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Developing e-Ticket System for the Public Transport Sector of Bangladesh

Master's thesis

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Tallinn 2021

TALLINNA TEHNIKAÜLIKOOL
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Bangladeshi ühistranspordisektori e-pileti süsteemi arendamine

Magistritöö

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Tallinn 2021

Author's Declaration of Originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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10.06.2021

Abstract

With the blessings of ICT, the use of e-Ticket can change the service quality of any public service, especially the Public Transport Sector. Bangladesh is facing lots of issues in the payment system in the public transport sector. Even though there has a fixed amount of fare, the company owner earns more money forcefully from the passengers. People are highly dissatisfied with the service and the Government because of the poor service in the public transport sector. Even Government loses lots of reviews from this sector because there is no one accountable for the problems. The only ICT-enabled solution like e-Ticketing which saves service delivery time and cost can change the overall system. In the e-Ticketing system, passengers will pay the ticket price electronically by using the RFID card or QR code. This study was conducted to propose the digital E-Ticketing system to upgrade the manual payment/fare collection system to gear up into a new dimension. Based on 100 samples, the study revealed that most of the people are dissatisfied with the manual payment system, and 50% of people are also willing to use the prepaid payment system using e-Ticket.

Index Terms- Public Transport, Design Science, Good Governance, NPM, Change Management, E-Ticket, RFID, QR Code, Transparency.

This thesis is written in English and is 87 pages long, including 9 chapters and 32 figures.

Acknowledgment

First and foremost, I humbly express my most profound sense of gratitude to the Supreme arbiter, Almighty Allah, for enabling me to complete my research successfully. Secondly, I wish to express my sincere appreciation to my supervisor Valentyna Tsap, Researcher, Institute of Information Technology, Tallinn University of Technology, for her much-appreciated encouragement and wise guidance. It was tough to complete this thesis without her great advice and insightful comments, which have enriched my work.

In addition, I would also like to thanks my dear friend Maria Lourdes Bacud for her constructive criticism and practical suggestions. I am also thankful to my younger cousin Shohan and Munia for their helpful support in making sense of what I have accomplished. The support from my friends and classmates in Estonia has brought me an immense motivation to pursue and not to give up on every hurdle faced while writing this study.

I am grateful to my parents for their immeasurable sacrifice, blessings, and constant inspiration throughout my life, which led me to all of my success in life. Finally and most importantly, I am sincerely indebted to my loving and supportive wife, Umme Sayma Busra, who provided unending support and inspiration. From the very beginning of this research work, she has always been with me with her helpful advice and valuable suggestions.

Mohammad Momin Reja

List of Abbreviations and Terms

e-Ticket	Electronic Ticket
ICT	Information and Communication Technology
ID	Identification
NID	National Identity
QR	Quick Response
RFID	Radio Frequency Identification
DSR	Design Science Research
IT	Information Technology
DSRIS	Design Science Research in Information Science
KII	Key Informant Interview
IFA	Institute of Financial Accountants
NPM	New Public Management
PROSCI	Professional and Science
SHRM	Society for Human Resource Management
CEO	Chief Executive Officer
DMIC	Delhi Mumbai Industrial Corridor
EU	European Union
eID	Electronic Identity
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
e-Ticket	Electronic Ticket
ICT	Information and Communication Technology
ID	Identification
NID	National Identity
QR	Quick Response
RFID	Radio Frequency Identification
DSR	Design Science Research
IT	Information Technology

DSRIS	Design Science Research in Information Science
KII	Key Informant Interview
IFA	Institute of Financial Accountants
NPM	New Public Management
PROSCI	Professional and Science
SHRM	Society for Human Resource Management
CEO	Chief Executive Officer
DMIC	Delhi Mumbai Industrial Corridor
EU	European Union
eID	Electronic Identity
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
DRT	Demand-Responsive Transport
NFC	Near-field communication
ITS	Intelligent Transportation Systems
FFPT	Free-Fare Public Transportation
SMS	Short Message Service
AFC	Automated Fare Collection
NPS	National Payment Switch
a2i	Access to Information
DMRT	Dhaka Mass Rapid Transit
JICA	Japan International Cooperation Agency
RSTP	Revised Strategic Transport Plan
BRT	Bus Rapid Transit
MRT	Mass Rapid Transit

Table of Contents

List of Figures

1 INTRODUCTION

1.1 Overview of the Research

Today's world's success stories mostly rely upon the blessings of Information and Communication Technology (ICT). Almost all the developed countries are introducing newer technologies to support their citizens to ensure better public service. The key to having better e-government is to digitize the service. The developed Governments are practicing to make the best use of e-service while the developing governments are still trying different strategies. From different research analyses, it is seen that the first and foremost initiative is to introduce electronic id to access all the public service. Bangladesh is also a developing country that has already introduced digital ID cards as NID(National Identity), but from this digital card still, citizens are not getting its full benefits. The top reasons behind this are people are still not aware, and they still do not know the benefits of it. People seem to keep this very securely rather than using it.

From some developed countries, it is seen that they sometimes use a different electronic card to get benefits of public service, like the transport service. In Estonia, there has a travel card for public transport service. I am also focusing on introducing a kind of service by which people of Bangladesh can get the best service from the public transport system, want to develop the public transport service by introducing a digital solution. I will be focusing on introducing an e-Ticket and a QR code solution by which people can travel easily without manual payment.

1.2 Motivation

Bangladesh is the world's most densely populated and developing country all over the world. Within the area of 148,460 square kilometers, there live more than 162 billion people. As time is changing, Bangladesh is also trying to develop each of its public sectors. Each of the public sectors is sunken under tremendous corruption in either its health sector, transport sector, education sector, or any sector. Bangladesh Government is working hard and soul to make a Digital Bangladesh with Vision 2021. Bangladeshi

current ruling party, Bangladesh Awami League who is now in government is working hard so that within 2021 the country will be digitally [42].

In Bangladesh, e-commerce fields e-Payment is widely being used for several years. In July 2011, bKash Limited, Bangladesh, first started a mobile banking service. bKash was created in such a way that everyone, even those without a bank account, can use this financial service via their mobile phone. The value proposition is straightforward: a convenient way to keep money secured and safe, and a very simple way for transferring money and making any kind of payment [22]. As mobile banking started increasing rapidly, e payment in shopping also increased.

But still, digitization is under development, and its progress is very slow. According to the Bangladesh Road Transport Authority record of 2017, there have 294,80,00 registered vehicles in the country and also have a huge number of non-registered vehicles. Most of the vehicles are in the private sector. Each year when there is a fluctuation in oil prices, the transport owner increases the travel rent. And even after a few days, the price is stable the price does not decrease. And all these extra amounts of money are taken by the general people. The Government is concern about the payment system and trying to manage it properly. But because of mismanagement still, the Government can't manage. For this reason, there is a lack of public satisfaction with the transport system. Also, the Government is losing a huge amount of tax. There are also several issues with this transport system. From all this perspective I decided to work in this transport sector. Among all these sectors, if we can digitize the transport sector by introducing e-Ticket like Estonian Bus Cards, it will dramatically change the public transport system and drastically reduce corruption in the transport sector.

It is not possible to make all the vehicles under a government, so in my proposed system, all the private and Government vehicles will be under few companies. As with the Estonian transport system, there will be an electronic Ticket for each people. There will be a Card scanning device on each vehicle. The citizens have to purchase an e-Ticket with different packages (daily, weekly, or monthly). There will be a booth in a different place to recharge the Smart Card. Whenever anyone will purchase a card or recharge the card, the money will be distributed to the company account, and the fixed tax amount will be sent to the government account. The scanning device will be integrated with software, and at the same time, the device will be connected to the internet always. Whenever

anyone scans their e-Ticket, the software will match the identification number with the Government central citizen's database, and it will also check if the card is expired or not. Also, there will be a mobile application that will scan the QR code installed in the vehicle. If anyone does not like to carry an extra card, they can do the same thing with the mobile app. People can either use the smart RFID card or QR code in their smart device. People can recharge their accounts by themselves by login into the transport portal.

This is how the system may work, but the approach might change after proper data collection. The challenges are how securely we can transfer the money to company and Government account, if any device is damaged, how quickly it will be recovered, and another major challenge is how citizens will welcome this new system, how everyone can seamlessly scan the Card. If we can successfully implement this system, it will help each and everyone, and it will help the vehicle owner and also each general people.

So the main target of this research is to introduce a new electronic payment system to facilitate the Bangladesh Public Transport sector. A prototype will be developed which will provide the e-ticketing service for Public Transport.

1.3 Research Questions

The first and foremost important initiative for the research is to figure out the appropriate research questions. This research targets to create a proposed model by answering the research questions. According to my research, there have several challenges to develop and implement such a system. Based on this, the most important concern is the payment system, and later, the other issues are like the Transparency of the system and to develop such a system. Before developing the proposed model I will be seeking the perceptions of current experience and the probable acceptance of newly designed solutions from target users, and this will be validated with the specialist of the specific fields.

With these challenges, below are the research question:

The main research question is:

- How to design and implement the e-Ticket system in Bangladesh?

The main concern of my research is to design and implement an easy and simple electronic payment system that will have acceptance in society. In Bangladesh, people suffer a lot while paying the rent/fare of transport. From all perspectives, the payment

system should be designed in such a way so that all concerning parties are benefitted. Even the technology for the design and implementation should also be up-to-date so that the electronic payment development may be easier and future up-gradation may also be simpler. This research question will be a concern, how the e-ticket system will be designed and how to implement it in Bangladesh Transport Sector.

Regarding the main question, the sub-questions are as follows:

- How to Increase the Transparency of e-Ticket in the transport sector?

"Transparency has been defined as the disclosure of information (Egels-Zandén et al., 2015; Doorey, 2011; Mol, 2014) that enables fair competition (Akerlof, 1970), profitable business ventures (Tapscott et al., 2003), and company fulfillment regarding sustainability efforts (Kaptein et al., 2003; Kaynak et al., 2012)" [4]. For developing public service delivery, Transparency has been broadly encouraged [1]. Different countries have their approach to accomplish this goal to increase transparency in the public service sector which should also be considered for the Bangladeshi Public Transport sector. As in the proposed system, there will be a profound change in the payment system, so Transparency is the main concern. When a government operates in an open, widely known, and accepted manner, it is said to be a transparent government [2]. In a free and open society, the Government is obliged to maintain Transparency while sharing information with its citizens [3]. Every necessary initiative should be taken to increase transparency so that the Public Transport Company and the citizens can trust the system and rely on the digital e-ticket system.

- What are the benefits of this proposed solution in the transport sector?

The main target of implementing a new digital system is to get the most benefits from the system. Government, Transport company and the citizens should be benefitted. The Government is losing millions of dollars in taxes from the transport sector, and Travel companies are also losing money. And lastly and most importantly, the citizens are the main victims who are losing money but are not getting the proper service as desired. The hassle of hand-to-hand payment of fare will no longer exist; no bargain with the contractor will exist either. Overall, the system will come up with the best and easier payment system to ensure satisfaction for all concerning parties.

- What is the suitable solution for architecture and design?

This sub-question describes the main queries for such a digital system like e-Ticket in the Bangladesh Transport sector. In the e-Ticket system, there will be options for QR Code scan. This question is one of the top concerns to the main stakeholders, what will be the suitable system, how will be the architectural design, for whom the solution will be developed, and also how to develop the best solution is a matter of great concern.

2. RESEARCH DESIGN AND METHODOLOGY

After analyzing the research methodology and taking into account the research topic, Design Science Research is chosen.

In Bangladesh, there has already a digital ID card (NID), but still, citizens are not well aware of the use of this Card. Also yet it is not possible to get all the public services from this Card. So the thoughts and attitudes of the major citizens are very important.

To implement such an e-Ticket system for public transport, it is necessary to know what the thoughts of the citizens about the digital cards for public transport are. So at the same time, it is also important to collect the research data. The online interview can be conducted by one-on-one interview approach.

To accomplish the desired goal of research based on a particular phenomenon, proper research methodology should be chosen from the very beginning of the research. It helps the audience as well as the researchers to understand and identify the overall approach of the research. Even the research conducting persons should be well organized and so that the research does not waste time or money [16].

Anil Kumar Jharotia, From the Tecnia Institute of Advanced Studies, GGSIP University, Delhi, India, defined how important is the method section of any research. From the method section, any research committee can get a clear picture of how the research problems will be tacked, and as well as it shows the whole work plan how the research will be completed [17].

Research methodology might be characterized by how experimentally the research study may be done. Through investigation methodology, the research issues can be unraveled in a more precise way [18].

2.1 Design Science Research

Panos Y. Papalambros mentioned several factors to define and support design Science methodology, what are the products complexity, process design along with the relevant organizations. He also mentioned that it is important to acknowledge the brains behind the intricate design of the goods/products and their users. [19].

DSR is treated as a qualitative research method where the design process is the main object, as it produces information concurrently about the method used to design an artifact as well as the design of the artifact itself [15]. Design science is a method of study that focuses on designing new information technology (IT) artifacts [9, 20]. The DSR is based on the concept of systematic knowledge creation and building to provide new, inventive, authentic, and intriguing facts, or objects to the concerned community [13,20].

Design Science was introduced for research in the information science(IS) domain. The researchers of the 60s and 70s mainly concentrated on natural and social science research based on design science to understand the DSR pattern [21].

For developing the e-Ticket system in the transport sector and for determining and categorizing prospects and difficulties [23], I have chosen the design science methodology. The Design Science approach is learning through building.

For this research purpose, Kuechler and Vaishnavi's General Design Cycle will be used. They found this DR process by studying the Design Science Research in Information Science(DSRIS) [24].
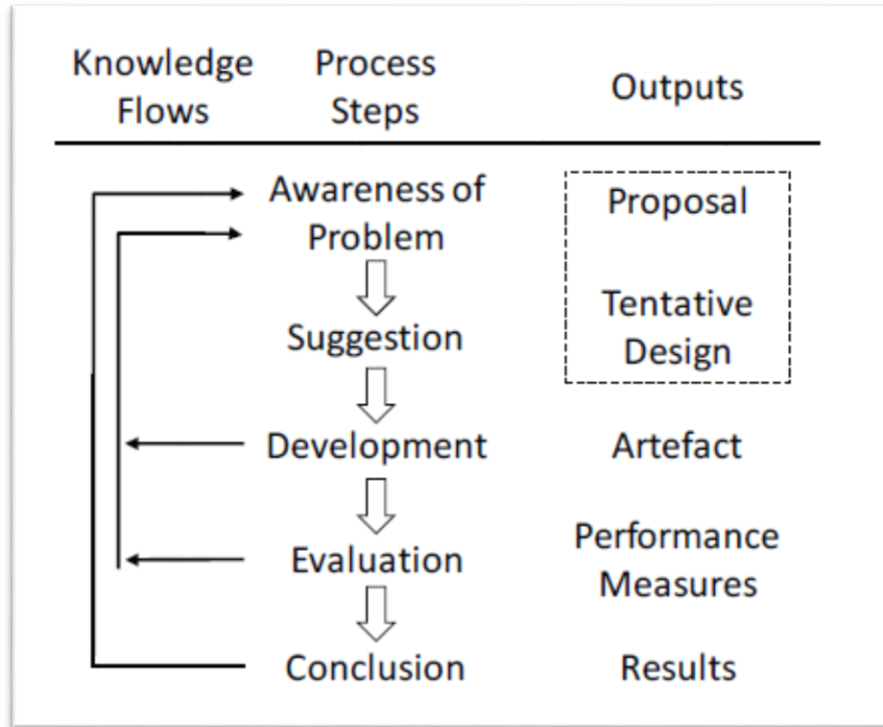
Figure 1. General Design Cycle of DSR [24].

