

# Human Tracking Mechanism for Institutions using RFID and Facial Recognition

Rameez Shaik, L.V. Patil

**Abstract:** *The Adoption of digital content by the institutional members & students have seen rapid growth in recent years. The students could access the content across various devices, platform & applications, which has a direct implication on the physical presence of the student. The institutions follow old & very traditional base approach like a manual record of attendance to track the company of students which consumes a lot of time & efforts from the staff members. The study looks at the various technologies available in the market & present the implementation of the best possible solution. The latest use of technology of Facial Recognition with a combination of RFID will enhance the tracking process & also provide valuable insight into student behaviour. The data collected by the system can further utilize to improve the efficiency & effectiveness of student behaviour patterns & predict the learning trend, which will help the institutions to make the correct decisions.*

**Keywords:** *Tracking system, Big Data Analytics, Bio-metric, Face Recognition, Bluetooth, Iris, Android Application.*

## I.INTRODUCTION

Physical participation is one of the ways to showcase if someone is interested or to get involved. In the educational institutions, the physical appearance of the students plays a vital role to showcase the interest in educational activities. The research proved that the physical participation of students has a direct impact on their academic results. The additional case expressed that the student who has less involvement in the institutions tends to have poor performance in academics. The faculty members of an Institute tracks the attendance of each participated student. The existing way to maintain manual records is very time-consuming, not effective & require someone to orchestrate the process. The paper records have then been store into the digital system for further references. There is a fair chance of data quality & manipulation issues for the data which is entered manually by the institution employees. Most of the Indian educational institution does not have the correct framework to address these problems. Some of the common issues faced in the traditional use of tracking the presence of student are manual errors, loss of recorded copies which will not help the students & well as institutions. So there is a need to have a mechanism which could automate the process of capturing the presence of student without any manual intervention. The existing use of technology must introduce an electronic framework that can oversee and assist the faculty members with taking the attendance rapidly & error-prone.

The institution can quickly implement the automated framework digitally without manual intervention. The other concern of having the attendance records in the copy form is that the faculty member may lose it & would be difficult to retrieve it [2]. The digital framework is generating server related activities which are reaching in terabytes. The student activities & digital educational system modules receive an enormous amount of data daily. Traditional analytical programs prolong to meet the analysis requirements as the data requirements are exploding. To track the activities accurately, we do require a mobile application which helps to access the digital content at ease on any portable devices. Today mobile applications are based on various platforms such as android, IOS or windows help to capture precise data is provide a basis for a large number of parallel computation & analysis on educational data to extract relevant patterns. The educational institutions are gaining valuable insight based on the analytical tools to make education better amongst large heterogeneous populations of the student from various demographic. While the enhancement towards the digital front is quicken each hour, biometrics base innovations have started to change drastically. Biometrics innovations support the personality through attributes, for example, fingerprints, faces, irises, retinal samples, palm prints, voice, transcribed marks, etc. These techniques, which utilize physical information, help the individual validation technique that is more acceptable than regular strategies, for example, a secret phrase or ID cards. The individual biometric data are more reliable & error-prone. Such information to the individual is trustworthy & remains for the agreed duration of time [3]. It is essential to identify the correct tools & instruments to use in the logical examinations. Standardized tracking methods, Radio frequency identification framework, Bluetooth related framework & NFC are some of the examples which could use in the process. The initial use of these methodologies are costly in implementation & had restricted use. These days in digital enhance validation process consists of numerous biometric based systems. Biometric advancements & its techniques on individuals depends on physiological or social attributes. Biometrics denotes as the "robotized distinguishing proof or confirmation of human personality through the estimation of repeatable physiological and conduct attributes" (Association of Biometric, 2004). Different kinds of biometric methods are listed.

