

# Pi Attendance Management

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**Abstract**—Organizations are comprised of a number of people involved in different tasks and roles whether it is business or academic organizations. Ensuring the participation and presence of these individuals is of utmost importance. For this, some sort of attendance checking and management system is employed by almost all of these organizations. In this paper we examine the problems faced by the survey participants and the problems in different attendance management systems and the tradeoffs among them. Finally in terms of future work, we intend to implement three solutions from among these based on our user survey and implement a simpler, cheaper and more accessible version of it.

**Index Terms**—Attendance Management, NFC, RFID, Bluetooth, biometric, facial recognition attendance, error prone,.

## I. INTRODUCTION

Software engineering is a dynamic field and with the advancement of data science and artificial intelligence, there is a boom of easier and less complex methods in terms of implementation for various projects. In this paper, we focus on an important issue: attendance management. As part of our project goals, we will explore various research papers for attendance issues and solutions, conduct a survey, and, in future work, develop our own solutions for attendance management. Our survey result shows that there is a high demand to address the problem of attendance, which is time consuming, error prone, and record tracking. This makes it harder for professors and instructors to keep track of attendance. Singla, Gahlot et al. In the paper “Bluetooth Based Attendance Management System” have presented a unique software engineering idea for the attendance management problem. The problem they have addressed is “calling out individual names or by passing around an attendance sheet,” which of course would result in high time consumption and many errors. Poor attendance management also has a negative impact on students lower attendance makes their grades lower in class.

## II. LITERATURE REVIEW

What we found in the Literature- Attendance Management has been addressed in the past in a variety of ways. To address the plethora of software implementations, we could classify the different types into those using Student ID cards and a card reader, Barcode and similar coding, Biometrics, One time Passwords and Near Field Communication (NFC)

(5). Implementing software for attendance management needs to solve several problems that occur with manual logging of attendance. For example, manual logging is time consuming, prone to cheating, and cumbersome for student grading and other metrics(7). Each class of implementation comes with its own problems and drawbacks, but most have advantages and improvements compared to manual logging(5).

One of the most common ways that attendance management is handled with technology is with the use of Student ID cards that have an IC chip or magnetic record (5). One example used a .NET and Oracle based system that implements card readers(7). This is good because it uses the student’s IDs to automate and keep track of records. However, in extremely large classrooms, it may be the case that long lines can form waiting to scan a card just for attendance (5). This is similar to if a professor had a sign in sheet at the door for students to manually log their attendance. This also does not solve the issue of cheating. Students may swipe their “buddy’s” card to mark them present. This is also not necessarily cost effective, because it requires card readers, as well as the need for card replacement when students lose/break them (5).

Barcode scanners could also be used. This category also includes other two-dimensional coded systems. These are generally easy to implement and would not require particular devices, as mobile phones could be implemented to read them. Students could have a simple piece of paper with the days barcode printed out (or in another format) and use an in class mobile device to read it as they go by. This means a barcode implementation is cost effective and would prove beneficial to the automation of attendance (5).

For example, the University of Mississippi, did a quick prototype simulation for a bar code implementation. Classroom scanners would need to be integrated with their current data management system. More servers would be needed to handle input data to send to the data management system. The prototype simulated 4 scanners in 2 classrooms with a quickly put together reporting system. They wanted to see the effectiveness before implementing it school wide considering the costs of barcode scanners(6). Their simulation showed that the barcode scanner would be a more effective way to take attendance in terms of the management and interpretation of the attendance data for participation grades, final attendance counts, as well as dropping students after a certain number of missed classes, especially in terms of a large class size (6).

A key component of this prototype was the use of Simple Stream Query Language (SSQL). SSQL is made to run in standalone interpreter and its syntax is like SQL, but adds capabilities to handle data streams. Each piece of data is defined as a packet. This allows multiple packets and packet types per stream, so there is no need to filter data. It has Window Based Queries, Trigger controlled queries, File based Queries Simple Stream In/Out/ Export Control, Stream merging, Traditional Query Operations, and an Interpreter based system(6). Because of this, the simulated experiment was an app that used only 30 lines of code to handle incoming data and export it to a simple easy to read file (6).

From finger print scanners to iris scanners, and voice recognition to face recognition, Biometrics is an interesting, but costly implementation idea for attendance tracking (8). Biometrics if applied correctly can get rid of the possibility of cheating and assure professors of correct attendance. This also has the potential for an invisible, “in the background”, logging of attendance in the form of facial recognition. Budapest University of Technology went a step further and implemented biometrics with an NFC technique to decrease impersonation (7). We can even have mobility with a finger print system that uses a handheld device and a host application for management of data(7).

One time passwords are also easy to implement in which a professor shows a password in class for students to type in an app for attendance. However, this can also lead to impersonation and validity problems(8) (5). This could also take a significant amount of time in class.

