

RADIO FREQUENCY IDENTIFICATION FOR ACADEMIC MANAGEMENT

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Abstract

This research aims to demonstrate a comparison of the frequency using Radio Frequency Identification (RFID) technology in the academic services in one of the private universities in Bandung. One of the indicators measured in this research is the number of user's RFID cards on each service within a certain period. The method used in this research is a comparative descriptive analysis with a quantitative approach to data – the use of RFID data from academic services, including library visit services, academic administration services, and system services parking. The results of the effectiveness of RFID card usage in each academic service so it can facilitate each access service using only one card. The use of RFID Smart Card technology on library visit service has a very high percentage with a rate of 17.81%, while parking system service has a low rate with a value of 0.64% in a year.

Keywords: Academic, Higher education institutions, Library, Parking, RFID.

1. Introduction

Traditional magnetic cards are replaced by smart cards and Radio Frequency Identification (RFID) as they have various advantages for users, such as providing more storage for security like encryption and electronic signatures [1]. Besides, the application of RFID has a lot of advantages. It can be widely used in various fields such as parking access, academic field, and automatic data collection [2]. RFID itself is defined as a new technology that merges the use of electromagnetic or electrostatic coupling as a part of the radio frequency from the electromagnetic spectrum that could uniquely identify an object, animal, or person [3]. RFID is a valuable business and technology consisting of Electronic Product Code (EPC) – Nonvolatile Random Access Memories (NVRAM) as a viable storage alternative site for user data that allows wireless exchange of data [4].

The use of RFID in the university environment has been rapidly grown and used as identity cards, library services, information services, as well as for the attendance of officers or students [5]. The RFID technology is now implemented in several industries, including parking system with various features such as payment system [6]. The development of RFID technology is growing insanelly from year to year, most universities may implement the form of RFID technology system in every activity or services available in the university [7]. One of the implementations of RFID technology in the academic is in the library. The use of RFID in the library is to provide the convenience to check-in and check-out for library visitors [8].

Previous researches have implemented several RFID technologies in industrial fields or even education field. RFID also designed specifically in the field of academic for students that can be used for monitoring attendance, using library services, and canteen. One of the implementations of RFID technology in the academic is in the library. The use of RFID in the library is to provide the convenience to check-in and check-out for the students [9]. As for research of RFID in parking management provides easy user authentication and reduce parking payment waiting time, and makes it easier to monitor the number of available parking slots [10]. From a variety of RFID implementation that has been applied from both industry and education, this research will calculate the effectiveness of the use of RFID cards in academic services in university, which include Library visit service, academic administration services, and parking system services. Calculation of the effectiveness of RFID card usage based on the frequency card usage from the academic service in the university. The result of the report card frequency used in each academic service can be a reference for the management of the university in developing RFID technology [11-15].

The method used in this research is a comparative and descriptive analysis with a quantitative approach to data – the use of RFID data from academic services including library visit services, academic administration services, and system services parking. This research aims to demonstrate a comparison of the frequency uses of RFID technology in one of the private universities in Bandung.

2. Literature Review

The method used in this research was comparative descriptive analysis with a quantitative approach to data—the use of RFID data from academic services

including library visit services, academic administration services, and system services parking. Figure 1 shows the process of identifying visitors who wanted to visit the library. Each visitor that enters the library should go directly to the place of information to do RFID tapping, after the process of RFID tapping finish, then the RFID reader will do the data reading and identification of the RFID card used. If the card is already registered in the database, the ID and the name of the visitor will be directly stored on the visitor's information system. If the card is not registered then the visitor can register the card used in the RFID system. Once registered, the visitor will be logged automatically by the system then he/she will go directly to the library and get services in the library.

