Smart Class Room Attendance System Based on Proprietary Automatic Student Sensing Classroom Chairs

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Abstract: **Attendance system is a system that is used to track the attendance of a particular person and is applied in the industries, schools, universities or working places. The traditional way for taking attendance has drawback, which is the data of the attendance list cannot be reuse and tracking and tracing student's attendance is harder. The technology-based attendance system such as sensors and biometrics based attendance system reduced human involvement and errors. Thus in this paper, a multi touch sensor based attendance system is presented. A comparative study between Our Proprietary Touch Sensor, NFC and RFID is also discussed thoroughly, especially in terms of their architectures, functionality features, benefits and weakness. Overall, even both NFC and RFID attendance system increases the efficiency in recording attendance, touch sensor based system is providing more conveniences and cheaper infrastructure in both operational and setup cost as compared to the first two.**

Keywords: **Attendance system, Multi Touch Sensors, Near field communication (NFC), Radio frequency Identification (RFID), Smart Chairs, Automatic Presence Detection.**

I.   INTRODUCTION

Successful schools begin by engaging students and making sure that they will come to school regularly, so the attendance rate become very important. Attendance system is a system that is used to track the attendance of a particular person and is applied in the industries, schools, universities or working places. The attendance rate will be calculated based to the average percentage of students attending school in every class of the course. The attendance rate is important because students are more likely to succeed in academics when they attend class consistently. It's difficult for the lecturer and the class to build their skills and progress if a large number of students are frequently absent. Moreover, the students have given the right to have their own time management in university. This will cause the attendance rate of the class become a major problem because some student may choose to absent from the class. Therefore, students from university in Malaysia are required to attend the class not less than 80% per semester otherwise student will be barred from taking any examinations.

The traditional way for taking attendance has drawback, which is the data of the attendance list hard to reuse. If the lecturer wants to calculate the percentage of the students that attend to the class, he/she has to calculate manually or input by typing. This also easy lead to human error such as the lecturer may wrongly. The technology-based attendance system will reduce the human involvement and decrease the human error. There are various types of attendance systems that are applied in different fields. Mostly, the working places are still using the punch card system. But some of them had integrated their system into biometric attendance system. The biometric attendance system is based on fingerprint identification using extraction of minutiae techniques and it is very reliable and convenient to verify the identity of people. Human fingerprint is read by the reader to take the attendance as the uniqueness of human's fingerprints [1]. Another technology is Radio Frequency Identification (RFID) based attendance system that consists of RFID Reader,

RFID Tag, LCD displays and microcontroller unit [2]. RFID can be interfaced to microcontroller through Universal Synchronous, Asynchronous Receiver Transmitter (USART) [2]. Data is transferred from RFID cards to reader and from there to the microcontroller. These attendance systems are important for large scale organizations in order for them to process a large number of workers' attendances rapidly. It makes the work more efficient and produces accurate results.

The NFC based attendance system is another means to tackle conventional attendance system problems. above. Because the installation cost of NFC based attendance system is lower than the other advance attendance system likes the fingerprint attendance system. The main advantages of the NFC are the simple and quick way of using it and the speed of connection establishment is fast [4]. Besides that, other important advantages of NFC technology have also included the transmission range of NFC devices. The transmission range is so short, when the user separates the two devices more than the limited range, then communication is broken [5]. The NFC based attendance system can process the data collected in a quicker way compared to manual system which need to enter the data one by one. Besides, all the data will be saved on the server and this can avoid of losing any students' attendance. Students can also check their attendance rate using their smartphones through the login system from time to time to avoid any miss entering of attendance. Thus the main objective of this paper has present a new NFC based attendance system capable of recording and tracking students' attendance in the classroom. Second objective will look into two-different sensor based attendance system which is RFID and NFC-enabled.

II. DEVELOPMENTS IN AUTOMATIC ATTENDANCE TECHNOLOGIES

There have some researches that develop technology-based attendance system. Basically technology-based attendance system can divided into two groups; i) Biometric-based Attendance System and ii) Sensor-based Attendance System. Next we will discuss some of related systems within this two group.

