Smartphone for Next Generation Attendance System and Human Resources Payroll System

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Abstract—A wide variety of current attendance system can be found easily in the market, but there are still some deficiencies in the attendance system; how the company will control employees are outside the office building and how employees can take advantage of the attendance system to view a variety of information needed. The modern attendance system must integrated with a human resources management and payroll system. Others issues with current attendance system, beside could not control the staff who work outside the office are conventional attendance system that spends a lot of paper and a long process due to be entered manually into the system for processing payroll, while the electronic attendance system with limited device can cause queues at the time employee entry and exit the office building. In this work, we introduce online attendance system on mobile devices and is integrated with the payroll system. It is a system created to overcome some of the limitations that occur in manual or electronic attendance system which is often conventionally used today. We utilized Global Positioning System (GPS), microphone, and fingerprint scanner that available on a smartphone or others mobile devices. We developed our application base on android platform because the android is the most platforms that have been using in the most mobile devices. Using our proposed methodology, the employee can do attendance using their mobile devices and the do not need to be in queue and the employee who work outside the office also can do the attendance. Our research showed that our proposed methodology can used for the next generation absence system.

I. INTRODUCTION

In order to obtain a good result of recording the attendance, currently widely used various methods attendance, either by manual recording or using the attendance machine that many in the market in which each attendance machine uses a method that is different to identify the person. Each of these systems has its drawbacks and its advantages. In the manual attendance system, does not need to build the infrastructure and installation and also does not need to purchase expensive equipment, but accuracy is doubtful. Furthermore, compiling and calculating for preparing the payroll is also more difficult to do than the attendance system that uses machine. Whereas if you want to use attendance machine, it must issue a number of costs necessary to purchase the attendance machine and there is the infrastructure cost that must be purchased and installed when it was about to implement this system. The number of users who will use the attendance machine must also be proportional to the number of attendance machine itself, otherwise it could have an impact on the queue when the user simultaneously wish to access attendance machine, such as when to come to work and clock out after work. Today attendance system also do not have a feature to record the user’s position, add to the list of attendance system limitations that exist at the moment.

Furthermore both methods have limitations in performance, for example, when the company had a payroll system which also records the working hours of the employee, then the system operator must enter the employee attendance data and working hour manually. The next limitation is also found is when companies that have employee to work outside of the building companies. It is a lot of difficulties to take the attendance of the employee who work outside the office and also will be difficult to integrate with payroll systems owned by the human resources. Therefore, it needs a system that is able to overcome the problems of absenteeism so that it can be more effective, more accurate and can be integrated with payroll systems whose purpose is to facilitate in the assessment of the performance of each employee concerned.

In our work we developed attendance system that utilize the sensors on the mobile device such as GPS (Global Positioning System), microphone, and fingerprint scanner. The microphone on a mobile device is very simple to be a tool for identifying. It is natural that the user can be identified with fairly simple [1]. The user just needs to talk as usual, cause of this method can be accepted easily by the user [2]. The storage required to store the template should be small enough so it’s easy to be stored on the mobile device [3] as well as the value of the crossover error rate (CER) which is suitable for systems that require security with medium-level systems such as attendance system. CER is an intersection (intersect) between the false accept rate and false rejection rate. The value of each owned by different methods of biometrics taken from [5] and [4] is shown in Table I and Table II.

Based on the above considerations, we decided to use voice (voice recognition) and fingerprint as an identification method. The attendance system using fingerprint had been discussed in [6]. In this paper, we will focus in voice recognition for attending system. We will use voice recognition method [7]
TABLE I
BIOMETRIC EVALUATION

<table>
<thead>
<tr>
<th>Biometric</th>
<th>FAR</th>
<th>FRR</th>
<th>Subjects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>1%</td>
<td>10%</td>
<td>37437</td>
<td>Varied light</td>
</tr>
<tr>
<td>Fingerprint</td>
<td>2%</td>
<td>2%</td>
<td>25000</td>
<td>Rotation</td>
</tr>
<tr>
<td>Iris</td>
<td>0.94%</td>
<td>0.99%</td>
<td>1224</td>
<td>Environment</td>
</tr>
<tr>
<td>Keystrokes</td>
<td>7%</td>
<td>0.1%</td>
<td>15</td>
<td>6 month period</td>
</tr>
<tr>
<td>Voice</td>
<td>2%</td>
<td>10%</td>
<td>30</td>
<td>Multilingual</td>
</tr>
</tbody>
</table>

because it does not require other device or instrument that are used with the attendance system due to the availability of microphone on a mobile device. In terms of CER also suitable for systems requiring the medium security level (2%). Identification by voice recognition is also easy to do because the user only needs to speak as usual so that the user also easily trained to use the proposed attendance system.