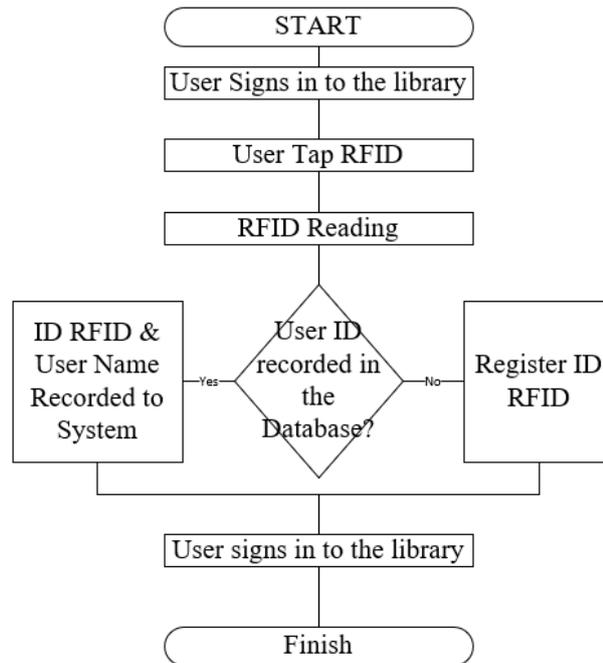


Fig. 1. Work chart RFID based system of library visits.

Figure 2 shows the process for getting into an academic service. Every visitor enters the student admission room and taps their RFID that will be identified by the system. If the card is already registered in the database, the ID and name of the visitor will directly be stored on the visitor's information system and the visitor can directly choose the desired service. If the card has not been registered then the visitor can register the card used in the RFID system. Once registered, the visitor will be listed automatically by the system and can choose the service that they will choose. After the service selection process, the visitor waits for the call to get the academic service [16].

Figure 3 is a business process used in the RFID-based parking system. User's vehicles will have to enter and approach the RFID card reader, then the system will read the RFID card and perform the data matching on the database. If the RFID data is already in the database then the entrance gate will open automatically, then visitors can enter the parking area.

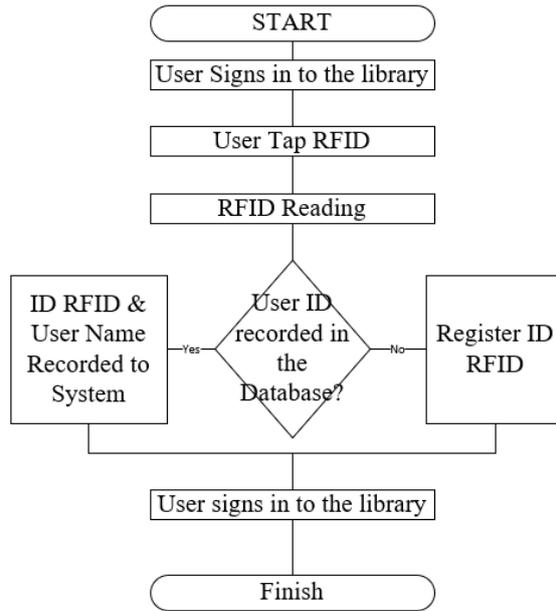


Fig. 2. Work chart RFID based system of academic service.

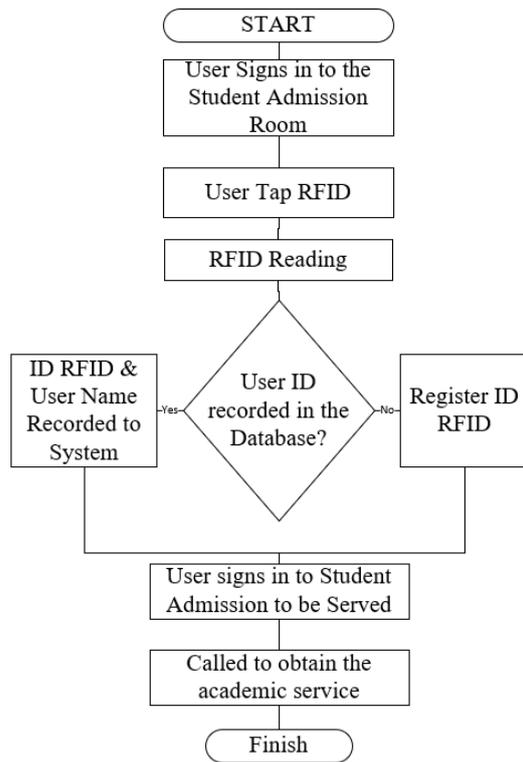


Fig. 3. RFID based parking system.

