UNIVERSITETI I EVROPËS JUGLINDORE УНИВЕРЗИТЕТ НА ЈУГОИСТОЧНА ЕВРОПА SOUTH EAST EUROPEAN UNIVERSITY

FAKULTETI I SHKENCAVE DHE TEKNOLOGJIVE BASHKËKOHORE

ФАКУЛТЕТ ЗА СОВРЕМЕНИ НАУКИ И ТЕХНОЛОГИИ FACULTY OF CONTEMPORARY SCIENCES AND TECHNOLOGIES

POSTGRADUATE STUDIES – SECOND CYCLE

THESIS:

Micropayment platform using Mobile & QR Codes

CANDIDATE:
Haris Haxhimehmeti

MENTOR:
Prof.Dr. Adrian Besimi

Tetovo, December 2019

I certify that I am the original author of this work with title "Micropayment platform using Mobile and QR Codes", except citations of references

Candidate: Haris Haxhimehmeti

Lecturer's statement

Referring to the candidate's, Haris Haxhimehmeti, request for proofreading his master's thesis "*Micropayment platform using Mobile & QR Codes*". I, Zejnepe Haxhimehmeti was born on 15.12.1955, with identification number 1001817228, by profession Professor of English language, state that I have proofread this topic: *"Micropayment platform using Mobile & QR Codes",* after the completed proofreading I have done, I state that the work paper meets all proofreading standards and is complete.

I am also attaching this statement the court's affirmation of my appointment as a judicial translator and my diploma.

Mitrovica, December/2019

respectfully,
Prof. Zejnepe Haxhimehmeti

Agj . I.nr. 214/2003

KRYETRARI I GJYKATES SE QARKUT NE MITROVICE, duke vendosur lidhur me kerkesen e Zejnepe Haxhimehmeti nga Mitrovica, per caktimin e saj per perkthhese -interprete gjyqesor, ne baze te nenit 56 al.l, te Rregullores mbi veprimtarine e gjykatave (Fletorja zyrtare e KSAK nr.7/81) merre kete:

A K T V E N D I M

ZEJNEPE HAXHIMEHMETI nga Mitrovica, caktohet perkthhese – interprete gjyqesor per territorin e Gjykates se Qarkut ne Mitrovice, per gjuhen Angleze.

Ky vendim mbetet ne fuqi deri sa mos te revokohet.

A r s y e t i m

Zejnepe Haxhimehmeti nga Mitrovica, ka ushtruar kerkese ne Gjykaten e Qarkut ne Mitrovice, qe te merret vendimi per caktimin e saj per perkthhese – interprete gjyqesor, per gjuhen Angleze nga se disponon me kualifikime perkatese dhe me mjafte pervoje pune.

Kryetari i kesaj gjykate konforme nenit 56 al.l te Rregullores mbi veprimtarine e gjykatave shqyrtoi dhe vlersoi kerkesen e Zejnepe Haxhimehmetin dhe gjeti se:

Kerkesa e Zejnepe Haxhimehmetit eshte e bazuar.

Gjate vendosjes lidhur me kerkesen e te permendurit u vertetue se enjejti ka kryer Fakultetin e Filologjis ne Prishtine me dt. 25. nentor 1981.ne Degen e Gjuhes dhe te Letersise Angleze - Certifikata 04 830/2 te dt. 11. tetor 2002.

Pasi se gjykates i nevojitet nje profil i tille i ekspertit, u vendos qe gjykata te bashkepunon me te permendurin.

Per punen e bere ne emer dhe ne llogari te gjykates i njejti merr shperblimin sipas rregullores se gjykates.

Me kete aktvendim te njoftohet i permenduri dhe nje kopje te mbetet ne dosjen personale.

GJYKATA E QARKUT NE MITROVICE, me 08.09.2003.

KRYETARI I GJYKATES
Kajtlan Baruti

DUPLIKAT

United Nations Interim
Administration Mission in Kosovo

Universiteti i Prishtinës
University of Prishtina

PHILOLOGICAL FACULTY

DIPLOMA

IN UNIVERSITY EDUCATION

ZEJNEPE RIZA GASHI

BORN IN MITROVICA ON **15 DECEMBER 1955**

REGISTERED IN THE ACADEMIC YEAR **1975/76**

COMPLETED ALL THE REQUIRED EXAMINATIONS

AT THE PHILOLOGICAL FACULTY

DEPARTMENT OF **ENGLISH LANGUAGE AND LITERATURE**

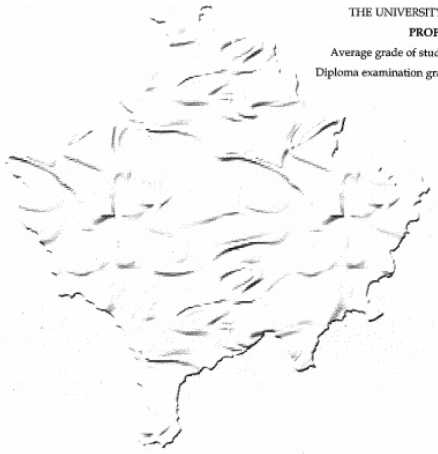
ON 25 NOVEMBER 1981 AND OBTAINED

THE UNIVERSITY TITLE

PROFESSOR

Average grade of studies **6.87**

Diploma examination grade **6.75**



FAKULTETI I FILOLOGJISË

DIPLOMË

E KUALIFIKIMIT UNIVERSITAR

ZEJNEPE RIZA GASHI

LINDUR NË MITROVICË MË **15 DHJETOR 1955**
REGJISTRUAR NË VITIN AKADEMIK **1975/76**
MË **25. 11. 1981** I KA DHËNË PROVIMET E PARAPARA
PËR TË MBARUAR FAKULTETIN E FILOLOGJISË
DEGA GJUHË DHE LETËRSI ANGLEZE
DHE ME KËTË MERR KUALIFIKIMIN

PROFESOR

Nota mesatare gjatë studimeve **6.87**
Nota e provimit të diplomës **6.75**

PRISHTINË, MË **30 MAJ 2007**, NR. **1087**

Dekani — Prof. Dr. Nuhi Rexhepi

Rektori — Prof. asc. Enver Hasani

Acknowledgement

Before all I would like to thank God, who through my faith gave me strength and motivation to complete my studies and achieve to obtain master degree in the field of Computer Sciences.

Also, sincerest gratitude I dedicate to my family that has supported me hesitation lot in my academic journey. Certainly, I would not be half as good as I am if I had not had the full support of my family which consists of my mother, my wife, my daughter and my brother. I, as a son, husband, father and brother wish with all my heart not to be disappointed after all sacrifices to support my education.

Special thanks go to two my professors, Prof. Betim Cico, a man with vast knowledge and great potential in many areas who helped me a lot with his instructions concerning the researches and writing a good proposal thesis. Also, my mentor professor, Assoc. Prof. Dr. Adrian Besimi who is guiding me from now on. I was really honored to collaborate with them to bring the final version of may work paper and bestly complete the master thesis. With a hope that I will please them with my thesis I conclude the acknowledgement part.

Contents

Table of figures

Abstract

The Mobile payment system as part of Fintech has a potential to dig up and find solutions and alternatives for what was discovered in that regard until nowadays. Some solutions of it are the micropayments processing systems, which process payments that have fees processing greater than the value of wanted item itself. Except the research paper which elaborates what was achieved concerning the related works and what was left. Here I will include a Web & Mobile app using Xamarin in order to create the app on two platforms IOS and android with minimal changes after the code is completed for one of the platforms. Mobile app will leverage QR codes as payment "Coins" for the purpose of micro payments, such as purchasing a photo for 0.1$ or anything similar. Once the account is re-filled with "coins" by using credit cards, next phases transactions are to be handled through the system without any fee.

Keywords – Mobile Payment system, Micropayment, Mobile Application, QR-Code

Abstrakti

Sistemi i pagesave ne mobil, si pjesë e Fintech, ka një potencial për të hulumtuar dhe gjetur zgjidhje dhe alternativa për ato që janë zbuluar në këtë drejtim deri në ditët e sotme. Si zgjidhje janë edhe sistemet e procesimit të mikropayments (mikropagesave), në të cilat vlera procesimit është më e madhe se vlera e vetë artikullit të kërkuar. Përveç hulumtimit dhe studimit, që përshkruajnë ato që u studiuar në lidhje me mikropagesat dhe se çfarë ka mbetur pa u thënë nga to, do të krijohet një aplikacion Mobile duke përdorur Xamarin në mënyrë që të krijohet aplikacionit në dy platforma IOS dhe Android me ndryshime minimale pasi kodi të ketë përfunduar për njërën prej platformave operative. Aplikacioni do të përdorë kodet QR si pagesa për qëllime të mikropagesave, siç është blerja e një fotografie për 0,1 $ ose ndonjë produkti të ngjashjshëm. Pasi llogaria të rimbushet me "monedha" duke përdorur kartat e kreditit, transaksionet në fazat e ardhshme do të trajtohen përmes sistemit pa ndonjë tarifë.

Апстракт

Мобилниот систем за плаќање како дел од Финтех, кој има потенцијал да истражува и да пронајде решенија и алтернативи за оние откриени во овој поглед до денес. Некои решенија се исто така системи за обработка на микроплаќања чија процесна вредност е поголема од потребната вредност на самата ствар. Покрај истражувањето и опишувањето на што се научи за микроплаќањата и за она што остана неплатено, ќе се создаде и мобилна апликација со употреба на Хамарин со цел да се создаде апликација и во платформите за иОС и Андроид со минимални промени откако ќе се заврши кодот во една од платформите. Апликацијата ќе користи QR кодови како плаќање за целите на микроплаќање, како што е купување фотографија за 0,1 долари или сличен производ. Откако сметката ќе се наполни со „монети“ со користење на кредитни картички, трансакциите во следните фази ќе се управуваат преку системот без надомест.

Chapter 1. Introduction

This chapter deals with introduction to the thesis, including some of the key concepts that are related to micropayment giving explanations from the broadest one, which is Fintech, to the narrowest – in this case, the Micropayment. In this chapter are also included objectives and hypothesis of the thesis, which are defined and further explained.

Two industries are breaking all barriers in the last decade. Both that can be combined as one whole called **Fintech** (Financial Technology). It is the industry where finances meet the technology by aiding to perform financial activities. In other words, FinTech is the new technology which is expanding and bringing a new era and competing with classic financial methods. Many people apply Fintech in everyday life. According to the report from EY Fintech Adoption Index (EY Fintech, 2017) there were 33% of consumers in the world that used at least two services of Fintech. China is proceeding with 69% with majority of consumers using the category of money transfer and payments.

Fintech has many priorities. Some of them are: fast transactions, online banking and online loan application. The shorter waiting time at bank affiliations has made customers embrace Fintech for certain purposes while the financial institutions started a new era in their approach.

Mobile payment is one part of Fintech and the players involved in a mobile payment system are: Customer, Merchant, Issuing Bank, Acquiring bank. But also, there are many other methods and techniques to make a mobile payment which depends on the way we use the mobile and what we are buying or what we are paying for. In case we want to use our mobile as a point of sale in a grocery we can deal with mPos (Mobile point of sale). In line with this, we use the Mobile Banking while communicating with our bank concerning the account information, make a transaction or Mobile Commerce for buying and selling through mobile. To defend what we are saying that this might be the future is shown in the statistics in 2019 Statista chart (Loesche, 2018), Mobile commerce will cover 67.2 % of total shares in e-

commerce with 2.32 trillion US dollars sales, while in 2020 this percentage increases to the cover of 70.4% with 2.91 trillion US dollars sales.

(Ali, Clark, & Patrick, 2017) consider the electronic micropayment transactions equivalent to purchases made using pocket cash or spare changes. But there are so many opinions about the maximal amount of a micropayment, for instance (Paypal, 2010) considers each transaction under £5 as a micropayment and the other giant company of financial services (Visa, 2010) considers the transaction as micropayment when the amount is less than 20 AUD. On the other hand, most of the companies agree that a transaction can be considered as a micropayment when the transaction amount is less than transaction fees or mathematically expressed: *Transaction Amount* < *Transaction fees* from which we can buy a digital or virtual good. (Verme, 2014) describes a digital good as an object which can be represented and can be used or delivered in a digital way such are: books, movies, songs etc, while virtual goods are virtual objects that mostly can be purchased on games and can be related to a real object.

In this thesis, the focus will be in explaining how the mobile payment system works especially when we have to do with micropayments so the people can understand how to use and implement it in practice. According to one of the researches mentioned below in Chapter 2, (De, Dey, Mankar, & Mukherjea, 2015), one can see that people can be familiarized using QR code for a mobile payment very quickly. So, in this sense why not apply that method here in Balkan region and give instructions to people of different ages and start making payments and transactions without having cash in our pockets. But, there is a doubt that the main burden here is the category of old people. In fact, they are afraid that they are cheated or someone will steal their money, another thing is that they don't trust the action if they do not see the money or don't touch it, they have a perception that there no money is there. The second issue to be tackled here is the security part which is stressful until your mobile shows the statement "your transaction is completed/done" Then comes the time to be relieved and be on the safe side that the payment was completed and enjoy it.

Objectives

Main objective of the thesis is to do the research for micropayment technology, the way it works and how to be improved, to deliver a good/simple research about micropayment for Balkan region in order to be more familiarized with the concept and encourage people not to be afraid to jump into a new technology. In addition to the research conducted in the thesis, an implementation of a micro-payment platform will be completed, both for IOS and Android users with all necessary functionalities that consumers can use by being in two main roles: either a Customer or Merchant.

Hypothesis and Research Questions

- **H1:** QR-Code technology makes purchases easier for users more than any other form of payment.

In order to verify this hypothesis there is a need to answer the following questions throughout the thesis:

  - Can people be irritated if they are not familiar with QR-Code format?

    There is no space for irritation, the process is executed faster using QR-Code than typing the data. When a consumer realizes this, he/she will be really satisfied for consuming less time. Additionally, we will try to support our main hypothesis with supportive hypothesis:

- **H2:** Security is the main attribute for the system of payments to be accepted by users.
- **H3:** A Small business can benefit from micropayment system.

By mean of raised questions and hypothesis this research will tackle few most important components related to Mobile payments: the use of QR codes as means of payments, the security components of these types of payments and the ease of payments.

In this chapter we met some of the key concepts for micropayments, and the basic structure of the thesis. We saw that the main hypothesis is to use empirical data about use of QR Code and mobile payment technologies, in Balkan region especially in Kosovo.

Chapter 2. Literature Review

This chapter contains review of certain articles that deal with some attributes of micropayments systems like: software architectures, security, mobile payment methods, mobile acceptance of the system, QR Code method to complete a payment, component interaction and so on. It is organized in a way that it starts with reviewing papers related to systems for Micro-payment transactions, existing models of acceptance, moving to Security and Protocols, the Future work initiated by researchers and it concludes with identifying research gaps.

Before moving forward, some concepts that are used in a mobile payment system are further elaborated throughout the review of existing literature.

Among others, we need to be familiarized with four key concepts of mobile systems that deal with money that (De Albuquerque, Diniz, & Cernev, 2014) explained in their paper as follows:

1. Mobile Transaction refers to any payment that is done on mobile devices and which is enabled by technology regardless whether it belongs or not to financial areas.

2. Mobile payment includes payments that are executed through digital mobility technologies, with or without the use of mobile telecommunications.

3. Mobile Banking is related to any banking services that is performed with a mobile device, so we can follow the transactions history, account statements etc. Said in a word, most of the things that we can do physically at the bank we replace with mobile banking concerning the Mobile Payment and Mobile transaction in some services.

4. Mobile Money or just M-Money or E-Money it a digital coin equal to the money in our wallet, and in this case, it can be related with mobile wallet which is a repository that can be used to store money and the personal, credit and debit cards information. In this case, what we realize is that M-Payment, M-Banking and M-Money can be under the umbrella of M-Transaction due to the fact that three concepts deal with transactions.

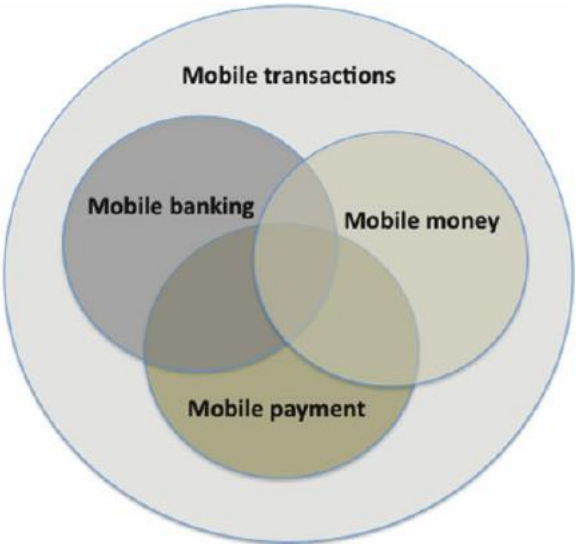


Figure 1 Relationship between the main terms used in the field of financial transactions via mobile devices - adapted from Cernev (2010).

Back to the authors (Ali, Clark, & Patrick, 2017), they also mentioned four key properties in a micropayment that should be considered during system development: Anonymity, Security, Unlinkability and the Untraceability.

- **Anonymity** is a sensitive property, which assures the customer that his information is not public but strong anonymity can bring the issue of money laundering so in that case would be good that anonymity is not performed completely between customer and the bank.

- **Security** is the second property that is mentioned in this article, while (Isern-Deyà, Rotger, Payeras-Capellà, & Puigserver, 2012) put anonymity under security requirements together with Unlinkability and Untraceability**.**

Unlinkability has to do with not supporting the option to link the transfer with the user who did that, so again, in this case, the user needs to stay anonym, and

Untraceability is the property, which does not allow tracing the past and current transactions of the user in the system.

In their paper, the authors added also three properties as Functional features: **Low Transactional cost, Lower Limit and Financial risk, which** they found as crucial for defining and developing the micropayment system. . The third one is **Transferability** which should assure us that the money will move around the stakeholders with no interruptions or any

other issue. The fourth one which is mentioned as one of the main properties is **Payment Method** which is sub-divided in two ways: *Post-Paid* and *Pre-Paid*. There is not any big difference among them, it just a matter of preferences which one to use in a mobile payments system. .

As for the payments initiations, according to (Párhonyi, Quartel, Pras, & Nieuwenhuis, 2005) there are three types of them:

1. Payer Initiated payment - in this scenario is the buyer who initiates when to perform the payment on a micropayment system.

2. *Payee initiated payment* - which is not widespread and can hardly find a system on this method where the vendor initiates the payment in the system.

3. *Jointly initiated payment* - happens in which case both (buyer and the vendor) initiate the same payment.

Based on the above- mentioned properties and regardless the type of payment system in a word, the system must be able to move value from one party to another including processing and settling the payment, providing a standard that the buyer and merchant on that system agree to. In line with this, the system needs to provide merchant and the buyer the methods and instruments in order to perform the transaction (Rea, Dalinghaus, Nelms, & Maurer, 2017).

Related to this, (Sherman, 2014) in his article says that performing a payment transaction through mobile device costs less than with a branch or using ATM.

Bank Channel	Simple transaction cost (US$)
Branch	1.34
ATM	0.16
Call center	0.13

Mobile	0.10

Table 1 Transaction costs for different bank channels (Sherman 2014)

Systems for Micro-payment transactions

Sometimes typing on phone can be really annoying, it happened to everyone to press the wrong letter on mobile keyboard, so luckily that there are other solutions to avoid typing and not only for the error typing reason but also for faster processing. One of the solutions is processing QR Code, which can populate the text fields by just scanning it. (De, Dey, Mankar, & Mukherjea, 2015) compared text base services with those that use QR Code. The study was applied to 46 participants (11 female and 37 male) which were grouped two a non-literate people who could just read the numbers on the screen and the semi-literate ones who had basic knowledge in English and are literate. All they had to do was to put the 10-digits of merchant's number, amount and the PIN and scan the QR Code on Android OS. And the results showed that the people would rather prefer QR Code instead of Text based system. Another indicator of this result was the time consuming which is less for QR Code than Text Based. Figure 2 shows that people with prior experiences on smart phones in typing on keyboard can complete the task faster than the people with no experience, which is logical. But on the other hand, there is not a big difference on time for the people with experience or not using QR code.

