

Automatic Attendance System

Initial Project Description

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ABSTRACT

Attendance Management is very important in both schools and universities. Teachers and Professors spend a lot of time managing it manually. Especially when the size of the class is large, it is impossible to check the presence of each and every student. While there have been lot of different methods experimented and tested manually, most of them are time consuming, difficult to organize, manage, and not foolproof. With the advancement and the availability of the technology such as smart phones and laptops, which are widely used among students, we could solve this problem in an efficient manner. Attendance management using these technologies can be unsupervised, quick and foolproof. Besides WiFi, camera and browser, we surveyed around 50 people using Google forms and found out that NFC and GPS are some of the other technologies that are prevalent in modern smart phone devices and have considered as promising technologies that would help in automating the attendance management system and solve the above mentioned problems.

1. INTRODUCTION

Attendance is mandatory in most schools and even in some courses in universities. While importance of attending classes can vary from student to student, it is very important to many instructors. The biggest problem with this is that it can be an extremely time-consuming process.

Manually taking attendance of each student could eat up into significant portion of class time meant for teaching. The amount of time only increases with the size of the class. For extremely large classes, this method is unrealistic. Randomly checking attendance of few students would save time but does not guarantee attendance of every student. Many instructors use attendance sheets to save time but this makes it extremely easy for students to falsely register attendance through proxy for students not in class. Even RFID based attendance systems that use more hardware are easily prone to proxy registration.

Quiz based attendance which is employed by some lecturers is a decent solution to the problem. Lecturers set aside 5 minutes at end of lectures to give pop quizzes. This ensures not only that students attend class but that they are paying attention during it. The main drawback of this approach is that it requires significant effort on the part of instructor. Many instructors may not have the time to do this for every class.

Considering that mobile phones and laptops are widely used by students, a software for an automatic attendance system is the most effective way to solve this problem. Most current mobile phones are equipped with technologies such as NFC, GPS, WiFi and camera that can be leveraged to provide location and identity checks to help us design a simple, foolproof attendance system.

The proposed system needs to be easy to use for both instructors and students, allow to quickly take attendance of all students and be protected from any fraudulent methods of registering attendance. Such a system would save time and effort for the instructor who could use the extra time to teach.

2. USER SURVEY

Fifty students were surveyed to understand their experience with the attendance system in the past and what type of technologies could be used to automate the attendance management system efficiently.

Question 1: *What percentage of your teachers/professors have taken attendance in school and college?* We asked this question to gauge how many teachers consider attendance important. This will give a rough estimate of what percentage of teachers and professors would be benefited from an automated attendance management system software.

Question 2: *Have you ever attended the class just to satisfy the attendance requirement?* We asked this question to understand the mentality of the students toward attendance systems. When there is no or poor attendance system in existence, students tend to miss the classes.

Question 3: *How much time is wasted in taking attendance? Answer format: (Average time taken, number of students in the class)?* There are different factors, such as type of method used, speed of the professor, that affect the time wasted to record the attendance. We mainly asked

this question to get a rough average estimate of time wasted when manual attendance system is employed for a class of fixed size.

Question 4: *What types of attendance system have you experienced?* a. Manually calling out each roll number/student name. b. Manually calling out few random student's name/roll number c. Quiz based d. Attendance Clicker. We asked this question mainly to understand how prevalent are these methods in existence. Problem with option 'a' is that it consumes too much time, especially when the size of the class is large. Problem with option 'b' and 'c' are that they are not foolproof.

Question 5: *How often do you forget to carry your phone or tablet (or it is switched off)?* Phones and tablets are some of the widely used gadgets and could be used to automate the whole attendance management process. We wanted to know how widely it is used by students and available to them inside the classroom.

Question 6: *Do you carry laptop to your class regularly?* Besides phone/tablet, Laptops are widely used gadgets. And, we wanted to know how widely it is used. If it is widely used, we believe it could be used as one of the ways to automate the attendance management system.