Figure 4 shows the RFID system for parking which has two parts—parking entrance and parking exit. The system, in general, is almost the same, vehicle exits and tap their RFID in the RFID parking system. RFID data will be read and matched with the data contained in the database. However, when the vehicle exits from the parking system the amount of the balance on the RFID card will be checked beforehand [17-19]. If the balance is sufficient, the gate will automatically open and the system will record the output. If the amount of balance is insufficient, the user can pay for parking with the manual system of payment which is paying directly to the worker.

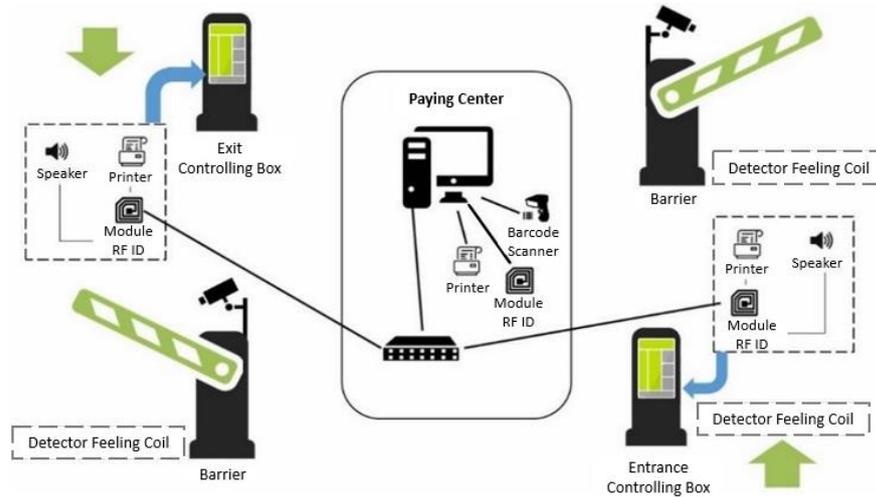


Fig. 4. Work chart RFID based parking system.

3. Data Analysis and Discussion

In the implementation of research that is used both on the library visit service, academic service, and the parking system using RFID based card with the type of card which is EM4100 with a frequency of 125 kHz. The card belongs to an identification card user who has their IDs stored in a chip that will be detected if pasted on an RFID identification device called RFID readers.

3.1. Design of library visit service systems

Figure 5 shows a business process or a flow used in the library visitor system. The initial process, user or library visitor comes to the information table to perform the tapping process in the RFID card reading system. RFID tapping is the process of reading the card identification through the RFID system, the data that reads will be matched to the data that already stored in the database. If the data that reads according to the data already exists in the database then the user data will be stored in the system as library visitors. Visitors can directly enter into the library to do activities either reading, borrowing the book, or trying to find the books they need. This smart card detection in the library can be applied to check-in or check-out for the library visitors [9]. The process of data logging system visitors based on RFID cards shown in Fig. 6.

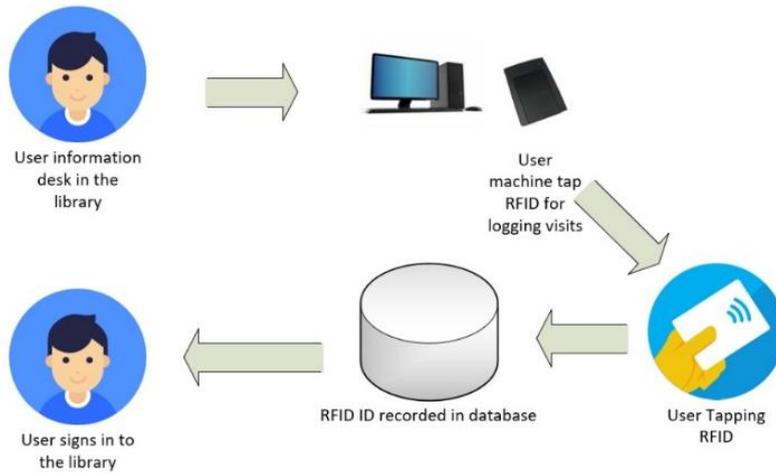


Fig. 5. RFID based system of library visits.

