Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X
IMPACT FACTOR: 6.017

IJCSMC, Vol. 7, Issue. 8, August 2018, pg.60 – 66

Attendance Management System for Educational Sector: Critical Review

Zainab Hussein Arif[1], Nabeel Salih Ali[2], Nurul Azma Zakaria[3], Mohammed Nasser Al-Mhiqani[4]

[2]ITRDC Centre, University of Kufa, Iraq
[3]Centre for Advanced Computing, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka (UTeM), Melaka, Malaysia
[4]Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka (UTeM), Melaka, Malaysia
[1] Zhussian94@gmail.com; [2] Nabeel@uokufa.edu.iq; [3] Azma@utem.edu.my, [4] Almohaiqny@gmail.com

Abstract— To maintain the attendance records, several government organisations and educational institutions in many countries still depend on the paper-based attendance approach. This approach has presented several disadvantages such as time-consuming and wastage of environmental resources. There is a necessity to change these traditional methods of attendance recording with more efficient ones. Thus, many works have been done in this direction. Moreover, this study aims to analyse the most recent studies on automated attendance systems regarding the timeline. Our critical review has highlighted studies in the existing literature concerning technology, application domain, and main findings. Moreover, shed light on most numerous studies on any of three previous aspects.

Keywords— Attendance management system, AMS, Attendance, Academic, Education, Attendance records, Registration.

I. INTRODUCTION

Generally speaking, information technology systems have presented various advantages for a variety of application domains, which increases the importance of the adoption of these systems [1-3]. Furthermore, the information technology represented an essential tool that helps countries to enhance their economy in both the educational and industrial sectors [4-6]. Suitable attendance recording and management has become important in today's world. Attendance is one of the work ethics valued by employers. Most of the educational institutions and government organisations in developing countries still use paper-based attendance method for maintaining the attendance records [7]. So, there is a critical need for adopting the attendance management system for measuring the organisations' efficiency. Regarding organisational perspective, it helps to possess a tracking for attendance and assessment for particular individuals in different sectors such as employees, university staff and students [8]. Not apart from attendance, usually in the academic sector, attendance management process could help to increase the desire of attending on-time and raising the education level [9]. On other hands, in the industrial sector, the attendance system may be employed as a tool for different activities such as, analysing human resources, manage the daily attendance process, and record the overtime information and transfer it to the payroll system [10]. Several drawbacks have reported using traditional attendance approach such as time-consuming [9], and students may sign on the attendance sheet instead of their friends while they are absent [11].

Accordingly, the last few decades various developments have achieved to provide an automatic approach to attendance management [12-13]. The most critical step in the automatic attendance system is the data gathering process, and data processing model, numerous of well-known technologies have hired for this target such as biometric, RFID, magnetic stripe, and the barcode [14]. To end, this study aims to provide a critical analysis of particular studies that have conducted in the context of attendance systems.

II. CRITICAL REVIEW OF THE EXISTING ATTENDANCE SYSTEMS

This section presents a critical review of the works and attempts by previous authors in details and highlights their main-findings, technology, and sectors implemented. This section conceptually provides insights into the last universal works. These works, which have been conducted from 2012 until 2017, were aimed to determine and eliminate the lacks for the traditional methods and techniques regarding attendance management systems. Table 1, presents a critical review of the proposed system in attendance management systems with several technologies and highlights their main findings, technology, and application domain.