Question 7: *Please select all the options available in your phone.* a. NFC b. GPS c. Bluetooth. We asked this question to know what are the potential technologies that could be used to automate the process, besides browser and camera which have become basic features in modern smartphone devices.

3. DATA ANALYSIS AND INFERENCES

These questions were asked to our peers mostly students or fresh graduates. This gives us a student's perspective of the attendance system.

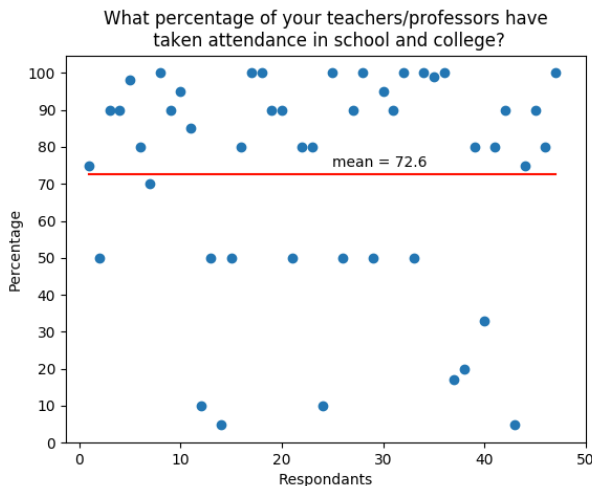


Figure 1: Scatter plot of Percentage of professors taking attendance

Most of the respondents answered that the attendance was

important to their teachers or professors. The mean of importance was about 73%. But a closer observation reveals that most of the respondents believed it to be higher than the mean. The mean is at this level because of a few low valued responses. In any case, we can infer that roughly 73% of teachers would be benefited from this software.

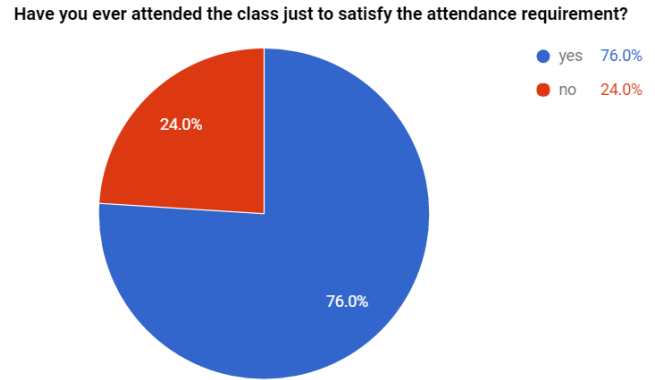


Figure 2: Pie chart of Importance of attendance to students

76% of the students valued attending classes if attendance was taken seriously. This shows the importance given by students to attendance. From this we can conclude taking attendance, will increase the students going to class.

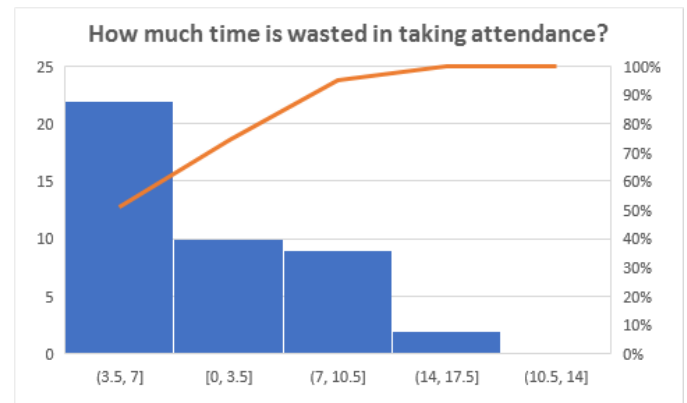


Figure 3: Pareto graph of time taken for attendance

Above is a pareto graph with the x-axis representing the range of "time taken for attendance" and y-axis representing the number of respondents whose answer fall in each frequency. We can see that that most of the students responded that time expended for taking attendance about 7 minutes (average). The time of about 7 minutes was for a class of size 50 students, but as the class strength increased the time taken also increased. In most cases the total class duration was less than one hour. So the average time wasted for taking attendance was about 12% of the class time.

