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QR Technology to Automate Health Condition Detection Payment System: A Case Study in Schools of the Kingdom of Saudi Arabia

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Abstract—Food allergy is a common and rising problem among children. Many students have their first allergic reaction at school, one of these is anaphylaxis, which can be fatal. This study discovered that several schools' processes lacked safety regulations and information on how to handle allergy issues and chronic diseases like diabetes where students were not supervised or monitored during the cafeteria purchasing process. Academic institutions have no obvious prevention or effort when purchasing food containing allergens or negatively impacting the health status of students who suffer from chronic diseases. The stability of students' health must be maintained because it greatly affects their performance and educational achievement. To address this issue, this paper uses a business reengineering process to propose the automation of the whole food-purchasing process, which will aid in detecting and avoiding allergic occurrences and preventing any side effects from eating foods that are conflicting with students' health. This may be achieved by designing a smart card with an embedded QR code that reveals which foods cause an allergic reaction in a student. A survey was distributed to determine and examine how the cafeteria will handle allergic children and whether any management or policy is applied in the school. Also, the survey findings indicate that the integration of QR technology into the food purchasing process would improve health condition detection. The family supported that the suggested solution would be advantageous because it ensured their children avoided eating not allowed food. Moreover, by analyzing and simulating the as-is process and the suggested process, the results demonstrate that there is an improvement in quality and time.

Keywords—QR code, smart card, food allergies, Business Process reengineering, health condition detection.

I. INTRODUCTION

THE Kingdom of Saudi Arabia is heading towards several modern and contemporary trends to support its Vision 2030, including using smart payment methods instead of cash at all levels, even in school canteens. Since it was officially implemented in some schools, the scope of this strategy has been expanded. Smart cards are now widely used in schools as a practical way to pay for students' meals.

The smart card strategy, including QR code payment, helps reduce congestion, contact and protect students from viruses. Paying with a QR code also eliminates long waiting times and prevents crowds from forming in certain areas [1]. This strategy has many advantages due to the benefits to the mental and physical health of students including: (i) saving cash for school purchases which prevents many related problems such as aggressive behavior; (ii) stopping social bullying of students who receive meals free school; (iii) doing the parents charge the card.

Recently, the most frequently used technological tool in the modern era especially in the COVID-19 pandemic is the Quick Response Code (QR Code). Using QR codes for transactions has become an effective way to obtain information. A QR barcode scanner or a smart device with a moderate image sensor can recognize this type of barcode. Students simply use a QR code to receive a receipt and make payment at the cashier, allowing for faster processing of information compared to traditional methods and other financial transactions.

Students are attracted to sweets, fast food, and other similar foods. The physical health of some students is also at risk, necessitating full control of dietary habits and appropriate monitoring in schools. For more care, the school needs to know the health status of each student and the data of the students, especially those who suffer from chronic diseases such as diabetes and food allergies, to provide appropriate food to students from the school cafeteria commensurate with their health which is crucial for effective education. The study aims to reveal the student's health status through a QR scan that contains information about the student's diseases. The proposed solution includes details of the student's illness and the foods that he is forbidden to eat in the school cafeteria. This is achieved by including these data in a QR code. To get the information or make the payment the cashier simply has to locate their camera on the QR code. Additionally, the plan is to use the smart card to pay in the school cafeteria and rely on the student's health information to decide whether to allow the purchase of cafeteria food. This will help control the students' healthy habits and ensure that the student's medical condition is stable and safe. The combination of these two topics' high importance led us to suggest a cooperative solution to the issue to support the physical health of students with chronic diseases and to adopt the benefits of smart card payment, in which smart cards address these difficulties by supplying secure storage and immediate access to a patient's medical history.

The paper is organized as follows: the second section addresses the literature review, which covers the management of illnesses and food allergies at schools in multiple countries, as well as a discussion of a number of suggested solutions

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involving smart cards and QR code technologies. The methodology is explained in the third section, along with the process of discovery which describes the as-is process. Furthermore, it encompasses process analysis, which involves both qualitative and quantitative analysis. It also covers the implementation process which includes a comprehensive discussion of the simulation results, and it also contains the suggested solution-to-be model from the reengineering process. The fourth section has the results and discussion. Lastly, the fifth section contains the conclusion and future work.

II. LITERATURE REVIEW

The proposed solution is based on a mixture of concepts. Therefore, in this section previous works related to food allergies and chronic diseases in schools, QR-based solutions, and smart card-based solutions are presented. Moreover, by presenting previous studies it was determined whether there are ways to detect food allergies in schools.

A. Food Allergy and Chronic Diseases in Schools

The issue of allergies has become a major concern, necessitating the development of systems and treatment protocols to effectively address this problem. Reference [2] aims to evaluate the level of awareness of teachers regarding food allergies. The research was conducted in the Jazan region of Saudi Arabia. Using a random sampling technique to select schools to collect data. The questionnaire was posted on the website of the designated school. After that, the data were collected and analyzed by the SPSS program, and the results were evaluated by determining percentages and standard deviations. Thus, it was concluded from the results that most school teachers do not have much knowledge about common foods for food allergies such as nuts and peanuts. As well, 80% of them do not know that lactose intolerance is a form of food allergy and hence they lack of knowledge about it.