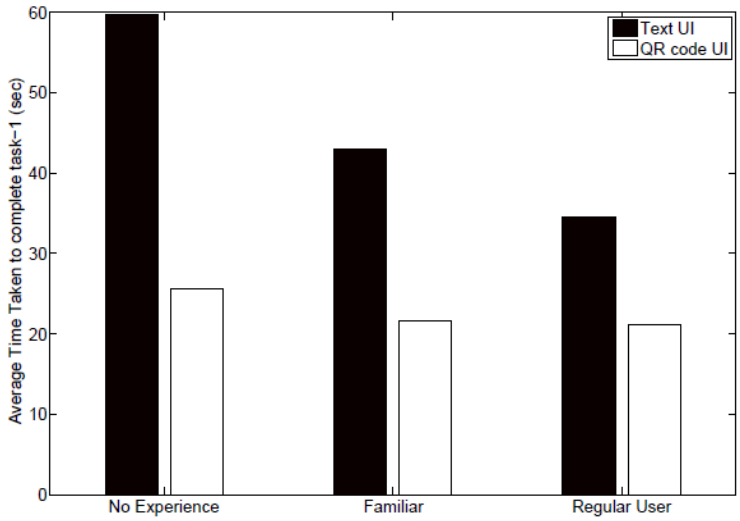


Figure 2 Experience of smartphone affects user response in text UI more significantly than in QR code UI [(De, Dey, Mankar, & Mukherjea, 2015)]

One of the mobile apps that use the QR Code feature for “Quick” payments instead of texting is WeChat Wallet which is very popular in China including payments for utility bills and other municipal services. According to (Lee, 2018), in the year 2018, WeChat Pay used to have 8000 million users that handled transactions in 13 different currencies. All that people need to do is to learn how to use the phone to scan the code on shops, which is easy to learn, so with something that can be learned in 10min max, the time can be saved for each purchase. This issue was raised among many experts which is shown in the following case. (Kow, Gui, & Cheng, 2017) argue that QR codes payment are good for small and frequent payments, by saving time for exchanging the coins and the sellers can focus more on work than on counting the payment or the change.

Figure 3 A WeChat Wallet QR code card, (Kow, Gui, & Cheng, 2017)

There are three key stakeholders in a micropayment system: Customer, Vendor and the Broker or Financial Institution. To have the job at the best completed, they need to interact and there are some ways that these stakeholders interact with each other. One model is NetPay, described by (Dai & Grundy, 2002), when customers can buy e-coins from a broker that are saved in an e-wallet and can be spent for micro-payments to a vendor, (the interaction between stakeholders is described in details on Figure 4). That time they had to communicate different parts of the system and for this purpose, they used Common Object Request Broker Architecture (CORBA) framework, which was proper for the time being, but we can say that for nowadays implementation it is an old way of communication to use CORBA.

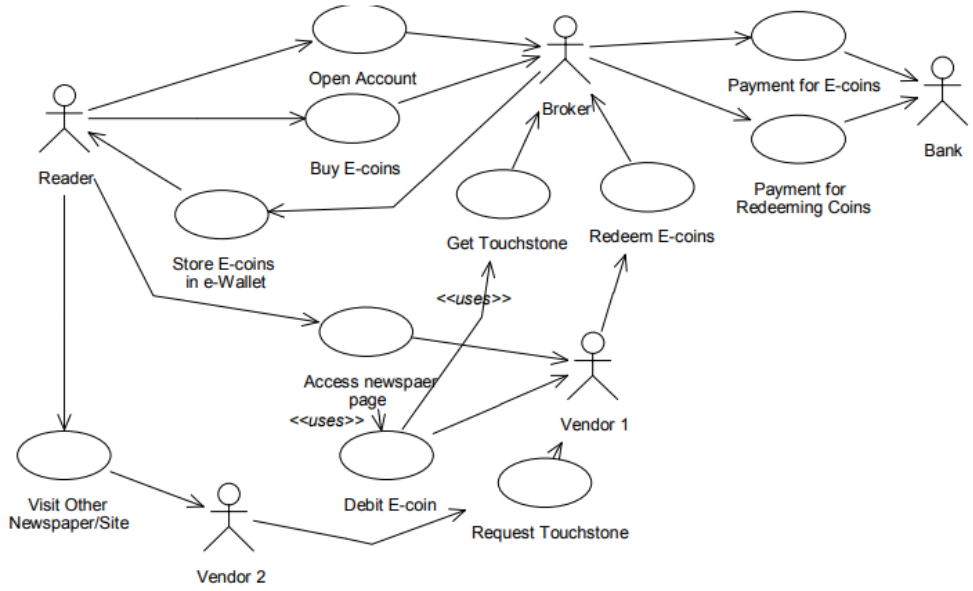


Figure 4 NetPay Component Interactions, (Dai & Grundy, 2002),

(Huang, et al., 2016) Designed and developed a newer system like NetPay, called Mobile and Electronic NetPay (M&E-NetPay), which is found more effective and can be used on both platforms: Mobile and Web. This was developed on .NET and as a replacement of CORBA Based; it uses Web Services in XML format and Simple Object Access Protocol (SOAP). This system has its components in three servers: *Web Server* which deploys the applications of broker and vendors. *Application Server* contains the Business logic of the system and web services and is as a middleware between Web Server and Database Server and the last one *Database Server,* which manages and stores the required data and information (figure 5).

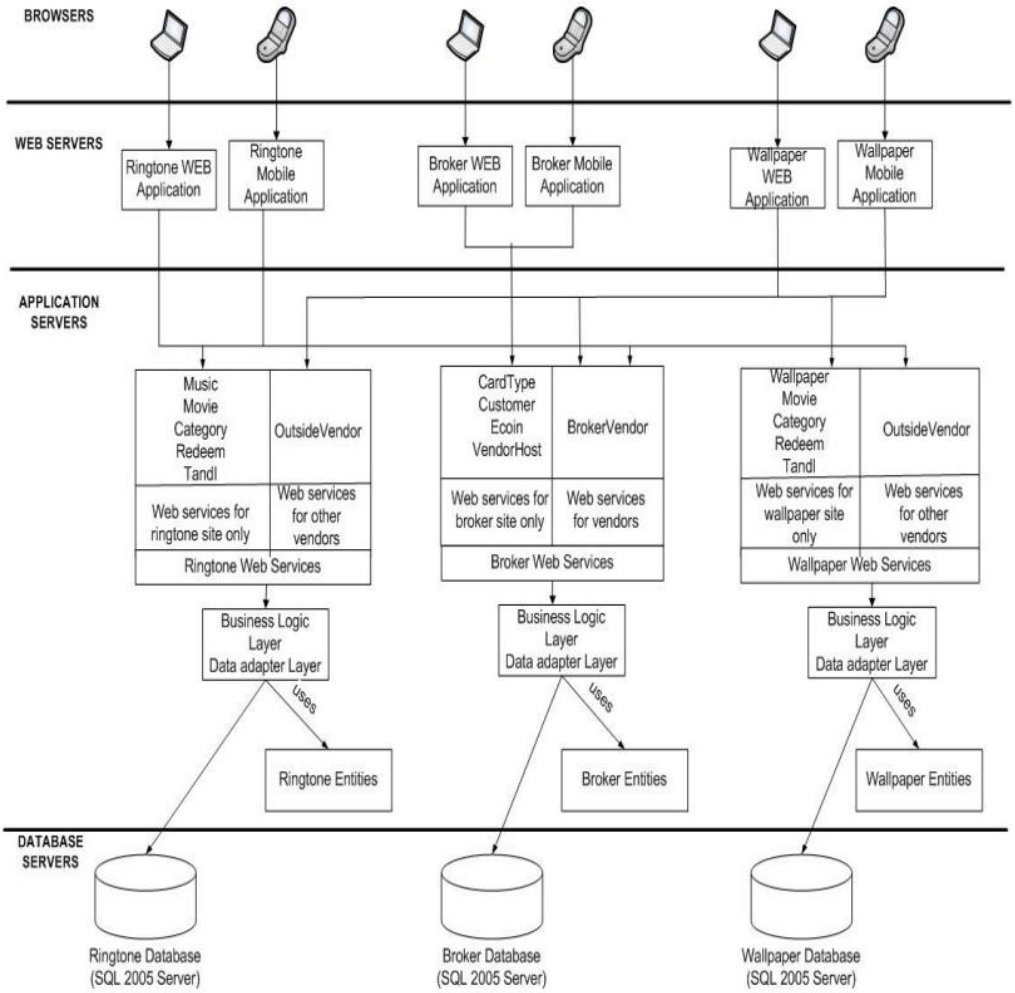


Figure 5 Software Application architecture for M&E-NetPay, (Huang, et al., 2016),

M&E-NetPay system is implemented in pre-paid method and there are two forms of payments between stakeholders. The first is when the client sends the request to the broker for e-coins in which case he performs macro-transaction because of buying lot of e-coins at once. Moreover, when he pays to the vendor with e-coins, so in this case he performs micro-transactions. In this case, the Client and the Vendor should have same broker in order to manipulate with e-coins.

Another solution with set of protocols is NetBill. (Sirbu & Tygar, 1995) defines Netbill as "*a business model, set of protocols, and software implementation for commerce in information goods and other network delivered services. It has very low transaction costs for micropayments (around 1¢ for a 10¢ item), protects the privacy of the transaction, and is highly scalable"*. Of special interest is our new certified delivery mechanism, which delivers information goods only if the customer has paid for them otherwise the delivery cannot be

completed. Therefore, for a successful transaction with NetBill, eight steps need to be followed.

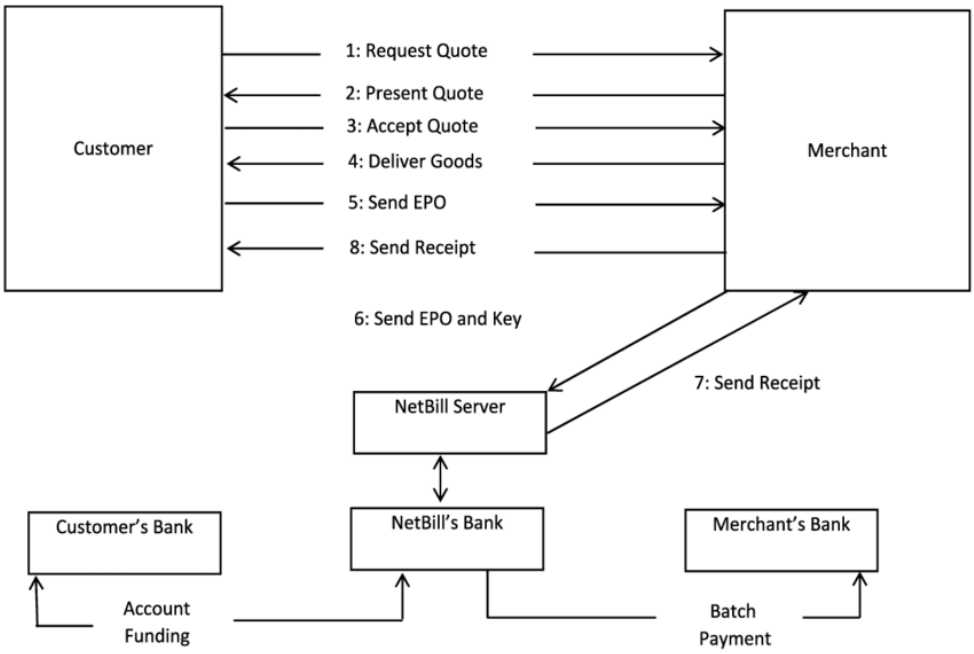


Figure 6 NetBill payment protocol, (AL Saqqar, Bentahar, Sultan, & El-Menshawy, 2014)

Here I am going to describe the NetBill transaction from the very first step- both the customer and merchant authenticate each other using a public-key certificate. After that, the customer requests a quote from the merchant. The merchant sends the quote to the customer. If the customer accepts the quote, then the merchant sends the digital information (delivers the goods) encrypted and withholds the key. The customer constructs an electronic payment order (EPO) including a description for the received goods to the merchant. The merchant verifies the EPO and sends it to the NetBill server. The NetBill server checks the customer bank account and credits the payment on the merchant account. Then, a receipt including the key to decrypt the goods is sent to the merchant first and then to the customer. Finally, the customer decrypts the purchased information after receiving the key with the receipt (AL Saqqar, Bentahar, Sultan, & El-Menshawy, 2014). In the description we can see direct communication which is developed between participants, the customer and the merchant. It is also noticed that there are many exchanged messages between participants, which can be considered as a disadvantage of the NetBill. Apart from the fact that there are many messages the NetBill is very secure due to the fact that the messages are encrypted.

Not all mobile payment systems work the same on different societies or countries. According to (Kow, Gui, & Cheng, 2017), same system that was developed in Switzerland failed to take the lead and spread among the Swiss population. They claimed that money changes "the form" by four properties: *allocation, timing, uses and quantity. In this regard* the system designers need to have answers for *actors* – who is participating in a transaction, *the context* – where the transaction will happen, *representation* – how or the way the money will be represented, *quantity* – how much money is in a transaction between payer and the payee*, Flow* – the flow of money between payer and the payee and *Timing* – when the transaction is going to happen.

Models of acceptance

Technology acceptance theories and models has been developed in many *sub-theories* and is used depending on the way, which people consider as a right path to follow in order to understand how user will interact by accepting and using the technology. On one hand (Orè & Rodriguez, 2017) studied and compared 10 models by applying and adapting the model in four steps:

1. Identifying Models of Human behavior where they identified the existing models of human behavior and the variables of each of models.

2. Establish selection criteria based on research – is the criteria that can help with preparing the analyses of each models.

3. Perform comparative analysis of the models based on the criteria, which were prepared in step 2.

4. Select the model according to the research based on result on step 3.

The model which has met all the criteria is Technology Acceptance Model (TAM) which is also described in earlier papers. For the first, it was described in 1989. According to (Davis, 1989) there are many variables that may influence to use (TAM). Among them there are two more important:

The **Perceived usefulness (PU):** which the author defines as:" the degree to which a person believes that using a particular system would enhance his or her job performance"[).] And the

Perceived ease-of-use (PEOU): this one the author defines as: "the degree to which a person believes that using a particular system would be free from effort"), TAM at the early stages suggested that the behavioral intention to use a new technology depends on its perceived usefulness and its perceived ease of use (Venkatesh, Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model, 2000). On the other hand, (Oliveira, Thomas, Baptista, & Campos, 2016) suggested another way of choosing the model acceptance by combining the models - *Unified theory of acceptance and use of technology (UTAUT2).* This is one of the suggested model which is characterized by performance expectancy, effort expectancy, social influence and facilitating conditions. Later on (Venkatesh, Thong, & Xu, 2012) added three more characteristics: hedonic motivation, price value and the habit. The other model is Diffusion of innovations (DOI) which relies on innovation as a focal characteristic of this model. The third one that is added in this article above is the *perceived security, which* deals with how clients feel secure about using the technology. Related to perceived security (George, 2002) in his article mentions that the Information Security as one of the biggest obstacles that prevents users to accept the e-commerce. The last feature is *Users intention to* recommend *mobile payment technology.* Based on the analyses in this article that this combination of models can be useful without some of the mentioned variables above and found in the paper form Venkatesh, Thong, & Xu, we can start from the principle “unity is the power”. In line with this, I can agree that by combining models and adding or removing some of the variables we can earn a new model. This model should be more efficient and should be adapted easily in micropayment system or any other system, especially where we add the security as a function, which is a core thing where people deal with money in any form.

Security and Protocols

Most of the people want to be secure when they have money on their pockets and want to spend those at a mall, so the feeling that our money is secure removes us a big fret from our head. The same thing happens when we perform a payment on internet. No matter if it is performed on Web or Mobile app, this kind of payment should be executed with the validation that means the user who is doing the payment is an authorized person to use the payment information to perform this task. Moreover, this can be achieved by doing some authentications before the money is gone from the wallet. Related to this, (Cha, Lee, Park,

Lee, & Ji, 2015) classified authentication in three major basic authentication technology: possession, knowledge and property. There is another authentication factor, which includes location information by using GPS service and check the history of the valid locations from where the user did the purchases from his mobile phone. Therefore, security is not always enough, but we have to be sure at least we have precautions for preventing the attacks from them who want our information. Therefore, based to that, in order to be on the safe side instead of using only one authentication we can combine two of the authentication models mentioned above, for instance we can use knowledge-based authentication by using a password and feature based authentication by using the fingerprint. According to International Telecommunication Union (ITU), which published a standard ITU-T X.1158 that describes a need for multi authentication factor and the risk of using single authentication. Therefore, it is considered that multi authentication factors are the way to go forward. In order to use multi authentication we need to check the criteria if we can support it, and according to Telecommunication standardization sector of International Telecommunication Union (ITU), (ITU-T, 2014), the following criteria should be used to select the specific type of multi-factor authentication mechanisms used by the Relying Party (RP) and the service provider:

• The desired level of entity authentication assurance (EAA);

• The Mobile technology is an enormous potential for researching solutions in security, but there is a need to be aware for mobile capacity and capability to perform these authentication. for instance, not all the users have their mobiles with finger print feature therefore we need to check what to do in that case, maybe we need to allow the user to disable the multi authentication function and leave the user with the risk to use only the password, or allow the user to choose two models that he wants to use on multi authentication model and in this case we need to check again the mobile capabilities to use those two models-residual risk after applying multi-factor authentication mechanisms;

• The complexity in implementation of authentication mechanisms (e.g., computing power and speed, maturity of technology, scalability of technology);

• The practicability of the multi-factor authentication methods (i.e., difficult update of credential and key distribution);

• The assumption underlying the authentication solution; and

• The authentication failure rates.

(Schwartz, 2016) Recommends a new protocol for micropayments in web called Interledger Protocol (ILP), which is easy to implement and use on web technology and the author calls it as protocol of the web, for the web. This protocol is beneficial for all stakeholders in a micropayment system (customers, merchants, banks) through ILP APIs or Libraries. ILP is an open payment protocol for payments across different payment network that is being developed in the W3C Interledger community Group.

Future work

Most of these papers raise new questions, give new ideas for the future of Micropayment systems. These ideas might be used in the future and be developed even further, until we get the answers. From the review of the articles that are mentioned above, we have parts for software architectures, security, mobile payment methods, mobile acceptance of the system, QR Code method for performing a payment and the component interaction.

Research gaps

During the literature review of the research and technical papers that were written by scholars, it is noticed that not all things are covered in those papers and noticed that there are some questions left unanswered. Based on the literature review conducted, there are some gaps that are worth to be mentioned in following paragraphs:

Which payment method to use? We saw that there are many systems that use pre-paid method for payments, but also noticed, that there are also many systems that use post-paid method, so in this case could not figure out if one of the methods is more advanced than the other and why use that one! Which of them has less financial risk or any other weakness that can affect the system that we will develop?

Interconnection between parts of the system! How we should implement this part, surely that the CORBA method is not preferred anymore as it is considered as outdated method. Should we continue with Web Services using SOAP messages or what if we start to communicate in JSON format instead?

Statistics? Some of the researches had statistics and surveys from different countries, but never saw that any of those was dealing with “Balkan Countries” (Albania, Kosovo, Macedonia, Montenegro, Serbia, Bosnia and Herzegovina, Croatia, Greece). Is there any system that was developed in these countries? Or how is the percentage of the population that performs any micropayment? And which system they prefer? However, I assume which system will be used, based on the surveys that were developed during this time that I worked on this thesis.

Identified research gap

As part of this thesis, the plan is to propose a new micropayment system by adapting some of the parts mentioned above and the comparison of the existing systems with the new one. In addition to the conceptual solution, the plans are to implement a prototype platform using .NET technology for Web and Mobile, which would practically show and run the proposed approach.

We saw some of the key parts of the micropayment system by reviewing research papers for every part, like implementation of the micropayments systems taking some examples that were developed in almost each continent. In addition, we touched the security part of the system, which considered being crucial part `for widespread use. We saw also, what is missing in those papers and what we should be focusing during the thesis - about payment methods and statistics. There are so many parts that are covered above, which will be decomposed in the following chapters.

Chapter 3. Research Methodology

Based on chapter 2 findings, and for the purpose of conduct the research, the following research methods are to be used: Analytical method; empirical method; comparative methods; historical method.

Scientific research requires careful steps to reach a desired outcome, goals and the ultimate goal. To achieve these, it is of great importance to choose the right methodology. It is exactly what leads to the desired result. There are authors who argue that research should awaken a sense of pleasure – enjoyment and creativity, (Marczyk, DeMatteo, & Festinger, 2005).

