Design of Cashless Payment System with RFID to Improve Services of School Canteen: A Case Study

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Abstract

As we are in the midst of the COVID-19 pandemic, people are coping up with the "new normal" and finding ways to prevent transmission of the virus. Pen and paper has been replaced by automation that will make life much easier for all. Radio Frequency Identification or RFID is a type of wireless technology that utilizes radio waves in order to transmit data. RFID systems include three parts which are RFID tags, RFID reader, and an antenna. The RFID reader and antenna combination sends out radio frequency energy in order to power up the chip in the RFID card for it to be able to transfer data. When this type of system is applied in payment transactions like in a cafeteria or canteen, it will help eliminate long queues and record inventory and sales within a short amount of time. This paper covers the opinions and views of the customers and concessionaires regarding the alternative approach to the current payment system of using cash in transactions into a cashless transaction system using RFID technology. The researchers used survey questionnaires that made use of the Likert Scale in order to gather data and analyze the results. The paper shows comparison between the current and proposed processes and highlights the process which can be eliminated in order to improve the current payment system. Furthermore, the study includes a prototype design of the payment system with RFID technology.

Keywords

COVID-19, RFID, canteen, cashless transaction

1. Introduction

Now that everyone is experiencing the effect of the pandemic, companies and establishments have been slowly adjusting for the "New Normal" to be able to continue operating their businesses. The pandemic suddenly became a turning point such as having a contact-free economy. The contact-free economy in the sense that e-banks and reloadable cards are used as a payment transaction when purchasing. RFID is one of the most convenient and beneficial systems in which it can help improve the daily services of a certain company or business (Manoharan and Rakshit, 2020).

RFID technology is one of the factors that can help affect the development of the so-called "New Normal" way of lifestyle especially in cafeterias because of the variations of features and benefits that it can provide not only for the customers but also for the concessionaires. And because of this pandemic, people are afraid to be infected by the virus through the use of physical money (Aji et al. 2020). People are still in the process of adopting new practices in the current situation hence, some prefer using cash as payment mainly because they lack trust in technology. Another problem is that university cafeterias or other establishments before the pandemic do not implement certain systems for their process to be more convenient for the customers and the concessionaires present (Marasigan, 2017).

This research considered the opportunities of implementing a cashless payment system with RFID to Higher Education Institution's (HEI's) cafeteria to resolve certain issues and improve their services. Further, the system is more accessible to the users.

2. Literature Review

The COVID-19 outbreak has alarmed people all over the world. The transmission of the virus even in a single droplet has worried everyone. An RFID-based cashless system that is aiming to provide a comfortable, tension-free and easy way of payment (Gaikwad et al. 2017). In the Philippines, tolls use RFID as payment to lessen problems and reduce congestion in different expressways (Satyasrikanth et al. 2016). The Radio Frequency Identification (RFID) is an application that helps in different industries and our daily lives. This benefits the digital world as it raises new developments in terms of concept, device and application. It is indeed possible that the RFID will continuously implement applications that will be an advantage for our society and humanity (Duroc, 2018). RFID technology which aims to be one of the most convenient and efficient payment transaction systems in terms of different cases which confidently use payment systems that rely more on physical transactions than contactless transactions which are solely more appropriate for this time being (Arbonida et al. 2019) . RFID can also provide convenient transactions if the user is a bit far on the store; they have the option to transact online and not on the physical store itself. Nowadays, users tend to implement and welcome cashless transactions because not only it can generate efficiency but also it can display a faster phase of purchasing goods; with the idea of the researchers the access and errors can be limited because of the system transactions that will be beneficial for the user and also the concessionaires of the physical store itself (Mall and Shaikh. 2017). Usual requirements in making the system are RFID reader, RFID tags and software tools such as Netbeans, Android studio, MySQL server and PHP. Numerous establishments have been using this system even before the pandemic but some are still using the traditional way. Most canteens use pen-paper, cash, manual calculations and manual inventory record keeping that consumes so much time and shows an inefficient way to operate a business. With the use of RFID technology, reducing service time, time, eliminates queues, eliminates the burden of counting, and giving change. The use of RFID technology can also be a reliable way of storing the records and going through them easier (Mall and Shaikh. 2017). RFID eases the work of both students and staff as it can be used at many places like libraries and canteens. Since it is associated with a unique ID, it may ensure the student's security (Nsengumuremyu et al. 2018). Challenges are not exempted when transitioning to a cash basis method to a cashless method (Pizzol et al. 2018). But with the help of this system, it does not only help business but also improves the development of the country's economy (Soukal and Hedvicakova, 2014).