A. Biometric Based Attendance System

Biometric-based attendance system recognize a person identity based on the biological characteristic such as fingerprint, hand geometry, voice, retina, iris and face recognition which reliably distinguishes one person from another or used to recognized the identity. They have five subsystems: data collection, signal process, matcher, storage and transmission. However, the biometric system is suitable for highly secured system and mostly the biometric system is expensive [9]. Kadry and Smaili [10], implement an attendance system based on iris recognition. The system takes attendance as follows ;a) a digital image of one person's eyes to be verified is captured ;b) feature extracting algorithm is carried out;c) minutiae are extracted and stored as a template for verifying later; d) eople to be verified place his eye on the iris recognition sensor and e) matching algorithm is applied to match minutiae. Talaviya et.al [11], implement a system that takes attendance of student by using fingerprint sensor module. When the student enrolls his/her finger on the finger print sensor module, his/her fingerprint will matched with database to mark the attendance. Chintalapti and Raghunadh [12], implement an automated attendance management system based on face detection and recognition algorithm. Every time the student enter the class, his / her images will be capture by the camera placed in the entrance. The images will retrieve the identity of the student and take attendance for that student. They use Viola-Jones algorithm for the face detection part. There are five performance evaluation conditions used by them for the face recognition part, which are PCA + Distance Classifier, LDA + Distance Classifier, PCA + SVM, PCA + Bayes, LBPH + Distance Classifier. As a whole biometrics systems are known for its more expensive means of setup and operational costs. In term of its accuracy, biometrics attendance system prevents cheating and has lesser false alarm rate.

B. Sensor-Based Attendance System

Barcode technology is a method of identification, which is used to retrieve in a shape of symbol generally in bar, vertical, space, square and dots which have different width with each one A reader of scanners are required to identify the data that represent by each barcode by using light beam and scan directly to barcode. During scanning process, a scanner measured intensity of reflected light at black and white region. A black region will absorb the light, meanwhile white region will reflect it [9]. Smart card is built with variety of chip with a simple memory consisting of byte of information may have range from 1K up to 64K of microcontroller or multi-application memory. Smart card can use as individual identification, building access and network access are part of a multi-tiered program that is in the final stages of rolling out. The data in smart card can be read when a physical contact has a reader [9]. Meng and Mahinderjit [9], implement an attendance, which take attendance by using RFID. Figure 1 shows the system architecture of the RFID attendance system[9].
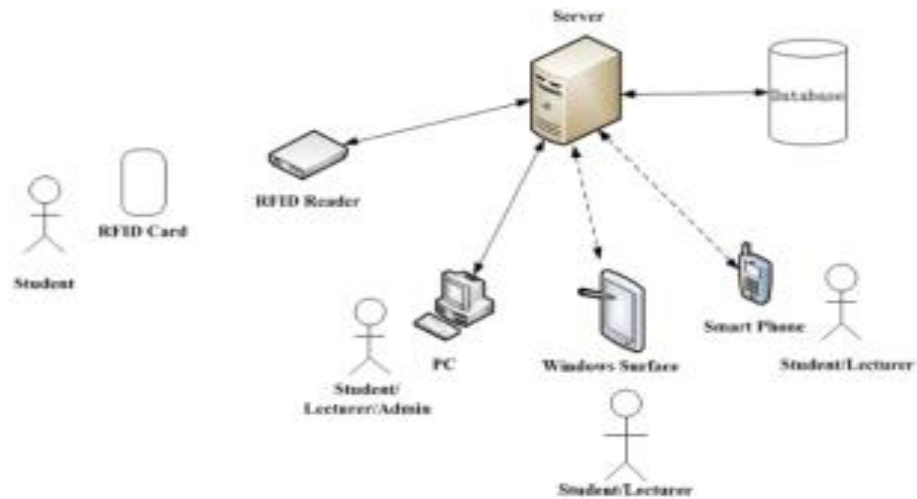
Figure 1. System Architecture for RFID attendance system [9]