In another allergy management study [3], the objective was to collect new information generated by school districts about how they deal with and manage food allergies. The target audience here is the school feeding managers for each district. One person was selected to submit and complete a survey and sensitivity management mechanism in their area. The method that was used was to design a questionnaire and distribute it to a random sample of the target audience. According to more than half of the respondents, their school districts have a food allergy management plan and, as a result, provide meals for students who are allergic to milk, peanuts, almonds, and eggs. Based on the findings of this study, the researchers suggest that future research outlines the systematic implementation of best practices related to food allergy management across a continuum of school area sizes, production standards, and food service standards.

In another study [4] on food allergies, the aim was to assess the knowledge of parents in Saudi Arabia by analyzing and explaining potential aspects of a food allergy. The method used to collect data was through a questionnaire that was posted on social media platforms. The questionnaire addresses questions in three areas about how to recognize and manage food allergy symptoms, as well as basic food allergy information. The target audience is parents from several regions in the Kingdom of Saudi Arabia (KSA) and from several different social levels to assess individuals' level of awareness and proficiency in managing food allergies. Results from the questionnaire led to the determination that the majority of parents lacked sufficient knowledge regarding food allergies. Therefore, this affects the students and poses a risk when not dealing properly with reactions resulting from food allergies. A severe situation that can result in hypersensitivity and even death is food allergy (FA). Since allergy symptoms can occur among students, prompt intervention is necessary and must be started by staff members.

Reference [5] assessed the understanding, attitudes, and practices of primary educators in Saudi Arabia's Al-Kharj Governorate regarding FA. From February to April 2021, a FA research study was carried out. A number of different settings and random sampling techniques were used to digitally spread a survey to Al-Kharj's primary educators. The result showed that 22.20% of respondents said that their school has first aid supplies for food-induced anaphylactic reactions; the other 80% either were unsure if there was a strategy in place or noted that there was none. The majority of educators (98.1%) concurred that a strategy for handling allergies brought on by food is necessary. Approximately 73% of the educators said they were knowledgeable of FA; 49.26% of them stated they learned about FA from the web and social networks. Approximately 80% of the educators either did not realize or did not think that FA could result in allergy or even death. While 18% said they had no idea about what to do, 42% stated that they would contact the family members and request that they transport the child to the doctor. The study reveals that instructors lack the required skills and proper behaviors but had a very good mindset toward FA. Teachers should be educated and trained in the recognition and management of acute allergy-related anaphylaxis incidents, according to the policy initiatives that should be established by the proficient well-being and regulatory authorities. Each school should have a suitable strategy in place for handling responses brought on by FA.

B. QR-Based Solutions

The study of [6] is one of the initiatives that have been put forward to find solutions for social distancing. There are also many studies that discussed the same problem using the QR code [7]-[10], and it will be discussed in the QR section. It aims to develop an automated system for the school cafeteria that enables contactless buying and selling, selection of food, and payment to reduce the transmission of diseases among students. By implementing this system, it has proven to be efficient and has contributed to reducing infections among students while also enhancing cafeteria services to a higher standard. All the functions within the system have been thoroughly tested and approved.

The study of [7] was conducted in Malaysia's UTHM University Café, where a solution to the issues of waiting and long lineups has been put forth. Based on the waterfall approach, a system for ordering food and paying using a QR

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code has been created to simplify the traditional process. Before adopting the suggested solution, a questionnaire was published to evaluate the experience of university students purchasing coffee. According to the results, 90% of students find it uncomfortable to visit a coffee shop during an epidemic for various reasons, including the following: overcrowding (57.1%), lack of social distancing (39.3%), and long lines (50%). Additionally, 96.7% of them desire a method that simplifies café food ordering. To assess students' satisfaction with the system's effectiveness after implementing the suggested solution, they conducted a survey. The results showed that 64% of respondents were satisfied with the system, while 83% reported being very satisfied. The suggested technique makes it simpler for students to select food online, and it can lessen crowding while people are purchasing food. As we all know, precautionary and proactive measures are essential, especially in the case of significant viral transmission problems like COVID-19, which can be transmitted through touch. Therefore, using technology to order meals rather than standing in line can help reduce the risk of virus infections.

Study of [8] examined the operation of cafeterias in large enterprises along with a workable solution. Because they do not have the resources to prepare their own meals, the corporation offers cafeteria services to its employees. The paper emphasized the cafeteria's current technology, which is, based on a substantially detrimental effect on the process of utilizing data because computations must be done manually. Data loss or easy modification presents another concern. Cash is also a major issue because the user needs to carry cash everywhere. There is a problem with the final payment in the debt scenario. If the billing person delivers a signed receipt for the remaining balance, he is required to bring the receipt with him when he visits the cafeteria the following time. They require a system that enables efficient operations for their sizable crew. The workplace cafeteria administration solution offers a practical user interface, menu layout, billing functions, and more for a variety of food businesses. It combines touchscreen operations, smart billing design, and inventory management. The Android cafeteria system enables online registration, reading of the electronic menu card, and selection of meals. The technology for reading QR codes is employed for placing orders. This app reduces the workload of waiters, allowing staff members to efficiently place orders online for the chef.

