Smart Attendance System

Swarnendu Ghosh, Mohammed Shafi KP, Neeraj Mogal, Prabhu Kalyan Nayak, Biswajeet Champaty[#]
School of Engineering, Ajeenkya DY Patil University, Pune, Maharashtra 412105, India
[#]*biswajeet.champaty@adypu.edu.in*

***Abstract*— The current study delineates the design and development of a smart attendance system for students in schools or colleges for optimum utilization of the teaching-learning time. The proposed device is a biometric attendance recorder that uses the fingerprint sensor in conjunction with Arduino UNO. The device stored the fingerprint impressions of all the faculties and students of an institute through the process of enrolment. During the attendance, the registering fingerprint of students was matched with the enrolled database. In case of a match, the name of the student was registered in that device and sent wirelessly to an in-lab made Android application through Bluetooth protocol service. The Android application is only accessible by the authorized personnel to monitor the student attendance and to share for academic record. The device is highly secured as it can only be activated by the fingerprint recognition of the concerned authorized personnel (faculties). The device is low-cost, robust, portable and user-friendly. The device being handy and cheap gives an edge over the products that are currently available in the market. The device saves time in class, thus increases the valuable teaching learning time of teachers and students giving them greater opportunity to teach and learn respectively.**

***Keywords*— Fingerprint sensor, Attendance system, Arduino, Bluetooth module**

I. INTRODUCTION

A survey was made by taking 52 first year B.Tech students of School of Engineering, AJEENKYA DY PATIL UNIVERSITY, Pune to calculate the average time taken by a faculty to take attendance through dedicated enterprise resource planning (ERP). The study revealed that each faculty took approximately 8-10 minutes to complete the attendance of students, which accounts 20% of the assigned class time. In an average, 70 minutes of time was utilized for taking the attendance in a day which is a futility of time. Hence, considering the above fact this smart attendance system (SAS) was proposed for effective class time management.

Now-a-days, there are verities of biometric SAS available in the market which are based on face recognition [1, 2] , iris scanning [3] and fingerprint recognition [4]. The face recognition SAS needs larger storage space for storing images. Moreover, these systems are costly [4] are dependent on the background, physical appearance and expression of the stored faces. Iris scanning SAS are secured, accurate and takes less detection time compared to face recognition SAS [3]. But the reported drawback is that the cost of the iris detection machine is very high as compared to the other biometric attendance systems [4]. In addition, the distance for iris detection is a major drawback with the iris based attendance system, i.e., there should be a particular distance between the user and the scanner for iris detection [4]. Fingerprint recognition based SAS are cost-effective and are highly secured as compared to other biometric systems [5]. This machine is one of the popular biometric systems due to its portability and user-friendly features. Though the variation in skin morphology has an impact during the process of fingerprint recognition, the use of other fingers limited this drawback. RFID based SAS are other widespread devices for attendance recording and monitoring. The likely drawbacks in these devices are proxy attendance due to misuse of RFID cards [6]. Moreover, the marketed SAS devices are bulky, stationary [4], internet dependent [7] and lack of GSM connectivity [8].

The SAS is an economic and secure option to the current market available attendance recording models. The device is internet independent, portable, secure and time saving. The attendance taken with SAS can easily be shared with anyone using any sharing app installed on the phone of the teacher. It makes the SAS really a great choice for attendance taking.

II. REQUIREMENTS

JHD162A (16x2) Liquid Crystal Display (LCD) Screen (Sunrom Electronics, India), R305 V 1.6 Fingerprint Sensor (Sunrom Electronics, India), Arduino Uno R3 (Arduino Italy), HC05 Bluetooth sensor (Technophilia Systems Pvt. Ltd, India) and jumper wires were used in this study.

