International Journal of Future Generation Communication and Networking
Vol. 13, No. 2, 2020 pp.1562-1573

Automated Attendance Tracking System using Firebase Real-Time Database

M. Julie Therese[1]
Assistant Professor, Department of ECE, Sri Manakula Vinayagar Engineering College, Puducherry
A.Dharaneeswari[2]
Department of ECE, Sri Manakula Vinayagar Engineering College, Puducherry
M.Kanishma[3]
Department of ECE, Sri Manakula Vinayagar Engineering College, Puducherry
N.Keerthana[4]
Department of ECE, Sri Manakula Vinayagar Engineering College, Puducherry

Abstract

In school and college student's attendance plays a vital role, there are cases reported that children are missing when they travel to and from school or college. According to Home ministry around 1 lakh children go missing, that has become a matter of critical importance. With an intention to keep students safe while fulfilling their basic rights to education, a design has been proposed that automatically updates the attendance of a student in the database and simultaneously sends information to the parent, class advisor and Head of the Department. This method has been designed to be implemented specifically in college, the approach of taking the attendance on daily and hourly basis is a reason for students to behave disciplined. Sometimes the traditional practice of taking attendance seems to be complicated and there are ways where a student can dodge and if taken physically it leads to more time consumption and can be prone to human errors. Hence several automated techniques were devised like fingerprint, Radio Frequency Identification (RFID), Iris recognition etc. these techniques have their own shortcomings, here a framework called Automated Attendance Tracker using Firebase Real-time Database is proposed. This effort defines an efficient object detection algorithm i.e. Haar Cascade algorithm that automatically identifies the student and updates the server through Representational State Transfer Application Program Interface (REST API) without much human effort. The attendance is taken by placing a web camera inside the classroom that endlessly captures the images of the student, identifies the faces in image and updates the attendance. The updated attendance is sent to the parent and class advisor through Short Message Service (SMS) and via Electronic-mail to the Head of the Department (HOD) and Administration wing. This highly improves the efficiency of system and is found to be less time consuming.

Keywords— *Automated Attendance Tracker, Firebase Real-time Database, Haar Cascade Algorithm, REST API*

I. INTRODUCTION

Studies show that a significant amount of time is spent on taking attendance in the classroom, it is found that nearly 15% of the total time in one hour lecture is consumed for taking attendance manually. To make the productive use of time inside the classroom, automated attendance tracking systems were proposed. These systems includes Radio Frequency Identification (RFID) based Attendance Monitoring System, Fingerprint based Attendance System, Android Mobile Based Attendance System, Face Recognition based Attendance System etc. Initially the automated attendance tracking system had a hardware that has to be coded and a distant server that has to work together for acquiring data and processing it electronically. The standard way of taking attendance in school or college is by calling the names of the student by the teacher, students responding on their roll numbers and marking 'A' or 'P' on logbook subsequently. This technique looks better and cheaper. The biggest drawback in using the standard technique is, taking attendance is tedious, writing or marking the information and then calculating the percentage of attendance, sorting, transferring it onto a personal computer for additional backup etc. are complex and can be prone to errors. The system becomes ineffective when there are large number of students in a class. Hence moving to a software based automated attendance system not only eliminates manual errors and makes the task simple, it ensures that the students uphold discipline by following the mandatory rules of the college and thereby uplift the quality of education in the institution.

II. LITERATURE REVIEW

In this section some of the related work described for motivation to do the work to be carried out.

ISSN: 2233-7857 IJFGCN

Hidayat, Muhammad Ayat, *et al.* [1] For students, attendance is a basic requirement. The participation of a student cannot be accessed by the faculty in the absence of the attendance process. Generally, manual attendance is taken using paper and later signed by the students. This process leads to various complications such as excessive usage of paper and challenging for the administration to summarize the results of the student attendance. Hence, attendance system is essential to gather data rapidly, precisely, and efficiently. In this paper, it is done by collecting data, analyzing, designing, and implementing the system. This system is formed by using Java Android programming languages, Ibeacon for identifying the classroom and PHP. The key purpose of this study is to schedule warnings based on IBEACON which makes the attendance process more efficient and can simply be examined by the faculty and the administration.

Othman, Mahfudzah, *et al.* [2] In academic institutions student's attendance record are one of the important documents which replicate on the reliability of institutions and student's performance. However, the managing process of these documents had been done using pen and papers by making it less efficient. This paper deliberates about the growth of new online attendance system and its architecture is based on the web. The online attendance is made cost-effective by integrating various web-based technologies such as Apache Web Server, PHP, and MySQL. This system involves 4 key phases used in the construction of the framework. It is an automated process to generate warning reports and an online attendance report. Therefore, the system is well organized by the process of reporting and recording the attendance of a student.