TABLE 1 COMPARISON OF THE PREVIOUS ATTENDANCE SYSTEMS BASED ON CRITICAL REVIEW

Author(s)& Year	Technology	Sector	Main Findings
Patel et al., 2012	RFID	Academic	Proposed a real-time intelligent system to record students' attendance [13].
Singhal, & Gujral, 2012	RFID	Academic	Implemented an RFID remote monitoring attendance system by sending SMS approach based on GSM cellular network [15].
Saparkhojayev & Guvercin, 2012	RFID	Academic	Presented attendance system based on RFID technology in Suleyman Demirel University, Kazakhstan [16].
Benyo et al., 2012	NFC	Academic	Introduced and developed an autonomous student attendance system by implemented NFC technology [17].
Chiagozie, & Nwaji, 2012	RFID	Academic & Organization	Proposed a time-attendance management system with a door unit based on RFID technology [18].
Yuru et al., 2013	RFID	Academic	Designed an attendance checking system of class based on embedded of ARM and RFID technology [4].
PVN & Gupta, 2013	Fingerprint - GSM	Academic	Conducted a portable attendance system by using a GSM network with fingerprint technique to manage and recording attendance module for a student in class and sending a record to student parent's via GSM-based mobile network [19].
Talaviya et al., 2013	Fingerprint - Zigbee	Academic	A wireless attendance monitoring system proposed to maintain, manage, and record student attendance in a university institute automatically based on biometric fingerprint-based and Zigbee technology [20].
Behara & Raghunadh, 2013	Face recognition	Organization	Proposed an automatic attendance monitoring and management system in the real-time environment to record time and attendance application using biometric face recognition based on attendance system [21].
Hui et al., 2014	Mobile Based	Academic	Designed and developed a student attendance system based on mobile based attendance via detecting the geographical locations of smartphones [22].
Baban, 2014	QR Code	Academic	Presented student attendance system to record, view, monitor, and checking attendance recording by using a QR code scanned by smartphones [23].
Yadav& Nainan, 2014	RFID-GSM	Academic	An automatic attendance management system presented for students and teachers as well using GSM for sending notifications to parents [24].
Arbain et al., 2014	RFID-ARDUINO	Academic	Proposed an attendance system to record and manage student attendance automatically in the lab by using RFID-ARDUINO approach in web-based laboratories settings [25].
Tiwari et al., 2014	RFID-GPRS	Academic	Conducted GPRS based student attendance system which it can be easily accessed by the lecturers via the web to check and monitor student attendance recording [26].
Kurniali, 2014	RFID	Academic	Developed a student attendance management system by using RFID with the web-based approach to managing student's attendance in an Indonesian higher education institution [27].
Zainal et al., 2014	Fingerprint - Arduino	Organization	Presented a security and portability attendance system by design and developed attendance monitoring and management system by using biometric fingerprint technology and Arduino microcontroller [28].

Bhise et al., 2015	Mobile Based	Academic	Developed a student's attendance system based on NFC Technology in school and colleges and implemented in mobile-based application [29].
Pranali et al., 2015	Mifare	Academic	Adopted and developed an attendance monitoring system based on Mifare technology and server-based for tracking and positioning students in campus settings [30].
FARPAT et al., 2015	RFID-GSM	Academic	Managed student's attendance via proposing an automatic computing system in classrooms by using RFID technology [31].
Mishra et al., 2015	RFID-ARDUINO	Organization	Proposed a secure system for employees' attendance system based on RFID module [32].
Shengli et al., 2015	RFID	Enterprise	Conducted automatic attendance system based on RFID card connected with Arduino microcontroller via the real-time database environment to manage the employee's attendance in an enterprise [33].
Kuriakose & Vermaak, 2015	RFID	Academic	Proposed an automate attendance registration system by using Java-based RFID technology to monitor, management students attendance at the Central University of Technology, South Africa [34].
Praveen Kumar and Mani Kumar, 2015	RFID-IoT	Academic-Enterprise	Presented attendance management system based on RFID and IoT applications which can be system accessed from anywhere and stored attendance records in the cloud and be sending SMS to several smartphones [35].
Wagh et al., 2015	Face Recognition	Academic	An automated and smart attendance system proposed for classroom attendance based on face recognition using Eigenface and PCA algorithms [36].
Khatun et al., 2015	Iris Recognition	Academic	Adopted and implement an iris recognition based attendance system to record and management students' attendance and sent a report to the predefined E-mail address in the MATLAB programming environment [37].
Noor et al., 2015	Android-based	Academic	Proposed Android-based application via used as a sensor by camera device to take, manage student attendance records [8].
Kumar & Kumar. 2015	Bluetooth - Face Identification	Academic	Conducted a system to monitor, track, and position student attendance in campus based on Bluetooth -Face identification technologies [38].
Yadav et al., 2015	Fingerprint	Enterprise	An automated fingerprint recognition system presented and implemented to design a portable attendance system [39].
Potadar et al., 2015	Fingerprint	Academic	Proposed a biometric-based attendance system to record, monitor, and tracking student attendance by using fingerprint technique to reduce the risk of false attendance recording [40].
Jaikumar et al., 2015	Fingerprint	Academic	Offered a study to propose an attendance monitoring system for student attendance based on fingerprint recognition with GSM network in the academic domain [41].
Srinidhi & Roy , 2015	RFID-Biometric	Academic	Developed and adopted an automation attendance monitoring and management system based on web-based applications using RFID and biometrics technologies for an academic college and university environment with safe and secure system advantages [42].
Kamaraju & Kumar, 2015	Fingerprint-Zigbee	Enterprise	Proposed a real-time attendance management system for easy and time-saving employee's attendance at any organisation using Zigbee and fingerprints based attendance [43].
Ya'acob et al., 2016	Arduino	Academic	RFID Efficient student attendance management system presented with a web portal to reduce the time of taking the attendance compared with the traditional system [44].
Sayanekar et al., 2016	Face Recognition-NFC enabled ID card	Academic	NFC technology and Face recognition technique biometric-based attendance system management proposed for tracking and recording students' attendance at various locations in campus [2].
Sunehra & Goud, 2016	Arduino and Raspberry Pi	Academic	Conducted a recording and consolidation system for student attendance based on Arduino and Raspberry Pi microcontroller boards with secure, affordable and user-friendly advantages [1].
Kohalli et al., 2016	Smart Sensor	Enterprise	Produced a hassle-free system for attendance management and monitoring attendance records via a wireless network of smart devices (IoT) [9].
Jacob et al., 2016	Mobile- NFC	Academic	Introduced attendance management system for university students by using NFC mobile based attendance system [5].

