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Online Classroom Attendance System Based on RFID Technology and Cloud Computing

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Abstract —Students attendance in the classroom is one of instrument for marking in the end of class, several students are cheating they attendance while manual system used which is signed the form or sheet. Furthermore, manual sheet attendance is ineffective way while digital technology available and widely used in today. This research proposed on online attendance system for students and lecturers, where every student before entering the classroom have to tap their student card on RFID reader available in front of classroom. Attendance for time in and out set to complete of attendance in a lecture. Time tolerance for late and early out is set 10 minutes before and after the schedule time. Similar to students, every lecture required to tap as well before and after teaching in the classroom, besides that lecturer required to hold his card on RFID reader to on electricity in the classroom else no electricity and no power supply provided. The data of students and lecturer attendance with room number is set and send to a database for student's attendance record and honorarium for lecturer. This system tested in a classroom of Faculty of Engineering, Islamic University of Riau with the number of students is 40. Data collected by RFID reader passed to the cloud server through Arduino Microcontroller for filtering in case student double tapped in RFID scanner. In order to match and avoid cheating by students who tap double students card thus a camera installed in the classroom for record and match student face by image recognition system to picture taken as in the card. The system gives effective and efficiency in administration, paperless and efficiency for staff to control and check in manual attendance is one of the advantages of this system.

Keywords— Classroom attendance, RFID reader, Cloud computing, Database

I. INTRODUCTION

Classroom teaching is a common method that currently applying by most the academic institution including in school and colleges. The conventional method by having manually signed the attendance in a sheet of paper then passed around the classroom while lecturer conducts the teaching in the classroom is wide implements nowadays. This method could undoubtedly allow the students to do cheating about their attendance in the classroom, where a student may sign for an absent student. Besides that, the attendance form can be easily misplaced or lost during circulate it. A stricter approach specially to prevent students to do cheating about their attendance is additionally tedious have to do, where a lecturer calls out the individual names of every student based on student name list and validate the presence of every single student. This way of manual methods of taking students attendance has been proven but to be difficult and time consuming to check every student. Uncontrolled, whether the authenticated student is responding or not, calculation of consolidated attendance is another major task which may cause manual errors. In some other cases, the attendance sheet may become lost or stolen by some of the students. The consequences of such issues with paper-based attendance register have made it stressful and non-effective, most especially in large classes. As a result, there is a need to come up with a new and modern way of tracking and managing attendance records of students in higher institutions of academic learning more efficiently and effectively.

Therefore, it is very important to develop a system for attendance equipped with an online database, especially to prevent data loss as well as to promote paperless and green technology and environmental campaign. Besides that, the application will help to reduce time being wasted, leading to higher learning productivity in class. There are a few paperless attendance systems that have been developed but such systems need to be equipped with either a computer or RFID reader, resulting in an additional cost for hardware and its maintenance may incur. With that in mind, we have aimed to address this issue by having a system with minimal hardware requirement and at the same time, enhancing the mobility aspect of the existing attendance systems. Furthermore, to overcome such troubles as mention in the above discussion, we are in need of an automated attendance management system. There are many methods available in which the basic concept is the same. In this system proposed an automatic student and staff (lecturer) attendance system, where RFID reader installed in every classroom and assign with an identity for identification of what classroom used.

II. RELATED WORKS

This section discussed on several works have been done on previous research conducted. In previous works review related systems and student different for the methods in record student's attendance. The use of android based system for students attendance as discussed in [1] where the application installed then can be download the students list from a designated web server. Refer to students attend in the classroom after their scan the card to Radio Frequency Identification (RFID) reader [2]. Additional of device such as cameras used to support the system information and student's attendance confirmation. Another research discussed on this attendance system which elaborate in [3, 4] describe the students attendance without human interference. The used of camera as a method to fix in the classroom and will capture the image of student going into room, the faces of students are detected and then recognized and match to the database and finally attendance of student is marked.

The other research is developed student attendance system used a fraction of the classroom for participation points and lead the students' attendance list into a preset teaching system such as attendance by checking every student, random questioning based on the list, and quiz. Similar to the ladder ranking system that widely used in current online computer games, students can check their ranking of accumulated absence and points in the end of class as a long term stimulus for study. [5-7].

The traditional student attendance system required physically sign the attendance sheet every time conduct lecture in the classroom. This method is unnecessarily time consuming to notice and mark student's name on the attendance sheet. This is happening that some students may accidentally mark the others student name or willingly to do it. Normally, the hard copy of attendance sheet after a few weeks may get lost or easily get messy. Used of smartphone such android technology will help teacher to get student attendance easily by online system then be able to check percentage student attend the class as well to copy or print it. By using the stored information, teacher easily to mark student attendance, attendance percentage calculations, marking intruders' entry, send emails or send message to the parent to keep them updated about their child's attendance at the school or college [8, 9].