Singh, Manjot, *et al.* [3] In today's era irrespective of the field of education or defining both qualitative and quantitative data, gathering of data is necessary for sustaining the reliability of research. The probabilities of error taking place can be reduced by data acquisition. In this paper, the proposed framework has small accessible hardware, a remote sensor, and software constituents for acquisition. It can be implemented in schools, colleges, industries, and hospitals. This system is used for taking attendance in colleges and schools making it modest and well-organized. The educational organizations are the main users where there is a prerequisite of user-friendly, energy-efficient, portable, and protected automated system. Therefore, the prototype delivers an integrated solution with an embedded attendance system. The advantages are small size and low power consumption.

Shah, Soumil Nitin, *et al.* [4] This paper presents a new model of observing student attendance using Radio Frequency Identification (RFID) with the Internet of Things (IoT). Many schools and colleges are almost worried about student unbalanced attendance. Student's overall performance can be exaggerated due to truancy. The outdated method of taking attendance by signing on paper or by calling names is very time overwhelming. The top solution to handle these difficulties is RFID based attendance system using the Internet of Things.

Sawhney, Shreyak, *et al.* [5] For teachers, attendance management is a crucial task done manually. In order to overcome these complications smart attendance management system is implemented. Additionally, authentication is a significant issue in this system. This process is executed by using biometric method. To improve this method facial recognition is used. It is a major feature for verification and used in various applications such as CCTV system, human to machine interaction and grid security. By this proposed model. The issue of marking present even in the absence of student can be avoided. It implements automated attendance tracking of students using Principle Component Analysis (PCA), Eigen face values and Convolution Neural Network.

Kamelia, Lia, *et al.* [6] The fingerprint attendance system will decrease the problem triggered manually such as lagging in data management system. The main purpose of the system is to develop a real time module that combines GPS and fingerprint module. The ZFM-20 is used as an input as well as tool to provide security. GPS is used to track the location and sends it to the mobile phone. Arduino sends a text message to the user about the location data automatically. The report can be accessed using Short Message Service (SMS) and via application.

ISSN: 2233-7857 IJFGCN

Akbar, Md Sajid, *et al.* [7] In order to eradicate the chance of fraudulent in manual attendance system a framework is proposed based on RFID. In this model face recognition is merged with Radio Frequency Identification (RFID) to identify the official student and counts the presence and absence in the classroom. This system retains the data of each student registered and provide essential data. By using this model the limitations of the existing system can be destroyed.

Noor, Siti Aisah Mohd, *et al.* [8] addresses that the ordinary approach of taking the student's attendance is a greater reason for students to behave undisciplined. Students take advantage of the traditional practice of attendance by improving their cheating behavior. Hence in this paper, a reliable method of taking attendance digitally using an app from the lecturer's own android hardware device has been introduced. The device scans the student's ID card for the barcode and updates to the PC database where it matches with the student's list. This paper proves to reduce the time consumption and to be economical enough by reducing the hardware and paper cost.

Utomo, Subroto Budhi, et al. [9] disserts that even though the trend of the employees to bring their own hardware device to record attendance is assumed to be non-fraudulent, the attendance system itself lacks security which makes the employee cheat during the work. Thus in this paper, multiple security factors have been introduced which helps in detecting the employer's fake location using GPS and also tests the attendance using a fingerprint and an ID. This eventually protects the attendance system and prevents employees to commit fraud.

Johar, R., et al. [10] This paper uses the IoT with an event-driven system to see how efficient it is at a definite moment. It is based on keeping the low power motion sensor working and the other parts of the system in the standby mode. This project is based on a raspberry pi 3 board with two sensors and webcams and works in such a way that the embedded processor is alarmed after the detection of every person moving and this in return stimulates the webcam and communication block. The authorities were notified through email after the attendance status is updated on the cloud log. This paper shows an improved system performance and power consumption due to the event-driven feature.

III. PROPOSED WORK

A. Haar Cascade Algorithm

Haar Cascade algorithm is used for object detection and is a machine learning algorithm. With this algorithm one can identify objects in videos or images. This algorithm is operating in four stages as shown in Fig.1. Haar feature selection selects features in the face like eyes, eyebrows, nose, mouth etc. The feature selection is done based on Edge features, Line features, Four rectangle features. It differentiates the brighter part and darker part of our face as white color and black color. The output of this stage is given to the next part, creating integral images, this stage performs summation of intensities of pixels and shows certain specific regions (features) of the image.