Near Field Communication is a wide umbrella that encompasses many different wireless logging methods, such as RFID, BLE Beacon, and Wifi (5). This may also have a higher cost because of the possible need for RFID readers, beacon transmitters, and mobile devices (5). “NFC is new, short range, high frequency, low bandwidth, and wireless communication technology(7).” Advantages of NFC is that “NFC technology is now integrated into mobile devices which can be used for online payment, access control, user id, and transfer of personal/private info (7).” It activates by touching 2 NFC devices together. When based on RFID, it uses initiator and a target. An initiator is active with internal power for IC’s that generate an outgoing signal. A target is passive with no power, so we could use simple stickers or cards. There are three modes which include reader/writer mode where an NFC device reads or writes to a tag, card emulation mode where the NFC device acts like a card or tag, and peer to peer mode where there’s an exchange of info between two NFC devices(7).

Focusing on RFID specifically, RFID be used as a “an automated identification and data collection technology” (pp. 01)(2). It is cost effective, and one proposed system that used RFID identifies, monitors, and uses inventory control for data saving to solve the problem of a time consuming recording process for attendance(2). All it takes is for a reader to scan a unique RFID tag, and a student is logged as present (9). BIS has RFID based commercial system. It

sends SMS and email to parents automatically. Data is sent to a BISAM server. It also includes a time management part for keeping track of employee attendance (7). Another solution focuses on Bluetooth technology in which a Bluetooth technology and Media Access Control system would keep automatic track of student’s attendance by connecting to their phones(1). However, “The device must positively identify students and provide reliable class attendance logs for the benefit of students, lecturers and the University, as described in the previous section” (pp. 227)(1). NFC is malleable and has been used in many different research and implementation projects. For instance, Technical University of Cartagena developed NFC based system using NFC active and passive devices, or NFC readers, where NFC server hosts linked to the university network. Students and teachers would install mobile app on their devices, and would run upon touching the reader (7). Some have even gone so far as to combine NFC properties with social media for attendance, though it was focused on campus event attendance, not class attendance. The participant provides an SNS Id, downloads application, and upon attendance, the meeting name, session name, and sns ID is set by the participant. Touching the tag in the session, sends info to server, and participant gets all sns IDs in attendance to connect with “facebook” or “twitter” friends that are also in attendance(7).

In order to fix many of the listed problems listed with general NFC implementations, one solution was suggested that does not require specific NFC or RFID readers. The only requirement was for each student to have a smart phone, though there were contingency implementations for the case of a student not having a smart phone. The TouchIn system uses a reader unit and web server unit. The Software that would be required in the reader unit would be a client application to be installed on the mobile phone. For the web unit a web based attendance application for admins and professors. The reader unit is responsible for reading student info. from a mobile device. Device Id is used for verifying the student. (assuming student has NFC enabled mobile device and internet connection). In the case that student does not have nfc enabled device- NFC tag can be issued, like a card, or bracelet. TouchIn was Designed with PHP, Javascript, and MySQL(7).

There are implementations that have been explored that don’t necessarily fall into the proposed classifications of attendance systems. For example, desktop applications such as moodle, or something where the teacher check boxes next to student names(7). A Client server socket program where students registered individually from personal laptop was also used(7). However, one other interesting solution is a combination of mobile device and web service. During the lecture, a mobile device is passed around to each student. The student finds his/her id from a list, confirms identity, and chooses registration by selfie or signature. Once registered as “in class” that students Id is removed from the list, allowing for and instant view of who’s not there. Considered “unique and useful” according to paper. All selfies and signatures paired with ID’s are then sent to a “roll sheet database”(8). Considered

“more interesting, convenient, fresh innovative, and special” compared to form paper(8). However, it was shown through experimentation that the main disadvantage was the lack of feedback opportunities.

The proposed system may fix some of the problems associated with the different categories listed, such as how it is less costly, highly usable. It can even be used during a lecture. However, it still has some costs in each classroom which would require some kind of mobile device, and it could be a distraction being passed around during a class. Also, it does not fix the problem of verifying that a particular student is actually in class. One student could just use signature registration for him and a friend. Other than the drawbacks, this is a novel idea, easy to implement, and highly usable, with the exception of feedback encouragement.

Overall, solutions mentioned and the different types of systems give many improvements to manual logging in terms of time taken, and accuracy for records. The problem of taking attendance manually takes time and efforts to write it back and it manual entering of attendance is a headache for instructors (4). Students might miss their names and others may sign under the wrong person (4). Though there are drawbacks such as cost and the difficulty of implementation, an attendance management application based on one or more of the listed categories would help professors and students with the attendance management problem in academic institutes (4).