To obtain the possible answers to the research question, the defined process in Figure 1 is treated as an effective process. Before going to the next level at first needs to be aware of the problems.

Hevner et al. said that the Awareness phase must focus on the business problem, and at the same time, it ought to be acknowledgeable. And the solutions based on the awareness phase should review the main discussed issues in the suggestion phase [24].

The awareness phase is the first phase in the design cycle which is the most complex and large. From experienced existing knowledge, we can get figure out the main problem areas. After this stage, the Suggestion phase starts, which leads us to upgrade the current payment system of the public transport and develop the proposed e-Ticket system.

The valuable suggestions will be considered, and the artifacts will be designed. In our case, the e-Ticket system can be treated as the designed artifact. This Development phase is an iterative process. Initial designed application/ software will be validated by several IT professionals of Bangladesh. Based on their comment, further, up-gradation will proceed.

Once the e-Ticket system is built, there is a need for evaluation. "Beyond a simple prototype, evaluation confirms a rapid growth regarding the conceptual approach of the research." [24]. Proper evaluation could be conducted by the relevant group of information science and also by the real-world users of the e-ticket solution. According to Skyrius & Bujauskas, the Evaluation phase upsurges the research at the practical level, and the research increases at the industrial level as well [24]. Initially, the e-Ticket system will be launched as a pilot project in few areas of the capital city of Dhaka. After a certain time, the feedback from the real will be collected, and thus the system will be upgraded. For example, after this stage, we can figure out how the people are reacting with the different package types. Based on this we can introduce more packages in the Payment system.

Concludingly, the final results or the conclusions are taken from the IT artifact. On the contrary, since every process can lead to possible repetitions and improvements of the previous/primary steps as portrayed in Fig. 1, the entire process on its own can be considered immensely recurring [25].

The model of Kuechler and Vaishnavi is an iterative process that enables the prospects to modify or update the designed model and theory expansion.

Though Wieringa(2014) and van Aken(2004) has defined Design Knowledge as a holistic and heuristic by its nature, so they concentrated on using in-context validation to explain the progression [26]. Dyb°a et al. (2012) honed in on certain unseen background variables that might impact the problem-solution pair. For this reason, it was almost impossible to prove the impact of the solution. And for this situation, they relied on the heuristic approach [26]. So in our subject of study, we must evaluate multiple problem-solution pairs for getting a better understanding.

2.2 Data Sample

Dhaka, the Capital City of Bangladesh, suffers from a variety of issues as a result of this massive population pressure, including a shortage of housing and other basic amenities, pollution, and, most notably, an inefficient transportation system. On the contrary, the transportation infrastructure has not been maintained. Dhaka now has some of the world's worst traffic jams [77]. This problem is not only in Dhaka but all over the country.
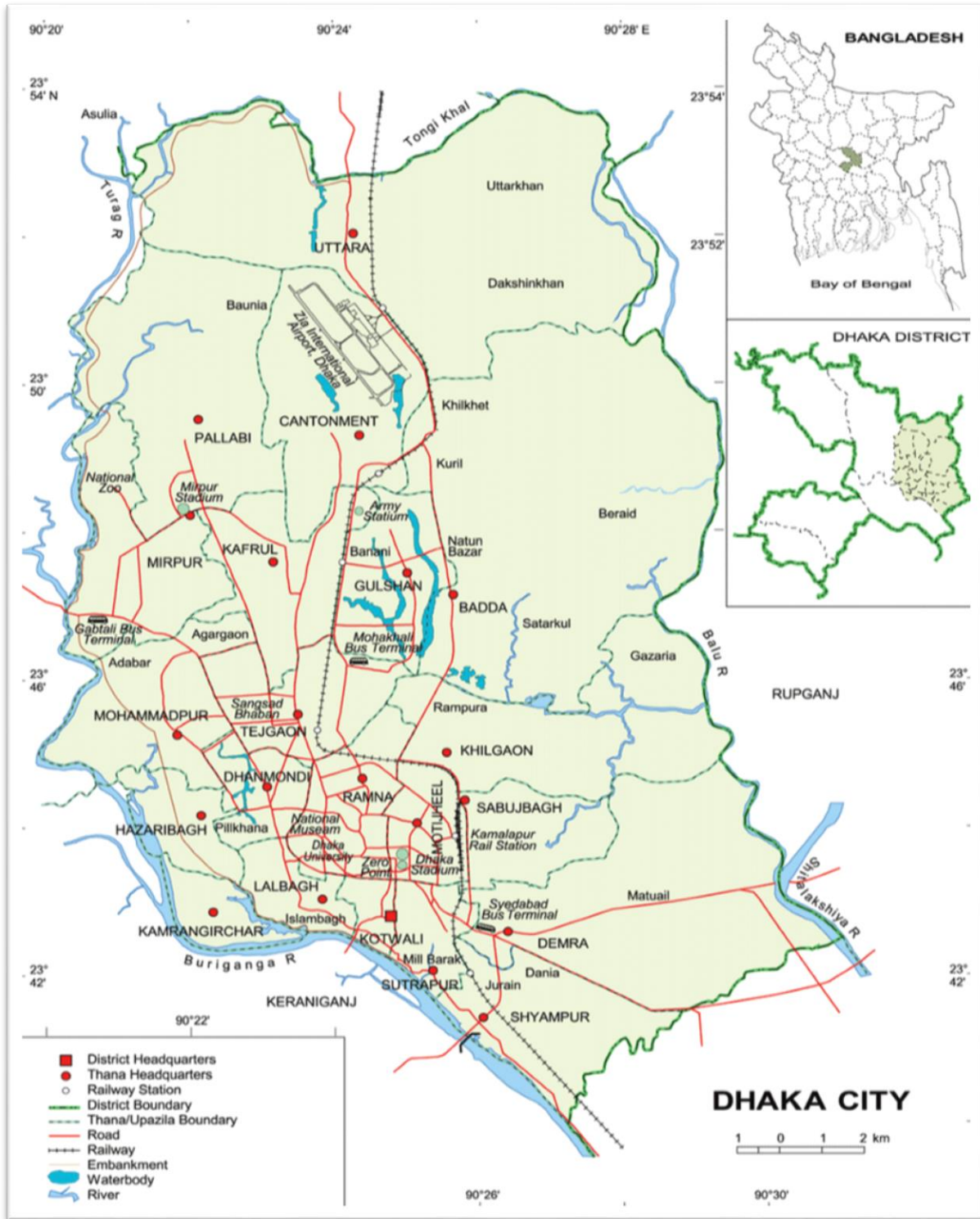
Figure 2. Dhaka City Roadmap

2.2.1 Sample Size Determination

In this study, simple random sampling method will be used. The following statistical formula will be applied for sample size determination:

$$n = \frac{z^2 . p. q. N}{z^2 . p. q + (N - 1)e^2}$$

$$= 96.038 \sim 100$$

Here,

$n =$ Sample size

$N =$ Targeted population

$e =$ Marginal error

$p =$ Proportion of population with certain characteristics

$q =$ Proportion of population without certain characteristics (1-p)

$z =$ Level of significance

Given values mentioned in the sampling estimate:

N =   4565128 (People age between 20-60 years)

e =   0.1 (10% marginal error)

p =   0.5

q =   factor q (1-p) = 0.5

z =   1.96 (at 95% confidence level)

Calculating the values, we get the sample size =97 considering 95% confidence level and 8% marginal error, but for rounding-up as well as more representation of the beneficiaries, the assessment considers a total of 100 respondents as part of a quantitative survey.

2.2.2 Collection of Primary Information through Online-based Survey

Adult citizens of Dhaka who use public transportation daily are target participants of the study. Responses will be gathered from an online survey (Google form) created specifically for this purpose. During the report, the Helsinki Declaration guidelines for human participant testing are followed. The research plans to collect a sample of 100 (approximately) people from which data will be analyzed. The study objective will be stated in the questionnaire during the online survey,

and all responses will be obtained with the consent of the respondents. Furthermore, the survey responses would be received anonymously, protecting the respondents' confidentiality. These data will be analyzed through STATA software.

2.2.3 Collection of Information through Key Informant Interview (KII)

Several Key Informant Interview (KII) meetings will be held with related people from the public and private transportation sectors, academia, and other fields. KII will also be conducted with other relevant stakeholders, such as transportation consultants, planners, and researchers, to collect their expert opinions on the studied subject. The data will be collected through a virtual interview session. The interviews will be taken in the native language, so after the interview, they will be transcribed and analyzed. Thematic analysis will be done by using the most popular and effective NVivo tool. Based on the interview, the transcribed results will be divided into several them, and then the analysis will be performed.

3. THEORETICAL BACKGROUND

This chapter represents the theoretical concepts in a more detailed form to describe the core idea in the subject of the thesis. A brief discussion about Good Governance, Public Service Management, and Change Management is shown here. Also, how this theory lies, a proper interconnection for the introduction of the e-ticket is discussed broadly.

3.1 Good Governance

There has no concrete explanation of Good Governance. But we will try to find out the relevant definitions from different scholars thought which will further be helpful to relate the thesis discussion. Whenever introducing a new service in the public service sector, it always tries to focus on providing the best facilities to the citizens. And without ICT Good governance is almost impossible. ICT plays a vital role on this basis.

Neena Jindal et al. mentioned the ICT tools as the vital instruments for developing good governance. The presence of ICT opens new prospects so that Government can manage the process uniquely and more efficiently; they said [27].

Several countries have demonstrated an interest in using information technologies to restructuring various public sectors. And for the development of Government and giant agencies, countries around the world are introducing ICT as a crucial tool [28].

In 1988 Kofi Annan, Former United Nations Secretary-General mentioned good governance as a key that could minimize poverty and foster the growth of every nation [29]. Through the means of the establishment of a standard for good governance, improved service delivery and progressive liability are aimed at while talking about what good governance should consist of. Efficient decisiveness, better usage of resources, progressive accountability for the supervision of resources;

are some of the factors that should be encouraged through effective governance in the public sector. [30].

European Commission enlisted five major fluid governance principles; they are accountability, participation, openness, coherence, and effectiveness [29]. Richard K. Bemile from Methodist University College Ghana mentioned eight major characteristics of good governance, including participatory, agreement situated, responsible, straightforward, responsive, viable and productive, impartial and comprehensive, and the rule of law is followed accordingly [31]. OECD also focused on some specific terms while defining good governance. They were also similar to the previous ones like responsibility, proficiency, responsiveness, straightforwardness, and adequacy, forward vision, and the law rules [29].

Citing Sahni (2003), Adebayo (2014) had come up with some more clear definitions. They describe good governance as a collection of policies, principles, and organizations by which society manages social, political, and economic processes by engaging with the public and private sectors [32]. However, their definition also concentrates on the development of Government.

But if we look into Srivastava's (2009) definition we can realize how good governance could have a greater emphasis on reducing fraud, power misuse, chicanery, and embezzlement of funds [32].

Srivastava (2009) also mentioned, to establish a further betterment inefficiency, legality, and reliability of the system, it refers to the acquisition of the new traits and values of governance. Therefore, a good definition of good governance is an element of the establishment of positive excellencies of organization and end of indecencies of deteriorations. Shortly, what it must contain are the traits of being productive, acceptable and legal administrative system, be people-caring and empathetic. [32].

From the above-mentioned definition, it is easily understood how the studied subject is going to help to establish good governance in Bangladesh. The e-Ticket system has lots of facilities like the public sector service provider should be accountable for any misinterpretation, the travel cost will be open for all, and each citizen will pay the same fare. As I mentioned earlier, the Transport owner nowadays demands the fare as they wish. But in the blessing of the newly introduced e-Ticket, the fare distribution will be transparent; the corruption will be reduced. However, since corruption is

one of the major challenges in the development of every developing nation, such as Bangladesh, we will never be able to eradicate it. From the Nigerian case study in 2014, we can see how they faced challenges to eliminate corruption even with good governance; thus, they mentioned it as one of the most crucial tasks faced by African countries [32].

Still, we may conclude that e-Ticket would aid in the reduction of corruption. As a result, the Government would have a positive reputation among people, increasing public satisfaction. And obviously, this can facilitate the country to develop its socio-economic standing.

Md. Mahedi Hasan et al. from Prime University, Bangladesh, had a simple and greater thought about e-Payment and how this could be a streamline to establish a good government. Say, E-payment is a concept currently that is no longer in a debatable position that demands an improvement in government standards and policies. The primary issue when it comes to key policy considerations is merely the lacking of systematic tax collection in Bangladesh's current public transportation sector. This entire process of collection of the taxes would be more clear and have fewer regulatory requirements under the New Public Management [44].

The word "good governance" should not be seen as a catch-all phrase for a variety of issues. Merilee Grindle from Harvard Kennedy School mentioned governance is generally perceived [33].

Many public services are now accessible online due to developments in ICT. E-Payment is being adopted almost all over the world. Bangladesh is also not different in this perspective. The Government E-payments Adoption Ranking (GEAR) portrays that most governments are focusing on the accessibility of electronic exchange administrations for residents and organizations at various levels. However, they have critical work to do in improving three territories that help e-installments selection, specifically framework, social and financial setting, and strategy/policy [34].

Whenever we are discussing Good Governance, the New Public Management concept comes to mind. However, there may have some differences but are related to each other in terms of improving the efficiency and effectiveness of governance.

3.2 New Public Management

Hood, 1990; Pollitt & Dan, 2011 said that most of the countries in the last four decades had reshaped the public sector using the New Public Management [35]. Nazmul Ahsan Kalimullah et al. (2012) stated good governance as an adaptation of new public management in public administration [43]. They mentioned NPM as a philosophy and a package of specific management methods or techniques to achieve the goal [43].

For the last three decades, the public sector management body has been under several vital changes. As a result, there was a necessity of introducing the New Public Management. Almquist *et al.* (2013) highlighted this issue and also focused that accountability to society [36].

The lack of any systematic, proper tax collection process in Bangladesh's existing public transportation sector is one of the major issues. This tax collection process would be more straightforward and have fewer bureaucratic constraints under the New Public Management.

As mentioned in good governance, the Government itself should be accountable for a change based on the newly introduced e-Ticket. Jagat, Revenio said that the Government itself would be responsible and will serve as the skipper and controller of New Public Management where several topics will be considered such as deregulation, redistribution, governments less interference, the market's utmost importance, and decreased size of Government [37].

This new approach is to moving aways from the traditional administrative mode. Fakhrul Islam(2015) mentioned similar ideas, new open administration addresses a change of public area and its relationship with Government and society [39].

Fatemi and Behmanesh also mentioned that more tasks are now assigned to the private sectors in the new concept of management [37]. So, both public and private organizations will be held accountable.

There may remain several arguments whether to choose public or private management; there have obvious benefits of NPM. During this pandemic, both advantages and disadvantages were reported. The Swedish and the Spanish people blamed the service of contract-out for care homes,

whereas the Australian Government earned positive feedback to fight against the pandemic because of the collaboration of public-private partnerships [35].

And in terms of implementation of NPM and to improve performance of deliverable service of the public sector, the ICT has become the key factor [53]. In e-Governance, ICT is used to improve cost-efficiency to provide more appropriate services while still allowing people to access information, allowing a government to become more accountable and transparent [40]. The application of the ICT has been implemented in the different 'devices' of administration strategy, specifically, authority, treasure, and hierarchical limit. [41].

These days, the transformation of administrative services is primarily focused on the use and advancement of e-government to improve public participation by developing mutual information communication through ICT [42].

After discussing all aforementioned ideas from different scholars, we found a good relationship between good governance and NPM based on ICT. It is believed that based on Good Government and New public management, Introducing e-Ticket in the public transportation sector will help us to achieve the thesis study's target.

As the growth of technology is rapid so the development of the overall process should be paced at the perfect speed. And also, as the NPM might also be introduced so, there will raise the issue of Change Management. The processes, technological changes, and overall infrastructure changes will have a great effect on society.

