A Hybrid Approach of Automated Attendance System and Chat Bot for Educational Institutions

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***Abstract*— Traditional paper attendance methods can be time consuming and proxy can be marked by the attendees. The use of automated technology increases security and reduces the time required to track the participants. Facial recognition systems use different algorithms to improve accuracy and precision. Large infrastructure institutions need help directing students and faculty to specific locations. Having an automated help desk bot solves a major localization problem anywhere in a large infrastructure organization. The purpose of the project is to provide the attendance offerings, growth the security in opposition to proxy attendance and give directional statistics for the user. The Smart Attendance System utilizes a face recognition algorithm to identify students and record their attendance. The system is designed to be user-friendly and efficient, allowing teachers to easily manage attendance records and generate reports. The system's architecture is built on Flask API, a lightweight framework that allows for the creation of RESTful APIs. The system's backend is developed in Python, which is well-suited for machine learning and data processing. The frontend is designed to be user-friendly, with an intuitive interface that allows users to view attendance records and generate reports. The Chat Bot is developed to assist students with their queries related to attendance, schedules, and other academic-related matters. The system is integrated with natural language processing algorithms to provide a conversational experience for users. The integration of these two systems can enhance the overall academic experience for both students and teachers, reducing administrative workload and improving communication.**

Keywords—Facial recognition, Talking Robot, Smart Attendance, Face detection, Speech recognition.

I.INTRODUCTION

Attendance monitoring is a very important process in almost all institutions and organizations. Current methods are to use paper or books to record student attendance. This method is easy to imitate and timesheets can be lost or damaged. Therefore, attendance through this traditional method takes a long time, so it is necessary to have an automated and reliable system. The Attendance Monitoring System (AMS) will provide the necessary solution. [1-2]

The system will click on the student's photo and generate an attendance excel sheet using OpenCV. Teachers can then download this Excel sheet to further track each student. And the system can even be applied to the receiving bot. By using voice recognition in the system via python, it will be able to communicate with the user. It uses natural language to facilitate turn-based communication between users and bot.

The human-machine dialogue develops through voice interaction, which allows great flexibility and ease of interactivity. Facial detection consists of identifying detected objects as known or unknown faces. The facial recognition problem is often confused with the face detection problem. Facial recognition, on the other hand, decides whether a "face" is a known or unknown person, and for this it uses a database of faces to verify incoming faces. Use the Face Recognition API to learn and recognize faces from a database and generate output to tag student attendance. [3-5]

II.OBJECTIVES

1. Accurate Attendance Tracking: The main purpose of the smart attendance system is to accurately track the student or employee attendance records. The system must be able to register attendance in real time to avoid errors such as repeated entries or omissions.
2. Automatic Reports: Another purpose of the smart attendance system is to automate the process of generating attendance reports. The system should be able to generate attendance reports for each student or employee, and attendance reports for the entire class or organization.
3. Improve efficiency: Using the smart attendance system is expected to increase efficiency and reduce the workload of teachers or HR staff. The system will automatically perform tasks such as attendance, record absences and generate reports.
4.Improved Communication: The smart attendance system can improve communication between teachers, students and parents as it enables real-time updating of attendance records.
5. Increased Security: An intelligent management system time and attendance can increase the security of a by providing a record of who was present at a specific location in the at any given time.
6.Increase engagement: Chatbots can help increase engagement with customers by providing interactive experiences such as games, quizzes, and surveys. It can help build stronger relationships between customers and businesses. [6-8]

III. PROBLEM STATEMENT

The suggested system, as opposed to using the traditional techniques, attempts to establish as the following things:

1. An atomized computerized platform that records the attendance of the learners by making use of technology that recognizes faces.

2. In addition to this, it will be able to facilitate interaction in a back-and-forth manner between the user and the system.

