Facial Recognition Attendance Using LBPH Algorithm

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***Abstract*—The implementation of a Facial Recognition System can aid in identifying or verifying a person's identity from a digital image. Accurate attendance records are vital to classroom evaluation. However, manual attendance tracking can result in errors, missed students, or duplicate entries. The adoption of the Face Recognition-based attendance system could help eliminate these shortcomings. This innovative approach involves utilizing a camera to capture input images, detecting faces using algorithms such as Haar cascade, Eigen values, support vector machines, or the Fisher face algorithm, verifying the faces against a database of student profiles, and marking attendance in an Excel sheet. The use of Open CV, an open-source computer vision library, ensures the efficient functioning of the system. The proposed model involves training the system with the authorized students' faces to create a database. The system crops and stores the images in a database with corresponding labels and extracts features using algorithms such as LBPH, Eigen values, support vector machines and Fisher face algorithm. The Face Recognition-based attendance system could help automate attendance records with high accuracy and reduce the burden of manual attendance tracking.**

***Index Terms*—facial recognition system, deep learning, Local Binary Pattern Histogram (LBPH) algorithm, Single Shot Multi Box Detector (SSD), computer vision, E- Attendance System, video surveillance, accuracy, efficiency, network architecture, training methodology**

I. Introduction

Teachers want Ed Tech solutions that enable them to successfully handle their short class time in the competitive world on today, as hours of work are growing and time in the classroom is reducing. Taking everyday attendance of students is one of the official tasks that teachers often have to finish instead of concentrating on teaching. The staff finds it difficult to manually take attendance and maintain it in files and gathers, which also takes up unnecessary classroom time. There are several school software programs ready to speed up the registration procedure and reduce employee effort in order to address such inefficient tasks.One of these, named an internet-based attendance system or an internet-based attendance management system, was created to automate schools' daily attendance information. It also helps in producing simplified student attendance reports as well as maintaining correct records. The working hours, breaks, login and logout times, and daily attendance are all tracked by the attendance management system. It stops employees from wasting time. All attendance devices, including electronic cards, fingerprinting, and recognition of facial features devices, are controlled in real-time by an attendance management system. Schools of every kind can manage different attendance needs with the help of electronic student tracking software. With this approach, writing letters, leave lists, daily attendance reports, and other documents is very easy to understand. A student attendance system helps teachers time by enabling them to track students' attendance online across class. It is used to maintain track of student attendance, records of delays, attendance history, and other necessary information. You can speed up the regular attendance process by keeping track of the student's attendance via student attendance technology. Educational institutions may collect, organize, and analyze daily student attendance data with the use of an online attendance management system. This application allows teachers to generate student attendance reports that are 100Goal: Managing the manual process of taking attendance is the main goal for creating an attendance management system. The program's automatic compilation of the reports at the finish or halfway of every meeting is a further component in its development. In many schools and colleges, monitoring attendance using the traditional method is a difficult task. In addition, it adds to the workload for faculty members who must manually call students' names to record attendance—a process that could take up to five minutes during a full class. This takes a lot of time. There is a possibility of substitute attendance. As a result, a lot of organizations started using more techniques for monitoring attendance, such as the usage of Radio Frequency Identification [3], iris detection [4], Bio metric recognition, and more. But because these systems are queue-based, they could take longer to complete and are more demanding. Face

recognition has created an important bio metric characteristic that is quiet and simple to pick up. Systems that rely on facial recognition are not very sensitive to different attitudes on the face. Verification and face identification are the two elements that make up a face recognition system. While face verification compares a face image to an original face image in a 1:1 matching procedure, face verification analyzes an input face image to a 1:N problem. The objective of this platform is to create an attendance system based on facial recognition software. Here, a person's face will be taken into account while recording attendance. These days, facial recognition is becoming more and more popular. In the current study, we suggested a system that uses real-time video streaming of classes to identify students' faces. If the detected face is in the database, attendance would be registered. It will take less time with this new system than with the old ones.

