International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

An Intelligent Sensor based Automatic Attendance Management System Using IoT

Dr. A. Meenakshi[1], Ms. K. Leelarani[2], Ms. S. Shopika[3], Mr.M.Rajasekaran[4]
[1]Professor & HOD-CSE,
Kamaraj college of Engineering and Technology, Vellakulam
Tamilnadu, India
e-mail: meenakshicse@kamarajengg.edu.in
[2]Assistant Professor**,** Department of CSE,
Kamaraj College of Engineering and Technology, Vellakulam
Tamilnadu, India
e-mail: leelaranicse@kamarajengg.edu.in
[3]Assistant Professor**,** Department of CSE,
Kamaraj College of Engineering and Technology, Vellakulam
Tamilnadu, India
e-mail: shopikacse@kamarajengg.edu.in
[4]Assistant Professor**,** Department of CSE,
Kamaraj College of Engineering and Technology, Vellakulam
Tamilnadu, India
e-mail: rajasekarancse@kamarajengg.edu.in

Abstract—The need for intelligent and distributed monitoring systems based on sensor networks of diverse application systems is growing as a result of the field of industrial control in network applications developing so quickly. It is required to check the body temperatures and attendance when students and staffs visit schools and colleges during this COVID 19 pandemic. A solution is developed here for the purpose of tracking temperatures and attendance management using a smart thermometer without being in contact in order to keep social distance. The person (both staff and student) faces are captured by the ESP32 Camera for training and testing purposes. After the training is over, the ESP32 Micro Controller board registers the student or faculty facial image. For attendance purposes, the MLX90614 IR Temperature Sensor will measure the body temperature of students or instructors. Both the collected data and the email-based attendance notification will be transferred to the cloud using IoT. The message "Please leave the college and take care of your health" will be communicated to the person if their temperature exceeds the threshold level.

Keywords- Attendance Management; ESP32 Micro Controller; ESP32 camera, OLED Display; Arduino IDE; MLX90614 - IR sensor.

I. INTRODUCTION

The Internet of Things (IoT) is a network of physical items that have sensors, software, and other technologies built into them with the intention of connecting to and exchanging data with other systems and devices online. IoT has emerged as one of the most crucial 21st-century technologies [1]. Things like vehicles, thermostats, and kitchen equipment can all be interconnected with people. Seamless connection between people, processes, and things is possible with embedded devices. IoT bridges the physical and digital worlds. Machine-to-Machine (M2M) communication, also known as communication-IoT, promotes connectivity between devices [2]

Face recognition is a combination of computer technology and artificial intelligence [3]. It has emerged as the most difficult subject in this field as a result of its enormously difficult innovation and wide-ranging application possibilities. The smart attendance system often uses biometrics to operate. One of the biometric techniques to enhance this system is face recognition. Facial recognition, a key component of biometric authentication, is widely utilized in a variety of applications, including network security, video surveillance, CCTV footage systems, human-computer interface, and access control systems found indoors [4].

II. RELATED WORKS

Many number of research works related to attendance monitoring system using smart thermometer have been analyzed and some of them are taken here for reference. RFID is a fundamental component of the Internet of Things, and RFID devices are wireless microchips that are used to tag items for automatic identification. Create and build a smart attendance system with the aid of an RFID module and

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

microcontroller [5]. Issues like head posture and light intensity are handled using a variety of techniques such illumination invariant, Viola and Jones algorithm, and principle component analysis. The two main processes in this system are face detection and face recognition. Following this, the discovered faces can be compared by cross-referencing with the student face database. The attendance and records of pupils can be effectively maintained with this sophisticated system [6].

