

Review on Student Attendance Maintenance System: A Discontentment

Anshuman Kalla and Dileep Kumar Tiwari

Abstract In many countries including India, monitoring student attendance, in almost all the educational sectors be it schools, institutes, college or universities, is still a tedious, time-consuming, error-prone, unmanageable and manual process. The above fact is hard to fathom in the present era where technological developments are on the cutting-edge and technology-driven solutions have served as primary key to unlock doors to trouble free quality life. Thus the paper aims to bring in lime light the importance of careful monitoring of student attendance, hardship associated with prevailing ways of monitoring student attendance, typical nature of problem of student attendance maintenance (as compared other problems with innate identification requirement), RFID as a promising technology, salient features (and needs) to which student attendance systems should be tailored. The paper reviews of some of the work done so far in the field of RFID based student attendance maintenance systems. The paper aims to lay foundation for focused research to develop and deploy not just feasible but broadly acceptable technical solution for maintenance of student attendance in all educational sectors.

Keywords RFID · Student attendance maintenance system · Attendance monitoring system

Introduction

Education forms the foundation of human lives and almost everyone spends significant portion of his/her lifetime at educational institutes. Thus scientific and technological advancements should fully intervene to simplify numerous issues involved and to improvise the quality of teaching. One basic but highly perplexing

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academic chore, that still lacks technological elegance in its conduction, is student attendance maintenance system. Various indispensable steps involved in managing student attendance system are scanning, storing, analyzing, and sharing. There are several reasons that validate importance of monitoring student attendance and are discussed as follows:

- i. Many courses, specially technical courses, require students to regularly attend the lectures and perform experiments in laboratories. Guidelines/norms regarding minimum student attendance have been put forward by various apex bodies for example by All India Council of Technical Education (AICTE) in India. Student's attendance should be above this minimum criterion in order to be eligible to write exams pertaining to a course. Thus monitoring and maintaining student attendance becomes essential and integral part of academics activities.
- ii. Many professors allocate some percentage of final grades to student attendance in order to create better academic environment that promotes interactions and discussions leading to the better understanding of the subject & thereby improves lecture delivery.
- iii. Many schools, institutes and universities strongly consider student attendance during classes as one of the prominent performance indexes. In fact, higher student attendance (above the minimum criterion) directly implies willingness of students to attend classes and thus indicates quality of teaching of a particular educational institute.
- iv. Educational institutes may also take into account student attendance as one of the parameters for evaluating performance of faculty members during annual appraisal.
- v. Student attendance might also work as one of the pivotal input data for department(s) of basic and higher education to understand current educational scenario and accordingly develop and roll-out strategies to empower education.

From the above discussion it is quite evident that student attendance is crucial but unfortunately till today conventional ways (which were prevalent about several decades ago) are being followed. Surprisingly not a single technical solution has been so developed such that it could be fully deployed in all the educational sectors like schools, colleges, universities etc.

Student Attendance and Related Problems

The existing two variants of conventional way of marking student attendance are (i) students signing an attendance sheet at the end of class and instructor preserving that sheet in a file (ii) students replying verbally to the roll-calls made in class by the instructor and simultaneously marking of either presence or absence in a register,

i.e., book-keeping. Such orthodox ways of maintaining attendance has several associated entangled problems which are discussed as follow:

1. Most noticeable is the reduction in effective lecture duration. As experienced by every instructor and mentioned in [1], the traditional ways of marking student attendance nibble about 10 min of the total lecture duration for a class of 60 students. Thus if the total lecture duration is 1 h then total wastage is around 15–20 %. The time wastage would increase if the total lecture duration is lesser as attendance scanning time is only dependent on total number of students.
2. Nowadays, in significant number of educational institutes, it is mandatory to digitize the attendance recorded during the class by manually entering the attendance from paper register or attendance sheet in software. The attendance database so created could be easily used for analyzing, understanding, deciding, and sharing of records. Thus instructors further need to devote some more time off-class (sitting in their cabins/offices) for the same which subsequently increases percentage of effective time wastage for maintaining student attendance records.
3. The entire process of attendance (i.e., recording attendance during lecture duration and then uploading it to software) is error-prone. Student(s) may sign attendance sheet or reply to roll-call for other students intentionally or accidentally. In former case it results in hoax (proxy) attendance and later case results in loss of attendance.
4. In institutes where digitization (i.e., uploading attendance to software) is not performed, preservability is an issue since attendance is recorded only in paper sheets or paper registers. In addition, absence of software requires manual analysis to be carried out before each examination so as to prepare a list of eligible students and debarred students.
5. In case of occasional mistake made by the instructor while marking attendance during lectures may either lead to permanent errors or untidy register/sheet (as instructor tires to correct errors by overwriting).
6. Last but not least; if class is big in term of number of students then registering attendance could be quite troublesome as during that time normally students get themselves engage in chatting with each other.