Another study [9] aims to propose a system that can accept orders both in person and digitally through a website, then display the orders on screens inside the cafeteria. Ordering meals in the cafeteria became a stressful task as the virus situation worsened, and there were concerns about the unsanitary and inefficient food purchasing process. Additionally, the university cafeteria experienced significant overcrowding during lunchtime, resulting in long lines. Therefore, implementing a system that allows students and faculty to place online food orders using a QR code is seen as a solution to address these issues. Once an order is placed, it is immediately displayed on a screen in the cafeteria's kitchen area. The system provides various types of notifications, including order placement, order approval, order rejection, successful E-Wallet payment, successful E-Wallet refill, and order delivery.

In [10], researchers demonstrate the significant role of data implementation, particularly the use of QR codes, in the era of the COVID-19 pandemic. QR codes are a data collection and visualization system. When conducting a study, sample size is crucial because the larger the sample, the more accurate the results become. Data were collected from various sources, including hospitals, Disease Control and Prevention agencies, and Large-Scale Data Centers. These data underwent several processing steps to extract valuable information. Machine learning techniques, natural language processing (NLP) on clinical notes, and data from wearable devices like the Apple Watch, which measures parameters such as pulse frequency, bone density, and blood pressure in real-time, were applied. The final step involved visualizing the data on two of the most popular apps, one for payments (Alipay) and another for communication (WeChat). After collecting the data, the application could assign different colors based on individuals' health conditions.

C. Smart Card-Based Solutions

The goal of [11] is to streamline and simplify the process of recording student attendance during lectures by using smart cards. This approach aims to eliminate the need for paper documents to track attendance. In this system, each student and lecturer is provided with a smart card that contains their relevant data. Each smart card carries a serial number which is scanned by a reader for attendance. This process is done using Near Field Communication (NFC) technology, and the serial number is sent to the server for database verification. If the card is registered, the operation is recorded as successful; otherwise, it is reported as unsuccessful. After conducting several tests, including the distance test and the card reading test, the results were that the distance required for the reader to read the serial number successfully is less than 4 cm. The reader can read the card serial number with 100% accuracy correctly.

In another study [12] of smart cards, the goal is to combine multiple cards into a single smart card for multiple uses based on Internet of Things (IoT) and RFID technology. However, the IoT facilitates the integration of diverse platforms by establishing a cohesive network that enables uninterrupted communication and seamless exchange of data among interconnected devices and systems. The proposed smart card system consists of two parts: a program according to the specific user sector and the device on which the program will be installed. After implementing and designing the proposed system in the field of banking and electricity and using barcode technology in case the card is forgotten or lost, it was concluded that using one card for multiple purposes makes it easier for the user to manage and track transactions from a single portal.

In another study [13], authors focused on the smart card system in the city of Pinta, Jakarta, a proposal is made to transform Jakarta into a smart city by integrating various systems with people and devices. The suggestion is to consolidate multiple cards into a single smart card that can serve various purposes through barcode technology. To utilize this

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barcode, users would require a smartphone or another device equipped with card reader software. The study introduces a new framework aimed at promoting the utilization of information and communication technologies (ICTs) as a means of addressing issues and enhancing the overall quality of life for the city's residents. The aim of the study conducted by [14] is to enhance the student experience within the college by implementing a multi-functional card equipped with a QR code. This card is designed to assist students in conducting transactions at various locations within the campus, including the cafeteria, stationery stores, and the library. The card is engineered to provide a high level of security, which is beneficial for students. In the proposed solution, the process begins with the card being scanned, and the information stored in the database is checked. The system then verifies the students' availability, and the final step involves making payments, which are completed by scanning the card.

The objective of [15] was to create a single smart card with multiple functionalities, including storing patient personal data, medical drug information, and insurance details. This innovation aimed to reduce the number of cards that patients needed to carry, safeguard data from potential loss, and simplify the process for doctors to access patient information. The proposed solution outlined in this paper involved the development of a smart card integrated with NFC (Near-Field Communication) technology, connected to a web-based platform for comprehensive patient data storage. This system was designed using the NetBeans application and utilized a database for information storage. The web-based component contained patient history and dietary recommendations, accessible via a unique patient ID when doctors scanned the card. To ensure security and protect privacy, researchers generated a hash value to represent patient information.

III. METHODOLOGY

Business Process Management (BPM) [16] includes four phases: Process discovery (As-Is Model), Process Analysis, Process Redesign (To Be Model), Process Automation and Monitoring.