III. METHODOLOGY

a) SAS module design

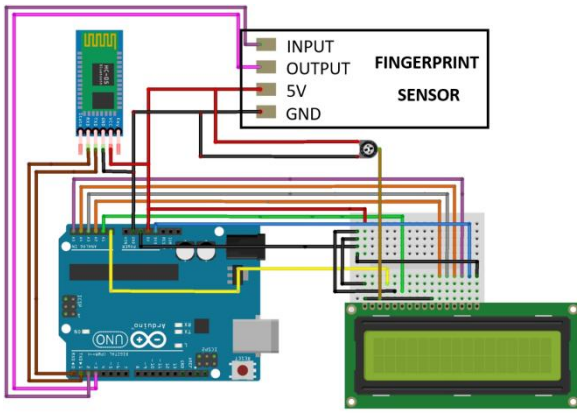

Fig. 1 circuit diagram of SAS module

The SAS was comprised of fingerprint sensor, Arduino UNO microcontroller, Bluetooth module and LCD screen. The fingerprint sensor was used for biometric input, LCD was used for visual feedback and the Bluetooth module was used for wireless data transmission. All the peripheral sensors were powered from the Arduino UNO which was connected to a 9V DC battery source. The circuit diagram of SAS module has been given in Fig. 1.

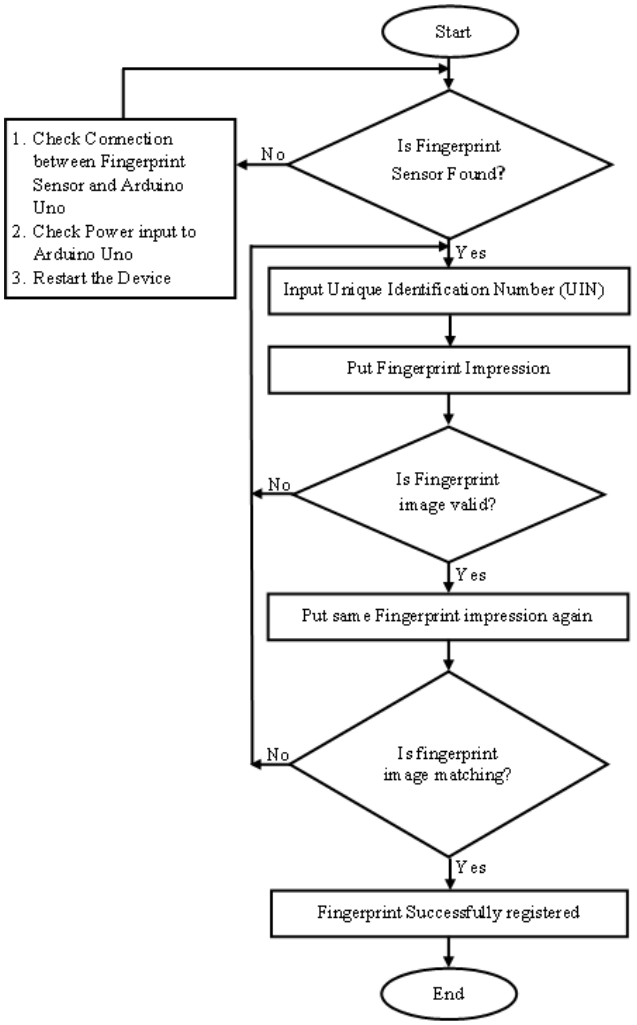

Fig. 2 Flow chart for fingerprint registration

The fingerprint impression of all the students and the faculties were enrolled and registered with unique identification number (UIN). All the UINs were used in the Arduino IDE program to recognize particular students and faculties. During the process of attendance, the thumb impression of a student was matched with the stored database. In case of a match, the registered UIN was identified and the associated student name was reflected on the LCD screen which confirmed the attendance of that particular student. The name of that student was transmitted wirelessly to an in-lab made Android application through Bluetooth. The overall process was explained through a flowchart given in Fig. 2.

