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Web Services to Overcome Interoperability in Fingerprint-based Attendance Systems

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***Abstract*—The fingerprint-based attendance management process generally consists of recording, management, and reporting. The method of recording attendance data is done with the help of fingerprint attendance machine. Even though the computer connection is running online, the administrator still needs to process and generate reports because there is no real-time interconnection between devices. Web services such as Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) are among the technologies that can support real-time processing, which has been used in previous studies. SOAP is more secure than REST. Solutions to overcome these problems, this study used SOAP-based web service on the fingerprint attendance management system, to support real-time data access. The results of the research have made web services that can overcome the problem of interoperability between fingerprint machines and systems, so that data can be accessed in real-time and safer.**

Keywords: Attendance Management System, Interoperability, Real-time, SOAP, Web Service

I. INTRODUCTION

Attendance management is an attendance management activity in work setting to minimize losses due to employee downtime. The attendance management system needs to be well managed because it has high relevance to workplace productivity and organizational profitability [1]. Various methods of attendance management have been performed, such as manual attendance controls based on hours of in and out of work, semi-computer use such as timesheets, and utilization of electronic equipment as a tool for recording and managing attendance data [2]. In general, attendance management can be categorized into several groups including manual system, semi-manual system, card-based system and biometric system.

a. Manual System

The manual system entirely without using information technology, attendance register mechanism is done using a notebook. The user must make a name, attendance and then sign his attendance list. This system is easy to do but has shortcomings including requiring long time attendance and no user authentication. With the current technological developments, this system has begun to be abandoned and not used anymore.

b. Semi-Manual System

This attendance system has started using information technology such as the use of spreadsheets or other data processing applications that exist on the computer but only used as a recap of data only. For attendance data still done manually by signing a sheet of attendance paper. In this mechanism is almost the same as the manual system is still a lot of errors and possible fraud, data theft or damage.

c. Card Based System

The use of tags to record attendance is better than the manual system, but it still allows cheating by card making cards to co-workers. Card-based systems using RFID and barcode have been done by several researchers [3] [4].

d. Biometric Systems

This system recognizes a person by identifying human physical patterns, such as fingerprint patterns, facial patterns, sound patterns or iris patterns. Currently, biometric mechanisms are considered to be commonly used and most secure due to the use of direct authentication to users. Nevertheless, biometrics are influenced by light intensity, image quality and distortion in images.

Biometric technology is the basis of a variety of highly secure personal identification and verification solutions, as well as reliable authentication mechanisms. Fingerprint pattern authentication is one of the implementations of biometric technology that has more advantages over other biometrics [5] [6]. Besides, the fingerprint is also one of the most widely used biometric technologies and with good reception rates [7].

Fingerprint based attendance management process generally consists of recording, managing and reporting. In this system attendance is recorded at attendance management machine. Furthermore, the management and reporting process will be carried out on the computer based on data obtained from attendance management machine. Based on research [8] fingerprint-based attendance is better than the manual, but the process of making a report is done by an admin after passing the management process so that the report cannot be presented in realtime. There were also studies [9] and [10] that designed and developed an arduino and fingerprint-based attendance system but the system was vulnerable to being attacked by intruders because the mechanism carried out shared the same database and there were no security measures.

The system that will be developed in this paper uses an existing fingerprint engine and guarantees its security by utilizing web service technology to overcome interoperability between platforms, so that the data exchange process can be carried out in real time. Web

service architectures such as Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) [11] have been used in various previous studies. SOAP web service architecture is safer than Representational State Transfer (REST) [12] [13]. While REST is more suitable to be applied to cellular devices that are limited by resources on handheld devices [14].

Therefore this research focuses on SOAP-based web service implementation on fingerprint attendance management system, to support realtime reporting systems.

