



## A Survey On E- Payment Systems

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### Abstract

The creation of smartphones, communication devices, and the internet have all had a significant impact on global trade in the modern era. This has given rise to a new industry known as "electronic commerce," or "E-commerce," which is the use of smart devices and the internet for the exchange and display of goods and products. The need for a means of transferring money between people and businesses globally led to the creation of the so-called electronic payment, which is the foundation of electronic commerce and involves using computers and other smart devices to transfer money between the bank accounts of the relevant parties. This paper reviewed the most important electronic payment methods currently available and the security features of each method, as the adoption of any method depends on the availability of service by the responsible authorities in a particular region and the living level of that region. But, in general, mobile wallet applications that use NFC technology are considered one of the most adopted methods worldwide due to their ease of use and the availability of NFC service in most modern smartphones.

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### Introduction

Electronic commerce (e-commerce) is the use of the Internet and electronic media to trade goods and services (1). E-commerce encompasses a wide range of commercial activities conducted through the Internet, including product and service offerings, order placement, purchasing, after-sales services, bill payments, installment plans, and contract arrangements. In electronic commerce, business transactions occur without direct physical exchange, with the Internet or a private network serving as the link between merchants and customers (2).

E-commerce can be classified into six categories: Business to Business (B2B), which involves commercial services between companies; Business to Consumer (B2C), which refers to transactions between businesses and consumers; Consumer to consumer (C2C), which entails business activities between consumers; Consumer to business (C2B), a type of electronic commerce where consumers offer their products and services online for companies to bid on and purchase; Business to administration (B2A), which includes transactions between companies and government departments, such as legal documents, records, social security, financial statements, taxes, etc.; and Consumer to administration (C2A), which involves transactions over the Internet between consumers and government departments, such as Social Security, taxes, and health services. (1,3)

With the development of electronic commerce, the expansion of companies, and the advent of the communications revolution, there has been an increasing demand for a way to exchange money electronically (electronic payments) with people worldwide (4). E-payment is an abbreviation for electronic payment, which enables two parties to exchange

money to acquire products or services digitally. These parties can be a bank, a corporation, a government, or simply an individual. E-payments include transactions conducted with debit cards, credit cards, and mobile devices. The most common form is E-Payment networks that connect bank accounts and facilitate monetary exchange via bank deposits (5).

Electronic payment systems are essential in providing the infrastructure required for internet-based payments. They have become integral components and critical to the further development of electronic commerce and electronic business (6). In our current time, with the rapid development of mobile devices and their applications, as well as their widespread use for communication and bridging distances, conducting financial and banking transactions using mobile phones has become necessary for individuals regardless of their cultural and living level or geographical area. The phone has become essential to many people's lives, simplifying financial and banking transactions (7).

Mobile payment systems (m-payments) rely on mobile phone technology, allowing consumers to make payments whether they have a bank account or open an e-wallet account with a payment service provider. Customers no longer need to carry or use physical currency, and m-payment provides convenience and speed (8, 9). Individuals, corporations, governments, and non-profit organizations can use cards, mobile phones, or the Internet to make cashless payments for goods and services. Mobile payments offer various advantages, including cost and time savings, increased sales, and reduced transaction costs. (10).

Despite the widespread adoption of electronic commerce and the growing interest in electronic payment, many people are still unaware of the various types of electronic payment methods. This paper aims to provide a comprehensive overview of the most important payment methods currently in use and their characteristics. It is important to note that the discussion of payment method security is beyond the scope of this research.

This paper is organized as follows: Section II presents key concepts in mobile payments, Section III examines the currently used electronic payment methods, Section IV explores the mobile technology that will be used in conjunction with mobile payments, and finally, Section V concludes the paper.

### **E\_ payments:**

Halim et al. (11) define an E-Payment System as an innovative payment mechanism that utilizes electronic media instead of cash. E-payment systems are described as electronic value transfer systems that enable the payer's payment to be transferred to the recipient through the E-payment method. E-payment services provide a web-based interface that allows users to remotely access, manage, and transact with their bank accounts. In general, E-payment refers to online payments made via the Internet.