Researchers have proposed a variety of technologies, such as face recognition-based attendance systems, barcodes, and fingerprint identification, to replace the manual attendance procedure, which is indicated by the signature on a standard attendance sheet. Face detection and recognition technology in conjunction with RFID technology forms the basis of the classroom attendance system. It successfully achieved the identification confirmation of the class's students [7]. When the student inserts the card in front of the RFID card reader, the microcontroller from the 8051 family reads the data and compares it with the data stored inside. If the data matches, the LCD shows a message verifying that student's admittance; otherwise, it shows a message disputing the attendance. By tapping the state button connected to the microcontroller, the condition of a student's attendance can be obtained via this system [8].

The usage of a face recognizer library in combination with an effective and clever technique of recording attendance was suggested. Email notification of the absence of the absentee's employee or ward is sent to the absentee's manager or parents, as appropriate. This project's goal is to provide new features to already existing projects, such as massive data storage and quick processing, while using less expensive technology [9]. The Local Binary Pattern Histogram (LBPH) face recognizer is used by the system known as Intelligent Attendance System based on Face Recognition to identify the person's face in real time [10]. Since light has an impact on Eigen faces and Fisher faces, ideal lighting conditions in real life cannot be guaranteed. This method decides who is present and who is not by comparing the test image to the training image. The technology automatically updates an excel sheet that contains the attendance data.

A face-based smart attendance system was suggested to keep track of student attendance. The system begins taking pictures automatically as the time for a given subject approaches. Once a face detection and recognition technique has been applied to the provided image, students who have been identified are marked as present, and their attendance is updated with the appropriate time and subject ID. In order to identify students in photographs, the histogram of oriented gradient approach is applied to calculate and analyze the students' facial features [11]. A smart automatic contactless attendance system was developed that can also track the attendee's body temperature [12]. When an attendee's temperature is unusually high, the appropriate authorities are notified, and the employee is forbidden from entering their employment out of consideration for the safety of the other employees. Every attendee's information was tracked employing cloud monitoring and computing, which allowed for surveillance from any location with access to the internet.

A case study of an Internet of Things-based system for tracking student attendance at the University of Port Harcourt was examined. The hardware and web application make up the system. The fingerprint sensor authenticates students while they are in class and registers them during the course registration process. The system is connected to a webpage for file storage using the WiFi-enabled ESP32 microcontroller, which also uses thin film transistor liquid crystal display to display information [13]. A Smart Attendance System Using RFID and Face ID was suggested by embedding RFID tags in student ID cards and putting RFID receivers in the appropriate courses for the attendance process. This system would use microcontrollers like Arduino or the Raspberry Pi to detect that UID and check for an individual's data. The person's attendance will be recorded directly if they come to class with that ID card. Face ID is used for verification in order to prevent proxy attendance. Additionally, it produces an attendance report in Excel Sheets layout [14]. It was suggested to use automatic attendance marking based on face recognition [15]. The technology that is being used creates an excel sheet in addition to recording attendance. This technology also successfully recognizes faces coming from various angles. The face photos are first taken in HD 1080p, and after noise reduction, the facial features are detected using the HOG technique. This system uses the Dlib face recognition API, which has a 97.38% face detection and recognition prediction accuracy.

III. SYSTEM REQUIREMENTS

A. Hardware Requirements

ESP32 Controller: Grbl Arduino Firmware Supported by ESP32 CNC Controller Board Three stepper motor drivers and an ESP32 board are installed on a wireless CNC board. A breakout panel for NodeMCU 32S that also accepts three stepper motor drivers, the Grbl ESP32 CNC development board is made to run the Grbl open - sourced Arduino firmware to operate remote CNC machines.

ESP32 Camera: It is only need to insert it into a connector on the board because it already has all the components necessary to connect the camera to the ESP32. A micro SD card can also be used with this particular model. Additionally, the board comes with 4MB of external PSRAM and 512 KB of internal RAM. The board comes with an OV2640 camera model.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
Article Received: 12 October 2022 Revised: 14 November 2022 Accepted: 26 December 2022

MLX90614 - IR sensor: Melexis's MLX90614 is an infrared thermometer sensor for use in non-contact temperature readings. The IR Sensitive thermopile detector chip and the signal conditioning ASSP are both contained in the same TO39 package in the MLX90614 sensor module. It can continuously measure temperatures between -20° and 120° C.