One of the main methodologies used in this thesis is analytical methodology. Through the analytical method that I used in the course of the text, starting from the elaboration of the used literature to the argumentation of the theses of this paper, aimed to analyze all the theories, data, examples and programs given which would help achieve the final result. This method is the key one used in this thesis. Except of analyzing the micropayment systems that are already in use worldwide, we will analyze payment methods: prepaid or postpaid in order to define which method is better than the other one by analyzing advantages and disadvantages for each method. We will analyze also the mobile wallet system, which is being used a lot nowadays.

Like analytic, also comparative method is used mostly in implementation design of other systems and payment methods. Comparative methods can be used among the systems that are mentioned in previous chapter, like comparing Netpay with Netbill or with Paypal, answering questions if we need to use a broker or a service provider or be a provider where the customer uses our system for an e-commerce platform?! Or is it better to use e-coins and a mobile wallet or only a prepaid system?!

If you are a person that keeps leather wallet wherever you go, you will not have a problem to hold an electronic wallet in your smart phone. According to (Pahva, 2019) E-Wallet is a form of pre-paid account where you store money first and then you can make transaction in both forms online and offline. We must mention that like Credit Cards, we can use Mobile Wallets only with the merchants that accept that kind of wallet. It can be that if you have a mobile

wallet with you, you don't need a leather wallet anymore! You can store all credit cards on mobile wallet, and you don't need to keep those cards. (Worldpay, 2019) that eWallets accounted for 3% of US in-store spend in 2018 and that will be 7% in 2022. From what is described and according to statistics one day the eWallet will replace leather wallet and no need to carry on money or credit cards.

In the above text we mentioned that there two mayor types for payment methods in a micropayment system which can also be found in a non-micropayment system and those are prepaid and postpaid methods. Worth to mention that direct payment can be found on a micropayment system but not in a micropayment because if that would be accepted in a micropayment then we will not have any reason to distinguish those.

There are other methods too that derived from the above ones which we can implement in our system. Whether we use prepaid or postpaid method, we can make the payment with a credit card by allowing the customer to enter the card details in our system, which undoubtedly are safe secured, and hold the details encrypted. But we can also add another method in our system, that is the Mobile Wallet so that we can register a credit card there in order to charge the card after a certain period of time or the sum that is spent which makes us to use the postpaid method or the other way round, top up our wallet through credit card and then spent the money that we have on our wallet, so this method is the prepaid one. We want to compare prepaid and postpaid methods, to see which of them better solution for our system is. In other terms, we can say that prepaid method using a mobile wallet is like depositing the money in our bank account and we can spend only the amount we have and nothing more. So, for instance we have only 2 € in our wallet, and the product or service costs 2.2 €, it means that we can't buy it (figure 7). while if we use the postpaid there is no need to be worried if you have the money or not, we can buy products and pay later but of course there should be a contract or something that can assure the seller that you will pay the money later (figure 8).

There are people who prefer first to put money into system and when buy something the money will be deducted from the account. This is a *Pre-Paid* form and as a method we can see on Paypal where we can deposit an amount of money in our account and then make purchases. Another system is M-Pesa developed in Kenya where according to (Kremers &

James, 2017) in Kenya there are more mobile money accounts than bank accounts, so for Pre-paid method would be good to develop an extra feature in the system to alert the client when his wallet is running out of money (i.e. $5), we can alert him by suggesting him to refill his account so he will have money there to make purchases. In addition, the other form is if we want first to buy goods and services and then after a certain period or the chosen date we will be billed for what we have spent during that range. This *Post-Paid* method we can find when we use Ads/Boost on Facebook.

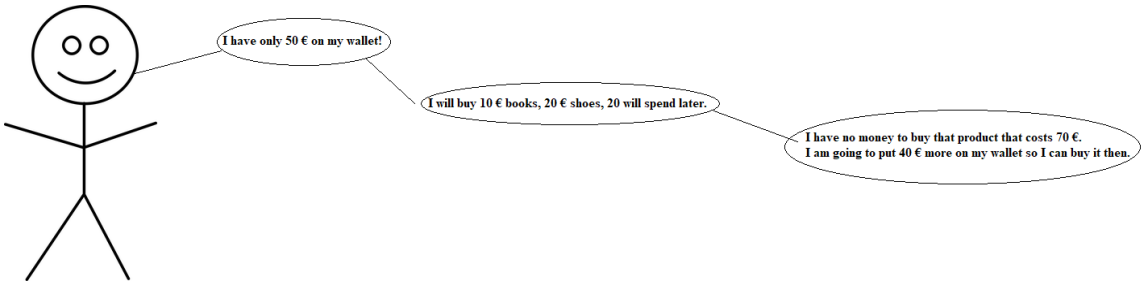


Figure 7 Prepaid method, you know how much money you have to spend

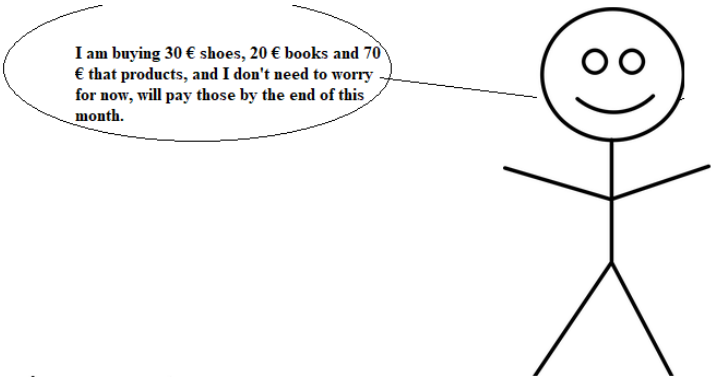


Figure 8 Post-paid method, you do not need to worry about the amount of money you have for the moment

Based on H1 hypothesis we have to use empirical data, empiricism in our field is inevitable, and as a method in this research finds room for the publication of data in tabular form, and not only that it has presented existing facts about the program and research. Empiricism in this paper also includes a part of the statistical method. For instance, Figure 2 related to H1, according to it the people can perform a task faster with QR code than writing a form to make a payment. Apart of Figure 2, in order to prove H1 hypothesis, there will be two surveys

(Appendix C & E). The first one will be for customers who want to use the system for buying goods or services and the other survey is for merchants – for them who want to sell goods or services using a micropayment system. Except of covering H1 hypothesis, surveys also try to prove H2 hypothesis, by making questions how much secure or safe do people feel by using the micropayment system. On quantitative method that we used with the surveys, we used questions with multiple choices where we asked about the age, gender, experiences with mobile payment, if they feel secure about mobile payments, if they use QR Code and if they prefer QR Code instead the text typing. The surveys are conducted mostly online, but concerning the survey with merchants, we found more effective by doing the survey in person and they responded more quickly. The survey targeted people from Kosovo of above 18 years old but there is no one participating in the survey that is older than 60. There were 54 females and 40 males. It took only two or three minutes to fill the survey, but usually merchants didn't have time to check their mails, so we mostly used in person for this category, all the surveys are filled anonymously. A customer was defined as a person who will buy goods or services online through mobile and a merchant was defined as the person who owns a physical store and wants to sell goods or services online. 94 (ninety-four) responses of the survey come from customers. There were some optional questions in the survey and customers ignored to respond. As for merchants, there were 51 responses, still with some optional questions.

The historical method, even which is not a core methodology for our topic and is one of the shortened but worth to mention it helps us to sketch the way things have used to be earlier so that we can explain the evolution of the program and the theories that have led to this program.

In order to make my thesis more arguing you will find a treatment that goes from the general review of the theories to a particular one in the entire narrative of the work. Therefore, in this sense, the deductive and the inductive method find a space in the research. In most cases, they are found used together with the analytical method. As for this method, generally I will treat researches from different authors who correspond with my theses, in which case through this preview of the case, we will be able to develop specific thesis raised, as I go on the top of literature review from defining the key elements in a mobile payment system to the examples of a system.

All the methods together are found based on the need of the topic we have addressed, therefore, none of the methods can be assigned to any specifically addressed chapter or theme. Excluding the empirical method that has an important place to construct one of the main hypotheses, also the feature for using and analyzing the empirical data.

Two methodologies that are used and will be used in following chapters are analytic and empirical methodologies. Most of the researches that are mentioned in Chapter 2 deal with analyzing of systems and parts of the systems while the empirical one is used to see how a micropayment system can be accepted in Kosovo if we create one system for them that is described in following chapters.

Chapter 4. Research findings

After many papers that are read and finding the gaps from those papers, we will mention our findings only for three main methods that we used: Analytics, comparative and empirical.

First findings concerning the analytic and comparative methodologies are related to payment methods: Prepaid and Postpaid payment methods, also for mobile wallet.

Advantages and disadvantages of prepaid

One advantage that is worth to be mentioned is that customer has more control on how much money he spends, because he spends the entire amount he has. According to (Kokko, 2000), customers have anonymity feature when they use prepaid method but on prepaid it is very difficult to trace and maintain customer loyalty.

As we mentioned when we were comparing these methods, what something costs more than we have on our wallet?! And that has been sold while you were adding money on your wallet. So, this can be considered as a disadvantage but also, we mentioned that you have a limitation that sometime can be a good thing.

According to (Mennen, 2005) the main benefit of post-paid method is that you don't need to care about credit balance, so usually if you don't send any limit you can spend as much as you can.

However, as usually, one thing can be good for a stakeholder but for the other one not. In the above mentioned case, this might be a good solution for the broker but not that good for the customer on postpaid method, so if the customer does not have any limitation for spending, then he will be less worried about the spending and he will spend more than he planned and he can be furious, but the broker may be happy because he can get a fee for every transaction that customer made.

With the postpaid method, customer usually don't need to care to check if the payment day approaches or expires because most of systems will get the money from his account automatically, so this is a good thing not to worry about. However, what if the customer bought many products or services and the payment day arrived and you don't have money

his account?! That would be a bad situation for the provider especially in cases if you gave fake information while registering or you entered a stolen credit card for payment or might be that you closed that account. In these cases the provider isn't safe and loses a lot.

In our app, the customer can save a credit card or PayPal account, and "*withdraw*" money, but putting in his wallet in our app, and then he can use his budget for buying goods. It works with a merchant; only that he will save his credit card and transfer the money from his wallet in our app. The wallet in our mobile bank is used to save the credit cards, paypal account etc and transfer the money back and forth.

Another finding is about one of the largest and widespread system M-Pesa, which started to be used in Kenya but now operates in more than 10 countries. One thing worth to mention is the risk of the system that can be adopted in one country but in another not, which disables the transfer to be performed. In chapter 2 we saw how the system failed in Switzerland. Same for M-Pesa in Albania which has operated since 2015 which means , which means for two years, but it's shut down and became nonfunctional in 2017 (Macharia, 2017).

Second finding related to the survey (empirical) is related to the first two our hypothesis (H1 and H2), which state that QR Code technology performs faster than any other of methods of filling data in a payment method, also the second hypothesis according to which the security is core attribute in order that the system to be accepted by people. Figure 2 in Chapter 2 shows that people prefer more QR Code technology and they think that this is faster way than filling the textbox with their data. Same results result from our survey in which case out of 96 people who filled the survey as customers, 76 responded to the question: *Do you believe it is easier to scan a QR Code and fill in the fields automatically, or fill in the required fields in typing by phone?* They answered as follows: 41 people said that they prefer QR Code, 11 said that they prefer to type the data and 24 said that they do not mind which form they use, it is important to complete the transaction regardless the way performed. (Figure 9). In addition, out of 96 (ninety-six) there are 92 people who responded to the question if they ever used the QR Code technology, in which case 35 said that they never used it and 57 said that they used the QR Code technology (figure 10). The complete questions and the results of the surveys are amended to Appendix section.

Based on the results of our survey we can say that we support our H1 hypothesis that users would prefer QR Code more than typing in a mobile platform.

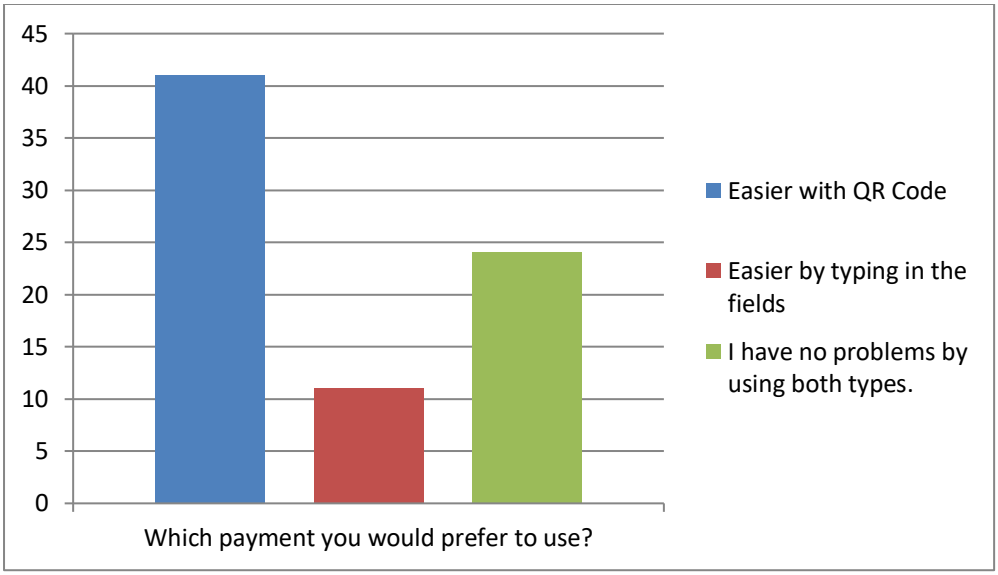


Figure 9 Chart is showing which form is easier to use in a mobile payment

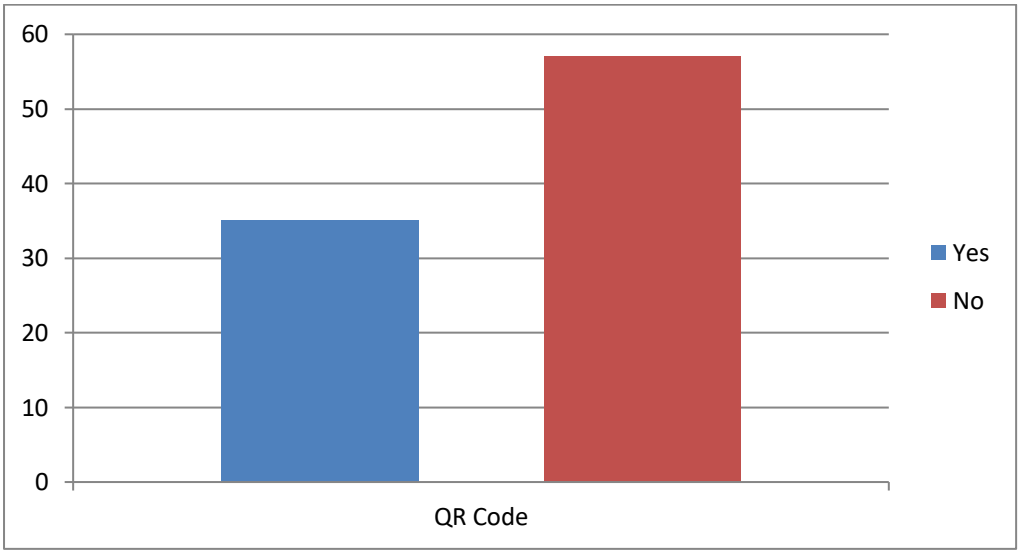


Figure 10 Chart showing how many participants used the QR Code

There was also a question related to H2 hypothesis, and the question is about why they didn't perform any mobile payment, and if that has to do with feeling secure and safe by using a mobile payment platform, 43 participants responded to this question, out of which 16 said that they don't feel secure by using any mobile payment platform (figure 11). According to

the result, concerning this question there is also another non-defined reason from 16 people who did not make any payment through mobile.

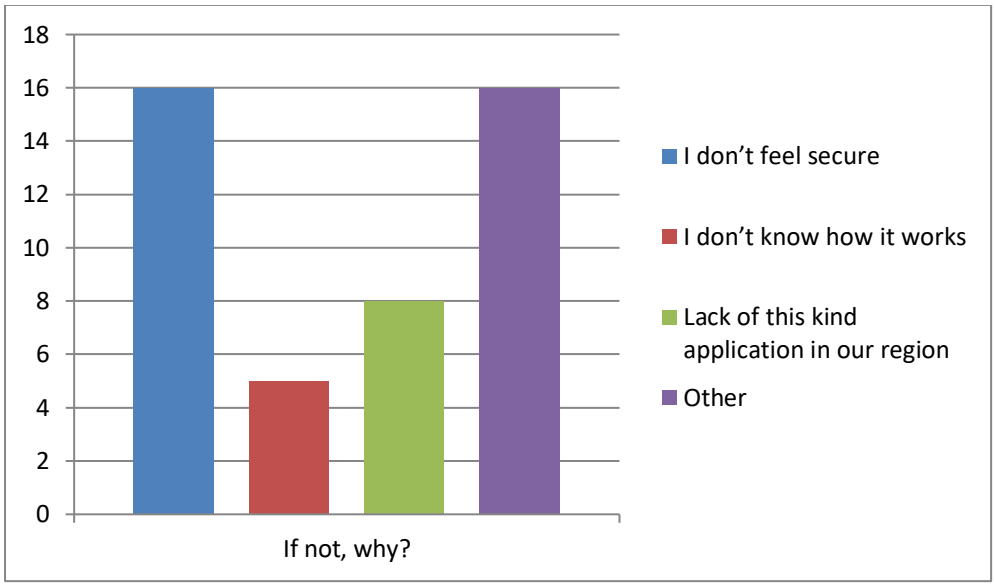


Figure 11 Chart showing why they did not make any mobile payment

It is not just the customers that prefer the QR Code system, we have almost the same result from the merchants that participated in the survey (51 in total). Majority were pro the QR Code system instead of any other form to make a payment (Figure 14), 27 of them said the QR Code is easier system than other forms, but also 12 said that they don't mind the form of performing the payment. The main difference that we can say between the customer and the merchant response is that the reason why they don't perform any mobile or online payment is because of lack of information for that method and that their clients prefer mostly to pay only by cash (Figure 15 and 16).