3.3 Change Management

Based on the research study, there will have drastic changes in the different organizations of Bangladesh, including the public-private organizations. The main changes will be found in the Transport Authority. Similarly, adapting to this newly designed e-Ticket system there will also have a great impact on the citizens. In 2018, Maëlezig Bigi et al. had an analysis on ICT and Change Management of both the French public and private sector. They found a different perception among the public and private sector employees. They found that with the change ICT

and management, Public sector employees expressed discouragement, while in the private sector, employees reacted positively with involvement and fair work recognition [44].

There have several definitions of Change Management. Motab Raja Aljohani defined Change management is defined as a cluster of skills and abilities which are needed for effective inception and execution of progress [45].

Therefore Muhammad Hashim has defined Change Management in the most simple and easily understandable way. According to him, when any organization plans to amend the recent business process to a newly formed pattern to adapt to the rapid changes for the maximum benefits, then it can be said the Change Management term comes [45]. The process includes the changes of organizational activities as well as the implementation [45].

The above-mentioned definitions are based on Organizational Changes. PROSCI, an expert organization, also focused on organizational changes while defining change management. According to them, Change Management guides how to successfully adopt the organizational changes for success [46].

Maciej Teczke et al. defined it as a systematic approach to improving the environment through the management of citizens, processes, and technology, as well as preserving competitiveness through the alignment of business strategies with external changes [47].

However, SHRM org definition is not specifically focused on any specific organization but a whole environment. According to their definition, Change management is the purposeful procedure and use of data, instruments, and resources to oversee change. The characterization and the welcoming of the corporal plan of action, designs, strategies, and progress susceptible to counteract the transitions in the external setup are also included [48].

To adopt change management, there remain several models which might be implemented based on the studied research. Based on the research context, this will be not only a particular organizational change but also an overall change in different concerning parties, including public, private organizations, and most importantly, to the people. According to research from Forbes in

2016, 38% are willing to adapt to new things. When this 38% of people were given a new idea, they welcomed it, but 62% of people are not willing to leave their current comfort zones [49].

The Department of Human Resources of Manchester Metropolitan University focused on three overlapping aspects while introducing change; they are; people, processes, and culture [70]. So to define any model, we should keep in mind these three aspects. One of the main concerns of this study is to make a transparent e-Ticket system so that people easily rely on it. To make the huge population of Bangladesh adapt to the change is always a great challenge. So keeping in mind this fact, there needs to choose a proper change management model.

For good governance, it is always a challenge to choose the appropriate model of change management. Change management is often an intimidating task because it necessitates the cooperation of the front and backend IT infrastructure of any organization (Apostolou et al.,2011) [50]. Therefore Sushil and Saboohi (2010) mentioned, "Managing e-government is invariably managing change" [50]. Kifle and Low Kim Cheng mentioned to keep in mind while introducing any new changes, and technological modification brings changes in several sectors as the culture, policy, mindset, process, and organizational structure. They mentioned that the changes in innovation acquire changes in strategy, culture, outlook, hierarchical design, and the cycle [50].

Based on the study, we can talk about Lewin's three-step model (Unfreezing, Moving, and Refreeing), where the current state of the process will be changed and finally institutionalize the change into the strategic objective [51].
Fred Nickols mentioned this model as a staged approach. He said that it leads to pondering an arranged way to deal with evolving things. Looking before you jump is typically stable practice[52].

Figure 3. Lewin's Change Model [51]

McKinsey's 7s Model is one of the best examples which follows a long-term strategy [51].
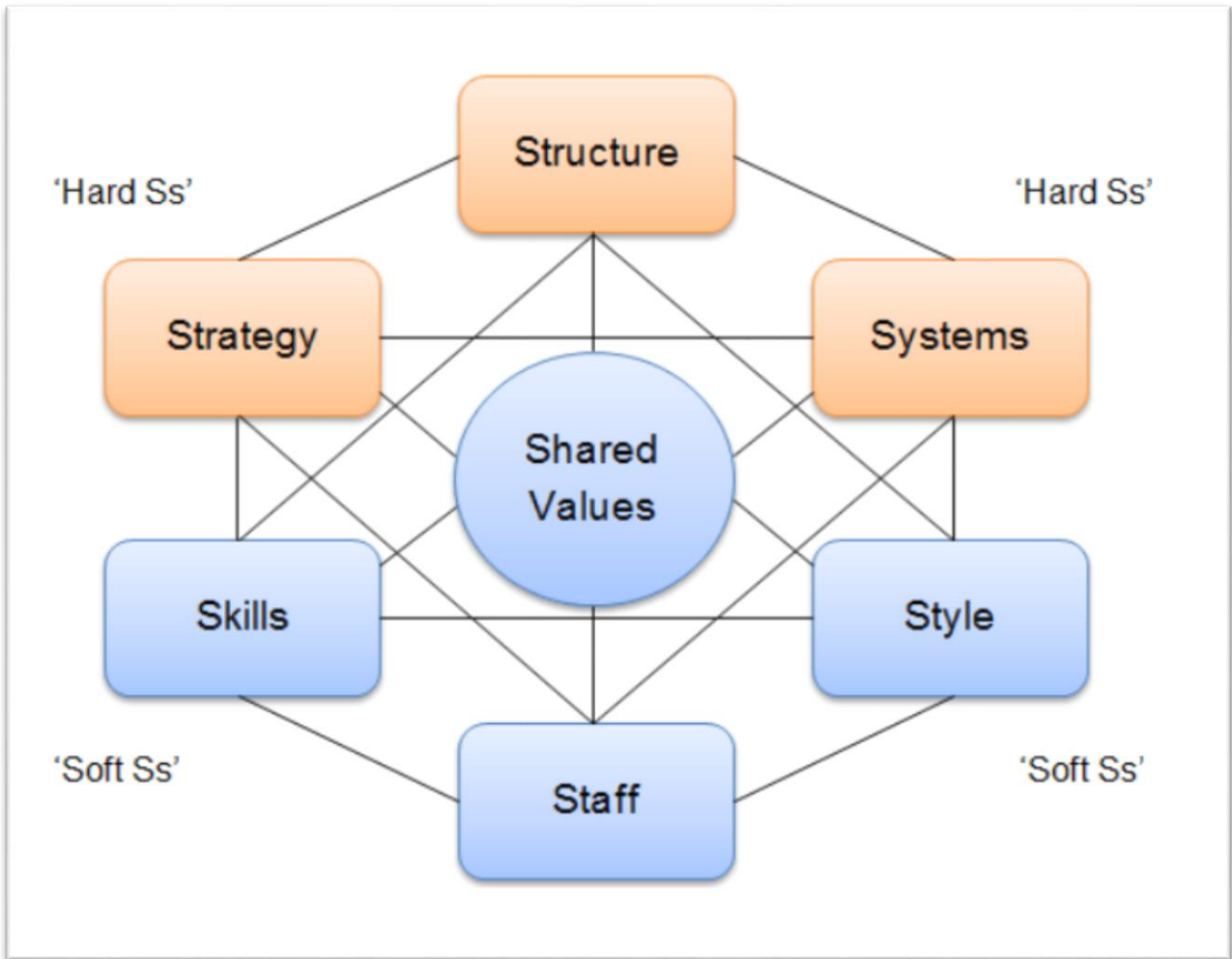

Figure 4. McKinsey's 7s Model [51]

In 1998 Pendlebury et al. designed a model of the Ten Key factors which can be used in any situation of changes, and also it was not mandatory to implement all the processes simultaneously; according to the requirements, the processes can also be implemented separately [47]. The keys are; 1. Vision defining, 2. Catalyzing, 3. Activating, 4. Navigating, 5. Delivering, 6. Involvement, 7. Handling power, 8. Emotions controlling, 9. Training, and 10. Communicating enthusiastically [47].

Another best model could be Leavitt's Extended Model, where they mentioned that technological changes cause process changes as well as changes in cultural structure [50].
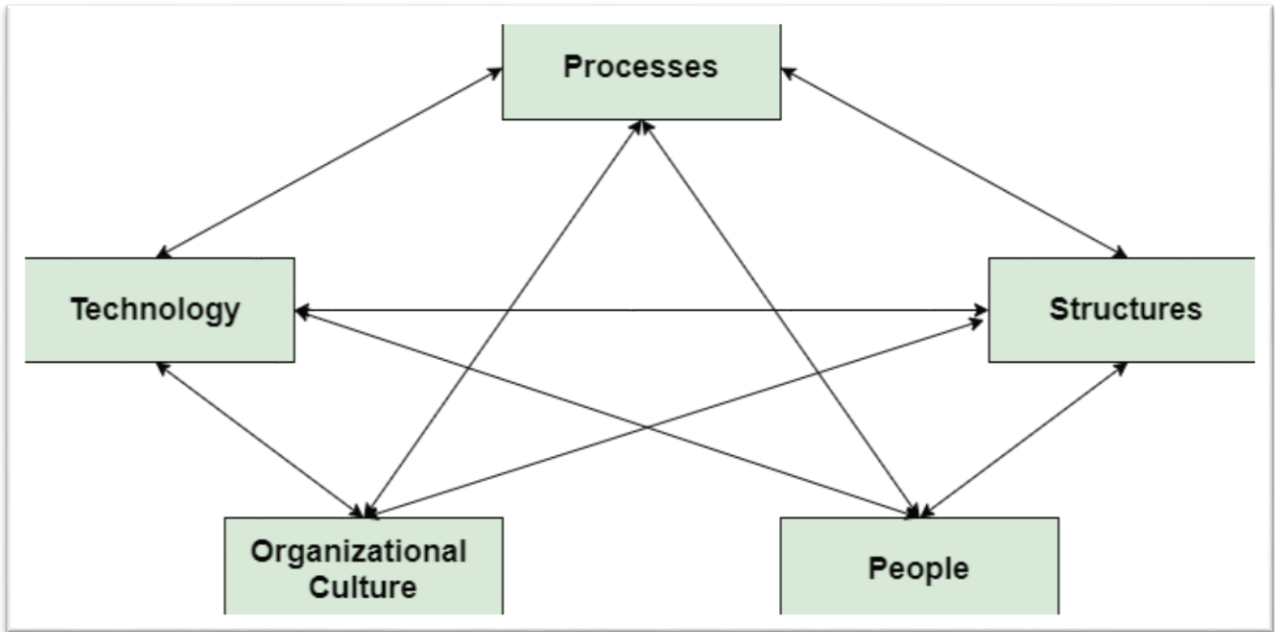
Figure 5. Leavitt's Extended Model [50]

4. STATE OF THE ART

The transportation system is one of the most crucial aspects of a country's overall development. Amitabh Kant, CEO, Delhi Mumbai Industrial Corridor (DMIC), agrees that domestic transportation is the primary trait when it comes to economic betterment [5]. The socio-economic development of any nation mostly relies on the transport system. From history, it is also proved that the key to the development of first-world countries is the developed transport system.

However, this chapter will give an overview of the e-payment system practice in different developed countries, which will help us to gain some experience. We can also notice how these technologies have helped the countries to practice as good governance. We will emphasize more on the Estonian e-payment in the public transport sector, specifically on the Smartcard.

If we look into the public transport system in the countries of the EU, almost all have the world's best transport system. EU countries have simply had a revolution in the transport sector. As a forthcoming of transportation of Europe, the ICT resolutions are being apparent [6]. ICT application plays a vital role in this case, where eID is a standard example.

In a co-funded project by European Commission, the COMPASS project, ICT is highlighted as a critical element in the full realization of the initiative. The project has identified classifications of ICT applications specifically intended for the passenger:
[6]

- Transportation Management Systems, Supports the planning and management of an efficient transport system.
- Traveler Information Systems assists the traveler on the basic details, such as time of travel, travel-routes, conditions of traffic, etc., needed by the traveler to plan and purchase for his travel. It allows the access of information to the travelers.

- Smart Ticketing and Tolling Applications, Innovative solutions on the dispensing the tickets- buy and pay point
- Vehicle-to-Infrastructure (V2I) applications, Wireless cooperative interaction to interoperate the vehicles and infrastructure based on the regulation of traffic system.
- Vehicle-to-Vehicle (V2V) applications, Collaboration amidst the applications of the vehicles, and the dissemination of the important transport services to the passengers focusing on safety, mobility, and efficiency of the operations
- demand-responsive Transport (DRT) services, Mechanism involving the picked-up and dropped off locations (fixed routes) of passengers.

According to Moroz, OV, and Moroz MM [7,8], Municipal traveler transportation is one of the most critical factors in ensuring a city's survival and effectiveness when linking various areas of the reimbursement into a single complex organism [9]. Today, Cell phones with NFC modules are increasingly being used in conjunction with NFC technology. These incorporate the telephones of notable makers like Nokia, Benq, Samsung, HTC, LG. They permit admittance in a rundown of the latest computerized administrations, for example, - ticket enlistment, which implies intuitive methods for installment out in the open vehicle frameworks; - electronic installments as a choice to money and plastic Mastercards for buying products and paying for administrations. In a few countries of Europe as Russia, Italy, France, Germany, Spain, and Great Britain, and in addition, the USA and Japan [9].

According to a report of 2018, based upon the Kingly city in Rwanda, due to cash handling problems and theft, metropolitan buses were depleted to forty percent of their profits for handling the cash issue manually, and scams and organizations lacked the data they needed to better deploy their fleets. Among a major three co-operatives bus service, Kigali was one of them who partnered with local firm AC Group to install near-field communications (NFC) technology on buses, allowing for 'Tap & Go' payments. Riders can now pay instantly with pre-loaded smart cards and be transported without any delay. And this changes the result dramatically, as, in the first few months, the revenue rose by 140 percent [10].

From research, it is also found that QR codes and RFID cards are also being used for a smart transport system. RFID technology has long been regarded as a significant converging technology

of the twentieth century. RFID's application in Intelligent Transportation Systems is obtaining fame and acceptance under its prevalent usage when it comes to the area of control of the toll and the management of the overall transportation market [12].

4.1 Estonian Public Transport e-Payment

In the digital transport sector, the biggest example is the Tallinn Bus card in Estonia. Estonia is the world's first e-government country where almost every public services are online-based. Estonian all e-Service data are interconnected using one digital platform, x-Road, which operated all the data exchange of existing service and also facilitated the newly introduced service [53]. Since January 2013, the city of Tallinn, Estonia's capital, has implemented an FFPT (Free-Fare Public Transportation) scheme for all of its citizens. The service is operated by city-run operators. Anyone can buy a QR ticket to validate on public transport. In general, the people of Tallinn have a personalized electronic Smart card to travel inside the city free of cost. This card is integrated with the personal Identity Number.

Estonia introduced its first Estonian ID card in January 2002. Since then, we can see how Estonia has become one of the most advanced countries based on ICT [54]. Before that, Tallinn has had introduced the Tallinn card in 1998, which allows the cardholder to use it as a travel ticket for unlimited free traveling in public transport [55].

But what took more interest base on my research study is the Smartcard(Ühiskaart). The green, plastic card is used as a farecard which can be bought from the post office, Tallinn City Government customer service desk, or from any R-Kiosk by costing €2 and recharging suitable packages [56].

Figure 6. Tallinn Smartcard [57]

Tourists from other countries can buy non-personalized Smartcards also, but they have a personalized smartcard, the cardholder must be listed in the population register. Anyone from EU or non-EU if want to have the personalized Smartcard; the process is similar. [57]. Also, by login into pilet.ee, any allowed people can also personalize by themselves, using the iOS or Android app. People can also top up the card by themselves [58]. The cardholder can upload money for 1,3,5 and 30 days of validation. It is also possible to purchase an hourly e-ticket by loading 1.5 euros in the Smartcard. Each time traveler swipes the Smartcard in the validator in the vehicles. The validator will show green light if the card is valid; otherwise, it shows red light [59]. Like in Tallinn, Tartu city also introduced such Smartcard (Tallinn Bussikaart) from 1st September 2015 [60]. If we look back in the past, we see that the area of Viimsi Municipality was the first to decide not to use paper-based tickets [61].