II. Literature Survey

One of the rare methods of bio metric identification that has the advantages of high precision and moderate intrusiveness is face recognition. It is simpler than a physiological method while maintaining the accuracy of one. The increasing amount of real-world applications requiring the recognition of human faces have inspired numerous researchers to develop various face recognition systems during the past thirty years. A number of problems combine to make automatic facial recognition a highly complex commitment. On the other hand, the facial image that is entered into the database can frequently be obtained in a variety of ways.Automatic face identification is essential because it must be able to handle a large number of different kinds of the same face image due to variations in parameters such as 1. Present, 2. Light, 3. Communication, 4. Motion, 5. Hair on the face, 6. Eye wear 7. The image background. Advanced face recognition technology has many commercial uses, including electronic identification, monitoring, psychology, computer user interface image-film processing, security systems, smart cards, and personal recognition. Face recognition, which originated in still images, can now be performed in both still images and video segments. Three primary categories can be used to group numerous methods of facial recognition for still photos: 1. A holistic method 2. A feature-based approach 3. Product with hybrid approach. The individual application's demands, the amount of computing power at hand, and the planned compromise between accuracy and efficiency all impact the choice of approach.

1. Holistic method: A face recognition system utilizing a holistic approach, also known as a global function, considers the entire face region as input data. The most popular face recognition method, itself, is an example of a holistic approach. Other holistic methods include fisher faces, the use of support vector machines, nearest feature lines (NFL), statistical itself, and independent-component analysis methods. They are all dependent on principal component analysis, or PCA, methods, which are useful for minimizing the size of a dataset while compromising its quality. 2. Characteristic In a feature-based approach, the eyes are segmented and used as input data for a framework classifier. Based approaches, or local features, involve features on the face, such as the nose. This group includes electromagnetically geometry, dynamic link design, and hidden Markov algorithm techniques. Based on DLA, one of the most effective of these systems is the elastic bunch graph match (EBGM) system [40],[41]. In these graph matching methods, wavelets—particularly Gabor wavelets—serve as the essential building blocks for facial representation. In a local feature representation, wavelet coefficients with values for many scales and rotation based on fixed wave bases are typically used.The wavelet coefficients that are calculated locally exhibit resilience against variations in clarity, translation, distortion, rotation, and scaling. To convey the pattern classes, the grid is positioned correctly over the image and saved in figure 2(a) along with the locally generated jet of each grid point. When a new image emerges, it is converted into a grid of jets and all previously saved model graphs are compared to the image. By creating and shifting linkages between vertices in the model domain, the DLA is conformed.

3. Hybrid approach: This strategy is based on how the human visual system processes both local and holistic features. The important elements that impact the hybrid approach's efficiency are how to decide which features to include and how to combine them in a way that preserves their benefits while avoiding their drawbacks as well. In the field of machine learning, these kinds of problems are closely related to ensembles learning and the multiple classifier system (MCS). Tragically, these issues are still unsolved even in these fields. Even this, a lot of work in these areas has given us some insights into how to solve these problems, and these lessons can be applied when creating a hybrid face recognition system. A hybrid strategy that utilizes both local and holistic information for recognition could be a useful tool for streamlining classifier complexity while improving the accuracy of generalization. (2015) Shirodkar M, et al. [41] suggested method for monitoring attendance involves comparing photographic faces to the student face database and marking punctuality using the face focus technique. Edelweiss Practical Science and Technology, Sakshi et al., 2021 Sakshi, Singh P, Sharma C, Sharma S, and Khan AI are cited. Applied sciences and applications for advanced attendance administration systems (2021) In light of this, Edelweiss Applied Sci Tech.For the length of the admissions procedure, student photos are taken in unique movements and saved in the college database. The device already has cameras attached to take a student's front-only picture. If the image matches one in the database, the device will automatically label the present student as that particular one. Reports are accessible for downloading from the front end at any time by authorities. The creator's finishing efficiency with the suggested system was 83.2Due of variances in the students' poses, the author of this study installed an exceptionally high-definition camera above the blackboard and captured every student three times over the whole class hour. The writer regards the Viola-Jones algorithm for face detection in their knowledge because of its rapid feature determination process.

The device will capture and process data in three frames, with the frame presenting the most precise detection charge that the gadget will take into account when tracking attendance in an Excel file. A model of an automatic attendance system was presented by the authors in [4]. The model focuses on how approved student are identified and registered as they enter and exit the classroom using face recognition and Radio Frequency Identification (RFID). Every registered student's real record is tracked by the system. In addition, the system saves every pupil's data in the attendance record for a particular class and gives out the necessary data based on demand.