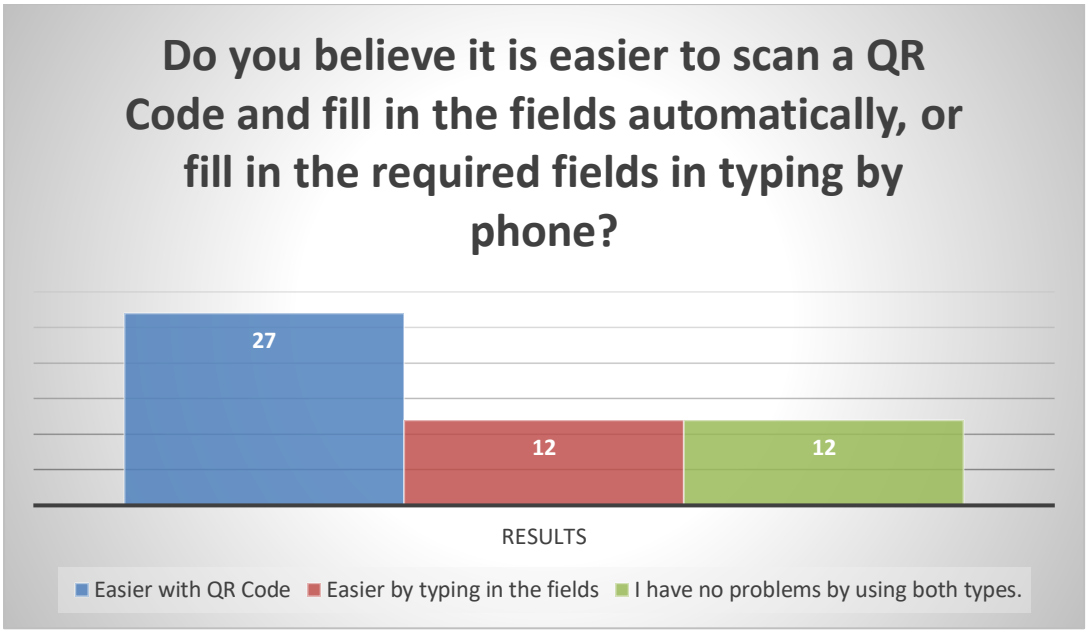


Figure 12 Question to merchants regarding the QR Code system

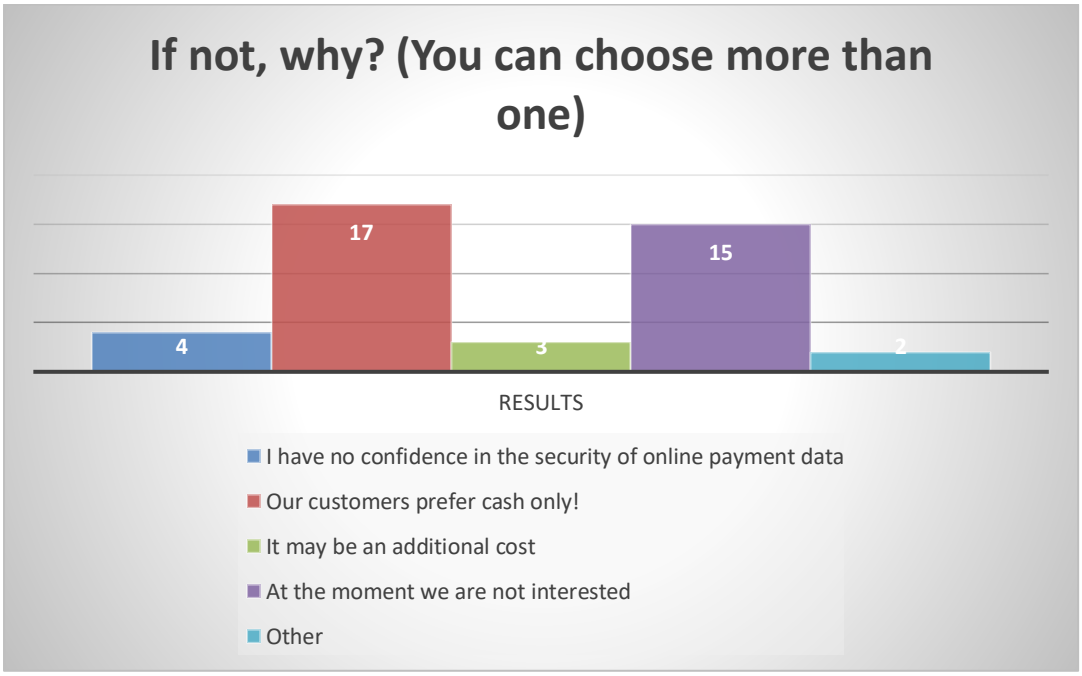


Figure 13 Question to merchants regarding, why they do not use mobile or online payment

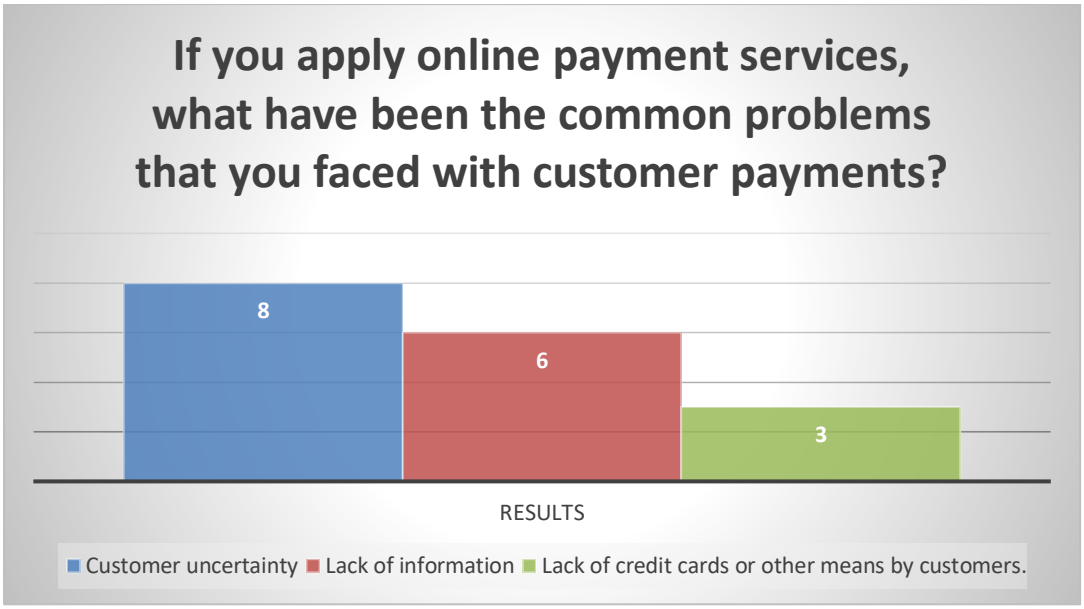


Figure 14 Question to merchants regarding to what common problems they face for online payments

The three main methods that are used and explained in this chapter and those that helped us to define the thesis not mentioning too much the implementation. Third finding related to historical data and all the above mentioned will result in new implementation of a micropayment system, where the stakeholders and some parts of the implementation are defined as systems earlier described (Paypal, M-Pesa, NetBill etc). The newer technology and all the details of its implementation are described in the following chapter. One of the newest technologies that is used in mobile and web app is Firabase, which is owned by Google and has more than 15 products that help developers for improvement and better developing app. For our system, two products that would help are Cloud Firestore (that plays role in a database) and Authentication. Other technologies that are not mentioned in implementation of above systems are No Sql Db and consuming the web services with REST APIs.

Chapter 5. Implementation

Implementing a micropayment system is not that easy, or we can say that is much harder to implement it than a mobile payment system that deals with macropayment. The reason for this is that micropayment entails in the macropayment system also. This chapter defines also the target users by defining categories, experience and the age also define the tools that are needed to create the system, user requirements and use cases. By the end we also describe prototypes which will be amended in appendix section.

Problem space

Context

Smartphones are becoming more and more necessary to be used for payments whether being an individual or a company. People who want to make a payment, especially a micropayment through phones are having doubts because of high fees, security issues and the usability of a complex app.

A kind of solution will help people to make a payment fast and secure with low fee and the finally will be easy to use. Low fees can be a crucial thing, because customers don't pay any fee if they pay with cash, so why they do need to use our application?! They always will compare the application system with cash flow (Pras, Párhonyi, & Nieuwenhuis, 2005). If someone steals, your credit card data or you go to a small shop that does not have any Point of Sale terminal because of high processing fees, which is not worth of having it for a small business or even to pay for that credit card reader and its maintenance. These fees can be Transactional, Scheduled, and Incidental (Ebrahimi, 2018). Therefore, we need to take advantage of the recent advances in technology to bring new exciting solutions to people who want to make micropayments and for merchants that are happy with app/transaction fees.

Use

The plan is first to design an application that creates solutions for people and businesses that offer products with small prices. But, from this also can benefit not only small businesses, because business that use a macropayment system can process also micropayments, micropayment users are not preferred to use macropayment system because of the implementation and the fees.

People

Experience of users

- **Work Experience** – All levels
- **General Smartphone Experience** – There is no need to be an expert of using the phone, only basic knowledge is required to perform any mobile payment is preferable
- **Specific Smartphone Experience** – Using QR-Code, internet surfing, syncing phone and pc.

- **Experience with this product** – Smartphones
- **Experience with similar products** – Using PCs/laptops for surfing on web.

Category of users

- **Primary users** – Business owners who sale products with low prices and their clients that have credit cards
- **Secondary users -** Business owners who sales products with high prices
- **User communities** - The general audience that are over 18 years old
- **Excluded users** – Children, kids that are under 18 year old because they can't have a credit card

Usability

- **Easy to learn and to remember how to use**
- **Efficient**
- **Safe**
- **Recommender**

Project Product

The product for this thesis will be system built in: Xamarin Form using MS Visual Studio 2017 and Firebase database.

Assumptions

Since this project is planned to be developed during my theses, then we assume that:

1. There is enough time ahead for this project and

2. Since payment gateway cannot be implemented in Kosovo, the plan for payment gateway must be fulfilled

Dependencies

This project is not dependent on any other project.

Risk and limitations

This project should be completed by the time I finish the thesis. As the final product of the project contains the thesis and the mobile app then:

1. I should be more developed in programming.

2. The lack of a team causes difficulties to implement the project

Predictions

Effort

Me, as the only team member, will do my best with a consecutive work and develop the mobile app in next five months.

Expenses and Timing

Timing is based on my time as a master's student.

Size of deliverables

1. 10000 lines of code
2. +50 pages of thesis

Delivery Plan

1. A Thesis Project Proposal
2. Thesis and documentation
3. System Design

Project cycle

The methodology to be used in this mobile App is RAD (Rapid Application Development) due to a limited time.

Project activity

During the preparation for the thesis and the mobile app, I will have meeting with my mentor where during our meeting the milestones will be:

1. Checking the Methodology
2. Software requirements
3. System Design
4. System Development

Facilities and Tools

The technology to be used is the following:

1. MS Visual Studio 2017 – IDE
2. C# Programing Language
3. Xamarin Form mobile application
4. Firebase Database

Identifying needs & establishing requirements

Target audience and their needs

The target audience for this application will be people that want to avoid cash money and credit cards regardless whether they are customers or merchants. But also, this application is eligible to be used by all other interested people to provide them with another option to make a payment and buy goods using one of their favorite device which now days is a smartphone. For instance, a person goes for shopping, but he forgot the wallet at home with his money

and credit cards, to make his concerns easier he can pay with tis phone by scanning the QR Code, which is printed on the product.

User Requirements

The key point of a system is to know what a user requires from the system to complete a task. This chapter consists of use cases that are needed for our system. So Figure 12 shows a use case diagram for a micro payment system which includes 10 main use cases. The two stakeholders in our system are: Client and the Merchant who perform some common tasks in our system and there will be four to five different use cases for user roles. All the use cases are described in scenarios for each separate actor including the steps that she/he needs to follow in order to perform the task.

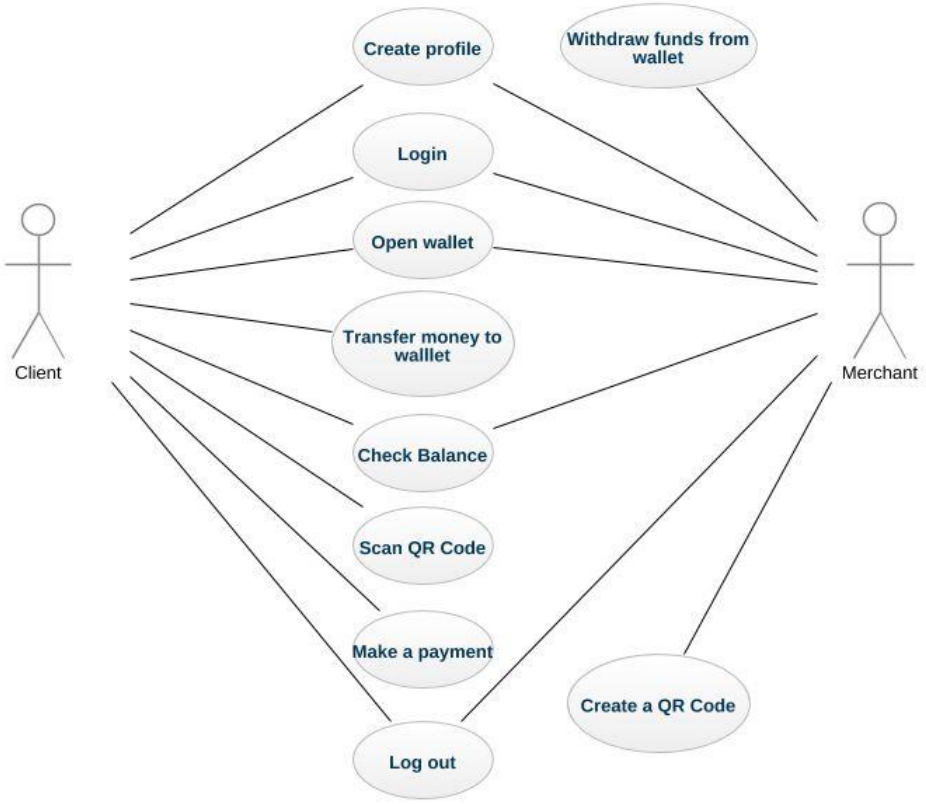


Figure 15 Use Case Diagram for Micropayment system

Use Case List

ID	User Case Name	Primary Actor	Complexity
UC-01	Create Profile		
UC-02	Login		

UC-03	Open Wallet		
UC-04	Transfer Money to wallet	Client	
UC-05	Check Balance		
UC-06	Scan QR Code	Client	
UC-07	Make a payment	Client	
UC-08	Create QR Code	Merchant	
UC-09	Withdraw funds	Merchant	
UC-10	Log out		

UC-01	
Use Case	Create Profile
Actor	Visitor
Pre-condition	No Precondition
Post-condition	
Description	1. Open the app 2. Click register 3. Fill the fields 4. Accept terms and condition 5. Click sign up
Basic flow	Successful registration
Exceptional flow	Error message, issue regarding visitor data, who is asked to provide valid information

UC-02	
Use Case	Login
Actor	Client/Merchant
Pre-condition	Already registered (existing user)
Post-condition	

Description	1. Write username and password 2. Click login
Basic flow	User enters on his dashboard
Exceptional flow	Error message, issue regarding to wrong username or password.

UC-03	
Use Case	Open Wallet
Actor	Client/Merchant
Pre-condition	Logged in
Post-condition	
Description	1. Click create wallet 2. Give a name to wallet 3. Click open wallet
Basic flow	Wallet is created
Exceptional flow	

UC-04	
Use Case	Transfer Money to wallet
Actor	Client
Pre-condition	Wallet is created
Post-condition	
Description	1. Go to wallet management 2. Click add money to wallet 3. Write credit card or Paypal details 4. Click the amount that you want to transfer 5. Confirm that
Basic flow	Funds are transferred to your wallet

Exceptional flow	Funds couldn't be transferred because wrong credit card or Paypal account

UC-05	
Use Case	Check Balance
Actor	Client/Merchant
Pre-condition	Wallet is created
Post-condition	
Description	1. Go to wallet management 2. Click Check Balance
Basic flow	You can check the balance that you have on wallet
Exceptional flow	

UC-06	
Use Case	Scan QR Code
Actor	Client
Pre-condition	Logged in
Post-condition	
Description	1. Go to your dashboard 2. Click scan a product 3. Scan QR Code
Basic flow	You should see product details
Exceptional flow	QR Code wasn't generated correctly

UC-07	
Use Case	Make a payment
Actor	Client
Pre-condition	Logged in
Post-condition	

Description	1. Go to your dashboard 2. Click scan a product 3. Scan QR Code 4. Click Pay for the product
Basic flow	Receive a confirmation that the payment is made
Exceptional flow	Insufficient funds in the wallet

UC-08	
Use Case	Create QR Code
Actor	Merchant
Pre-condition	Logged in
Post-condition	
Description	1. Go to your dashboard 2. Click create QR Code 3. Enter product title, description and the amount 4. Click create
Basic flow	A QR Code should be generated
Exceptional flow	

UC-09	
Use Case	Withdraw funds
Actor	Merchant
Pre-condition	Wallet is created
Post-condition	
Description	5. Go to wallet management 6. Link wallet with credit card or Paypal 7. Click withdraw funds 8. Confirm that

Basic flow	Wallet is linked to the Credit Card or Paypal
Exceptional flow	Wallet couldn't be linked because wrong credit card or Paypal account

UC-10	
Use Case	Log out
Actor	Client/Merchant
Pre-condition	Logged in
Post-condition	
Description	1. Go to your dashboard 2. Click Logout
Basic flow	You are now on login page
Exceptional flow	

User Flow

Above are described the use cases that are needed in the system. Figure 13 shows the way they are related to complete the task and the way the user launches the app including all the steps and decisions that she/he can make in our system. He launches the app as a visitor and needs to sign up for the role of Customer or Merchant if he is not registered yet. Otherwise, he goes to login page and enters his valid email and password, and he required a second authentication, which is needed to provide the pattern pin he added when he created the account. After that he can use all the features of the system for his role, like add or pay a product, edit his profile, transfer money to/from his account etc.

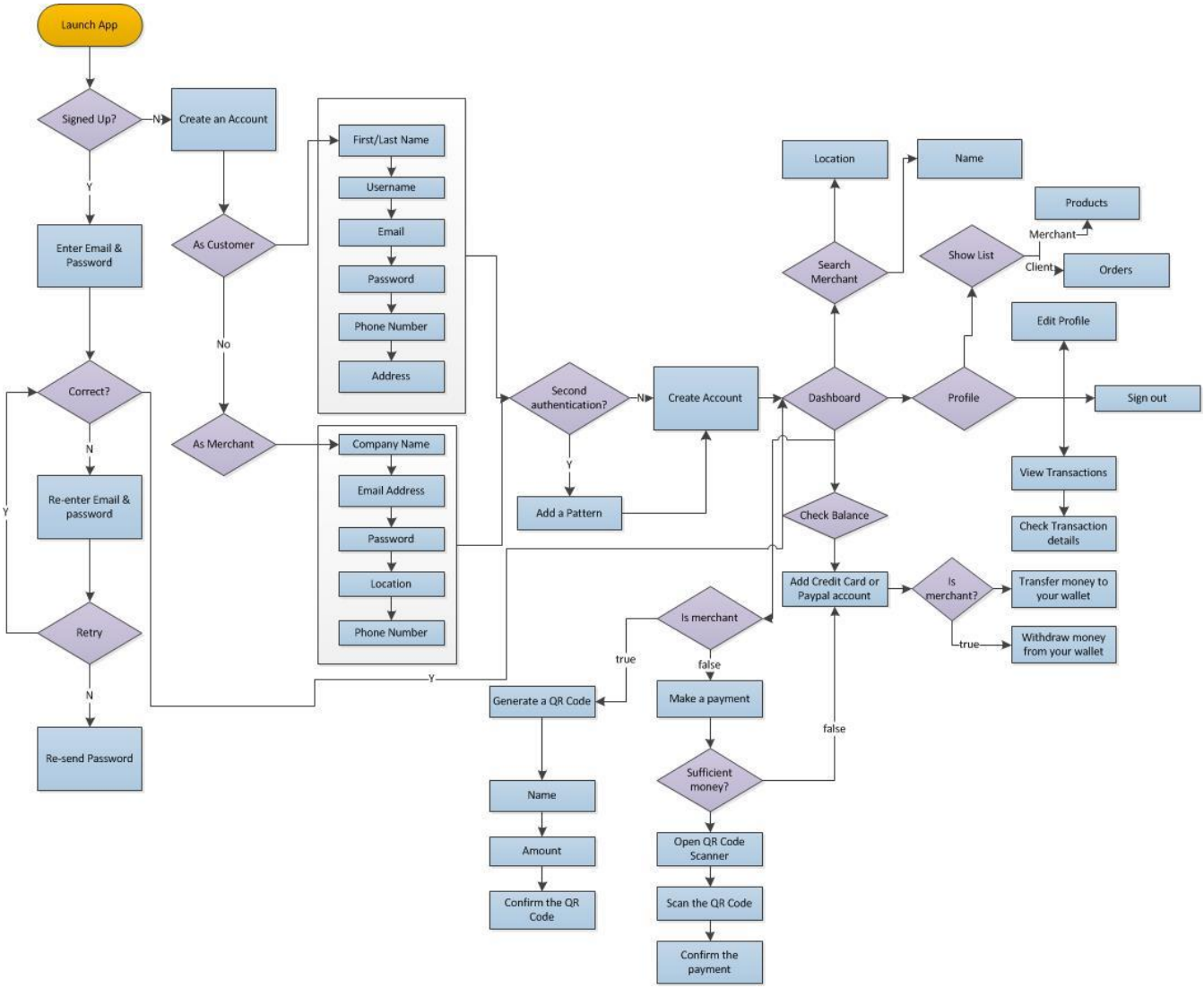


Figure 16 User's flow

Requirements

Functional Requirements

- Scalability
- Availability
- Security
- Stability
- Offers communication between merchant and bank
- Payment initiations
- System must work on both platforms Android and IOS
- Wireless access

- Real-time client-server communication

User Requirements

Merchant Requirements

- Able to login
- Able to receive money on his wallet
- Able to create QR codes for his products
- Easy- to-use interface
- Anonymity
- Security
- Withdraw money from the wallet on multiple payment method
    - Bank
    - Paypal

Customer Requirements

- Able to login
- Able to send money
- Able to pay for a product
- Able to check the balance
- Able to add money on his balance from different payment method
    - Credit card
    - Paypal
- Anonymity
- Security

Legislative Requirements

- The system should work according to the regulation on bank transactions

Security Requirements

- Confidentiality
- Two-factor Authentication
- Updating OS
- Privacy
- Trust

Design & Prototyping

Low-fidelity prototypes

Low fidelity prototypes where carried out via sketching and by utilizing paper prototyping. I have utilized our scenarios to determine what types of interface screens would be required to create the functionalities from the Use Caste list. Using these methods, the structure of the interface and navigation was determined.