IV.METHODOLOGY

The project methodology is divided into two parts: -

1. Speech Recognition (For front desk application)
2. Facial Recognition (For attendance monitoring)

A. Speech Recognition

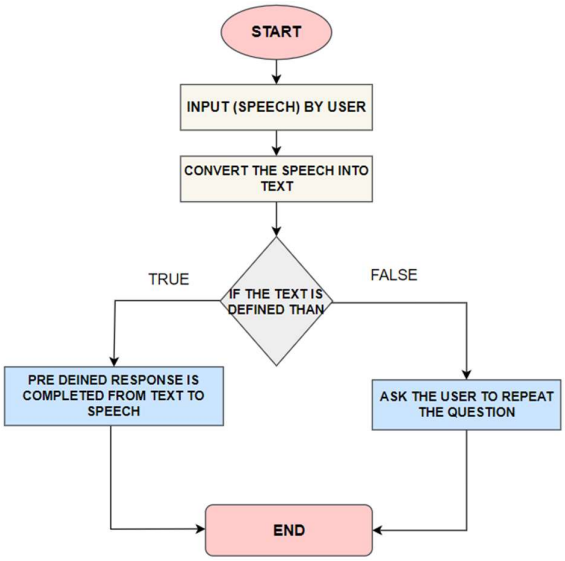

Fig. 1 Flow-chart for Speech Recognition

In Fig.1 the flowchart of how the speech recognition module works is given. The mic installed on the system captures the speech signal coming from the user and the software running (Python Code) on the processor processes the signal i.e., it converts the speech by user into text using the Speech-to-Text library. Now if the speech converted to text is defined then it responds with the predefined answers fed in the system and if the speech is not defined it asks the user to initial with the predefined questions. The output that is given to the user by the system is in speech form, which is converted from Text-to-Speech library. Visitors or users can approach the system and ask it in which location to find a particular place. Here, speech is used as a reference for the inquiry. The system then indicates the correct location to the visitor using speech as its output. [9-12]

B. External speech recognition module [1]

The robot's interaction capabilities in an application involving a front desk were purposefully restricted to the following three systems: a touch-sensitive tablet, a vision system, and voice communication. Within the framework of the chosen tactic, the capability to communicate with the robot through the use of natural speech (Natural Language Processing, or NLP) approaches was deemed the most important factor in ensuring the effective and alluring operation of the system. [13-15]

• Microphone A, which is more affordable.

• Microphone B, which is designed for professional use.

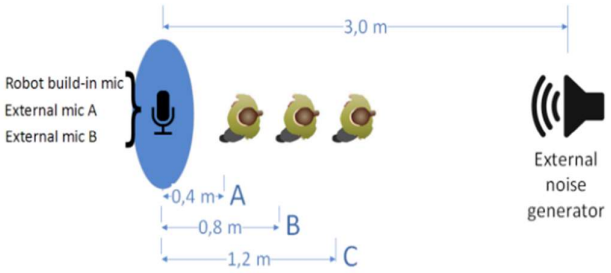

Fig. 2 Speech-to-Text mic testing system. A, B, C—microphone range Speech-to-text response times service

TABLE I. COMPARISON OF THE EFFECTS OF MICROPHONES HARDWARE PERFORMANCE AND INTERLOCUTOR-ROBOT PROXIMITY ON GOOGLE CLOUD'S SPEECH-TO-TEXT SERVICE'S LEVENSHTEIN DISTANCE VALUE. [9]

Distance to the microphone	Mic A (lower price)	Mic B (professional)
0.40 m	0.25	0.00
0.80 m	0.75	0.00
1.20 m	1.25	0.00

TABLE II. LEVENSHTEIN DISTANCE VALUE FOR THE 2-WORD, SHORT PHRASES

Distance to the microphone	Mic A (lower price)	Mic B (professional)
0.40 m	0.00	0.00
0.80 m	0.00	0.00
1.20 m	0.00	0.00

TABLE III. LEVENSHTEIN DISTANCE VALUE FOR THE 4-WORD PHRASES

Distance to the microphone	Mic A (lower price)	Mic B (professional)
0.40 m	0.00	0.50
0.80 m	0.50	0.50
1.20 m	0.25	0.50

TABLE IV. LEVENSHTEIN DISTANCE VALUE FOR LOHNEG PHRASES

Distance to the microphone	Mic A (lower price)	Mic B (professional)
0.40 m	1.875	5.00
0.80 m	10.500	3.50
1.20 m	15.375	5.25

Local microphones and professional microphones are two types of audio recording devices that are commonly used in different settings. While both types of microphones serve the same purpose of recording audio, there are significant differences in their design, quality, and accuracy. In terms of accuracy, professional microphones are generally considered to be more accurate than local microphones. [16-20]

In terms of accuracy, professional microphones have a higher signal-to-noise ratio, which means that they can capture sound with greater clarity and precision. They are also designed to reduce background noise and interference, which can distort the audio.