b) Development of Android application for Attendance Monitoring

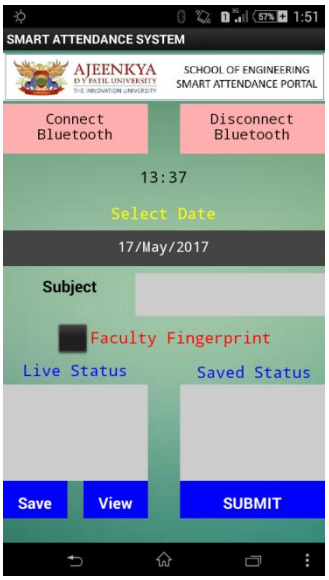

Fig. 3 In-lab made Android application for attendance recording

An android application was made with the help of MIT App Inventor-2 to record and monitor the attendance (Fig. 3). After successful fingerprint recognition of a student in the SAS, the name of the student was transmitted to the application through Bluetooth. The users of this Android application are the authorized personnel other than the students. The processes in the Android application start with the manual connection to the SAS through Bluetooth followed by selecting the correct date and entering the subject code. The (UTC+05:30) time zone was used in the Android application in 24:00 format and was updated automatically as per the current mobile time. In the backend of the Android program, a .txt file was created by using a combination of entered subject code and date as file name. This format made the data retrieval process easier. There was a check box reminder for the faculty to log-in in the SAS through fingerprint impression which activated the SAS and the Android application. As soon as the faculty logged in to the system, the name of that faculty and his/her assigned subject name was transmitted to the Android application through Bluetooth and a message namely, "start attendance" flashed on the LCD screen of the SAS. Certainly, the SAS was handed over to the students to put their attendance through fingerprint impression and passed it on. At the end of the student attendance process, the faculty has to click the 'save' and 'view' button to review the name of the students present. The 'Submit' button was designed to share the recorded attendance via email. The processes occurring in the Android application was explained through a flowchart given in Fig. 4.