II. Literature Review

A. *Web Service*

Web Service is a set of functions, logic, the method as a standard exchange of data between applications or systems that can be accessed remotely by various devices with different programming languages, architectures or platforms. Web services must be stateless so that they can be read and located multi-platform [15]. The structure of the web service can be built using Simple Object Access Protocol (SOAP) or REpresentational State Transfer (REST), while the function is represented in the form of text, JSON or XML format. In general, the format using JSON and XML. Fig. 1. shows the logical structure of the communication stack for Web services. The difference between SOAP and REST is shown in Table 1.

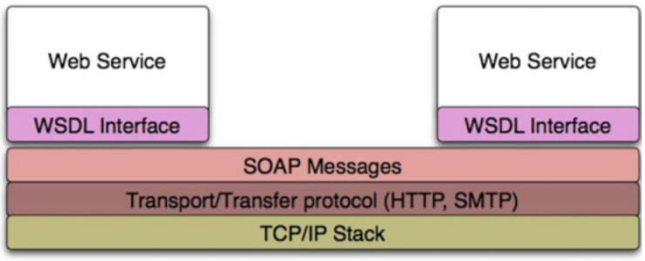

Fig. 1. Web services: communication stack

TABLE I. Difference Between SOAP and REST

Description	SOAP	REST
Communication protocol	HTTP, HTTPS, SMTP, FTP	HTTP, HTTPS
Bandwidth usage	In the number of requests that many, relatively wasteful bandwidth. This is because of the abundance of markup in XML format writing	Relatively bandwidth-saving, because extra markups like in XML are not used
Usage trends	Many have begun to switch to REST, although there are still those who maintain, for example for the integration of applications into the legacy system of a company.	Start famous, widely used by leading web service providers, such as Twitter, Yahoo !, Flickr, Bloglines, Technorati, Google, Amazon, eBay, etc.
Rule of writing	Strictly, following the XML specification (SOAP v1.2)	No special specifications
Format response	XML with SOAP specification. It is a bit hard for us to read directly and understand it.	XML, JSON, or other plain text formats. This makes it easy for the recipient of the response to read and understand it.
Attachment file	Can (because it can return the response in binary format)	Can not

B. *Simple Object Access Protocol (SOAP)*

SOAP is a standard data exchange in XML format in the network to communicate with programs on the operating system, technology, and programming languages the same or different.

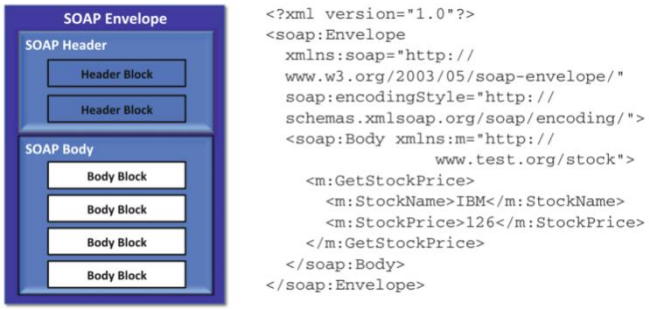

Fig. 2. SOAP Message and An example of a SOAP request [15]

SOAP document structure in Fig. 2. in the form of an XML document containing the elements:

1. Envelope, the part that identifies the XML document as a SOAP message.
2. The header element contains application information about SOAP messages.
3. Body elements that contain calls and respond to information.
4. Fault element that contains error messages that occur during processing time.

C. *Real-time*

The term Real-time is used to describe how a computer system receives data and then communicates it or makes it available immediately [16]. Real-time also refers to the time at which an event occurred and its reporting or recording almost simultaneously [17].

D. *Fingerprint Attendance System*

A system of attendance management in work settings to minimize losses due to employee downtime [8]. In this system, there is attendance software that is paired with hours of time for employees using fingerprint pattern matching technology for authentication.

E. Related Work

Various researches related to fingerprint time attendance have been done before. The application of fingerprint-based presence technology has been done by [8] and [7]. On this research, on average, it only discusses the use of fingerprint machines compared to traditional presence mechanisms.

Likewise, [18] applying Wireless technology to the Fingerprint Attendance Marking System that can present a framework using attendance management can be made automatically online. But the system does not have security measures to protect attendance data.