Please see Appendix A to view sketches and low fidelity prototypes.

High-fidelity prototypes

The high-fidelity prototype of the Hear application was created utilizing Adobe Photoshop and basic of XAML in Xamarin. These provided a prototype that showcased interaction and the information architecture of the Mobile App while not introducing the actual functionality. Some of the UI have changed from Low-Fidelity prototypes because of the usability and simplicity.

Please see Appendix B to view screenshots of the High-Fidelity Prototype.

Chapter 6. Conclusion

In this thesis, there are some key findings, but in reality, where are findings there are also some gaps for future works. Most of the findings are from empirical data that are collected from potential customers and merchants in Kosovo region. Concerning the three hypothesis that are defined, the collected data support that: (H1) people think that QR Code technology is easier and faster than other technologies, in our case, we compared with populating the fields through typing, (H2) Main attribute for people to use a micropayment system (mobile payment in general) is security in payment transactions, if they feel secure that their data will not be compromised they are able to use the system, (H3) for this hypothesis based on analyzing of evolution of mobile payments, transaction fees and the architecture of micropayment system, we can say that small businesses benefit from this kind of systems regardless whether they use only for online shopping or also directly in the stores.

In first chapter we were informed about the Fintech technology that is surrounding us every day with more and more innovative services and some of us rely to those. Also described the objectives for the thesis by raising the hypothesis which we supported on the other chapters.

Second chapter as one of the focal chapters of our thesis gave us a clear picture for the micropayment systems by elaborating the systems in many directions like: architectural, security, model of acceptance etc. We did see also how some systems may be accepted in a region or country and can be totally the opposite in another part of the globe. This part was more analytic but it was very helpful for us to define the next chapters and to give a direction to our thesis.

Third and fourth chapters are related, the first one described all the methodology that we used for supporting our hypothesis and we had to use not only one or two methods but more then that for defending the hypothesis and touching every part of a micropayment systems, starting with analytic and historical methodologies and continuing with empirical and comparative methodologies. Empirical methodology helps us to know more closely how a microsystem will be expected in Balkan region, and how merchants and customers are willing to go towards mobile payment platforms and not only in a micropayment platform. We also have measured the usability of the QR Code system comparing with typing.

For software engineers and developers, the fifth chapter is that one that they will enjoy the most, which is full with specifications and technical descriptions for implementing a micropayment system. I believe that in this chapter there may be some gaps, so expecting that other software engineers can change or amend on this chapter.

Mobile payment systems are rapidly increasing. As the micropayment is part of it, we can claim the same thing for micropayment systems. This means that there is always a room for improvements for these systems. For instance, since September 2019, EU Payment Service Directive (PSD2) requires Strong Customer Authentication (SCA) for electronic payments (Commission, 2017), which means that they need to use at least two of three authentications elements: *Something they know* which can be password or PIN code; *Something they own* i.e. mobile phone; *Something they are* which means they have to use fingerprint or iris scan. Since our system was developed before September 2019, the system is developed with two authentications which belong in the category *something they know* (we use password and PIN pattern).

At the end we conclude that micropayment systems have a great future ahead which will help people and businesses to do business whether it will be B2B, B2C or C2C at low costs and maybe why not to live in a cashless world!

Bibliography

AL Saqqar, F., Bentahar, J., Sultan, K., & El-Menshawy, M. (February de 2014). On the interaction between knowledge and social commitments in multi-agent systems. *Applied Intelligence; doi: 10.1007/s10489-013-0513-x*, págs. 1-25 .

Ali, S. T., Clark, D., & Patrick, M. (2017). The Nuts and Bolts of Micropayment: A Survey. *arXiv e-prints*, 19.

Cha, B.-R., Lee, S.-H., Park, S.-B., Lee, G.-K., & Ji, Y.-K. (2015). Design of Micro-payment to Strengthen Security by 2 Factor Authentication with Mobile & Wearable Devices. *Security, Reliability, and Safety* (págs. 28-32). doi: 10.14257/astl.2015.109.07.

Commission, E. (27 de November de 2017). *Payment Services Directive (PSD2): Regulatory Technical Standards (RTS) enabling consumers to benefit from safer and more innovative electronic payments.* Obtenido de EUROPA - European Union website, the official EU website: https://europa.eu/rapid/press-release_MEMO-17-4961_en.htm

Dai, X., & Grundy, J. (2002). Architecture of a Micro-payment System for Thinclient Web Applications. *International Conference on Internet Computing* (págs. 444-450). Las Vegas: CSREA Press.

Davis, F. D. (01 de September de 1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly Vol. 13, No. 3*, págs. 319-340.

De Albuquerque, J., Diniz, E., & Cernev, A. (2014). Mobile payments: a scoping study of the literature and issues for future research. *Information Development* (págs. 81-84). DOI: 10.1177/0266666914557338.

De, P., Dey, K., Mankar, V., & Mukherjea, S. (2015). An assessment of QR code as a user interface enable for Mobile Payment Apps on Smartphones. *the 7th International Conference* (págs. 81-84). DOI: 10.1145/2835966.2835977.

Ebrahimi, A. (23 de August de 2018). *The Complete Guide To Credit Card Processing Rates & Fees*. Obtenido de Merchant Maverick: https://www.merchantmaverick.com/the-complete-guide-to-credit-card-processing-rates-and-fees/

EY Fintech, A. (2017). *The rapid emergence of FinTech.* EYGM Limited.

George, J. (May de 2002). Influences on the Intent to Make Internet Purchases. *Internet Research*, págs. 165-180.

Huang, X., Jinsong, B., Dai, X., Singh, E., Huang, W., & Huang, C. (August de 2016). M&E-NetPay: A Micropayment System for Mobile and Electronic Commerce. *Symmetry vol 8; doi: 10.3390/sym8080074*.

Isern-Deyà, A., Rotger, L., Payeras-Capellà, M. M., & Puigserver, M. (April de 2012). Anonymous, Fair and Untraceable Micropayment Scheme: Application to LBS. *IEEE Latin America Transactions, vol 10*, págs. 1774-1784.

ITU-T. (2014). *SERIES X: DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY - Secure applications and services – Security protocols.* ITU-T Study Group 16.

Kokko, J. (2000). Mobile Internet charging: prepaid vs. postpaid.

Kow, Y., Gui, X., & Cheng, W. (2017). Special Digital Monies: The Design of Alipay and WeChat Wallet for Mobile Payment Practices in China. *Human-Computer Interaction – INTERACT 2017: 16th IFIP TC 13 International Conference, Part IV* (págs. 136-155). Mumbai, India,: Proceedings, doi:10.1007/978-3-319-68059-0_9; isbn: 978-3-319-68058-3.

Kremers, R., & James, B. (31 de March de 2017). Mobile Payments, Social Money: Everyday Politics. *NEW POLITICAL ECONOMY; DOI: 10.1080/13563467.2017.1306503*, págs. 645-660.

Lee, E. (01 de March de 2018). *WeChat Pay tries to duplicate domestic success overseas with killer recipe: social networking*. Obtenido de TechNode - Latest news and trends about tech in China: https://technode.com/2018/03/01/wechat-pay-social-networking/

Loesche, D. (06 de March de 2018). *Mobile E-commerce is up and Poised for Further Growth*. Obtenido de Statista - The Statistics Portal for Market Data, Market ...: https://www.statista.com/chart/13139/estimated-worldwide-mobile-e-commerce-sales/

Macharia, K. (05 de July de 2017). *Vodafone to shut down M-Pesa in Albania.* Obtenido de Capital Business: https://www.capitalfm.co.ke/business/2017/07/vodafone-shut-m-pesa-albania/

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2005). *Essentials of Research Design and Methodology.* New Jersey: John Wiley & Sons, Inc. ISBN-13: 978-0471470533.

Mennen, A. (2005). Postpaid. En A. Mennen, *it's Your Call: The Complete Guide to Mobile Phones* (pág. 36). Zilmere, Australia: Relianz Communications Pty Ltd.

Oliveira, T., Thomas, M., Baptista, G., & Campos, F. (August de 2016). Mobile payment: understanding the determinants of customer adoption and intention to recommend the technology. *Computers in Human Behavior, vol 61*, págs. 404-414.

Orè, B. S., & Rodriguez, L. L. (2017). TAM: A Reference Model For Mobile Cash Adoption. *ICICM 2017 Proceedings of the 7th International Conference on Information*

Communication and Management (págs. 148-152). Moscow: ISBN: 978-1-4503-5279-6.

Pahva, A. (19 de August de 2019). *eWallet | Everything you should know about Prepaid Wallets*. Obtenido de Feedough | Business Models & Startup Feeds: https://www.feedough.com/e-wallet/

Párhonyi, R., Quartel, D., Pras, A., & Nieuwenhuis, B. (2005). An interconnection architecture for micropayment systems. *Proceedings of the 7th International Conference on Electronic Commerce, ICEC* (págs. 633-640). Xi'an, China: DOI: 10.1145/1089551.1089665 .

Paypal. (2010). *You can earn more with Micropayments*. Obtenido de Paypal Website: https://www.paypal.com/uk/webapps/mpp/micropayments

Pras, A., Párhonyi, R., & Nieuwenhuis, B. (2005). Second Generation Micropayment Systems: Lessons Learned. *International Federation for Information Processing Digital Library; Challenges of Expanding Internet: E-Commerce, E-Business, and E-Government; vol:189*.

Rea, S., Dalinghaus, U., Nelms, T., & Maurer, B. (2017). Riding the Rails of Mobile Payments: Financial Inclusion, Mobile Phones, and infrastructure. En *The Routledge Companion to Digital Ethnography* (págs. 363-373). UC Irvine: Routledge, ISBN: 978-1-138-94091-8.

Schwartz, E. (2016). A payment Protocol of the Web, for the Web. *WWW '16 Companion Proceedings of the 25th International Conference Companion on World Wide Web* (págs. 279-280). Montréal, Québec, Canada: ISBN: 978-1-4503-4144-8/16/04, doi:10.1145/2872518.2889305.

Sherman, M. (06 de June de 2014). An introduction to mobile payments: Market drivers, applications, and inhibitors. *doi: 10.1145/2593902.259392; isbn: 978-1-4503-2878-4*.

Sirbu, M., & Tygar, J. (August de 1995). NetBill: An Internet Commerce System Optimized for Network Delivered Services. *IEEE Personal Communications Volume: 2 , Issue: 4*, págs. 34 - 39.

Venkatesh, V. (December de 2000). Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. *Information Systems Research*, págs. 342-365.

Venkatesh, V., Thong, J., & Xu, X. (March de 2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly, vol 36*, págs. 157-178.

Verme, P. L. (2014). Virtual currencies, Micropayments and Monetary policy: where are we coming from and where does the industry stand? *Journal of Virtual Worlds Research. vol 7*, 1-10.

Visa. (24 de June de 2010). *Visa launches new way to pay online.* Obtenido de Payclick by Visa: https://web.archive.org/web/20110706110908/https://www.payclick.com.au/getattachment/e693f4a2-3e0b-4811-841e-5c43ef5aa19b/payclick-Press-Release-24-June-2010.aspx

Worldpay, T. E. (09 de July de 2019). *Small business guide to mobile wallets*. Obtenido de Worldpay: Global Selector: https://www.worldpay.com/en-us/insights-hub/article/business-guide-to-mobile-wallets

Appendix

Appendix A

Low-Fidelity Prototype

Figure 17 Login page

Figure 18 Register page

Figure 19 Forgot password page

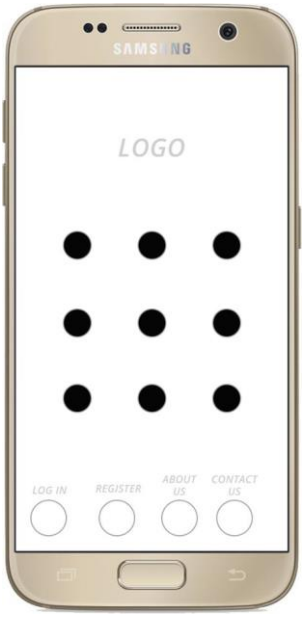


Figure 20 pattern login/register

Figure 21 Transactions list

Figure 22 Transaction detail

Figure 23 Search Merchant

Figure 24 Profile Page

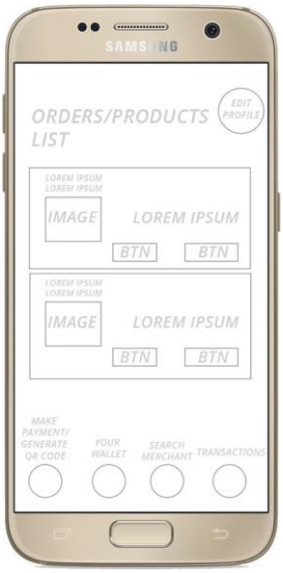


Figure 25 Orders/Product list page

Figure 26 Order/Product details

Figure 27 Merchant generating a QR Code

Figure 28 Merchant generated the QR Code

Figure 29 Client opens the QR Code Scanner

Figure 30 Client checks the Payment detail after scanning the QR Code

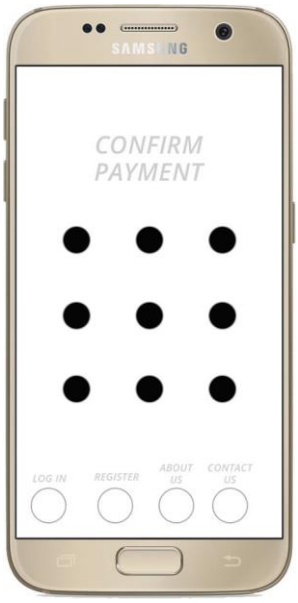


Figure 31 Client confirms the payment with a password or pattern code

Appendix B

High-Fidelity Prototype

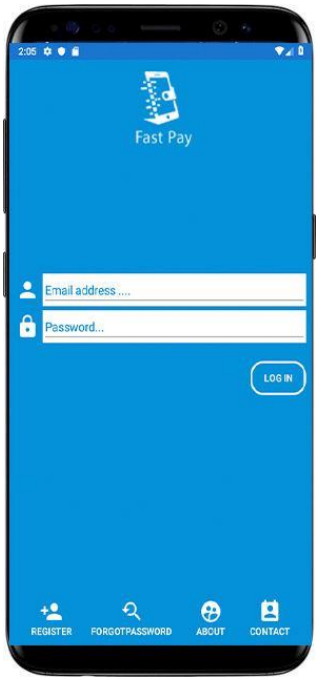


Figure 32 High-Fidelity prototype of Login Page

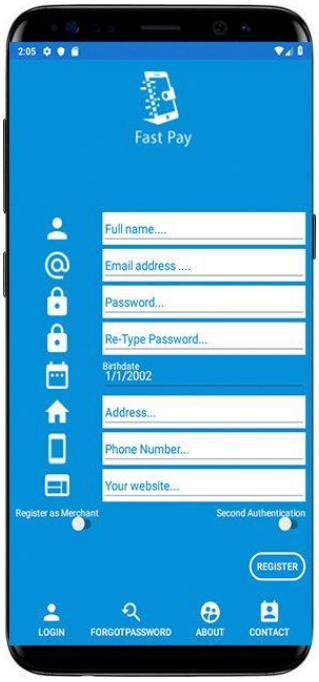


Figure 33 High-Fidelity prototype of Register Page

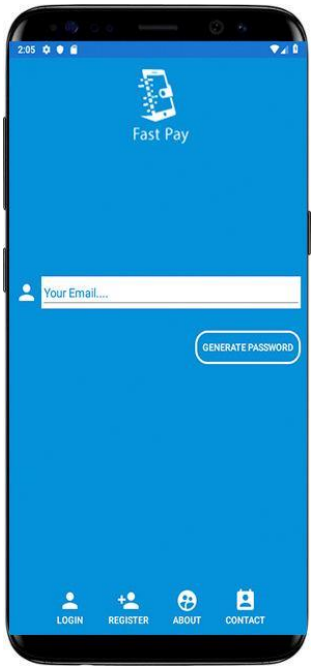


Figure 34 High-Fidelity prototype of Forgot Password Page

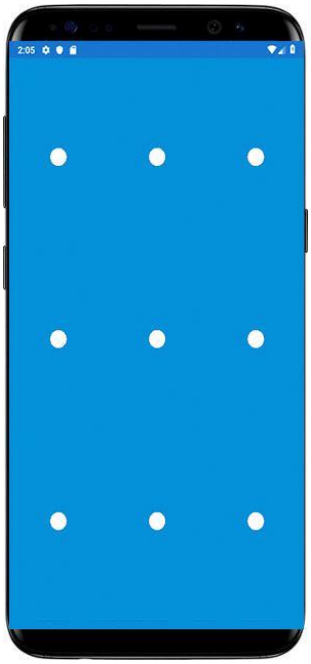


Figure 35 High-Fidelity prototype of Pattern Login Page

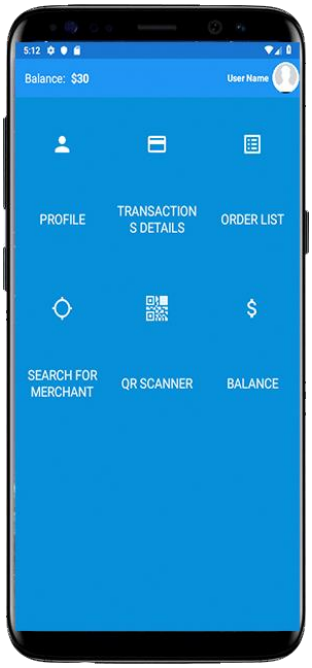


Figure 36 High-Fidelity prototype of Dashboard

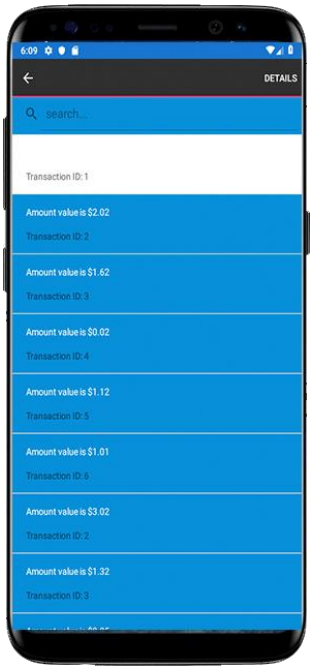


Figure 37 High-Fidelity prototype of Transactions List

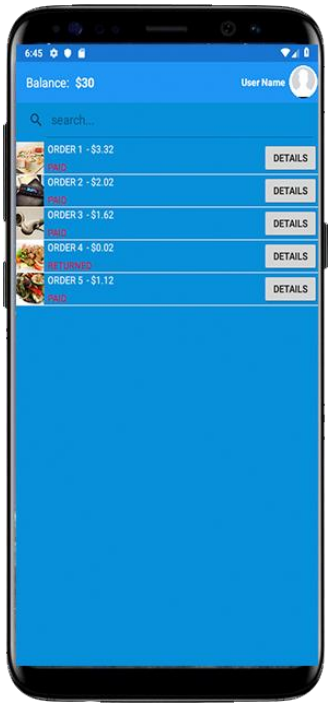


Figure 38 High-Fidelity prototype for Orders/Products list

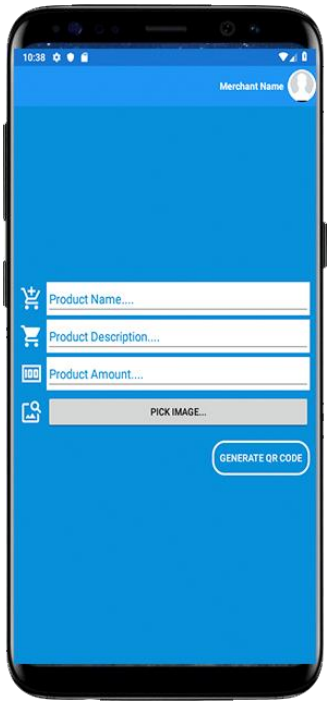


Figure 39 High-Fidelity prototype for Adding the product by merchant

Figure 40 High-Fidelity prototype of generating QR Code for the product

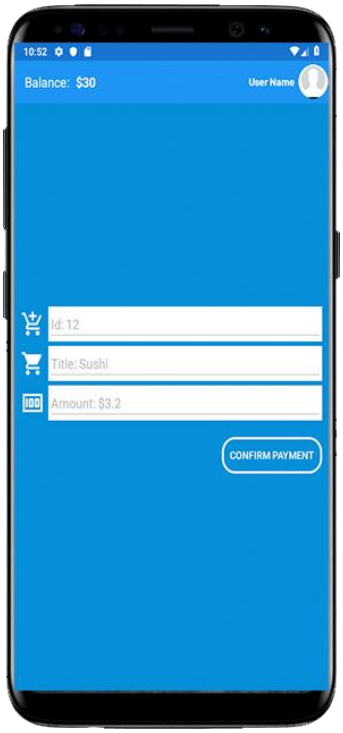


Figure 41 High-Fidelity Prototype of Confirming the payment from the customer

Appendix C

Client Questionnaire

1. Age?

18-24	25-34	35-45	46-60	+60

2. Gender

Male	Female

3. What kind of system do you have in your phone?

IOS	ANDROID

4. How much do you feel or would you feel secure in making mobile payments?

None	Enough to perform a payment	very

5. Have you made any payment by phone?

Yes	No

6. If not, why?

I don't feel secure	I don't know how it works	Lack of this kind application in our region	Other

7. If so, have you used any of these types? (You can select more than one)

Mobile web app	Online wallet	Credit Card	Near Field Communication (NFC)	Mobile Banking

8. If you have made any mobile payment, how often have you done so?

1-2 times a week	1-2 times a month	More rarely	More often

9. In which cases you use or would you rather use the mobile payments?

Online Shopping	Payments in a restaurants or Groceries	Money transfer

10. Have you ever used the QR Code system?

Yes	No

11. If yes, which application do you use?

Viber	QR Droid	Bar-Code	Quick Scan	Other

12. Do you believe it's easier to scan a QR Code and fill in the fields automatically, or fill in the required fields in typing by phone?