Nature of Problem of Student Attendance Maintenance

Maintaining attendance records is inevitable and mandatory part of day-to-day working of any organization be it a business enterprise or an educational institute. But there is subtle difference between monitoring attendance (requiring individual's identification) at a business enterprise and at an educational institute. People working in an average-scale business enterprise might be significantly less than the students studying in an average-scale educational institute. Also, what is important for business enterprise is to monitor entry time and exit time of every employee

each day, whereas in any institute, attendance has to be recorded during each lecture provided that there could be many lectures per day. It would be sufficient to install one identification reader at the entry gate of each building of business enterprise but for educational institute there should be one identification reader available in each class room. Hence it could be well understood that both number of identification readers and number of identification tags (that carries individual's identification) required are more in educational institute. It is worth noticing that increase in percentage of identification readers is much more alarming than number of identification tags since the cost per unit reader is much higher than the cost per unit tag. Thus the cost of deploying an attendance maintenance system, which is primarily governed by number of reader required, would be tremendously high for educational institute. The situation is exacerbated by the fact that money seems not to be an issue for business enterprises but is certainly a great concern for educational institutes.

From the above discussion it is clear that fundamental requirement for a successful technical solution for student attendance maintenance system, would be low overall cost. In other words the solution should offer low CAPital EXpenditure (CAPEX) as well as marginally low OPERating EXpenditure (OPEX). The other requirements will be discussed shortly.

RFID Technology

Among several competing identification technologies like barcode, optical character recognition (OCR), voice recognition, RFID, biometric identification (fingerprint, iris, ear, face), smart card, etc., the RFID technology seems to be the most promising for current problem of monitoring student attendance. The numerous advantage [2] of RFID over the other technologies are (i) Technology is quite mature today, (ii) Ability to read in hostile environments, (iii) Real time reading capability, (iv) Fast reading of RFID tags (cards), i.e., around 0.5 s [2], (v) No physical contact between RFID reader and tag thus no wear and tear (vi) RFID when used with passive tags than operational expenditure (OPEX) is low as replacement of battery within a tag is not required, (vii) Reading of RFID tags is not affected by orientation or position provided they are within the reading range, (viii) Reading is not affected by dirt or damp, (ix) Cost of RFID tag is very cheap, (x) Data density is very high, etc. Thus present paper has focused on the work done so far for student attendance maintenance system using RFID technology.

Salient Feature of Student Attendance System

Due to typical nature of student attendance problem there are some salient features that should be preferably incorporated when designing a technical solution that could be globally accepted and deployed. Such requirements are discussed below:

1. **Cost:** As discussed before the cost is the preeminent concern for educational institutes. For complete deployment of any technical solution for student attendance maintenance system the cost per unit system should be very low so that even small schools could effortlessly afford it.
2. **Portable:** The device should be portable so that faculty members could carry it in classrooms as sometimes it is not good idea to install it in each classroom for many reasons like increase in cost, security of device, etc. Thus the device should preferably a handheld device.
3. **Power Efficient:** In case student attendance device is handheld device then most probably it is driven by (rechargeable) DC power supply. Thus the circuitry must draw as much less power supply as possible as it would add to operating expenses which should be minimized.
4. **Compact:** The device (and its printed circuit board) should be designed in such a way that minimum numbers of components should be used and they should be placed in an optimum and compact way.
5. **Light Weight:** It is an apparent need for a handheld device that it should be light in weight so that instructors could effortlessly carry it in classroom and if needed could be circulated among the students for scanning attendance.
6. **Authorization:** Attendance system should allow only faculty members to scan attendance, upload it to central database, refresh the internal memory of device, etc. Students on the other hand should be allowed only to mark their attendance by their ID cards.
7. **Audio and Visual Acknowledgment:** It is necessary to provide students with some kind of acknowledgment when they flash their ID cards over a device for marking attendance. The acknowledgment would signify students that their attendance is scanned successfully by the attendance system.
8. **Simple and Elegant Circuit Design:** This feature would allow easy large scale production and repairing of devices.

