

# Point of Sale (POS) Network with Embedded Fingerprint Biometric Authentication

<sup>1</sup>Hussah Adnan Alzamel, <sup>2</sup>Muneerah Alshabanah, <sup>2</sup>Mutasem k. Alsmadi

<sup>1</sup>Department of Finance, College of Applied Studies and Community Service, Imam Abdurrahman Bin Faisal University, Al-Dammam, Saudi Arabia

<sup>2</sup>Department of Management Information Systems, College of Applied Studies and Community Service, Imam Abdurrahman Bin Faisal University, Al-Dammam, Saudi Arabia

## ABSTRACT

The steady growth in electronic transactions has promoted the Automated Teller Machine (ATM) thereby making it the main transaction channel for carrying out financial transactions. Conventional method of identification based on possession of ID cards or exclusive knowledge like a social security number or a password are not all together reliable. However, this has also increased the amount of fraudulent activities carried out on Automated Teller Machines (ATMs) thereby calling for efficient security mechanisms and increasing the demand for fast and accurate user identification and authentication in ATMs. In this paper, an embedded fingerprint biometric authentication scheme for Point of Sale (POS) network as additional security option to the ATM card is proposed. A fingerprint biometric technique was fused with personal identification numbers (PIN's) for authentication to upgrade the security level. The proposed idea will solve the problems that may face the customers such as theft, counterfeiting, oblivion or loss the card. Therefore, the customer will be identified once putting his finger on the reader (based on finger scanning) and the system recognizes the customer without requiring keys or cards of support. We have distributed a questioner to 586 responders, the obtained results show the importance of fingerprint biometric authentication for POS network as additional security option to the ATM card.

**Keywords :** POS, ATM, Fingerprint, Security, Biometric.

## I. INTRODUCTION

The Automated Teller Machines (ATMs) provide numerous monetary services to the society and the number of users has increased tremendously due to the promotion of cashless societies by major financial institutions [1-5]. Existing ATMs are based on plastic cards with a metallic chip which is combined with a PIN (Personal Identification Number) [6]. Together this serves as a medium for logging into the banking platform of the ATM in use. The current form of authentication has withstood the taste of time but

however, it has not been fail proof as previous research has shown [7, 8]. Individuals making use of ATMs have complained of lost funds due to hackers gaining knowledge of their PINs [9] and furthermore, many individuals have also bemoaned the inability to carry out transactions due to lost or damaged debit cards thereby having to pay for a replacement. These factors have been tackled by previous researchers who propose the introduction of a biometric method of authenticating individuals and the banking community especially in developing countries with a high a level of crime and financial fraud rate.

Biometrics can be defined as a measurable physiological and behavioral characteristic that can be captured and subsequently compared with another instance at the time of verification. It is an automated method of recognizing a person based on physiological or behavioral characteristic. It is a measure of an individual's unique physical or behavioral trait which can be used in validating or authenticating an individual. Common physical biometric characteristics include fingerprints, hand or palm geometry, retina, iris and facial scans while common behavioral characteristics are signature, handwriting, keystrokes and voice match. Biometrics technologies are a very secure way of authentication, this is due to the uniqueness of biometric data which cannot be shared, copied or lost. The authors in [10] pointed out that biometric based authentication offers several advantages over other authentication mechanisms and research has shown that the fingerprint technology in particular, can give a considerably more precise and reliable client validation.

The technological revolution influenced everything [11-46], even the methods that aim to improve the shopping and banking systems. Today, the use of Artificial Intelligence (AI) algorithms is expansive, particularly in providing solutions to challenging problems including patterns recognition and retrieval of information [26, 39, 43, 47-61], image segmentation [11, 12, 22, 42, 62-66], analysis of medical images [67-71], Learning Management System [72-97], nurse rostering problem [41], Healthcare Monitoring system [25, 98], as well as prediction of river flow [40, 99, 100]. Accordingly, many systems have used the Artificial Intelligence as an effective tool for biometric authentication and using it in the transactions and banking systems [101-103].

According to the tremendous technology revolution in 21st Century, many countries have begun to replace traditional tools with more modern tools. Technology is absolutely important in everyone's life. Therefore, the countries have started using technology more than it used to be, because of its direct impact on their economy, some of the problems that were faced by these countries have been solved by using technology. Also, the financial sector started to develop financial services by using the financial technology (FinTech), which is one of the most important technologies, invented to help financial institutions to increased number of customers in each institution and satisfy their desires. Henceforth, the idea of finding a secure alternative to the debit card to solve all it problems (such as; theft, card loss and fraud), by adding fingerprint to the POS machine will reduce the incidence of these Problems as well as saving time and effort.