4.2 Different Countries e-Ticketing System in Public Transport

4.2.1 Belgium

From September 2007, Belgium started practicing the SMS ticketing system as an alternative to selling tickets on the bus and got great success. During the first month of deployment, every day, 1700 SMS tickets were being sold**.** In 2008 Poland introduced a mobile payment system via Skycash, which is also successful [11]. At first, one of the transport company De Lijn had introduced the SMS payment system. There only needed to send a message DL to 4884 for getting a one-hour ticket and DLD to buy a full day ticket [62].

Also, by buying an Antwerp City Card, people can choose to travel from 24 hours, 48 hours, and 72 hours based on the paid money [63].

4.2.2 Finland

If we look into Finland's transport sector, we will see, they are using Smart card-based public transport fare collection systems since 1988. The Helsinki Card/ Helsinki Card CITY serves as a ticket for unlimited rides on Helsinki public transportation, including buses, trams, metro, commuter trains, and the Suomenlinna ferry [13]. Most of the big city of Finland has a different strategy of the transport system, but all use Electronic Id with the electronic payment system. In general, the introduction of smartcards per se leads to an increase in the demand for public transport [13].

People of Helsinki can purchase an HSL card(this card is valid in the specific area of Helsinki) which is the most popular for Helsinki public transport. Using the HSL App, users can do e-payment and travel around [64]. Even within 2023, Helsinki Regional Transport, in partnership with TVV lippu-ja maksujärjestelmä Oy (LMJ), has planned to switch all its travel payments via contactless EMV. A UK-based transit transaction payment company Littlepay is working on this project to achieve this cashless e-payment service [65].

4.2.3 Germany

Germany also has taken lots of initiative and solutions in the field of e-payment, especially for e-ticket and m-ticket(mobile ticket). Back in 1998, they have started to develop the contactless e-payment system in electronic ticketing. In 2007 a completely mobile phone-based ticketing system was introduced, which is HandyTicket Deutschland. The passengers can buy their tickets and pay via mobile application with any of the payment methods, including credit card, SEPA debit card, and so on [66]. Passengers can purchase a ticket online based on daily, weekly, and even single [66].

Nowadays (AFC) Automated Fare Collection is also introduced MaskTech used the MTCOS technical stable operating system in Germany, which is based on the VDV-KA (Verein Deutscher Verkehrsbetriebe - Kernapplikation) standard. Based on Common Criteria certified public key-

based smart card controller, this standard specifies a data structure and interfaces for fare management and e-ticketing solutions. VDV-KA promises interoperability over the terminal and backend system in Germany [67].

4.2.4 China

One of the world's biggest and largely populated count is China. China has made a revolution in the digital e-payment system. According to the estimation of 2017, China's mobile payments were double than 2016, and for 890 million unique payments, the transaction amount was $17 trillion [68]. They also estimated that within 2022 there would be more than 700 million transactions [68].

Nowadays days, china has also adapted the e-payment service to maintain its huge public transport sector. There are several payment methods to pay for the travels. In 2017 UnionPay introduced a "tap and go" application named QuickPass.It allows the passengers to pay money by QR code scanning. Smart mobile applications and NFC technologies were also used. The passengers just needed to place their mobile near the card slots [69].

AliPay, WeChat Pay, JDPay all provide the e-payment service, which is also being used in several cities. Tencent, one of the Giant Chinese internet, introduce e-payment on May 8, 2018, on the Shenzhen subway [38].

5. BANGLADESH: CURRENT DEVELOPMENT IN E-TICKET SYSTEM

Nowadays, electronic payment is widely being used all over Bangladesh. E-commerce has been dramatically developed everywhere. As a result, electronic payment was the most important factor. Online Banking, mobile banking is now very familiar to almost every citizen of the country. But as cyber threats are a major issue, still few people are afraid of such transactions. Several electronic payment systems are already known and being used, like BKash, Rocket, Nogod, NPS(National Payment Switch).

Bangladesh Bank, the central bank of Bangladesh, already launched NPS in 2012 [22], but still, all the banks have not yet joined this platform. NPS is a common platform for payment which is a cost-effective and easier way of the transaction [22]. The other system like BKash, Rocket, or Nogod is called SMS banking or mobile banking system. For any payment on an e-commerce site, or recharge mobile bill, pay the electricity bill, people can use these SMS banking services as well as also can use the Online banking service.

According to Prothom-Alo, one of the top Newspapers in Bangladesh reported in 2014, and the online market was dramatically growing from 15 percent to 20 parents, where the engagement of peoples shopping online also increase by about 1.5 to 2 million [72].

Currently, all Bangladeshi Banks have online services. One can easily transfer money from one account to any other account in a different bank and can also pay any type of bill online.

From March 2009, Bangladesh railway has introduced the e-Ticket system, which was a revolutionary step in the e-Ticketing system in such public transport sector. This e-Ticket is a digital version of a paper-based ticket. Passengers can purchase the ticket using their mobile or specific sales point; the e-ticket will then be sent as SMS to that mobile. With the SMS, passengers can go to the station and collect the paper-based ticket [71].

Though Bangladesh Railway ticket is called e-Ticket but yet it is not fully digital. People are still to collect paper-based tickets. The main benefit people get the hassle-free, transparent and effective purchasing of the ticket by online payment.

Taking into account the ticket collections process, Shohoz.com, a European and Bangladesh Investors collaboration, have initiated the e-Ticket Service in 2014, where they provide the e-Ticket facility for Bus Travel on the long route and deliver the ticket to the passengers home [73].

In April 2016, Access To Information (a2i) program did a study based on the Time, Cost, and Visit for Bangladesh Railway e-Ticket service where they found that within seven years, the system became popular among the citizens, and 25% of the tickets have been sold as e-Ticket. They did a study with 384 samples and found that an average of 75% of the time is saved and cost reduced by 84% [74].

Bangladesh, especially the capital city Dhaka, is being populated day by day, and the number of traffic jams is increasing tremendously. For this reason, the Government has already taken several giant initiatives which are under development. Among them, DMRT (Dhaka Mass Rapid Transit) is the topmost priority which will be based on Metro Rail transport.

To facilitate this plan in 2016 Bangladesh government, with the help of JICA, resulted from the RSTP as a metropolitan blueprint for Dhaka with a 20-year planning horizon [75]. RSTP also proposed 2 BRT(Bus Rapid Transit) lines along with the MRT and estimated these would have a capacity of transport of 18,000 to 46,000 passengers in each hour. These both systems will also introduce the automated fare collection system, which will also be an e-Ticket system [75].

6. RESULTS

A strategy for assessing subjective and qualitative information/data is analysis, specifically, a thematic one. It's commonly used to depict a gathering of writings, for example, interview transcripts. It's typically used to describe a group of texts, such as interview transcripts. This study aimed to look at the data and see if there were any recurring trends – subjects, concepts, and patterns of context that came up repeatedly [77].

The qualitative research and thematic analysis were carried out using the NVivo tools for Qualitative Data Analysis (QDA) [78]. Technology for qualitative data analysis is frequently considered to be founded on grounded hypothesis ways to deal with the analysis of data, in which the emergence of the data preceding from the theory, and the software frequently includes "memoing" devices to aid in theoretical creation. When it comes to data interpretation, using a grounded theory approach involves letting the data "speak for themselves" rather than addressing the data across current analytical constructs [79]. Excel software was used to clean and organize the survey data for the analysis.