3. Methodology

This chapter presents the methods and tools used to identify the current situation, analyze results of data and the proposed design of the system.

3.1 Data Gathering

The researchers collected data from the 53 students and 3 concessionaires of the HEI's Cafeteria through a survey. The survey was conducted online using a purposive method. The questionnaires for both customers and concessionaires are divided into categories such as utilization, issues, security, and importance. For the utilization category, the researchers want to determine how often they visit the cafeteria and their choice of payment. Issues category consists of questions about the problems they observe, how long they wait in line and if they are satisfied with current procedures. For the security category, the authors asked about their views or perceptions about RFID payment systems.

3.2 Analysis and Design

In analyzing the survey, the researchers used graphs and Frequency for questions incorporated with the Likert Scale to analyze the data gathered from survey responses. The frequency distribution is one of the most appropriate tools for the results to be presented and organized. By this, it determines the strong and the weak points of the answers. Microsoft Excel was used which also provides a variety of charts to show the results of the survey. The frequency distribution is important to organize and easily understand the gathered data as a whole. Frequency determines and represents the outcomes on the given observation specifically on the Likert scale because the questions are mostly done on the observations and views of the customers and concessionaires. They also used Justinmind which is a prototyping tool in order to see the possible outcome of the system.

The current situation of the canteen services is more on the manual type of transaction in which it uses mostly pen and paper and cash registers as their mode of payment. There are 3 tools appropriate for analyzing the current situation of HEI's cafeteria. These are S.W.O.T analysis, Process maps and flow process chart. S.W.O.T. Analysis is the one tool which separates the different strong and weak points of the processes given in the situation; the main use of the S.W.O.T. analysis is to list down the different aspects of the strong points to the threat and opportunities of the services of the current situation in the service provided by the cafeteria. One use of the SWOT analysis is to determine and provide points that can be given based on their current situation. Showing the opportunities and threats of the current situation can be great because it can determine the capabilities of their service and threats that can be difficult for them to handle because of the competition with the other university cafeterias. A process map is a tool that is also appropriate for the situation because it can display the current process of the cafeteria and with this, it can determine the weak points and strong points of their processes. With this, the researchers can be able to show different ideas on what to do to improve the processes and the services provided by the cafeteria. And lastly, the Flow Process chart to determine the failure points that needed to be eliminated in the process. The researchers also made a wireframe of the RFID payment system using Justinmind, a prototyping tool, to show the proposed design of the system.

4. Results and Discussion

This chapter presents and interprets the data gathered from the respondents and showcases the comparison between the current and improved processes of Mapua University of Makati. The designed user interface is also shown in this chapter.

4.1 Current and Improved Process

STRENGTHS
Accomodating Concessionaires
Affordable varities of food

WEAKNESSES
Manual Transaction System
Less Accommodation
Time consumption/Waiting time

OPPORTUNITIES
RFID Technology
Greater accommodation
More convenient service
Productive and efficient reports

THREATS
Modern service implemented from other cafeteria
Convenient systems in other universities
Large capacities of customers

Figure 1. SWOT Analysis

The SWOT Analysis talks about the Strengths, Weaknesses, Opportunities and Threats of the HEI's cafeteria even before the pandemic. For Strengths, they have accommodating concessionaires and a variety of food is affordable. For Weaknesses, they use manual transactions like pen and paper. This also makes it time consuming when lining up since there is a large number of students. The cafeteria also has limited space for the customers and therefore, some students rather eat outside the campus. With the said weaknesses, opportunities may arise. First is the use of RFID technology as payment for more convenient service. Another is that they could have productive and efficient reports with the help