## II. RELATED WORK

### 2.1 Mada Pay

Mada pay is a smart mobile payment service with a special application that has the highest standards of security and encryption of private information. It allows cardholders to keep their entire bank card (both current and credit linked) in one application on smart phones. The cardholder will be able to complete the payment process for purchases up to a maximum of 100 Riyals per purchase, once the smart phone is passed after opening the lock of the phone using the secret code, On the POS device supported by the service. There is no limit to the cards that can be saved in the Pay application, and the same card can be saved on more than one device. Pay Range is widely accepted within and outside the kingdom for millions of stores that support NFCs based on National Payment system in line with international

networks supported by the card used. What is known as the near-communication technique is the abbreviation of Near Field Communication (NFC) Is a 13.56 MHz wireless communication technology that can transmit data at a maximum speed of 474 kbps and is different from being able to exchange data in a very narrow range not exceeding 4 centimeters between the two ends of the exchange of information (phone, receiver or other phone). Use of financial transactions is possible because it is so secure that it cannot be remotely dealt with remotely [104].

## 2.2 POS devices (mPOS)

This service enables you to pay your purchases from any trade shows available at this point (POS) using ATM cards and credit cards (Visa, Mastercard and American). Express). The POS network transfers the amount of your purchases from the card account to the merchant account as these accounts are within the scope of the Saudi Payment Network, the GCC network, MasterCard, Visa and American Express. The POS device allows the merchant to accept all types of bank cards (Mada, MasterCard, Visa and American Express cards). It is the ideal payment option for cardholders rather than cash, and is the most convenient payment solution for mobile business owners. The device will be linked to the merchant account at the bank to settle the amounts of transactions quickly, easily and safely, with the possibility of the trader to report the transactions executed through the device and the total amounts settled through the Internet banking companies and institutions (Flex Business) [105].

## III. PROJECT DESCRIPTION

Absumha service allows the customer to use the POS network with the ATM card and the fingerprint. Therefore; it requests from the customer to enter PIN number and his/her fingerprint to be placed on a

Fingerprint reader. The fingerprint reader accepts the fingerprint and seeks to match the live sample with the already registered templates in the banks database. When the fingerprint is found correct, the customer will be able to do the required payment, otherwise the customer is denied access. The system also allows the customer to use more than one account in several banks so that he chooses the bank that he/she wants to withdraw the amount from it. The service will provide security, privacy and ease of use for the customer. The bank will also benefit from fees for financial transactions as well as maintenance, installation and replacement fees. The Saudi Payments Network will receive a portion of the fees. The benefit will also count merchants as it will reduce the problems they face in paying, procrastination and the delay of payments.



**Figure 1 :** The proposed POS with Embedded Fingerprint Biometric Authentication.

The POS device consists of physical parts as shown in figure 1, a scanner that reads the customer's fingerprint, a screen showing all the customer's data including the account number and the amount to be deducted, cards and a receipt, a keyboard containing the numbers and button of entry and withdrawal, as well as confirm and correct the operation and the port of the card. Also, the logo of absumha project was designed as shown in Figure 2.



Figure 2 : The proposed logo for the project

#### IV. FEASIBILITY STUDY

For market study, a questionnaire consisting of 16 questions was presented. The number of males who answered the questionnaire was 159 and the number of females was 427. In response to the questionnaire, the market need was derived from the use of the fingerprint POS network. The majority of 198 respondents responded to the need for a fingerprint system, while those who preferred ATM cards numbered 69, while those who did not mind using both methods were 319. Moreover, the results of the questionnaire revealed that there are many drawbacks faced by people using ATM cards such as the expiration of the card, forgetting and losing the card as well. The majority of respondents believed that the fingerprint system would reduce theft and counterfeiting, and the majority expressed their desire to document their register with the banks if the idea was applied. Respondents also said that the fingerprint system would save a lot of time as well as facilitate their payments.

#### 4.1 Marketing study

##### 4.1.1. Product Description

**Absumha** service allows the customer to use the POS network with the ATM card and the fingerprint. The

idea is to put the customer finger in the fingerprint reader in the POS network, where the customer's fingerprint is linked to his bank account in advance. The system also allows the customer to use more than one account in several banks so that he chooses the bank to deduct the amount of the process through. The POS network is small in size and easy to use and provided by banks, and the people who will get benefit from it are customers, banks and traders. The service will provide security, privacy and ease of use for the customer. The bank will also benefit from fees for financial transactions as well as maintenance, installation and replacement fees. The Saudi Payments Network will receive a portion of the fees.