The data were used for the elaborative statistical study to determine the characteristics of the related variables and any possible relationships between them. STATA software was used to do the descriptive analysis with data visualization.
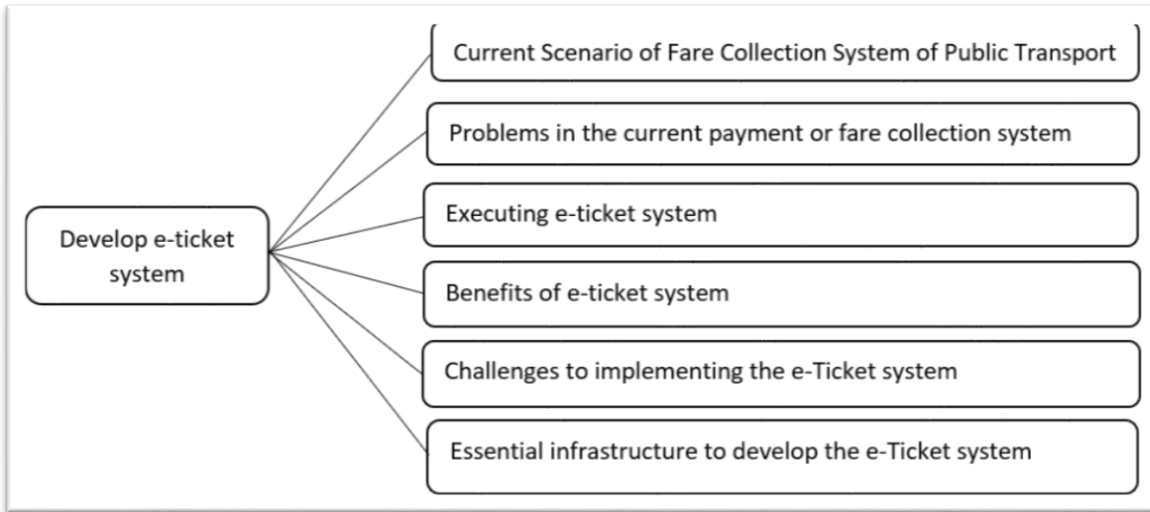
Figure 7. Thematic Network Model of the Emergent Themes
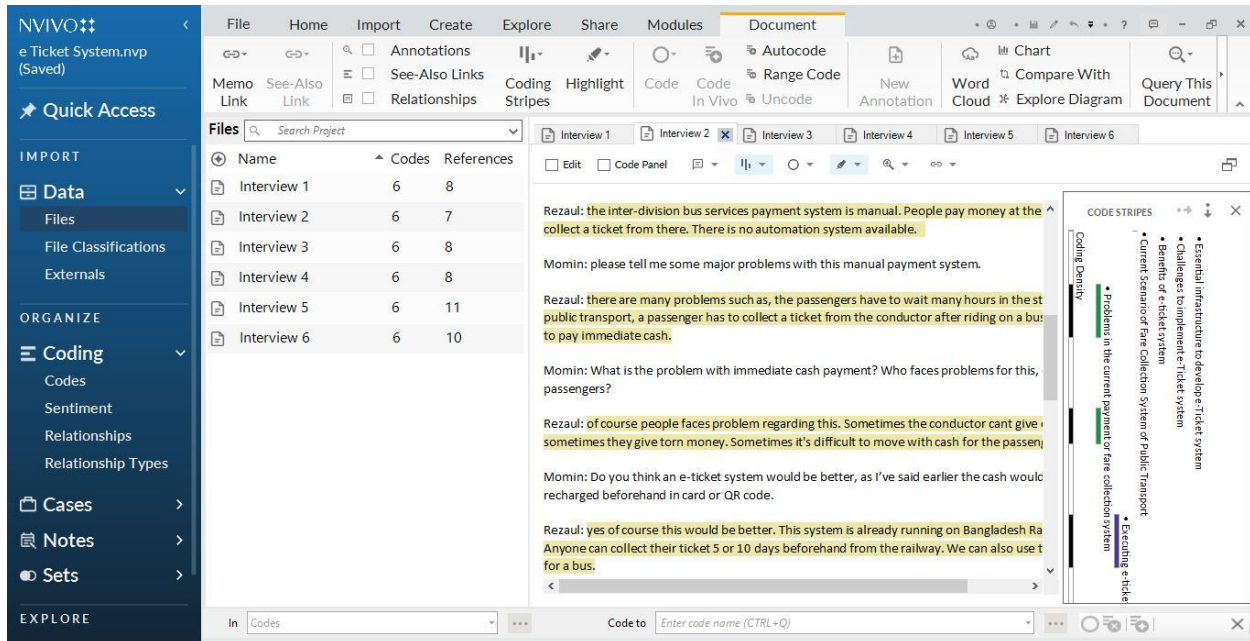
Figure 8. NVivo Tools File View
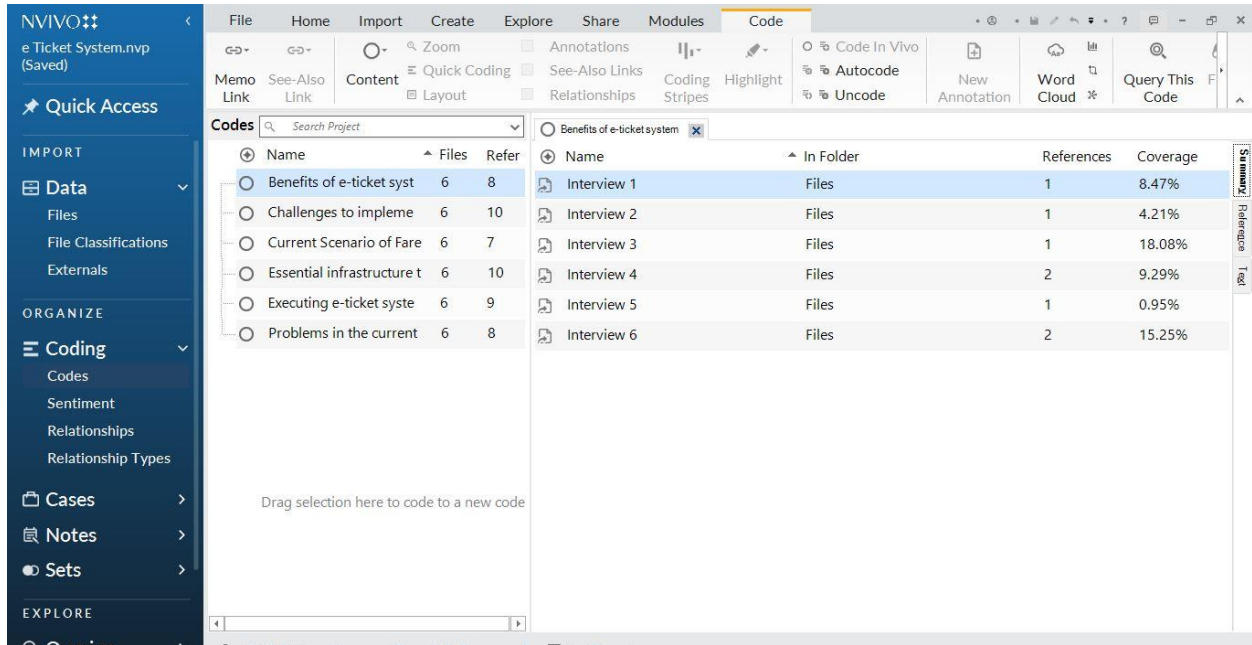
Figure 9. NVivo Tools Code Sample 1
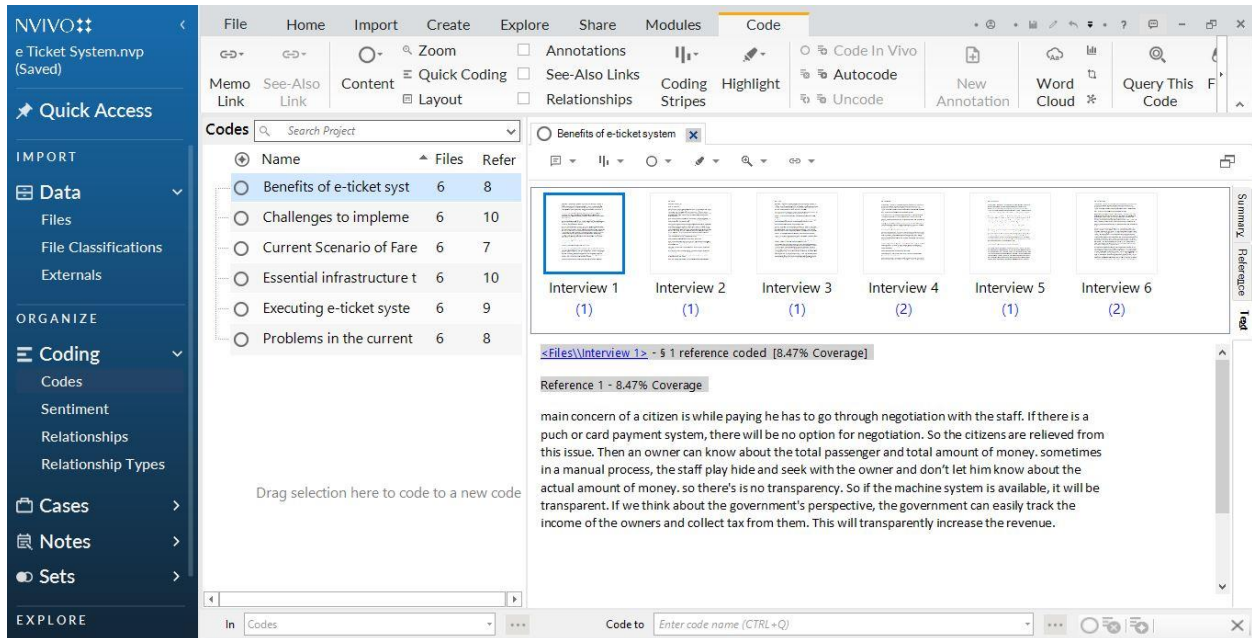
Figure 10. NVivo Tools Code Sample 2
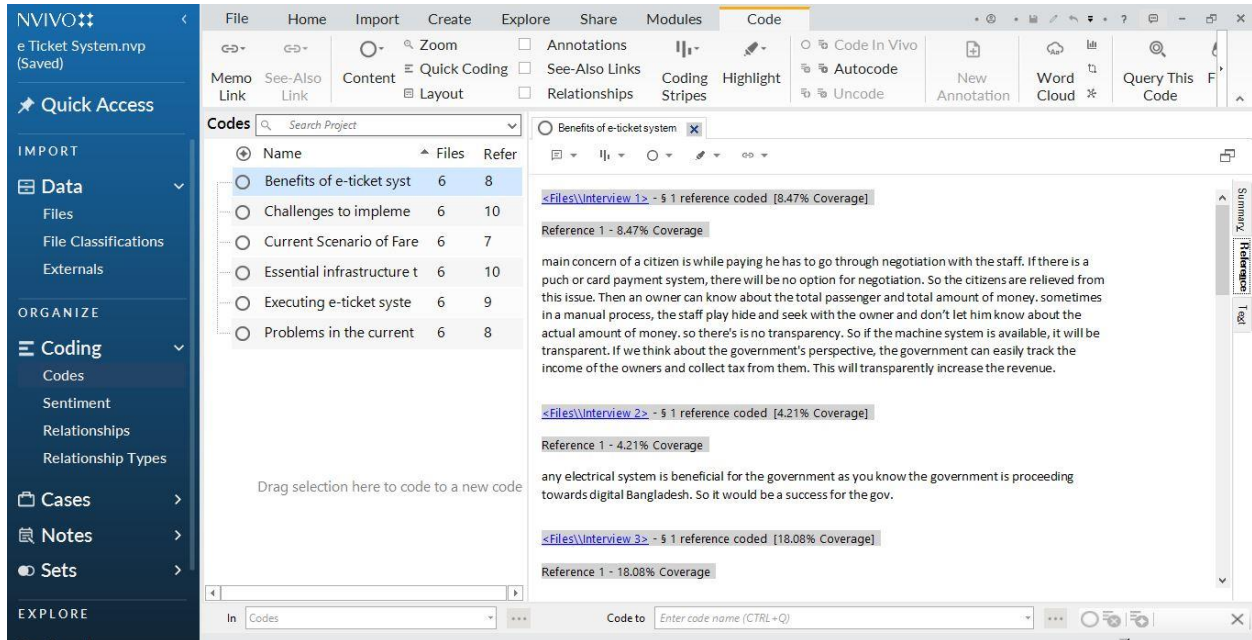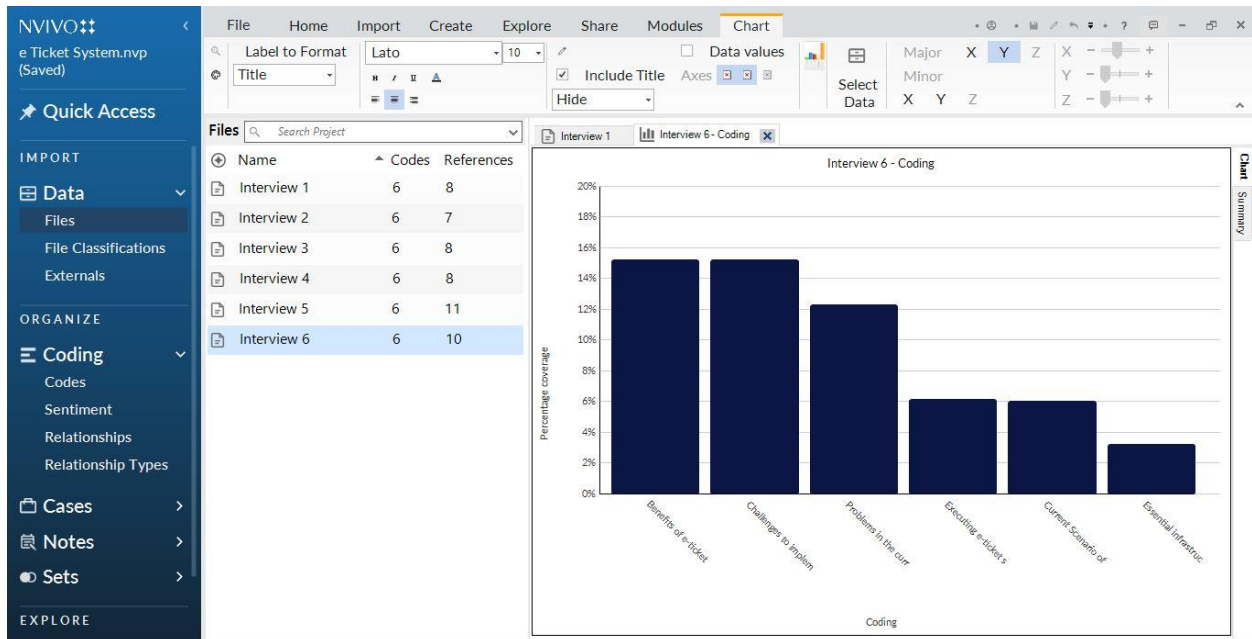
Figure 11. NVivo Tools Code Sample 3
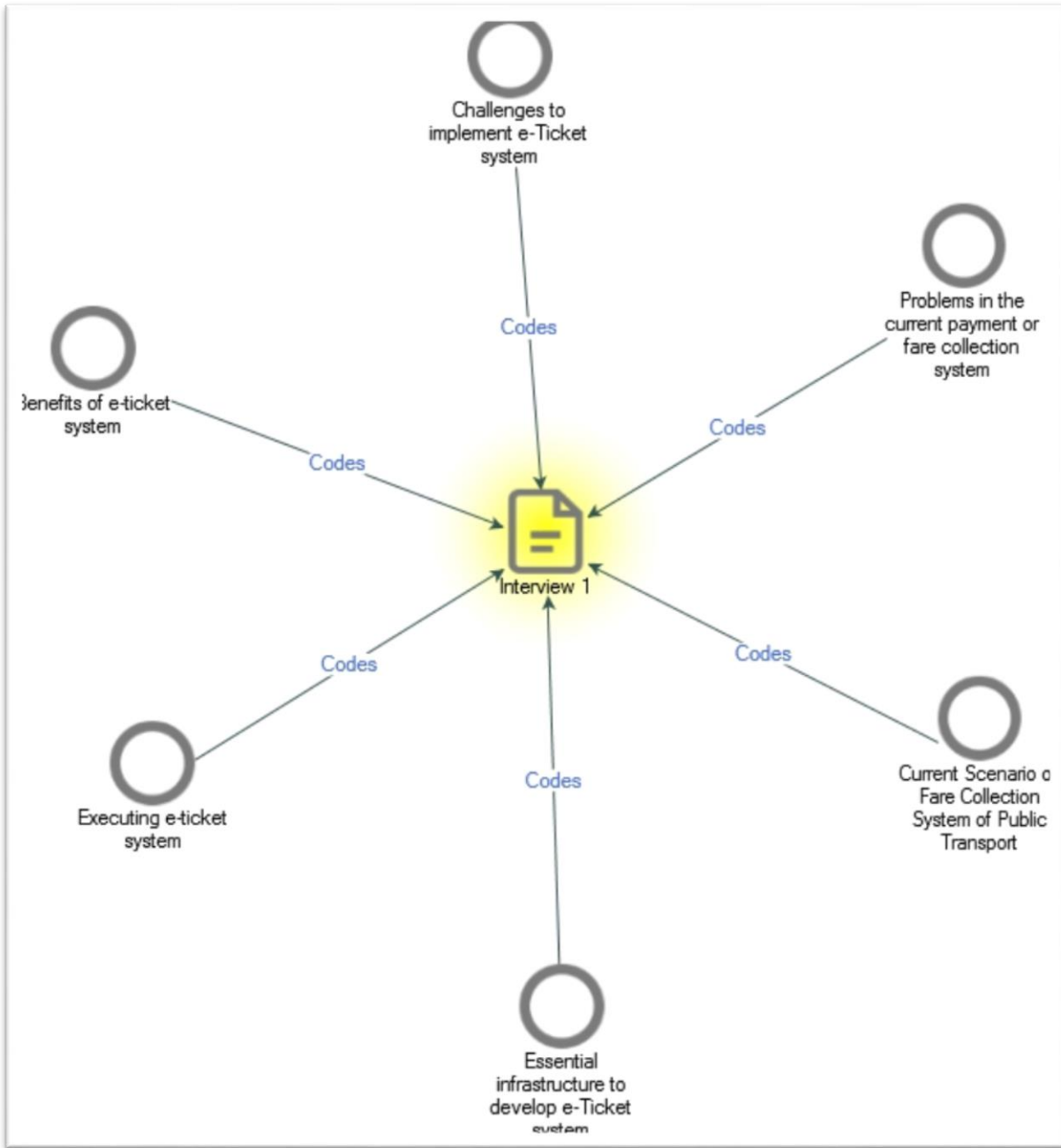

Figure 12. NVivo Tools Chart View

Figure 13. Thematic Nodes

6.1 Result

Of the total online surveyed, about 37% are government service holders, and 19% are private service holders, 15% are academicians, 13% are software developers, and others (Figure:12).
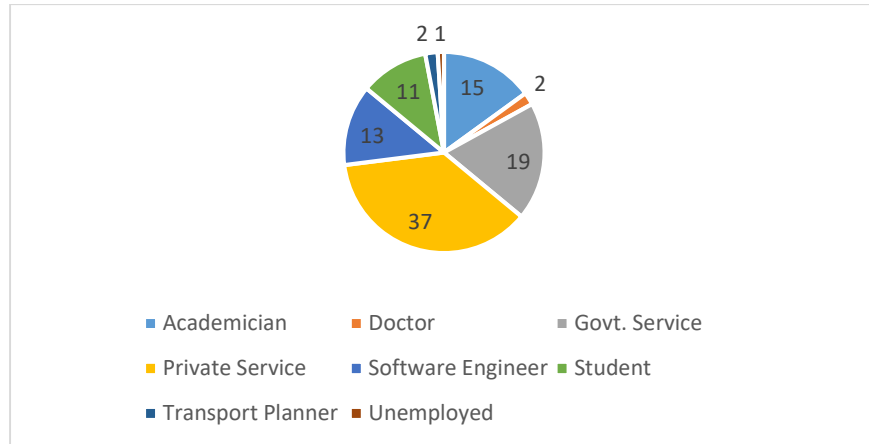
Figure 14. Professionals Information of Survey Participant

From the survey result, it is seen that majority of the time people use public transport to go from one place to another. People are so much dependent on the public transport system.
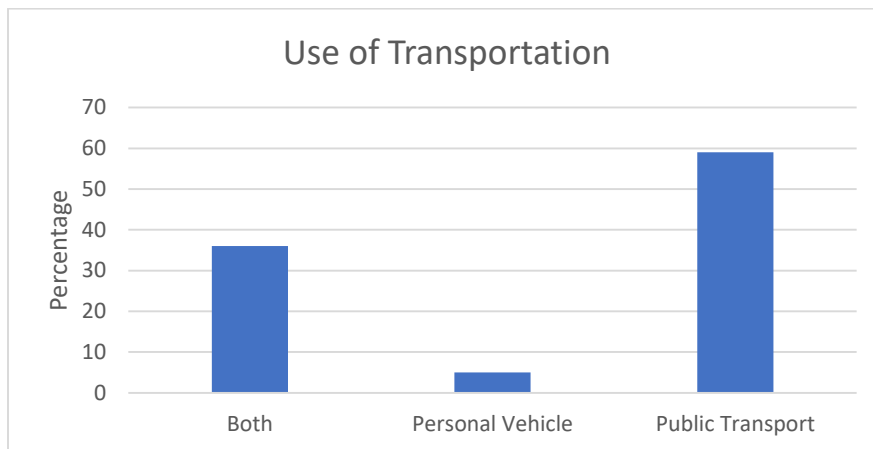
Figure 15. Use of Public Transport System

6.1.1 Current Scenario of Fare Collection System of Public Transport

The inter-division and outside the city public transport services payment system is manual. There is no automation system available. There are some kinds of stuff in every bus (public transport) such as the driver, conductor, and helper.

Mainly The conductor is in charge of collecting fares; he collects the fare from passengers within the journey, in the bus. But in other developed countries, we can see that a passenger has to punch a card before getting on a bus, and after the journey, when he gets off from the bus, he punches a card, and the fare automatically cuts for his certain destination. The fare system is connected to the route permit.

BRTA works with the license, route permit. BRTA fixes a certain amount per kilometer, but the public transport authority doesn't abide by these fare amounts. These things make chaos. It's not like that the Government isn't taking steps; the Long-distance buses, trains, the airline also has a ticketing system. But the local or city service buses don't include these facilities.

6.1.2 Problems in the Current Payment or Fare Collection System

The manual fare collection system has big issues with accountability and Transparency. There isn't a single service that is consistently structured.

A passenger cannot offer the government-set fare since each bus company sets its fare. Since the bus owners have no idea how many people are traveling, they set a regular fixed price for the bus drivers, which creates a troublesome situation. To get more passengers, the bus driver stops the buses on the side of the road. As a result, the drivers and conductors are always in a rush to obtain more money from the passengers, who are not always aware of the costs.

There is chaos occasionally, which results in a serious fight. The Government is also missing out on revenue because they don't have an estimate of overall fare collection. After riding on a bus, passengers must pay cash immediately to obtain a ticket from the bus conductor. It is difficult to travel with cash for the passengers at times. The bus conductor can't give changes most of the time, and sometimes they give torn money as changes.

Staff's attitude is not conducive to passenger comfort. Women, old people, and special people don't get proper facilities. The bus staff doesn't care about them or try to avoid them as they don't have any accountability.

