Self-Ordering Machine for Canteen (SELFO)

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***Abstract*— In this paper, we proposed a self-ordering machine for canteen named SELFO. Nowadays, the ordering system in canteen requires a lot of cash for change money, a tiresome daily manual recapitulation, and order forms that require sellers to spend extra money. Therefore, we proposed a machine as a solution to those problems. This machine can eliminate the need of change money, do automatic recapitulation and reduce the cost of order forms. Customers can order menu using an interactive menu in this machine, pay using a contact card, and wait for the order to be delivered, while recapitulation data is stored directly in the database. The hardware Machine designed using Raspberry Pi 3B+, touchscreen LCD 10.1", thermal printer, and the card reader that we made based on ATMEGA 328P. While the software program is based on python.**

Keywords— SELFO, User Interface, Contact Card

I. INTRODUCTION

A canteen is a store that sells food and drinks at a place like a school, college, or office. Nowadays, most of the canteen using the manual system for payments or purchases of foods and drinks they sell. Based on the surveys and interviews we have done in several canteens at Bandung Institute of Technology, this system caused several problems.

First, a difficulty to find an exact amount of change money for transactions. The sellers often give customers candy as change even though it violates the law in Indonesia as stipulated in the Law No. 8 of 1999 concerning Consumer Protection Article 15. Also in the Substitute Government Regulation Law No. 2 of 2008 concerning the Second Amendment to Law No. 23 of 1999 concerning Bank Indonesia which states that any act that uses money or has the purpose of payment or an obligation that must be fulfilled with money if carried out in the territory of the Republic of Indonesia must use rupiah, unless otherwise stipulated by a Bank Indonesia Regulation. [2]

Second, buying physical order forms requires sellers to spend extra expense. The order forms used by the sellers consist of three copies: one for customer, one for pantry, and one for recapitulation. According to the interviews we conducted, canteens in Bandung Institute of Technology could spend up to 850,000 rupiahs for the order form only.

Third, manual recapitulation can be a trouble according to the sellers. They do sales recapitulation every day based on a copy of the order form they collect. Then they manually copy the data into the computer and compare it with the cash they get. This process is not efficient and the amount of money that they get is difference with the data on the computer.

This self-ordering machine (SELFO) is an integrated system that can connect to the application on the seller's computer. Customers can place their order and make payment using smart card via this machine. The ordered items are then sent to the seller's application. The seller can monitor customer's orders. By using SELFO, sellers don't have to provide change and physical order forms. Besides that, the recapitulation process has been done automatically. So, there will be no differences between the amounts of money that the seller gets and the data on the computer.

II. SYSTEM DESIGN

This Self-ordering system consists of three subsystems: ordering machine or SELFO itself, server, and seller application. The relation between each subsystem is illustrated in Figure 1.

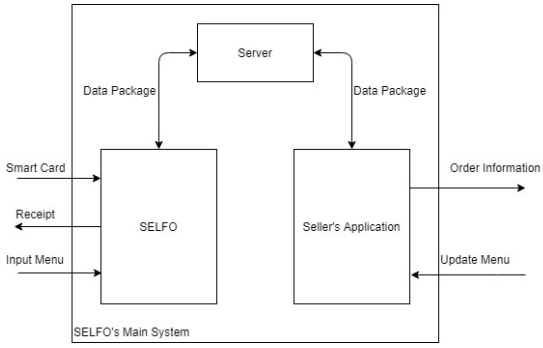

Figure 1. SELFO functional correlation

SELFO device acts as the client. The device consists of one Raspberry Pi 3B+ as the main processor, one touchscreen LCD 10.1'' as the interactive display, thermal printer with a 58mm width of thermal paper to print the order receipt, power supply, and an ATMEGA 328P-based card reader. The SELFO's system diagram is shown in Figure 2 below:

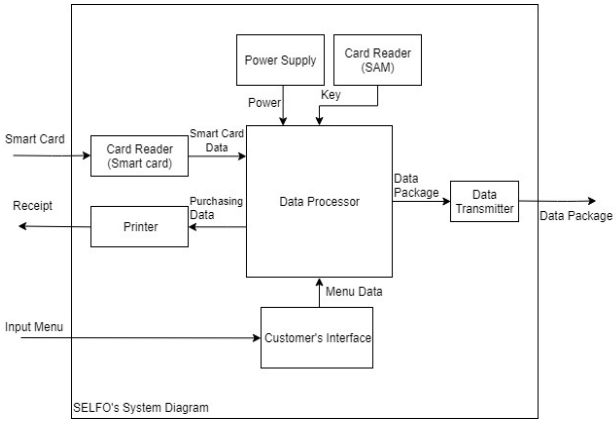

Figure 2. SELFO's Subsystem Diagram Block

Local server is used in this system. The purposes of it is to store, send and receive data either from and to SELFO or from and to seller's application.

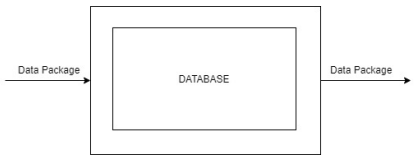

Figure 3. Server's Subsystem Diagram Block

Seller's application will be run on the seller's computer. This application can monitor the menu ordered by the customer, edit or update the menu displayed on the SELFO interface. The block diagram of the seller's application can be seen in Figure 4.

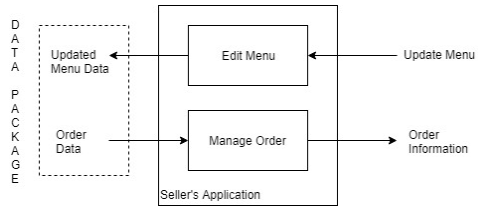

Figure 4. Seller's Application Block Diagram

In this article, all of the subsystems will be discussed. This includes all of the components of the system which are SELFO, server, and seller application

A. Smartcard Reader Module

One of the SELFO subsystem is a smart card reader module. This module can read two contact type smartcards (smartcard and SAM). ATMega328p was chosen as the microcontroller because of its low-power consumption and low-cost. The schematic design of this smart card can be seen in Figure 5.

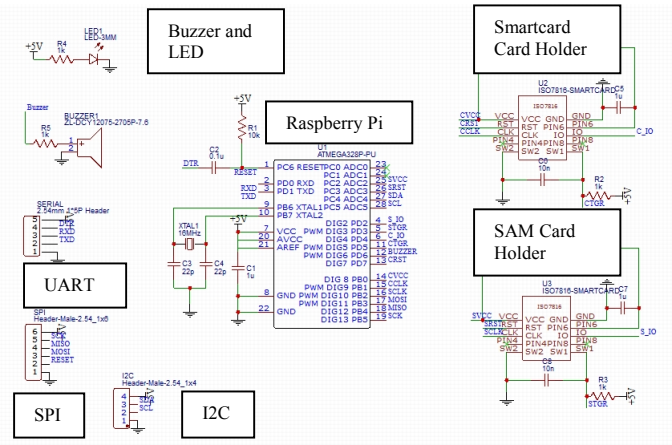

Figure 5. Smart Card Reader Schematic's Reader

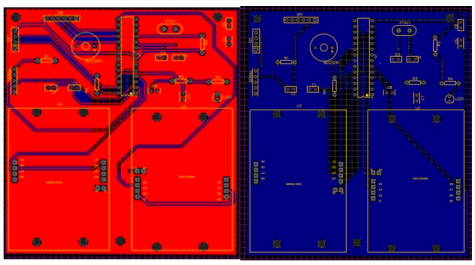

Figure 6. Smart Card Reader PCB Layout

B. Reader Module Program

First, program will initialize all pins that will be used by defining them as input or output and set their voltage level. After that, program will read the trigger pin in smart card holder. If it detects a card, the program will activate the smart card by raising its voltage level and turn on the card's clock. The same process also happens for SAM. Next, program will wait for data coming from serial port. The data will be converted into hexadecimal first before being processed in the next step. This step is necessary as the cards need hexadecimal format for the communication process. Program will check the command's tag in the beginning of the transmission. The tag will determine where the command will be sent. If the corresponding tag and command accepted by the destination, the card will send a reply. Otherwise, the program will send an error message. All the process can be seen in the flowchart as shown in Figure 7.