of the system. In this way, it will be convenient and efficient for both concessionaires and customers. Lastly, Threats. First is the modern service in other cafeterias of different universities by using technology. This makes it convenient for them in terms of paying and tracking their purchases. This results in a large capacity of customers.
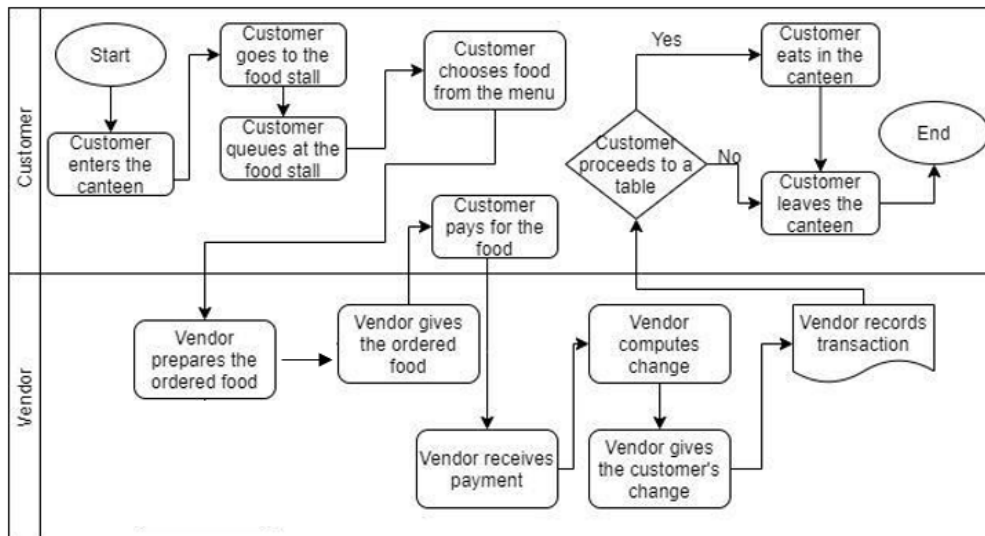

Figure 2. Current Process map

Figure 2 shows the current process of the cafeteria which starts from the customer entering to dining-in or leaving. Actors involved are the customers and the vendors of different stalls. It starts when the customer enters the canteen. The customer goes to the food stall to order and lines up. Once the customer is near the cashier, he/she chooses food from the menu and tells it to the vendor. The vendor prepares the food and gives it to the customer. Then, the customer pays for his/her order. Vendor computes the change if there is any and gives change to the customer. The vendor then records the transaction with the customer. Once the order is complete and the change is given, the customer proceeds to the table. If there is space, customers eat in the cafeteria. If space is already occupied by other students, customers leave the cafeteria.

Step #	Activity description	Time (minutes)	Distance (meters)	Operation i	Transport ð	Inspection	Delay D	Storage S	Value Category	Remarks
1	Customer enters the canteen	1	1		x				ENVA	
2	Customer goes to the food stall of their choice	1	20		x				ENVA	Distance varies
3	Customer queues in the stall	3	0				x		NVA	Time of queue can be reduced
4	Customer chooses from the stall's menu	3	0	x					ENVA	
5	Vendor prepares the ordered food	1	0	x					VA	
6	Vendor gives ordered food to the customer	1	0	x					VA	
7	Customer pays for the ordered food	1	0	x					ENVA	
8	Vendor receives the customer's payment	1	0	x					NVA	Can be removed
9	Vendor computes change	1	0				x		NVA	Can be removed
10	Vendor gives the customer's change	1	0	x					NVA	Can be removed
11	Vendor records the transaction	1	0					x	ENVA	Can be automatically recorded
12	Customer proceeds to a table	1	10		x				ENVA	Distance varies
13	Customer leaves canteen	1	10		x				ENVA	Distance varies
14										
15										
	Count:			6	4	0	2	1		
	Time per process step:			8	4	0	4	1		
	Total VA	2			Total NVA	4		Total ENVA	7	
	VA Time	2			NVA Time	6	Minutes	ENVA Time	8	Minutes
	Distance traveled	41			Lead Time	16	Minutes	VS Ratio	12.500%	

Figure 3. Flow process chart

Figure 3 is the current Flow Process of the cafeteria wherein it shows the Value Added, Essential non-value added and Non value-added activity which will be eliminated and will result in an efficient and more effective process. There are 2 Value Added activities and 7 Essential non value-added activities. Moreover, there are 4 Non value-added activities which shall be removed and time can be reduced to the proposed process because these activities do not add value to the service. The results show that there is a lead time of 16 minutes that can be lessened once the RFID payment system is used.