There are two types of mobile payments based on location: remote and proximity. A remote payment transaction is an electronic payment transaction conducted over the Internet or through a remote communication device. Remote payments can be performed from any location and at any time without needing a point-of-sale (POS) machine. They can be either P2P (peer-to-peer) or P2B (person-to-business) payments.

Mobile proximity payments involve the consumer and payee being in the same location and communicating through proximity technology, such as Near Field Communication (NFC), Quick Response (QR) codes, Bluetooth technology, etc. Mobile contactless payments are a subset of mobile proximity payments (12, 13).

On the other hand, there are two ways to operate e-payment systems: online payments and offline payments. In online payments, the vendor verifies the payment sent by the purchaser with a bank before serving the purchaser. In offline payments, there is no requirement for an online connection to the bank, except when excessive spending needs to be identified.(14)

Electronic payment offers numerous benefits, including the ability to make remote payments without needing to physically visit places of sale, which proves useful in cases of epidemics such as the COVID-19 pandemic. Another benefit is availability, as purchases can be made anytime, from anywhere, and over any distance. Safety is also a significant advantage of electronic payment since there is no need to carry physical money, reducing the risk of loss and theft (15).

It is important to remember a payment system must possess the following characteristics to be accepted globally:

- Trust: The electronic payment system should be a trusted platform for customers.
- Confidentiality: Data must be protected from being accessed by unauthorized parties and should only be available to relevant parties.
- Security: The system must be secure against risks, fraud, and hacking.
- Availability: The system should be accessible for use at any time.
- Cost-effectiveness: Transaction costs should adhere to the regulations set by the relevant authorities.
- Integration capability: The system must ensure compatibility with existing payment systems that share similar features and should be seamlessly integrated within the same environment as the new payment system. (6, 11)

**Types of Mobile Payments**

**payment cards:**

Electronic transaction cards are the fundamental components required for electronic payments. These cards are typically made of plastic and have a magnetic stripe on the back. In general, there are three types of cards: credit cards, debit cards, and smart cards.

A credit card is a small rectangular piece of plastic or metal with magnetic strip, issued by a bank or financial services company. It allows cardholders to borrow funds to make purchases of goods and services at merchants who accept cards. Cardholders are required to repay the borrowed funds, along with any applicable interest and agreed-upon charges, either in full by the billing date or over time.

A debit card, also known as an ATM card, is a magnetic strip prepaid card that allows direct access to funds from a checking account. It can be used to make purchases and withdraw cash from ATMs. Debit cards offer the convenience of reducing the need to carry cash, although they may sometimes incur fees.

A smart card is a physical card with an embedded microprocessor, often referred to as a computer processor or a microchip. It is similar to debit card, but it provide enhanced security and privacy compared to other financial or transaction storage cards available in the market. They serve as a secure storage location for sensitive or confidential information.( 16, 17, 10, 4). Table 1: summarizes the difference between the three types of cards.

Table 1: the difference between payments cards(17)

<b>features</b>	<b>Credit cards</b>	<b>Debit cards</b>	<b>smart cards</b>
<b>definition</b>	A credit card is essentially an electronic card that banks and other credit agencies issue to customers. It may have a chip or a magnetic data strip.	Debit cards are provided to consumers by their respective banks and have both a magnetic strip and a chip.	A smart card has a embedded microprocessor, it is like a computer processor or a microchip.
<b>Actual payment time</b>	Post-Paid	Pre-Paid	Pre-Paid
<b>Online or offline transactions</b>	Online transactions	offline transactions	offline transactions
<b>costs</b>	high costs. Not suitable for small payments	Low costs	Low costs
<b>Limit on transfer</b>	Depends on the limit of the credit card	Depends on how much money is saved	Depends on how much money is saved