3.2. Design of the Academic Administration Service System

Figure 6 shows how a business process or a flow used in the academic service system at university. The initial process is that the user or the visitor can go directly to the RFID-based queue machine to tap the card and that will be processed in the RFID card reading system. RFID tapping process is the process of reading and identifying the card through the RFID reader, the data that has been read will be matched to the data that already stored in the database. If the data that has been read matches with the data contained in the database, the user data will be stored in the system then the user can choose the service that they intended to use. Some of the academic services that are used are financial services, academic leave, student mail, and other academic services. Next, the data will be stored on the system and the academic service personnel will call and help the visitor according to their needs.

3.3. Design of parking service system

Figure 7 shows a monthly average of the data that use RFID in the library system that reaches 90% with the highest percentage is in October reach 97.98% and the lowest is in January with a percentage of 96.17%. However, the percentage increase in February was 0.46 percent, reaching 96.63%. The use of RFID increased again in March by 0.15 to 96.48%. Nevertheless, there was a decline in April with a percentage of 0.38 and reach 96.10%. It can be seen that there is a significant decline with the number 0.6 and reach 95.50%, as for June the number decline about 2.26 and reached 93.24%. However, the number was increased in July with the number of 3.07, which was the most significant increase that ever happened and reached 96.31%. You could see the additional percentage of 1.36 and reach 97.67%. The percentage decrease again in September by 0.89 which means the percentage decline to 96.78%. However, there was a 1.2 increase in October which resulted in visitors using 97.98% with the decrease of 0.93%, with the average RFID user 97.05%. It indicates that RFID has been well utilized in the library's visitor service.

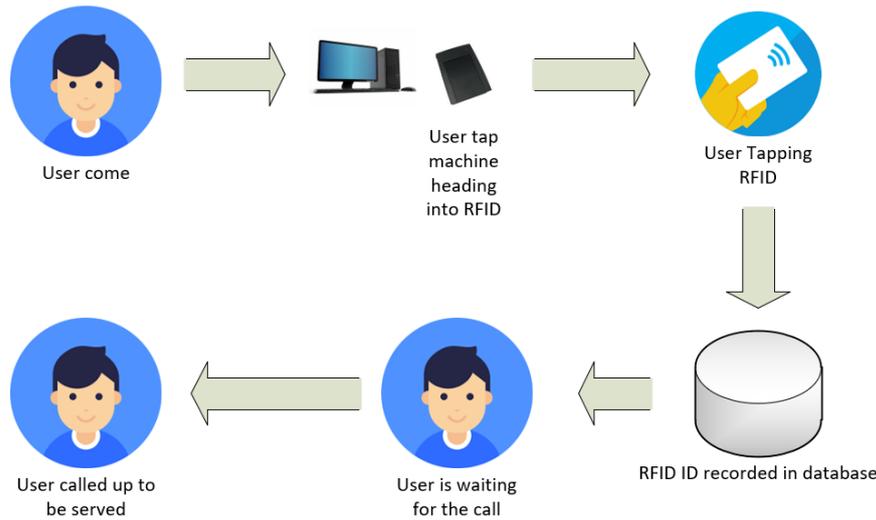


Fig. 6. RFID based system of academic service.

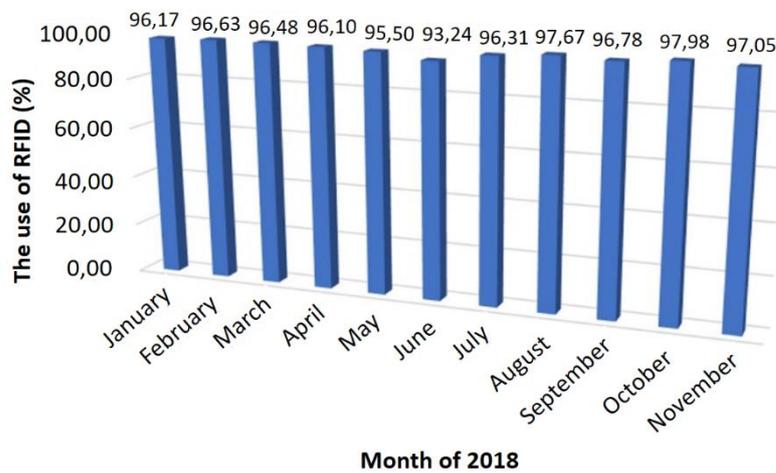


Fig. 7. Percentage of the use RFID in library visit.