WHAT ARE THE COMMON PROBLEMS ENCOUNTERED BY THE STAFF? Check if necessary:
3 responses

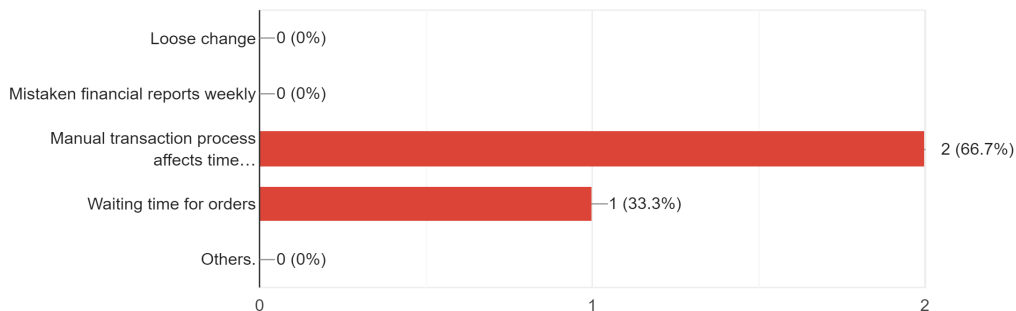|	
Loose change	0 (0%)
Mistaken financial reports weekly	0 (0%)
Manual transaction process affects time…	2 (66.7%)
Waiting time for orders	1 (33.3%)
Others.	0 (0%)

Figure 4. Problems Encountered by Concessionaires

Different problems and issues are encountered in the cafeteria not only by customers but also the staff. For the customers, food choices are what they are concerned about. 2 out of 3 concessionaires of the university said that the manual transaction which is by the use of pen and paper, is the most common problem done by the staff because it is

time consuming and results in misunderstandings. 1 voted for the waiting time of orders as the most common problem since they had to prepare the orders of dozens of customers. These are shown in Figure 4.

PRESENTATION OF TABLE				
	4 (SA)	3 (A)	2 (D)	1 (SD)
Do you believe that the university should implement cashless transactions using RFID technology?	16	31	5	1
Do you believe that using RFID cards as payment is safe and trustworthy?	13	33	6	1
Do you think that Security plays an important role in implementing a cashless system?	33	19	0	1
Would the implementation of Cashless payment benefit the future of the University?	18	35	0	0

Figure 5. Students Survey Results

The researchers distributed an online survey wherein they can determine the opinions and views of the students/customers regarding the RFID payment System. Majority believes that this system benefits especially in this time of pandemic where all are concerned about their safety. Thus, having a contactless transaction is a big advantage to everyone. Based on Figure 6, the majority of the respondents agree that the university should implement the RFID payment system. This is because of the manual process being time-consuming and misunderstandings for both students and staff. 33 out of 53 students believe that RFID cards as payment are safe and trustworthy because according to them, they do not feel safe carrying cash in public places. The majority of the respondents Strongly Agrees that Security plays an important role when implementing a cashless system since software usually has defects and malicious attacks. Lastly, 35 out of 53 students which is majority of the respondents thinks that the cashless payment benefits the future of the university as it will ease the work of students and staff in tracking transactions and because the rise of digital is at its peak.

Figure 6. Advantage of System to Concessionnaires

Based on the survey, the concessionaires think that the most advantage of the said system is that it could reduce labor costs. In Figure 6, it talks about the views of the concessionnaires on the advantages of the RFID payment system once it is implemented. 2 out of 3 concessionaires strongly agree that it can improve the efficiency of data. 2 out of 3