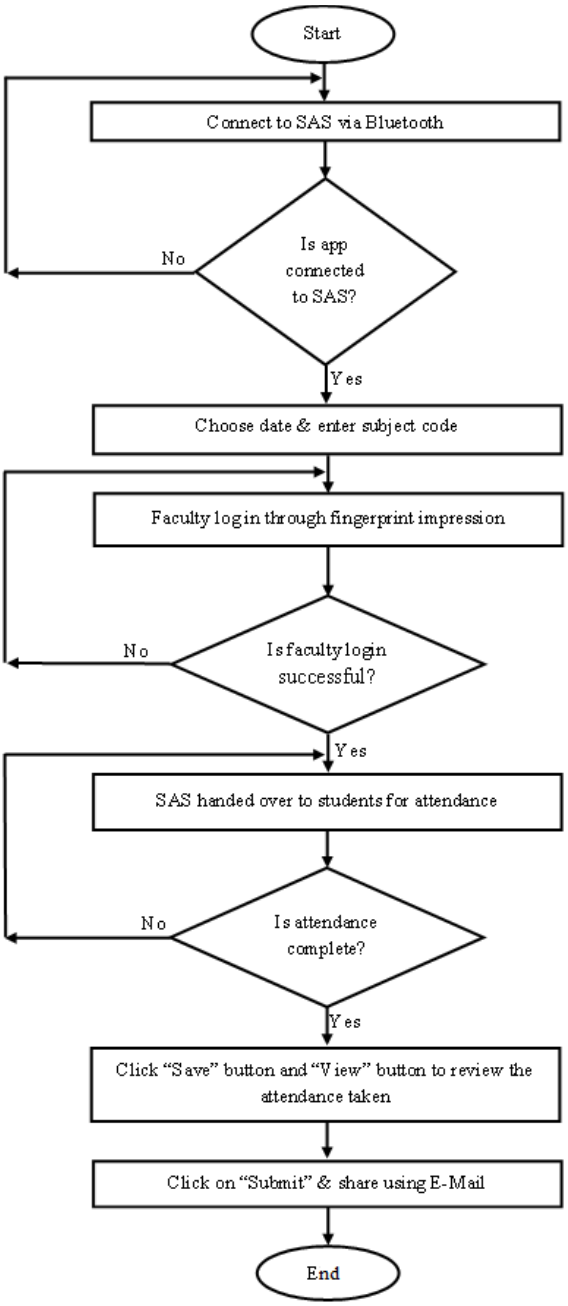

Fig. 4 Flow chart showing the working of the Android application

IV. RESULT

a) Development and working of SAS module

Fig. 5a shows the developed SAS device and the internal circuitry is shown in Fig. 5b. The LCD display and the fingerprint scanner are the exposed for the convenient use. The processes (enrolment, registration and recognition) occurring inside the fingerprint sensor were visualized through the LCD display.

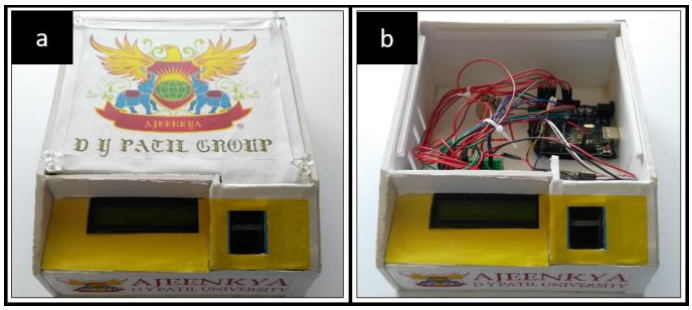

Fig. 5 (a) Developed SAS device, (b) Internal circuitry

The processes involved in SAS module were fingerprint recognition, database matching, data storage and transmission. The process of fingerprint recognition was based on enrolment and registration (Fig. 6). The process of enrolment started with successful detection of fingerprint sensor and assigning a UIN for a fingerprint (Fig. 6a). The program checked for valid fingerprint to enrol and converted that to image (Fig. 6b). The program rechecked for the same fingerprint impression for confirming a match (Fig. 6c). The particular fingerprint was stored and registered with the entered UIN (Fig. 6d).

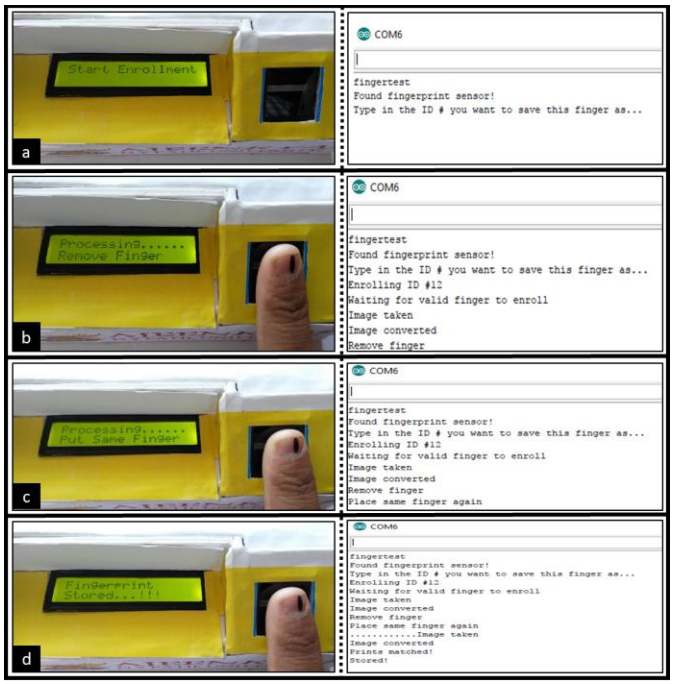

Fig. 6 Process of fingerprint enrolment and registration: (a) device ready for enrolment and assign UIN (Enrolling ID) for a new fingerprint, (b) fingerprint impression for first time (c) same fingerprint impression for second time to confirm the match, and (d) fingerprint registered successfully and associated UIN is stored in the database.