### **Digital or mobile wallets:**

Moon et al. (18) defined an E-wallet as a tool, application, or program that combines the customer's personal information with a bank card or account information, providing real-time services for money transfers via smart devices, computers, etc. These technologies offer new and secure payment methods (19). The use of an E-wallet in the payment process is one of the most commonly used techniques today due to its ease and security (3). E-wallets are accessed through the Internet and smartphone applications (20). When a smartphone functions as a digital wallet, it can store digital coupons, digital money (transactions), digital cards, and digital receipts, forming a mobile wallet. Mobile wallet services allow users to download apps from online stores onto their smartphones and use them for online and offline transactions. In the future, mobile wallets are expected to provide even more convenient payment solutions by utilizing cutting-edge technologies that connect smartphones to the physical world, such as NFC (Near Field Communication), sound waves, QR codes, and cloud-based solutions (4). Digital wallets are prepaid accounts that store user financial values, such as bitcoin, debit, and credit card information, to facilitate online transactions (10, 21). Nowadays, many customers prefer using e-wallet smartphone solutions, such as Google Wallet, Apple Pay, Android Pay, Amazon Pay, Phone Pay, and others for micro and macro purchases, utility bill payments, and various other transactions. One of the main reasons for the global growth of the e-wallet sector is that these solutions provide faster, more reliable, and trustworthy payment environments (22).

### **Cryptocurrencies**

Cryptocurrency is a digital payment system that utilizes virtual cryptocurrency instead of physical currency and does not depend on a bank account. It first appeared in 2009 with the introduction of the first cryptocurrency, bitcoin. Subsequently, other types of cryptocurrencies emerged, such as Litecoin and Ethereum, which heavily rely on the characteristics of bitcoin with some modifications. Regular bitcoin users utilize digital wallets, similar to electronic banking software, to manage their bitcoin cash and facilitate sending and receiving bitcoin payments. Bitcoins exist solely as information stored in files on a computer or mobile device.

The name "cryptocurrency" derives from the combination of encryption and electronic money, as it employs special keys to enhance security. The functioning of cryptocurrency is based on the principle of decentralization through blockchain technology. It is not issued by any government entity, making it immune to interference and manipulation. The core concept behind cryptocurrency is to provide a fast and cost-effective method for global money transfers with a certain level of privacy. Transactions conducted with bitcoin are irreversible since cryptocurrency systems, including bitcoin and Ethereum, utilize a private key as the sole credential for account management. Possessing the private key grants full control over the cryptocurrency account. Once a cryptocurrency transaction is signed by the private key, it is considered legally binding and irreversible. Theft and loss of private keys are the primary reasons for the loss of digital currency assets. Consequently, the security of cryptocurrency assets relies on the security of the private key (23, 24, 25, 26).

### **Wearable devices**

Despite the widespread use of mobile devices, wearable technology has started integrating into our daily lives. Wearable devices, such as smartwatches, smart bands, and other gadgets, can be worn on the user's body. These wearables are typically equipped with various sensors that provide sensory and scanning features, such as biofeedback and physiological function tracking. Smartphone manufacturers like Apple, Samsung, and LG are actively developing wearable devices, also known as wearables. For instance, Apple Watch users can transform their wearable into a payment device by securely storing their credit or debit card information on a chip. The increasing popularity of smart devices presents significant opportunities across various industries, particularly in the payments sector (27). This payment method, which involves the use of wearable gadgets, is still relatively new. Real-world examples include making payments with digital rings or smartwatches (23).

### **Internet or mobile banking**

Internet banking refers to the use of the Internet as a remote delivery channel for banking services. These services include traditional features like opening a deposit account or transferring funds between accounts, as well as newer services like electronic bill presentation and payment. With electronic bill presentation and payment, customers can receive and pay bills through the bank's website. On the other hand, mobile banking (M-Banking) specifically refers to banking services provided through mobile communication devices such as cellphones.