agree that the system can track and control their sales which is easier to check inventory. 2 out of 3 also agree that it would be easier to make daily reports. 2 out of 3 strongly agree that the system is made to have a functional business process and lastly, 2 out of 3 strongly agree that once the system is implemented, it can block any unknown actions.
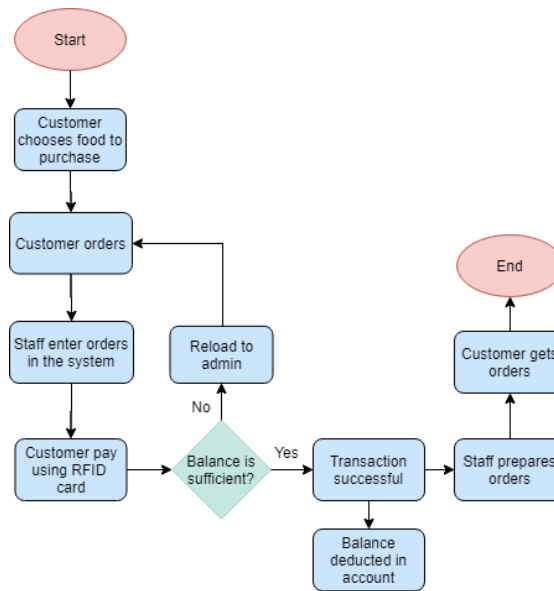

Figure 7. *Improved Process map*

Figure 7 shows the improved process map once the RFID payment system is applied in the cafeteria. The process starts when the customer enters the cafeteria and chooses what to order. Then the customer orders and the vendor enters the order into the system. After that, the customer pays using the RFID reloadable card. If the balance is insufficient, the customer shall reload to the admin. If the balance is sufficient, his/her balance will be deducted hence, the transaction is successful. After the payment, staff prepares the order and the process ends when the customer receives his/her order. Compared to the current system, the improved process will have lesser lead time as it has a system that will help in the efficiency of the business process. With the help of the RFID payment system, it helps reduce labor cost and eliminate long queues. The non-value adding activities from the current process are now removed and result in a more structured business process as shown in Figure 8.

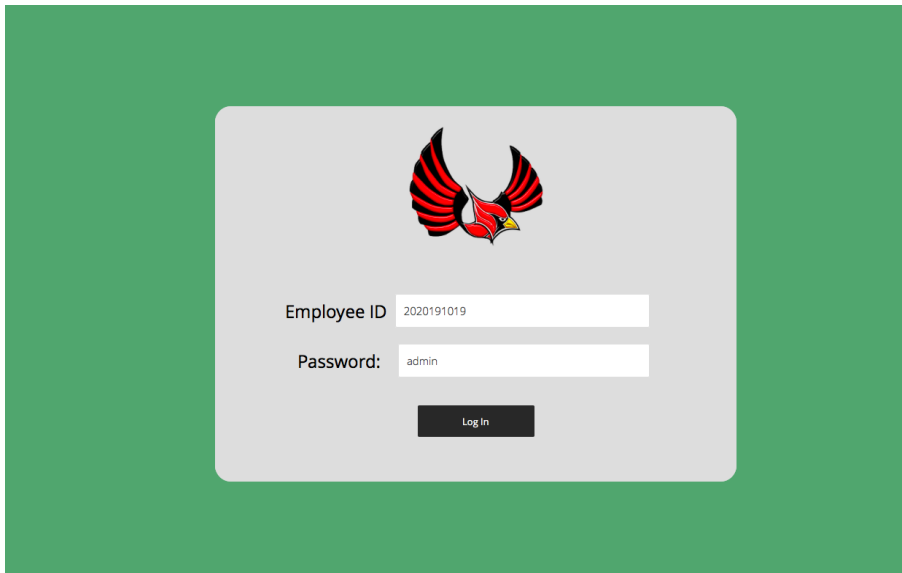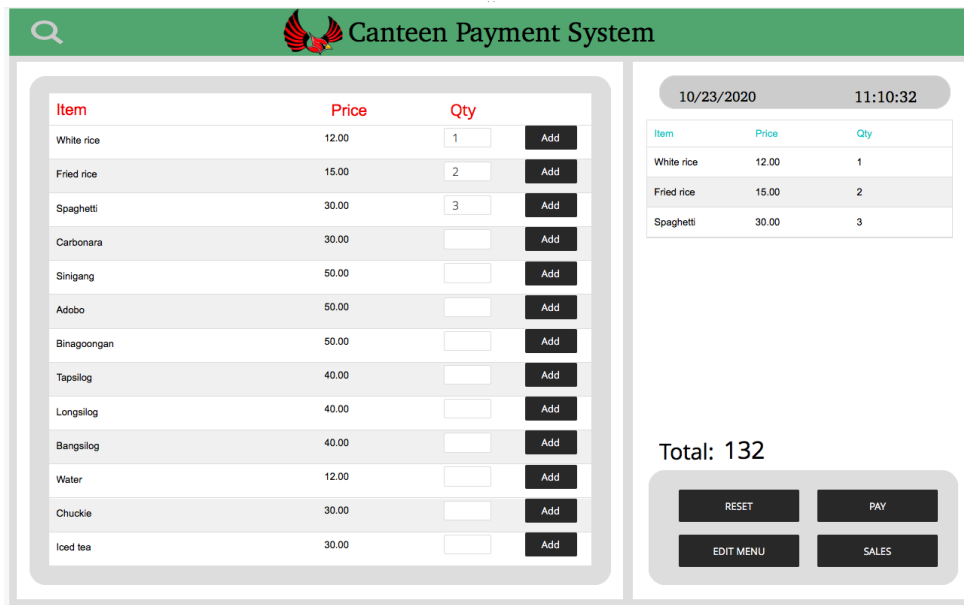### 3.2 Design of User Interface