b) Attendance recording

Fig. 7 Faculty login and device activation

The Android application was connected to the SAS through Bluetooth. The change in background color of the "connect Bluetooth" button changed from red to green confirmed the successful connection of the Android application with the SAS (Fig. 7a). The faculty picked the date and entered the subject code as 'ED'. A text file was created in a format "subject-codedd mm yyyy.txt " to store the name of the students present in that class. As a reminder to the faculty, the "Faculty Fingerprint" check box was ticked followed by faculty log in to the device through fingerprint impression (Fig. 7b).The name of the registered faculty for that course was confirmed by showing his/her name in the Android application as well as in the serial monitor of the Arduino connected to the device (Fig. 7c). A volunteer named "Biswajeet Sir" participated during this study as a faculty-in-charge for the subject named "ED".

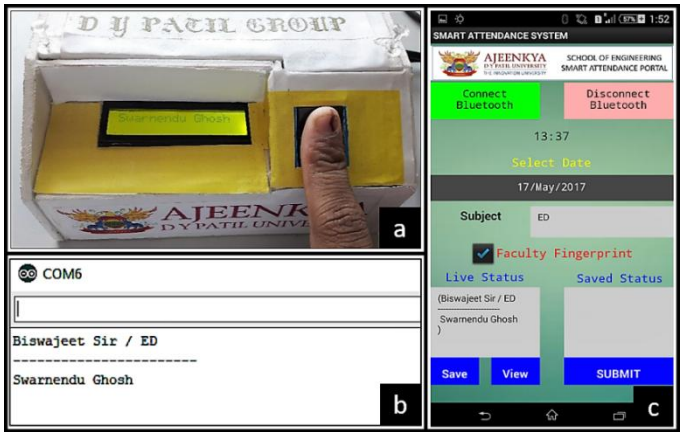

Fig. 8 Student attendance registration

After faculty log in, the SAS device was activated and was handed over to the students to register their attendance. During the study, a volunteer named "Swarnendu Ghosh" participated as a student to register his attendance. He was registered with UIN #12 during enrolment. When the SAS received the fingerprint impression of the student volunteer, it searched for associated UIN in the database. As UIN #12 matched with the fingerprint of the student volunteer, the name associated with the UIN #12 (Swarnendu Ghosh) flashed on the LCD screen of the SAS device confirming his presence in the class (Fig. 8a). The same name was transmitted wirelessly to the Android application running on the mobile phone of the faculty and listed in the status window (below the "faculty name / subject name") (Fig. 8c).

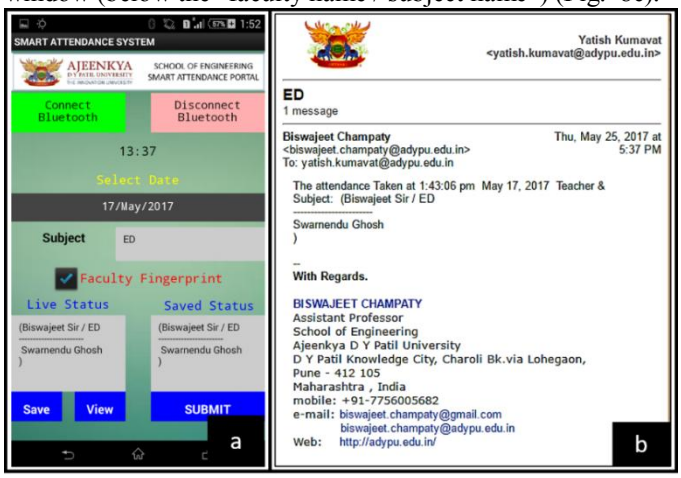

Fig. 9 Attendance sharing: (a) Name of students present shown in the Android application for sharing, and (b) Name of the students present shared through email