A. Process Discovery

1. Survey

A survey was conducted, which will be discussed in detail in this section. The survey aimed to enhance understanding and reduce the risk of allergic reactions when purchasing food from the cafeteria. An online questionnaire was developed [17] and subsequently distributed to a random sample of parents with school-aged children via social media platforms. The total sample size was (n = 115), and the questionnaire was available for three days from January 1. Before analyzing the obtained data, it was checked to see if there were any insufficient or missing responses, and the data were classified and filtered.

2. Data Analysis

According to the results, 25.2% of the students have food allergies, and 51.3% of them do not find suitable food for their health conditions in the cafeteria. This is a significant issue that cannot be overlooked. Regarding the sources of guidance and awareness about prohibited foods, 64.3% of the information comes from parents, with no clearly defined role for school staff in this matter. Therefore, students are primarily responsible for understanding what foods are appropriate for them, which may not be ideal for younger ages.

Additionally, the survey highlighted the lack of supervision during the cafeteria purchasing process. Specifically, 63.5% of parents mentioned that their students are not supervised during mealtime purchases, while 36.5% stated that some level of supervision does occur. However, only 14.8% of parents expressed satisfaction with the overall procedure. This indicates a need for improved supervision and guidance to ensure students' safety and well-being when selecting their meals.

In an effort to gauge parents' acceptance of the proposed improvement process, an overwhelming majority, specifically 90.4% of parents, expressed support for the idea of implementing a supervision system to prevent their children from purchasing allergenic foods.
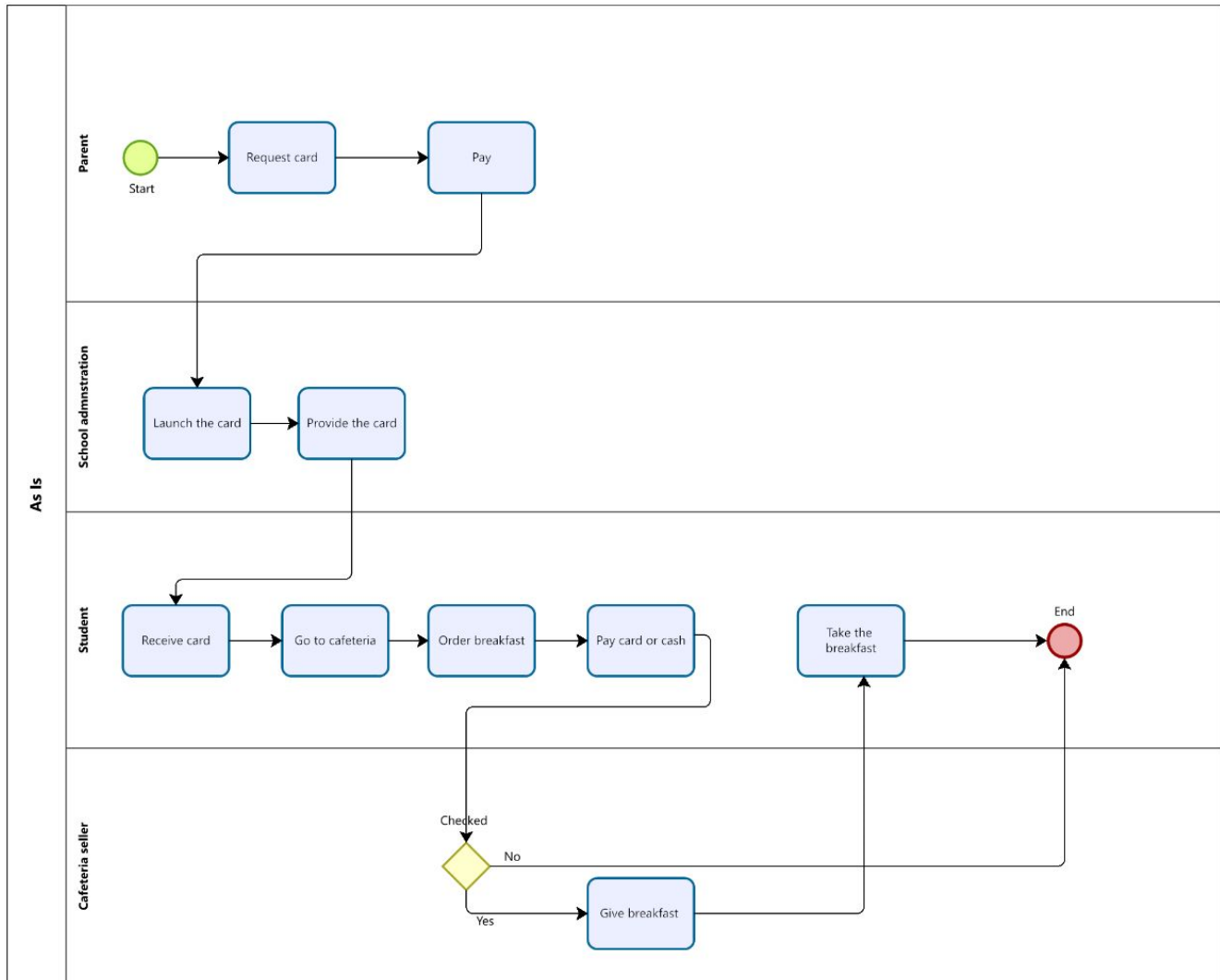
3. As-Is Process