3.4. Analysis of RFID usage level in academic administrative services

Figure 8 shows the percentage of registered RFID users using their card in the Academic Administration Service within a year with the highest percentage of the use RFID in Academic Service is in November and the lowest percentage is in April. However, in January, the percentage of visitors using their RFID is 98.18% which raises 0.03 to 98.21% in February. It raises again until 98.64% with the number of 0.43 in March. The percentage decreases to 97.85% in April which means the number of decreased is 0.36. However, the percentage immediately raises 0.51 in May that changes to 98.36% and decreases again in June to 98.30% with the number 0.06% and the following month decreases again 0.19 into 98.11%. The percentage steadily raises by 0.73 in August to 98.84%. However, the

percentage decreases 0.22 in September into 98.62%. As for October, it raises 0.54 which means the percentage is 99.16%, and for November, the number raised by 0.05% that makes the percentage changes to 99.21%.

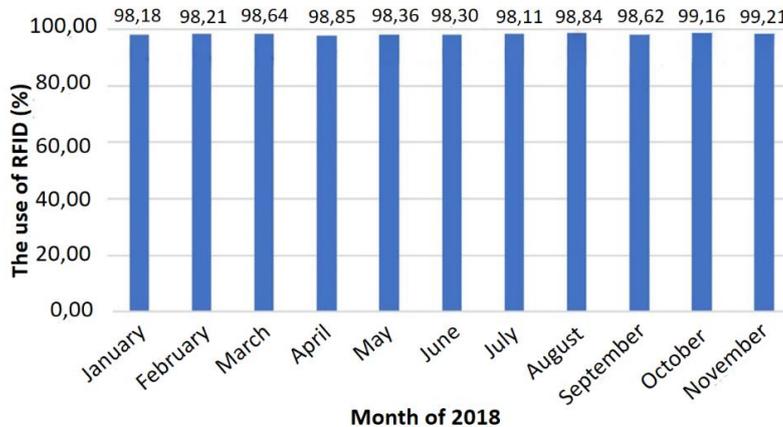


Fig. 8. Percentage of the use RFID in academic administrative service.

3.5. Analysis of RFID usage level in parking system services

Figure 9 shows the percentage of RFID that uses a parking system service where the highest percentage is 65% in February and the lowest percentage is 6% in July. The percentage of which had been using their RFID card started at 46% in January and increased by 21 in February to 65%. March suffered a decrease by 43 into 22% and decreased 8 in April to 14%. The percentage increased by 4 to 18% in May but decreased by 3 to 15% in June. The decreased happened in July by 9 to 6%. August experienced an increase of 18% from 6 to 24%, decreased by 12 to 12% in September but raises by 1 to 13% in October. However, there was a decrease at November by 5 to 8%. It shows that the usage of RFID has not been well utilized in parking system service whereas the application of RFID technology can improve security and safety [12]. Besides, in the future, the payment pattern of the parking system with RFID based is an automated system that can enclose effective payments and can be sustainable [10].

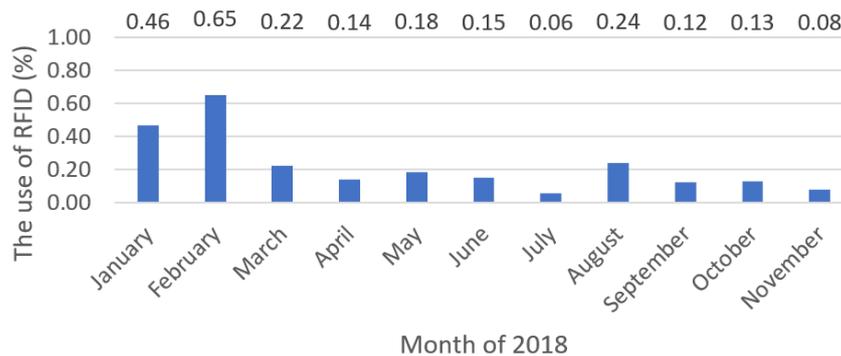


Fig. 9. Percentage of the use RFID in parking system.

3.6. The analysis of comparison in RFID usage in every service

In addition to explaining the percentage of comparison between Library Visit, Academic Service, and Parking System (see Table 1).

