INTEGRATED AND EFFICIENT ATTENDANCE MANAGEMENT SYSTEM BASED ON RADIO FREQUENCY IDENTIFICATION (RFID)

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ABSTRACT

Mostly companies or organizations need systems to record their employee attendance. Employee attendance data is very important for companies as one of the parameters to assess performance and discipline of their employees. Nowadays, there are a variety of attendance recording mechanism from manual system to biometrics systems. In this study will be discussed about attendance management system based on Radio Frequency Identification (RFID) technology. RFID is one of enabler technology for Internet of Things (IoT) which is currently being developed. That application of IoT concept can provide solution for many problems that occur in the society, one of them is attendance management system. That system is part of Human Resource Management System (HRMIS) which is the system has been developed has high flexibility to integrate with another system, has transaction processing speed better than biometrics system, and requires an efficient investment for devices. Currently, attendance management system based on RFID has been deployed and running in the production environment and widely used in the Telkom University.

Keywords: *Internet of Things, Radio Frequency Identification, Attendance Management System*

1. INTRODUCTION

Science, especially related to information technology is now growing rapidly and can help solve the problems that exist in the society. One of the many concepts that are currently developed is the Internet of Things (IoT). Considering the functionality and identity as central it is reasonable to define the IoT as "Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts". Technologies that support and enabling IoT vision such as Radio Frequency Identification (RFID), Wireless Sensor Network (WSN), and middleware [*10*]. Many application of IoT concept actually a lot of lead to the development of smart environment. Smart environment defined as interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless ubiquitous sensing, data analytics and information representation with Cloud computing as the unifying framework [*3*]. The specific application of smart environment such as smart city, smart building, smart transportation, smart home, smart retail, etc. In this study will be discussed about attendance management system based on Radio Frequency Identification (RFID) technology. This system is part of smart building which is the system has been developed has high flexibility to integrate with existing system.

Nowadays, mostly companies or organizations need system to record employees attendance. Employee's attendance data is important for control employee's discipline. There are a variety of attendance recording mechanism from manual system or use information technology such as Radio Frequency Identification (RFID) and biometric technologies such as Fingerprint, iris recognition, face recognition, etc. Each of these technologies has advantages and disadvantages. For example biometric system offers assurance that the validity of the transaction is an actual person. However, based on our experience, attendance system using biometrics such as fingerprints have a problem if there are employees who have a thin fingerprint. This causes a fingerprint cannot be recognized and even recognizable as fingerprints others. Otherwise, some people objected to use

attendance system using fingerprint because healthy reasons. Fingerprint sensor has been touched by many people and we don't know whether a person carries germ. This problem really can be solved with iris recognition and face recognition system. There are more sterile than fingerprint because they are contactless. However, biometric system will running slow and heavy when employee's data grow. Employee's data and their attribute must be store in each device memory so if a company has many building then data must be registered to every device in the building. It will certainly complicate for data management because scattered data. Furthermore, the cost for build biometric system relatively expensive than another. On the other side Radio Frequency Identification (RFID) technology offers flexibility of data integration, robustness, and more efficient device investment.

Base on that considerations then we developed attendance management system based on RFID. The priority of system has been developed is integration with existing system and efficiency of investment. Result of system implementation will be compared with another work which is using biometrics (fingerprint and iris recognition) **[6,11].** While several studies related RFID for attendance is used to monitor student attendance. However, the proposed system requires a PC as a terminal for each RFID Reader devices so it needs of substantial investment. **[5,9,1].** Several studies use RS232 interface for communication between RFID Reader and terminal. **[13].** Use of RS232 interface is not flexible because it has rarely computers using the interface. Furthermore, maximum RS232 cable operation range is 45 meters using high quality cable. There is study that uses wireless communication beside RS232 for communication between RFID Reader to control circuit and database server. Pre-Defined tag is stored into microcontroller ROM that has maximum capacity 512 Card ID. These proposed system has maximum capacity of 256 RFID Reader   **[2]**. One study also proposes architecture student attendance system using UHF RFID with Ethernet interface **[8].**

