has become an essential factor in institutions/organizations for students and teachers. Their presence makes institutions grow in all the possible aspects to reach the vision, mission, and goals of the institution. Students gain lots of information from the lecturers who have more experience. [1] The old method of recording student presence in the class was calling students names one after another and note it down in the Attendance Sheet. Another way of taking attendance was by students writing their names on a sheet of paper and their signature. As technology is evolving much faster than the food, we grow. Facial detection, which is an integral part of every device, can be used for recognizing the student's faces. The geometry of the student's faces is captured by using a digital camera, and the structure of an individual face is considered as a unique ID for recognizing the face. The facial structures like nose, mouth, eyes are considered for making distinguishable landmarks of different faces. The images that are captured using a digital camera are made to form a dataset, and it can be used for comparison purposes. Several algorithms like CNN, KNN algorithms were used to train and test this machine learning model to get accurate predictions.

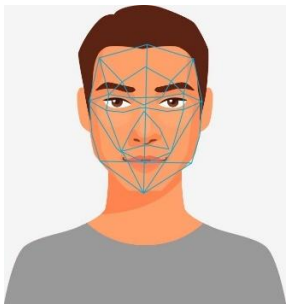

**Fig 1: Face Recognition**

For any management or teacher to analyze the student, we should keep track of them, which can be done by recording biometrics. Initially, the fingerprints are scanned by using a scanner and from these several features like Arch, Whorl, Loop, Line Unit and Fragment, Ending, Bifurcation, Eye, Hook, Pores, Line Shape, Ridges, Warts and Scars are extracted and stored into the database. Then the model is trained and tested by using the extracted information. To classify the fingerprints, we will use the Convolutional Neural Network (CNN) Algorithm.

**Fig 2: Finger Print Scanning**

## II. LITERATURE REVIEW

A Student Attendance System, which records the student's log-in and log-out time in the classroom environment by using a Personal Component Analysis (PCA) Algorithm. [1] A deep learning-based new face recognition system for monitoring the attendance of the students uses most advanced technology like Convolutional Neural Network (CNN) for detecting the face and to generate face embedding's, which gives 95.02% accuracy on the dataset that is used for training the model/system. [2]

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* Correspondence Author
**K.RaviTeja***, CSE department, GITAM University, Bangalore, India. Email: send2raviteja@gmail.com
**Brahmananda S H**, CSE department, GITAM University, Bangalore, India. Email: shbrahma@gmail.com
**Swasthika Jain T J**, CSE department GITAM University, Bangalore, India. Email: swasthika.jain@gitam.edu

To make attendance taking system faster and more accurate, a student attendance system which uses an image processing technique for face detection and recognition.

To detect the face, we use the Viola-Jones algorithm, and for face recognition, we use the Local Binary Pattern (LBP) method. [3] Student regular class attendance plays a vital role in assessing the student's capability. The conventional methods are consuming more time and insecure. An automatic attendance management system which is integrated with ubiquitous components for making the device portable to manage the attendance of students by using a Face Recognition technology.

[4] Buddy punching is a traditional way of taking attendance of the students, employees, or staff of any organization which deals with paperwork and managing that paperwork. Smart attendance is introduced to overcome the olden technique by using a biometric scanning technique. [5] An Automatic Face Recognition, a Deep Learning based technology captures the videos of students by using a surveillance camera and convert the video frames into images, which reduces the amount of time required for capturing the faces of the student [6].

With the growth of technology, everything is becoming smarter and more wireless. A Smart Bluetooth based attendance system reduces the errors made by humans, collect the attendance, and provide the statistics to the administrators to make decisions. [7] A Traditional attendance-based system is causing spoofing and wasting lots of time. A Radio Frequency Identification (RFID) and novel face recognition technique evaluated for student identification that combines both the traditional approach and the Multi-Scale Structural Similarity (MS-SSIM) index. [8]

So, after reviewing some of the papers relevant to this research, we came to know that CNN's algorithm is an effective way to train real-time picture face models. With the aid of the literature, we have come to know that using a multi-model system, we can achieve better results than the previous work. They also pushed towards a multi-model smart attendance model in order to reduce the instability of a single model framework.

