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Smart Attendace System Using ML

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Abstract: ***The world is changing, and automatic face recognition (AFR) technologies have advanced greatly. Smart Attendance with Real-Time Face Recognition is a practical method for managing the student attendance system on a daily basis. The technique of recognising a student's face for collecting attendance using facial biometrics based on high-definition monitor footage and other information technology is known as a face recognition-based attendance system. In my face recognition project, a computer system will be able to quickly and accurately find and recognise human faces in pictures or videos being taken using a security camera.***
Many algorithms and methods have been created to enhance facial recognition ability, however deep learning is the idea that will be used in this case. It assists in turning the video frames into photos so that the student's face can be quickly identified for their attendance and the attendance database can be quickly updated automatically.
Keywords: Smart Attendance, Automatic face recognition, ML, Deep Learning, GSM

I. INTRODUCTION

Institutions of higher learning are now worried about students' attendance patterns. This is mostly because a student's participation at the institute has an impact on their overall academic success. Calling out the roll call or having students sign a piece of paper are the two main traditional ways to record attendance. They both take more time and are more challenging. Therefore, a computer-based student attendance management system is needed, which will let the faculty keep attendance records automatically. Python was used to implement the automated attendance system in this project. Our plans to create a "Automated Attendance System Based on Facial Recognition" with broad applicability have been predicted. Face identification is included in the application, saving time and removing the possibility of proxy attendance.

These days, technology tries to impart fantastic knowledge-based technical advancements. One of the fascinating fields is machine learning, which enables the machine to train itself by using some datasets as input and produces the right results during testing by using various learning algorithms. Today, attendance is seen as a key component for both students and teachers in educational institutions.

With the development of machine learning technology, the system now tracks the data it has collected and determines the kids' attendance performance automatically. In general, there are two distinct ways that the student's attendance system can be maintained: the Manual Attendance System (MAS) and the Automated Attendance System (AAS). In a manual student attendance management system, the instructor in charge of the relevant topic must call the students' names and manually record their attendance.

Manual attendance may be seen of as a time-consuming process, or occasionally a student may answer more than once regarding the absence of a friend, or the teacher may overlook someone. Therefore, when we consider the conventional method of taking attendance in the classroom, a difficulty occurs.

We use an automatic attendance system to address all of these problems (AAS). The use of this technology has numerous benefits. A few of them include

1) Time tracking is made simpler by automation, and staff is not required to keep an eye on the system constantly. System automation eliminates human mistake.
2) With a quick and precise identification process, a time and attendance system utilising facial recognition technology may reliably report attendance, absence, and overtime.
3) Without any human error, facial recognition software can precisely track time and attendance.
4) Facial biometric time tracking enables you to monitor workers as well as guests, who can then be monitored around the workplace.

Drawbacks of various Attendance systems:

Types of the Attendance systems	Drawback
RFID-based	Fraudulent usage
Fingerprint-based	Time consuming for students to wait and give their attendance
Iris-based	Invades the privacy of the user
Wireless-based	Poor performance if topography is bad

Face recognition can be used to solve a wide range of issues, including the processing of images and films, human-computer interaction, criminal identification, etc. This has inspired researchers to create computational models that are rather straightforward and straightforward to use in order to recognise the faces. The current system is inefficient and only represents a small portion of face space. In spite of the fact that these facial images appear to have great spatial dimensions, this crucial element must be taken into account. Therefore, it is preferable to simply consider a subspace with reduced dimensionality to represent this face space rather than the entire face space with large dimensions.. The goal is to implement the system (model) for a particular face and distinguish it from a large number of stored faces with some real-time variations as well. This project approach uses haar cascade analysis algorithm for the recognition of the images. It gives us efficient way to find the lower dimensional space.

II. LITERATURE SURVEY

1) Dhanush Gowda H.L, K Vishal Keertiraj B. R, Neha Kumari Dubey, “Face Recognition based Attendance System”, International Journal of Engineering Research & Technology (IJERT)), is built on the use of face recognition to address problems with the prior attendance system. In order to do face detection and identification, this system uses a camera to take pictures of the students. The taken image is checked one by one with the face database to look for the employee's face, and when a match is made, attendance will be noted.