The primary purpose of online banking is to facilitate banking operations for both customers and the bank by eliminating the need for customers to physically visit a bank branch. This saves time and money for customers. Additionally, online banking allows customers to perform transactions quickly from anywhere and anytime, as long as

they are connected to the Internet. From the bank's perspective, providing Internet banking helps reduce operating costs and also encourages customers to become bank customers (28)(18).

For financial transfers, most banks rely on various channels such as short message service (SMS), Unstructured Supplementary Service Data (USSD), subscriber identity module application toolkit, and mobile web. Among these options, SMS is generally the least expensive compared to other channels (29).

**Face payments (face pay):**

This form of payment mechanism first appeared and spread across several regions worldwide in 2013. With this mode of payment, there is no need for a payment card or passwords that can be lost or stolen. All you have to do is swipe your face across the payment machine. This method allows for quick payment and eliminates the need for employees to be present to complete the process. Payments can be made at any time, from any location, and using any means. This payment option is known for its speed and security. However, one of its drawbacks is that it requires specific equipment at shopping malls, even though most recent smartphones include facial recognition capabilities for capturing the face.(30)(31)

table 2: summarize of E\_payment types

<b>Payment type</b>	<b>Definition</b>	<b>Example</b> (source Google)
<b>Credit cards</b>	It enables holders to borrow money to pay for products and services at card-accepting merchants and then pay back the borrowed money with the agreed-upon interest, plus any agreed-upon additional fees.	Visa card
<b>Debit cards</b>	Funds are withdrawn directly from a current account. They are used to purchase products and services and to withdraw cash from ATMs. Sometimes an additional fee is added	Visa Debit cards, American Express Serve.
<b>Smart card</b>	It contains a microprocessor chip that ensures greater confidentiality and security of stored information	Master card, SIM card
<b>Digital or mobile wallets:</b>	A digital wallet is an application on an electronic device that stores payment information and allows you to securely make purchases without carrying cash or cards	PayPal , Apple Pay, Samsung Pay, Alipay
<b>cryptocurrencies</b>	Encrypted electronic money or the so-called virtual currencies, which achieve the principle of decentralization in dealing	Bitcoin (BTC), Ripple (XRP), Litecoin (LTC), Cardano (ADA)
<b>Wearable devices</b>	smart devices that can be	smart watches, wristband,

	Wearable and used for payments and financial transactions	Apple watches, A contactless payment jacket , digital rings, Smart Glasses
<b>Internet or mobile banking</b>	Using computer or mobile device to access and manage one’s banking accounts and conduct various financial transactions	Chase Online Banking, Bank of America Online Banking,
<b>Face payments (face pay</b>	Pay with your face only	Facepay, Alipay's "Smile to Pay", Amazon One, PopPay

**Mobile payments technology:**

**QR code Payments:**

Quick Response codes(Figure 1) first debuted in early 1994 intending to improve auto-tracking and encoding of manufactured goods. These 2-D matrix barcodes can contain various types of information, such as product details, manufacturer names, SMS (Short Message Service), and URLs (Uniform Resource Locators). QR codes are more efficient as they can store more information and offer greater flexibility in terms of storage capacity. Since its recognition in China in 2016, QR code payment has become the most popular contactless mobile payment method, applicable to both bitcoin transactions and online phone bill payments. Alipay serves as an example of a QR code payment market (32).

The most significant advantage of QR codes is their cost-effectiveness for both customers and businesses. Customers simply need to use a mobile banking app or an electronic wallet to make a purchase. They can then open the app, scan the QR code, confirm the amount, and proceed with the payment. Additionally, shops, especially smaller ones, are not required to invest in expensive point-of-sale (POS) machines. They can simply apply a sticker with a QR code to accept electronic payments. By displaying a QR code on the payment counter, retailers can accept payments from any customer, bank, or electronic wallet, with the funds immediately credited to their account (33).