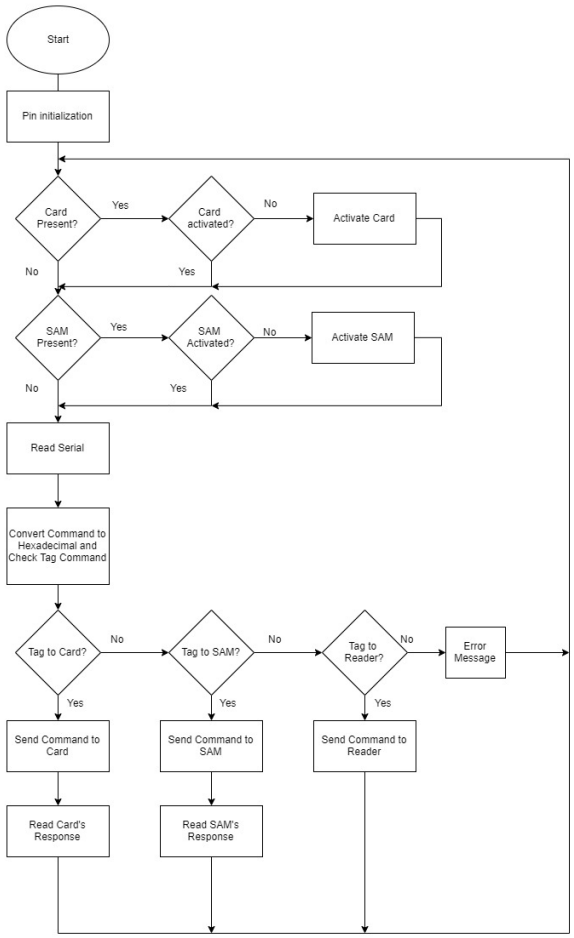

Figure 7. Reader Module Flowchart

C. Card Reading Program

Reading process between ATMega328p and Raspberry Pi will be done by using serial communication. APDU Command will be sent into Reader Module from Raspberry Pi via serial port before forwarded to the smart card.

In this program, Raspberry Pi will always waiting/reading for data coming from the serial port. If the reader detects a card in its smartcard holder, the program will proceed into authentication process. Both smartcard and SAM will undergo a simple mutual authentication algorithm. Both cards will verify each other keys in order to proceed to the next step. A success authentication will authorize the card to undergo the next step which is checking the card's balance. If the card has a sufficient balance, the program will compute the remaining balance and write it into the card. After that, the program will read the card's ID for recapitulation. All of the process can be seen in Figure 8.

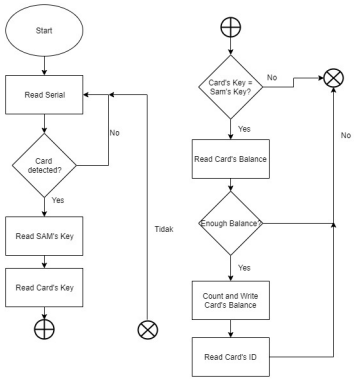

Figure 8. Card Reading Flowchart

D. *Power Supply*

Power Supply in this system serves to provide power to each component safely. The components supplied through this power supply are Raspberry Pi, LCD, and printer. The following diagram shows the distribution power needed for each component:

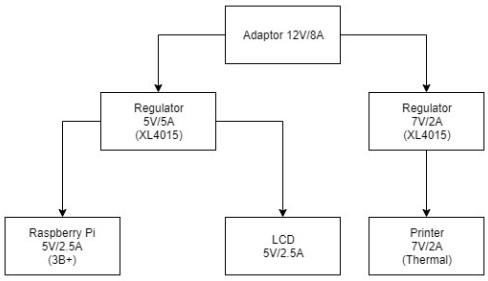

Figure 9. Power Supply distribution diagram

In order to reach 7V for printer and 5V for raspberry pi and LCD. We used XL4015 as the regulator. The schematic and layout PCB designed for power supply shown in Figure 10 and Figure 11.