Figure 8 Log-in

Figure 9 Main page

In Figure 8, the employee needs to log-in the system. The employee shall enter his registered employee ID and password. After successfully logging into the system, the user will be brought to the main page Figure 9. In the main page, there are also four buttons that lead to other pages. Once the customer is ready to order, the employee shall enter the order, quantity of orders of the customer then select 'add' to calculate the orders. The total will be in Peso. The employee can select 'reset' in case the customer would like to change orders. A time and date stamp is also shown to record the purchase of a student which will be reflected in their MyMapua account.
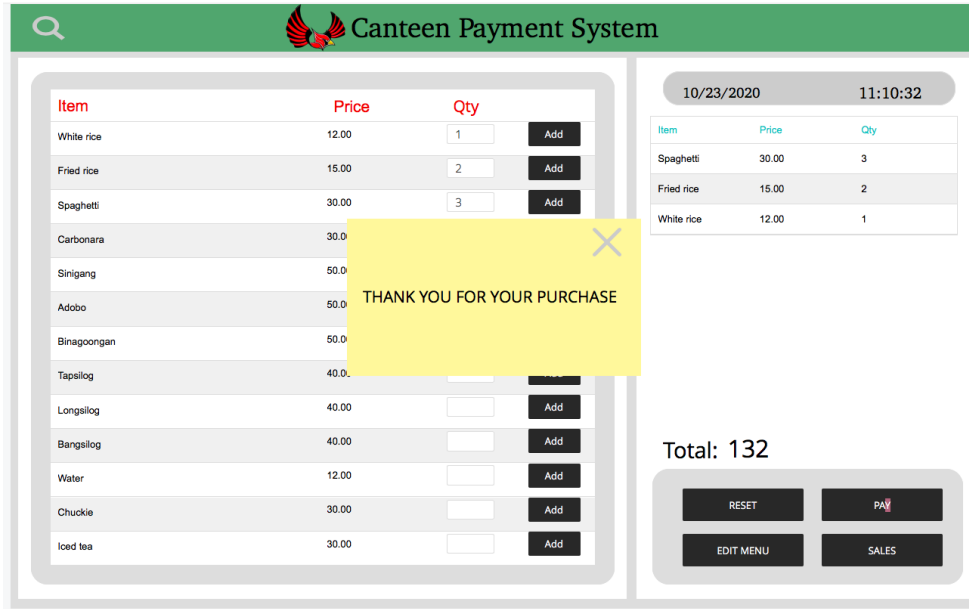
Figure 10 Payment window