Easier with QR Code	Easier by typing in the fields	I have no problems by using both types.

Appendix D

Results

1. Age?

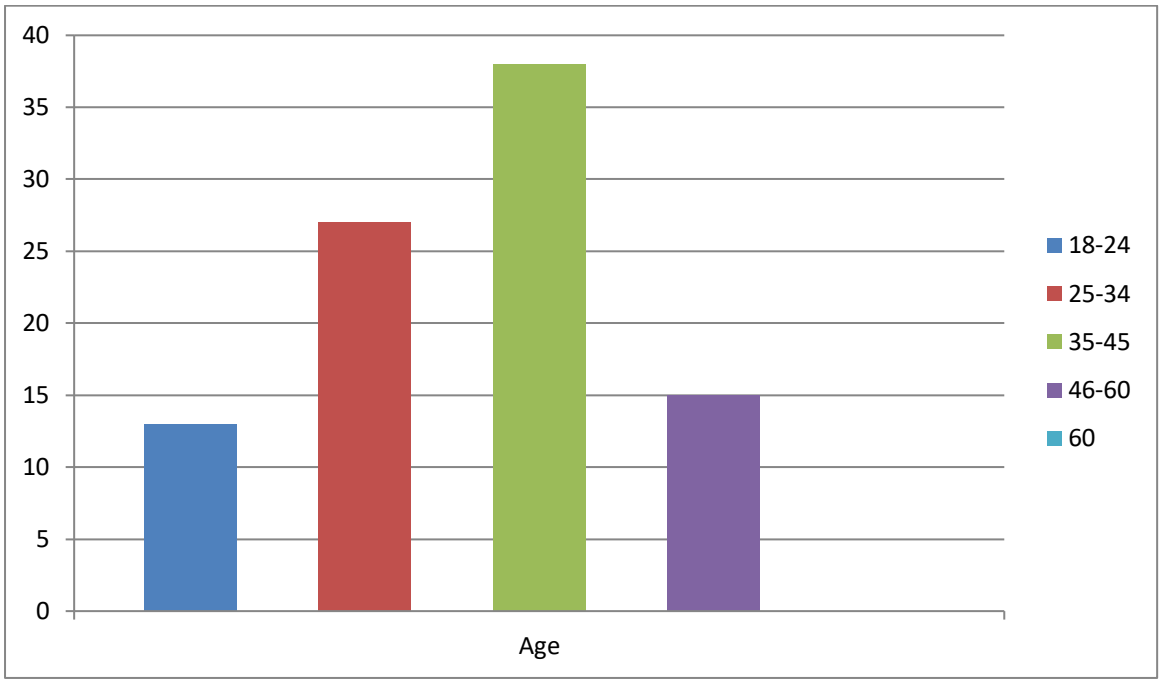


Figure 42 Chart showing the age of participants

2. Gender

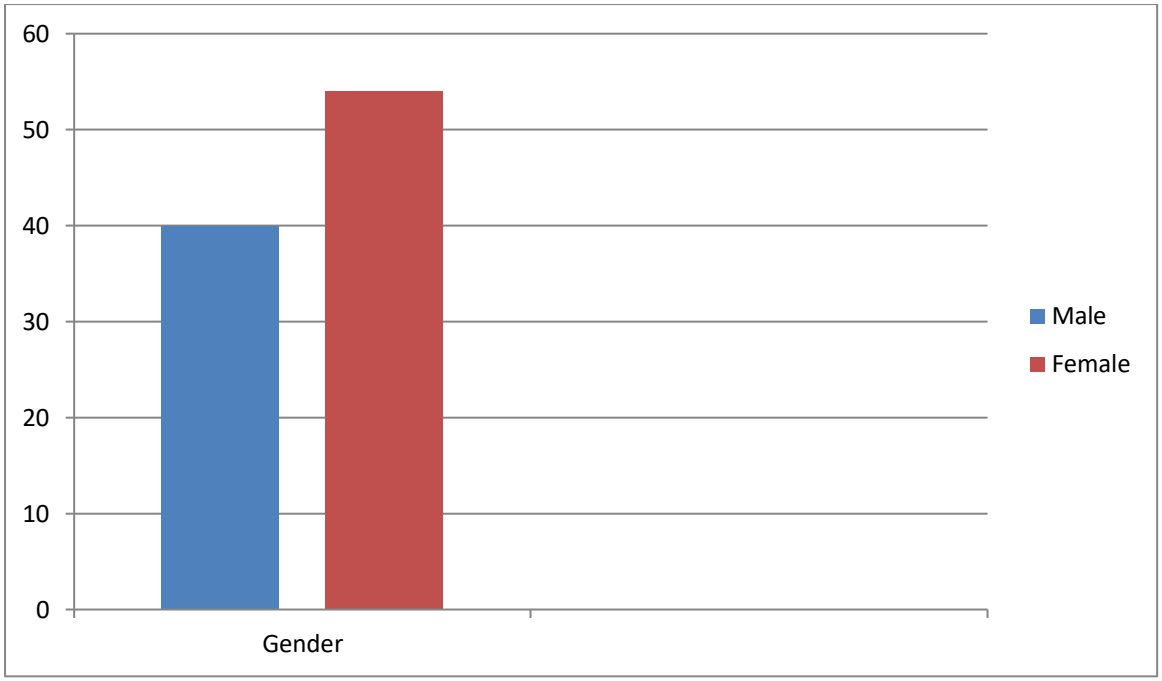


Figure 43 Chart showing the gender of participants

3. What kind of system do you have in your phone?

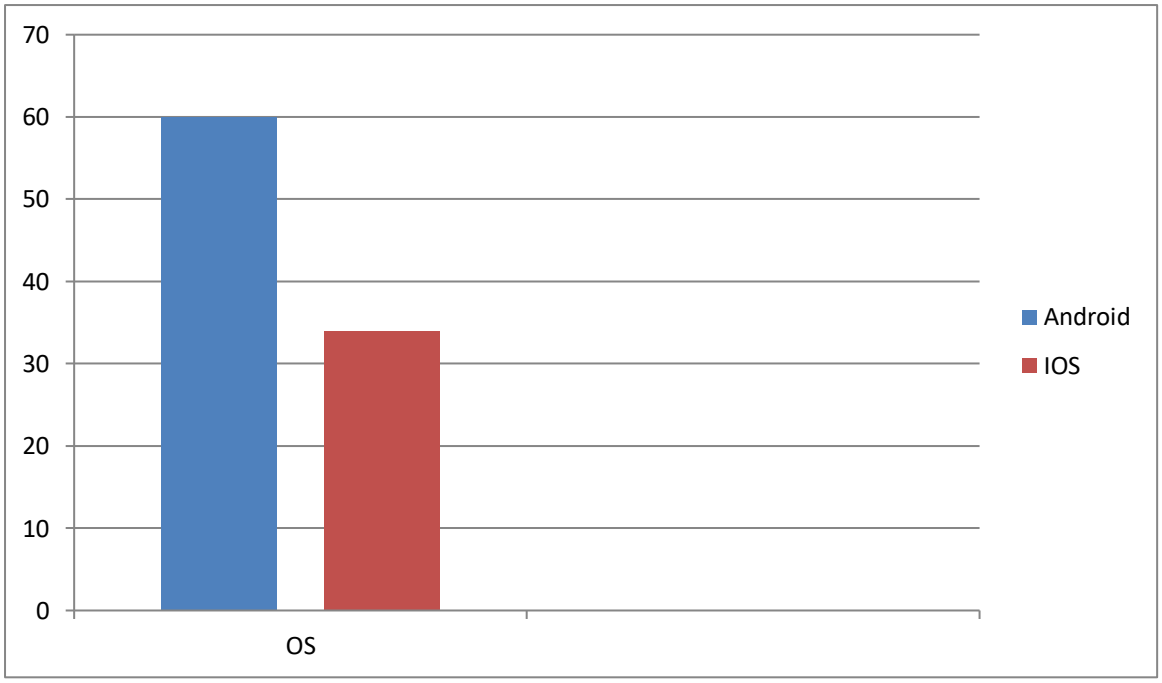


Figure 44 Chart showing the Operation System on their phones

4. How much do you feel or would you feel secure in making mobile payments?

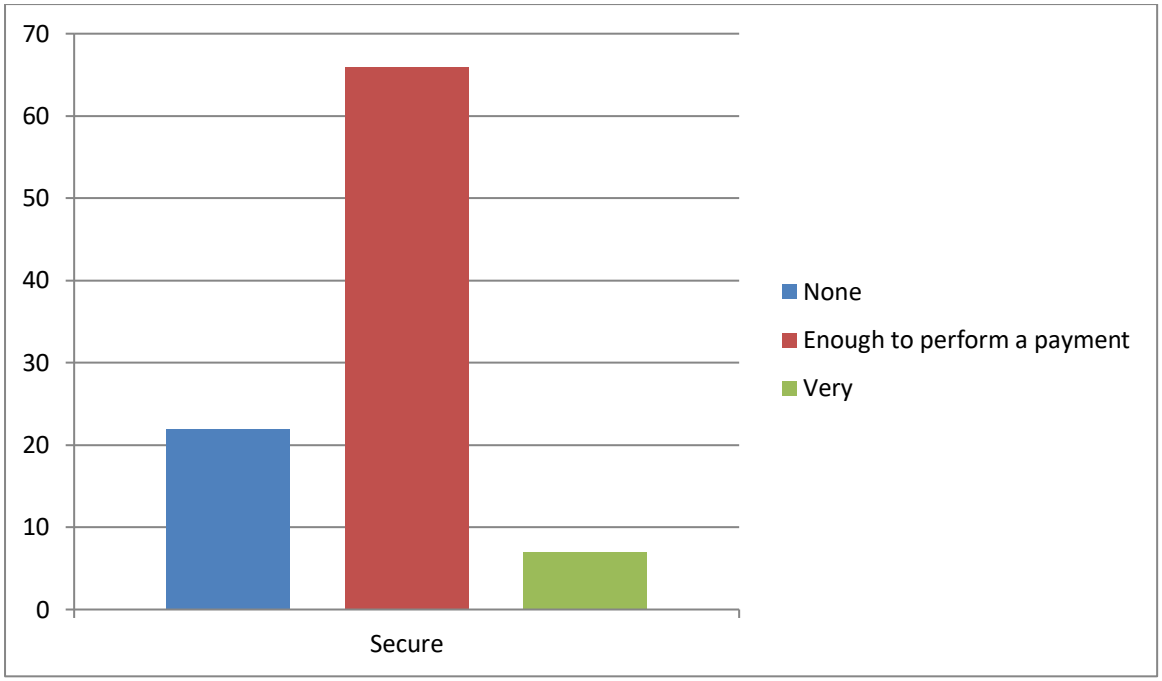


Figure 45 Chart showing the security part for making mobile payments

5. Have you made a payment by phone?

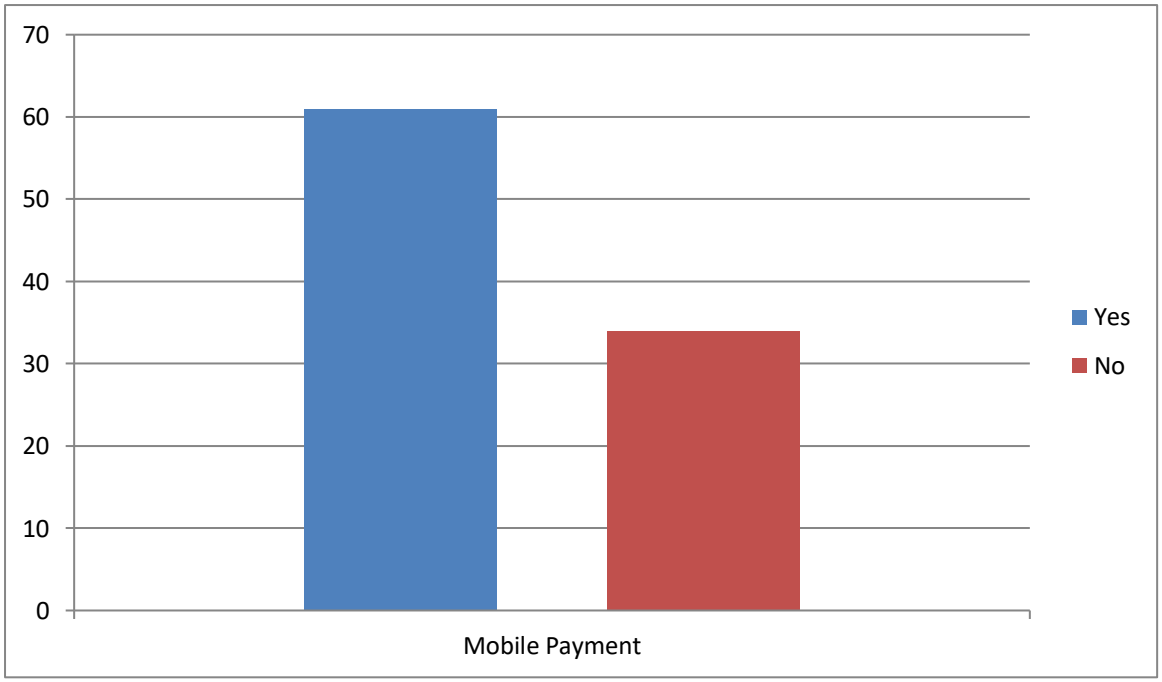


Figure 46 Chart that showing if the participants made a mobile payment

6. If not, why?

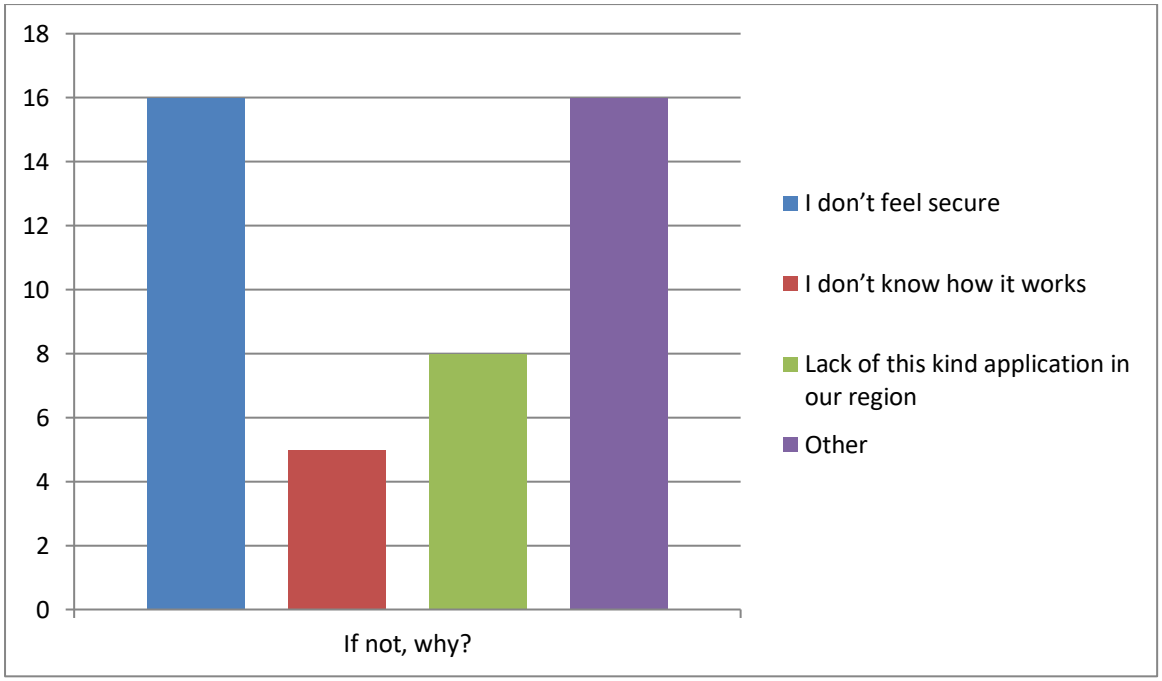


Figure 47 Chart showing why they didn't make any mobile payment

7. If yes, have you used any of these types? (You can select more than one)

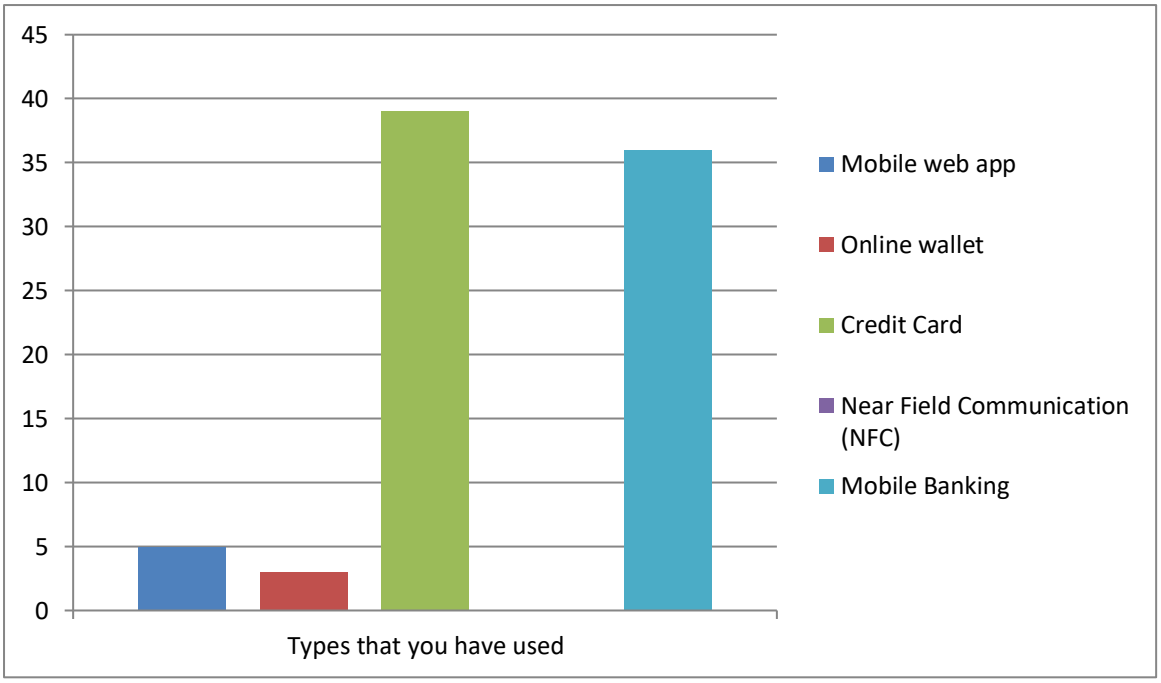


Figure 48 Chart showing which type of mobile payment the participants have used

8. If you have made any mobile payments, how often have you done so?

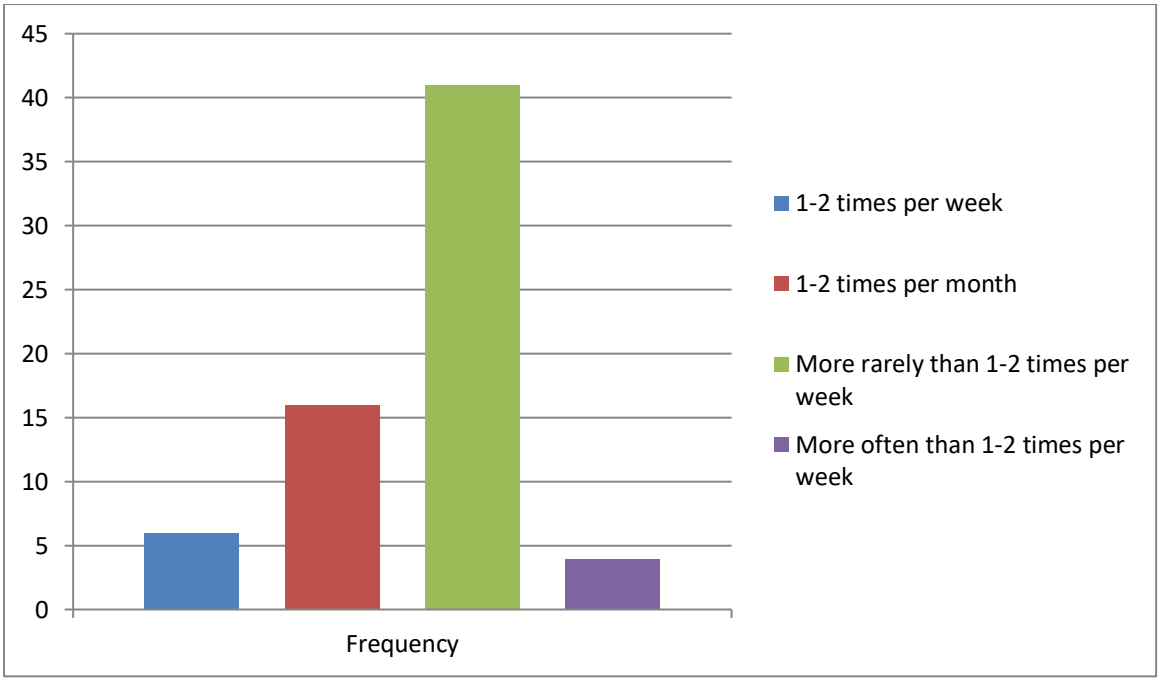


Figure 49 Chart showing the frequency of making mobile payments by participants

9. What do you use or would you rather use the mobile payments?

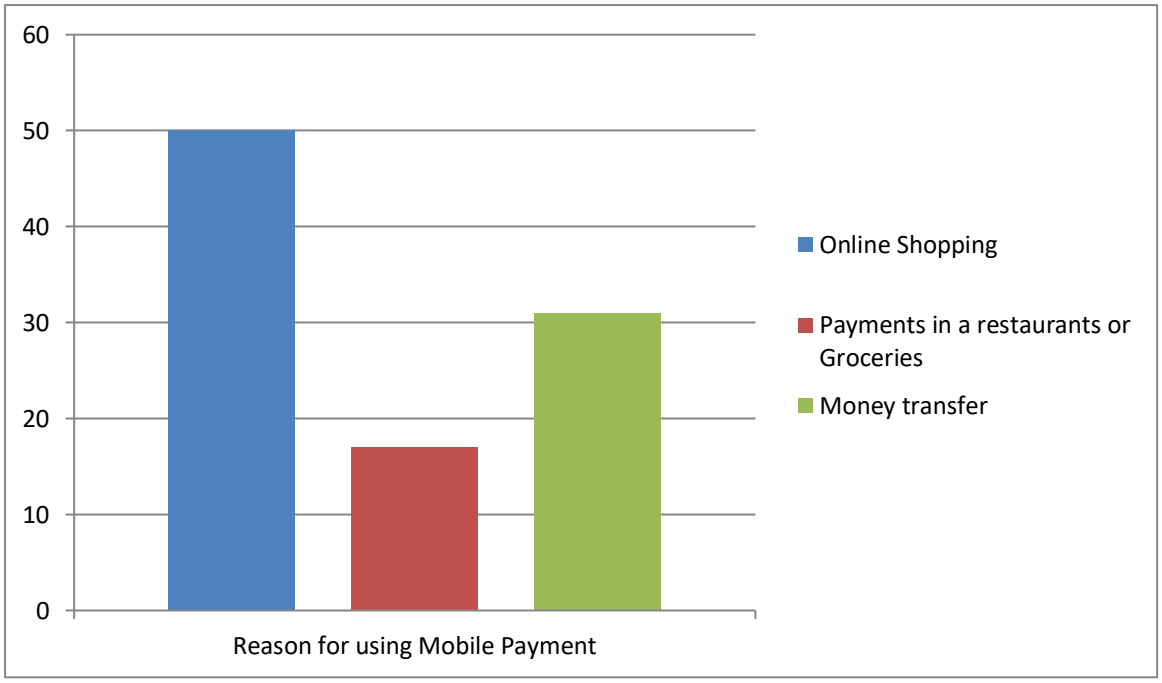


Figure 50 Chart showing for what they would use the mobile payment

10. Have you ever used the QR Code system?

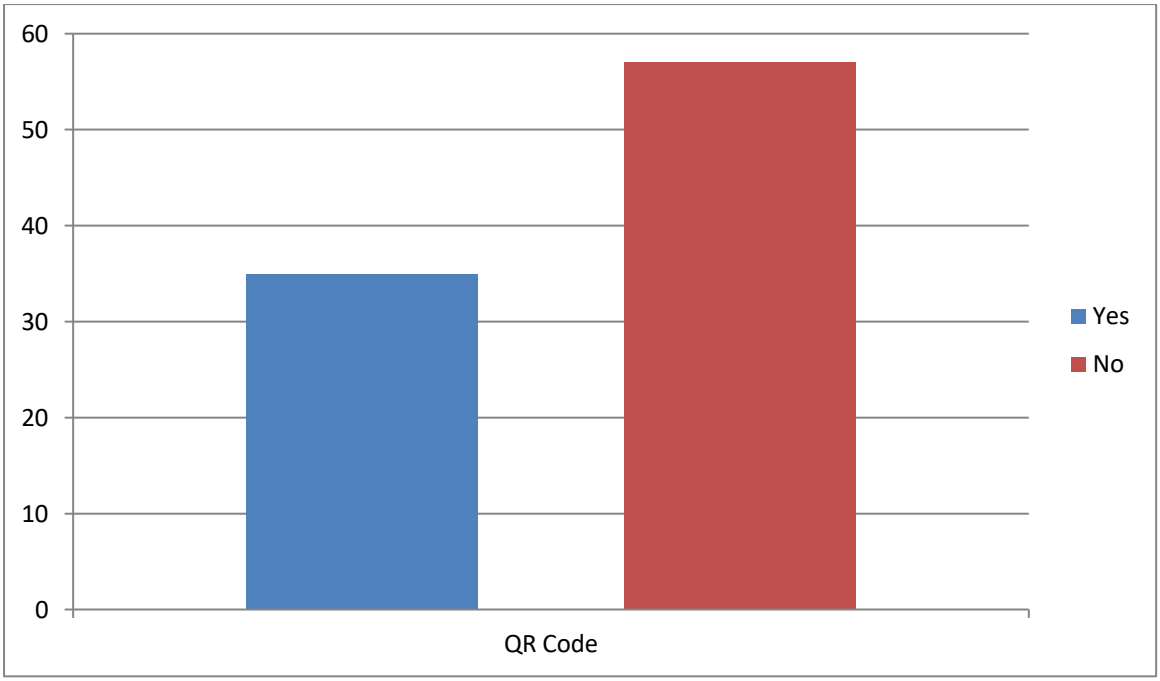


Figure 51 Chart showing how many participants used the QR Code

11. If yes, which application do you use?

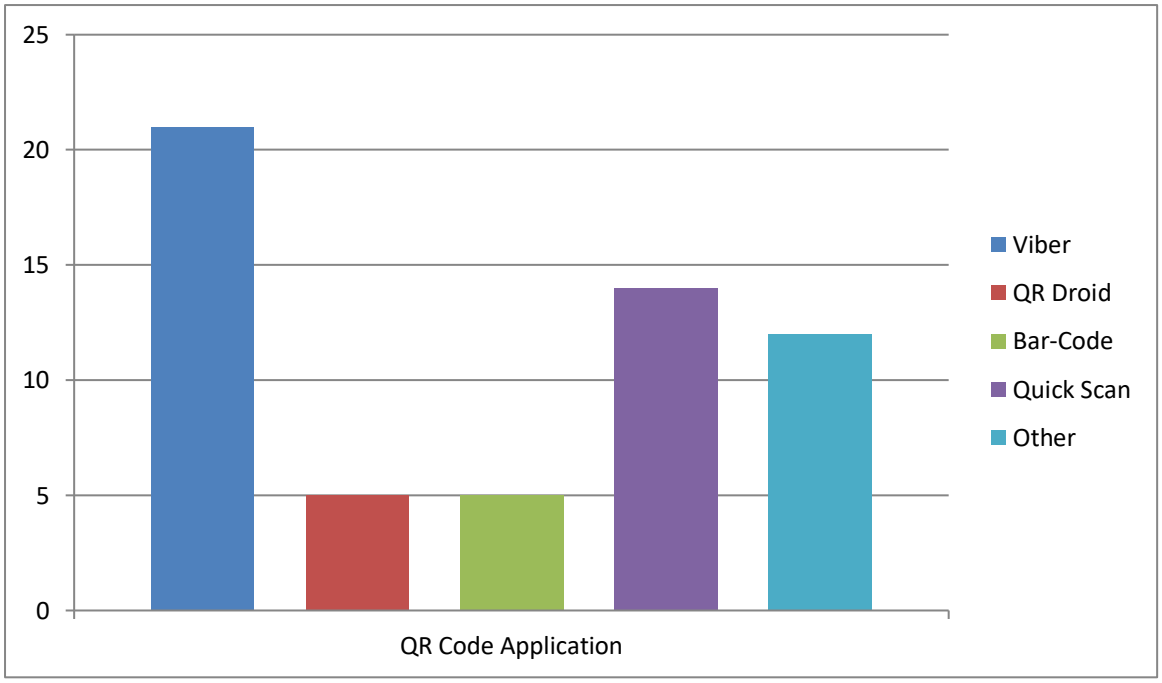