The authors of this study [5] developed and put into operation an attendance system that makes use of iris identification. The first thing that the visitors were compelled to do was register their information and retinal template. The technology automatically recorded attendance in class by taking a picture of every pupil's eye, identifying their iris, and looking for an appropriate match in the database that was built. The web was used as a prototype. The authors of [6] developed an attendance system that used facial recognition technologies. The system was developed using algorithms that included Viola-Jones and Histogram of Oriented Gradients (HOG) characteristics together with a Support Vector Machine (SVM) classification. The authors drew into account a number of real-time conditions, involving expanding, clarity, obstacles, and position. Using the MATLAB GUI, quantitative analysis based on peak signal to Noise Ratio (PSNR) values has been carried out. By analyzing the Receiver Operating Characteristics (ROC) arc, the authors in [7] carried out research to figure out which facial recognition algorithm—Eigenface and Fisher face—provided by the Open CV 2.4.8 were the best. They then incorporated the method into the system for tracking attendance. The ROC curve suggested that Eigenface outperformed Fisherface in the studies performed for this paper. The precision of the system that used the Eigenface algorithm was between 70

In [8], authors used Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) to demonstrate a face recognition the solution for an instructional student attendance system. The aforementioned methods were employed to extract characteristics from the students' faces, and then the Radial Basis Function (RBF) was employed to classify the objects on the features. The correctness rate achieved by this method was 82

III. PROPOSED METHODOLOGY

The purpose of the Software Requirement Definition (SRD) is to specify the universal resource location (URL) and effectiveness that the Automated Network Recovery Application must implement. It attempts at establishing an understanding of the features and requirements of the end product as imagined by the client and the creation team. The attached file contains a categorized complete list of the needed requirements. It provides details about design and implementation prohibitions, exterior connection requirements, system characteristics, malfunctioned requires, and dependencies to project builders executives, users, technicians, and document writers. For businesses and groups to evaluate their market performance and establish a competitive edge, needs awareness is fundamental. Using recognition of facial features technology, the suggested approach seeks to automate the current individuals timekeeping system. Storing and recording every pupil's face for attendance records is the main objective. It is important that every facial feature be correctly identified while taking an image. Using methods for recognizing faces on the captured image, teachers can take attendance in class without requiring to actually do it. This essay covers the issues that are frequently associated with keeping written records. The Haar Cascade algorithms are applied to identify faces, while the Local Binary Pattern Histogram (LBPH) methodology is used to identify faces of pupils. The Face Recognition-based Class attendance method that is being developed. For the system to work, a camera must be placed in the classroom in an orientation that allows it to record each pupil in.

Both the detection tool and the simulator are provided by Open-CV. Using Open-CV, we can train a classification algorithm for any object, including automobiles, aircraft, and structures. For the cascade image classification algorithm, there are two main states: recognition and learning. Open-CV offers two cascading classifier training applications such as Opencv train cascade and Opencv retraining. The classification algorithm is maintained in an independent file format in these two programs. We require a collection of instances for learning.

Two categories of samples exist: • Negative sample: It has to do with images of non objects. • Positive samples: This is a significant picture that has recognizable things. While the collection of positive data is generated by the Open CV create samples tool, a set of negative data requires to be systematically provided. Negative Example Random pictures are used to generate negative examples. In a text file, samples with negative values are inserted. A picture filename for the sample that is negative is included in each line of the file, corresponding to the location of the content of the file. This file needs to be made by hand. Multiple dimensions can be seen in specified photos.

Positive Example The OpenCV create samples tool produces samples that are positive. These instances can be generated from an earlier the collection or from a single image containing an object. It's essential to keep in mind that, as the utility suggested above simply applies to the viewpoint modification, we need a sizable dataset of positive examples before you submit it. Step 1: First, input pictures (or video) in gray scale format must be installed, together with the required XML classification systems. Step 2: Once the image has been transformed to gray scale, we can modify it by cropping, resizing, sharpening, and blurring it as required. The next stage is segmentation of the image, which involves locating many objects inside a single picture so that the machine learning algorithm is able to quickly identify faces and objects in the picture.The proposed system for Face Recognition based Classroom attendance system