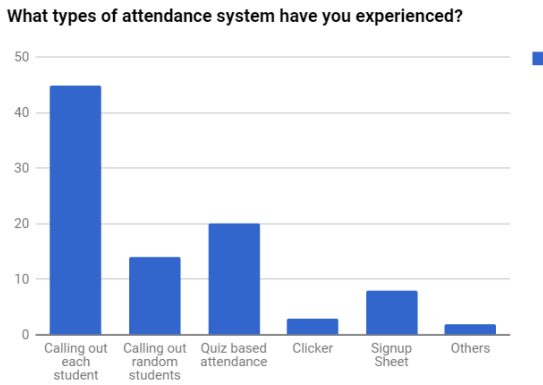


Figure 4: Bar graph of Different types of attendance systems

In this question students were allowed to select more than one option and they were also allowed to write an answer not available in the options. More than 90% of the students had experience traditional methods of taking attendance, i.e., calling out the names or roll numbers. There were considerable number of students who had also undergone quiz based attendance. One of the options we didn't provide in the survey was "Sign-up Sheet". As we had provided the students a blank box to fill in with other answers. We received considerable amount of responses which meant "Sign-up Sheet". This also shows that the students were not answering the survey seriously. However, very few students selected clicker (one of the modern methods of taking attendance).

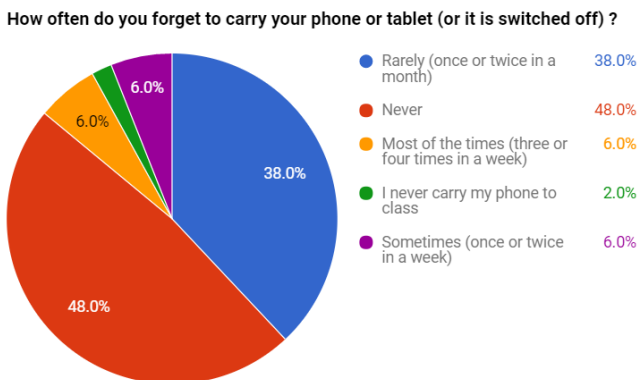


Figure 5: Pie chart of Availability of mobile phones in class

About half of the students always bring their phones to the class. And about 90% of the students either forget it once or twice a month or bring it always. Only 1 respondent out of 50 did not carry mobile phone to the class. This shows that a mobile based attendance system will be very useful and appropriate.

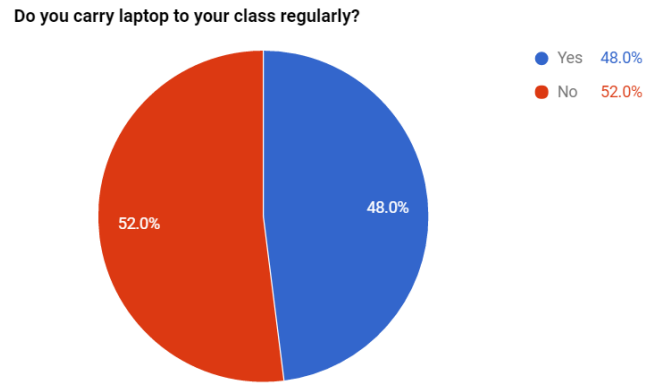


Figure 6: Pie chart of Availability of laptops in class

About 50% of the students don't carry their laptops to the class regularly. This is one of the option we were considering along with mobile phones. As more than half of the students do not carry their laptops to the classroom, phone based attendance tracking is better option.