Review of Related Work

Authors in [3] have proposed RFID based attendance management system. The designed hardware comprises of off-the-shelf Intersoft RFID Demokit-1 that offers serial data transmission facility and within which there is TR-RO1-OEM RFID reader module operating at 125 kHz. The communication between RFID reader and computer is realized with help of USB-to-RS-232 serial converter. The link between RFID reader module and USB-to-RS-232 serial converter is established by using RS-232 serial cable (male to female, DE-9 type) whereas USB cable (one end standard—A and another end standard—B) is used between USB-to-RS-232 serial converter (standard—B, end is connected) and USB port of computer (standard—A, end is connected). Further, 9 V battery is used to supply power to RFID reader module. Software part is developed using Microsoft Visual C# for programming

and Microsoft SQL Server for database management system. Authors recommended installing RFID reader at the gate of every classroom. Students need to flash their ID cards while entering and exiting classroom. On successful reading of ID cards, RFID reader sends the data containing arrival and departure timings to server (running on connected computer). For sharing the recorded attendance SMS and email facility is also being incorporated through which weekly summary of attendance could be send to concerned people. Since installing RFID reader at gates of class rooms leaves possibility of impersonation thus authors proposed to use biometric security along with RFID in future to circumvent the problem.

In [1] authors developed RFID technology based attendance managements systems and propose to analyze the scalability and efficiency of such attendance systems. Software has been developed which intends to provide facility to generate attendance report for a given course, to manage large records and to securely store data. Visual Basic 6.0 has been used for programming and Microsoft Access for providing database. The hardware section consists of readymade RFID module from NSK Electronics which works on the 125 kHz and has reading sensitivity of 10 cm. The middleware is equipped with AT89S52 microcontroller from Atmel Corporation, external EEPROM to store the data and 16×2 LCD for display. Authors concluded that for a class of 60 students, RFID enabled attendance system takes 12 s to record attendance as compared to 120 s by bar code enabled attendance system and 600 s by using conventional way of marking attendance. Authors advocate that RFID technology could be best suitable technology for student attendance system provided the cost of RFID tag and RFID reader is reduced.

The paper [4] introduced RFID based time attendance management system for companies (with large number of working employees), primarily to maintain attendance database along with entry and exit times. The system is also used to make the entry restricted by controlling the opening of gate based on scanning of RFID cards. The proposed system consists of both hardware and software sections. Hardware part includes RFID reader (operating at 125 kHz frequency, reading range of 7 cm, of make Seeed Company and supports UME4100 protocol enabled RFID tags), Atmel AT89S52 microcontroller, motor to drive opening and closing of entry/exit gate and RS-232 serial-to-USB converter. If scanned tag is found to be authorized then microcontroller actuates the motor to open the entry gate. Authors used Microsoft Visual Studio 2008 and Microsoft.Net framework for programming and creating graphical user interface (GUI). In addition Microsoft Access 2007 has been utilized for database management. Two databases used are register database and attendance database. Register database holds identification of all the registered employees and is used as backhand database to identify authorized users whereas attendance database holds all the attendance records. Authors suggest using LCD to display identification details and IP camera to avoid impersonation in future.

In [5] authors employed multiple technologies for creating a smart attendance maintenance system; RFID technology to scan ID cards of students, biometric finger print technology to enhance security and GSM (Global System for Mobile Communication) to convey student attendance to their parents/guardians. Authors have advised to install a RFID scanning device at the main entry point of the

institute's campus. Student on entering institute flashes his/her RFID card and the entry in institute is marked. Simultaneously SMS is being sent to the registered guardian. Further, biometric finger print module is also being installed at each block (within campus) where again second level of verification is performed by scanning finger prints of students. Thus student's presence could be tracked at two levels. Authors have developed a webpage over ASP.Net which facilitates an easy access to students, guardians and instructors with different privilege levels. Software part is developed using VB.Net and database is managed over MS SQL. In future, authors expect to use GPS for exact location tracking and suggest installing one RFID reader at entry point of each classroom.