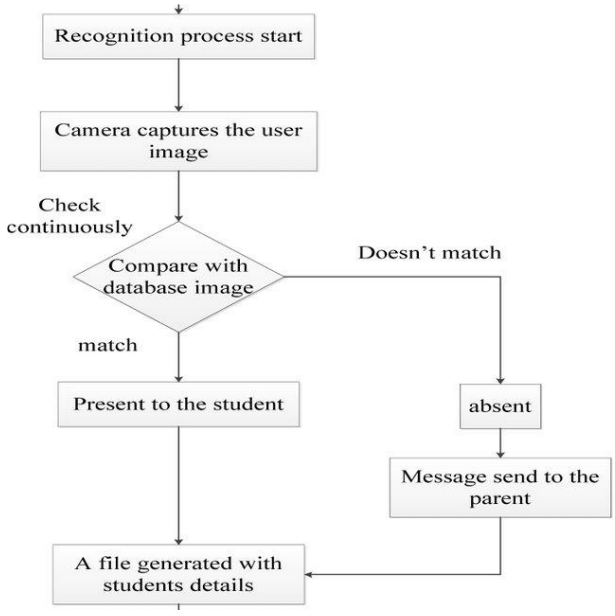

Fig. 1. System Architecture.

Generally, there are three steps to this process:

1) **Dataset Creation:** A web-based footage serves to take pictures of the pupils. Each pupil will be captured in multiple pictures from various perspectives and movements. These photos are processed beforehand. To capture the Region of Interests (ROI), which will be eventually used in the process of identification, the photos are reduced. The trimmed pictures must then be resized to a specific pixel location. After that, these RGB pictures will be converted to grayscale version. Once that, a folder holding the names of every pupil will have these pictures stored in it.
2) **Face Detection:** Face detection here is performed using Haar Cascade Classifier with OpenCV. Haar Cascade algorithm needs to be trained to detect human faces before it can be used for face detection. This is called feature extraction. The haar cascade training data used is an xml file haar cascade frontal face default. The haar features shown in Fig.2. will be used for feature extraction Here, OpenCV's Haar Cascade Classification is used to identify faces. While the Haar Cascade technique can be implemented for face identification, it must be taught to identify human faces. We refer to this as feature extraction. An xml file named haar cascade frontal face default contains the haar cascade training data. For feature extraction, the haar features displayed in Fig. 2 will be utilized.
3) **Corrections on Attendance:** Throughout the face recognition process, the faces that were identified will be noted as present in the spreadsheet, while the remaining faces will be recorded as absent. A list of the absences will then be forwarded to the relevant departments. At the end of every month, the corresponding attendance sheet will be modified for the departments.Faces will be recognized from the live broadcast classroom footage during each session. The photos in the dataset will be contrasted with the faces that were recognized. Should a match be discovered, the appropriate student's attendance will be registered. A list of absentees will be sent to the appropriate instructor monitoring the session at the conclusion of all of them.

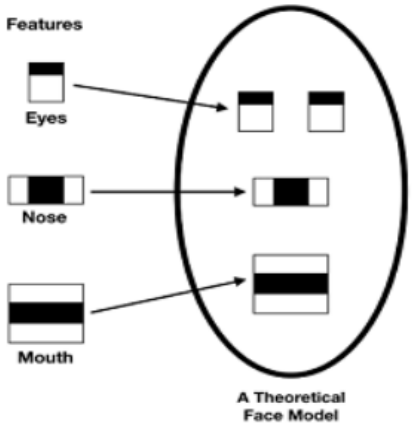

Fig. 2. Haar Features

IV. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware Requirements

- **Computer or Server**: Training and deploying the LBPH model requires a machine or servers with enough RAM and computing power. The size of the dataset, the level of detail of the model, and the required object detection rate will all affect the machine's specifications.
- **GPU (Graphics Processing Unit)**: GPU acceleration can be very helpful for deep learning model training and inference. It is advised to use an exceptionally well GPU with backing to expedite the modelling and conclusion procedures.
- **Camera or Video Input**: If the Facial recognition system is designed to work with live camera feeds or video streams, a compatible camera or video input device is required.

B. Software Requirements

- **Operating System**: The choice of operating system depends on the specific software frameworks and libraries used for implementing the LBPH algorithm. Common choices include Windows, Linux (e.g., Ubuntu), or macOS.
- **Deep Learning Framework**: A deep learning framework is required to implement and train the LBPH algorithm. Popular frameworks such as TensorFlow, PyTorch, or Caffe provide prebuilt implementations offer the necessary tools for model training and deployment.