RFID is an automatic identification method, whereby identification data are stored in electronic devices, called RFID tags (Transponders), and RFID readers (interrogators) retrieve these data. Based on the figure, students only needs to place their RFID tags which contain a unique id number on the reader and their attendance will be taken immediately. Every time the student enters / leaves the class, they need to scan their RFID tags with RFID reader. The RFID reader will read the identification code in the RFID tags and transfer the code to the PC, which connected with USB. A program in PC will retrieve the student's identity from the database using the identification code that received and take attendance for that student. RFID based attendance systems are costly and requires extra infrastructure for its operational. Ayu and Ahmad [13], implement NFC supported attendance system in a University Environment named as TouchIn. Before the class start, the lecturer will run a mobile application on his/her own NFC-enabled smartphone, students that want to take the attendance will run another mobile application which will fetch the student ID from file, read the device ID and beam (send) it to the lecturer's device by simply touching the device. The attendance of the student will be taken. This system has disadvantages if compared to this project such as the accuracy is low on the identification part. The student can help his/her friend taking attendance, although his/her friend is absent. They just need to borrow their smartphone to his/her friend and his/her friend can scan the lecture's device with the smartphone and attendance will be taken.

C. Near Field Communication Attendance System Overview

A smartphone is a mobile phone with an operating system. Smartphones typically include the features of a phone with those other popular mobile devices, such as personal digital assistants, media player and GPS navigation unit. Most have a touchscreen interface and can run 3rd-party apps, and are camera phones. Later smartphones add broadband internet web browsing, WI-FI motion sensor and mobile payment mechanisms. Soomro, 2013[5], shows that almost 2 billion people all around the world will be using Smartphones, Laptop, Tablets and Desktops by 2014. This rapid growth for smartphones over the years shows the amount of users of smartphones are increasing and this means it will be easier to just put in an NFC tag on each of the smartphones for people to use it and it'll be more convenient. Besides that, most of the Android smartphones has the NFC tag.

NFC stands for Near Field Communication which is a wireless communication interface for the devices that equipped with NFC [3]. The working distance for NFC is just up to 10cm only, but the set up time is just less than 0.1s [3]. There are 2 kinds of modes which is active mode and passive mode for the NFC devices [3] (as shown in Table 1). The device which generates its own RF field is called an active device, while the device which retrieves the power from another device is called a passive device. Besides that, the device which starts the communication is called an initiator. The initiator is only in active mode and could have many targets which either active mode or passive mode. One initiator can only communicate with one target at one of time while other relevant targets will be ignored at first [3]. Hence, the broadcasting message is impossible in the NFC.

D. System Architecture NFC-Enabled Student Attendance System

The proposed system in this project is a web based attendance system using NFC technology in Android smartphones. The system has two main components which are reader unit and server unit which is hardware and software components

respectively. The hardware component of reader unit are NFC enabled Android smartphone and student materials card with NFC tag while the server unit is the computer that host web services and databases. This part of the paper consists of, how two sections that are User Interface which explains about the user interface of the project and the System interface which also explains about the System interface about how it works and how is it done. The figures 2 show the examples of the interfaces.