In the case of cash transactions, the student directly hands over cash to the cafeteria staff in exchange for their chosen meals. Conversely, when using a payment card, a parent or guardian must visit the school administration to acquire a smart card for their child's cafeteria payments. The process is as follows:

1. The guardian initiates the process by requesting a cafeteria payment card from the school administration.
2. The school administration issues the card and collects payment from the parent or guardian based on the desired amount to be loaded onto the card.
3. Once the card is obtained, the student can use it to make purchases at the school cafeteria.
4. At the cafeteria, the student selects their breakfast dishes and presents the card to the cafeteria staff.
5. The cafeteria staff deducts the purchased amount from the card if there is a sufficient balance.
6. The student is then free to enjoy their chosen breakfast items.

This system offers convenience and transparency in cafeteria transactions, ensuring that students have access to meals without the need for cash transactions.

The roles and responsibilities in the student cafeteria payment card system are as follows:

a. *Parent:*
- Request a card from the school administration.
- Pay the required amount to the school administration.

b. *School Administration:*
- Launch the card payment system.
- Provide the card to the student.

c. *Student:*
- Visit the cafeteria.
- Place orders for breakfast.
- Make payment using either the card or cash.
- Receive breakfast upon successful payment.

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Fig. 1 As-is business process

d.   Cafeteria Seller:
- Accept payment (either money or card) from the student.
- Take breakfast orders from students.
- Verify if the payment amount is sufficient.
- Serve breakfast to students if the payment is adequate.

These roles ensure the smooth operation of the cafeteria payment system, allowing students to purchase breakfast efficiently and conveniently.

B. Process Analysis

In this section, we will analyze the As-is process, conducting both qualitative and quantitative assessments.

1. Issues in the Current As-Is Business Process

The problems with the traditional method can be divided into several categories. First, there are schools that do not use cards for purchasing, which is a cumulative problem. Cash payments can lead to bullying for some disadvantaged students who are experiencing financial difficulties. Another issue is the debt scenario in which cash is paid and the remainder of the money is returned to the buyer. Some schools use traditional card purchase methods, which are used only for purchase purposes without any medical information related to the student. This method has drawbacks such as requiring a parent to attend the school and pay to release the card. One of the most common problems in the current system is the need for the parents to request the card through the school administration, which takes the parent's effort in terms of transportation and time. The process may take up to a day to get one card. Furthermore, there is currently no system or process in place for detecting students' allergies or health conditions that may lead to allergic reactions, and there is a lack of proactive measures to prevent students from purchasing foods that may trigger allergies or exacerbate existing health issues like chronic diseases. The responsibility for educating students about allergenic foods primarily falls on

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their families in the traditional system. Awareness and guidance regarding food choices are currently provided solely by parents, and the responsibility for ensuring that students eat foods suitable for their health rests with the students and their families. Furthermore, there is no comprehensive medical record of each student's health condition in the school, which means that any health issues that arise during school hours are not readily known to the school's educational staff. The proposed solution in this study aims to address these issues comprehensively.

2. Qualitative Analysis (Value-Added Analysis)

Before initiating the redesign of any business process, we perform a value-added analysis. This is a qualitative analysis aimed at identifying and eliminating waste. The value-added analysis is a simple, two-stage process. Initially, we systematically examine the process model step by step, breaking down each step into smaller stages. These steps represent the work units within the job. The identification of three classification types - (1) value-added, (2) business-value added, and (3) non-added value processes - is crucial. The value-added analysis for process description is presented in Table I.

The Fishbone diagram in Fig. 2 illustrates the problem, which is the system's failure to accommodate health conditions. The reasons behind this issue are as follows [19]:

1. Environment: Lack of devices supporting the system's application in the cafeteria due to budget constraints.
2. Method: Parents filling out forms with incorrect information due to form illegibility.
3. Human factor: Cafeteria workers making mistakes due to inadequate training.
4. Material: Insufficient availability of food suitable for students' health conditions in the cafeteria.