However, one disadvantage in using QR codes is that cybercriminals can target them. The QR code may direct users to suspicious websites, leading to the download of malware or viruses onto the victim's phone. Hackers can then potentially access sensitive information, such as personal information, social media accounts and passwords, and real-time location (3).



Figure(1) QR code

**NFC contactless Payments :**

This form of communication was launched in 2008 and has been in use since then (27). NFC (Near Field Communication) is a wireless technology that enables electronic devices in close proximity (within 10 cm or less) to exchange data. You can make in-person payments at stores or compatible terminals by simply bringing your mobile device close to the terminal. NFC technology offers several advantages, including widespread availability and the flexibility to be used on existing mobile devices by installing a chip. It has a wide range of applications, is user-friendly, and provides value-added services. NFC payments are secure because they require manual activation or proximity to the receiver, encouraging proactive user engagement. Additionally, NFC is based on open standards, making it cost-effective for users who do not need to pay license fees. Overall, NFC technology is a versatile and secure method for making payments and accessing services (34, 15).



Near field communication (NFC)-based mobile payment is one of the newest and most popular mobile payment technologies. Portable devices are equipped with NFC tags, which can act as digital wallets, allowing customers to conduct transactions by waving their devices over NFC-enabled payment terminals and point-of-sale (POS) terminals (35), without requiring mobile networks or a power supply (36). The main benefits of NFC technology include its scope and availability, as it can be implemented on all existing mobile terminals by installing a chip, generating a wide range of new services for users and the terminals themselves. It has diverse applications such as billing, car payments, leisure activities, and more. NFC technology is easy to use since it only requires the parties involved to be within a specific proximity. It offers security by requiring manual activation or close proximity for payment, promoting proactive user behavior. It also generates value-added services, works on devices equipped with contactless features, serves as a platform for cash receipt, payment, and transportation worldwide. It is economically attractive due to its reliance on open standards without licensing fees (37). However, one of the disadvantages of NFC is that it requires modern smartphones equipped with a contact chip (27). Table below (table 3) summarize the difference between NFC and QR. Figure(2) illustrate the operating mode of NFC and uses of each mode



Figure 2 NFC operating mode(source (RFID 4u))

Table 3: the difference between QR and NFC(27)

feature	QR	NFC
<b>Product simplicity</b>	QR codes can be produced by anyone. There are various websites available on the internet which provide such services at no cost	NFC requires a specialized organization to produce a chip that needs to be embedded in the product
<b>Using simplicity</b>	It is simple and every one can use it easily	It is easy for those who are familiar with modern technologies
<b>Visibility</b>	Visibility of the QR code is necessary to scan the product. This might cause a problem if the print is not dark or readable enough	NFC does not need to be visible to work
<b>security</b>	QR codes can be used by hackers to mislead the users, resulting in coming in contact with a virus.	The contact is made at a very close distance of no more than 10 cm So NFC is more secure than QR
<b>Flexibility</b>	Once the QR code is printed.it is not possible to do any change to it, because it will lead to errors, so making any change	The owner of the NFC chip can reprogram the system anytime leading to more flexibility. It also helps in saving time, money, and effort

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	requires printing anew QR code.	
<b>Material needed</b>	Requires a phone with a suitable camera capable of scanning the QR code	To work properly, need an NFC chip embedded in the device

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### **SMS based Mobile Payments:**

This simple and user-friendly payment system, eliminates the need for lengthy technical payment steps (15). SMS payments are used to make purchases on mobile devices. In this method, a mobile payment service provider receives a text message containing payment information. The mobile payment service provider facilitates the transaction between the customer and the merchant, and the purchase price is added to the mobile subscriber's monthly phone bill. SMS payments are particularly suitable for people without a bank account and are commonly used for small payments in developing countries (38). An early example of mobile payment via SMS texts was demonstrated by Coca-Cola using a Coke vending machine in 1997 (39).

However, the SMS system faces four security-related drawbacks, which include storage issues in the recipient terminal after message completion, the absence of coding, the lack of delivery confirmation, and the reduced transmission capacity due to the limit of 160 characters (37).