2) Nandhini R, Duraimurugan N, S.P. Chokkalingam, “Face Recognition Based Attendance System” International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8, Issue-3S, February 2019) , An automated attendance system based on face recognition is a biometric system that typically logs the attendance of every student in a class by detecting and identifying each of their faces. This recorded information is then ideally transmitted to a server device that may compute the attendance of each student and store and update the corresponding data in a database.

3) Hussain, Dugar, Deka, Hannan, 2014, “RFID based Student Attendance System” RFID technology is used to improve the older attendance system. In this system, a tag and a reader is again used as a method of tracking the attendance of the students.

4) Kumar Yadav, Singh, Pujari, Mishra, 2015, “Fingerprint Based Attendance System Using Microcontroller” proposed a solution of using fingerprint to mark the attendance. To handle the fingerprint identification procedure, this device uses two microcontrollers. A fingerprint sensor will first be used to obtain the fingerprint pattern, and then microcontroller 1 will receive the data. The information is then passed from microcontroller 1 to microcontroller 2, which checks it against the database stored there. Following the discovery of a student's match, the information is transmitted via serial communication to the PC to be displayed.

5) Akbar, Md Sajid, et al. "Face Recognition and RFID Verified Attendance System." 2018 International Conference on Computing, Electronics & Communications Engineering (iCCECE). IEEE, 2018. The author proposed a model of an automated attendance system.

6) The concept focuses on how face recognition and Radio Frequency Identification (RFID) work together to identify and count approved pupils as they enter and exit the classroom. Every student who has registered with the system has an authentic record kept. Additionally, the system maintains information about each student registered for a certain course in the attendance log and delivers necessary data as needed.

7) Mr. Rajvardhan Shendge1, Mr. Aditya Patil2, Mrs. Tejashree Shendge3 "Smart Attendance System using Face-Recognition", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056. Various systems are currently in use to manage and assess student attendance at universities. Even though these systems are extremely usable, their practicality and constraints pose a problem in the process.

III. PROBLEM STATEMENT

The daily evaluation of the classroom heavily weighs attendance. The teacher often checks it at the start and end of class, although it's possible that they might miss someone or check some students' answers more than once. Face recognition-based attendance systems use face recognition technology based on high-definition monitor picture or video and other information technologies to solve the challenge of recognising faces for taking attendance. The goal of face recognition is to enable computers to quickly and accurately locate and identify human faces in pictures and movies. For enhancing the effectiveness of face recognition, numerous algorithms and methods have been created. Biometrics includes face recognition as a key component. Basic human characteristics are compared to the data in biometrics. Algorithms are effective at extracting and implementing facial features, and some changes are made to the existing algorithm models to enhance their performance. Face-recognition computers could be used for a wide range of real-world purposes, such as identity verification, security measures, and criminal identification. There are typically two phases in the facial recognition system:

1) Face detection involves searching the input image for any faces, after which image processing purifies the facial image to make facial identification simpler.

2) Face Recognition is the technique of identifying a person by comparing their detected and processed face to a database of recognised faces.

A. Problem Objective

The following are the objectives of the project:

1) To develop a portable Smart Attendance System which is handy and self-powered.

2) To ensure the speed of the attendance recording process is faster than the previous system which can go as fast as approximately 3 second for each student.

3) Have enough memory space to store the database.

4) Able to recognize the face of an individual accurately based on the face database.

5) Allow parents to track their child's attendance.

6) Develop a database for the attendance management system.

B. Existing System

Punch locks or some other manual system is used in the conventional approach of recording attendance. However, this approach necessitates ongoing human oversight. However, thanks to advances in technology, an automatic attendance system has been developed that delivers significantly superior outcomes.