2. SYSTEM REQUIREMENT

2.1 System Criteria
In the attendance management system is developed, there are several criteria that must be met:
1. Integrated with Human Resource Management System (HRMIS)
   Attendance management system is part of existing HRMIS. Every RFID tag must be registered to employee's database. Thus, only actual employees who can perform transaction.
2. Efficiency investment
   In fact, several organization have requirement that the system development has to consider cost efficiency. In this work, the system only require an investment of RFID Reader without additional PC for terminal on every node. The investment cost no more than $100 for every node. RFID Reader are installed on every building, at least one RFID Reader on one building. The system can use existing server for middleware because the RFID middleware can be run side by side with another service. Whereas, for RFID tag need's we can use existing card like a member card, ID card, etc. So it should not require print the new card

2.2 Component Builder
There are required component for build attendance management system based on RFID, such as:
1. RFID Reader
   RFID Reader is used to user terminal to perform transaction. RFID Reader also called interrogator, which is device for detect and read RFID tag. This device give radio energy to passive RFID tag. RFID Reader can be handheld or stationary. Handheld reader is reader that can be operated on the move while stationary is reader who settled in one place. In this work, we use stationary high frequency reader which is has 10-15 cm operation range for read the tag comply with ISO 14443A standard. The reason is already a lot of tag in the form of card circulating in the society and can be used for attendance recording. RFID Readers, which are used also support the TCP/IP protocol that must have an Ethernet interface. RFID Reader will directly communicate with the server via the Local Area Network (LAN) so it does not need a PC on every node as a bridge of communication. Examples of RFID Reader, which are mounted can be seen in Figure 1 below:

Figure1: Installed RFID Reader

2. RFID Tag.
   For attendance system RFID tags typically used usually in the form of cards. The type of card

used must be in accordance with ISO 14443A which operates at a frequency of 13.56 MHz. In this work the type of card being used is the Mifare Classic 1K. Mifare Classic is the type of tag that is widely circulated and used until now because have low price. Another card that can be used is mifare ultralight or mifare DESFire.

3. RFID Middleware

The middleware is a software layer or a set of sub-layers interposed between the technological and the application levels. Its feature of hiding the details of different technologies is fundamental to exempt the programmer from issues that are not directly pertinent to her/his focus, which is the development of the specific application enabled by the IoT infrastructures **[4].** In this work the RFID middleware has function as RFID Reader controller, Transaction Controller, and Data Management. Type of middleware used is middleware for national ID card which is the result of research that has been done before **[12].** Figure 2 shows middleware that use in this work:
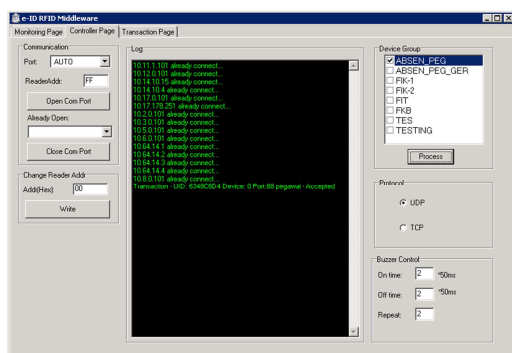
Figure 2: RFID Middleware

4. Network Infrastructure

Network infrastructure is needed for perform data communication between RFID Reader and middleware server. TCP/IP base Infrastructure uses because commonly used so it does not need new investment and development to build this attendance management based on RFID. In this work there is a location within the building of more than 20 Kilometers from the central data center. For data communication at a remote location Virtual Private Network (VPN) can be used.
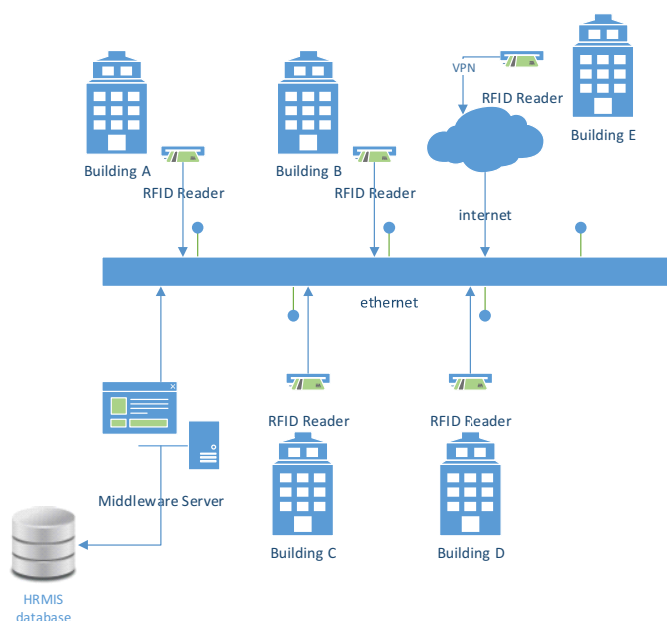