- **CUDA and cuDNN**: If GPU acceleration is utilized, installing CUDA and cuDNN libraries is necessary to enable GPU support for deep learning frameworks.
- **Additional Libraries**: Depending on the specific implementation and requirements, additional libraries and packages may be needed, such as NumPy, OpenCV (for image and video processing), and matplotlib (for visualization).
- **Development Environment**: An integrated development environment (IDE) or text editor of choice, such as PyCharm, Jupyter Notebook, or Visual Studio Code, can facilitate the coding and development process.

V. Experimental Results

Through a GUI, users have the ability to interact with the system. Users will primarily have access to three choices here: mark registration, faculty registration, and student registration being present. It is expected of the students to fill out the student registration form with all necessary information. Following the registration button's click, the webcam establishes automatically, presenting the window represented in Figure 3 and beginning to identify faces inside the frame. After then, it will begin to automatically take pictures until 60 samples have been collected or CRTL+Q is pressed. During pre-processing, these photos will be kept in the images used for training folder.The faculty members are required to fill out the instructor registration form with their email address and the appropriate course codes. This is essential since the corresponding to the departments will eventually receive a list of those who are absent.

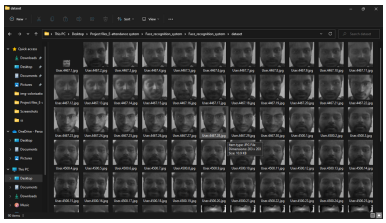

Fig. 3. Face Detection by the System.

Each training session, the necessary trainer needs to input their course code. The recording device will then turn on by itself after the course code has been entered. Figure 4 displays the facial recognition window where two enrolled students are recognized; if the individuals hadn't registered, the window would have shown "unidentified." The window will remove when you hit CTRL+Q, and the attendance will be modified in the spreadsheet. The identities of the absentees will then be sent to the appropriate faculty person.

- **Evaluation Metrics**: Benchmark datasets were used to assess the SSD method's real-time object detection execution. A number of metrics were calculated, including mean average precision (mAP), which gauges how accurately objects are detected. It is also possible to report additional metrics like recall, F1 score, and precision.

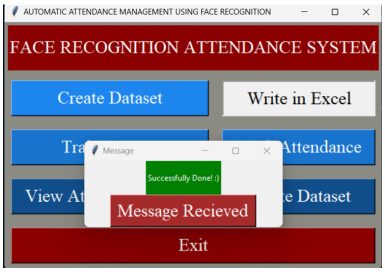

Fig. 4. Writing the attendance by the System

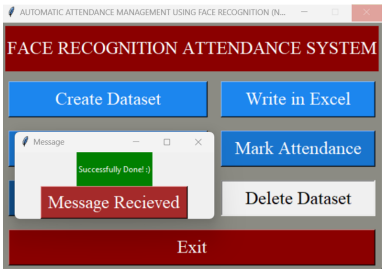

Fig. 5. Deleting the registered student from the dataset by the application.

- **Detection Accuracy**: The LBPH algorithm demonstrated high detection accuracy across various object classes. The mAP score indicated the overall performance of the system in terms of correctly identifying and localizing objects. Results showed that the algorithm achieved competitive or state-of-the-art performance compared to other object detection methods.
- **Scale and Variability**: The LBPH algorithm was tested on objects of different scales and aspect ratios. Results showed that the algorithm effectively handled scale variations, detecting both small and large objects accurately. The use of multi-scale feature maps and default boxes contributed to the robustness of the system.
- **Limitations and Challenges**: The discussion also addressed the limitations and challenges encountered during the implementation of the algorithm. For example, the algorithm may face difficulties in accurately detecting objects with extreme aspect ratios or occluded objects. Strategies to mitigate these limitations, such as data augmentation techniques or architecture modifications, were proposed for future enhancements.
- **Practical Applications**: The practical applications of the Facial Recognition system based on the algorithm were discussed. These may include autonomous driving, surveillance systems, or robotics, where fast and accurate object detection is crucial. The potential impact and benefits of the system in real-world scenarios were highlighted.
- **Future Directions**: The discussion section also provided insights into future research directions and possible improvements to the algorithm. Areas for further exploration may include incorporating advanced techniques such as attention mechanisms, exploring novel training strategies,

or addressing specific challenges in object detection, such as handling crowded scenes or detecting objects in challenging environmental conditions.