Next in the research [19], implementing a Zigbee-based student attendance system using local area networking (LAN). In this system students can report their presence via biometrics and attendance notifications are passed through the zigbee module, but the device can be damaged and attendance data will be exposed. Likewise with research [10], designing and developing Arduino and Fingerprint-based portable class attendance systems. This system has not been able to overcome interoperability between different platforms, so the mechanism by sharing databases is very vulnerable to attack and no security measures are used to protect information in the database.

The system developed in this paper is how to overcome interoperability, connect attendance data from fingerprint machines to different platforms in real time. The use of web service technology with SOAP architecture is expected to overcome the problems that occur, besides that the process of data exchange is safer.

III. Methodology

This stage presents the sequence of activities performed on the completion of the system. System development work follows the software development cycle, where before the job is implemented in the real world it needs a detailed design of the proposed model. This is explained in the following sub-sections.

A. System Requirements

The system proposed in this study aims to overcome the problem of interconnection between different machines by applying the concept of web service so that the attendance data on the device can be read directly by the system. The operator is not bothered anymore to sync data from the device, because data from the fingerprint machine can be manipulated in the real-time mode.

Commonly used and pre-existing fingerprint machines can be used and used, while web services and applications for clients as a presence management system are stored on the server, so that the change of user data or employees can be done online.

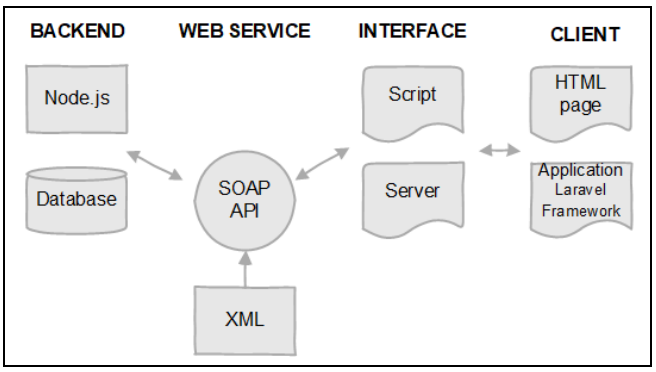

Fig. 3. System Requirements

Fig. 3. explain the needs of the system, backend using Node.js that can detect fingerprint machine as well as retrieve data from the fingerprint machine in real-time, nextly the data is stored in the MySQL database. Data exchange between devices with systems using Extensible Markup Language (XML) format. Frontend on the server and client using a web-based programming language laravel framework.

B. System Design

Service Attendance Management uses fingerprint identification patterns designed based on a client-server framework that refers to the system architecture diagram as seen in Fig. 4. The system consists of an online server that contains databases and services, web-based clients and hardware parts of fingerprint machines as clients.

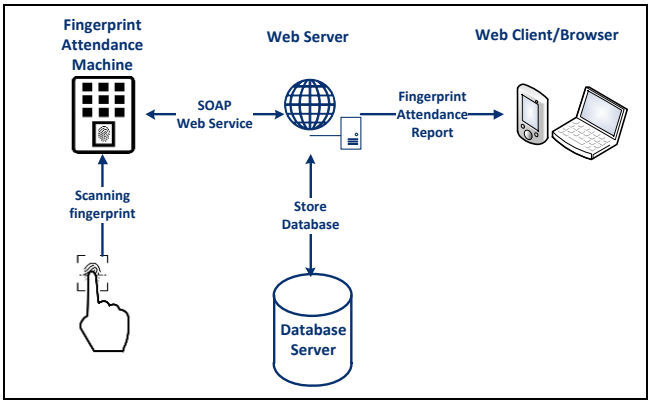

Fig. 4. System Architecture

Fig. 4. describes the real-time data retrieval mechanism between the fingerprint engine and the server utilizing the web service. Web services are capable of bridging different platforms as well as stateless. Presence data recorded on the server is stored in the database so that it can be manipulated and served for the benefit of management and users.