After completion of the student attendance, the device returned back to the faculty and the names of the students present were available in the "Live Status" window of the Android application. The data was saved and viewed in the "Saved Status" window by clicking the "Save" and "View" buttons, respectively (Fig. 9a). The data available in the "Saved Status" window was shared through Email (Fig. 9b).The data can also be shared through any pre-installed sharing applications. Serial monitor was used only to confirm the proper working of the device during this study.

c) Performance evaluation of the SAS device

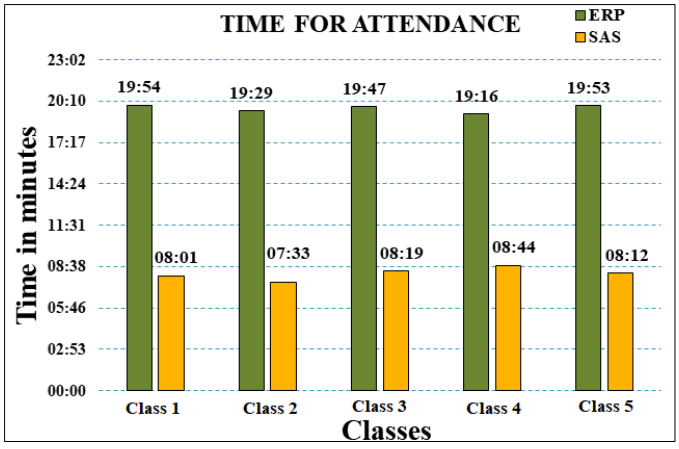

Fig. 10 Graph showing Time Taken During Attendance

TABLE I
TIME SAVED PER CLASS BY SAS

DAY		Classes					Average (Sec)	Average (Min)	Time saved per class (Min)	Time saved per day (Min)
		C1 (Sec)	C2 (Sec)	C3 (Sec)	C4 (Sec)	C5 (Sec)				
1	ERP	1142	1204	1192	1187	1245	1194	19:54	11:53	59:27
	SAS	542	452	421	452	536	480.6	08:01		
2	ERP	1164	1178	1145	1212	1146	1169	19:29	11:56	59:39
	SAS	479	435	465	482	405	453.2	07:33		
3	ERP	1154	1205	1212	1136	1230	1187.4	19:47	11:28	57:21
	SAS	535	423	531	525	482	499.2	08:19		
4	ERP	1132	1125	1210	1142	1171	1156	19:16	10:32	52:39
	SAS	490	481	526	500	624	524.2	08:44		
5	ERP	1140	1217	1193	1177	1237	1192.8	19:53	11:41	58:24
	SAS	540	480	480	420	540	492	08:12		
Average time saved per class									11:40	
Average time saved per day										57:30
Total time saved per week										287:30

The performance of the device was validated through a comparative study made between taking attendance through ERP and through SAS device at Ajeenkya DY Patil University. The device was tested for a week in twenty classes, five classes per day. The attendance was taken manually followed by the attendance taken through the SRS device. Each class was of 60 minutes and the student size was fixed for both the studies. The time required for taking the attendance in each class using ERP and SAS, time saved per class, time saved per day, average time saved per day and total time saved per week are tabulated in Table 1. The table has been represented graphically in Fig. 10. The study revealed that the average time saved by using the device per class was 11:53 min and per day was 57:30 min. Therefore, in an average approximately 287:30 min was saved per week which could be effectively utilized in teaching-learning time.

IV. CONCLUSION

The proposed study discusses the development of an interactive SAS system which addresses a vital educational issue related to huge time loss in taking attendance in the conventional methods which also posed the risks of proxy attendance givers. The SAS device was developed with the interfacing of fingerprint sensor, Bluetooth sensor, and LCD display with the Arduino Uno microcontroller; encased with in a handy enclosure. The device transmitted the name of the students (registered in a class) to an in-lab developed Android application. The Android application was available with the authorized personnel to record and share the attendance of a class. To avoid misuse of the SAS device, authorized fingerprint recognition was made mandatory to make the device active. Apart from its security feature, the device is portable, easy to operate and internet independent.

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