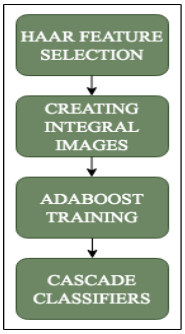

Fig. 1.1 Haar cascade algorithm stages

Yet for more accurate manipulation, the output of the second stage is given to Adaboost training. This stage is a classification stage, wherein a group of poorly performing classifiers are used iteratively to bring

ISSN: 2233-7857 IJFGCN

about high and accurate results. Finally, the last stage is Cascade classifiers, which is already trained with the positive and negative pixels of the region of interest in an image that facilitates to take a decision if the image can be passed or rejected.

B. Introduction to REST API

Generally, a client requests a server for a required information and the server responds to the client. Normally the response sent by a server to a client is an HTML webpage. But in real-time receiving a HTML webpage for a request generated is annoying, as the required information is only data and that too data in a structured format. Structured data can be in the form of XML format or JASON format.
In Representational State Transfer (REST), a client will send a request to a server, at this juncture the RESTAPI creates an object for the data, searches for the data requested, on finding the data it responds to the client with the values (state) of that particular object. Since the state of the object is transferred to the client, it is called as Representational State Transfer. Hence REST API is an approach for communication between a client and a server, for web services application.
Features of REST API

- It is more simpler than SOAP API
- It has proper documentation that is easy to understand for developing user defined applications
- It provides proper error messages that facilitates easy debugging

Resources are the data a client is requesting for, to create a resource, read it, update it and delete it, HTTP methods can be used as shown in the Fig.1.2. REST API does communication via HTTP methods.

Fig.1.2 HTTP methods of REST API

C. Introduction to Firebase Real-Time Database

Firebase Real-time Database allows to store and synchronize data between users in real time. When data is put on a Firebase Real-time Database it stores the data on cloud and notifies all the connected devices simultaneously. This data base is optimized for offline use, when a user loses internet, the database uses a local cache on the device to serve and store changes, when the user next comes online the local data synchronizes automatically. In order to keep data secured in Firebase Real-time database, database security rules are used. Since the Firebase Real-time data base is hosted in cloud, there is no requirement for server maintenance or operations.

D. Flow Diagram of the Proposed System

A web camera is in ON condition and is placed inside the classroom. This will detect the face of the student and checks whether the student is authorized or not. If the student is authorized, further process is initiated, using facial recognition technique (Haar Cascade algorithm) the student present is sent to the Firebase Real- time database where manipulation is carried out and the absentees of the day are identified. The attendance status is updated and stored in the database. This list will be sent to the Head of the Department and Administration wing through e-mail. The absentees list is sent to the class advisor and the absentee's parents are notified via SMS. If the student is unauthorized further process is declined. The entire process is shown in Fig.1.3.