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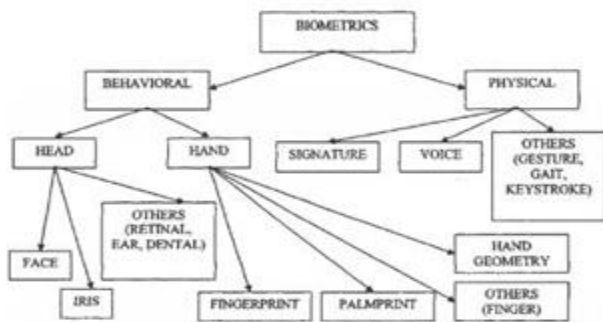
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**Fig.1: Biometrics Techniques**

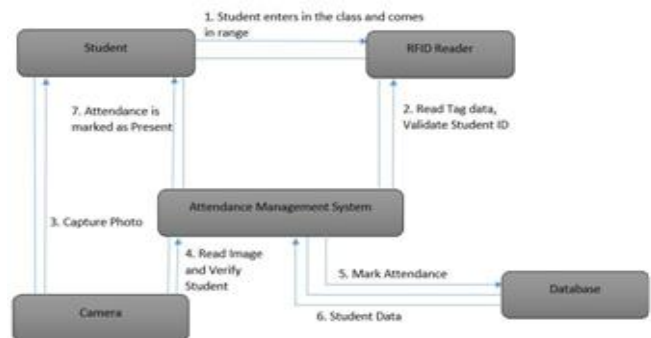
## II. RELATED WORK

The section eventually reveals some facts based on thoughtful analysis of many authors work as follows. Core Research recommended the utilization of a mechanized participation framework, which can lessen human contribution, manual information section mistake, and monotonous work. This framework is going to improve profitability, reduce finance mistake, and brought down compensation swelling, decreased extra time, the retirement of heritage frameworks, Elimination of paper expenses, and which can give all the reports on request. In this framework, the workforce needs to gauge participation physically, and just these records must be gone into the advanced framework. [4]. Another similar kind of project proposed, but as part of use case, the student should register themselves using client-server socket program from their own devices such as laptops. A session of the application creates an execution process for the list of students for a specific course. These courses display when the faculty members approve the request or start the application. The student presence is marked when clicked to checkbox of the student name, and afterwards, click the section button to stamp their presence. In 2013, Vishal Bhalla et al. [5], have recommended the participation framework, which can gauge participation in applying Bluetooth. In this task, presence marked using teachers cell phone. Application installed in faculties mobile device which triggers the notification on student mobile devices using Bluetooth and the data exchange by PDA Media Access Control (MAC). The student appearance marks once they acknowledge the report. In [6], Media Anugerah Ayu suggested the online participation framework using NFC innovation which named as Tochin System. In the framework, two methods of activities used where one of them is writer mode & other is a peer to peer mode. In this framework, each room of the institution has NFC enabled, which is a program to connect to the faculty members computer. In 2012, Josphineleela.R and Dr.M.Ramakrishnan [7] presented a framework in which participation has done using one of the biometric features of finger impression. This framework can apply for students & faculty members of the institution. In this method, the unique finger impression acknowledged for the presence of the subject, and it is orchestrated into the accompanying modules Pre-preparing, Minutiae Extraction, Reconstruction, Fingerprint Recognition and report. This new calculation reproduces the stage picture from Miniature. In 2010, Seifedine Kadry and Mohamad Smaili suggested using the iris-based framework, which is one of the techniques of bio-metric. A remote iris base organization framework executed, utilizing Daugman's calculation (Daugman, 2003). This biometric base

framework is challenging to implement due to the complex process of data. The implementation of the framework is too expensive & time-consuming authentication. The use of the iris base technology is implemented in the financial sector, such as banks & financial institution, where complex authentication is the highest priority.

## III. IMPLEMENTED FRAMEWORK

The human tracking mechanism is a universal application design architecture to automate and enhance the manual work of recording & communicating in near real-time. The implementation design combines two ways to authentication; one of them is to use RFID & other method include facial recognition. The logs of RFID & captured image is stored in the database system. During the process of authentication students, identity is fetched from RFID tag & matches with the secure image. Once the match is successful, then presence is marked against the authenticated subject, or else it is marked as absent. Above implementation helps to automate the subject tracking mechanism with fraud tolerance. The figure demonstrates the system workflow by using biometric facial recognition along with the RFID authentication to track more efficiently.

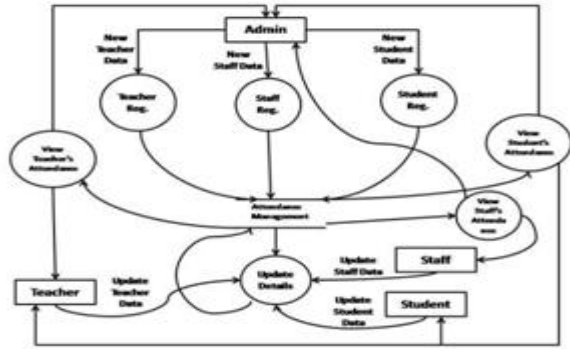


**Fig. 2: Processing system**

The functionality of the system, includes registration, near real-time tracking, are as follows.