C. Proposed System and Solution

The suggested system's job is to take a picture of every student's face and record it in a database for their attendance. The student's face must be photographed in a way that allows all of its features to be noted and compared to the data already on file. The project's basic operating premise is that video data is turned into images in order to be detected and recognised.

Additionally, attendance is provided together with the student's recognised image; otherwise, the system flags the student's record as being absent.

Additionally, a message is sent to the parent of the absentee and is shown on the LCD. The daily timetable or other information can also be shown on the LCD panel.

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IV. DESIGN METHODOLOGY

A. *Block Diagram Of The System*

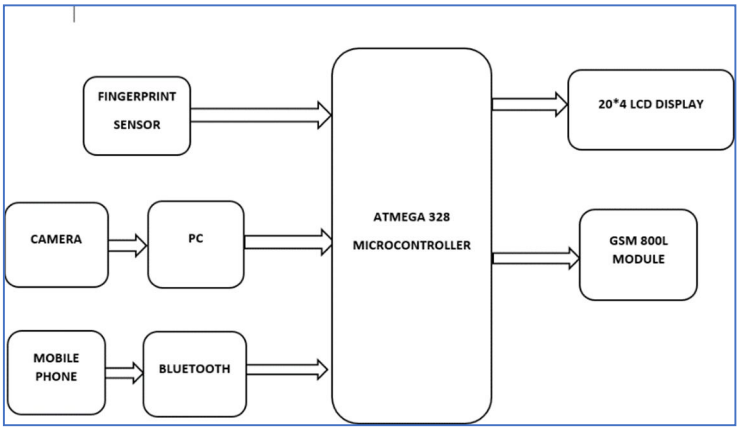

Fig 1: Block Diagram of Smart Attendance System

B. *Functional Unit Description*

In the figure we showed the hardware requirements & Technical approach in the way to design the system. The system consists of mainly parts like Microcontroller (ATmega328), Bluetooth, LCD display, GSM Module, Finger print sensor which are described briefly below.

C. *Microcontroller Atmega328*

Arduino UNO is an open-source prototyping platform based on ATmega328 microcontroller. It consists of 14 digital input/output (I/O) pins, six analogue inputs, a USB connection for programming the on-board microcontroller, a power jack, an ICSP header and a reset button. It is operated with a 16MHz crystal oscillator and contains everything needed to support the microcontroller.

D. *GSM Module*

A mobile communication modem is called GSM. It is a mobile communication system that is commonly utilised worldwide. GSM is a cellular technology that is open and digital and is used to provide mobile voice and data services. A GSM modem is a device that enables communication between a computer or any other processor and a network. It can also be a mobile phone.

E. *Web Camera*

ZEB-Crystal Clear is a web camera with a 3P lens having 1080 pixels with a resolution of 640x480. The web camera also comes with a built-in microphone, and auto white balance, night vision feature, and a manual switch for LED. It has Interface USB Image sensor CMOS Lens 3P quality lens. Video resolution 640 x 480 (30 FPS) Cable length 1.3 Meter The Webcam also has a Built-in Microphone Automatic white balance Night Vision Manual switch for LED.

F. *LCD (20X4) Display*

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 20x4 LCD display is very basic module and is very commonly used in various devices and circuits. A 20x4 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

G. *Hc-05 Bluetooth*

Microcontrollers may link to other devices and communicate wirelessly thanks to the HC-05 Bluetooth to serial converter. The HC-05 is a Bluetooth module that attaches to a microcontroller's serial port and enables Bluetooth communication between the microcontroller and other devices. The module itself can be used in a variety of applications, including smart home applications, remote controls, data logging applications, robotics, monitoring systems, and more. It can operate in both master and slave mode.

H. R307 Fingerprint Module

The R307 Fingerprint Module includes an optical fingerprint sensor, a high-speed DSP processor, a high-performance algorithm for fingerprint alignment, high-capacity FLASH chips, and other hardware and software components. It has a simple structure, stable performance, and features functions for fingerprint entry, image processing, fingerprint matching, searching, and template storage, among others.