Prince et al., 2016	IoT - Fingerprint	Academic	Presented a student attendance monitoring system in a classroom based on the principle of Internet of the Things (IoT) via designed a portable device using fingerprint module [45].
Nath & Mukhopadhyay (2017)	Mobile Android-based	Academic	Proposed a mobile-enabled on-line attendance system [46].
Devamane & Ramesh (2017)	Bluetooth and Face recognition	Academic-Organization	Propose attendance system based on Bluetooth and Face recognition [47].
Wang et al., (2017)	Face detection and recognition	Academic	Develops an automatic attendance system by integrating two deep learning algorithm Faster R-CNN face detection algorithm and SeetaFace face recognition algorithm [48].
Abdulsada, H. F. (2017)	Raspberry pi, RFID and Arduino	Academic	The attendance system proposed is used to manage attendance system in a large and branched factory or university from the central unit [49].
Mady & Hilles (2017)	face detection	Academic	Develop attendance system automatically in Al-Madinah International University (MEDIU) and achieve higher both accuracy and performance [50].
Dhope & Bhombe (2017)	Face Recognition	Academic	In this project an approach to the detection and identification of human faces is presented and then recognises the person by comparing characteristics of the face to those of known individuals is described [51].
Shukla (2017)	RFID and GSM	Academic	Design of microcontroller based attendance system using RFID and GSM has been presented [52].
Wang (2017)	EEG Signals	organisation	This paper presents a system for an attendance of small office by using EEG signal [53].
Buddhiwant, et al., (2017)	Mobile Android-based and GPS	Academic	An Android-based mobile application for attendance monitoring is presented [54].
Hendry et al., (2017)	QR Code	Academic	An attendance system that utilises the use of QR code [55].
Kumar et al., (2017)	raspberry pi and fingerprint	Academic	This paper discusses on the standardised fingerprint model which is used to synthesise the template of fingerprints [56]
Kavitha et al., (2017)	NFC and Arduino	Industry	A novel attendance system for members of the industry using NFC (Near Field Communication) is proposed [57].
Siddiqui et al., (2017)	Fingerprint and Arduino	Academic	The fingerprint based wireless attendance system aim to record the student attendance [58].
Jogiji & Ghate (2017)	RFID, WSN and Arduino Uno	Academic	The system provides effectiveness and efficiency in administering and managing the attendance procedure, hence improving productivity and staff development [59].

Many attempts have been made by researchers on developing wireless biomedical sensors for attendance systems. They mainly focused on improving technical solutions that address problems and challenges in recording, monitoring, positioning, tracking students or employees in compared with traditional systems that impose duplicate of works and efforts and increase human resources requirements. These solutions such as reliable, mature, legally, accepted, affordable, user-friendly, and secured. Most previous studies that proposed the attendance management systems implemented their systems with academic sectors exclude a few studies like (Behara & Raghunadh, 2013), (Zainal et al., 2014), (Mishra et al., 2015), (Shengli et al., 2015), (Yadav et al., 2015), (Kamaraju & Kumar, 2015), (Kohalli et al., 2016), (Wang, 2017), and (Kavitha et al., 2017) were implemented and conducted their attendance management system in public sectors. Whereas studies conducted by (Chiagozie, & Nwaji, 2012), (Praveen Kumar and Mani Kumar, 2015), are implemented in academic and public sectors.