### A. Student & Faculty Registration Platform

During admission of a student in an educational institution, registration form & process is explained to register into the system. During the process, the institution will issue an RFID Tag whose unique code data set saves into the database concerning its name. The student has to undergo through the biometric fingerprint scanner where fingerprint information stored in the database respective to their terms at the same time. The exact process is followed by the faculty members of the institution to register themselves with necessary information into the system. The faculty members can search for the specific student either by the name or ID. The system automatically calculates the attendance percentage as per the pre-configuration set by the authorized member of the institution. The teachers can later check the attendance percentage of the student for a particular period of days. It is a mandate for faculty members to update the courses related information into the system regularly. Different authorization roles are created while setting up the system where the faculty team needs to update their profile, attendance & leave base information.



**Fig.3: Data flow diagram**

Figure 3 demonstrates the data link of the process flow or system. Another critical functionality in the system that the student who registers for the different semester can track their daily class routine for the ongoing courses. The administration of institution can also frequently monitor their faculty members performance metrics which is calculated by the system automatically based on the student presence corresponding to each course. In this way, institutions can improve the quality of education for students.

**B. Near Real-Time Tracking**

The tracking mechanism/framework can mark the daily attendance of enrolled students, teachers, and other institutional staff automatically without any manual intervention. The RFID readers are installed at various places like entrance, exist gates and hotspots of the institution. Whenever a student enters the premises, the RFID automatically reads the unique code of RFID passive tag from their identity card and data is transferred to the server and get saved in the database. When the student present for an enrolled course, the RFID reader reads the unique code of the tag and cross-checks that information present in the system database. The checks against the attributes like semester number, subject code, classroom information and so on. After scanning the RFID, student photo is captured, and the image information is transfer later to the server for processing the image against the database copy. If the match is found, then the presence of student for that enrolled course is marked as a success. The facial recognition device will only be active at the scheduled time the course. The teacher who is delivering the lecture can decide on the activation time of the system where he can set the rule to mark the attendance as absent as penalty if the student visits the class late base on the threshold value.

The installation of the system completes at a faster pace due to less complexity. The facial recognition unit can install on the entrance of each classroom but not at all places, which can help to reduce the cost for the institution. The information which is present in the database can later put in use to analyze the data to take the necessary measure to improve the quality of education for students.

**C. Mathematical Model / Algorithm**

A model can explain its effects on different components and predict the correct implementation of the system.

The following equation could show the mathematical modelling of Face Recognition:

$$X = \{\sum, F, \delta, C\}$$

Y = Face Recognition.

$\sum$  = set of input parameters = {audio, video, character}

F = set of output symbol = {Match then inform r, Match Not Found}

- Starting the flow
- No. of training dataset  $N * N$  images
- Resize the dimensions of the image to  $N^2 * 1$
- Test set of  $N^2 * M$  Dimensions, M: number of images used for testing.
- Find average faces, subtract from the faces in the training sets, create matrix A

$$\psi = \frac{1}{M} \sum_{i=1}^M \Gamma_i$$

Where,

$\Psi$  = average no. of images,

M = number of image objects,

$\Gamma_i$  = denotes the images vector.

$\Phi_i = \Gamma_i - \Psi$

Where,  $i = 1, 2, 3 \dots M$ .

$A = [\Phi_1, \Phi_2, \Phi_3 \dots \Phi_M]$

- Compute covariance matrix:  $(AA')$
- Compute eigenvectors of the c covariance matrix.
- Compute Eigenfaces = No. of training image –no. of classes (total number of people) of eigenvectors.
- Create reduced Eigenface space. The selected set of vectors are then multiplied by the A matrix to generate the reduced result set.
- Evaluate the eigenface of an image object determines in the question.
- Next step would be the calculation of Euclidean distance for the Eigenfaces & the image object.
- Now the action is to search the insignificant Euclidian distance
- The output is as follows: Image object with the less Euclidian space or image is not recognizable.
- D = {the system cannot process the voice dataset, Eigen generates the grey image object; the key algorithms will execute till frames.}