Figure 52 Chart is showing which application, participants used for QR Code

12. Do you believe it is easier to scan a QR Code and fill in the fields automatically, or fill in the required fields in typing by phone?

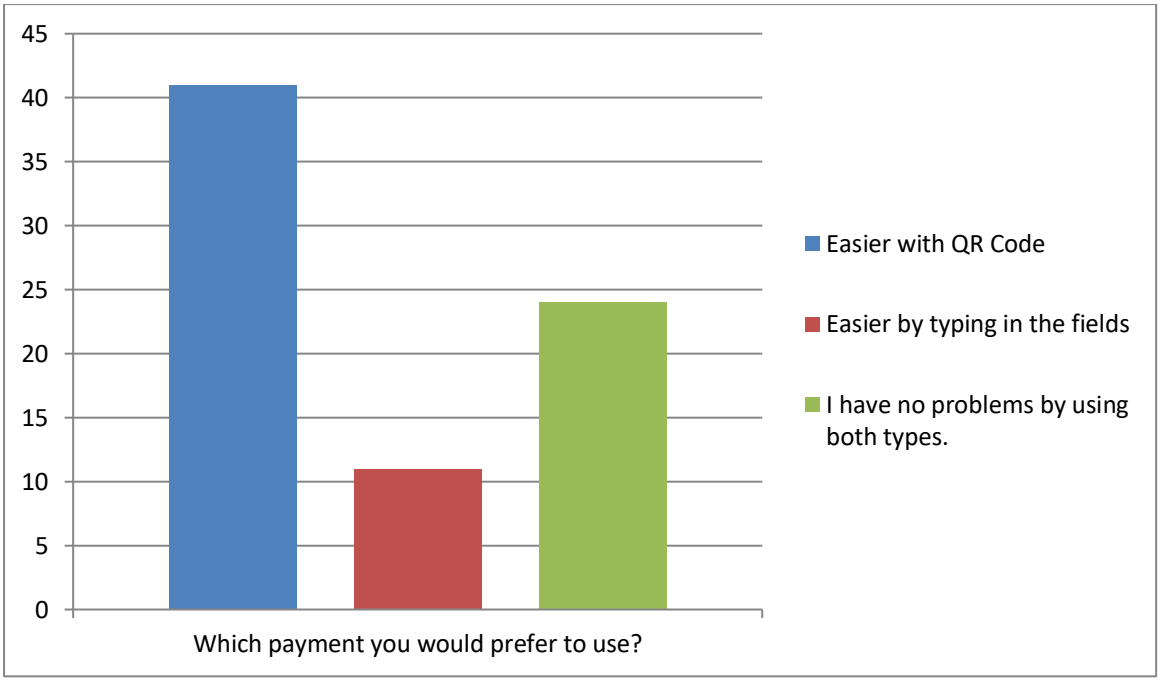


Figure 53 Chart is showing which form is easier to use in a mobile payment

Appendix E

Company Questionnaire

1. What is your business activity?

Restaurant/Hotel	Grocery	Fast Food	Bookstore	Boutique	Pharmacy	Other

2. How many employees does your business employ?

1-4	5-10	11-15	+15

3. Other than cash, how much do you know about other forms of payments?

POS/Credit Cards	Mobile Payments	Online Payments	Other

4. Have you performed online payment services as a business?

Yes	No

5. Do you plan to open an online payment service for your customers?

Yes	No

6. If not, why? (You can choose more than one)

I have no confidence in the security of	Our customers prefer cash only!	It may be an additional cost	At the moment we	Other

online payment data			are not interested	

7. If you apply online payment services, what have been the common problems that you faced with customer payments?

Customer uncertainty	Lack of information	Lack of credit cards or other means by customers.

8. How much do you feel or would you feel secure in making mobile payments?

None	Enough to perform a payment	Very

9. If you were to apply a mobile payment service using QR Code, you would do the following:

The client will show the QR-Code on the phone	The client will have the QR-Code printed next to the particular product

10. Do you believe it is easier to scan a QR Code and fill in the fields automatically, or fill in the required fields in typing by phone?

Easier with QR Code	Easier by typing in the fields	I have no problems by using both types.