##### 4.1.2 Market Description

Market segmentation aims at dividing the market into homogeneous sectors with each sector being viewed as a marketing objective by creating an appropriate marketing mix for each category. Absumha service will be based on financial services. On the basis of this, the financial market will be divided into individuals and companies, where the focus will be on the business sector, which is divided into small, medium and large companies. In addition, the market for which we will provide this service is a competitive market where there are many competitors who are developing services rapidly as Ather service provided by most banks which is one of the most competitors that has developed the POS network service. Table 1 below shows the characteristics of the target sector, where the service of the company focuses on the business sector of all sizes.

Table 1 : illustrates the characteristics of the target sector

Comparison criteria	Small Companies	Medium Companies	Large Companies
Independence of the Board of Directors	N/A	More independent than small	Full independence
Use of technology	Simple technology	More sophisticated technology	Advanced technology
Number of employees	Few	Medium	Large
Ability to innovate	Low	Medium	High
Capital size	Limited	Medium	Large
Need for funding	Low (high fluidity)	Medium	Large
Savings and investment	More savings and less investment	The correlation between savings and investment	Less savings and more investment
Risk and return	Low risk and return	Balance between risk and return	High risk and return
The need for marketing operations according to their market share	High because of its low market share	Medium	Less because of its high market share

The questionnaire clearly shows the need to activate the service of the fingerprint and make sure that there is an alternative to the ATM card because of the many problems that accompany it. Table 2 shows the number of transactions in the period from 2013 to

2017, the table shows that POS operations are increasing from year to year, indicating that the fingerprint system will be very popular with customers in the future.

Table 2 : shows the number of transactions using POS network

Period	Sales (in 1000 SR)	Period	Number of POS devices
2013	134,194,183	265,315,873	107,763
2014	159,970,264	327,034,423	138,779
2015	172,835,453	394,915,865	225,372
2016	182,748,679	524,569,736	267,827
2017	200,467,827	708,119,092	299,942

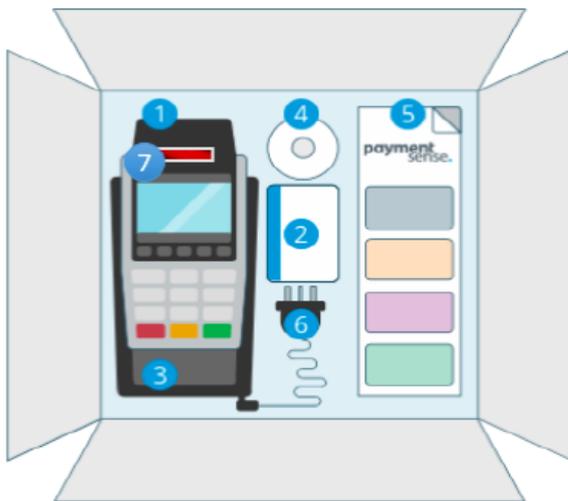
<http://www.sama.gov.sa/ar-sa/pages/default.aspx>, wed,21Mar,2018,8:03AM

One of the factors influencing the demand is the fear of using modern technical means. Therefore, it may not be available in all shops, and the demand at the beginning of the fingerprint service will be few. So Absumha will be announced through an explanatory video of the service in the social network.

### Packaging:

The packaging of the POS machine is shown in figure 3 which includes:

1. POS device
2. The seller's card uses for refunds
3. Charger and base
4. Printing paper receipt.
5. A publication for customers clarifying the service.
6. Cable for charging and internet connection.
7. Fingerprint scanner.



**Figure 3 :** Shows the method of packaging

Demand will be predicted by descriptive prediction, due to lack of historical data on demand. This prediction will be medium-term since it will provide a new service and add on the current POS network device. The survey also revealed that the total numbers of customers who wish to add a fingerprint

in the POS network are 79.2% from 591 people; this indicates customer desire for this new service.

### 4.1.3 Marketing Mix

#### • Banking Service

The fingerprint service has been introduced using the POS network, which aims to satisfy customers' need for a secure alternative. It provides time and effort besides the ATM card, where the customer is considered the cornerstone of service delivery. Currently, there are some alternatives that may affect the fingerprint service using the POS network such as Atheer, ATM and apple pays. However, after conducting a market study, customers are faced by problems with using an ATM card, losing or falsifying it, and fingerprint service is characterized by high security.