Additionally, many banks offer mobile banking services to consumers, including money transfers, balance inquiries, utility bill and mortgage alerts, ATM location information, transaction verification, and more. Banks use various delivery channels for money transfers, such as Short Message Service (SMS). However, several security concerns arise in SMS banking. For instance, hackers can easily intercept unencrypted text messages to obtain confidential customer data through sniffing. They can also modify beneficiary data without the client's knowledge. This makes the SMS vulnerable to replay attacks (29).

### **Conclusion:**

This paper discusses the most important electronic payment methods, including electronic cards, which are widely used and user-friendly options. Electronic wallets, utilizing communication technologies like Quick Response (QR) technology, are also popular and known to most users. However, they have some disadvantages, such as weak security that may allow access to suspicious sites. An electronic wallet using NFC technology is considered one of the most widespread payment methods globally. It is easy to use, widely available due to integration with modern phones, and relatively safe compared to other technologies.

SMS technology serves as an easy payment method that doesn't require an internet connection or a bank account, making it suitable for remote or economically disadvantaged areas. However, it is less secure.

Decentralized virtual currency e-wallets are used to exchange virtual currencies, but many consumers are still unfamiliar with them, as they are more accustomed to physical money. Wearable devices are another option for electronic payment, but their affordability depends on the client's financial situation and the challenges of acquiring such gadgets.

Face-based payment methods offer an extremely high level of security and are among the best forms of electronic payment. However, one drawback is the need for facial recognition devices at points of sale (POS), which can be expensive. Availability of this service also depends on financial and banking authorities.

Payment methods vary from region to region and country to country, depending on physical conditions, availability of POS devices, and services provided by relevant agencies. It is essential to inform customers about the value and advantages of electronic payment before approving transactions and provide guidance on avoiding corresponding scams.

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## دراسة استقصائية عن أنظمة الدفع الإلكتروني

شيماء شكيب محمد و ياسين حكمت اسماعيل

قسم الاحصاء والمعلوماتية ، كلية علوم الحاسوب والرياضيات، جامعة الموصل، الموصل، العراق.

قسم علوم الحاسوب ، كلية علوم الحاسوب والرياضيات، جامعة الموصل، الموصل، العراق.

**الخلاصة:** انعكس تطور التكنولوجيا وتصنيع أجهزة الاتصالات والهواتف الذكية وانتشار الإنترنت بشكل كبير على التجارة العالمية وأدى إلى ظهور ما يسمى بالتجارة الإلكترونية وهو استخدام الأجهزة الذكية والإنترنت في تبادل وعرض السلع والمنتجات. نتيجة لذلك ، يجب أن تكون هناك أداة لتبادل الأموال بين الأفراد والشركات في جميع أنحاء العالم. ظهرت المدفوعات الإلكترونية ، وهي استخدام أجهزة الكمبيوتر والأجهزة الذكية لتبادل الأموال وتحويلها بين الحسابات المصرفية للأطراف المعنية ، والتي تعتبر العمود الفقري للتجارة الإلكترونية. استعرضت هذه الورقة أهم طرق الدفع الإلكتروني المتاحة حالياً والميزات الأمنية لكل طريقة ، حيث يتم اعتماد أي طريقة على مدى توفر الخدمة من قبل الجهات المسؤولة في منطقة المعنية ومستوى المعيشة لتلك المنطقة. ولكن ، بشكل عام ، تطبيقات المحفظة النقالة التي تستخدم تقنية NFC تعتبر واحدة من أكثر الأساليب المعتمدة في جميع أنحاء العالم نظراً لسهولة استخدامها وتوافر خدمة NFC في معظم الهواتف الذكية الحديثة.

**الكلمات المفتاحية:** المدفوعات الإلكترونية ، الدفع عبر الهاتف المتحرك ، محافظ المحمول ، نفك ، ريال قطري ، والرسائل القصيرة.