### III. METHODOLOGY

Research has shown that attendance management is a crucial problem. In order to further research issues related to attendance management, we used a survey created in Google Forms. The survey was sent out to various professors, to include those in NC State’s Computer Science Department, and to various University students. Some questions were multiple choice and others were open ended questions, giving the respondent an opportunity to give quick feedback as well as detailed ideas. There were a total of 51 participants.

#### A. Survey Results

Are you a student, or are you a professor? (51 responses)

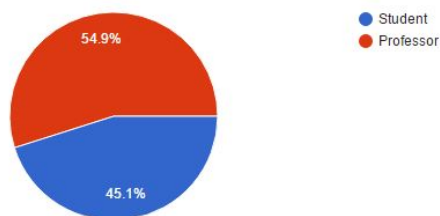


Figure 1. Background of respondents

The purpose of this question in Figure 2 was to find out what kind of problems the users are facing due to attendance management. The total respondents’ data shows 64.7 percent leaned towards “time consuming” nature of attendance taking.

What do you think is the main concern with taking attendance? (51 responses)

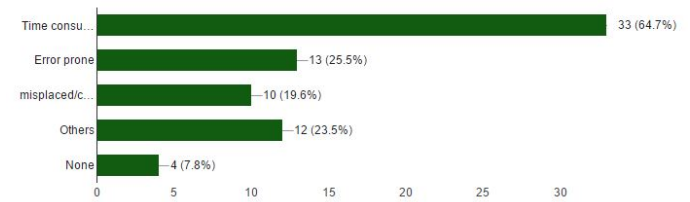


Figure 2. Attendance concerns

What kind of technology would you expect to be implemented for better attendance management? (47 responses)

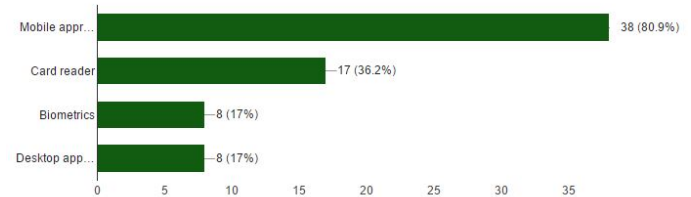


Figure 3. Technology preference

This shows us the importance of developing a product that can save time so that instructors can focus on teaching in class instead of attendance. Around 25 percent percent thought that error prone factors were a significant concern. So, we also need to keep in mind accuracy and reliability in our solutions.

We were interested in finding out about user preference in attendance management technology. In Figure 3 we mentioned four approaches namely mobile, card reader, biometric and desktop application. 80.9 percent of respondents preferred mobile applications. Mobile usage is more widespread in today’s times, which is what makes it convenient and less time consuming to a majority of the respondents. In the subsequent question, seen in Figure 4, this preference towards mobile technology continues. This trend steered our team towards focusing on mobile application development.

Lastly, we focused on the cost of the technology. The

Do you think Smart Phones might be an appropriate method of taking attendance? (51 responses)

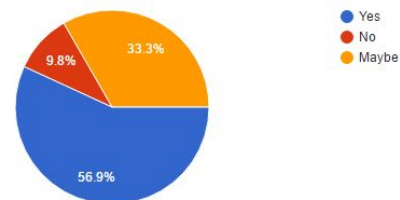


Figure 4. Smartphone preference

Attendance Management software and equipment can be expensive. How much do you think the university should invest in non-manual attendance software?  
(49 responses)

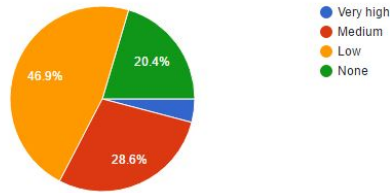


Figure 5. Expenditure expectation

above question clearly shows that almost half of the users are expecting a low cost product. On a side note, other interesting comments from the open ended questions:

*What issues have you dealt with in the past concerning taking attendance for your classes?*

Here also, the majority of responses were either related to time consuming issues or attendance was usually not taken. *What would you expect an efficient attendance management system to look like?*

Interesting ideas from this question's responses included the need for a combination of class engagement and attendance, where quizzes or participation materials completed by students would be used for attendance. At least one professor was encouraging suggesting that excellence and quality are important but imperfection is OK.

#### IV. CONCLUSION

In conclusion, attendance management is a time consuming and error prone process. Our user survey shows an inclination towards low cost mobile technology to address the biggest issues of attendance, namely time consumption and error possibility. Research solutions also reflect these findings. In the future, we are targeting derived implementations of the solutions proposed in the research papers, modified to suit mobile technology.

#### APPENDIX A

##### PROOF OF THE FIRST ZONKLAR EQUATION

##### ACKNOWLEDGMENT

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