An online web server can be used on a computer connected to the Internet. For public access, the server must be configured with a public IP address so that the user from the client application can access the presence data. The web client can monitor data in real-time by accessing client application from a web browser.

C. *The flow of the system*

Shown in Figure 5 Web Design Flowcharts that have been designed. There are two services designed, the first "Checking Connection," used to check the data connection between the fingerprint machine with the system. The second service "Get Data From Fingerprint Machine" is designed for the process of retrieving attendance data and employee data from a fingerprint machine stored in the database.

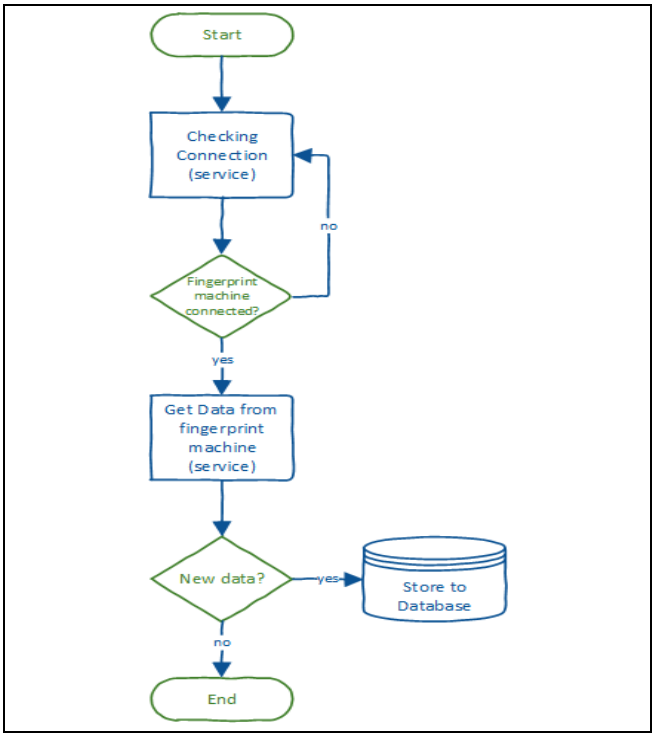

Fig. 5. The flow of the system

IV. Result and Discussion

By following a pre-designed design, built applications can be implemented on the server side and client-side. The traditional service works well for capturing and storing attendance records in real-time. Aspects of ease and portability of the system are also emphasized in the current order, so users can directly see the attendance records of the fingerprint machine. Officers can also directly monitor and recapitulate attendance data.

The connection between the fingerprint machine and the system can be seen in the backend of the visualization process shown in Fig. 6.

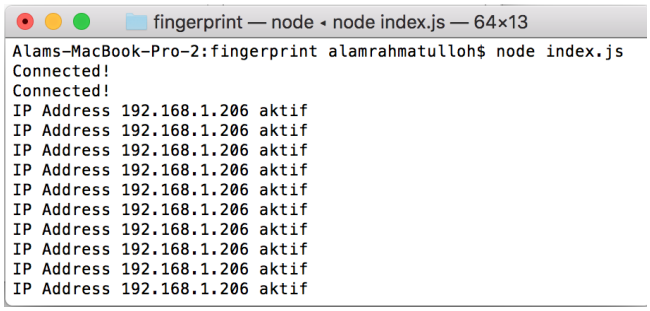

Fig. 6. Backend Process Connection with Fingerprint Machine

```
...
$connection = fsockopen($ip, "80", $errno, $errstr, 1);
if ($connection) {
    $xmlRequest = $this->getUserProfileRequest($keyMachine);
    if ($isXMLOutput && $isRequestHistory) {
    $xmlRequest = $this->getLatestAbsenceRequest($keyMachine);
    }
    $newLine = "\r\n";
    fputs($connection, "POST /iWsService HTTP/1.0" . $newLine);
    fputs($connection, "Content-Type: text/xml" . $newLine);
    fputs($connection, "Content-Length: " . strlen($xmlRequest)
.   $newLine . $newLine);
    fputs($connection, $xmlRequest . $newLine);
    while ($response = fgets($connection, 1024)) {
          $buffer = $buffer . $response;
    }
} else {
    if ($isXMLOutput) {
          return 'Connection Failed';
    }
    return false;
}
...
```

Fig. 7. Source code service

Fig. 7. shows the piece of source code web service connection system with the machine built, while the backend system for data exchange on the fingerprint machine with the server using XML can be seen in Fig. 8. and Fig. 9.