OLED: An OLED is a type of electronic display module that generates a visual image using liquid crystal. A relatively basic module frequently used in DIY projects and circuits is the OLED display. OLED displays the translated result on two lines, each with 16 characters. Each character in this OLED is displayed in a 5 by 7 pixel matrix.

B. Software Requirements

Arduino IDE: It is simple to write code and upload it to the board using the free and open-source Arduino Software (IDE). It functions on Linux, Mac OS X, and Windows. The environment is created using Processing and other open-source technologies and is written in Java.

IV. System Modules

ESP32 Controller: Grbl Arduino Firmware Supported by ESP32 CNC Controller Board Three stepper motor drivers and an ESP32 board are installed on a wireless CNC board. A breakout board for NodeMCU 32S that also accepts three stepper motor drivers, the Grbl ESP32 CNC development board is made to run Grbl open-source Arduino firmware to control wireless CNC machines. The ESP32's serial port prints the data it has received for display.

Figure 1. ESP32 Controller

To send and receive data over WiFi using a mobile phone, an application is used. Many Wifi Serial Applications were tried for Android, but "Serial Wifi Terminal" was chosen in the end. The function "begin()" accepts the argument "name of the ESP32 Wifi Device". If it is left empty, the name ESP32, which is the default, is used. Initialize the standard serial transmission as well at 115200 baud rate. Figure 1 is shown for ESP32 controller.

ESP32 Camera: The ESP32-CAM Face Recognition System used in this suggested system doubles as an ESP32-CAM security system by identifying the faces of illegal people. The ESP32-CAM is a tiny camera module which is shown in figure 2 that uses an ESP32-S chip. A face recognition system can be constructed utilizing the ESP32-CAM module without the use of complicated programming or other parts.

Figure 2. ESP32 Camera

A very small OV2640 camera, an ESP32-S chip, and a micro SD card slot are all included with the AI-Thinker ESP32-CAM module. The micro SD card port can be used to store files or photographs captured by the camera. It is possible to use this ESP32-CAM module in many different IoT applications. In workplaces, educational institutions, and other private spaces, it can be employed as a face detection system.

MLX90614 IR Thermometer Sensor: Melexis's MLX90614 is an infrared thermometer sensor for use in non-contact temperature readings. The IR Sensitive thermopile detector chip and the signal conditioning ASSP are both contained in the same TO-39 package in the MLX90614 sensor module. It can continuously measure temperatures between -20° and 120° C. Mlx90614 function diagram. The principle behind how infrared thermometers function is known as black body radiation. Because of this, heated metal can emit a reddish or even white glow. These rays are picked up and measured by infrared thermometers.

The DS18b20 temperature sensor, for example, occasionally is unable to make contact with an object to measure the temperature. Due to its ability to measure two different types of temperatures, including ambient temperature and the temperature of an object at a distance, the contactless temperature sensor MLX90614 is employed in this application and it is given in figure 3.

Figure 3. MLX90614 IR Temperature Sensor

OLED Display: OLED modules are widely utilized in embedded systems due to their accessibility, low cost, and programmer friendliness. In our daily lives, the most of us

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

would have encountered these displays, either at PCOs or calculators. Now that the appearance and pinouts have been visualized, let's go a little more technical. This IC's job is to process the commands and data from the MCU in order to display relevant data on OLED Screen or display that is shown in figure 4 for the reference. By developing a custom library, the microcontroller may connect to an OLED module using an HD44780 IC

Figure 4. OLED Display

Data Transfer to Cloud and Mail: The body temperature will be detected by an IR sensor if the student or faculty member's face is identified, and the data will be saved in a Google sheet with the appropriate timestamp. Both the collected data and the email-based attendance notification will be transferred to the cloud. The message "Please leave the college and take good care of your health" will be communicated to the student if their temperature exceeds the threshold level.