6.1.3 Executing e-Ticket System

The e-ticket system can be weekly, monthly, or route-based, and it can come in a variety of packets so that a one- or two-month package system can be pursued. It would be ideal if it were a prepaid scheme, with passengers recharging a certain amount of money, such as 500 or 1,000 takas. In the survey, it was found that the people use decent money in travel fare every week which can be minimized by using e-ticketing system.
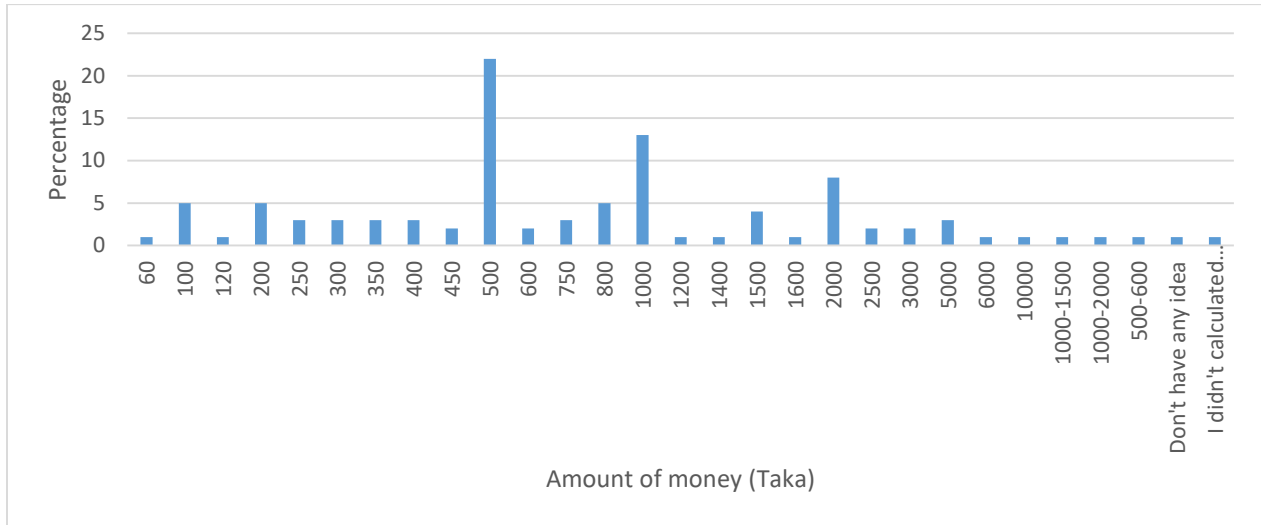
Figure 16. Cost of Fare in Week

The fare can be adjusted based on the distance traveled or per kilometer. The package systems should be simple to use.

There should be a machine equipped with a GPS that can measure the difference between where the passenger punched the first time and where the passenger punched the second time to deduct the fare.

Both RFID cards and QR code technologies can be used, but each has advantages and disadvantages. These scanning or codes cannot be used by people who do not have smartphones. If the drivers' or conductors' phones have an internet system, passengers who do not have access to the internet can sync their data from their phones.

6.1.4 Benefits of e-Ticket System

Passengers will benefit the most from an e-ticket system because they will know the correct fare for a certain distance. There will be no chaos because every bus will charge the same fare. People can put this time to good use by doing some effective works. According to the survey, around 60% of people believe that an e-ticketing system will save them money.

48
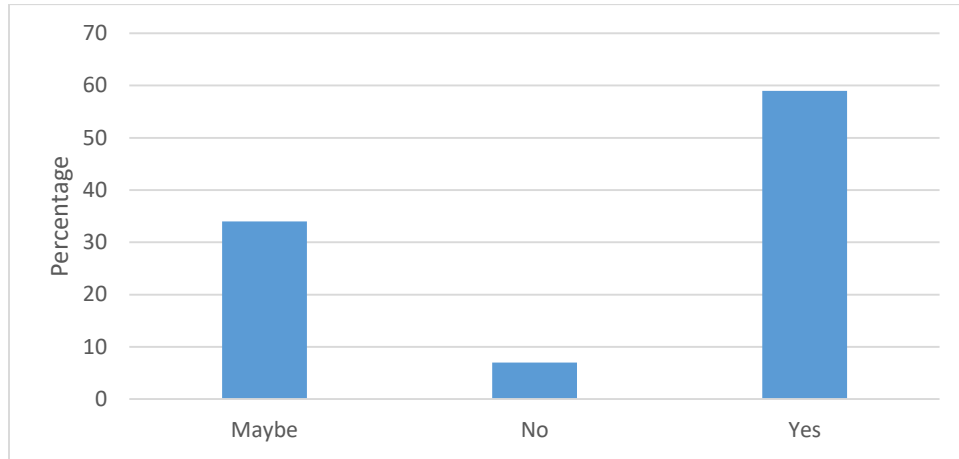
Figure 17. Participants Response about e-Ticket System Benefit

There will be no option for bargaining about fare if a push or card payment system will be used. In a manual fare collection system, the transportation worker plays hide and seek with the owner, keeping the actual amount of money hidden from them.

However, in the e-ticket system, transportation owners can see the total number of passengers and the total amount of money. Every bus driver has a regular target, as they must pay the owners a certain amount of money every day, so they try to get as many passengers as possible. As a result, they run the buses haphazardly. When he sees another bus, whether, from the same business or a different driver, he considers it his mission to overtake it, this will result in a traffic jam or even an accident. If this e-ticket scheme is implemented, these driver races will be halted, and the bus driver will be aware that he is only required to stop the bus at some points, rather than at all times.

There will be no additional passenger crowding, boarding, or unloading. There will be fewer road accidents. Since the conductor must collect the fare frequently, he often charges the passenger who has already paid, so these inconveniences will be eliminated if an e-ticket scheme will implement.

6.1.5 Challenges to Implementing the e-Ticket System

The e-ticket is a smart idea, but putting it into practice would be difficult for the Government. Among the transport workers, there is a large syndicate. For the Government, it is extremely difficult to eliminate the syndicate and implement an e-ticketing scheme.

The payment system should be relatively short and simple for passengers to be comfortable in using the e-ticket system. The passenger must be given multiple options to pay; only then will he take the e-ticket system. A regular passenger can pay with a card or a QR code, but a passenger who only flies once or twice would need a simpler payment system. If you are always linked to the internet, the service would be at its best. But it should be kept in mind that people don't always have internet data on their phones. Ensure the terminal system, where the vehicles will be parked at night.

The bus qualities should be ensured, how many years can a bus run in the road, number of seats, seats for women or aged, bus stands, these facilities must be included. Since the credit card is not accessible to the general public, the development of an e-ticket system necessitates the use of a digital sector. The general public is not familiar with advanced payment. The BRT system, Traffic Police system should be organized. The management system should be given priority.

6.1.6 Essential Infrastructure to Develop the e-Ticket System

The infrastructure of Dhaka city is vulnerable. There are no specific bus stops. Another barrier is there is no specific lane for a bus. There are more than 150 bus companies in Dhaka. It would be difficult for each organization to do it on its own. This strategy would be simple to enforce and manage if all buses are grouped into two or three companies.
Bus stops can be built in specific locations and every kilometer, with nice facilities such as shade, seats for travelers, and services for disabled people so that they can conveniently reach the stoppage. Every bus stop should have a bus bay where buses can conveniently park for one or two minutes.

The Government will organize numerous bus control boards, as well as obtain incorporate proposals from other nations.

Vehicle licensing, classification, and RFID monitoring systems should be readily accessible. Locally or nationwide, a route map should be developed. It is essential to create a digital archive. The main priorities would be the route rather than companies because the competition system creates chaos and accidents. To use this system, public transportation staff, maintenance personnel,

and owners must be trained. First and foremost, the system should be evaluated. The flaws or loopholes would become apparent at that stage.

7. PROPOSED MODEL

The proposed model is a fully online-based e-Ticketing system. There have several functionalities to fulfill all the necessary operations. The steps are divided into several sections. In general, one person will register in the Transport Portal and will recharge their account with the desired package. Different packages cost a different amount and will have their expiration period. After that, they will scan the smart RFID card or scan the QR code in the smartphone. The Scanning device will verify the data. That is how it will work.

7.1 System Implementation

Implementation of the system required to use –

- ✓ C# (MVC)
- ✓ ASP.NET,
- ✓ MSSQL,

7.2 Registration

To get the e-Ticket system's service, one must register to the government transport portal. For this, at first, there should be a Transport portal linked with Government central database. In this portal, there will be two different Roles, one for admin and another is for citizens themselves. In my initial design, one citizen can do registration in two ways.

Figure 18. User Interface for Registration
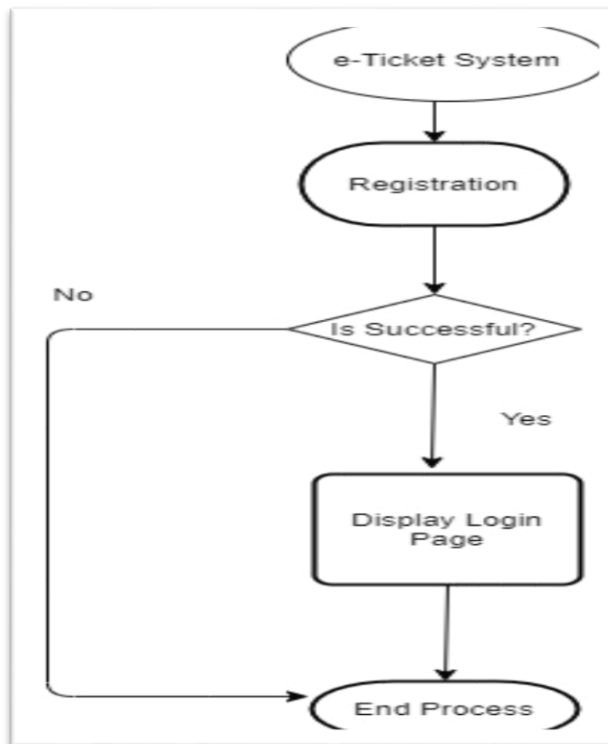
Figure 19. Activity Diagram of Registration Process

7.2.1 Registration Process for Vehicle Enlist in Transport

With the admin role, the owner of the vehicle can enlist their government-registered vehicle into the list. It means this vehicle will run on a specific route. When the owner registers and login to the transport portal, they can enlist their vehicle by providing the vehicle details along with the

license number. Later they can choose on which route they will run their vehicle. After that, they can assign the desired package which they want to offer to the citizens. From the list, citizens/ passengers can choose their desired packages. One thing to make sure that for the same route, the package cost will be the same for every vehicle.

7.2.2 The Registration process for Card Registration in Sales Point

In each government-registered sales point, the salesperson can register any citizen. In that case, a salesperson will log in to the transport portal as admin. If any citizens need to register and purchase the smart RFID card, they will provide the NID number to the salesperson. With the NID number, the salesperson will do the registration from the Register menu and hand over the purchased RFID smart card to the citizen. The Card can now be used as a transport card with proper payment packages.

7.2.3 Self Registration Process for Citizens

This is a self-registration process who don't want any RFID card. Instead, they are intended to use the QR code on their smart device. In the portal, there will be a self-registration menu. After clicking this menu, the self-registration page will open. The person will then enter the national Identification number and click submit button.
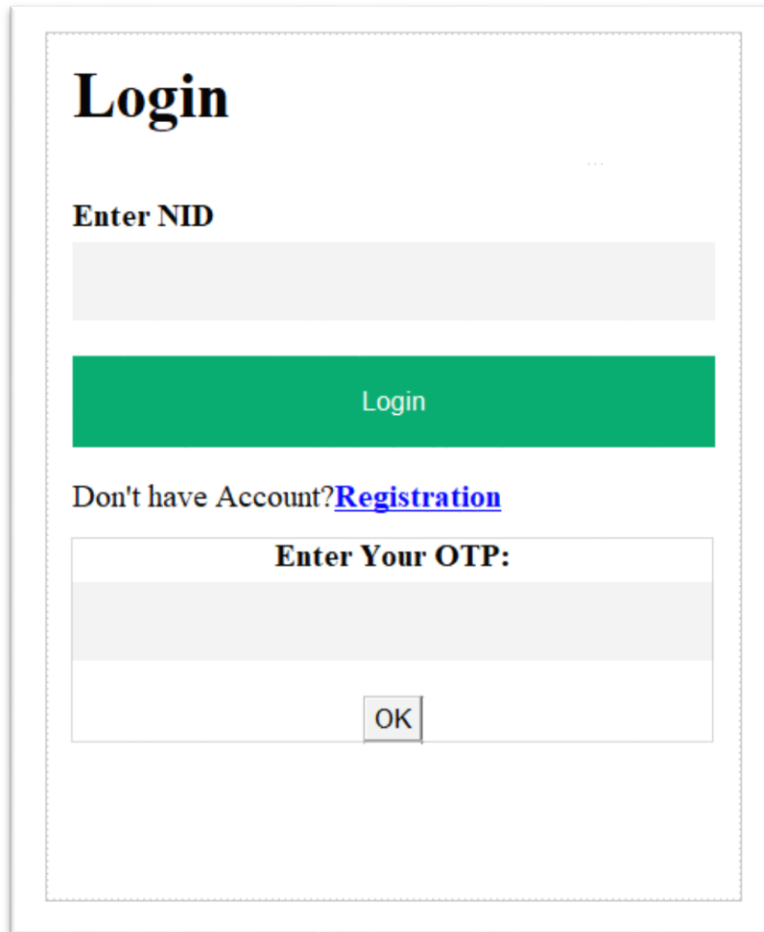
At that time, a push notification will be found on that citizen's phone(this phone number must be attached with the National Identification Number) with a verification code. This verification code will then be provided for the registration. If the code matches, then the registration is successful. And if the verification code expires or puts a wrong verification code, then a user-friendly error message will be shown. After successfully registration you are good to go on the next step, log in and then recharge the balance, and chose the package in the specific account.

7.3 Login

In the Transport portal, anyone registered in the system can log in by simply providing their National Identification Number. Once providing a valid NID number, if you click the OK Login button, a verification code will be sent to the person's registered mobile number. This verification code will expire after a certain period, for example, after 60 seconds. Within this time, the requester

has to provide the verification code in the specific field and click OK. If the Verification code matches, then the Home page will be opened. There will be several menus in the portal.