III. CONCLUSION

The innovation of information technology has a great deal with developments of attendance systems, which have investigated by many researchers in the current existing literature. Since the automated attendance systems have avoided the drawbacks of traditional ones, these systems have become very popular and applied in multiple domains. According to our study, we have found 52 studies that have been conducted based on the implementation of the attendance system scenario. These studies have classified according to the findings, type of technology has been used, and application domain category. The majority of articles have focused on developing such a system to support academic facilities. Furthermore, many studies have widely adopted RFID technology. We believe this research will continue to investigate further studies to highlight relevant aspects in this area such as challenges, research trends, other technologies have been adopted and so on.

REFERENCES

[1] Sunehra, D., & Goud, V. S. (2016, October). Attendance recording and consolidation system using Arduino and Raspberry Pi. In Signal Processing, Communication, Power and Embedded System (SCOPES), 2016 International Conference on (pp. 1240-1245). IEEE.

[2] Sayanekar, P., Rajiwate, A., Qazi, L., & Kulkarni, A. (2016). Customized NFC enabled ID card for Attendance and Transaction using Face Recognition. International Research Journal of Engineering and Technology, 3(9), pp. 1366- 1368.

[3] Ali, N. S., & Alyasseri, Z. A. A. (2017). Wireless Sensor Network and Web Application Hybrid Scheme for Healthcare Monitoring. Journal of Soft Computing and Decision Support Systems, 4(5), 1-7.

[4] Yuru, Z., Delong, C., & Liping, T. (2013). The Research and Application of College Student Attendance System based on RFID Technology. International Journal of Control and Automation, 6(2), 273-282.

[5] Jacob, J., Jha, K., Kotak, P., & Puthran, S. (2015, October). Mobile attendance using Near Field Communication and One-Time Password. In Green Computing and Internet of Things (ICGCIoT), 2015 International Conference on (pp. 1298-1303). IEEE.

[6] Ali, N. S., Alyasseri, Z. A. A., & Abdulmohson, A. (2018). Real-Time Heart Pulse Monitoring Technique Using Wireless Sensor Network and Mobile Application. International Journal of Electrical and Computer Engineering, 8(6).

[7] Walia, H., & Jain, N. (2016). Fingerprint Based Attendance Systems-A Review. International Research Journal of Engineering and Technology (IRJET) Volume, 3.

[8] Noor, S. A. M., Zaini, N., Latip, M. F. A., & Hamzah, N. (2015, December). Android-based attendance management system. In Systems, Process and Control (ICSPC), 2015 IEEE Conference on (pp. 118-122). IEEE.

[9] Kohalli, S. C., Kulkarni, R., Salimath, M., Hegde, M., & Hongal, R. (2016). Smart Wireless Attendance System. International Journal of Computer Sciences and Engineering, 4(10), pp. 131-137.

[10] Shakil, M., & Nandi, R. N. (2013). Attendance Management System for Industrial Worker using Finger Print Scanner. Global Journal of Computer Science and Technology.

[11] Patel, U. A., & Priya, S. (2014). Development of a student attendance management system using rfid and face recognition: A review. International Journal of Advance Research in Computer Science and Management Studies, 2(8), 109-119.

[12] Rjeib, H. D., Ali, N. S., Al Farawn, A., Al-Sadawi, B., & Alsharqi, H. (2018). Attendance and Information System using RFID and Web-Based Application for Academic Sector. International Journal of Advanced Computer Science and Applications, 9(1).

[13] Patel, R., Patel, N., & Gajjar, M. (2012). Online students' attendance monitoring system in classroom using radio frequency identification technology: a proposed system framework. International Journal of Emerging Technology and Advanced Engineering, 2(2), 61-66.

[14] Walia, H., & Jain, N. (2016). Fingerprint Based Attendance Systems-A Review. International Research Journal of Engineering and Technology, 3(5), pp. 1166- 1171.

[15] Singhal, Z., & Gujral, R. K. (2012). Anytime anywhere-remote monitoring of attendance system based on RFID using GSM network. International Journal of Computer Applications, 39(3), 37-41.

[16] Saparkhojayev, N., & Guvercin, S. (2012). Attendance Control System based on RFID-technology. IJCSI International Journal of Computer Science Issues, 9(3), 1694-0814.