Online Biometric-enabled Class Attendance Register System (OBCARS) prototype elaborate by [10] develop and design to change of misplaced and torn attendance register form in various classroom in school or college. System used biometric fingerprint reader for every student before entry the classroom. While the [11] discuss on student attendance system used Near Field Communication (NFC) system. The solution be able to provide a convenient and portable classroom learning system to the school or college and university to improve the interaction in the learning process among students and reduce the workload of lecturers in processing the attendance statistics [12, 13]. All over previous research used normal online system then in this research proposed a new method of online system for student and lecturer pairing to make sure lecturer attend in the classroom as well. Beside that the use of cloud computing is one of additional feature in this system to make sure data of student's attendee can be access staff in everywhere. Student attendance information is very important is not only for classroom marking but for finance department to pay lecturer honorarium.

Image recognition system has been developed in many kind of research, such as facial recognition and finger or thumb print recognition. Some research discussed on this image recognition using neural network and video recognition system as elaborated in [14-16]. An algorithm base image recognition system and implementation of students attendance using video camera with convolutional system as discuss in [17], while a crowded class attendance be able to recognize as elaborate in [18], finally a paper discuss on facial image recognition based on students behavior as in [19].

III. PROPOSED ONLINE ATTENDANCE SYSTEM

The proposed solution for online student attendance system uses several components and integration to become a system that is able to manage student's attendance. Difference to the current system that developed by other researchers, in this cloud computing has been used for data management system beside local server in an academic institution. Fig. 1 shows a block diagram of the student attendance system, where Arduino and RFID reader is the main unit for this system to control student and staff attendance.
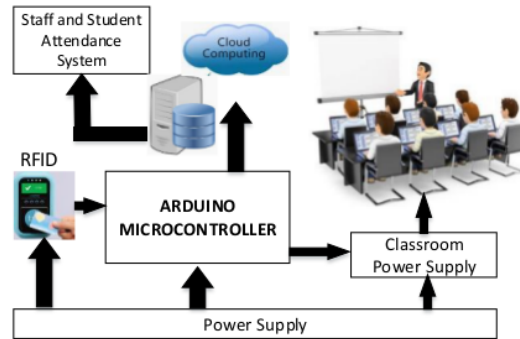
Fig. 1. Block diagram of student attendance system.

Student and staff card occupied with RFID chip which is Mifare 13.56 MHz and memory 1kB thus in this case users of the RFID reader to retrieve student or staff information by using an RFID system. Information stored in student card is limited, only the identity (ID) data stored with some information, this system designed to retrieve student ID information which is 9 characters same as to student matric number, as well as for the staff ID with 9 characters.

Fig. 2. Flowchart of the student attendance system to process the information.

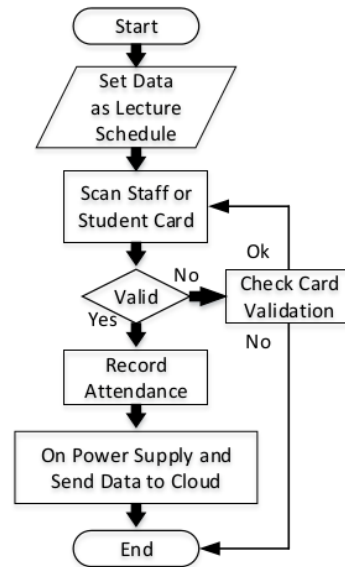Once ID of student or staff received by RFID reader then the information received in Arduino Microcontroller to compare to student or staff ID in database, this case student information linked to student academic management system, where every student as they are accountable for academic purpose, since the data and information available then attendance system only connected to the database without to set up a new database management system. Similar to student database, information of student classroom and schedule linked to the academic management system which every faculty have to manage lecture classroom, schedule, subject, time, and student registration the subject. Fig. 2 shows a flowchart of the attendance system that flows of the process in the system. All the information start from student scanning the card then system decide whether valid or information to process or not then make the decision of student attendance.

A. RFID

A set of sensing system with all the sensors to detect Radio Frequency Identification (RFID) is a technology based on wireless communication and Non-Line of Sight (NLOS) to retrieve information. Radio wave concept in RFID is able to collect information from the transponder (tag) to RFID reader, with advantages of this technology and more convenience for student attendance system thus apply in this system. Fig. 3 shows a sample of student ID card used in this system with an emended RFID chip.

Fig. 3. Sample of student ID card.