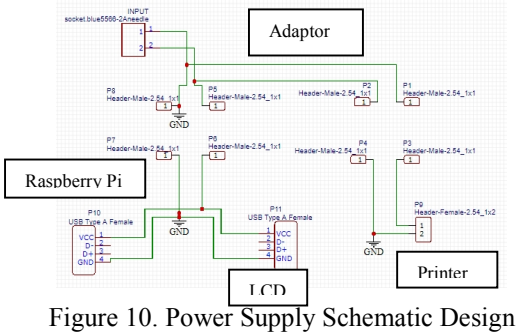

Figure 10. Power Supply Schematic Design

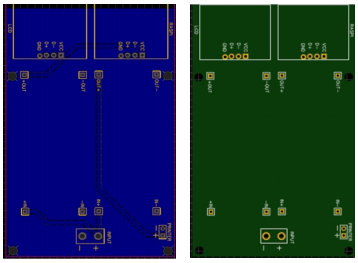

Figure 11. Power Supply PCB Layout

Port	Function
INPUT	Input power by adapter 12V/8A
P9	Supply 7V/2A to printer through regulator 12 to 7V
P10	Supply 5V/2.6A to Raspberry Pi through regulator 12 to 5V
P11	Supply 5V/2.5A to LCD paralleled with P10

Table 1. Power Supply Port

E. Printer

This module is used to print the receipt for the customer. This module is using thermal printing as its printing method. Components that exist within the receipt paper are date and time of transaction, order ID, nominal and remaining balance. There is also canteen's name and table number. The printer module is programmed using python and esc-pos library. The Figure 12 below is the format image of the receipt:

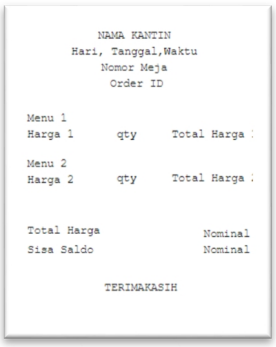

Figure 12. Format Design of Receipt

F. *SELFO Application*

The design flow of how the SELFO application work can be seen at the flow diagram at Figure 13 below.

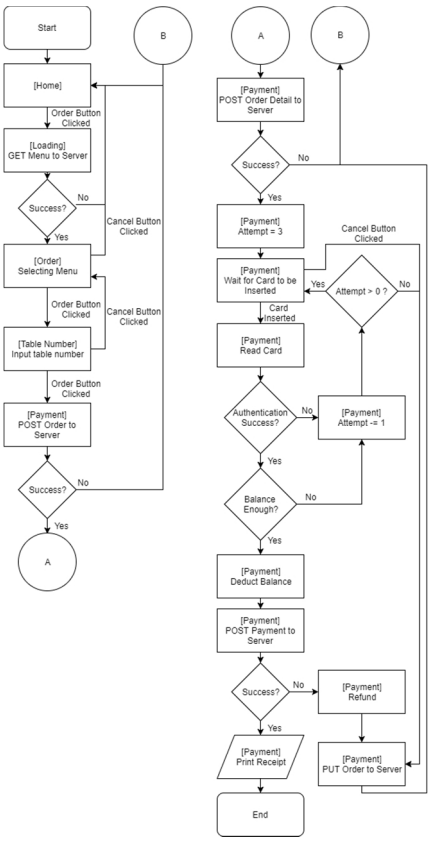

Figure 13. Flow Chart SELFO Application

G. *Server*

On the server, there will be an application which will handle the request both from the SELFO application and the seller application.

When there is an order, there will be a process to check whether the item menu is available or not. If it is available, there is a booking process so the quantity of the available item menu will be subtracted. But if the order is cancelled later, the item menu that has been booked will be cancelled so the quantity of the available item menu will be added again.

H. Seller Application

First, seller login to his account. Later, seller can see the incoming orders and process it. The incoming order is come from the server data. When the seller want to see the past orders, he can navigate to the history manager screen. When the seller want to modify his item menu, he can navigate to the menu manager screen.