The webcam in this place records pictures of the students. The photos from the webcam are sent to the computer or system, where the two processes—facial detection and face recognition—are run. The system then compares the student's face to the registered student's face and matches it to the information in the database. The information is transported from the computer to the microcontroller, where it is processed before being serially transferred to the GSM module, where it is sent to the parents. The LCD shows the note that was sent to the absentee's parent. It is also possible to show the daily timetable or any type of announcement on the LCD display. This system provides us with a two-factor authentication, one is the face recognition and second through the finger print recognition the attendance of the student is marked.

V. CIRCUIT DIAGRAM OF THE SYSTEM

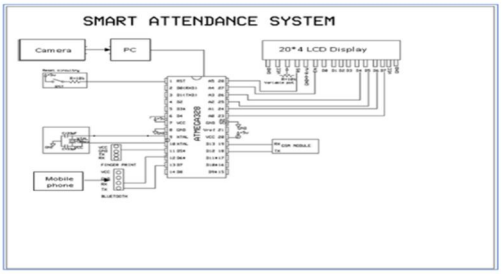

Fig 2: Circuit diagram of the System

VI. FLOWCHART OF THE SYSTEM

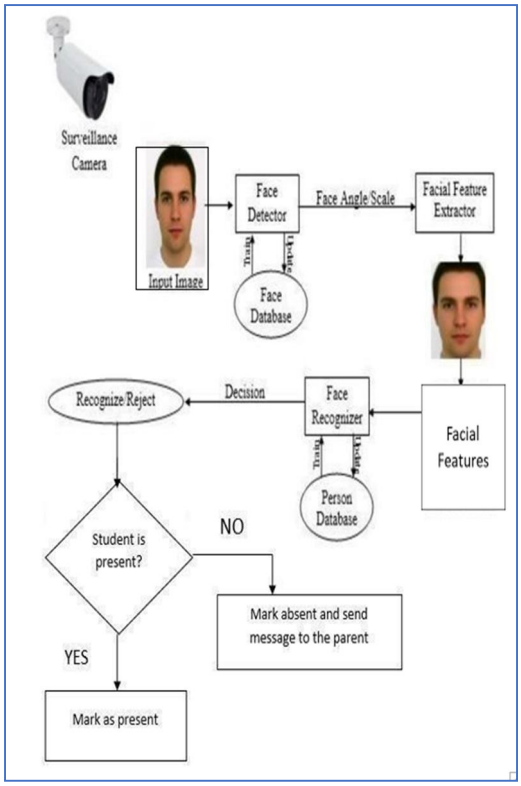

Fig 3: Flowchart of the system

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VII. WORKING OF THE SYSTEM

The hardware and software components make up the two aspects of the attendance tracking system's design. before the application. Before the design component can be developed, the hardware component must be finished in order to create a platform on which the software can run. In order for the software portion to function properly, we must first install a few libraries. Python is used to install OpenCV and Numpy..

A. Hardware Development

1) Camera Module with good mega pixels.
2) Power Supply Cable
3) LCD Display
4) GSM Module
5) Fingerprint Sensor
6) ATmega328 Microcontroller

B. Software Development

1) OpenCV

OpenCV (Open-source computer vision) is a library of programming functions mainly aimed at real-time computer vision. The OpenCV project was initially an Intel Research initiative to advance CPU-intensive applications, part of a series of projects including real-time raytracing and 3Ddisplay walls. The main contributors to the project included several optimization experts in Intel Russia, as well as Intel's Performance Library Team.

2) Face Detection: Haar Cascade Algorithm

Haar cascade algorithm are an effective way for object detection. This method was proposed by Paul Viola and Michael Jones in their paper Rapid Object Detection using a Boosted Cascade of Simple Features. Haar Cascade is a machine learning- based approach where a lot of positive and negative images are used to train the classifier.