In an attempt to show the ratio of the frequency of the usage of RFID card comparisons in academic service i.e. library visit system, academic administration service, and parking service then compare the amount of RFID already used in each system [20]. The amount of RFID that is already being used reaches the value of 13473. Details of the comparison of the number of uses and the percentage of use of RFID in each service that is shown in Table 1.

Table 1. Table of comparison use RFID on every service.

Month	Percentage use RFID on every service		
	Library Visit (%)	Academic Service (%)	Parking System (%)
January	15.86	14.01	1.86
February	20.23	18.37	1.17
March	15.27	13.41	0.90
April	17.74	15.88	0.49
May	11.18	9.32	0.59
June	6.14	4.28	0.23
July	17.64	15.79	0.22
August	28.98	27.12	0.39
September	17.82	15.97	0.39
October	29.18	27.32	0.58
November	15.89	14.04	0.23
Average	17.81	15.96	0.64

Figure 10 shows the percentage of RFID usage on each service where October has the highest percentage in Library Visit, Academic Service, and Parking system reach 29.18; 27.32, and 0.58%, respectively. June has the lowest percentage number of 6.14; 4.28; and 0.23%, respectively, in Library Visit, Academic Service, and Parking system. January has a percentage of 15.86; 14.01; and 1.86% in Library Visit, Academic Service, and Parking System, respectively. The number of RFID users in February increased by 4.37 to 20.23% in Library Visit. Then, Academic Service increased by 4.36 to 18.37%. Finally, the Parking System decreased by 0.69 to 1.17%. RFID users in March decreased by 5.05 to 15.27%; 4.96 to 13.41%; and 0.27 to 0.90% in Library Visit, Academic Service, and Parking System, respectively.

The increase in April was experienced by the Library Visit and Academic Service by 2.47 to 17.49% and 15.88% each, while the Parking System decreased by 0.41 to the number of 0.49%. The usage on May decreased by 6.56%, in which the Library Visit and Academic Service, respectively, were to 11.18% and 9.32%. The Parking System increased by 0.10 to 0.59%. June has decreased users in each service whereas the users in Library Visit decreased by 5.04 to 6.14%, Academic Service as much as 5.04 to 4.28%, and Parking System as much as 0.36 to 0.23%. July experienced an increment of users in the Library Service as much as 11.50% and Academic Service as much as 11.51% while Parking Service experienced a decline of 0.01% (which becomes 0.22%).

The user increases in August made the Library Service to be 13.36 to 28.98, Academic Service experienced a 9.48% increase to 27.12%, and a Parking system

that increased by 0.10 to 0.39%. September's user decreased in the Library Visit as much as 11.16 to the number of 17.82%. The decline in Academic Service was 11.15 to 15.97%, while the Parking System remained at 0.39%. October has increased the user by the amount of 11.36 to 29.18%, Academic Service by 11.35 to 27.32%, and Parking System as much as 0.19 to 0.58%. The decreased users in November reduce the Library Visit users by 13.29 to 15.89%, Academic Service of 13.28 to 14.04%, and Parking System by 0.35 to 0.23%.

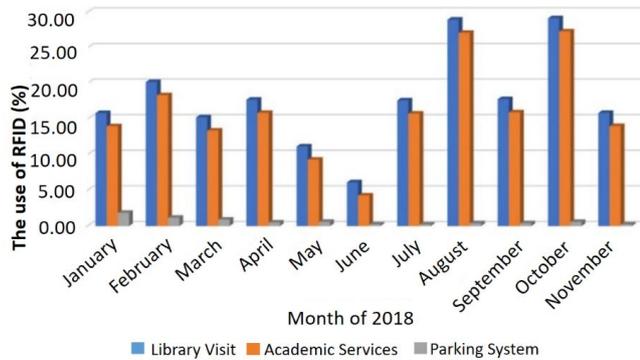


Fig. 10. Comparison percentage use RFID on every service academic.

Figure 11 shows a comparison of the frequency RFID usage in each section where the highest percentage is located in a library visit and the lowest is on the parking system. The use of RFID receipt the library visitors reaches 17.81% in a year with the difference of 1.85% with the academic administration service which has a percentage of 15.96 and 17.17% difference with the parking system which have a percentage of 0.64% the academic administrative service and the parking system service have a significant of 15.32%.