In contrast, local microphones are not as accurate as professional microphones, and they may be prone to interference and noise.

C. Code Implementation

Fig. 3 Libraries for Speech Recognition

The above image refers to the code that is to be executed for the speech recognition module using Python. There are different libraries used for computing the speech from the user to generate a predefined solution using speech for the user which includes following libraries [21,22]

- pyttsx3 (Text to Speech Library)
- speech recognition (Speech to Text Library)
- win sound (Pre-installed Windows sound, used for communicating the output)
- Time (display time)

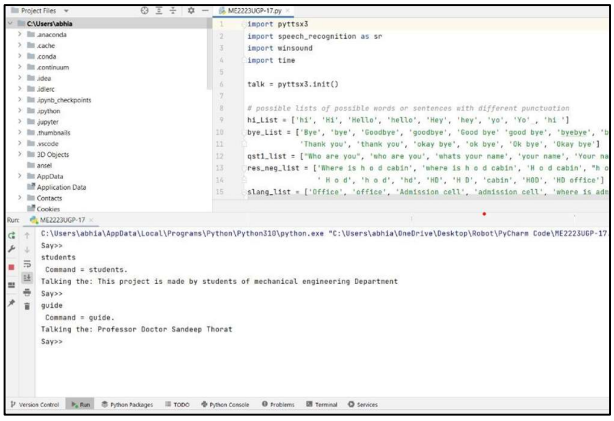

Fig. 4 Output for speech recognition

The above image refers to the output that is generated by the Python code when the user approaches the robot for a particular query. Using the sound available i.e., pre-installed in the Windows OS the robot communicates with the visitor.

When the robot captures the speech by the user, it converts the speech into text using the library available and then the text is then matched in the different set of lists that are predefined in the code. When the input by user matches with the predefined lists it delivers the required output using speech via the speaker that are connected in the system [23-25]

D. Face Recognition

In Fig.5 the flowchart for Facial Recognition is shown in which the image is captured for database generation and then when the same image is captured again the attendance is marked and an excel sheet is generated for faculties or higher authorities to take note.

The two different algorithms used for Facial Recognition are

1. HAAR Cascade [Accuracy Rate of 96.24%].
2. Local Binary Pattern Histogram (LBPH) [Accuracy rate of 94.74%].

The above image refers to the algorithm that has been used in the project for generating as well as identification of faces.

The HAAR Cascade is used for creating the new database of any individual with the use of the following steps:

HAAR Feature Selection

1. Creating Integral Images
2. Ada-boost Training
3. Cascading Classifiers.

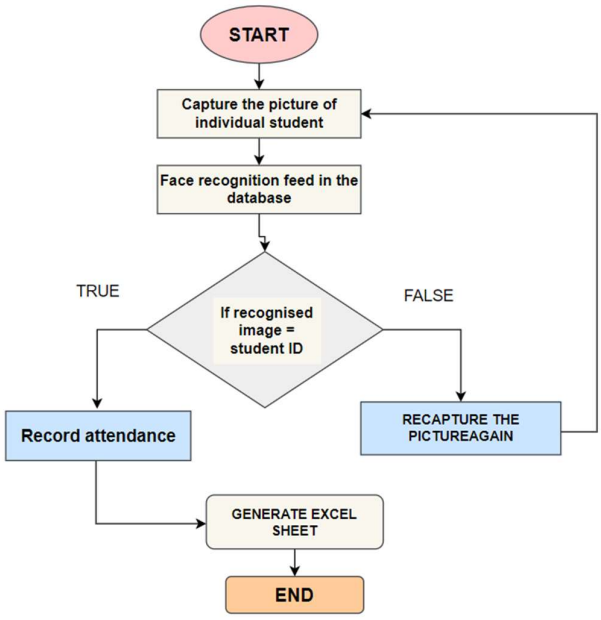

Fig. 5 Flow-chart for Facial Recognition

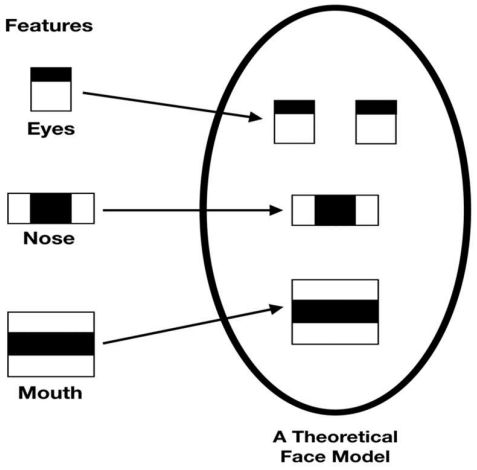

Fig. 6 HAAR Cascade

Local Binary Patterns Histogram (LBPH) is used for identifying the faces that are already defined in the database. This algorithm cuts the images in small pixels and assigns a particular pixel as its base pixel and thresholds the whole image into a matrix using its different classifiers it converts the image in binary. Then the binary pixels are converted into decimal and a histogram is generated of the particular feature. This histogram is then matched with the histogram of different available databases and generates the desirable output. The step-by-step process for LBPH is as follows: -

- Training the algorithm
- Applying the LBP operation
- Extracting Histogram
- Performing Face Recognition

The process of face detection involves partitioning an image

into two distinct groups: one of these classes contains faces, while the other class contains clutter. It is challenging because even if the faces are similar, they can have very different ages, skin tones, and expressions on their faces. This makes it tough to tell them apart. Variation in lighting conditions, image quality, and geometry, as well as the possibility of partial occlusion and camouflage, further complicate the challenge. Camouflage and partial occlusion are other complicating factors. For this reason, the perfect face detector would be able to identify the presence of any face, regardless of the lighting or the surrounding environment. The process of face detection can be broken down into two distinct stages. [26-27]

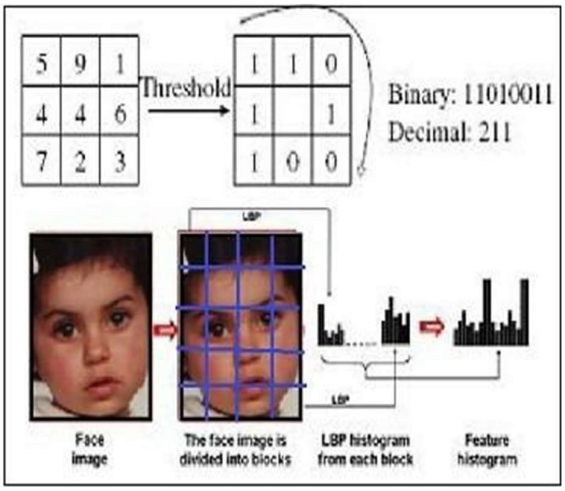

Fig. 7 LBPH Algorithm

Figure 6 illustrates the first step of the process, which is a classification task. This task accepts any arbitrary image as input and returns either a binary value of yes (1) or no (0), indicating whether or not the image contains planes. The face localization problem is the second stage, and its goal is to take an input image and output the location of one or more faces in that image as a bounding box with (x, y, width, and height). The face localization task is the second step in the process.

The system that has been developed is intended to take a picture of each student's face and save it in a database so that it may be used to track their attendance. It is necessary to take a picture of the student's face in a room with adequate lighting in order to recognise the student's facial features and determine the student's sitting and posture.

With this system, teachers do not need to manually record class attendance as the system will record the video. The system takes short videos as input and uses image processing/imaging to recognize faces and update the attendance database in a spreadsheet. [28-31]

E. Flask API

Flask API is a web application built using the Flask web framework in Python that provides a set of endpoints or routes for clients to interact with. APIs, or Application Programming Interfaces, allow different software systems to communicate with each other by exchanging data in a structured way.
Here is a high-level overview method for designing an automated attendance system using Flask API in Python:

1. Identify requirements: The first step is to identify the requirements for the attendance system. This includes understanding the attendance recording process, the type of data that needs to be captured, and the integration requirements with other systems.
2. Choose technology stack: Based on the requirements, choose the technology stack that is suitable for the project. In this case, we would choose Flask API and Python for the backend development.
3. Develop the facial recognition algorithm: Develop a facial recognition algorithm that is capable of identifying individuals from images captured by a camera. This would involve training the algorithm using machine learning techniques.
4. Create a database: Create a database to store attendance data. This database can be created using a relational database management system like MySQL.
5. Develop the frontend: Develop a user-friendly frontend that allows users to view attendance records and generate reports. This can be done using a frontend framework like React or Angular.
6. Integrate the system: Integrate the various components of the system, including the facial recognition algorithm, database, and frontend. This can be done using Flask API, which allows for the creation of RESTful APIs.
7. Test and deploy: Test the system thoroughly to ensure it is working as expected. Once testing is complete, deploy the system to a production environment.
8. Monitor and maintain: Monitor the system to ensure it is running smoothly and efficiently. Perform regular maintenance and updates as needed.