#### • Pricing of Banking Services

If the idea is sold to the banks, the price will be five hundred thousand Saudi Riyals based on the value invested from the production stage to the stage of developing the marketing strategies used. On the other hand, if the fingerprint using the POS network device is sold, the cost is estimated at SR 5,000 plus a profit margin of 2.5%, through the view of some sites in addition to communication with the Saudi banks to know the final cost. POS networks will be distributed through the bank to merchants or customers via direct distribution.

#### • Promotion of banking services

The bank advertising is one of the means of promotion that will be used to promote Absumha service, which aims to deliver all information related to the service to customers. The advertisement will clarify the shape of the device and what are the fingerprint service using POS networks and its features. Table 3 shows the cost of promoting Absumha service.

**Table 3 :** The cost of promoting Absumha service

Type	Cost/Percentage	Details of numbers
Cost	SR 5,000	The cost is estimated at 5000, depending on the contact with the official at the Saudi Investment Bank and with the suppliers.
Revenue	The revenue on the single transaction through the ATM card is 0.8%, while the revenue per transaction through the fingerprint is 0.95%, and the revenue per transaction through the credit card is 2.5%.	Revenue is obtained through the number of transactions. The bank takes 0.8% of the transaction through the ATM card and takes 2.5% on the one transaction through the credit card.
Profit margin	2.5%	The profit margin was estimated at 2.5% because of competition in the banking sector. Traders prefer to get the device at a lower cost.
Cost of promotion	SR 30,400	The cost of the video is estimated at 6000 riyals based on the video designer, and 4000 riyals on advertising in social media such as Twitter, Instagram and Snap Chat according to the number of times it appeared in the advertisement. SR 20400 is the cost of the publications in the branches of the bank, indicating its service to the customers, based on communication with the Sahara Advertising Agency for advertising services.

**• Design Distribution Structure**

Absumha service will be distributed through the bank to merchants or customers, which means direct distribution policy will be followed. The service will cover most of the shops, where the distribution policy will be used through the wider presentation of the service through a simple and comprehensive advertising of the idea to be clear, and to become accessible to the largest possible number of beneficiaries. This is through the offer of banks to it, where the bank to submit and offer to the Saudi Arabian Monetary Agency to apply as an addition to the POS network and Sama apply the idea effectively and distribute to the banks that request it.

**4.2 Technical study**

Technical feasibility study is one of the cornerstones of the feasibility study. Technical feasibility study leads to the clarity the technical aspects of the fingerprint service bt POS network. Technical feasibility study depends on the results obtained from the marketing study. We will mention location of the service, machinery and equipment required for the

service, identification of the required production elements and identification of the requirements and other services required by the service will be addressed.

**4.2.1 Locate the service**

It is the responsibility of the Bank to choose the appropriate location to provide fingerprint service by the POS network, and must be close to the target groups.

**4.2.2 Determining the service area**

The project does not need to allocate land or space to its own production unit, because the suppliers will be dependent on the manufacturer of the device with its own specifications.

Fingerprint with POS network will include 3 parts:

1. The final form which requires an indication of how the project will be presented.
2. Mechanism of work, which shows how the POS machine works using the fingerprint.
3. After-sale services.

**4.2.3 Machinery and equipment for service**

This service depends on the computer hardware to have the necessary software and databases. The costumer has to submit his fingerprint to be certified in case he wants to make payments with his fingerprint as a second option to the card. When the customer wants to make payments through the POS network using the fingerprint, the machine shows him all the banks accounts and he has to selects one of them.

- Tools used:
  - [1]. Network payment system.
  - [2]. Charge coupled device.

- Programs used:

Saudi Payments Network (SPAN): Connects ATMs and POS networks throughout the Kingdom of Saudi Arabia with a central network. Some bank programs are confidential so they cannot be compromised. Table 4 provides description of the tools necessary to the service to work properly.

**Table 4 :** Description of the tools necessary for the service

Tools	Description
Device shape	It is a device that provides service with an ATM card port and a fingerprint scanner and contains several buttons.
System to link client accounts	It is a system that shows the coaster accounts if he chooses the payment system by footprint
Port card	It is a special port for the card that the machine can read to be drawn from
Saudi Payments Network (SPAN)	It works to connect the device with a POS network all over Saudi Arabia with a central network.
charge device coupled	It is a matrix of light-sensitive cells that produces a light when exposed to a digital cycle electronically recorded, when the customer puts his finger on the device to identify the client's accounts.
Other programs	Bank programs are confidential, so they are not hacked.