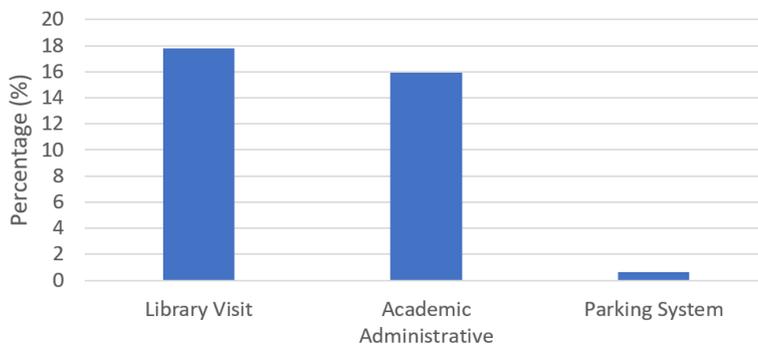


Fig. 11. Average percentage user of RFID.

3.7. The comparison between the user of RFID and non-RFID user

Figure 12 shows the number of RFID users in each academic service every year, wherein the highest number of RFID users for both Library Visit and Academic Service is in October reached 3931 and 3681 users as for Parking system, it reach 250 users in January [21, 22]. The lowest number was in June where users only

reached 827 and 577 users in Library Visit and Academic Service, and the Parking Service was in July with 30 users. In January, the use of RFID in the Library Visit, Academic Services, and Parking System reached 2137, 1887, and 250 users, respectively. In February, there was an increase of 588 users in the Library Visit and Academic Service. So, it reached 2725 and 2475 users in Library Visit and Academic Service respectively. Meanwhile, Parking System decreased by 93 to 157 users.

In March, there was a decrease of 668 users in the Library Visit and Academic Service, that each became 2057 and 1807 users, while the Parking System experienced a decrease of 36 to 121 users. In April, the Library Visit has increased by 250 to 2390 users and Academic Service has increased by 333 to 2140 users, while Parking Service has decreased by 55 to 66 users. In May, both the Library Visit and Academic Service met a decrease of 884 users, each to 1506 and 1256 users, on the other hand, Parking Service met an increase of 14 to 80 users. In June, the Library Visit and Academic Service decreased again with the same number of 679 users, each of them became 827 and 577 users, while Parking Service also experienced a decrease of 49 to 31 users. In July, the Library Visit and Academic Service both increased 1550 users, each to 2377 and 2127 users, while in Parking Service there was only one to 30 users.

In August, the number of Library Visit and Academic Service increased by 1527 users, each to 3904 and 3654 users, while Parking Service also increased by 23 to 53 users. In September, 1503 users decreased in the Library Visit and Academic Service, which became 2401 and 2151 users, while in Parking Service the number of users remained at 53. In October, the Library Visit and Academic Service increased by 1530 users each to 3931 and 3681, Parking Service also increased by 25 to 78 users. As for the last month, November, the Library Visit and Academic Service experienced a drastic decrease of 1790 users, each of which became 2141 and 1891, Parking Service also decreased by 47 to 31 users. It can be seen that RFID has a lot of advantages so it is very convenient to use RFID system in academic services [1].

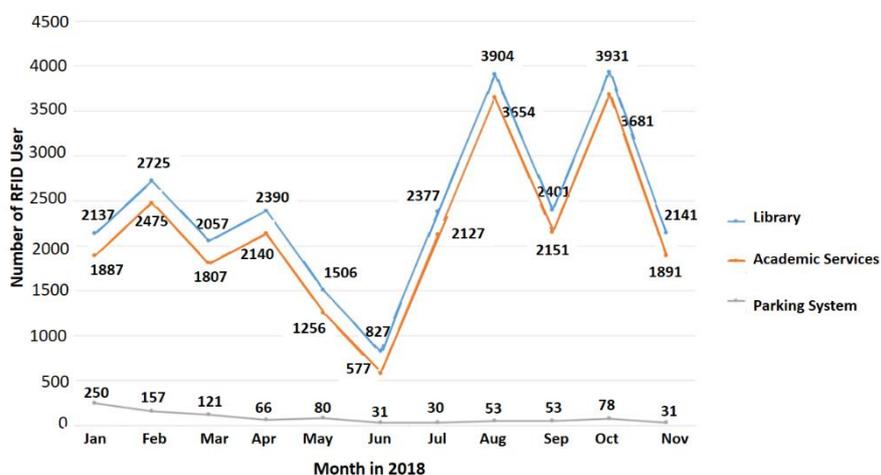


Fig. 12. Comparison of RFID in each service.