On the Home page, one can see the previous recharge and package history as well as can also see the current packages.
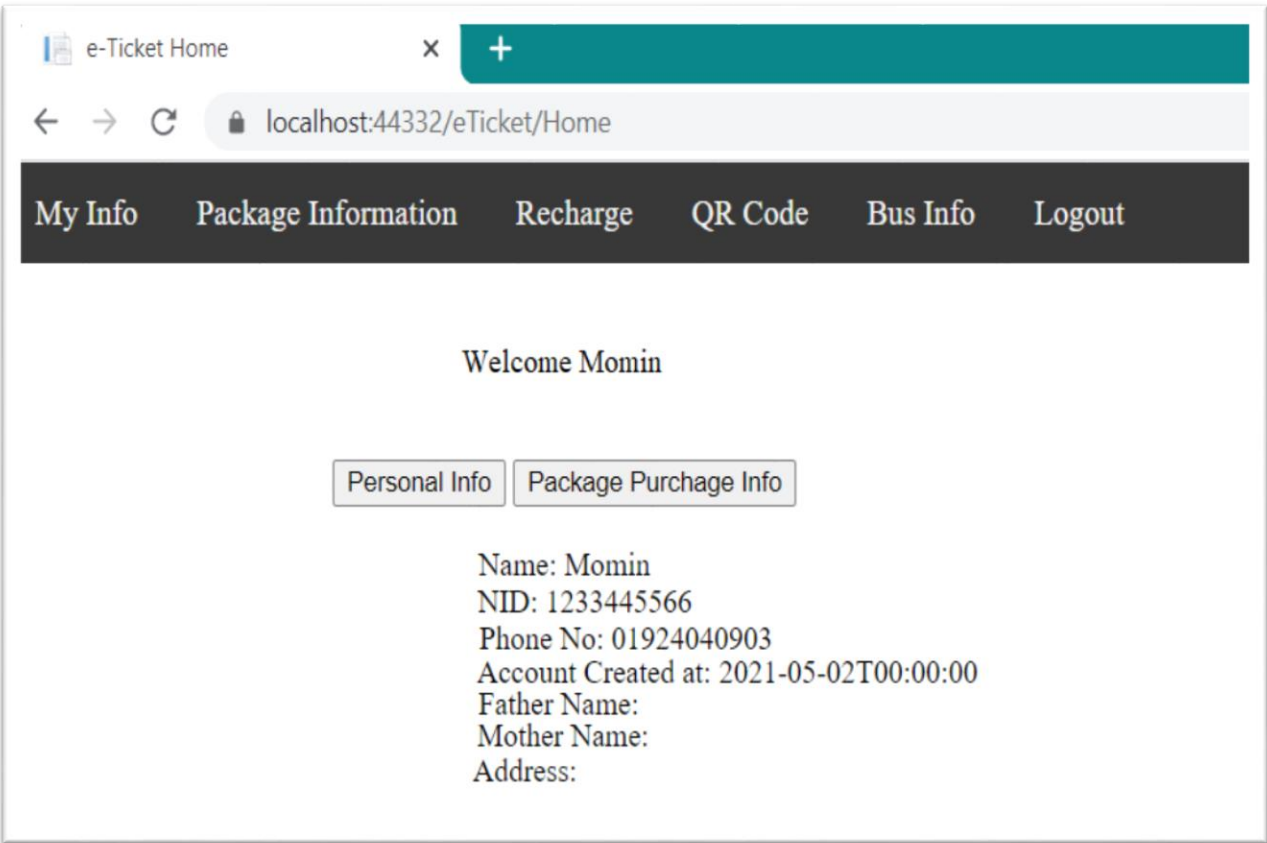

Figure 20. User Interface for Login

Figure 21. User Interface After Login.
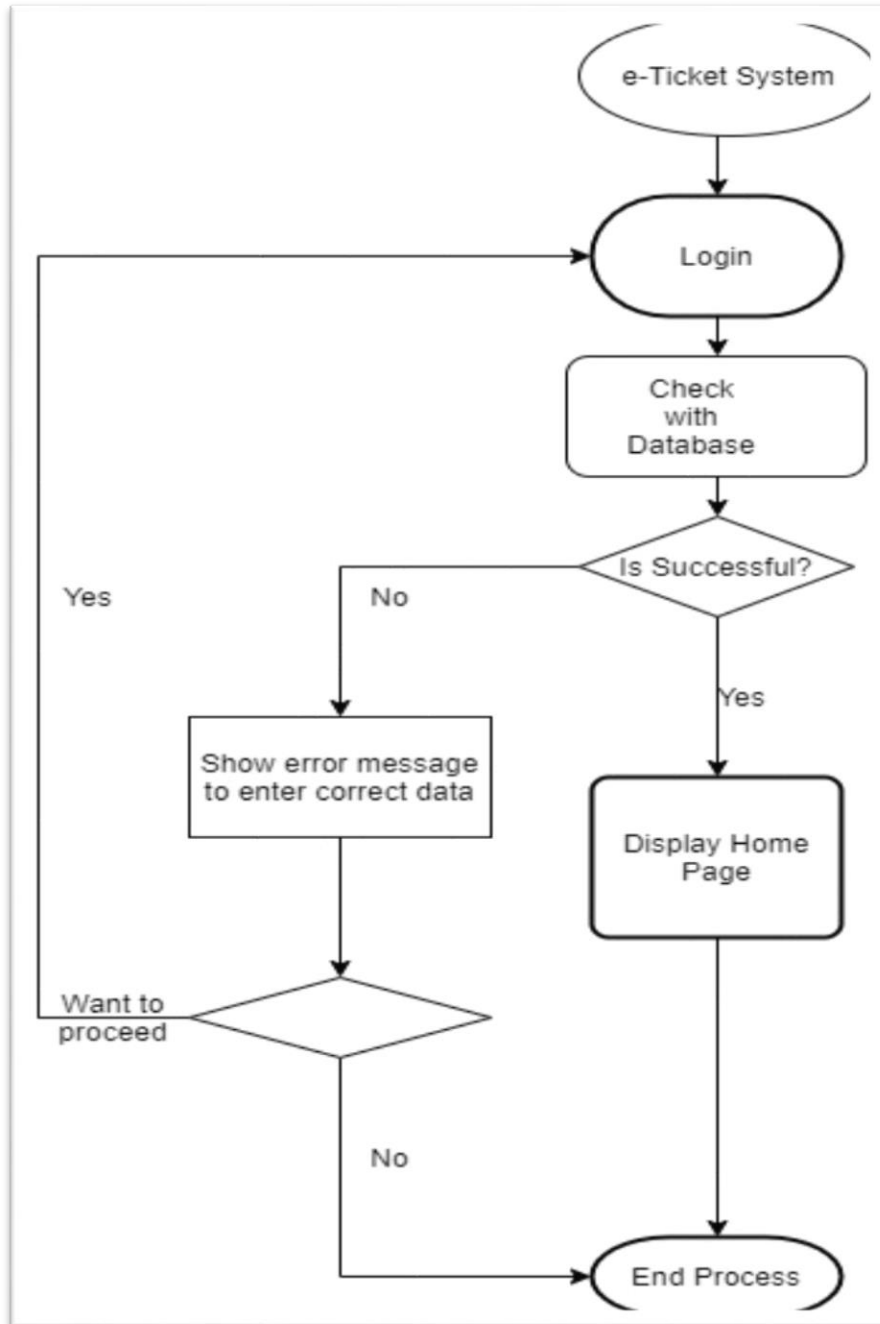
Figure 22. Activity Diagram of Login Process

7.4 Recharge and Package Selection

To make the system more user-friendly and to reduce dissatisfaction, there will be several packages with different types of amounts. There will be Daily Package, Weekly package, and Monthly packages. Each package will have a specific amount. Also, there will be an option to select a specific travel company because on different routes, and there will be running vehicles of different companies.

So if anyone wants to get any package, at first, the user has to select the company/route they are willing to use. After selecting the company, several packages will be seen. Based on their need, anyone can select the desired packages. After that, there will be the option for money transfer through any online banking. In Bangladesh, mobile banking is also very popular. So there will also be the option to pay the package bill via mobile banking also.

Any user can also recharge any package to another person's account. In that case, at the first step, the user has to provide the registered NID number of that specific account and proceed with further steps as regular. After each recharge, the money will be distributed among the travel company, and a fixed amount of tax will be automatically calculated and deposited to the Government account.

After recharge successfully, the user can use the smart RFID card and Mobile QR code application.

Figure 23. Recharge Step 1
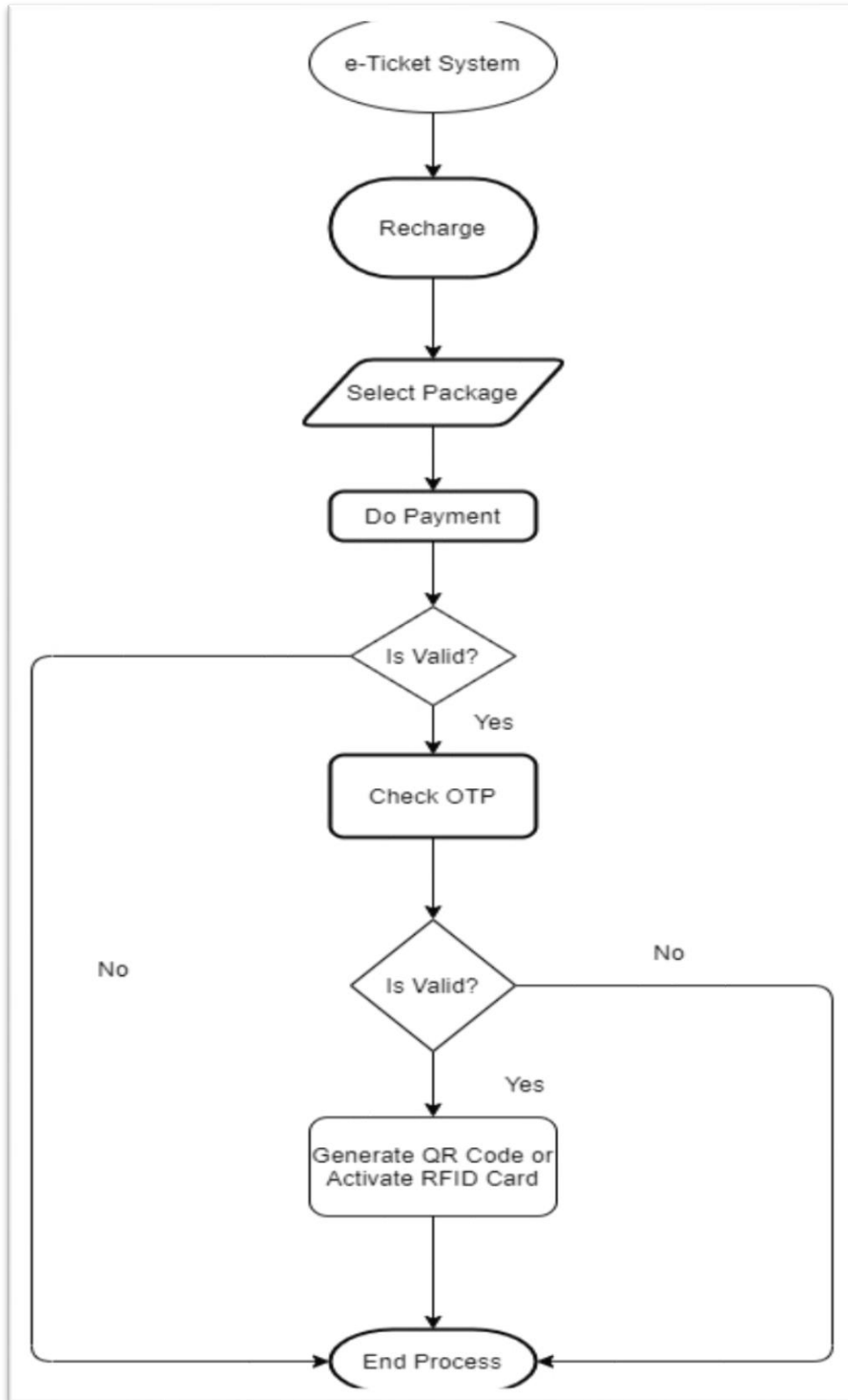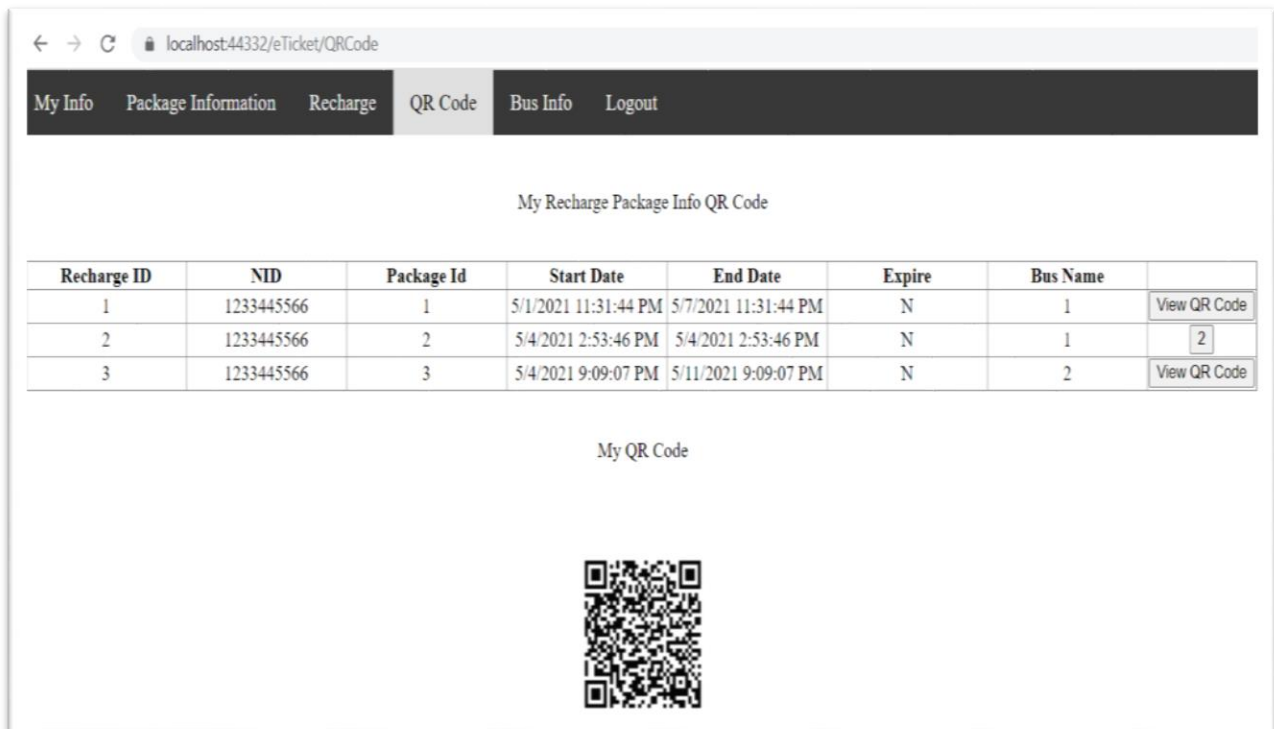
Figure 24. Recharge Step 2

Figure 25. Activity Diagram of Recharge Process

7.5 Scan Card or QR Code

In each vehicle, there will be a sufficient device. The device will have multiple features, and it will be able to scan the RFID card and the QR code from the smart device. On each scan, the device will verify the credentials of the Card or the QR code. If the passenger scans a card that is not valid, then it will beep. Validation will be defined based on different parameters, like the recharge amount, package expiration, and package company. And it will validate the citizen's authentication at first.

Figure 26. QR Code

Figure 27. Activity Diagram for Scan

7.6 USE Case Diagram

Here I am adding the list of simple Use Case diagram for the users in the e-Ticket system. The use case diagrams are intended to visualize the various approaches to explain the different processes of different users of the system.