#### 4.2.4 Production elements

This service requires many elements of production and other inputs to be finished in final form and the

project requires tangible part which will be made by mada machines or from external industries. We make the design as described in the product description to suit the model to be done.

- **Permits**

Point-of-sale services were introduced in 1990 in Saudi Arabia. Customers are provided with point-of-sale terminals through banks through the Merchant Agreement System (MSP). The Saudi Arabian Monetary Agency (SAMA) has also provided a point-of-sale engineer in each bank.

Banks and POS suppliers such as JEDIA should follow up the licenses issued by the Saudi Arabian Monetary Agency (SAMA). SAMA Department of Quality Assurance and Quality Assurance ensures the integrity of the purchasing process carried out through POS networks using the fingerprint, and technical testing is required to ensure that point-of-sale devices comply with international standards such as the EMVco standard.

- **Disclosure rules**

Trader Bank shall have access to all information related to the transactions made through the service, for the purpose of verifying the banking authorities (SAMA) on the operation process and the merchant's should accept this.

- **Protection**

Trader shall bear all costs and damages that may be incurred by the Bank as a result of negligence or misconduct of the Trader in connection with the transactions performed through service. In addition, the Bank is entitled to immediately suspend the Service from the Authority permanently or temporarily or to reserve any amount in the Trader's accounts until the damage and potential losses have been determined.

- **Statements and Guarantees**

The Bank and the merchant shall acknowledge and guarantee the following:

- [1]. The merchant has full authority to sign the agreement on the networks of POS and to fulfill the obligations contained therein.
- [2]. The dealer signing the agreement of the POS network will not conflict with SAMA documents.
- [3]. The trader must, at the time of signature of the agreement, continue to apply it throughout the contract period in accordance with applicable regulations.

- **Marketing services**

- a. The promotion of the service will be through a video graphic that explains the service to customers.
- b. Publication of the advertisement in the social media such as Twitter, Instagram and Snapchat.
- c. Publications in the branches of the bank to show the service for customers.

### 4.3 Financing Study

#### 4.3.1 Net present value

- The initial capital cost is SR 5000 after contacting the suppliers. This cost was calculated after adding the fingerprint to the POS network.
- Cash flow (annual revenue on transactions to be performed by merchant customers):
  1. Revenue on ATM card (2.5%)
  2. Revenue on Visa and Mastercard (2.5%)
  3. Revenue on fingerprint (0.95%)

Where the previous percentages (ATM, Visa and Mastercard) are reached from the banks, and as for the fingerprint, it is reached according to the Bank's

desire to make profit. The revenue for the first six years of the project will be calculated below:

- **First Year 2020**

The number of operations was forecasted based on previous data released by the Saudi Arabian Monetary Agency and showing the number of previous POS transactions in the Kingdom of Saudi Arabia as a whole. Hence, the last year 2019-2018 was based on the forecast for 2020, which was estimated by researchers as a new addition to the POS system. So, the researcher agreed on 4.25% in the first year.

- **Calculation of Initial Investment Cost**

As for the cost of the initial investment after we contacted several banks on the number of devices to be produced in the first year, especially as it is a new idea, Therefore, the Bank decided to contact the suppliers to request 10 thousand devices in the first year, where the initial investment cost is 50 million Saudi Riyals. And the result is that when the launch of any new project accompanied by apprehension by customers, initially the sales was expected about 10,000 thousand devices in the first year, that is, the initial investment cost for the first year:

$$10000 \times 5000 = 50 \text{ million}$$

According to preliminary calculations, the revenues obtained through the Absumha service for the next six years will cover the costs incurred. This shows that the investment is feasible and successful, and that the implementation of this project will generate profits.

## V. CONCLUISON

In this paper, an embedded fingerprint biometric authentication scheme for Point of Sale (POS) network as additional security option to the ATM

card was proposed. A fingerprint biometric technique was fused with personal identification numbers (PIN's) for authentication to upgrade the security level. The results of the study show the importance of having an additional substitute for the ATM card when dealing with the POS check. We conducted a feasibility study including marketing, technical and financial study, as well as analysis of time, cost, risks and expected problems. This service facilitates the customer to conduct daily transactions through the existence of an alternative to secure the card, and based on the results of the questionnaire, which showed the need of customers to have a safe alternative to the card and high support for the idea is expected as it will reduce the problems related to the ATM cards.

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