ISSN: 2233-7857 IJFGCN

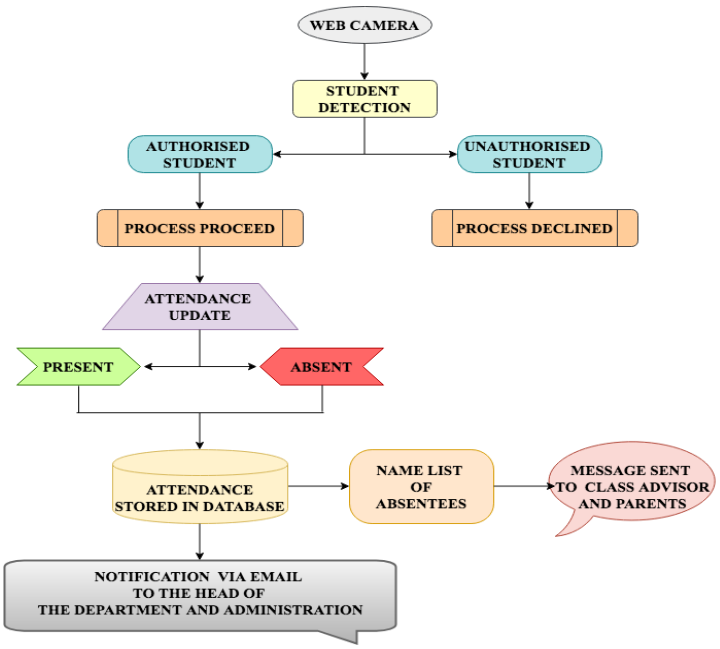

Fig. 1.3 Flowchart of Proposed Model

E. Process Involved in Framework

As shown in the Fig.1.4. the web camera captures the face of the student and the images are stored in the dataset. Previously, a set of photos are trained and stored in .jpg format by using Haar Cascade algorithm, the images in the dataset are compared with the trained photos. If it matches the student is present. The updated attendance is transferred to Firebase Real-time database through REST API by using POST or PUT method. The data stored in the database is in the form of Java Script Object Notation (JSON) tree format. Now, both present and absent list of the students are sent to server through REST API PUT method. The server reads it using PUT and GET method, the process continues by sending an email to the HOD and Administration wing via Simple Mail Transfer Protocol (SMTP), the absentee list is sent to the class advisor through SMS and further a notification is sent to the absentee's parents through FAST2SMS via SMS.

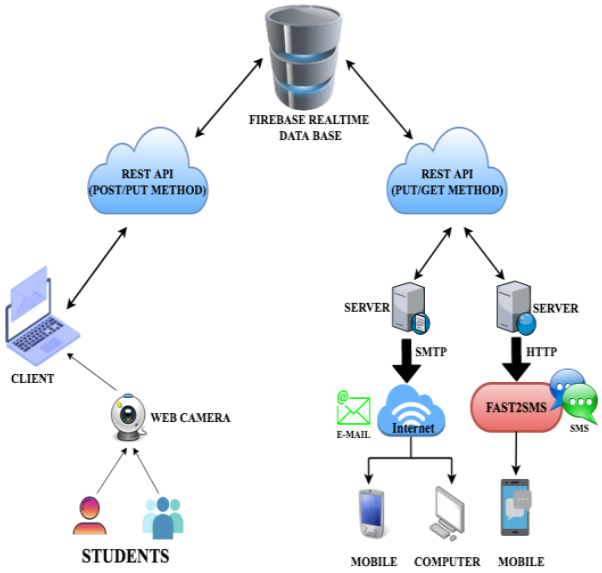

Fig.1.4 Working of Proposed Model

ISSN: 2233-7857 IJFGCN

IV. RESULTS AND DISCUSSION

STEP 1: The web camera captures the face of the student. It captures the face of both individual and group of students. Fig. Step 1(a) shows the face of the student and Step 1(b) shows the code behind the
process
STEP 2: By using Haar Cascade Algorithm, 100 photos are captured spontaneously and stored in dataset
***STEP 3*:** Using Haar Cascade Algorithm the training python code is shown and this is executed
STEP 4: Previously trained photos are stored in separate folder in the form of .jpg
STEP 5: The photos stored in the dataset is compared with the photos stored in the .jpg file by executing the entrance python code
***STEP 6*:** After execution process, the face of the student is detected and the output obtained is shown
STEP 7: Now the attendance is updated and stored in Firebase Real-time Database in the form of JSON tree
STEP 8: The output of the e-mail sent to the Head of the Department (HOD) and administration wing
STEP 9: Similarly, the absentees list is collected from the cloud database (Firebase Real-time Database) and sent to the class advisor via SMS
STEP 10: Likewise, the SMS is sent to the parent of the absentee
STEP 11: The output of the attendance percentage is calculated for a particular student by executing the percentage code that can be retrieved by the class advisor
STEP 12: The photos stored in the dataset is compared with the photos stored in the .jpg file by executing the exit python code

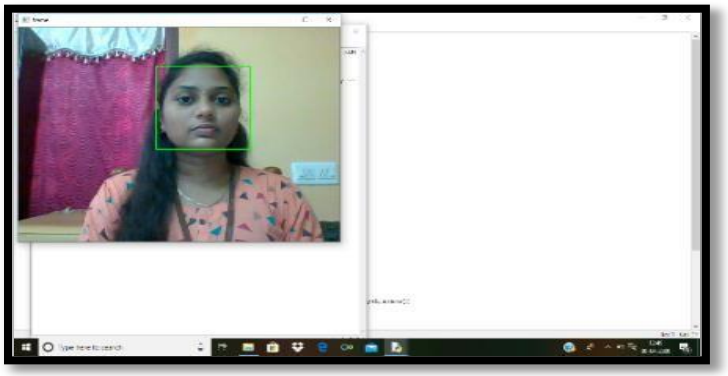

Fig.1.5 Step 1(a)