**IV. RESULTS AND DISCUSSION**

This section depicts the outcome of the system which intends to track human participation which can analyze the behaviour. There are many technologies which are present for monitoring the students like manual, Bluetooth base, infrared, wifi-enabled application. The solution is to create feasible & affordable devices which can remove the corns of the previous implementation. The framework uses RFID which can read several labels and process it in parallel, which is one of the most crucial features. The RFID works on the concept named as Automatic Identification and Data Capture (AIDC). AIDC feature automatically track objects, collect data points about them and that information is directly passed to the computer system. This method uses radio waves which transmit the data from RFID reader to RFID tag. The implementation of Facial biometric technique with RFID ensures that we have a fail-proof system which can be trusted and works accurately. The position of the camera directly impacts on the outcome due to various external factors like light, the position of the object and distance of the image object as there is two module in the framework which connects between each other by the application software.



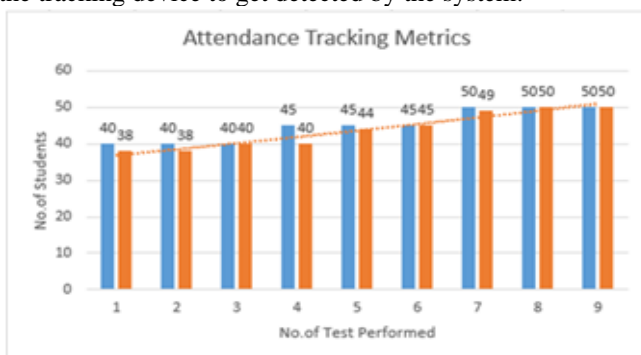
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With the help of application software, one can start, log, access the menu and mark the attendance by selection attendance list. The enrolment process is designed to allow individuals to enrol their details along with their images. The Facial recognition system is intended for an individual to attest his/her presence in the enrolled course but also track their presence across the campus. Table 1 demonstrates the number of test cases performed to track student based on the implementation of human tracking mechanism using RFID & Facial recognition techniques. The initial test was conducted on 50 subjects to validate the effectiveness of the identity device. For the first test run, the external parameters are set as accurate as possible or at higher configurations like lighting condition, the distance of image object, position of the image object. The device can identify 47 test subjects successfully & only three items were unsuccessful to validate.

**Table I: Details of Tracking**

Test No	# Students	Successful Track Rate	Unsuccessful Track Rate	Accuracy
1	40	38	2	95%
2	40	38	2	95%
3	40	40	0	100%
4	45	40	5	88%
5	45	44	1	97%
6	45	45	0	100%
7	50	49	1	98%
8	50	50	0	100%
9	50	50	0	100%

For the second test run, the external parameters are adjusted to the actual real scenario of an institution classroom where 48 students are accurately identity from a total of 50 test subjects. After analyzing the failed subject data logs, we identify the root cause of the unsuccessful tracking is due to one of the external parameter is time. The subject must spend a minimum amount of time near the tracking device to get detected by the system.



**Fig.4 Tracking Metric**

Figure 4 illustrates, graphical presentation of the accuracy of subject tracking by the implementation of a solution using RFID and Facial recognition. The improvement metrics show, In the second test run, the accuracy was improved by two percentage, which is 96% in total. After tweaking the external parameters, we see the increase in ratio to 100 rates, also considering the time spent by the subject with the tracking devices. The below table 2 demonstrates the elapsed time by the system as compared with the previous technology-based implementation. The average time consumed by the proposed solution is less as compared to

the survey performed on the other technologies. The average time is 8.7sec as compared with 11.6sec, which consider as to be the most promising results.

**Table II: Time elapsed for attendance**

Type of System	#Students	Total time (sec)	Average Time
Paper Based	50	580	11.6
NFC Cards	50	300	6.0
Facial + NFC	50	437.11	8.7

## V.CONCLUSION

The implementation of the suggested solution in educational institutions will increase the percentage of tracking and managing students without any manual intervention. The adoption of the system can be suitable for addressing the issues related to manual efforts & computation for managing students attendance. The system is a web-based system that allows the lecturer to compute students attendance via the web browser. This system can be easily implemented in a various number of an educational institution. It can be scalable as per the need, which makes the affordable solution to the educational sector. The data captured by the system can feed into various analytical tools to create different learning patterns as well as a retention plan for the students. The data can also be utilized to develop a predictive model of student behaviour which helps students & institutions to provide better & quality education.

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