TABLE I
VALUE ADD ANALYSIS

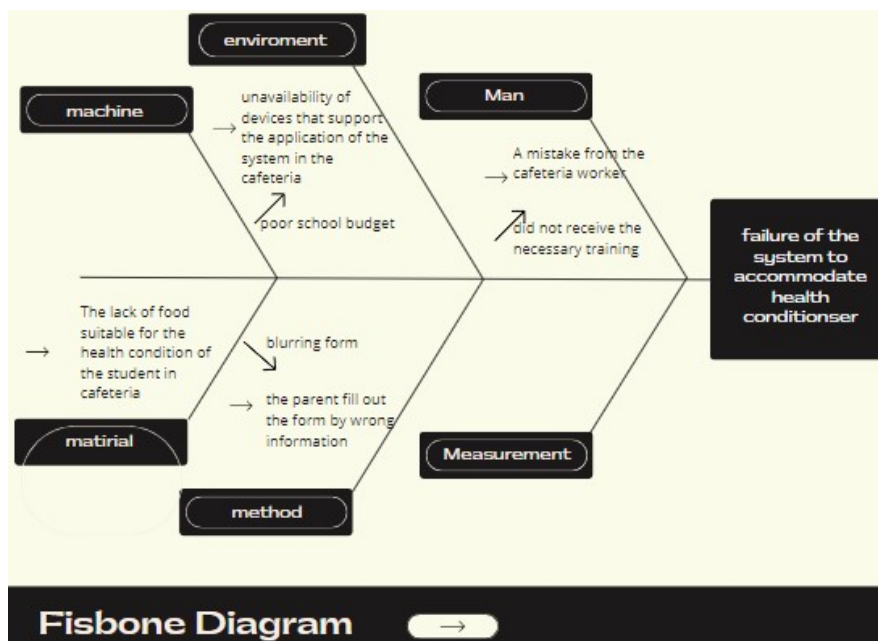| Step	Performer	Classification
Request card	Parent	NVA
Pay	Parent	NVA
launch the card	School administrator	BVA
Provide the card	Student	BVA
Receive card	Student	VA
Go to the cafeteria	Student	VA
Order breakfast	Student	VA
Pay	Student	BVA
Receive order	Cafeteria seller	VA
Give the breakfast and card	Cafeteria seller	VA
Take breakfast	Student	VA

Fig. 2 Fishbone diagram

C. Process Redesign (To-Be Process)

Business Process Redesign (BPR) is a complete rewrite of any business process. This is done to improve performance measurement and reduce costs and quality of service. In this section, we have redesigned the process (To-Be) Model.

1. Providing Services to Meet a Quality Measure

Students and parents express satisfaction with the services provided to them, including the automation of cafeteria payments and the detection of food allergies through the scanning of the smart card barcode. This approach effectively reduces students' exposure to allergic reactions caused by food allergies, enhancing safety and reliability for students with allergies. Consequently, parents feel more content and reassured regarding their children's well-being. This emphasis on quality assurance ensures the attainment of the highest quality standards. The main objective of quality assurance is to maintain a certain level of quality in the services provided by

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observing every step of the process. Moreover, monitoring will be implemented in the school cafeteria before selling meals by checking if the meal is appropriate for students with allergies by scanning the barcode on the smart card. On the other hand, quality is ensured in this scenario from the beginning of the process by requesting the card from the Noor system and handing it over to the child, and verifying whether the meals

provided are safe and suitable for students with allergies. Bizagi modeling [18] was used to create the To-Be process. Bizagi modeling enables the creation of multiple diagrams that describe a business process, data modeling, and automated platforms. It aids in a better understanding of the process flow. Fig. 3 illustrates the current process, which includes four roles: parent, system, student, and cafeteria seller.
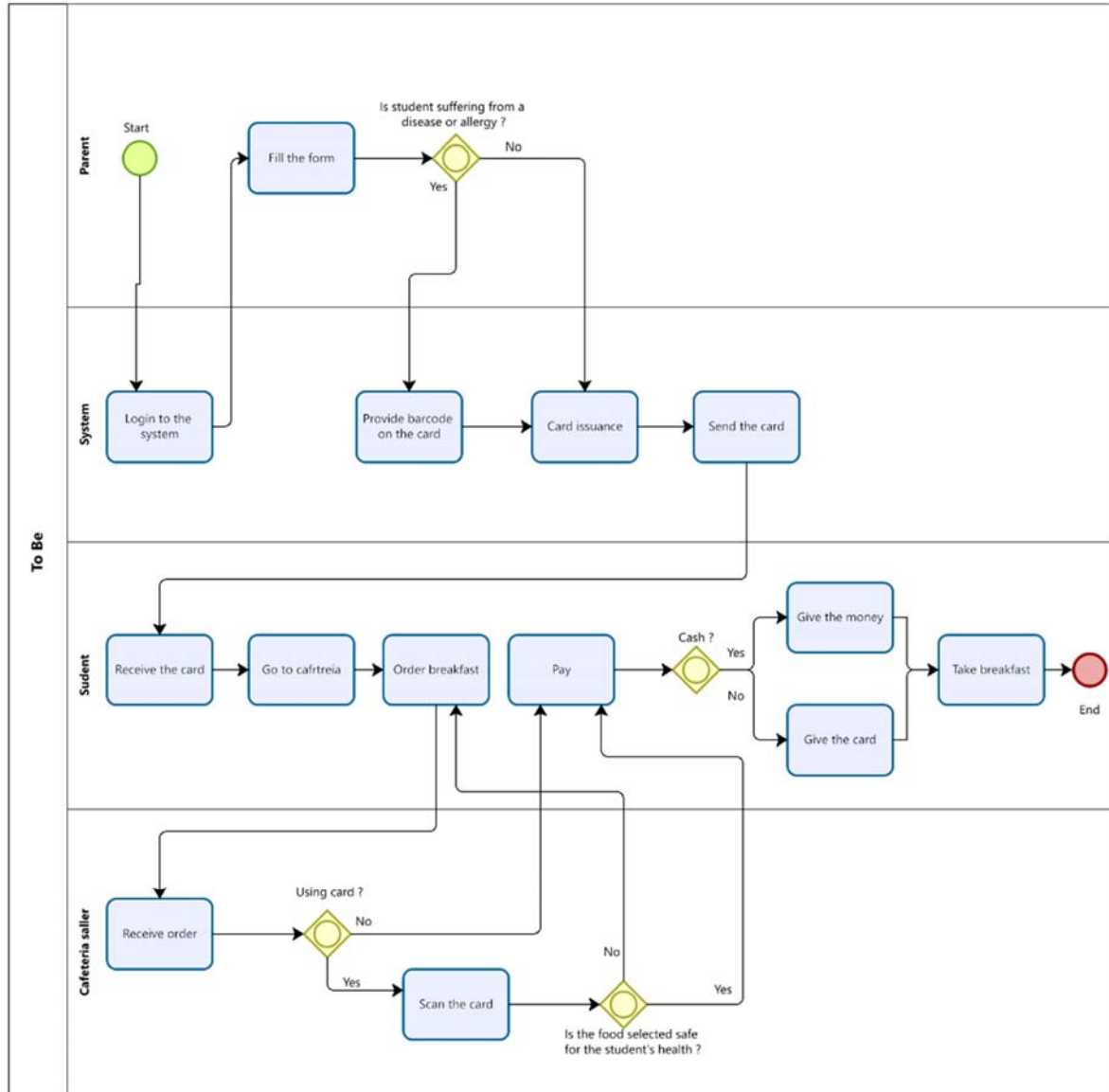