Figure 3: Attendance Management System Based On RFID Scheme

From Figure 3 above the entire RFID reader installed in each building connected to an Ethernet network. There also building that is connected via a VPN because the location is in remote area. The whole RFID Reader are controlled by middleware on the middleware server. Attendance transactional data from each RFID Reader will be processed by RFID middleware.

3. TESTING AND IMPLEMENTATION

3.1 Test Scenario

Transaction made on RFID Reader will be checked by rule manager in RFID middleware. In this scenario, the rule is executed to check whether the tag is used for transaction has been registered or not. If not then RFID middleware will send command to RFID Reader for return the feedback short beep one time and transaction data will be stored as garbage transaction. Meanwhile, if the transaction is valid than RFID middleware will return feedback twice short beep to RFID Reader. For more details, the scenario can be seen on figure 4 below:
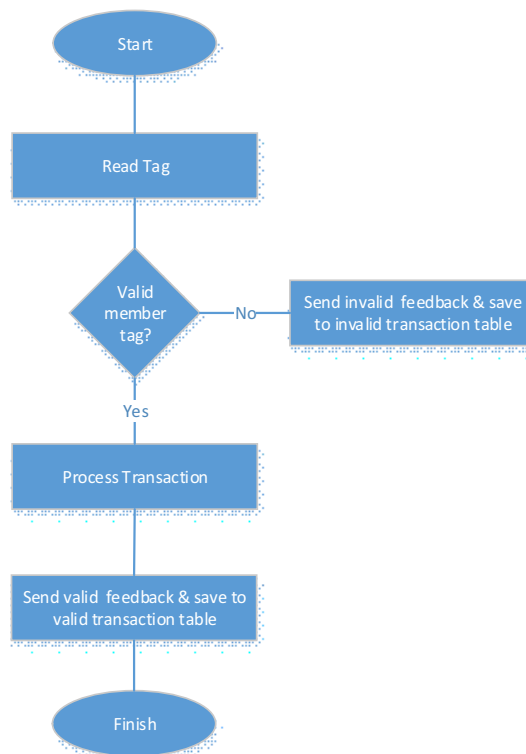
Figure 4: Simulation For Attendance Management Rules

Table 1. Average Transaction Time Of Each RFID Reader

Building	IP Address	Number of Transaction	Average Time (ms)
Gedung P-SDM	10.17.178.251	5	146.8
GEDUNG C	10.3.0.101	186	143.83
GEDUNG D	10.14.10.15	89	146.55
TEBS_GERLONG	10.160.0.200	45	130.02
GEDUNG P	10.17.0.101	100	147.25
GEDUNG A TEBS	10.64.14.1	38	142.11
Gedung B	10.2.0.101	38	146.13
GEDUNG F	10.5.0.101	18	147.39
Gedung LC	10.8.0.101	71	143.9
GEDUNG N	10.11.1.101	33	157.45
SISFO	10.100.0.102	71	109.65
Gedung G	10.6.0.101	34	150.03
GEDUNG C TEBS	10.64.14.3	91	146.7
GEDUNG B TEBS	10.64.14.2	106	151.13
Gedung D TEBS	10.64.14.4	52	150.27
GEDUNG E	10.14.10.4	34	143.62
Front Office	10.63.0.101	184	165.17
LOBI	10.129.0.8	134	184.93
Gedung L	10.12.0.101	31	144.87

3.2 Testing Result

Employee's attendance system based on RFID has been deployed on production environment and has been used by Telkom University. The entire building have been installed RFID Reader with total of Nineteen RFID Reader. Eighteen of them installed on existing buildings on the site so that communication using existing network infrastructure. Each RFID reader is connected using Cat5 UTP cable to the switch in the panel while connections from each building to the middleware server using a fiber optic connection. For one building is about 20 Km from the center of the data center so it uses a public network connection and uses Virtual Private Network (VPN) technology. Thus the retrieved data is real data from the transactions carried out by the employee for each RFID Reader within each building can be seen in table 1 as follows:

This transaction data obtained an average transaction time is 150.54 milliseconds. Time is measured in accordance with the transaction flow in Figure 4 by the start of reading the RFID tag reader to the shipping transaction status feedback. As for the transaction success rate is 100%, which means there are no transactions that are accepted but are not stored in the database. When compared with the fingerprint system, it has the average processing time per transaction is 3.79 seconds (3790 ms) and a 94% success rate [6]. Whereas for iris recognition system success rate is 98.3% [11]. So attendance management system based on RFID in this work is better in aspects of transaction processing speed and level of success.