[17] Benyo, B., Sodor, B., Doktor, T., & Fördős, G. (2012, April). Student attendance monitoring at the university using NFC. In Wireless Telecommunications Symposium (WTS), 2012 (pp. 1-5). IEEE.

[18] Chiagozie, O. G., & Nwaji, O. G. (2012). Radio frequency identification (RFID) based attendance system with automatic door unit. Academic Research International, 2(2), 168.

[19] Gupta, P. V. N. (2013). Fingerprint Based Student Attendance System Using GSM. International Journal of Science and Research (IJSR) ISSN (Online), 2319-7064.

[20] Talaviya, G., Ramteke, R., & Shete, A. K. (2013). Wireless fingerprint based college attendance system using Zigbee technology. International Journal of Engineering and Advanced Technology (IJEAT) ISSN, 2249, 8958.

[21] Behara, A., & Raghunadh, M. V. (2013). Real time face recognition system for time and attendance applications. International Journal of Electrical, Electronics and Data Communication, 1, 2320-2084.

[22] Hui, L. Y., Seok, K. H., & Hwan, K. B. (2014). A Study on the Location Based Automatic Attendance Check System with Smart Devices.

[23] Baban, M. H. M. (2014). Attendance checking system using quick response code for students at the University of Sulaimaniyah. Journal of Mathematics and Computer Science (JMCS).

[24] Yadav, R., & Nainan, S. (2014). Design of RFID based student attendance system with notification to parents using GSM. International Journal of Engineering, 3(2).
[25] Arbain, N., Nordin, N. F., Isa, N. M., & Saaidin, S. (2014, December). LAS: Web-based laboratory attendance system by integrating RFID-ARDUINO technology. In Electrical, Electronics and System Engineering (ICEESE), 2014 International Conference on (pp. 89-94). IEEE.
[26] Tiwari, A. S., Tiwari, A. S., Ade, N. M., Sheikh, S., Patel, N. R., & Khan, A. R. (2014, January). Optimized design of student attendance system using rfid. In International Conference on Machine Learning, Electrical and Mechanical Engineering (pp. 8-9).
[27] Kurniali, S. (2014). The Development of a Web-Based Attendance System with RFID for Higher Education Institution in Binus University. In EPJ Web of Conferences (Vol. 68, p. 00038). EDP Sciences.
[28] Zainal, N. I., Sidek, K. A., Gunawan, T. S., Manser, H., & Kartiwi, M. (2014, November). Design and development of portable classroom attendance system based on Arduino and fingerprint Biometric. In Information and Communication Technology for the Muslim World (ICT4M), 2014 the 5th International Conference on (pp. 1-4). IEEE.
[29] Abhilash Bhise1, Radhika Khichi2, Amol Korde3, Prof. Deepali Lokare. (2015). Attendance System Using NFC Technology with Embedded Camera on Mobile Device. International Journal of Advanced Research in Computer and Communication Engineering, 4(2), pp 350-353.
[30] Pranali, S., Mayuri, S., Manisha, T., & Varsha, J. (2015). An Intruder Tracking and Attendance Monitoring System Using Mifare Technology.
[31] FARPAT, S., VYAS, D., & CHAVAN, S. (2015). Monitoring Of Attendance Using RFID and GSM Technology, 3(2), pp. 1-8
[32] Mishra, Y., Marwah, G. K., & Verma, S. (2015). Arduino Based Smart RFID Security and Attendance System with Audio Acknowledgement. International Journal of Engineering Research and Technology, 4(1), pp 363-367.
[33] Shengli, K., Jun, Z., Guang, S., Chunhong, W., Wenpei, Z., & Tao, L. (2015). The Design and Implementation of the Attendance Management System based on Radio Frequency Identification Technology.
[34] Kuriakose, R. B., & Vermaak, H. J. (2015, November). Developing a Java based RFID application to automate student attendance monitoring. In Pattern Recognition Association of South Africa and Robotics and Mechatronics International Conference (PRASA-RobMech), 2015 (pp. 48-53). IEEE.
[35] M.Praveen Kumar and B.Mani Kumar. (2015). RFID based Attendance monitoring system Using IOT with TI CC3200 Launchpad. International Journal & Magazine of Engineering, Technology, Management and Research, 2(7), pp. 1465-1467.
[36] Wagh, P., Thakare, R., Chaudhari, J., & Patil, S. (2015, October). Attendance system based on face recognition using eigen face and PCA algorithms. In Green Computing and Internet of Things (ICGCIoT), 2015 International Conference on (pp. 303-308). IEEE.
[37] Khatun, A., Haque, A. F., Ahmed, S., & Rahman, M. M. (2015, May). Design and implementation of iris recognition based attendance management system. In Electrical Engineering and Information Communication Technology (ICEEICT), 2015 International Conference on (pp. 1-6). IEEE.
[38] Kumar, J., & Kumar, A. (2015). Automatic Attendance Monitoring and Tracking System Using Bluetooth and Face Identification. International Journal of Advanced Research in Electronics and Communication Engineering, 5(4), pp. 1116- 1170.
[39] Yadav, D. K., Singh, S., Pujari, S., & Mishra, P. (2015). Fingerprint Based Attendance System Using Microcontroller and LabView. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 4(6), 5111-5121.
[40] Potadar, M. P., Marathe, V. V., Khose, A. S., & Kotkar, L. A. (2015). Biometric Attendance Recording and Communication System. International journal of innovations in engineering and technology (IJIET), 5(2), 230-234.
[41] Jaikumar, K., Kumar, M. S., Rajkumar, S., & Sakthivel, A. (2015). Fingerprint Based Student Attendance System with SMS Alert to Parents. International Journal of Research in Engineering and Technology.
[42] Srinidhi, M. B., & Roy, R. (2015, January). A web enabled secured system for attendance monitoring and real time location tracking using Biometric and Radio Frequency Identification (RFID) technology. In Computer Communication and Informatics (ICCCI), 2015 International Conference on (pp. 1-5). IEEE.
[43] Kamaraju, M., & Kumar, P. A. (2015, March). Wireless fingerprint attendance management system. In Electrical, Computer and Communication Technologies (ICECCT), 2015 IEEE International Conference on (pp. 1-6). IEEE.
[44] Ya'acob, N., Adnan, S. F. S., Yusof, A. L., Azhar, A. E., Naim, N. F., Mustafa, N., & Mahmon, N. A. (2016). RFID lab management system using Arduino microcontroller approach associate with webpage.
[45] Prince, N., Sengupta, A., & Unni, M. K. (2016). Implementation of IoT Based Attendance System on a Dedicated Web-Server. International Journal of Scientific & Engineering Research, 7(6), pp. 351- 355.