Similar to the student ID card, every lecturer and staff occupied with RFID chip in ID card as well, thus the process of data retrieve same as to student ID card. Fig. 4 shows a sample of lecturer and staff ID card with an embedded RFID chip.
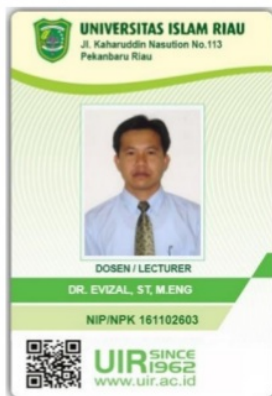

Fig. 4. : Sample of Lecturer and staff ID card.

B. Arduino

Arduino is a project based on an open source system that easy to use by the developer, hardware and software integrated system developed in a package. Currently, the Arduino module widely used in many application, thus in this attendance system used Arduino for microcontroller system. Fig. 5 shows a picture of the Arduino module connected to an RFID reader to read and retrieve card information. All the information analysis and to be matched to the database as well as class schedule and verification then final information stored in the database. In order to be accessed by any party that required this information thus a cloud database setup to keep all the information.
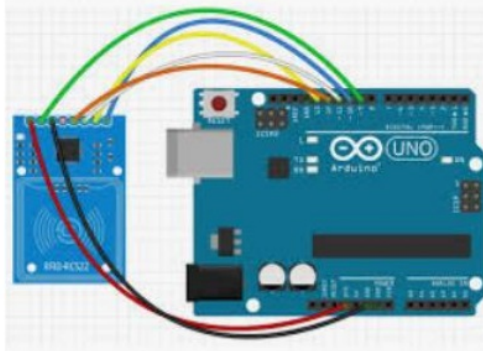
Fig. 5. An Arduino module with RFID reader.

C. Cloud Computing

Cloud computing is a technology in computer science recently become an alternative to change from the local server to the cloud. The demand for availability in a computer system resources and especially for the data storage and computing power system without direct to a local server that manages by the user. The term cloud computing is generally used to describe data centers available to many users over internet access. Fig. 6 shows a configuration of a cloud computing to be accessed by any user and the management system.
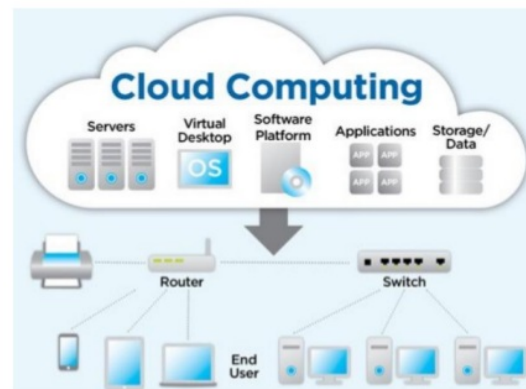
Fig. 6. Configuration of cloud computing.

D. Video Based Attendance Recognition

Student attendance system used RFID technology has been discussing in previous section, in order to match number of students tapped they are card on RFID reader to actual students attend in the classroom then face recognition system used. Fig. 7 shows a lecture conducted in a classroom and camera captured student facial image, take some time to complete number of students inside the classroom because various behavior of student.

Fig. 7. Lecture conducted in the classroom.

Simple process of students recognition because only to get confirmation and match the image of students in the classroom. Fig. 8 shows the process that consist of 3 steps, which is face detetction done by camera inside the classroom, next is extraction of image captured and final process is recognition of image which facial through our image segmentation by eigen vector implement in this research.
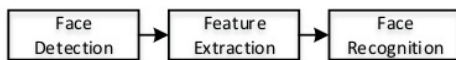

Fig. 8. Image recognition process.

The basic component to analysis th image started with initialize face image of students capture by camera, then changing to the convariant matrix of face capture by camera. Fig. 9 sample of image capture by camera to be analyse step by step for every student and match to picture on the card as recorded in the system.
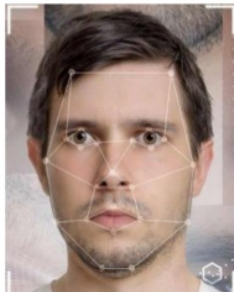

Fig. 9. Samlple of image capture by camera.

Processing of images capture for extraction which is matix number 3x3 as shows in Fig. 10.

$$\begin{bmatrix} 0 & 4 & 3 \\ 1 & 4 & 2 \\ 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 2 & 2 & 1 \\ 3 & 2 & 4 \\ 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 4 & 2 \\ 2 & 3 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$
(a)　　　　　(b)　　　　　(c)

Fig. 10. Convariance matrix image capture by camera (a) first image (b) second image (c) third image.