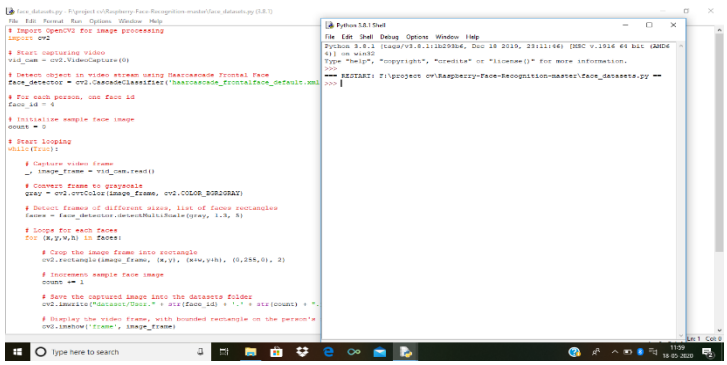

Fig.1.6 Step 1(b)

ISSN: 2233-7857 IJFGCN

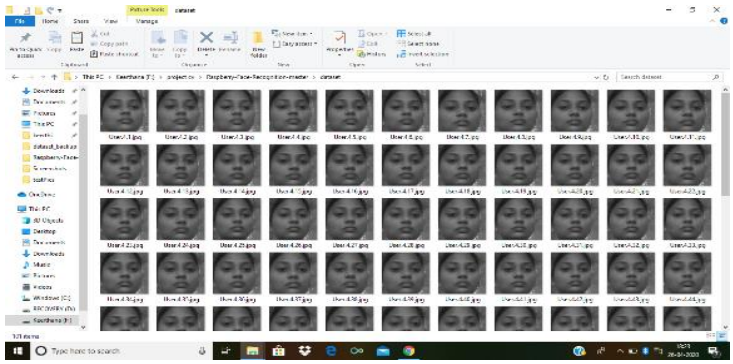

Fig.1.7 Step 2

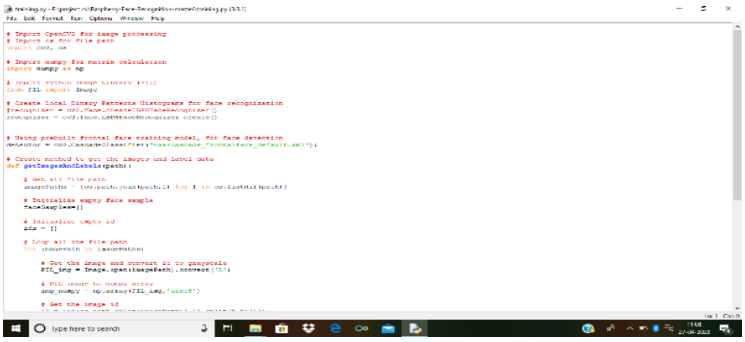

Fig.1.8 Step 3

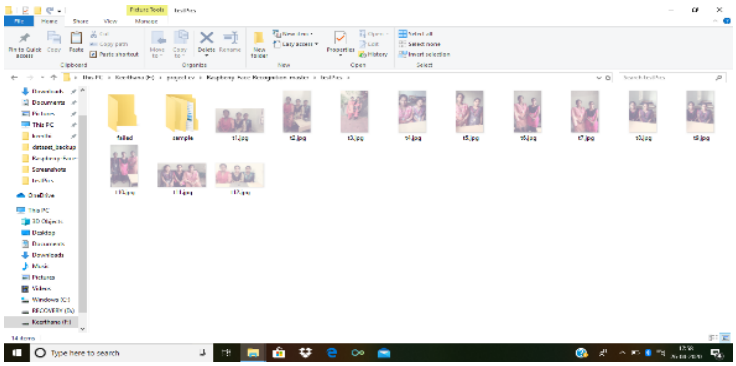

Fig.1.9 Step 4

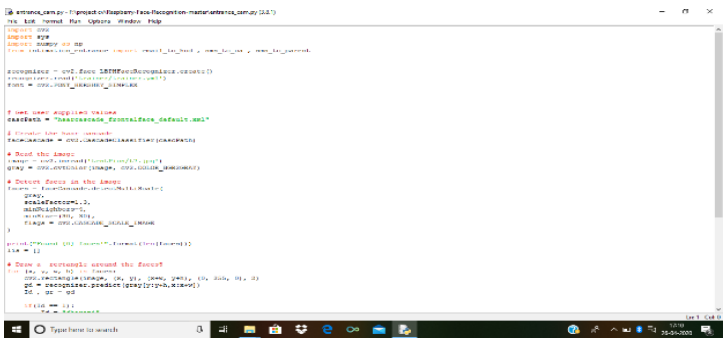

Fig.1.10 Step 5

ISSN: 2233-7857 IJFGCN

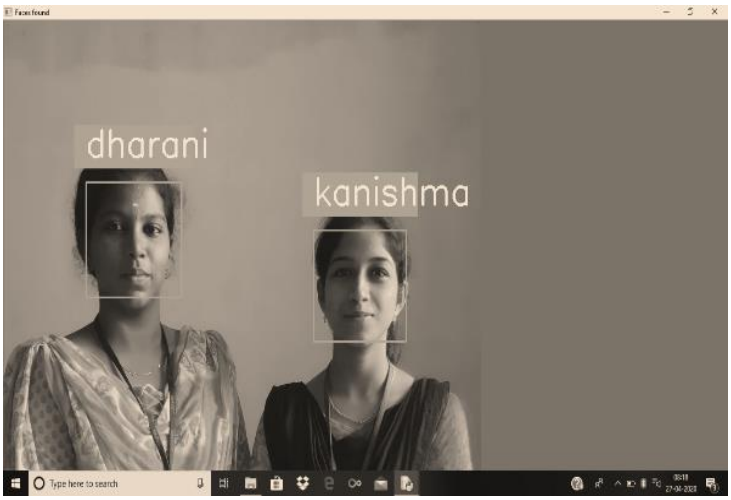

Fig.1.11 Step 6

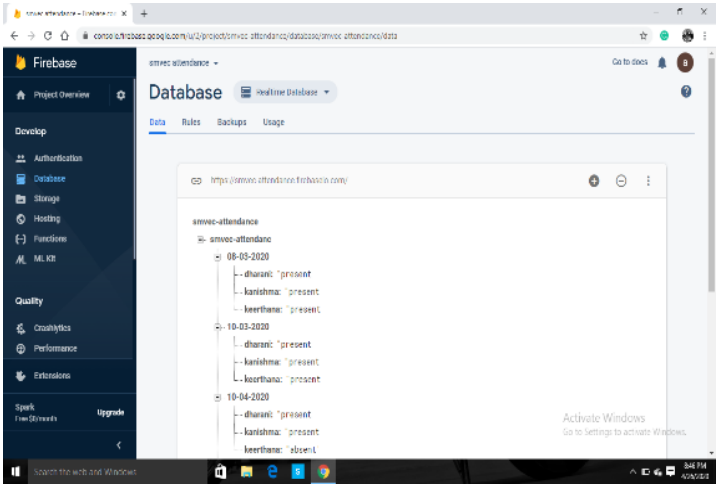

Fig.1.12 Step 7

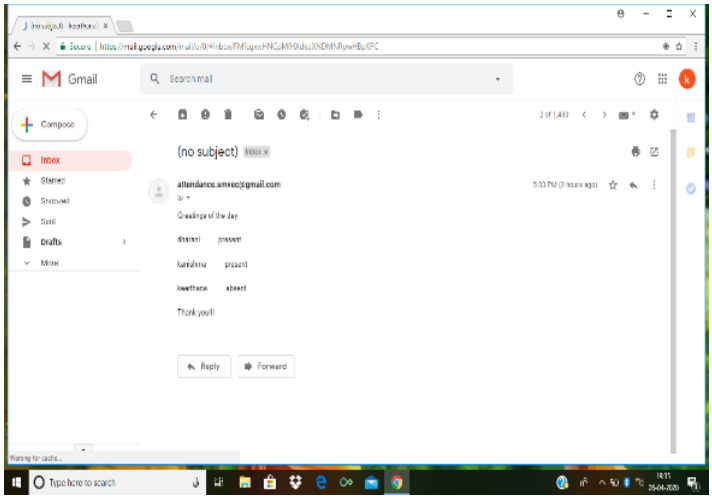

Fig.1.13 Step 8

ISSN: 2233-7857 IJFGCN

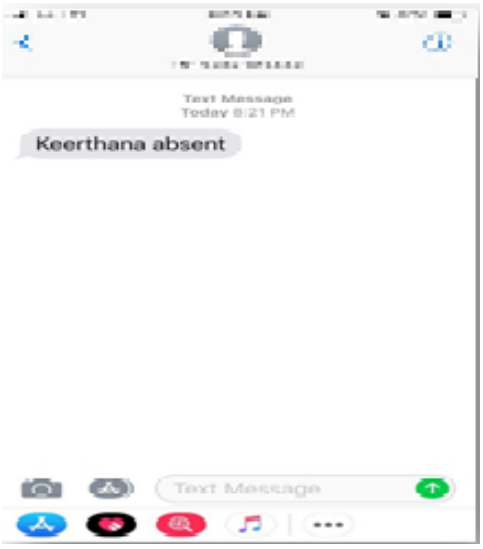

Fig.1.14 Step 9

Fig.1.15 Step 10

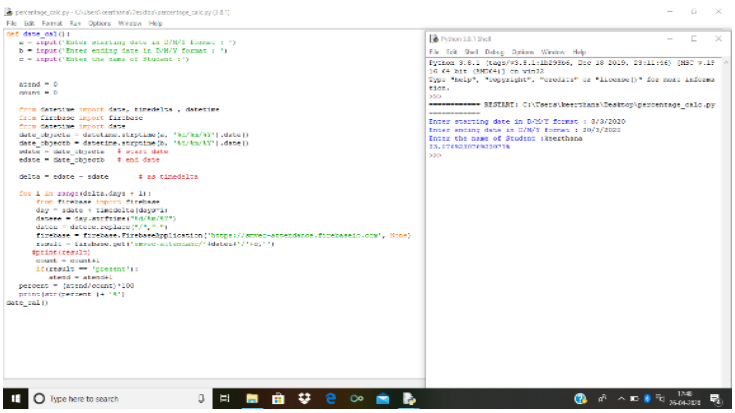

Fig.1.16 Step 11

ISSN: 2233-7857 IJFGCN

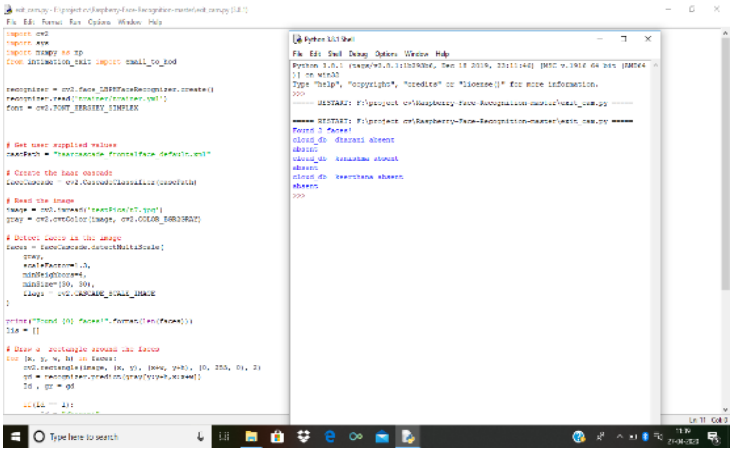

Fig.1.17 Step 12

V. CONCLUSION AND FUTURE SCOPE