In figure 10, once the customer is ready to pay, the employee shall select 'Pay' for the customer to tap their reloadable ID in the RFID reader. The system will receive their payment and deduct their balance which will be reflected in their MyMapua Account. A short message which says "Thank you for your Purchase" will appear once payment is done. If the balance is insufficient, it will not be deducted hence, the transaction will not push through. An edit menu button is also available when the concessionaire will change the menu whenever they want.
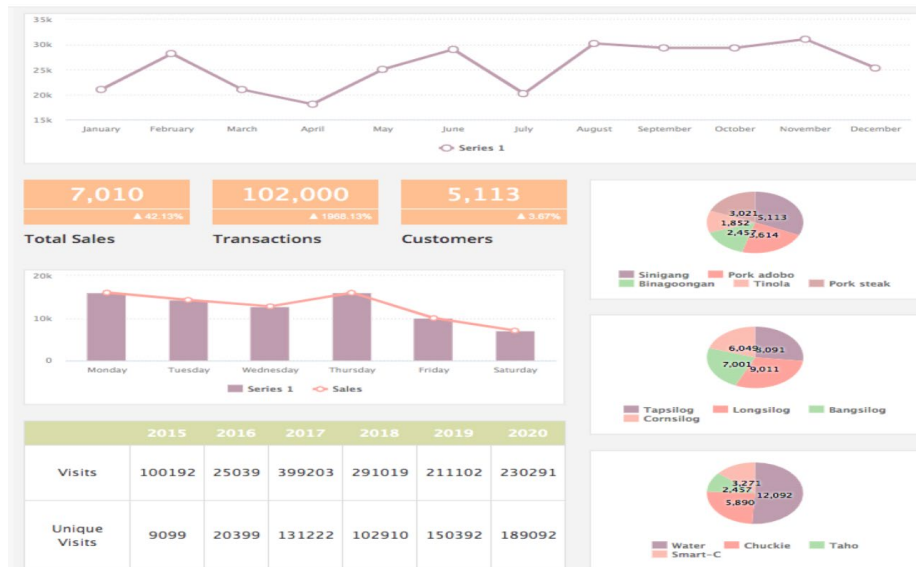

Figure 11 Dashboard

Figure 11 shows that if the 'Sales' button is selected, the real-time dashboard will appear. The dashboard helps the concessionaires in tracking data such as inventory, customers and decision-making. This involves numerical analytics which can be useful in common calculations (Schultz, 2017). With this, they can determine what the customers want within the next few days. It shows the total sales and transactions of the business per week and per month. It also shows their total visits and the most ordered product.

Figure 12. Payment History

The MyMapua website is a school portal accessible to students wherein they can view important information such as schedules, transcripts, payables etc. In the payment history, it contains fees paid for school such as matriculation fees, library fine etc. In figure 12, it shows that their transactions using RFID will be recorded in the MyMapua account under payment history. This will allow the student to view where the money was spent, date and timestamp and should help the student track his/her expenses. It will also show the remaining balance of the student in the reloadable card.

Conclusion

RFID is known for its cashless basis transaction on every tollway that the people are driving in, one of its features is the convenience it provides for all the drivers in the country. And with the idea of the researchers to bring it to the cafeteria of the university, it has gained potential as based on the study conducted. With all the results provided, the satisfaction of the students and the concessionaires will definitely increase in time once the said system which is the RFID based payment system in the cafeteria of the HEI's is going to be implemented in the near future. Given all the benefits that RFID can provide inside the vicinity, a lot of the customers gladly said that with the production of the said payment system it can have the ability to attain the highest potential of the cafeteria inside the university. The different features of the RFID based payment system will include the contactless transaction which can be very beneficial for the university and mostly after this pandemic that the people are encountering nowadays. One feature also is focused on the security of the customers and also the concessionaires itself; one factor that the system gave the students is its ability to track and record their transaction within the day which is also very efficient for the students and the accurate and efficient reports that it can provide for the concessionaires. The results on the survey conducted by the researchers are based on the ideas and opinions of both the customers and concessionaires on the implementation of the RFID based transaction system for the cafeteria, the outcome of the said survey attained positive feedbacks regarding the benefits of implementing the RFID technology to the cafeteria, some responses contained high development of sales and security of the customers while on the other hand, for the concessionaires; they stated that it would affect customer satisfaction and the growth of not only the university but also the cafeteria .

As per the results of the study, it was analyzed that this specific technology which is the RFID technology-based Transaction System in HEI's will greatly affect its growth and development as a full standard and competitive university among the others. It was also said that this certain implementation will solely benefit the satisfactions of both the concessionaires and the students of the university.

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