Employee attendance data that is already stored in the HRMIS database will reprocessed and displayed to the reporting system in HRMIS as shown in Figure 5 below:

Figure 5: Employees Attendance Reporting

4. CONCLUSION

The result of this work is integrated and efficient attendance management system based on Radio Frequency Identification (RFID). This system has already installed in production environment and widely used in Telkom University as part of Human Resource Management System (HRMIS). RFID middleware that is used in this work is the result of the research that has been done previously Transaction data indicate that system in this work is better in aspects of transaction speed and transaction success rate when compared to the attendance system using biometrics (fingerprint and iris recognition). In addition, the system only requires the installation of RFID Reader, when compared with other studies that most installations require a PC at each node to hold the transaction data before they are sent to the server. The needs of the network and server infrastructure using existing devices which is more efficient in terms of investment and utilization. However, there is a classic question if an employee card entrusted to other employees and the system cannot detect it. To deal with these problems, in the future will be added development of the facility of e-money card so that employee's card not carelessly entrusted to another person. In addition, this system can also be integrated with the IP camera so that each transaction will be photographed.

REFERENCES:

[1] Ankita Agrawal, Ashish Bansal. 2013. "Online Attendance Management System Using RFID with Object Counter." *International Journal of Information and Computation Technology* 131-138.

[2] Aqeel-ur-Rehman, Abu Zafar Abbasi, Zubair A. Shaikh. 2008. "Building A Smart University using RFID Technology." *International Conference on Computer Science and Software Engineering.* Karachi: IEEE Computer Society. 641-644.

[3] Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic, Marimuthu Palaniswami. 2013. "Internet of Things (IoT): A vision, architectural elements, and future directions, Future Generation Computer Systems." *Future Generation Computer Systems* (Elsevier) 1645–1660.

[4] Luigi Atzori, Antonio Iera, Giacomo Morabito. 2010. "The Internet of Things: A survey." *Computer Networks* (Elsevier) 2787–2805.

[5] Nurbek Saparkhojayev, Selim Guvercin. 2012. "Attendance Control System based on RFID-technology." *IJCSI International Journal of Computer Science.*

[6] O. Shoewu, O.A. Idowu. 2012. "Development of Attendance Management System using Biometrics." *The Pacific Journal of Science and Technology* 300-307.

[7] Okorafor G. Nwaji., Nosiri C. Onyebuchi., Opara, F. Kelechi. 2013. "Automatic Door Unit Radio Frequency Identification (RFID) Based Attendance System." *Int. J Sci. Emerging Tech* 200-211.

[8] Rajan Patel, Nimisha Patel, Mona Gajjar. 2012. "Online Students' Attendance Monitoring System in Classroom Using Radio Frequency Identification Technology: A Proposed System Framework." *International Journal of Emerging Technology and Advanced Engineering* 61-66.

[9] Samet Akpnar, Hakan Kaptan. 2010. "Computer aided school administration system using RFID." *Procedia Social and Behavioral Sciences* 4392–4397.

[10] Sebastian Lange, Gérald Santucci. 2008. *Internet of Things in 2020: Roadmap for The Future.* European Technology Platform on Smart System Integration.

[11] Seifedine Kadry, Mohamad Smaili. 2010. "Wireless attendance management system based on iris." *Scientific Research and Essays* 1428-143.

[12] Wijaya, Dedy Rahman. 2014. "Middleware Architecture For National Electronic ID Card: The Case Of e-KTP In Indonesia." *Journal of Theoretical and Applied Information Technology* 670-674.

[13] Zatin Singhal, Rajneesh Kumar Gujral. 2012. "Anytime Anywhere-Remote Monitoring of Attendance System based on RFID using GSM Network." *International Journal of Computer Applications.*