Next process is to calculate value of mean of the covariance matrix of images as shows in (1).

$$\Psi = \frac{1}{3}\sum_{n=1}^{3} \Gamma_n = \frac{1}{3}\left(\begin{bmatrix} 0 & 4 & 3 \\ 1 & 4 & 2 \\ 0 & 0 & 0 \end{bmatrix} + \begin{bmatrix} 2 & 2 & 1 \\ 3 & 2 & 4 \\ 0 & 0 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 4 & 2 \\ 2 & 3 & 0 \\ 0 & 0 & 0 \end{bmatrix}\right)$$

$$\Psi = \frac{1}{3}\begin{bmatrix} 1 & 3 & 2 \\ 2 & 3 & 2 \\ 0 & 0 & 0 \end{bmatrix} \tag{1}$$

In order to reduced the covariance matrix of segmentation facial image of students against mean to get or normal data, then (2), (3) and (4) shows the used.

$$\Phi_1 = \Gamma_1 - \Psi = \begin{bmatrix} 0 & 4 & 3 \\ 1 & 4 & 2 \\ 0 & 0 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 3 & 2 \\ 2 & 3 & 2 \\ 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\Phi_2 = \Gamma_2 - \Psi = \begin{bmatrix} 2 & 2 & 1 \\ 3 & 2 & 4 \\ 0 & 0 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 3 & 2 \\ 2 & 3 & 2 \\ 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\Phi_3 = \Gamma_3 - \Psi = \begin{bmatrix} 1 & 4 & 2 \\ 2 & 3 & 0 \\ 0 & 0 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 3 & 2 \\ 2 & 3 & 2 \\ 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$C = \frac{1}{M}\sum_{n=1}^{M} \Phi_n \Phi_n^T \tag{2}$$

$$C = AA^T \qquad A = [\Phi_1, \Phi_2, \dots, \Phi_M] \tag{3}$$

$$L = AA^T, \text{ where } L_{m,n} = \Phi_n \Phi_m^T \tag{4}$$

Final result image segmentation as show below,

$$L = \begin{pmatrix} \begin{bmatrix} 0 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \end{pmatrix}$$

$$L = \begin{bmatrix} 4 & 2 & 1 \\ 2 & 3 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

In summary all the step of facial image recognition can be wirte as:
- Once image decomposition of data obtained used eigenvalue and adjust;
- Then, to get eigenvector of eigen value decomposition of image data;

- Follow by sorting the image of eigenvectors;
- Finally, the data obtained as whos the final results of eigenvectors data adjusted.

Table 1 shows several expression of facial image of students during attenting the class or lecture, this image categories classified in order to record and help system in matching process, all the data recorded in the system as data for training of system.

TABLE I.　　Expression of Students Facial Styles

Step	Expression type
1	Normal
2	Smile
3	Sad
4	Upset / Angry
5	Normal with Glasses
6	Smile with Glasses
7	Sad with Glasses
8	Upset / Angry with Glasses

IV. RESULTS AND DISCUSSION

Application of student attendance system has been developed and tested in the real classroom, some class of lecture tested with this system. Fig. 11 shows a screenshot of student and lecturer attendance system in the classroom.

Fig. 11. Application student attendance system.

In this case, an average of students in a classroom is 40 students, in the previous student used manual sheet form that must sign to proof attendance in classroom, this application student just wipe the ID card to RFID reader installed in front of a classroom, if the status of the student is matched to class schedule then the information recorded and send to the data center, in this case, cloud computing used to store all the information. Maximum tolerance for the late in the classroom is 15 minute, so after late duration student consider absence although they wipe the ID card then no record keeps in the database. Similar to late toleration duration, the student must wipe ID card to RFID reader before the class finish to record the attendance, in this case, the duration is 10 minutes before and after time schedule after the schedule that every student must wipe the card else no out class recorded and student consider attendance not complete. Fig. 12 shows a system for management before class start have to set by the officer.

Fig. 12. Attendance schedule system.

A report of student attendance system generated once lecture class finished, the report shows for every student in a classroom that attends the subject conducted by the lecturer. The report also recorded attendance for all the weeks, in this case, 16 weeks to complete a subject in a semester. Fig. 13 shows a report sheet generated by this system.

Fig. 13. Student attendance report sheet.

All the information for every student and classroom including staff or lecturer conducted the lecture in classroom sent to the integrated database management system, the central database manages for a student account and payroll system for lecturer, this system assists in management to calculate hour of every lecturer in a month and amount to pay the honorarium. The information on student attendance record in cloud computing, then further development is to create a mobile system for the report to parent or guardian.

V. CONCLUSION

Student attendance system will benefit for an academic institution, instead of using a manual system that raises many issues and uncontrolled for student cheating. The system tested in several of lecture classroom, out of 38 students listed in the classroom where 36 students attend in the class and 2 students' absence recorded for the first testing, continue by 4 weeks. The system success to records all student and lecture attendance then record in a database. While facial recognition system by video camera installed in the classroom be able to match student face (image) to picture recorded in student card. The system helps the officer and efficient to management and staff with only verify the lecture in the classroom then confirmation before the final record. Cloud computing used as a database to make easy data retrieval from other parties.

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