The proposed attendance tracking system will serve as a useful approach to automate the attendance recording, it provides more accuracy and less prone to human error, works fast and is always synchronized to its connected devices. This seems to be an effective methodology when compared to conventional method and the other automated systems. As a future enhancement, live classes taken by the professor can be recorded and sent automatically to the absentees of the particular day.

REFERENCES

[1] M.Julie Therese, K. Reshma, R. Keerthana @ Rakshendra, K.Priyatharshiny, “Multilevel Secured Locker System Using IOT”, International Journal of Advanced Research in Innovative Discoveries in Engineering and Applications (IJARIDEA), Vol. 5, Issue 1, pg.1-7, 2020

[2] Hidayat, Muhammad Ayat, and Holong Marisi Simalango. "Students Attendance System and Notification of College Subject Schedule Based on Classroom Using IBeacon." 2018 3rd International Conference on Information Technology, Information System and Electrical Engineering (ICITISEE). IEEE, 2018.

[3] Singh, M., Khan, M. A., Singh, V., Patil, A., & Wadar, S. (2015, February). Attendance management system. In 2015 2nd International Conference on Electronics and Communication Systems (ICECS) (pp. 418-422). IEEE.

[4] Shah, Soumil Nitin, and Abdelshakour Abuzneid. "IoT Based Smart Attendance System (SAS) Using RFID." 2019 IEEE Long Island Systems, Applications and Technology Conference (LISAT). IEEE, 2019.

[5] Sawhney, S., Kacker, K., Jain, S., Singh, S. N., & Garg, R. (2019, January). Real-Time Smart Attendance System using Face Recognition Techniques. In 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence) (pp. 522-525). IEEE.

[6] Kamelia, L., Hamidi, E. A. D., Darmalaksana, W., & Nugraha, A. (2018, July). Real-Time Online Attendance System Based on Fingerprint and GPS in the Smartphone. In 2018 4th International Conference on Wireless and Telematics (ICWT) (pp. 1-4). IEEE.