Figure 13 shows the number of non-RFID users in the academic field every year. The highest number of non-RFID users for Library Visit and Academic Service is in April with the number of 97 and 47 users each, while for Parking Service is in October with the number of 61589 users. On the other hand, the lowest number of non-RFID users for Library Visit, Academic Service, and Parking Service is in June with the number of 60, 10, and 20293 users. In January, the number of non-RFID users reached 85 users for Library Visit, 35 users for Academic Service, and 53581 users for Parking Service.

In February, there was an increase of 10 users in the Library Visit and Academic Service so that it reached 95 and 45 users, while in contrast, the Parking Service decreased by 29510 users to 24071 users. In March, the number of non-RFID users was decreased by 20 users for both Library Visit and Academic Service into 75 and 25 users each, whilst in Parking Service, the number was increased by 30323 users to 54394 users.

In April, the number of non-RFID users was increased by 22 users for Library Visit and Academic Service so that it reached 97 and 47 users for both of it, whereas in Parking Service it decreased by 7665 users so that it reached 46729 users.

In May, the number of non-RFID users decreased by 20 users in Library Visit and Academic Services into 71 and 21 users each, for Parking Service decreased by 2968 users so that it reached 43761 users.

In June, the number of non-RFID users decreased by 11 users for Library Visit and Academic Services into 60 and 10 users each, in Parking Service decreased by 23468 users to 20293 users.

In July, there was an increase of 31 users for Library Visit and Academic Services so that it reached 41 and 91 users, the number of Parking Service increased by 31285 users into 51578 users.

In August, there was an increase of 2 users for Library Visit and Academic Services so that it reached 93 and 43 users, in contrast, there was a decrease of 29641 users for Parking Service so that it reached 21937 users.

In September, the number of non-RFID users was decreased by 13 users for Library Visit and Academic Services so that it reached 80 and 30 users, on the other hand, there was an increase of 21460 non-RFID users for Parking Service into 43397 users.

In October, the Library Visit and Academic Services gained 1 user so that it reached 81 and 31 users, at the same time the number of non-RFID users for Parking Service was an increase of 18192 users into 61589 users.

As for November, there was a decrease of 16 users in Library Visit and Academic Services so it reached 65 and 15 users, while in Parking Service there was a decrease of 22728 users so that it reached 38861 users.

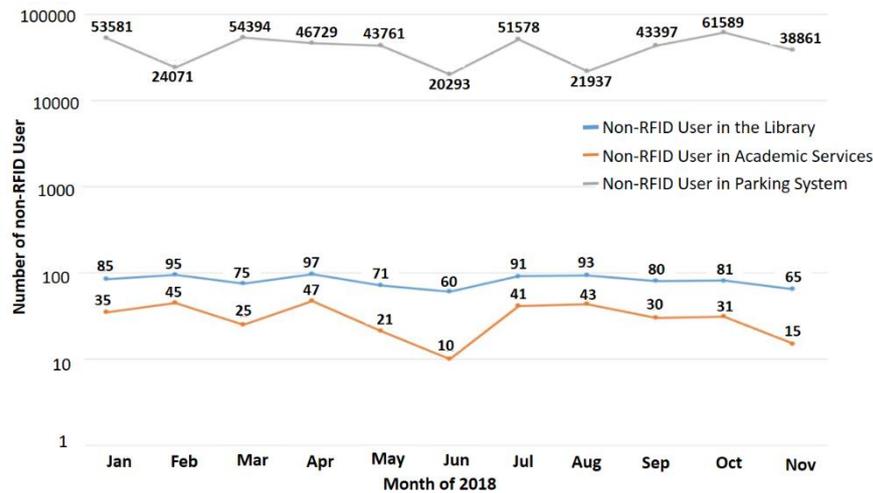


Fig. 13. Comparison of non-RFID User in each service.

4. Conclusion

The RFID technology has benefits on not only the users but also the university's services. The convenience provided is by using one card which can be accessed by all academic services at the university. The frequency of usage varies on each service with the highest usage located at the library service and the lowest is on the parking service.

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