VI. CONCLUSION

The endeavor has a very broad application in the future. In future periods, the assignment may be made available via an intranet connection. The project is extremely flexible in terms of development, consequently it can be upgraded in the near future as and when the need for the same arises. Now that the database Space Management program is ready and feasible, the buyer may take charge and implement the entire process in a far more accurate, error-free, and superior way. The project's future scope comprises the following components.

• Bar code: When a specific student is dismissed, their subsequent attendance is eliminated. The mechanism of attendance dependent upon readers. The daily attendance, working hours, breaks, login and logout times, and entertainment are all kept up to date by the attendance administration system. It stops individuals from stealing time. All attendance science and technology, including bio metric data, facial recognition, and clever cards, is integrated in real-time via an attendance management system.

Thus, it can be said in the end that in order to improve accuracy and performance, pre processing techniques like edge detection and increasing image augmentation and contrast should be used.

VII. REFERENCES

1 . *Akbar, Md Sajid, et al. "Face Recognition and RFID Verified Attendance System." 2018 International Conference on Computing, Electronics Communications Engineering (iCCECE). IEEE, 2018.*

2 *5. Okokpujie, Kennedy O., et al. "Design and implementation of a student attendance system using iris biometric recognition." 2017 International Conference on Computational Science and Computational Intelligence (CSCI). IEEE, 2017.*

3 *6. Rathod, Hemantkumar, et al. "Automated attendance system using machine learning approach." 2017 International Conference on Nascent Technologies in Engineering (ICNTE). IEEE, 2017.*

4 *7. Siswanto, Adrian Rhesa Septian, Anto Satriyo Nugroho, and Maulahikmah Galinium. "Implementation of face recognition algorithm for biometrics-based time attendance system." 2014 International Conference on ICT For Smart Society (ICISS). IEEE, 2014.*

5 *8. Lukas, Samuel, et al. "Student attendance system in classroom using face recognition technique." 2016 International Conference on Information and Communication Technology Convergence (ICTC). IEEE, 2016.*

6 *9. Salim, Omar Abdul Rhman, Rashidah Funke Olanrewaju, and Wasiu Adebayo Balogun. "Class attendance management system using face recognition." 2018 7th International Conference on Computer and Communication Engineering (ICCCE). IEEE, 2018.*

7 *Smitha, Pavithra S Hegde, Afshin, "Facial Recognition Based Attendance Management System", june 2020 International Journal of Engineering Research and V9(05).*

8 *Hapani, Smit, et al. "Automated Attendance System Using Image Processing." 2018 Fourth International Conference on Computing).*

9 *Rathod, Hemantkumar, et al. "Automated attendance system using machine learning approach." 2017 International Conference on Nascent Technologies in Engineering (ICNTE). IEEE, 2017.*

10 *Reena Gunjan, Anannya Mital, Muskan Jain. "Smart Capture - An Advanced Attendance System using facial Recognition". Conference: 2023 1st International Conference on Cognitive Computing and Engineering Education (ICCCEE).*

11 *Shireesha Chintalpati, M.V. Raghunadh. " Automated attendance based management system based on face recognition algorithms". Conference: 2013 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC).*

12 *Shubhobrata Bhattacharya, Gowtham Sandeep Nainala, Prosenjit Das, Aurobinda Routray. "Smart Attendance Monitoring System (SAMS): A Face Recognition Based Attendance System for Classroom Environment". Conference: 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT).*

13 *Shreyak Sawhney, Karan Kacker, Samyak Jain Shailendra Narayan Singh. "Real Time Smart Attendance System Using Face Recognition Techniques". Conference: 2019 9th International Conference on Cloud Computing, Data Science Engineering (Confluence).*

14 *Khem puthea, Rudy Hartanto, Risanuri Hidayat. " A review paper on attendance marking system based on face recognition". Conference: 2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE).*

15 *Ashwin Raj, Aparna Raj, Imteyaz Ahmad. " Smart Attendance Monitoring System With Computer Vision Using IOT ". February 2021Journal of Mobile Multimedia.*

16 *Husam Aizaq. " Student Attendance System Using iTag's Beacon Detection". Conference: 2023 20th International Multi-Conference on Systems, Signals Devices (SSD).*