V. IIAAMS - System Design and Implementation

The ESP32 Controller, Camera, OLED Display, and IR Temperature Sensor make up the proposed system. The ESP32 camera is used to find and identify faces, while the IR temperature sensor is used to measure body temperature. A specific person's body temperature is shown on an OLED display. Finally, data will be uploaded to the cloud and body temperature and attendance will be sent by SMS. The system architecture of the IIAAMS scheme is shown in figure 5.

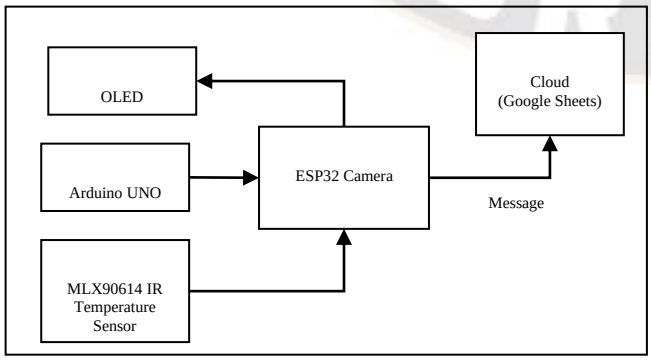

Figure 5. IIAAMS - System Architecture

The proposed IIAAMS model begins with the installation of temperature sensors to collect real-time temperature data that is matched to estimates of the surrounding environment's temperature. This technology was developed without a start button to enable wireless temperature control. The average body temperature is between 36.5 and 37.5 degrees Celsius. The varied body temperature measurements depend on a variety of factors, including age, level of effort, and the location on the body where the measurement was taken. The system will proceed to the next step of detecting and recognizing the face to significantly higher incidence if indeed the person in front of the prototype solution has a typical body temperature. The system locks the entry point and sends a message to the server with the magnitude of the observed temperature and the location where it was taken if the person's body temperature is greater than normal.

For attendance purposes, the MLX90614 IR Temperature Sensor will measure the body temperature of students or staffs. The body temperature will be detected by an IR sensor if the student or faculty member's face is identified, and the data will be saved in a Google sheet with the appropriate timestamp. Both the collected data and the email-based attendance notification will be transferred to the cloud. The message "Please leave the college and take care of your health" will be communicated to the person if their temperature exceeds the threshold level. According to the research, the system should automatically record attendance that has been verified by ongoing observation. The performance of attendance can be forecasted and improved by constant observation. The technology keeps track of attendees and temperature by capturing images of students' faces and measuring their body temperatures.

The workflow of the proposed methodology is described in figure 6, which ensures the efficient implementation. Thus, it improves the level of prediction in a more efficient way and it helps in detecting the problem beforehand itself. Figure 7 depicts use-case diagram for Smart Thermometer with Attendance Monitoring System.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