Fig. 3 The proposed model of the redesigned (To-Be) model

D. Process Implementation

In this section, we have implemented the proposed system through simulation and design of the proposed system.

1. Simulation Results

We try to analyze and comprehend the business procedures

in this section using the simulation technique. Simulation offers testing and evaluation of process performance under certain conditions or scenarios for the business process depicted in Table II, in order to aid in decision-making and promote continuous development. Utilizing Bizagi simulation allows for identifying and assessing all processes based on four steps:

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process validation, time, resource, and calendar analysis. The current model (As-Is) and the proposed model (To-Be) were simulated.

Time analysis simulation was used to run model simulations. The focus was on how long it takes to perform each task and how it can be improved [18]. As a result, Table II shows the simulation results of the current model (As-Is) and the time it takes to perform each task. Table III shows the simulation results of the To-Be model.

TABLE II
SIMULATION RESULT (AS-IS)

Name	Type	Min. time	Max. time	Avg. time	Total time
As is	process	2d 1h 12m 10s	2d 1h 12m 10s	2d 1h 12m 10s	2d 1h 12m 10s
Start	Start event				
Request card	Task	1d	1d	1d	1d
Pay	Task	30m	30m	30m	30m
Launch the card	Task	0	0	0	0
Provide the card	Task	20m	20m	20m	20m
Receive card	Task	10m	10m	10m	10m
Go to cafeteria	Task	5m	5m	5m	5m
Order breakfast	Task	2m	2m	2m	2m
Pay	Task	2m	2m	2m	2m
Cash	Gateway				
Give the money	Task	1m	1m	1m	1m
Give the card	Task	0	0	0	0
Give breakfast and Card	Task	2m	2m	2m	2m
End	End event				
Take the breakfast	Task	10s	10s	10s	10s
InclusiveGateway	Gateway				

TABLE III
SIMULATION RESULT (TO-BE)

Name	Type	Min. time	Max. time	Avg. time	Total time
To Be	process	35m 20s	35m 20s	35m 20s	35m 20s
Start	Start event				
Login to the system	Task	2m	2m	2m	2m
Fill the form	Task	5m	5m	5m	5m
Card issuance	Task	5m	5m	5m	5m
Send the card	Task	10m	10m	10m	10m
Provide QR on the card	Task	0	0	0	0
Receive the card	Task	1m	1m	1m	1m
Go to cafeteria	Task	5m	5m	5m	5m
Order breakfast	Task	2m	2m	2m	2m
Receive order	Task	1m	1m	1m	1m
Pay	Task	2m	2m	2m	2m
Scan the card	Task	1m	1m	1m	1m
Give the money	Task	0	0	0	0
Give the card	Task	20s	20s	20s	20s
Take breakfast	Task	1m	1m	1m	1m
End	End event				
Is the student suffering from a disease or allergy	Gateway				
Cash	Gateway				
Using card	Gateway				
Is the food selected safe for the student's health	Gateway				

Overall, when comparing the time analysis results of the target model (To-Be) with the actual model (As-Is), it was observed that in the actual model (As-Is), the entire process, including card request, issuance in the presence of a parent, payment, and card handover to the student, took 1 day and 30 minutes. In contrast, the proposed model (To-Be) streamlined the process, taking only 35 minutes and 20 seconds, and eliminating the need for parental presence as it operates through the system. These significant time reductions demonstrate clear improvement, corroborated by simulation results. It is important to note that while the inputs for the (As-Is) system are based on actual data, the inputs for the (To-Be) system are estimates and simulations based on analogous systems in other domains.