Authors in [6] advocated that combination of RFID technology with cloud computing has potential to permanently fix some of the prevailing hurdles for student attendance monitoring. Further, they envisage that collaborative usage of RFID technology and cloud computing would render time management as prime advantage. The recorded data from RFID readers is sent to cloud servers instead of local servers. MS Access and Visual Basic have been used for building backend database and developing user interface respectively. Hardware section uses readymade RFID module (operating frequency 125 kHz) from NSK Electronics, microcontroller, liquid crystal display, level converter and buzzer. RFID reader module is fixed at the entry point of each classroom. In future author propose to add SMS facility and augment biometric system for avoiding faulty attendance.

In [7] authors put forward a design of student attendance monitoring system which is web-based and uses RFID technology. The entire system is composed of three parts; (i) RFID reader module, (ii) data reporter module and (iii) server module. RFID reader module used is Mifare (AC900) operating at 125 kHz and is connected to hub (layer-1) or switch (layer-2) with help of RJ45 connector. Thus authors connected various RFID readers installed at different classrooms via layer-2 switch which is further connected to router. The data reporter module reads tag values through RFID reader module and conveys it to online server every 30 min. Web pages are developed in PHP and database is developed using MySQL. For testing and debugging purpose, XAMPP server is being used. Three types of login privileges have been allowed namely admin, lecturer, and student based on the obvious needs.

In [8] researchers developed a software for online student supervision using passive RFID by using MS Visual Basic 6.0 for programming, MS Access for storage information system (database management), Macromedia Dreamweaver MX for interfacing between LAN and server. Further, website is being developed using Active Server Pages (ASP) and it runs over Internet Information Services (IIS) server. Author tested performance of tag under high and low level noise with moisture in air.

Paper [9] built software for automation of attendance. The software is provisioned with numerous features like fetching from hardware the clock time at which card is scanned, marking of attendance and removing incorrect attendance, weightage calculation which shows eligibility of students to appear for opted

course, generating warning for non-eligible students, updating attendance by sending emails and SMS, etc.

Lim et al. in [10] designed a prototype for RFID based attendance system. The fundamental components of prototype are Microcontroller (PIC18F4550), RFID reader (EM4095 IC based), Real Time Clock (1307), MMC (Multi Media Card), 16×2 Liquid Crystal Display (LCD), Dual Driver Transceiver (MAX 232) and two types of power supplies AC and DC with rating 220 V and 12 V respectively. Microcontroller being the heart of circuitry reads a tag value by making use of reader and further stores the value in its internal electrical erasable read-only memory (EEPROM). The values being read is also displayed over LCD thus provides visual acknowledgement to user. Computer is interfaced with hardware section for data communication by using dual driver transceiver IC. The software used is Hyper-Terminal (available in windows operating system). The circuit normally works on AC but in absence of AC voltage, supply is automatically driven from 12 V standby battery. In Circuit Serial Programmer (ICSP) is being used to update microcontroller's program without removing in from circuit. The hardware supports serial programmer (JDM) which supports programmable interface controller (PIC) microcontrollers. Authors assert that their design is compact, low cost, portable, and light weight. Though not mentioned in the paper but a quick analysis would reveal that total cost of designed hardware should be around 450 INR which is still high for any attendance maintenance system in educational institutes. Perhaps there is still room for cost reduction as the cost of microcontroller used is very high.

In [11], authors made use of RFID reader YHU638 from EHUOYAN with operating frequency of 13.56 MHz for hardware section. The software part is built using JAVA. Researchers intend to install one RFID reader in each classroom. At the beginning of lecture, instructor enters his/her login and password to activate entire hardware, i.e., RFID reader and webcam to record attendance. Students then flash their RFID enabled ID cards, photo of individual student is clicked and attendance is recorded. The instructor then clicks the submit button to lock and upload the attendance data (tag values plus photos) to database. For future work authors propose to introduce GPS and GSM technology to the designed system.

Authors in [12] designed the software part and used off-the-shelf RFID reader operating at 125 kHz frequency. The software is developed based on client server model. RFID reader reads tag values and sends it to attached client computer. The client further sends the attendance data to the database. ASP.Net is used to develop the software and MySQL server 2008 is used for database handling. The client access the software through web browser to upload attendance to server. In future authors propose to use LCD display and IP camera to avoid proxy attendance.