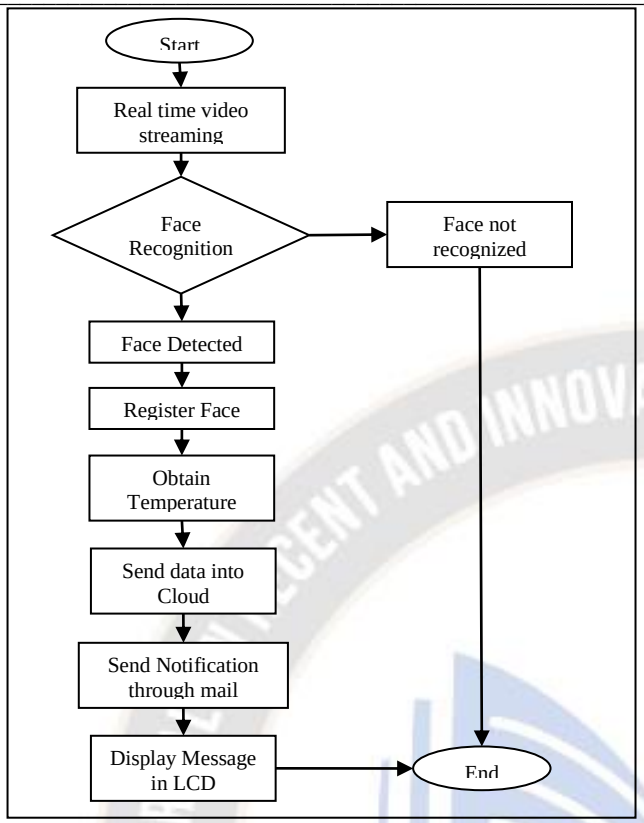

Figure 6. Workflow of IIAAMS Method

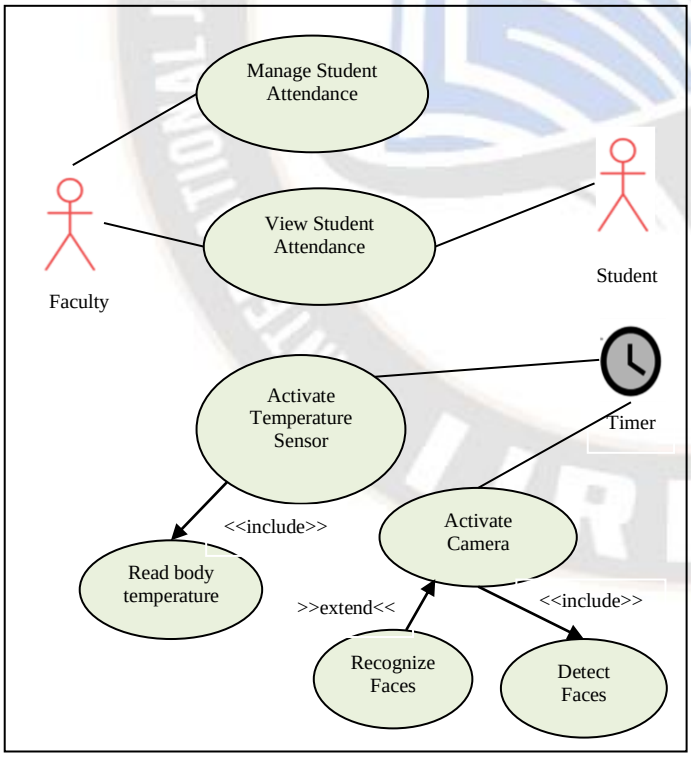

Figure 7. Use case Diagram of IIAAMS

VI. Results and Discussion

The system is implemented by (i) integrating Arduino UNO with EPS32 (ii) integrating MLX90614 with EPS32 and (iii) integrating OLED display with EPS32. The implemented system is able to detect the threshold values of the sensors and alert the end user with a notification message. Figure 8 shows the system implementation of the proposed IIAAMS methodology.

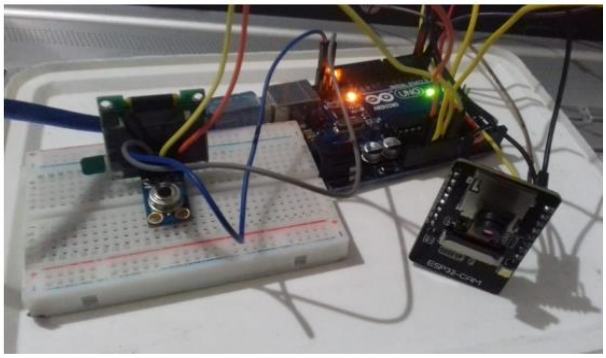

Figure 8. System Implementation

Temperature and face recognition should be checked frequently. Once a face is spotted, specific data is uploaded to the cloud and sent to certain students and staff. Data gathered from sensors is updated in the cloud, and staff and students are notified. Periodic reports from the sensors can be logged, allowing for the early detection of problems.