Figure 2. NFC-enabled Attendance System Interface

According to above figure, there are two classes of user which is the students and the lecturers.Next we will discuss on the NFC based attendance and this is shown in Figure 3. Firstly, the administrator of the school needs to create an account for the students and lecturers in order for them to login to the system. The admins are able to update the account and delete the account in case of wrong data is entered. Besides that, admin should generate a list of the students that enrolled in the particular subject for lecturers' reference. On the mobile app, students need to login to their account in order to register for the attendance for each class that they attend. They also can view the amount of attendance for respective subjects on their phones. For the lecturers, they need to login to the system first and select the subject every time they want to record the attendance. The lecturers will be able to calculate the total attendance of the class and generate a report about the attendance rate at the end of the semester.
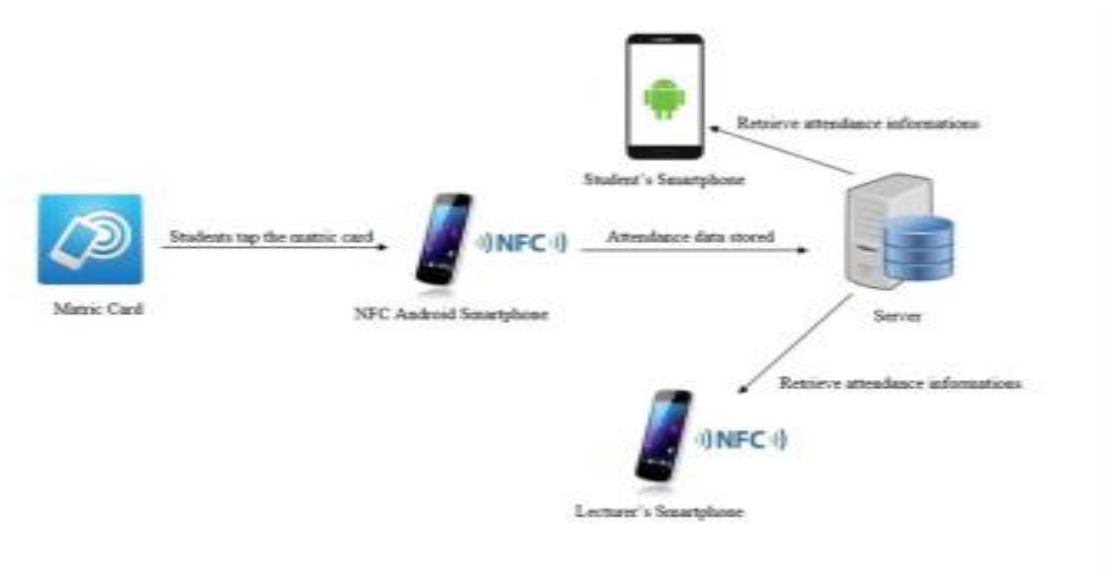

Figure 3. NFC-enabled System Architecture

The student has to tap the matric card towards the NFC android Smartphone and automatically the attendance will stored in the server. For the lecturers to check the attendance of the student, the system will retrieve the attendance information from the server to the Lecturer's smartphones. The system also does give the information to student's as well to check for them whether the days they have attended and did not attend for their own record. In this project, the implementation strategy used is bottom-up strategy. The implementation start from the lowest level of software unit such as view report, take attendance, generate reports and etc., which are the function within the student module and lecturer module. Then, all the lower units are linked together to form higher level units such as NFC module, student module and lecturer module. Next, the modules were designed and implemented, followed by the subsystems and finally the complete system.

In order to do the testing, users log in as the administrator, lecturer and students. RFID system, web page system, smartphone application and tablet application were fully tested. Below are the results of the functional testing shown in Table 2. Testing is the process of examining a component, subsystem, or system to determine its operational characteristic and whether it contains any defects. The lecturer will be assigned an account with ID and password. They need to login to the system with their corresponding authentication to create an attendance sheet of the conducted classes and view the report of the attendance of the student. They only can create the course they have enrolled. The student needs to approach their NFC tag (Matric card) to login, system to view their attendance report. The student can only take 1 time attendance in each attendance sheet of class conducted. Students who enroll for the course only can take the attendance.

User	Function	Description	Working
	Select User Type	Select the user type based on their type	YES
Lecturer	Login	Login with ID and password	YES
	Home page	Display option for lecturer	YES
	Create attendance sheet	Select course, time and date to create a new attendance sheet	YES
	Take attendance	Able to manually take attendance or read student's NFC tag	YES
	Proceed to take attendance on the current sheet	Continue with take attendance activity without create a new sheet	YES
	Generate report	Display a list of attendance of the student by selecting the course	YES
	View particular student attendance report	click on the student in the report to view the detail report	YES
	Filter attendance by date	Display a list of student attended the class on the selected the date	NO
Student	Login with NFC tag	Scan NFC tag to view report	YES
	View personal attendance	Display attendance of the student	YES
	View date and time of Class, attendance and absence	Click on the attribute to view the date and time	YES

Figure 3. NFC-based Attendance System Functional Testing

III.   CONCLUSION

Our concept is based on the further modification of the previous systems that we used before in RFID, NFC systems for attendance automation. Instead of making the process of attendance automatic, we designed a system that would require minimal student interference as well as faculty interference. It would be mostly automatic from start to end of the total process.