F. System Interface with Flask API

Fig. 8 Title for the web link

Title is displayed for authenticity of the Institutional Record.

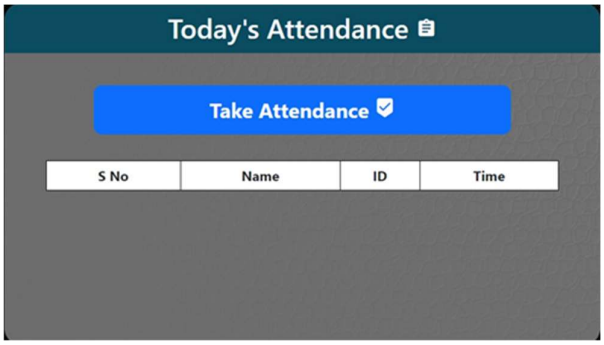

Fig. 9 Realtime attendance status record

The real-time data received and the name of student will be displayed after successful recognition of Image.

Fig. 10 Additional User Data Entry sequence

For new entry the User details needs to be enrolled in the database which will be stored for Image training.

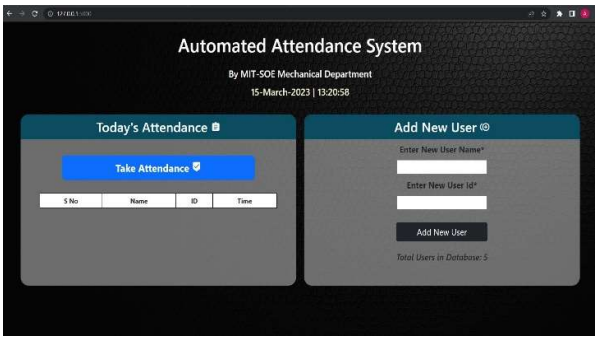

Fig. 11 Complete web interface for User

In the above picture, the system is divided into three main components: facial recognition algorithm, database management, and user interface and reporting.

The facial recognition algorithm component is responsible for capturing images of individuals, recognizing faces using machine learning algorithms, and updating the attendance records in the database.

The database management component stores and manages the attendance records. It includes a database management system, such as MySQL or PostgreSQL, which allows for efficient storage and retrieval of attendance data.

The user interface and reporting component provides a user-friendly interface for managing attendance records, generating reports, and visualizing attendance data. This component includes a web-based user interface, which can be accessed by teachers, students, or administrators.

Finally, the hardware components, such as cameras and sensors, are responsible for capturing data and sending it to the facial recognition algorithm for processing.

G. Code Implementation

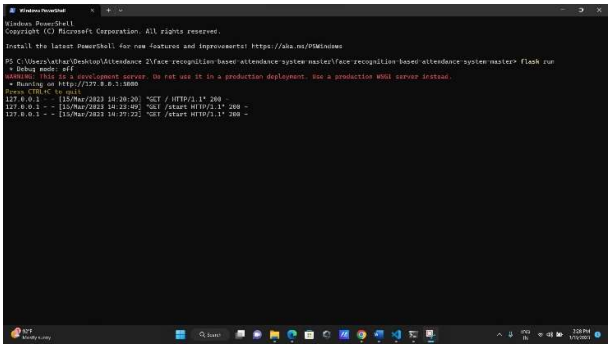

Fig. 12 Execution of Flask API

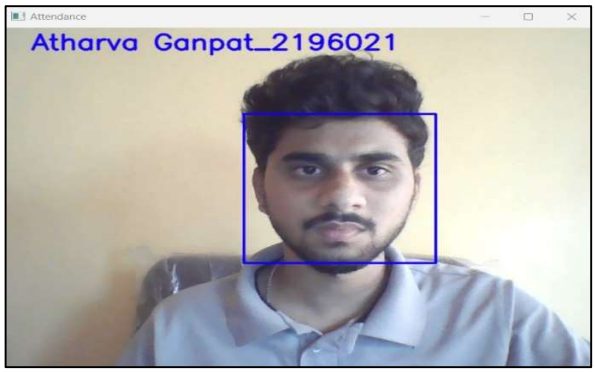

Fig. 13 Capturing Image

To open a Flask application through the terminal steps:

1. Open terminal on your computer.
2. Navigate to the directory where the Flask application is located.
3. Once in the directory containing the Flask application, you must activate the virtual environment (if you have one).
4.Once the virtual environment is activated, you can start the Flask application by running the "flask run" command in the terminal.
5.This command will start the Flask application and http://localhost:5000 can be accessed from your web browser.
6.Copy and paste the https link into any web browser of your choice.