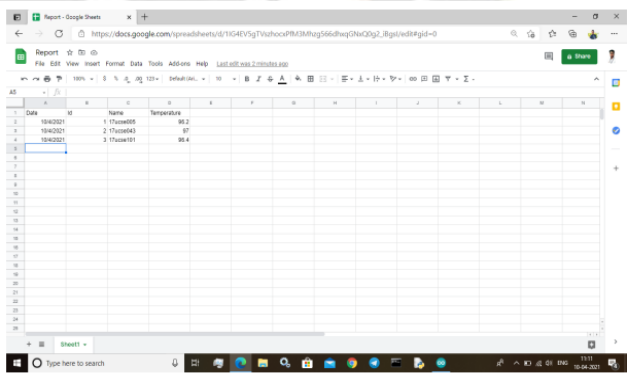

Figure 9. Data uploaded in Google Sheets

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

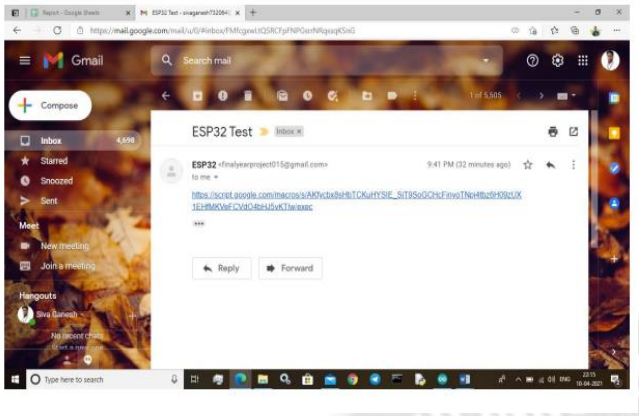

Figure 10. Attendance Notification sent through Email

Figure 9 describes the screenshots of data uploading in Google sheets. Figure 10 indicates the data transferred to the Mail by assisting cloud. Through the mail "Please leave the college and take good care of your health" will be communicated to the student if only their detected temperature exceeds the threshold level.

The Face Recognition Attendance System (FRAS) [16] multi-person video can characterize the video images of the presence students by choosing face recognition and detection. The suggested IIAAMS approach significantly increases efficiency when compared to the current FRAS and eliminates early exit and class skipping. Figure 11 illustrates the accuracy analysis of repeated testing for systems including FARS and IIAAMS using various test sample counts.

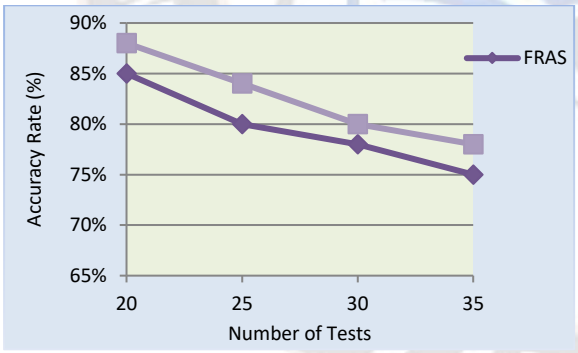

Figure 11. Accuracy Analysis

VII. Conclusion

An improved IoT based smart thermometer with attendance monitoring system is proposed here. The system's needs and operating principles are explained in detail. To routinely verify the data, this system uses a variety of sensors, including a temperature sensor, an ESP32 controller, and an Arduino UNO. Body temperature is detected by a temperature sensor, and a mobile device is alerted by email or SMS. Every time the sensors' threshold value changes, an Alert signal is sent to the specific students. By putting this strategy in place, the downtime for repairs can be minimized, which boosts productivity. Current project is particularly helpful in this pandemic condition on college campuses and in the industrial sector. Periodic machine reports can be noted, allowing for the early detection of problems when they arise. A prediction algorithm could be added to this system in the future so that the user can identify patterns whenever a machine is about to malfunction. This method can reduce the amount of time needed.