We have used a concept of making the class room smart itself for the purpose of the attendance. By this we mean that, instead of installing additional equipment in class room for attendance purposes, we have made the sitting chairs smart itself for the purpose of attendance.

We use two pressure sensors in series along with a tactile push button to act as a attendance sensor for each student (each chair).The one pressure sensor remains on the lower panel of the chair on which the student sits (base) and the other pressure sensor is kept on the back part of the chair (back side).The tactile push button switch is kept on the front table.

All the two pressure sensors as well as the push button are connected in series with each other. The two ends of this series sensors and button are connector to the base and the collector end of a transistor (2n2222 or bc547 or similar).The transistor is made to work as a switch in this system. When the student sits on the chair, he is asked to push the attendance button and sit back relaxed for few seconds, the student obeys and the voltage is dropped or gained across the collector and base end of the transistor(depends on whether the pressure sensor is negative or positive).Due to this, the transistor base gets activated and we take the output from the collector end of the transistor into the microcontroller(8051,8052,etc) input PIN. We bias the transistor in such a way that when the circuit of pressure sensor gets closed, the transistor gets activated and it gives a output to microcontroller. We will also keep a 3mm led in series with the pressure sensors so that the student also knows that his attendance is being accounted for. We now have to configure and program our microcontroller. In a 8051 microcontroller, we have three ports. In each port, we have 8 PINS, so a total of 24 PINS we have. We will use two ports as input ports and one as a output port. We also know that a 8051 is Bit addressable and each pin on every port can be used as a input. So we get 2*8=16 input lines for a single microcontroller. So the attendance of 16 students can be processed by a single 8051 microcontroller. If we consider a ideal classroom of about 60 students, then we will have to use 4 microcontrollers to simultaneously process all the 60 inputs. This will also mean that we have to use 60 transistors, 60 tactile switches,60 3mm led's, 120 biasing resistors, 120 pressure sensors and few capacitor components. We will also use a copper clad PCB and design and optimize our circuit using Multisim simulator and Diptrace. We will also use a common external memory for all the four microcontrollers. We will program the microcontrollers in such a way that all the attendance of 60 students get stored on 60 different memory addresses in the common memory. From this point, we can either use a Arduino Ethernet shield to interface our 8051 with internet directly using another Arduino module as a middle interface or we can directly interface 8051 with PC using RS232[14].The later one is easier and better than going for Arduino because Arduino is a third party hardware and that would make the system more complex. The interfacing element between the 8051 microcontroller will be a MAX232 IC by which we can transfer the data using 2 wires from 8051 to PC. We will only employ a single microcontroller for transfer job as we are using a common memory element. Hyper Terminal, a Windows XP application, can be used to receive or transmit serial data through RS232. To open Hyper Terminal, go to Start Menu, select all programs, go to Accessories, click on Communications and select Hyper Terminal. To start a new connection, go to File menu and click on new connection. The connection window opens up. Give a name to your connection and select 1st icon and click on OK. Connection property window opens here. Select Bit rate as 9600bps, Data bits 8, Parity as none, Stop bit 1, Flow control none and click OK. Now the serial data can be read on hyper terminal. In program, Timer1 is used with auto reload setting. The baud rate is fixed to 9600bps by loading TH1 to 0xFD. The value 0x50 is loaded in the SCON register. This will initialize the serial port in Mode1. The program continuously receives a character (say 'a') from the serial port of the computer and transmits it back.

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