III. IMPLEMENTATION RESULT

Implementation is done by operating the application according to the flow of the system that has been designed. First, the SELFO application is opened so that the home screen appears as shown in Figure 14 (a). Then the order button is pressed so that the Order page open. The selection process of the menu to be purchased as shown in Figure 14 (b). After that, the customer must input his table number as shown in Figure 14 (c). Customer will get his table number from a stack of table number sign beside the machine. Customer need to bring that to his table. Furthermore, if the menu to be purchased is not available, a warning will appear. But if the menu is available then the next process, reading the card, will begin. If the inserted card can't be authenticated or it doesn't have enough balance, a warning will appear as shown in Figure 14 (d). If the process runs well, the application will continue the process to send payment data to the server. If the sending data process fail, a refund process will begin. Otherwise, the application will display a successful message and tell the customer to remove the card. When the card is removed, the order receipt will be printed as shown in Figure 15.

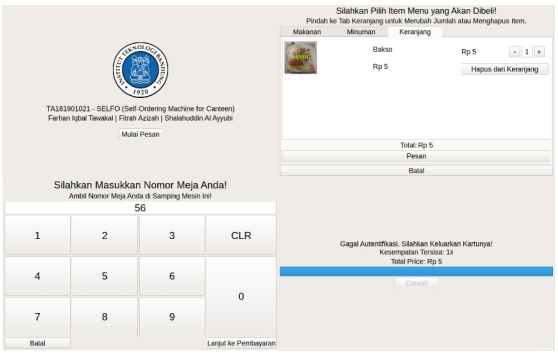

Figure 14. (a) Top Left: SELFO Application Home (b) Top Right: Menu Selection Window (c) Bottom Left: Table Number Entry Window (d) Bottom Right: Card Authentication Failed Warning

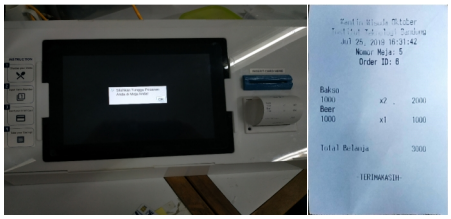

Figure 15. (a) Left: Ordering Process Completed (b) Right: Order Receipt

Next, testing the seller's application. First, the application is opened so that the home display appears as shown in Figure 16 (a). After that, the seller enters his username and password. Then, the application will immediately display the incoming order. In Figure 16 (b) it appears that the orders made on the SELFO application can be seen in the seller's application. Then the seller can determine whether the order will be processed or not. To edit the menu, the seller can navigate to the Menu Manager page, the display will look like in Figure 16 (c).

Because orders that have been made by the customer on the SELFO can be seen in the seller's application, it proves that the server works as it should be.

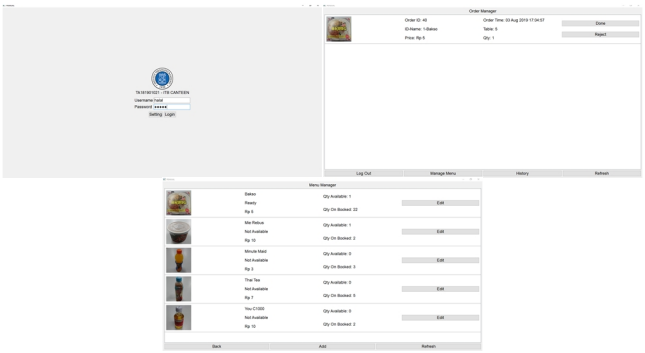

Figure 16. (a) Top Left: Seller Application Home (b) Top Right: Seller Application Order Manager (c) Bottom: Seller Application Menu Manager

Based on the interview we've done and the system we designed, a simple cost comparison was made.

Traditional		**SELFO**	
Order Form	$60/month	SELFO	$300 (once)
Cashier	$233/month	Admin	$233/month
		Receipt Paper	$10/month
Cost/month	$293		$243

Table 2 Cost Comparison

According to table 2, after calculating the SELFO price, after 6 month the monthly cost can be cut up to $50/month.

IV. CONCLUSION

The conclusions from the results of testing and implementation for the whole system are:

- SELFO has successfully become self-ordering and payment machine without using cash.
- With SAM, only special smart cards can be used to make payments using SELFO. This is intended as the security method.
- Seller application is able to accept orders from SELFO and edit menu on the SELFO application.
- The current design has completed the basic concept proposed. Development in several aspects can make this system better in the future.

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