3) Face Recognition: Local Binary Pattern Histogram

Local binary pattern histogram (LBPH) is a Face-Recognition algorithm it is used to recognize the face of a person. It is known for its performance and how it is able to recognize the face of a person from both front face and side face.
The working of the Face Recognition Software consists of following steps:

a) Webcams are used to record student images for the dataset. A single pupil will be captured in numerous pictures from various perspectives and motions. Pre-processing is performed on these photos. To acquire the Region of Interest (ROI), which will be used in the recognition procedure, the photos are cropped. The clipped photos must then be resized to a specific pixel position. Then, these RGB photos will be changed into grayscale versions. And after that, these pictures will be saved in a folder with the names of the respective students.
b) Face Recognition: In this case, OpenCV and the Haar-Cascade Classifier are used to detect faces. Here, we are use the OpenCV detect Multiscale module. To draw a rectangle around the faces in an image, this is necessary. There are three variables to take into account: scale Factor, miNeighbors, and minSize. When determining how much a picture has to be scaled down, scale Factor is employed. The number of neighbours that each candidate rectangle must have is specified by minNeighbors. Higher levels typically detect fewer faces but better image quality. The minimal object size is specified by minSize.

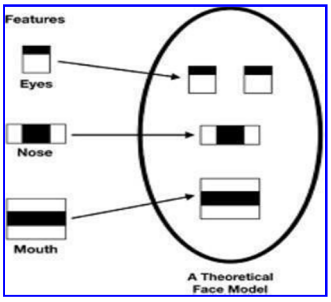

Fig 4: Types of HAAR Features

c) The process of recognising faces can be broken down into three parts. create training data, train a face recognizer, and make predictions. The photographs in the dataset will serve as the training data in this case. They will be given an integer label designating which student they belong to. This system uses the Local Binary Pattern Histogram as a face recognizer. First, the full face's list of local binary patterns (LBP) is compiled. Following the decimalization of these LBPs, histograms of all the decimal values are created. The best label for the student it belongs to is returned later on in the recognition process once the histogram of the face to be identified is generated and compared with the histograms that have already been computed.

d) Updating attendance Following the face recognition process, the excel sheet will have the recognised faces marked as present and the remaining faces marked as absent. The list of absentees will then be mailed to the appropriate faculties. At the conclusion of each month, faculties will receive an update with their monthly attendance sheet.

VIII. SIGNIFICANCE

A. Time-Saving for the Workforce

I'll start with the most useful and substantial advantage: time savings. As the saying goes, "time savings equals money savings." This would seem to be accurate given that production at work can rise when time is saved. What does one of your employees do as soon as they arrive at work each morning? Mark their attendance, of course.

They see a queue of individuals waiting in line as they go to enter their attendance. Don't you think it will take up some of their precious time? They may have worked during that time.

If you employ a facial recognition attendance system, you can do away with this entire trouble and allow your workers to begin working right away.

B. Increased Efficiency and Capability

Daily attendance tracking is an essential procedure for any firm. Manual attendance management, however, can take a lot of time and is prone to human mistake.

Using facial recognition as an automated attendance-management system, precise time records are produced, minimising expensive errors. So that managers can provide precise productivity and payroll information, correct data is helpful. As a result, manual workload is reduced, and as time and energy are freed up for other crucial tasks, manual workers' capacity and efficiency are increased.

C. Cost Cutting and Saves Money

The facial recognition software on smartphones helps monitor the time and attendance. As a result, no extra technology is necessary to deploy a facial recognition attendance system, and hence no maintenance costs are incurred. This solution is both cost-effective and efficient when contrasted to other biometric solutions.

D. Enhances Workplace Security

People are most likely to be hesitant about going back to the office and school after working in their pajamas at home for a long time. However, by implementing a facial recognition attendance system, you can make them feel more protected and secure as they return to work following COVID. One advantage of facial recognition is that it can prevent unauthorized individuals from entering your office.