References

[1] M. Bansal, M and S. Garg, S, "Internet of Things (IoT) based assistive devices," In IEEE 6th International Conference on Inventive Computation Technologies (ICICT), 2021, January, pp. 1006-1009.

[2] F.N.S Fikri and S. Widyarto, "Software engineering professional case study of advantage internet of thing in business industry," In Proceedings of the Informatics Conference, Mar. 2017, Vol. 2, No. 3.

[3] A. Elmahmudi and H. Ugail, "Deep face recognition using imperfect facial data," Future Generation Computer Systems, 2019, Vol. 99, pp. 213-225.

[4] S. Sawhney, K. Kacker, S. Jain, S.N. Singh and R. Garg, "Real-time smart attendance system using face recognition techniques," In IEEE 9th international conference on cloud computing, data science & engineering (Confluence), Jan. 2019, pp. 522-525.

[5] M. Sutar, M. Patil, and S. Waghmare, "Smart attendance system using RFID in IoT," International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2016, vol. 5, no. 4, pp. 1155-1159.

[6] P. Wagh, R. Thakare, J. Chaudhari, and S. "Patil Attendance system based on face recognition using eigen face and PCA algorithms," In IEEE International Conference on Green Computing and Internet of Things (ICGCIoT), Oct. 2015, pp. 303-308).

[7] F. R. Basthomi, K. Nasikhin, R. A. Saadah, D. D. Prasetyo, M. Syaiin, N. Rinanto and A. A. Soeprijanto, "Implementation of RFID attendance system with face detection using validation viola-jones and local binary pattern histogram method," In IEEE International Symposium on Electronics and Smart Devices (ISESD), Oct. 2019, pp. 1-6.

[8] W. Zeng, Q. Meng and R. Li, "Design of intelligent classroom attendance system based on face recognition," In IEEE 3rd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC), Mar. 2019, pp. 611-615.

[9] A. A. Raj, M. Shoheb, K. Arvind and K. S. Chethan, "Face recognition based smart attendance system," In International Conference on Intelligent Engineering and Management (ICIEM), Jun. 2020, pp. 354-357.

[10] A. Anand, V. Jha and L. Sharma "An improved local binary patterns histograms techniques for face recognition for real time application," International Journal of Recent

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 2s
DOI: https://doi.org/10.17762/ijritcc.v10i2s.5909
***Article Received**: 12 October 2022 **Revised**: 14 November 2022 **Accepted**: 26 December 2022*

Technology and Engineering, 2019, vol. 8, no. 27, pp. 524-529.

[11] K. Bhatti, L. Mughal, F. Khuhawar and S. Memon, "Smart attendance management system using face recognition," EAI Endorsed Transactions on Creative Technologies, 2018, vol. 5, no. 17.

[12] D. Patra, A. Agrawal, A. Srivastav and J. Kathirvelan, "Contactless Attendance cum Temperature Detection System with Real-time Alerts," In 2021 Innovations in Power and Advanced Computing Technologies (i-PACT), Nov. 2021, pp. 1-6.

[13] E. C. Joseph and G. O. Moses, "Development of an IoT-based Students' Attendance Monitoring System," International Journal of Engineering Research and Technology (IJRET), 2019, vol. 8, no.12, pp. 653-658.

[14] A. Rashmi, S. Brindha, S. B. Srinithin and A. Gnanasudharsan, "Smart Attendance System Using RFID and Face ID," International Conference on Communication, Computing and Internet of Things (IC3IoT), Mar. 2022, pp. 1-5.

[15] H. Sultan, M. H. Zafar, S. Anwer, A. Waris, H. Ijaz and M. Sarwar, "Real time face recognition based attendance system for university classroom," 2nd International Conference on Artificial Intelligence (ICAI), Mar. 2022, pp. 165-168.

[16] H. Yang and X. Han, "Face recognition attendance system based on real-time video processing," IEEE Access, vol.8, pp. 159143-159150.