TABLE II
CROSSOVER RATES

<table>
<thead>
<tr>
<th>Biometric</th>
<th>Crossover Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinal scan</td>
<td>0.0000001</td>
</tr>
<tr>
<td>Iris scan</td>
<td>0.000763</td>
</tr>
<tr>
<td>Fingerprint</td>
<td>0.2</td>
</tr>
<tr>
<td>Signature dynamic</td>
<td>2</td>
</tr>
<tr>
<td>Voice dynamic</td>
<td>2</td>
</tr>
</tbody>
</table>

Various factors that cause sound (voice) to be unique so that it can be used as a method of identification are different forms of articulation organ owned by each person as the sound cavity length, the characteristics of the vocal cords and the different habits of each person speaking [8]. The organ that produces sound is pharynx larynx (located below the epiglottis), pharynx oral (behind the tongue between the epiglottis and vellum), oral cavity (front velum and bounded by the lips, tongue and palate), pharynx nose (located above the velum, part cavity behind the nose) and nasal cavity (above the ceiling and extending from the pharynx to the nostrils) [8].

In this work has the scope to design architecture attendance system that is secure, whereas attendance system that can run on mobile devices with features that consist of modules check in, check out, permit, registration, check the schedule and salary calculation.

In this paper, we uses a mobile device to run Android-based attendance system on the client side using voice recognition [9] method for the verification of the user while the payroll application running on the admin side is a web-based application and is integrated with the attendance system on the mobile device. The process of testing voice recognition algorithm will also be made in this study to determine the threshold value or threshold to be used also the security level identification method [10] by conducting trials using sounds previously recorded.

II. ATTENDANCE SYSTEM

We introduced the attendance system that using voice recognition as verification of the user and verification for payroll systems as well. The application of human resources management running on the admin side to monitor the data sent by the client of absences application residing on the mobile device. The human resources management software include:

- Module payroll system consisting of payroll calculation and payroll calculation reports
- Module employees to register and checking the tasks
- Module schedule that composed kinds of shifts and working time of each shift
- Module work group consisting of the types of groups that are owned by the workers as well as items that can be embedded in the class application such as salary, benefits and so on.
- Module history and logs module to perform attendance recording and viewing timesheet of each employee
- Module management to manage each user can access this payroll system

The simulation in this study using Android-based mobile devices by utilizing the microphone and GPS hardware that is usually already available on the android device. Payroll systems are web-based system where the data coming from the attendance system on a mobile device are sent using HTTP Post through an internet connection and then processed by the payroll systems.

The overall system integration experiments will be done by spreading the sample at some point to confirm their attendance and then check the results of the absences on the payroll system. The process shown in figure 1.

Methods of analysis for the attendance system itself is done by collection of attendance data and identification data that is saved to the server. These attendance data was obtained from the clients in several different locations.

Data entry will be checked on the payroll system. If the result of checking the data are in accordance with the desired, it can be concluded that the system integration was successful, but if it does not meet it will be checked out where the mistakes that occurred in both attendance and payroll applications.

![Fig. 1. General architecture of attendance system.](image-url)
A. Voice Recognition Algorithm

In this work, we used voice recognition algorithm that measured the percentage of compatibility and matching between the template sounds are stored in a database on a server with 100 sample other sounds. This is done to obtain a proper threshold of match percentage that will be used to determine whether the voice data was regarded as a person who owned the voice data which is stored as a template in the database or not. In addition it will do trial identification using sounds that have been recorded previously, this is done to determine whether the algorithm voice recognition is used is relatively safe and difficult to be penetrated using a recorded voice or not [11], [12]. The process of analysis of the voice recognition algorithm are as follows,

- The system will generate random characters to be used as a challenge to the user
- Random character will be displayed on the screen and the user must immediately pronounce the characters in a certain time period
- Upon completion character is spoken, then the incoming sound will be identified
- If the character is pronounced the same as the characters that are generated by the previous system, then will be continued on the voice feature matching template in the database, otherwise it returns to the login screen.
- The process of matching the sound with the template feature is done, if the features match with the template, it will display the home screen, otherwise it will go back to the login screen.
- The matching process is done with relation one-to-one, the android device id is used as a data identifier voice templates on the server.

B. Proposed Attendance System Integrated to Payroll System

Current attendance system using the machine that generally divided into two types of machine such as stand-alone machine and PC-Based machine [13]. The attendance system stand alone is a system that can stand alone work without being connected to a computer at the time of use. In this case, said without connected computer does not mean really without a computer, the data processing still using applications installed in the computer. Stand alone architecture attendance system or current attendance system can be seen in Figure 2.

The proposed attendance system is a PC-Based machine as we can see in figure 3. The proposed attendance system designed to use voice as a method of identification, voice chosen based on several considerations, among others, due to the identification of the voice has a medium accuracy rate and also is not expensive compared to iris identification technique [14]. Moreover the voice recognation technique has a high acceptance rate by the users, it means that users are more receptive to the use of sound than other types of biometric such as DNA, Iris recognition, retinal scan and fingerprint. The devices that are used are also already available on the mobile device is a microphone.