[7] Akbar, M. S., Sarker, P., Mansoor, A. T., Al Ashray, A. M., & Uddin, J. (2018, August). Face Recognition and RFID Verified Attendance System. In 2018 International Conference on Computing, Electronics & Communications Engineering (iCCECE) (pp. 168-172). IEEE.

[8] Noor, S. A. M., Zaini, N., Latip, M. F. A., & Hamzah, N. (2015, December). Android-based attendance

ISSN: 2233-7857 IJFGCN

management system. In 2015 IEEE Conference on Systems, Process and Control (ICSPC) (pp. 118-122). IEEE.

[9] Utomo, S. B., & Hendradjaya, B. (2018, October). Multifactor Authentication on Mobile Secure Attendance System. In 2018 International Conference on ICT for Smart Society (ICISS) (pp. 1-5). IEEE.

[10] Johar, R., Qaisar, S. M., Subasi, A., & Kurdi, R. F. (2018, July). A Raspberry Pi Based Event Driven Quasi Real Time Attendance Tracker. In 2018 IEEE 3rd International Conference on Signal and Image Processing (ICSIP) (pp. 418-422). IEEE.

[11] Raj, R., Das, A., & Gupta, S. C. (2019, January). Proposal of an Efficient Approach to Attendance Monitoring System using Bluetooth. In 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence) (pp. 611-614). IEEE.

[12] Shukla, V. K., & Bhandari, N. (2019, February). Conceptual Framework for Enhancing Payroll Management and Attendance Monitoring System through RFID and Biometric. In 2019 Amity International Conference on Artificial Intelligence (AICAI) (pp. 188-192). IEEE.

[13] Yadav, V., & Bhole, G. P. (2019, February). Cloud Based Smart Attendance System for Educational Institutions. In 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon) (pp. 97-102). IEEE.

[14] Harikrishnan, J., Sudarsan, A., Sadashiv, A., & AS, R. A. (2019, March). Vision-Face Recognition Attendance Monitoring System for Surveillance using Deep Learning Technology and Computer Vision. In 2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN) (pp. 1-5). IEEE.

[15] Matilda, S., & Shahin, K. (2019, March). Student Attendance Monitoring System Using Image Processing. In 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN) (pp. 1-4). IEEE.

[16] Srivastava, T., Vaish, V., Sharma, P., & Khanna, P. (2019, March). Implementing Machine Learning for Face Recognition based Attendance Monitoring System. In 2019 6th International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 1254-1259). IEEE.

[17] James, C., & Nettikadan, D. (2019, April). Student Monitoring System for School Bus Using Facial Recognition. In 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI) (pp. 659-663). IEEE.

[18] Koppikar, U., Hiremath, S., Shiralkar, A., Rajoor, A., & Baligar, V. P. (2019, July). IoT based Smart Attendance Monitoring System using RFID. In 2019 1st International Conference on Advances in Information Technology (ICAIT) (pp. 193-197). IEEE.

[19] Samal, A., Purkait, K., Pandey, H., Das, U., & Swain, M. (2019, December). Smart Attendance Based Decision Support System for Mid-day Meal Scheme. In 2019 International Conference on Information Technology (ICIT) (pp. 365-370). IEEE.

[20] Hossain, M. I. A., Hossain, I., Banik, M., & Alam, M. A. (2018, June). IOT based Autonomous Class Attendance System using Non-Biometric Identification. In 2018 Joint 7th International Conference on Informatics, Electronics & Vision (ICIEV) and 2018 2nd International Conference on Imaging, Vision & Pattern Recognition (icIVPR) (pp. 268-271). IEEE.

[21] Mohana, H. S., & Mahanthesha, U. (2018, July). Smart Digital Monitoring for Attendance System. In 2018 International Conference on Recent Innovations in Electrical, Electronics & Communication Engineering (ICRIEECE) (pp. 612-616). IEEE.

[22] Mothwa, L., Tapamo, J. R., & Mapati, T. (2018, November). Conceptual Model of the Smart Attendance Monitoring System Using Computer Vision. In 2018 14th International Conference on Signal-

ISSN: 2233-7857 IJFGCN

Image Technology & Internet-Based Systems (SITIS) (pp. 229-234). IEEE.

[23] Tamboli, N., & Sardeshmukh, M. M. (2017, August). Facial Based Attendance Monitoring System Using Discriminative Robust Local Binary Pattern. In 2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA) (pp. 1-5). IEEE.

[24] Wakchaure, P., Shaikh, S., Rohida, K., Singh, S., & Ramdasi, A. Improved Intuitive Automated Attendance System using Unorthodox Algorithms. International Journal of Computer Applications, 975, 8887

ISSN: 2233-7857 IJFGCN