Fig. 8. XML employee data

Fig. 9. XML data attendance log

Fig. 8. and Fig. 9. represents employee data and presence logs obtained directly from machine fingerprint,

with List generated in XML format. While in Fig. 10. Can be used Presenting data visualization results after applied to the rules of working hours.

No	Nama	Tanggal	Jam Masuk dan Pulang Kerja	Scan Masuk 00:00:00 to 09:00:00	Status Jam Masuk	Scan Pulang 14:00:00 to 23:59:00	Status Jam Pulang
1	Adi Sulaiman	19/07/2018	08:00:00 - 16:00:00	08:47:20	Terlambat 32 menit, 20 detik.	14:05:31	Pulang Lebih Awal 1 jam, 24 menit, 29 detik.
2	Reza El Akbar	19/07/2018	08:00:00 - 16:00:00	08:32:09	Terlambat 17 menit, 9 detik.	15:31:53	Tepat Waktu Absen Pulang
3	Rohmat Gunawan	19/07/2018	08:00:00 - 16:00:00	08:15:42	Terlambat 42 detik.	14:04:57	Pulang Lebih Awal 1 jam, 25 menit, 3 detik.
4	Alam Rahmatulloh	19/07/2018	08:00:00 - 16:00:00	07:43:15	Masuk Lebih Awal 16 menit, 45 detik.	16:04:36	Lembur 4 menit, 36 detik.
5	Rezi	19/07/2018	08:00:00 - 16:00:00	07:37:21	Masuk Lebih Awal 22 menit, 39 detik.	15:37:19	Tepat Waktu Absen Pulang
6	Fakhru Sidqi	19/07/2018	08:00:00 - 16:00:00	07:02:08	Masuk Lebih Awal 57 menit, 52 detik.	19:04:14	Lembur 3 jam, 4 menit, 14 detik.
7	Fakhru Sidqi	18/07/2018	08:00:00 - 16:00:00	08:10:42	Tepat Waktu Absen Masuk	15:14:42	Pulang Lebih Awal 15 menit, 18 detik.
8	Rohmat Gunawan	18/07/2018	08:00:00 - 16:00:00	07:59:42	Masuk Lebih Awal 18 detik.	15:22:42	Pulang Lebih Awal 7 menit, 18 detik.
9	Adi Sulaiman	18/07/2018	08:00:00 - 16:00:00	06:59:42	Masuk Lebih Awal 1 jam, 18 detik.	14:59:42	Pulang Lebih Awal 30 menit, 18 detik.
10	Alam Rahmatulloh	18/07/2018	08:00:00 - 16:00:00	06:43:15	Masuk Lebih Awal 1 jam, 16 menit, 45 detik.	14:25:42	Pulang Lebih Awal 1 jam, 4 menit, 18 detik.

Fig. 10. Visualization attendance log

Fig. 11. Visualize Employee Logs

Fig. 11. is one example of visualization on the client side, employees in real-time can view attendance data starting from incoming scan up to scan out.

V. CONCLUSION

Attendance management services that have been built with SOAP architecture are able to overcome interoperability problems. Web services with data exchange using XML connect and retrieve attendance data from real-time fingerprint machines. Then this attendance data is forwarded to the server that makes the service call, if there is new data then it is stored in the database. Vice versa, from the system can update data into the fingerprint machine through the service.

The mechanism is safer compared to previous studies that share the same database. However, in the exchange of data on web services, security has not been applied such as data encryption or security applications in the form of tokens with different architectures [20]. This is an opportunity for further research.

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