## III. PROPOSED METHODOLOGY ARCHITECTURE

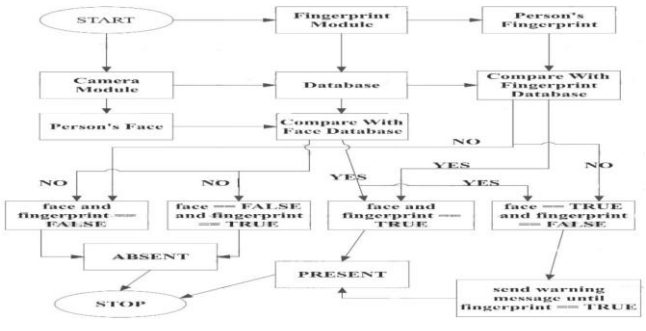


**Fig 3: Block Diagram of Proposed System**

## IV. IMPLEMENTATION

Initially, the Fingerprint templates and Face templates are collected and stored in the database. The fingerprints that are collected will be used for training the model by using a CNN algorithm.

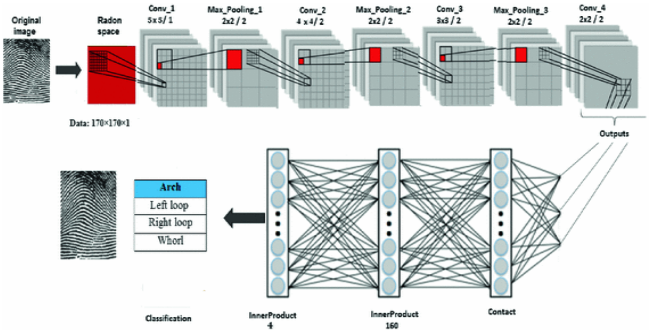


**Fig 4: Training the Model for Fingerprint Using CNN Algorithm**

Several features like an arch, tented loop, left loop, right loop, double loop, whorl, line-unit, line-fragment, ending, bifurcation, eye, hook, pores, line shape, incipient ridges, creases, warts, scars are extracted at different stages from the finger during the training process. After training, these features of each student are stored in the database. The extracted features figure is given below.

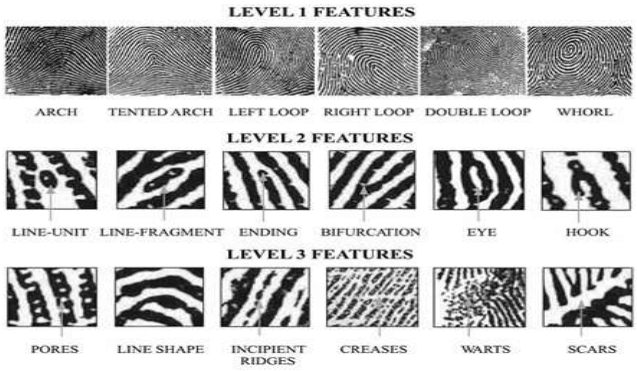


**Fig 5: Different Features of Fingers**

After extracting the finger features, we will proceed further to extract the features of the faces of students from the images we had taken. Similarly, here also, we will be using the CNN algorithm to train the model and recognize the face of a student. CNN algorithm of deep learning consists of 13 convolutional layers, 5 pooling layers, 3 fully connected layers, and SoftMax Layer. The fully connected layers have 54 channels, which indicates 54 identities in that layer.

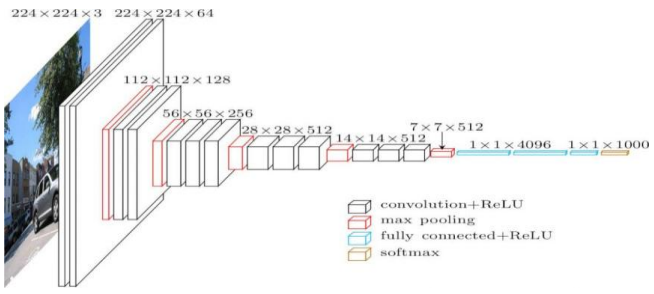


**Fig 6: Convolutional Neural Network Detection and Classification**

The Convolutional Layer output is denoted by using C and given by formulae,

$$C = \varphi(H(x, y)),$$

Where H (x, y) denoted the ReLU function,

$$\Phi (H (x, y)) = \max (0, H (x, y)),$$

$$H (x, y) = \sum_{m,n\varepsilon s} W (m, n) I_i' (x + m, y + n) + b,$$

Where W is the weight matrix, and b is biased. The ReLU function is used to reduce the computation and accelerate the network convergence. The output of the convolutional layer is taken by the pooling layer, which reduces parameters and spatial size. The output of pooling layer is denoted by P, and it is calculated by using the formulae,

$$P = g(C),$$

g (.) is used to calculate the max value. This function chooses the maximum value in the window and given for the next layer, and remaining values are discarded. The output of the fully connected layer is given $F_q$,

$$F_{q=}\Phi(\sum_{m,n\varepsilon s} W (m, n)\ P\ (x, y) + b),$$

Now, this data will be stored in the database. In the next step, the model is tested by taking unknown person fingerprint and facial features in real-time. The features of the person/student should follow certain constraints while matching those features with database features. The constraints are:

- If face and fingerprints are matched, then the student /person presence will be revised as "PRESENT."
- If face and fingerprints are not matched, then the student /person presence will be revised as "ABSENT."
- If the face is not matched and fingerprints are matched, then the student /person presence will be revised as "ABSENT."
- If the face is matched, but the finger is not matched, then the personal attendance will be marked as 'PRESENT,' and the warning message will be sent as 'Please put the finger' to that person.

By following these constraints, the person/student attendance will be recorded into the database along with log-in and log-out time. These data will be uploaded into the cloud/database of the institution/organization by using a raspberry pi microcontroller. The devices like camera and fingerprint scanner are connected to the raspberry pi microcontroller for performing all these operations. The commands to the microcontroller will be written in the Python language by using PyCharm platform to control the device.

## V. RESULT AND DISCUSSION

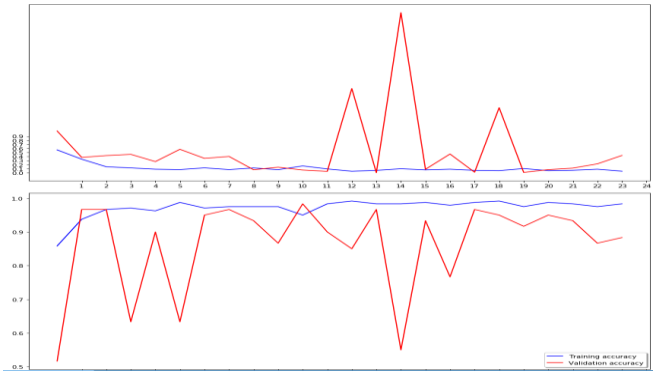


**Fig 7: Accuracy graph of the trained model and validation model**

The blue line in the graph indicates the trained model and red line in the graph indicates validated model which gives an average of 95 percentage accuracy in detecting face and fingerprint.

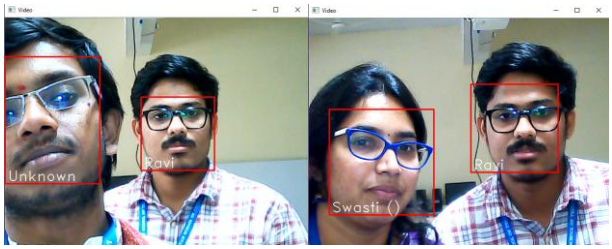


**Fig 8: Face detection in Real Time**

## VI. CONCLUSION

This Attendance Monitoring System reduces the amount of time consumed, and it also records the student/person in-time and out-time into the organization or to the class by considering both fingerprint and facial features. The main objective of this system is to identify the fingerprint and face of a person parallelly for monitoring the attendance of a student, which reduces the spoofing.

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## AUTHORS PROFILE

**K.RaviTeja,** currently pursuing M.Tech degree in Cyber Forensics and Information Security, GITAM School of Technology, Bengaluru Campus. He did his BE in Electronics and Communication Engineering from KPRIET. His area of interest in research is IoT, Networking, and Cyber Security. He had attended OWASP Seasides Conference. Participated in CTF challenges conducted by SECARMY. Won 2nd place in NASSCOM curathon Event.

**Dr. Brahmanand S. H.,** Professor and Head of Dept. CSE GITAM School of Technology, Bengaluru, Karnataka, India. He have also published article under reputed journals and some of them are lies under Scopus which have been identified by Elsevier Scopus among them "Review of Resource allocation in fog computing", "A Survey in IOT cyber-attacks and deep learning assistance that can be used to detect the attacks". And so on. The Research interest area is Cyber Security.

**Swasthika Jain T J,** currently working as Assistant Professor, Computer science of Engineering. GITAM School of Technology, Bengaluru Campus. She did her BE in Information Science and Engineering from Bahubali College of Engineering and her M.Tech in Computer Science and Engineering from Rajiv Gandhi Institute of Technology. She is pursuing her Ph.D in computer Science and Engineering. Her area of research is Big data analytics. She published papers in different areas like data analytics, wireless sensor network.