2. Recommended Solution
Business Process Modeling and Notation (BPMN) is being

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redesigned in an effort to change the process workflow and improve the standards of various business processes. Time, cost, quality, and flexibility are the main improvements required. In this paper, the goal is to redesign the workflow by automating the payment system and health status detection through barcode scanning on the health card to make it simpler and more centralized to ensure a better quality of service.

Analysis of the weaknesses identified in the current process, as described in the Process Discovery section, reveals several recommended improvements. These improvements primarily center around automating the payment system and enhancing sensitivity detection through the smart card.

In the proposed system, the Noor System [20], the card is requested through the child's account. This allows the guardian to record the child's data, including any allergies they may have. Fig. 4 illustrates the proposed form that parents need to complete to initiate the card issuance process for the student.

The card represents a significant advancement in managing and preventing allergies within the school. It is a versatile personal card that includes a QR code indicating the type of allergy the student has. This card is also used for purchasing items from the cafeteria. Fig. 5 displays the anticipated final design of the card.

Fig. 4 Form to be filled by parents
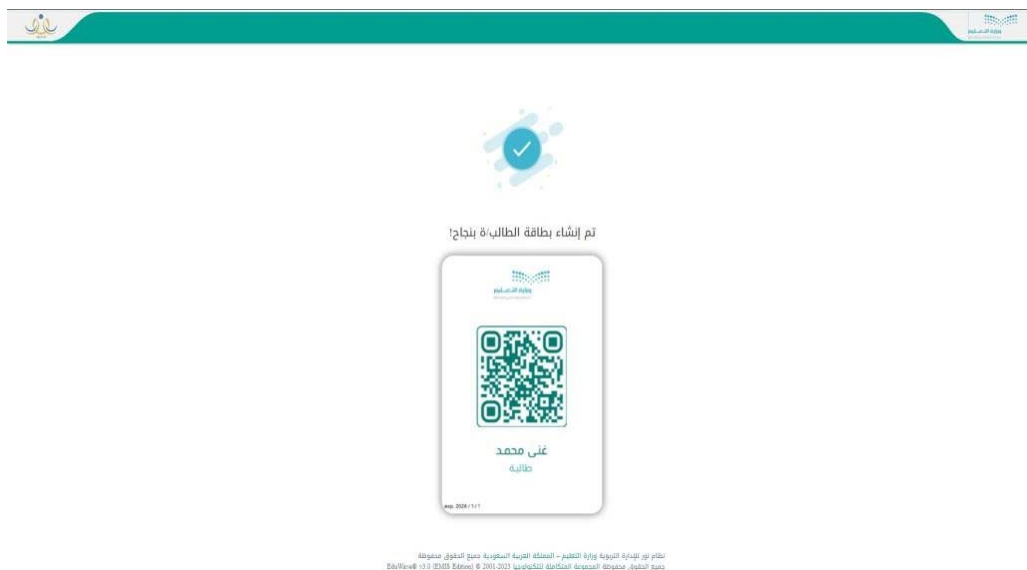
Fig. 5 The final design of the proposed card

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IV. RESULTS AND DISCUSSION

The analysis of data obtained from the questionnaire reveals the essential need for improving the current system based on two crucial criteria: time and quality. Dissatisfaction with the old system's method of monitoring students' health status is expressed by 35.7% of the sample, with 63.5% stating that there is no monitoring at all. This lack of effective monitoring places a significant burden on students and parents.

In contrast, the proposed To-Be model, which incorporates an automated system and QR technology, received approval from 90.4% of the sample, reflecting their satisfaction. Additionally, 75% of the surveyed individuals expressed their admiration for the presence of a card linked to the system. These percentages demonstrate an improvement in terms of quality.

Regarding the improvement in time efficiency, simulation tools were employed for measurement, providing accurate and objective results. In the previous system, the total time for all operations was two days, one hour, and 12 minutes. In the system, the total time for all operations was reduced to 35 minutes, indicating a significant and noticeable improvement. For instance, the time required to issue a card, which previously took a day, has been reduced to just 35 minutes. These improvements are summarized in Tables II and III.

V. CONCLUSION

The combination of two important aspects, the detection of health issues through a smart card and the automation of cafeteria payments, has led to the proposal of a collaborative solution addressing the physical health support of students with chronic illnesses/allergies, and leveraging the advantages of smart card payment using QR codes. Smart cards offer a secure means of storing and immediately accessing student-related information.

In conclusion, the questionnaire participants in our study have expressed a desire to enhance the process by implementing a system that contributes to maintaining and safeguarding students' health. This paper has presented an improved system for streamlining cafeteria payment operations, taking into account health conditions related to allergies or dietary restrictions among students. The proposed solution saves time, enhances the quality of school cafeteria services, and reduces health risks associated with allergies or chronic illnesses while students are at school. It achieves this by aligning the available food options with each student's specific health condition.

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