In our attendance systems, we use Mel Frequency Cepstral Coefficient (MFCC) algorithm [15], [16] in order to do comparison of voice and analyzes the data with the following steps:

- Install an application that uses voice recognition algorithms, MFCC, that have not been modified
- Trying to identify the voice recognition application either with the actual individual as well as the pre-recorded voice
• Modifying the voice recognition algorithm MFCC and identify both with the actual individual as well as the pre-recorded voice
• Comparing and conclude which one is more secure algorithm for use on a mobile device attendance system.

C. Experiments Tools

The tools that we used in this research can be seen in Table III.

<table>
<thead>
<tr>
<th>Device</th>
<th>Specification</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Phone</td>
<td>Android 4.0.4 Ice Cream Sandwich (API level 15)</td>
<td>Taking voice, sending data</td>
</tr>
<tr>
<td>Hosting/Server</td>
<td>350MB disk space, 25GB data transfer, 512MB virtual and web service memory</td>
<td>Payroll and data webservice</td>
</tr>
<tr>
<td>MySql Database</td>
<td>Version 5.5 RDBMS</td>
<td>Database payroll application</td>
</tr>
<tr>
<td>Eclipse IDE</td>
<td>Mars 4.5</td>
<td>Source code editor</td>
</tr>
<tr>
<td>Apache Web Server</td>
<td>Version 2.4.7</td>
<td>Admin Dashboard</td>
</tr>
</tbody>
</table>

III. SIMULATIONS AND RESULTS

A. Testing the accuracy of the algorithm

In this study, the test is done as much as one hundred (100) times for each scenario a voice identification. Scenario testing voice identification method is divided into three, namely:

• The first method of test by recording a sample to be used as a template voice then compared the samples with 100 samples the voice of the same person by saying the same character as well. This is done to get the average value of the results of the comparison template and sample the voice of the same person.
• The second method of testing by recording the voice of the user and then use of recording voice to identify. This method is done by not using a character challenge that aims to determine whether the MFCC algorithm method can easily be penetrated using pre-recorded voice / pre-recorded voice or not.
• The third method was the identification of a voice template with sample template that is not the owner of the voice, in which these results will be compared with the results of first method. The goal is to get the threshold value to be used in the system.

The results of first method, using voice from the same person to get the average value of the degree of fit the template and sample voice to be compared using the method of dynamic time warping.

Sample numbers in figure 4 is a sequence of experiments carried out, while the value is the value of the ratio between template with sample using a method of dynamic time warping. The test results of 100 samples obtained on average value of the ratio is 2973.230 with the lowest value and the highest value are 2550.249 and 6283.575.

The result of an experiment using recorded voice to obtain a comparison value between voice taken directly and recorded voice is shown in figure 4. This is done to determine the possibility can be penetrated by the voice recognition algorithm by recorded voice.

Sample numbers in figure 5 is a sequence of experiments carried out, while the value is the comparison between the template with a recorded voice using a method of dynamic time warping. From the test results of 100 samples obtained on average value of the ratio of 3930.560 to the lowest value and the highest value of 2495.658 36551.467.

B. Voice Registration and Matching on Smartphone

The attendance system will be work after the employee registered their smartphone and recorded their voice. They have to say the characters from A to Z. First, download and install the application then select Registration on the menu. The screen as shown in figure 6 will be appear. Next step is touch the Capture button and say the character shown on the
screen, then touch the stop button, and the next character will be shown on the screen. This process will continue until the last character is the character Z.

The attendance process will include voice identification process and the recording of user location coordinates, time, and date. The results of experiment of the attendance process can be seen in the figure 7. On main menu the employee has to select absence and will be the screen as shown in figure 7. In this screen will be shown the characters that employee has to say. In this example, employee has to press record and say the characters of L W X E D U Q A. Every time employee want to do absence, these character will be changed randomly. After finished say those characters then press the stop button and these information will be sent to the server for verification along with others information such as the date, time, GPS coordinate, android operating system number, and cell phone number. If the voice and others data matched then the server will record all the information.

IV. CONCLUSION

Attendance system designed in this study using voice as a method of identifying and recorded the GPS coordinate ensure the user’s location when attendance so that both of these things will prevent the user manipulation of the attendance system.

With the use of mobile devices based attendance system, it can prevent the queue as when using other attendance system, especially at peak hours where the number of users and the number of devices attendance system has a ratio that is not balanced. The mobile device based attendance system, each person have android-based mobile device can be mounted absences application so no need to queue in electronic attendance device or the manual provided by the company or organization.

Based on our experiment, the prescribed threshold used at less than or equal to 2974, so any comparison of voice that has results is less than or equal to the threshold will be deemed match. This threshold effect on the False Acceptance Rate (FAR) and False Rejection Rate (FRR), if the threshold is made bigger than 2974, then the percentage of FAR will be smaller and FRR getting bigger, this applies also vice versa. In this study, we using a threshold in 2974 it obtained a percentage of FAR and FRR of 5.88% and 11.76%.

REFERENCES