The above Fig. (13) shows how the image is captured with the user ID as name and roll number and detects all the parameters which will be used for facial recognition. The above process using LBPH (Local Binary Pattern Histogram) will match all the features with the database that is been available in the system. The algorithm creates a histogram which includes all the features and compares with the data sheets histogram. After comparing it the system marks the attendance and uploads the student's attendance in the available Excel sheet.

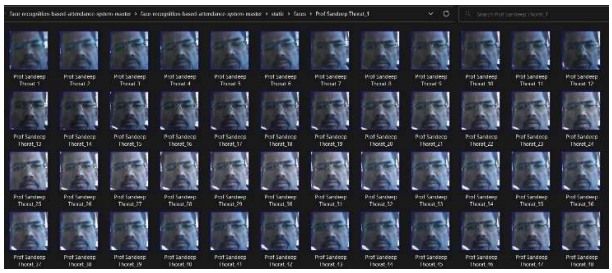

Fig. 14 Training Image Database

We conduct a series of experiments to demonstrate the effectiveness of the proposed method. 50 different images of 5 people were used in the training set. Figure (14) shows an example of a binary image detected by the HAAR cascade method of the extract_faces function.

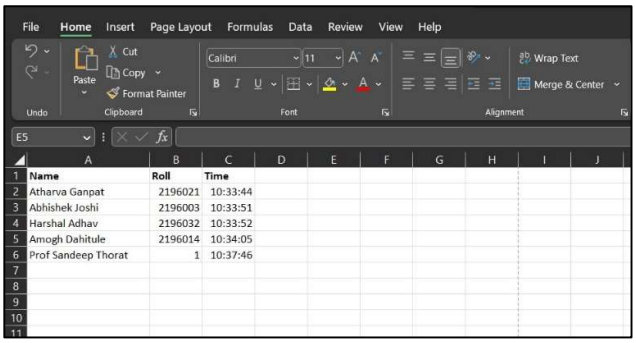

Fig. 15 Excel sheet

Automated attendance systems can be programmed to generate an Excel file containing attendance data for each session. Here are the steps to generate an Excel file in an automated attendance system:

1.First, create a template Excel file with the required headers for the attendance data, such as date, time, student name, and attendance status.

2.In the automated attendance system, create a script or program that captures attendance data. each session and stores it in a database or CSV file.

3.Use a library or tool to read the attendance data from the database or CSV file and write it to the Excel template file.

4.Save the generated Excel file to a specified location.

5.Finally, you can automate the entire process by scheduling the attendance system to run at specific intervals or triggering it using a specific event or action.

By following these steps, you can create an automated attendance system that generates an Excel file with attendance data for each session. The above Fig. (13) shows the generated

excel sheet for keeping the track of attendance records for faculties or administrators.

VIII. CONCLUSION

There are ways educational institutions and organizations can benefit greatly from implementing an automated attendance system. This not only simplifies the attendance process, but also ensures the accuracy and reliability of the recorded attendance data. In addition, the system can generate valuable information and reports that allow teachers and administrators to better understand student attendance patterns and identify potential issues before they escalate. In general, the automatic attendance system represents a major progress in the modernization of education and the organization and management. Its continuous development and improvement of will undoubtedly bring greater benefits to in the coming years. In this experimental study, the system was tested against a very robust, and the actual performance of the should be more accurate. A fully automatic frontal face detection system shows dummies and, in the opinion of researchers, does not require further work in this area. The next step will be to complete the real-time application of the system.

IX. ACKNOWLEGEMENT

It is indeed a matter of great pleasure and proud privilege to able to present this paper on "A Hybrid Approach of Automated Attendance System and Chat Bot for Educational Institutions". We would like to express our deepest gratitude to our guides, Prof. Dr. Anurag Nema and Prof. Dr. Sandeep G Thorat for their valuable guidance, timely help and consistent encouragement, and providing us with a great atmosphere to complete our paper.

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