E. Improved Employee Wellness and Productivity

Because you are not placing your finger on the device when utilizing a facial recognition attendance system, you may just relax and allow the biometric or mobile camera to capture your face, thereby limiting the spread of infections or illness. Since a standard camera can be used, facial recognition attendance systems are less expensive than other touch-free systems. Face attendance systems are simpler to adopt than iris recognition which requires users to stand still and may cause discomfort.

F. Automated Time Tracking

Entry and exit monitoring can be totally automated with facial recognition attendance systems. The powerful analytics in the system can locate and recognize faces without the need for human interference or physical verification. Tracking field employees‟ work time is simple by using facial recognition.

G. Easy Integration with Other Systems

Payroll systems can be connected to facial recognition attendance systems to track field employee work hours and determine pay. Since these systems are adjustable and flexible, you may change the way timeframes and dates are organised to make them compatible with other systems in your business. Additionally, you may rapidly change the default time settings according to your geolocation, enabling you to use the programme anywhere in the world without any additional requirements. A GPS-based facial recognition attendance system can be used by businesses with numerous locations to track the attendance of their field personnel at all work sites.

H. Easy to Manage Records

Managing a person's daily activities, entry time, and exit time are tough. Managing the same thing for hundreds of people is even more difficult. Imagine if someone asked you about student's attendance details from the past month. It will take you some time to go back and forth to get those details. But not with automatic attendance management.

IX. ADVANTAGES AND DISADVANTAGES

A. Advantages

1) It saves time.
2) It provides high security.
3) It easily tracks time.
4) It works effortlessly without anyone's dependency.
5) It is easy to manage and it helps to retrieve the details of any student with just a few clicks.

B. Disadvantages

1) Huge storage requirements
2) Vulnerable detection
3) Potential privacy issues

X. APPLICATIONS

1) Large application in institute where multiple attendances are carried out for different classes. The attendance will be short timed and reduce manual errors.
2) Can be used in finance.
3) Can be used in retail.
4) Can be used in government and industry.
5) It is also used in Automatic teller machine, retail banking, airport check-in etc.

XI. RESULT AND DISCUSSION

Finally, we are coming to our result and discussion part where we are going to show our font- end application, the working way, and the attendance sheet with real-time present data. The following findings have been obtained for the application of face recognition –

A. Software Results

1) User Interface: In this user interface application, we will see every option for taking, teaching, and reviewing images. There are numerous input choices, including ID, Name, and Status. The new students must provide their ID number, name, and snap one photo during registration. 60 samples are included in the photographs so that the computer can specifically identify the human in each one. Additionally, this interface has an option to quit and an attendance section where you may see the students that are currently enrolled.

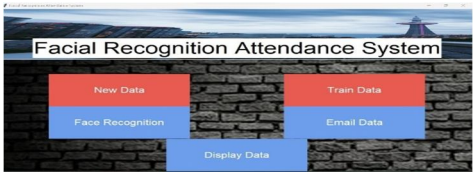

Fig 5: User Interface of Face Recognition System

2) *Face Detection:* Face detection means capturing or taking an image from the student. At the time of taking the image, this application will stop automatically taking 60 samples per label or student.

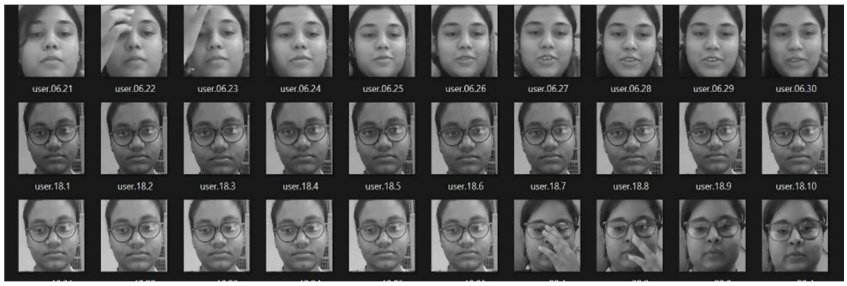

Fig 6: Face Detection

3) *Training Image:* With this choice, we can be training our set of 60 samples per student. Samples are placed in the master database allocated corresponding labels such as ID and Name.