Paper [13] developed software module to maintain student attendance system. ASP.NET is used for programming, SQL server for database management and C# is used to develop an application with GUI. The hardware part is composed of IR sensors, LPC-2148 microcontroller, LCD display, RFID reader, MAX-232 Dual Driver Transceiver, GSM/GPRS module. IR sensor mounted at gate is used to count the number of students (users) entering in classroom. Microcontroller

performs several tasks, out of which displaying the count from IR sensor on LCD display is one task. RFID reader reads the tag value when student flashes RFID enabled ID card over it and sends it to microcontroller. Further, microcontroller pushes this tag value to computer attached via dual driver IC. GSM/GPRS module connected to microcontroller is used to send the attendance data to web server.

In paper [14] authors published an attendance system which offers facility to be remotely monitored by using GSM network. The hardware section comprises of RFID reader with inbuilt dual driver transceiver, GSM module (SIM 300) and computer. MS Visual Basic 6.0 is being used for programming and configuring communication port whereas MS Access is used for database management. When user flashes the RFID tag over reader then attendance is recorded and simultaneously SMS is being sent to the registered user(s) who are interested in monitoring attendance.

Gopala Krishna et al. [15] designed an intelligent Campus Security Tracking (iCST) system for attendance and security purpose. For circuit designing authors used RFID reader to scan ID cards, Zigbee module to send data from hardware section to computer, GSM module to send SMS and make predefined voice call to registered guardians/parents and microprocessor (Freescale MC9S12XS128) to control overall process.

Das et al. [16] devised a RFID based time attendance system where RFID reader with inbuilt serial communication port is directly connected to computer with help of USB-to-RS-232 converter. C# is being used for programming and MS Access for database. The developed software provides registration facility to new users and allows attendance report generation in MS Excel and portable document format (pdf).

In [2] Ranjan Patel et al. worked on online attendance monitoring system which consists of RFID readers installed in each class room. These readers are connected to server through local area network (LAN). The server stores attendance records in a database and publishes them over Internet so that users can take a look.

Ademola et al. in [17] developed RFID based attendance system and introduced the use of pictorial database management. When a student swaps RFID enabled ID card over a reader then a successful reading and correct matching of tag value results in displaying a stored image of that student along with name, RFID tag value, current data and percentage of attendance. For hardware part authors used RFID- μ RW-USB (operating frequency 125 kHz) which can read and write EM4100, EM4205, EM305, Hitags and T55xx/67/xx tags/transponder value. MS Access is used for database management and Visual Studio 2012 IDE C++ is used programming.

Parvathy et al. in [18] devised a RFID based attendance management system for examination hall. The hardware part consists of readymade RFID reader (operating frequency 125 kHz) from NSK electronics, Liquid Crystal Display (16×2 LCD), buzzer for sound acknowledgment, Atmel AT89S52 microcontroller and dual driver transceiver (MAX-232). RFID reader supports UNIQUE or TK5530 protocol and FSK decoding is used to read tag value. Further, the reader section consists of PIC16F628 microcontroller, three shunted inverter gates, push-pull amplifier, voltage divider resistor, and filter capacitors for the required functioning. When

students swap their ID cards then their seating arrangement is shown on the LCD display.

Conclusion

Attendance monitoring is an intrinsic activity pertaining to any educational institute but till date conventional ways are being used in almost all the sectors of education. In the paper, an overview of various research work done so far in the area of RFID enabled student attendance maintenance system has been presented. It could easily be observed that most of researchers have focused on designing the software part and comparatively lesser efforts have been made to design and develop, equally important, hardware section while keeping in mind essential features like low cost, high power efficiency, handheld portability, etc. Like, in the case of computers the cost of operating system is a small percentage of overall cost of a computer, in the same way, for automation of student attendance, one would need to purchase single copy of a software (with required number of users) but number of hardware devices to be purchased would be very large in number. Thus the paper tries to pinpoint the increasing importance of designing and deploying a simple yet elegant technical solution with necessity to pay special attention on hardware part as well.

Authors hope that this paper would turn out to be a starting point for young researchers who desire to work on (application based problem of) student attendance maintenance system. At the same time the paper is expected to be a source of information for academicians (and related people) wishing to keep their knowledge updated.

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