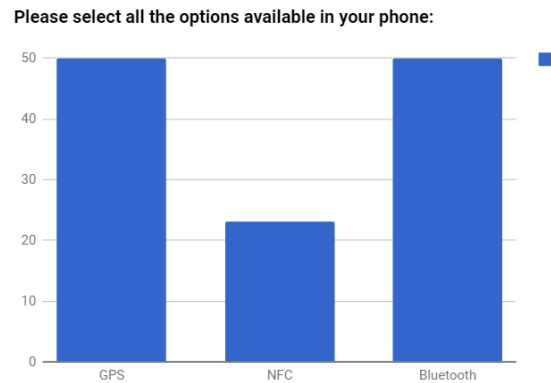


Figure 7: Bar graph of Various hardware components available in mobile phones

We wanted to check the various options available in the students' phones to build our mobile based application. We assumed everyone uses smartphone which have camera. Every student has GPS and Bluetooth options available. About half of the students also selected NFC.

4. TECHNOLOGIES

4.1 Near field communication (NFC)

Similar to WIFI, and Bluetooth, NFC allow wireless communication for data exchange between two digital devices. While WIFI and Bluetooth make use of radio transmissions, NFC uses Electromagnetic radio fields for data exchange. NFC is nothing but a set of communication protocols that help two electronic devices to communicate with each other. While WIFI, and Bluetooth devices can communicate over a distance of few meters, NFC devices will establish connection when they are brought as close as 4 centimeters. NFCs

have been widely used in the last few years in the areas such as mobile payments, social networking, and Media sharing.

NFC devices can operate in three different modes.[7] Under NFC card emulation mode, the NFC device can simulate a credit card and thus could be used for payments at point of sale. Mobile phone manufacturers such as Samsung, and Apple have employed this method on their high end smartphone devices. Under NFC reader/writer mode, NFC devices can read the data that are written to an inexpensive unpowered NFC tags. These modes can be used in lot of places such as Classrooms, Office meeting rooms, Restaurants, etc., where certain configurations for the phone, such as silent mode, is saved in the tag and the NFC enabled device can read and employ those configurations without manual interference. Under NFC peer-to-peer mode, two NFC enabled devices can establish connection and share data such as media contents, contacts, etc.,

4.2 Global Positioning System (GPS)

The Global Positioning System (GPS) provides geolocation and time information to a GPS receiver in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.[6]

The GPS system operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information.

The GPS concept is based on time and the known position of these satellites. The satellites carry very stable atomic clocks that are synchronized with one another and to ground clocks. Likewise, the satellite locations are known with great precision. GPS satellites continuously transmit their current time and position. A GPS receiver monitors these transmitted signals, and calculates the precise position of the receiver and its deviation from true time. The receiver must receive signal from at least four satellites for it to compute three position coordinates (this gives us latitude and longitude of the receiver) and clock deviation from satellite time.[6]

4.3 Quick Response (QR) code

Quick Response Code is two-dimensional barcode that can store data and be decoded extremely quickly. It has been approved as an AIM Standard, a JIS Standard and an ISO standard.[5]

QR Codes consist of black square dots arranged in a square grid on a white background. Black and White stand for binary numbers 1 and 0 respectively. There are three finder patterns located at the corners.[5]

QR Codes can store considerably large information: 2953 bytes of binary data, 7089 characters of numeric-only data, 4296 characters of alphanumeric data. [4] Advantages of using QR codes over other 2D barcodes are its large capacity, high speed scan, small printout size, omni-directional (readable from any direction in 360) and its error correction capability (data can be restored even if portions of it is damaged or distorted).[5]

5. LITERATURE SURVEY

5.1 Near field communication (NFC)

NFC is one of the latest technologies that is widely available in modern mobile phone devices. As discussed earlier, NFC devices can operate in three different modes, namely Card Emulation, Reader/Writer Mode, and Peer-to-peer mode. Among these modes, Reader/Writer mode and Peer-to-peer modes can be used to automate the attendance management system. Mobile Attendance using Near Field Communication and One-Time Password[3] discusses one such method of automating the attendance system. Though there are many different ways to solve the problem, NFC method is very fast and secure compared to most of the other methods.