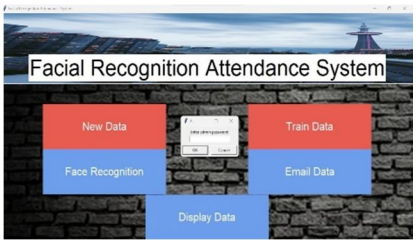

Fig 7: Training Data

4) *Face Recognition:* Face Recognition means testing the images. In the recognition stage, the system compares the capturing image with the archive image. If the system can identify the particular images with the storing image, then the faculty can see the ID number and Name of the particular student.


Fig 8: Face Recognition

5) *Attendance:* Upon completion of the Face Detection portion, the device will automatically mark the presence or absence in the attendance sheet. The attendance may be any file form, such as excel. We use the excel sheet in this report. The sheet contains the ID, name, year, and time of attendance.

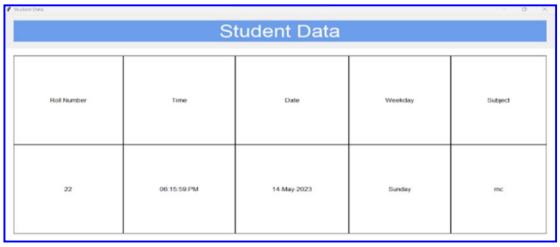

Fig 9: Student Attendance Data

B. Hardware Results

Fig 10: Hardware kit

In this project, we have used a GSM Module for sending message. We used 1 LED for power indication, and 1 Bluetooth for different function indications. We have interfaced 20*4 LCD which displays everything whenever the finger is placed or removed, or registering attendance or downloading data.

An optical fingerprint scanner works based on the principle of Total Internal Reflection (TIR). In an optical fingerprint scanner, a glass prism is used to facilitate TIR. Light from an LED (usually blue color) is allowed to enter through one face of the prism at a certain angle for the TIR to occur. The reflected light exits the prism through the other face where a lens and an image sensor (essentially camera) are placed.

When there isn't a finger on the prism, all of the light will be totally reflected off of it, leaving the image sensor with a simple image. The Evanescent Wave is a tiny amount of light that escapes during TIR and is present in the external medium. Different materials react differently to the evanescent wave depending on their refractive indices (RI). Only the ridges on a glass surface make good contact with it when we touch it. Air packets continue to keep the valleys isolated from the surface. Varied RIs in our skin and air cause them to have different effects on the evanescent field. Frustrated Total Internal Reflection is the name given to this phenomenon (FTIR). The image sensor notices this effect because it changes the intensities of the internally reflected light (see this image). The image sensor data is processed to produce a high contrast image which will be the digital version of the fingerprint. In capacitive sensors, which are more accurate and less bulky, there's no light involved. Instead, an array of capacitive sensors is arranged on the surface of the sensor and allowed to come in contact with the finger. The ridges and air packets affect the capacitive sensors differently. The data from the sensor array can be used to generate a digital image of the fingerprint.

XII. CONCLUSION

Before the development of this project. There were many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The main aim of this project is to capture the video of the students, convert it into frames, relate it with the database to ensure their presence or absence, mark attendance to the particular student to maintain the record. The Automated Classroom Attendance System helps in increasing the accuracy and speed ultimately achieve the high-precision real- time attendance to meet the need for automatic classroom evaluation.

XIII. FUTURE SCOPE

Facial recognition technology has a promising future. According to forecasters, this technology is anticipated to grow at an impressive rate and produce significant income in the years to come. The two most important areas that will be significantly impacted are security and surveillance.

Private businesses, public spaces, and educational institutions are some more places that are now embracing it. In order to prevent fraud in debit/credit card purchases and payments, particularly those made online, it is anticipated that shops and financial institutions will also embrace it in the upcoming years.

This technology would fill in the loopholes of largely prevalent inadequate password system. In the long run, robots using facial recognition technology may also come to foray. They can be helpful in completing the tasks that are impractical or difficult for human beings to complete.