Appendix F

Results

1. What is your business Activity?

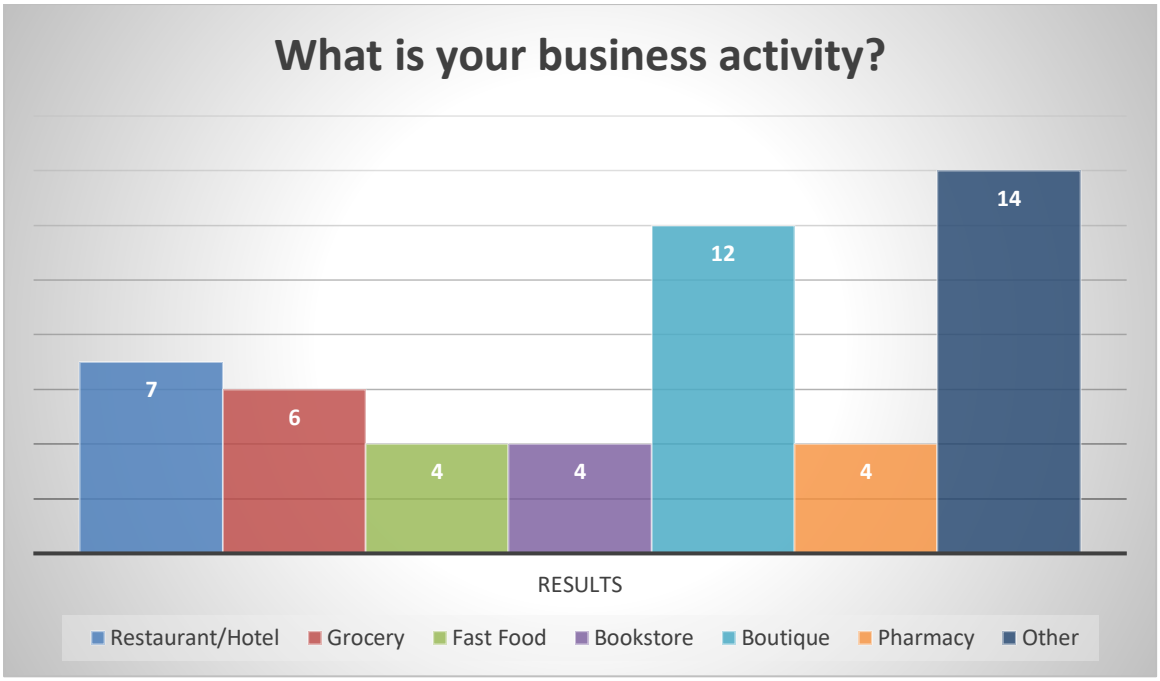


Figure 54 Result of first question from Merchant Survey

2. How many employees does your business employ?

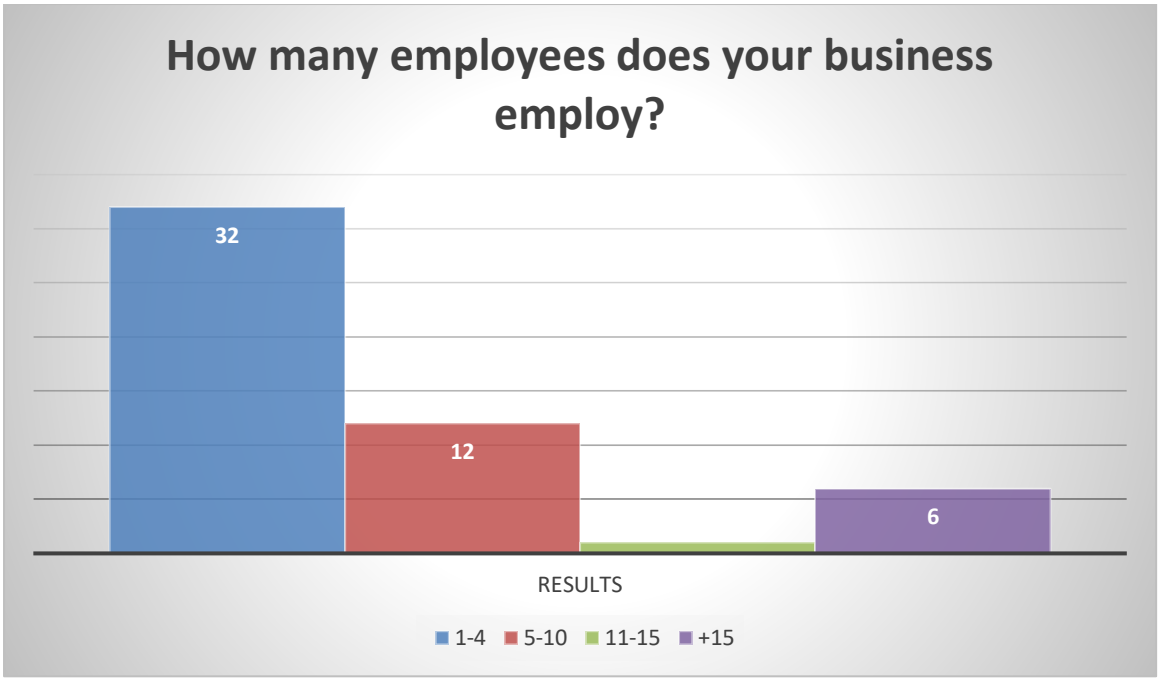


Figure 55 Result of second question from Merchant Survey

3. Other than cash, how much do you know about other forms of payments?

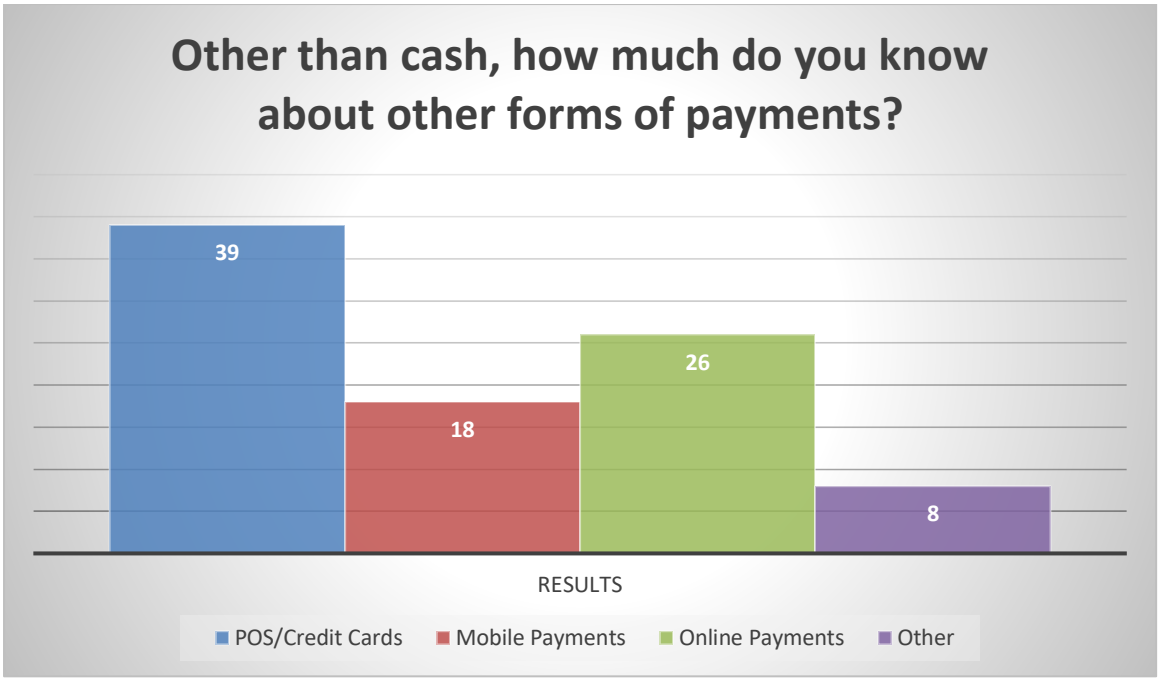


Figure 56 Result of third question from Merchant Survey

4. Have you performed online payment services as a business?

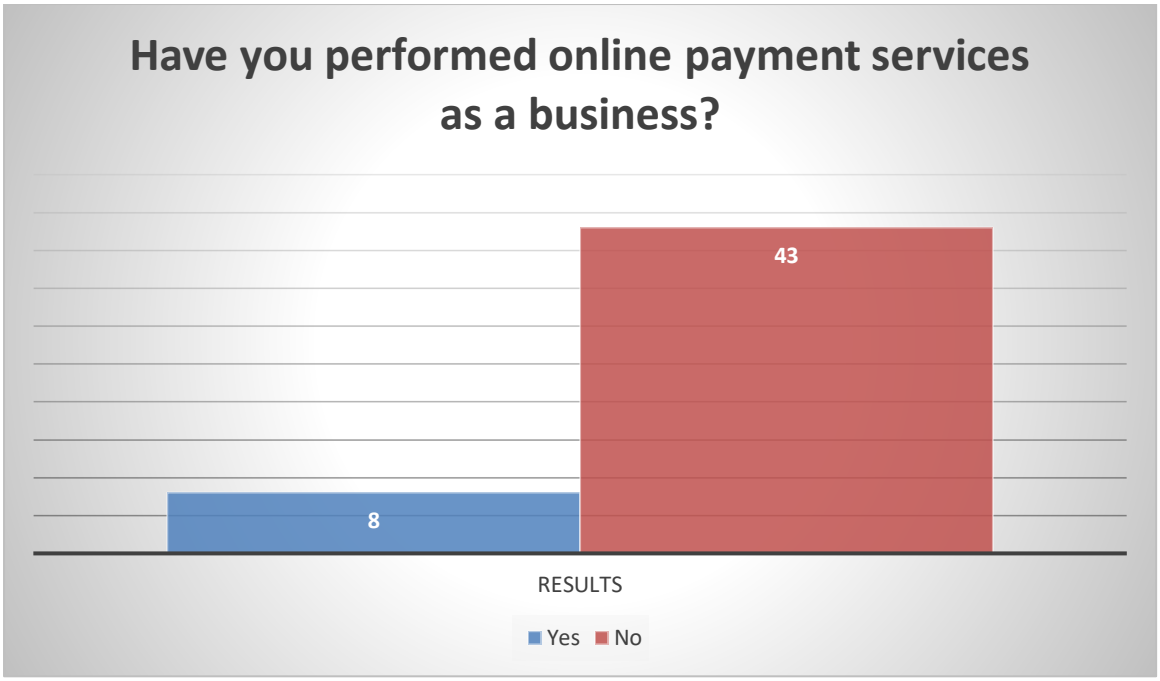


Figure 57 Result of fourth question from Merchant Survey

5. Do you plan to open an online payment service for your customers?

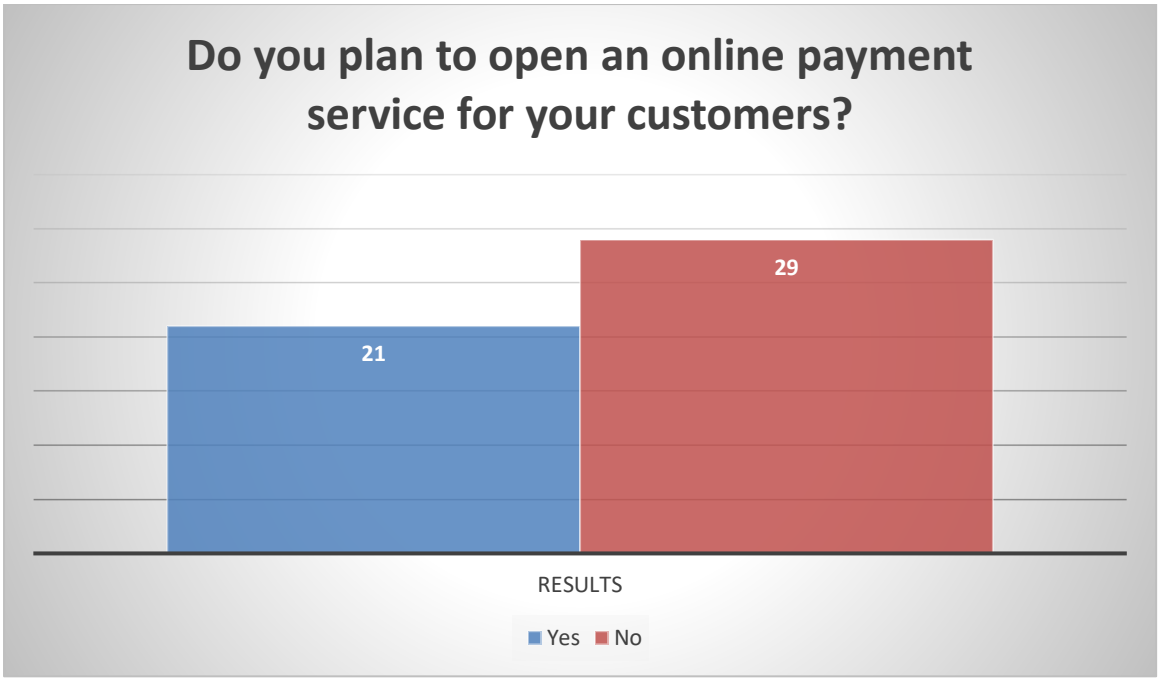


Figure 58 Result of fifth question from Merchant Survey

6. If not, why? (You can choose more than one)

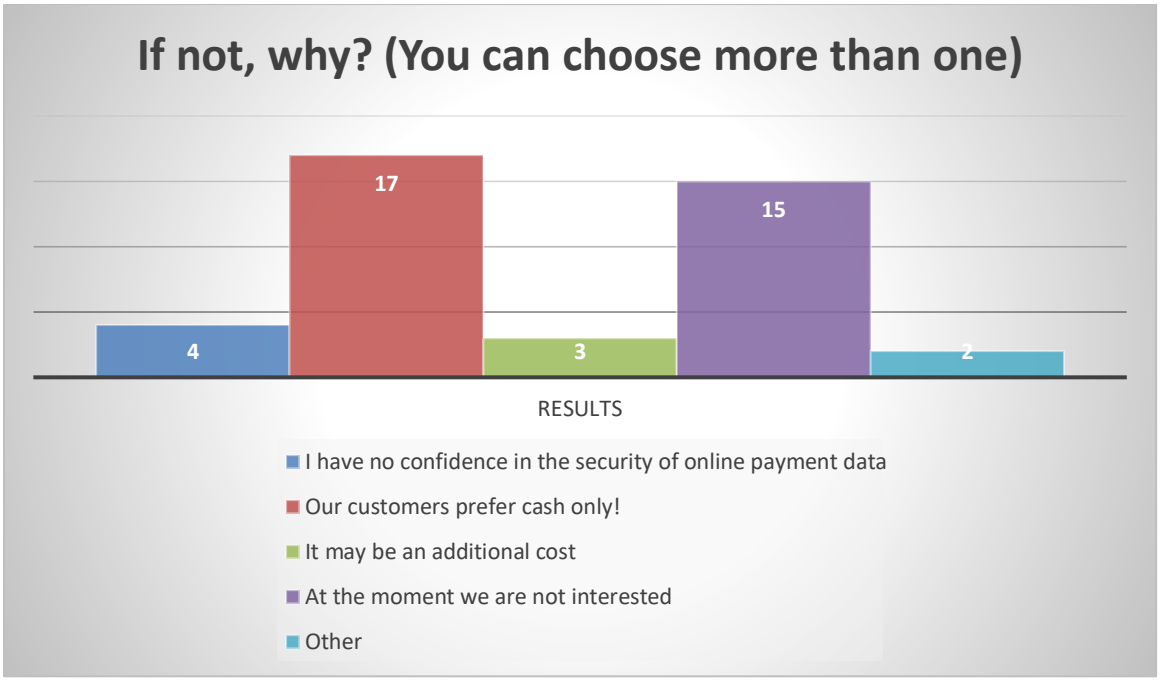


Figure 59 Result of sixth question from Merchant Survey

7. If you apply online payment services, what have been the common problems that you faced with customer payments?

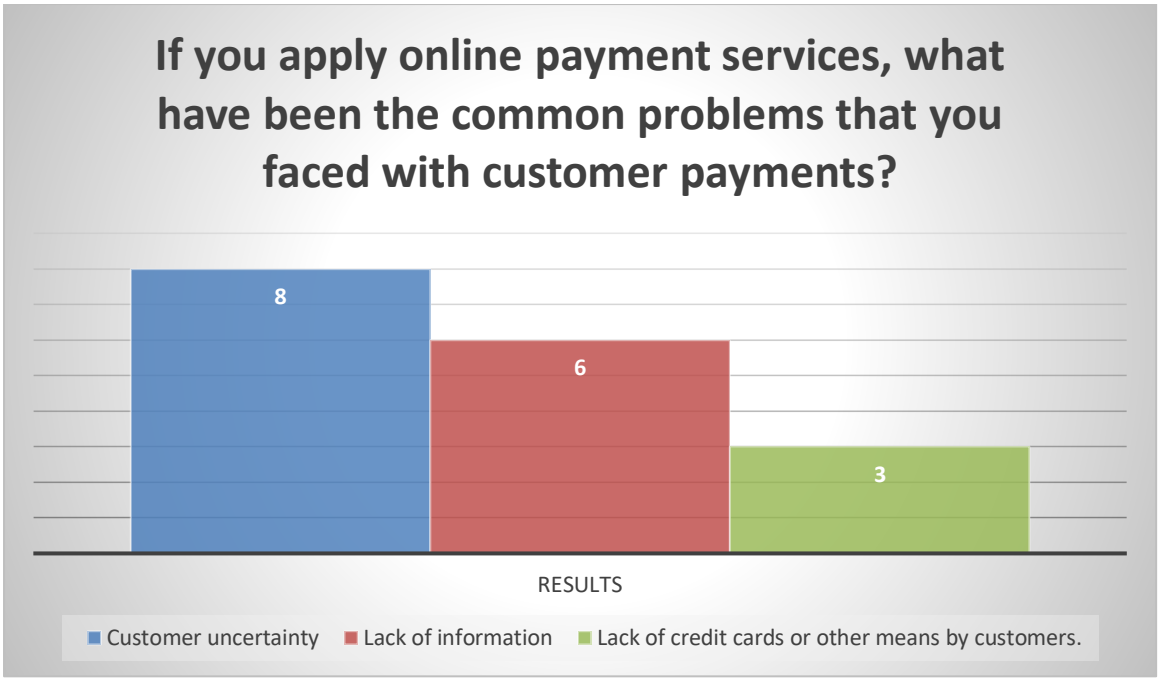


Figure 60 Result of seventh question from Merchant Survey

8. How much do you feel or would you feel secure in making mobile payments?

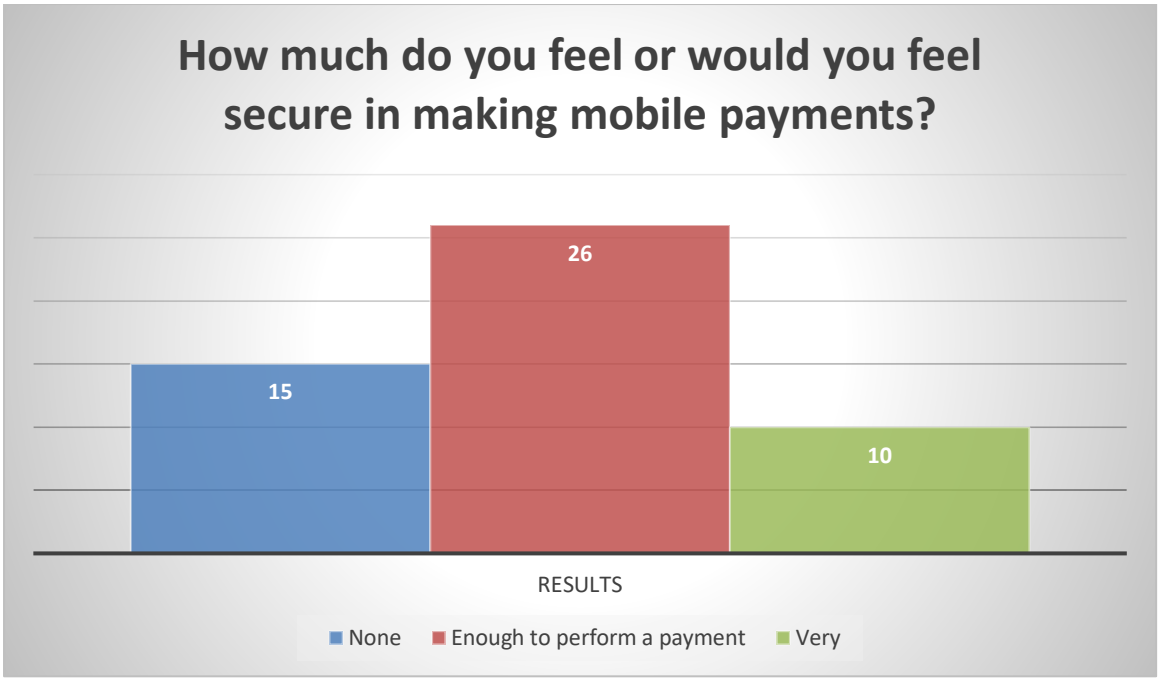


Figure 61 Result of eighth question from Merchant Survey

9. If you were to apply a mobile payment service using QR Code, you would do the following:

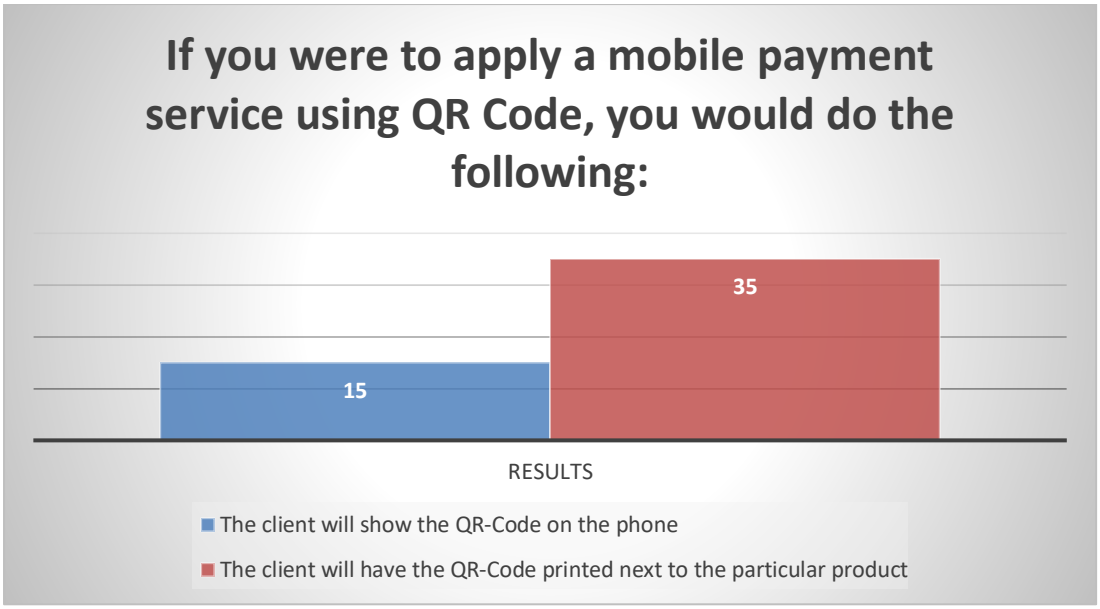


Figure 62 Result of ninth question from Merchant Survey

10. Do you believe it is easier to scan a QR Code and fill in the fields automatically, or fill in the required fields in typing by phone?

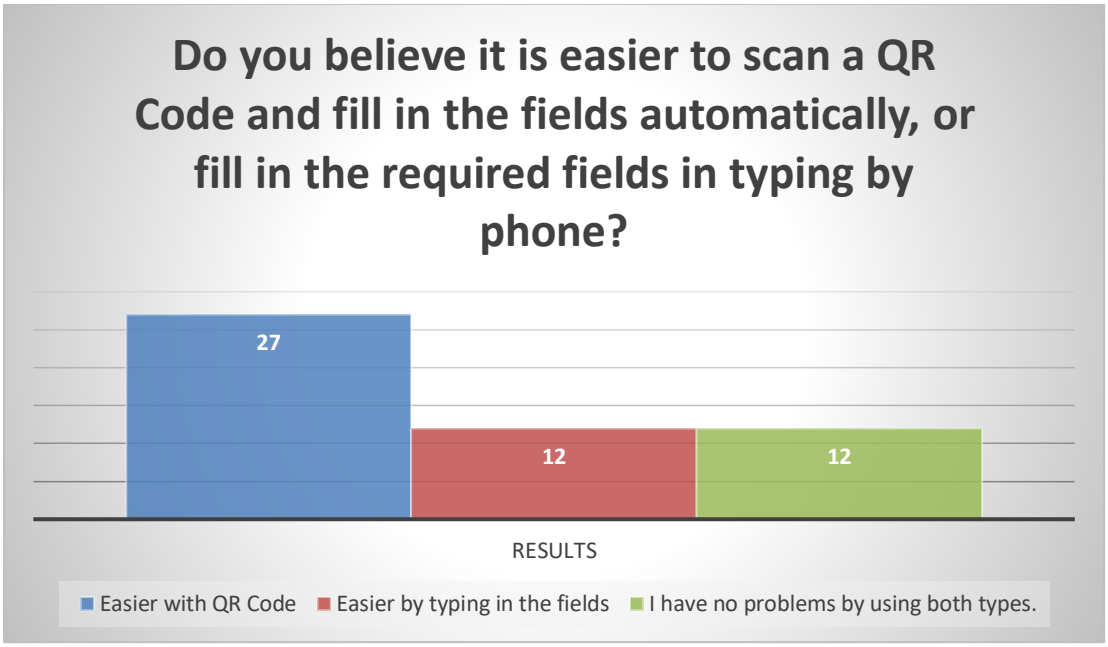


Figure 63 Result of tenth question from Merchant Survey