[46] Nath, A., & Mukhopadhyay, A. (2017). A Novel Student Attendance Tracking System Using Android Mobile Phone.
[47] Devamane, S. B., & Ramesh, K. P. Automatic Tracking and Attendance Analytics Using Bluetooth and Face Detection.
[48] Wang, D., Fu, R., & Luo, Z. (2017). Classroom Attendance Auto-management based on Deep Learning.
[49] Abdulsada, H. F. (2017). Design and Implementation of Smart Attendance System Based on Raspberry pi. Journal of University of Babylon, 25(5), 1610-1618.
[50] Mady, H. H., & Hilles, S. M. (2017). Efficient Real Time Attendance System Based on Face Detection Case Study "MEDIU Staff". International Journal on Contemporary Computer Research (IJCCR), 1(2), 21-25.
[51] Dhope, M. G., & Bhombe, D. L. (2017). Face Recognition Based Attendance System using SIFT Algorithm.
[52] Shukla, A. K. (2017). Microcontroller Based Attendance System Using RFID and GSM. International Journal of Emerging Technologies in Engineering Research (IJETER), 5(8).
[53] Wang, Q. (2017). 13. Small Office Attendance System Based on EEG Signals. Boletín Técnico, ISSN: 0376-723X, 55(12).
[54] Buddhiwant, A., Bharkshe, M., Bansod, R., & Chandekar, M. (2017). Smart Attendance Application. International Journal of Engineering and Management Research (IJEMR), 7(2), 221-224.
[55] Hendry, M. R. M., Rahman, M. N. A., & Seyal, A. H. Smart Attendance System Applying QR Code.
[56] Kumar, P., Suresh, K., & Indumati, T. Smart Attendance System using Raspberry Pi.
[57] Kavitha, E., Tarangini, K., & Roopak, H. (2017). Smart Card System using NFC. Science and Technology, 3(08), 212-215.
[58] Siddiqui, F., Naik, M., Yadav, S., & Sunesara, M. (2017). Wireless Attendance System Using Fingerprint. Imperial Journal of Interdisciplinary Research, 3(5).