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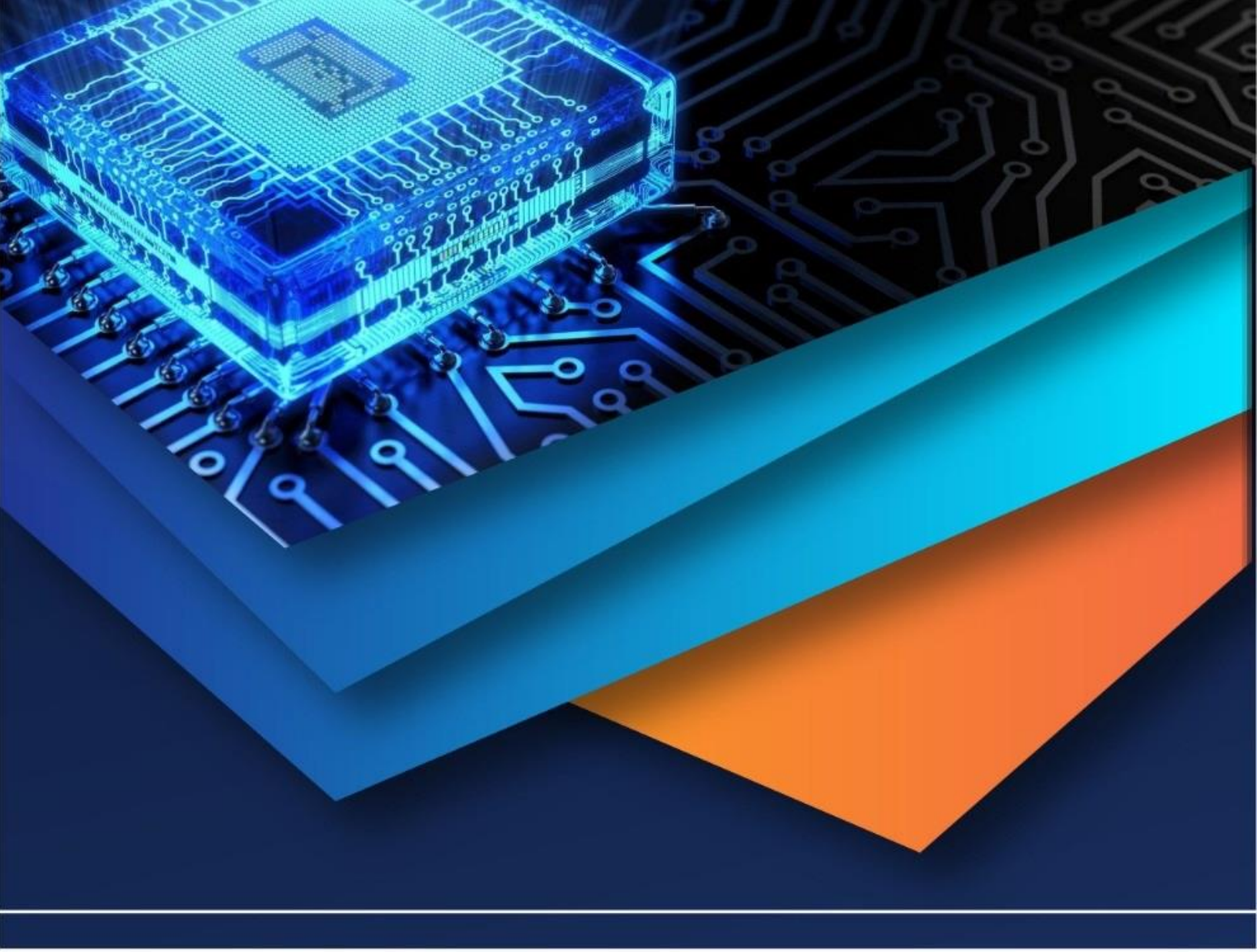

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