As discussed in the Technology section, two NFC device will establish the connection, and start communicating when they are brought together as close as 4 cms. As most of the students carry their mobile phones to the schools and the universities, they could register their attendance by simply bringing their phone near to a NFC tag or a NFC enabled device setup at the classroom. And, the mobile phone of the students should run a software that will communicate with a centralized server to register the presence of the student.

5.2 Global Positioning System (GPS)

The mobile application on both professor's and students' device could find the position of their respective devices and grant attendance based on proximity.

Once the professor creates an event (for a lecture) within the application. This event will be shown on the student's phone application. Students can select the appropriate event (lecture) they are attending. The application will calculate the proximity of the student and the professor. Then the centroid of all the students in that particular event will be computed. Based on 2 factors the attendance system will validate a student's attendance. Proximity of the student and the professor and the proximity of the student to the centroid of students. Based on a predefined distance threshold the attendance will be given to the students.[2]

There are few disadvantages: As the altitude is not calculated by the GPS, the student might get attendance if he's above or below the classroom (need not be inside the classroom). We can overcome this drawback using NFC and other authentication methods. Not receiving GPS signal inside the classroom. Student could hand over the mobile device to another student who can use the device to validate the attendance. The above problems can be prevented by using authentication methods like fingerprint and facial recognition.

5.3 Quick Response (QR) code

A mobile application could enable registering and logging in for both instructors and students. Instructors could login and generate QR codes anytime before class with specific information such as course, section no., instructor's name, date and time of class and a passcode.[4] This way the QR code would be unique to each class. We can use available web APIs such as the ones detailed at <http://goqr.me/api/> to generate and read QR codes.[1]

This QR code could be displayed on the first slide for students to scan with the camera on their smartphones. Depending upon the instructor's rules about coming late to class, it could also be displayed in the corners of the following slides as well keeping in mind that the system could capture the exact time at which the QR code is scanned.[4]

Students can login into the application on their own smartphones and scan the QR codes on the slides to register their attendance.

The biggest problem with simply scanning QR code is that this does not necessarily guarantee that the student himself/herself is in the class. Another student could just as easily login to the account and scan QR code for them. We could prevent this by additionally running an identity check before they scan the QR code. This can be done by taking a facial image[4] and comparing to other stored images of the student or maybe even through fingerprint authentication depending on the smartphone being used.

Even with the additional identity check, the system is still vulnerable to fraudulent acts because this process can easily be replicated outside class. So students could send an image of the QR code to other students outside class either by email, WhatsApp or Facebook thus allowing them to register their attendance. The best way to prevent this is to run a location check on the mobile maybe through GPS to ensure that the student is in the classroom while registering attendance.[4]

6. CONCLUSION

Our study reveals the importance of taking attendance, various attendance tracking methods in use and the wastage in time while taking attendance. The widespread use of mobile phones and the various hardware and software components available in mobile phones gives us plenty of opportunity to create a better attendance tracking system using mobile phones. An application built with combination of various methods discussed, such as NFC, GPS and QR-Code will increase time efficiency and decrease errors. Our studies also show that the mobile phone are used more than laptops and this reinforces our choice of platform, mobile phones, to implement this system. Implementation of any single method of might not be foolproof but the combination of the above mentioned methods will create a robust attendance tracking system.

7. FUTURE SCOPE

This attendance tracking system for students can be extended to the workshops, conferences and various other gatherings where the attendance might be important. It can also be used in the workplace to track the employee attendance, number of hours spent at the office etc. One of the most important resource available from this system is ready availability of attendance data. Data mining and Data analysis of this data gives insights which might not have been available before.

8. REFERENCES

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