7.6.1 Use Case Diagram for Government Transport Authority: Admin (Government)
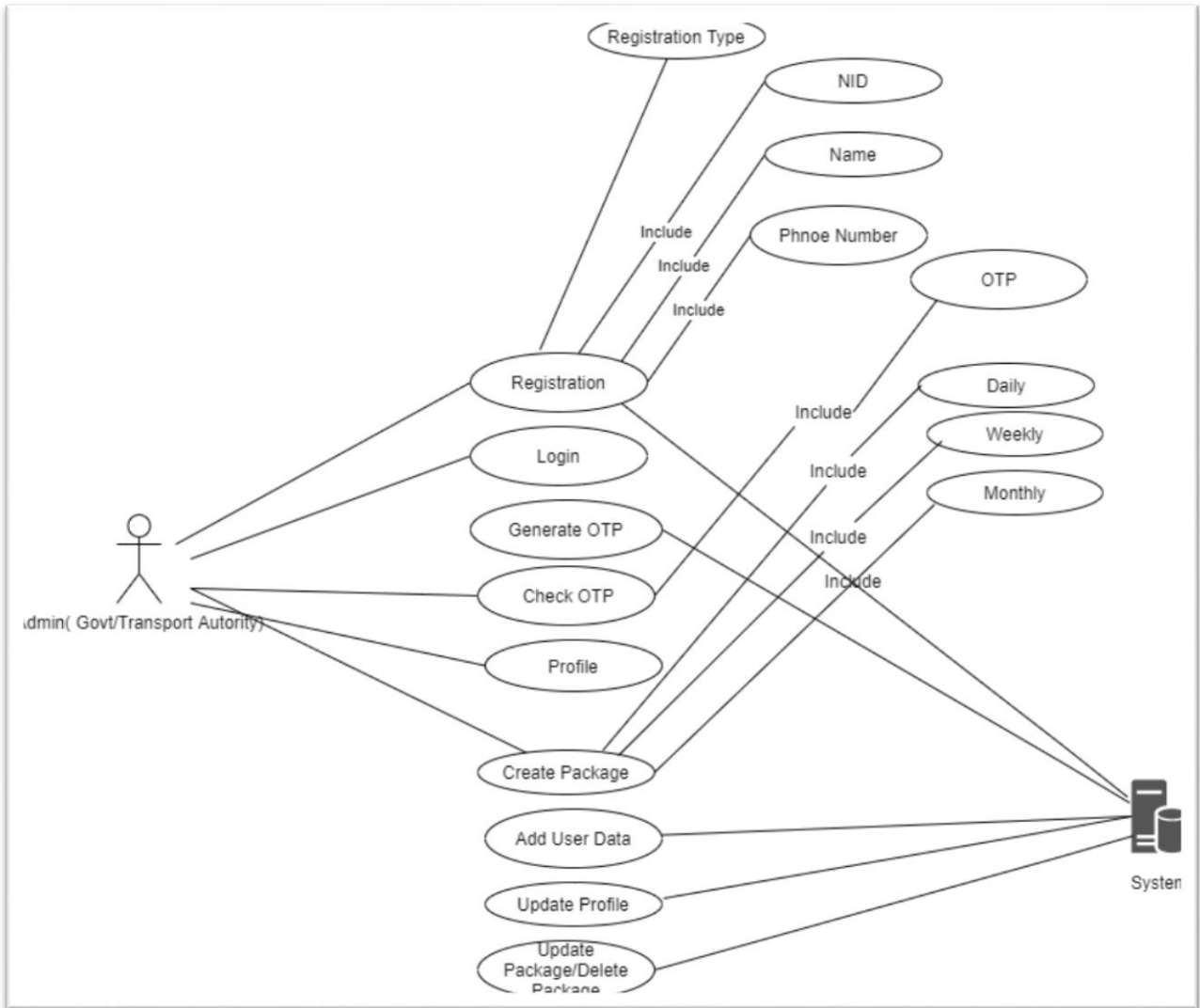
Figure 28. Use Case Diagram for Transport Authority

7.6.2 Use Case Diagram for Owner of Vehicle: Admin (Transport Company)

Figure 29. Use Case Diagram for Vehicle Owner

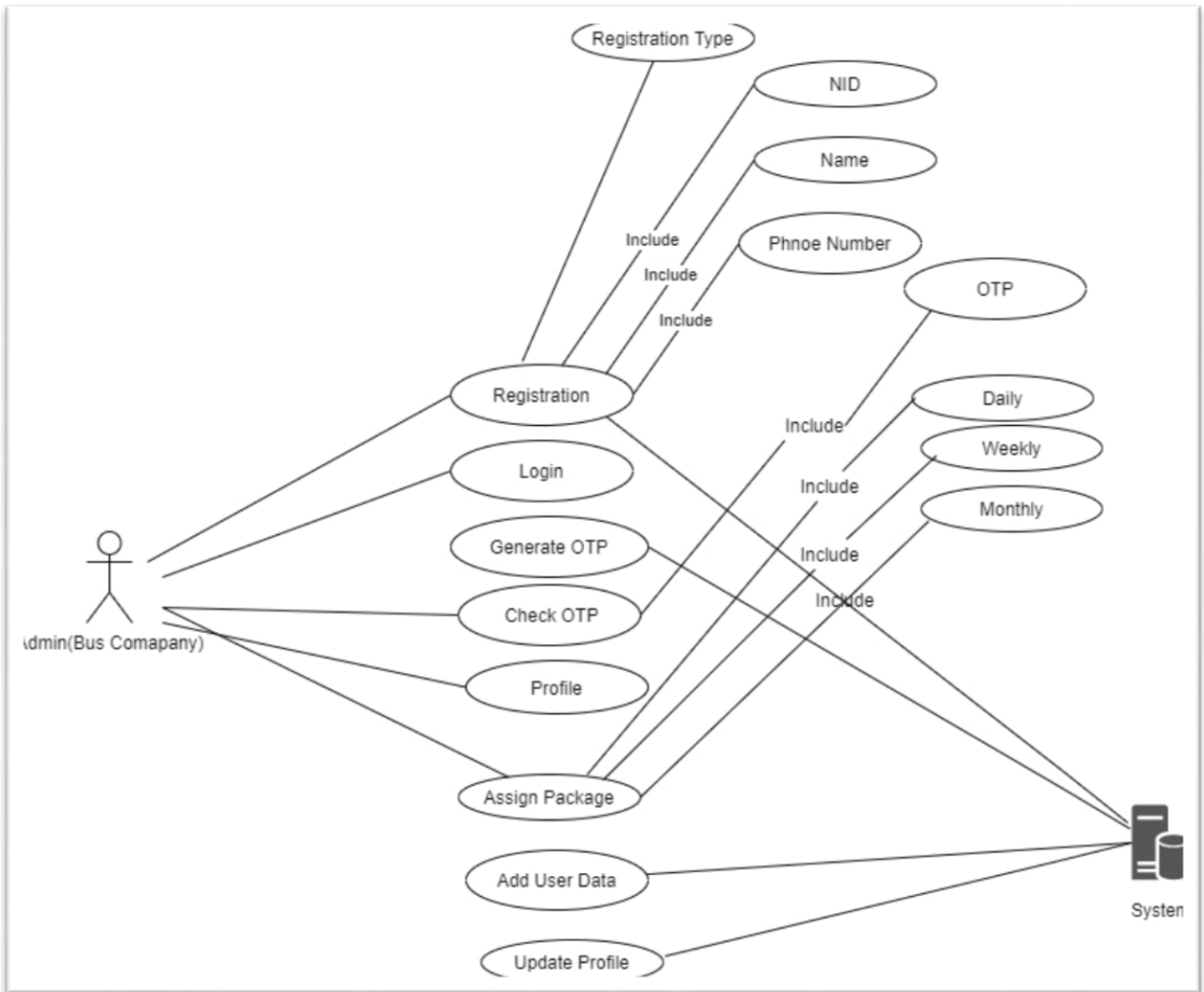### 7.6.3 Use Case Diagram for a Salesperson in Sales Point: Admin (Salespoint)

Figure 30. Use Case Diagram for the Salesperson

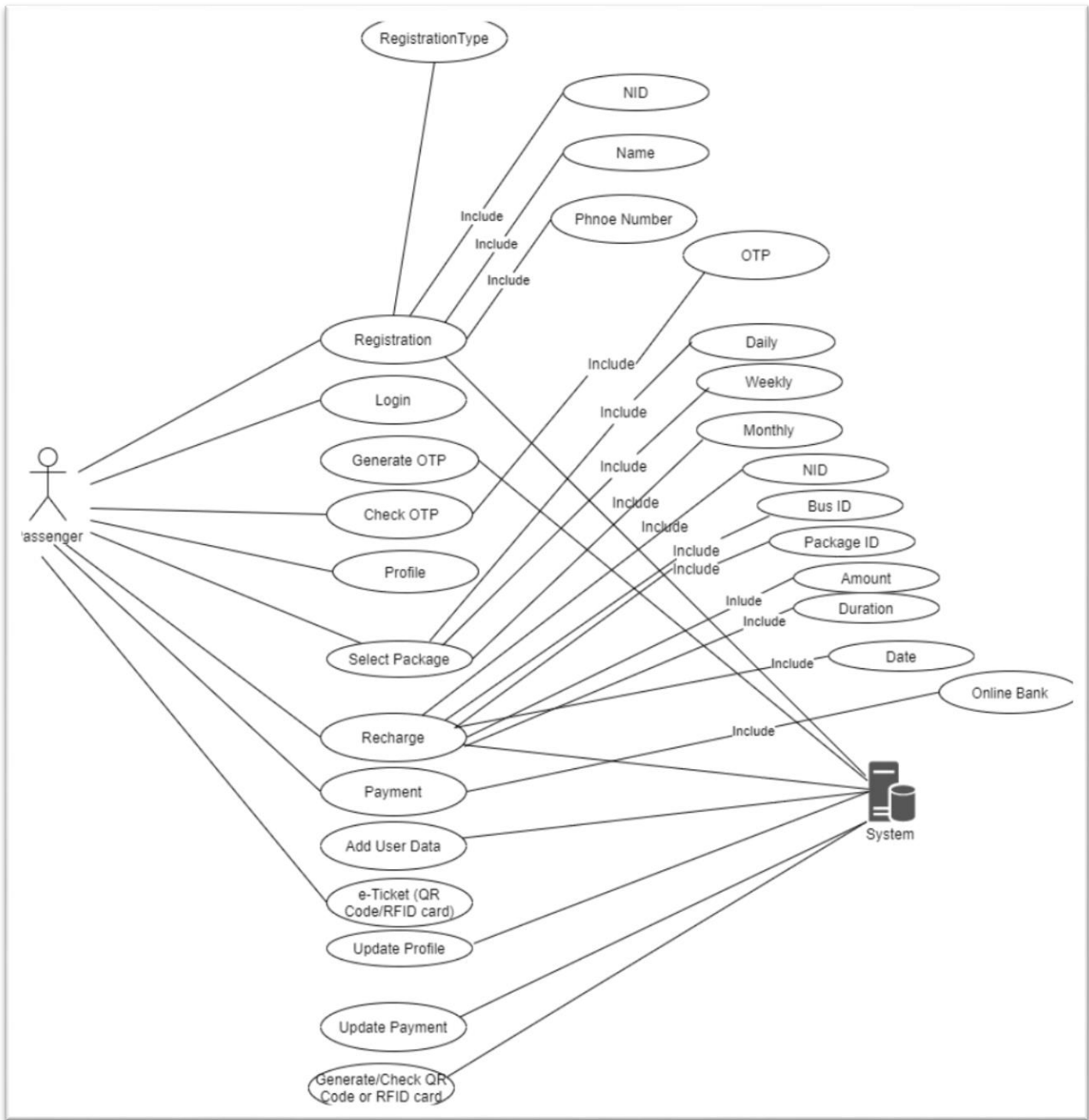## 7.6.4 Use Case Diagram for Passengers: User

Figure 31. Use Case Diagram for Passenger

7.7 Database Diagram

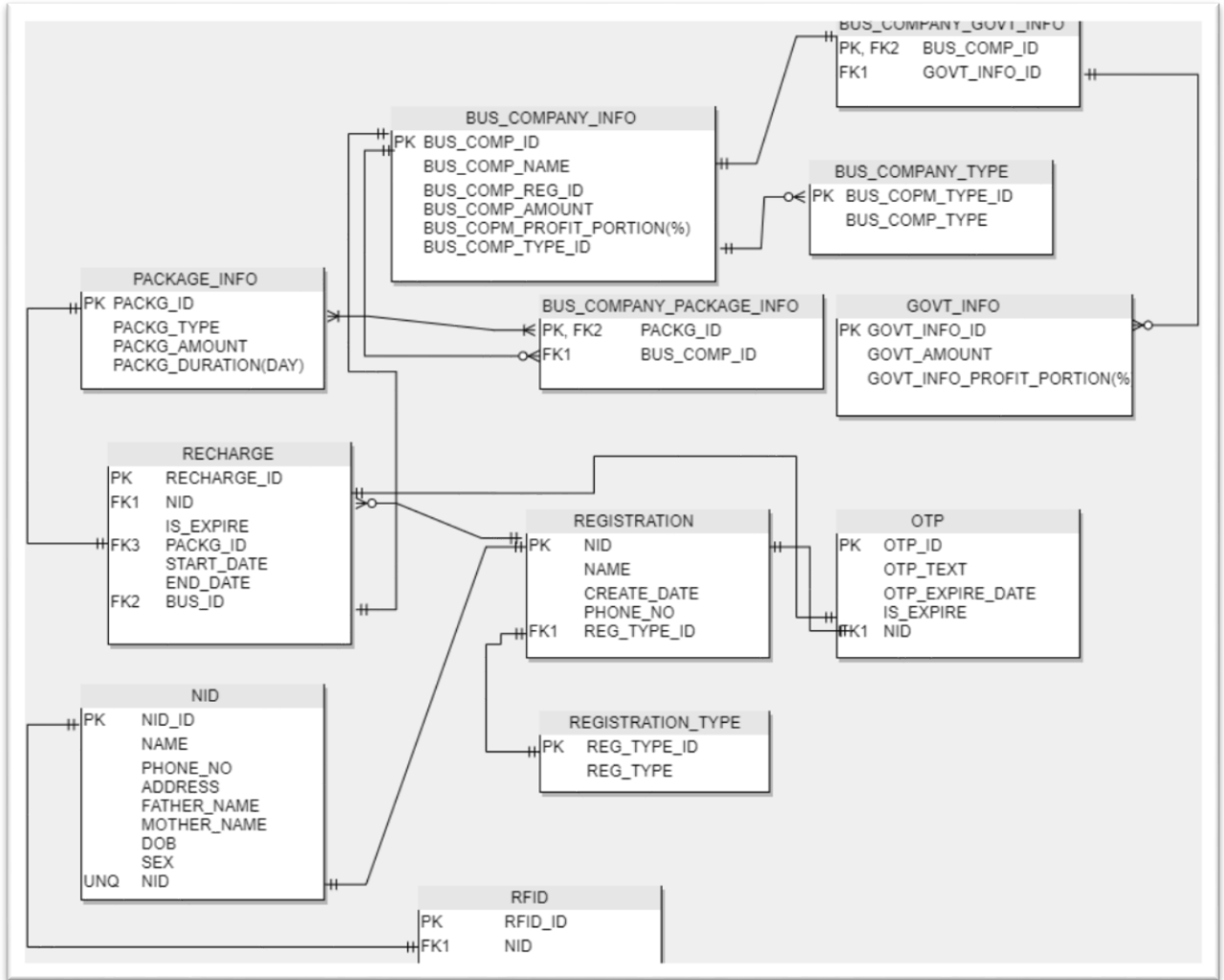The overall entity relationship of the database is shown in the below diagram.

Figure 32. ER Diagram.

8. ANALYSIS AND DISCUSSION

8.1 Summary of Findings

As I am originated from Bangladesh and have the experience to face the challenges of the current public transport manual payment system, I have found the significant difference between the developed countries payment system in public transport, and that inspired me a lot to work on the development of e-ticket system in Bangladesh public transport.

Studying the case study of several developed countries, I have seen so many gaps and ambiguous aspects which are concluded below.

Bangladesh is developing the ICT fields day by day. The government is trying to provide the best public service and planning to manage everything in a digitized manner. The government already introduced the e-Ticket in Train service, but still, it is not fully automated. E-commerce is developing rapidly, and at the same time, electronic payment is being familiar. People are still not adopted with the electronic service for several issues, a mon them a cyber threat, public awareness and trusts are the top issues.

After analyzing the case study of developed countries like Estonia, Belgium, Finland, Germany, Norway, and China we found they already adopted the e-Ticket system by developing the all necessary infrastructure. In Bangladesh, the citizens have NID card which is very resourceful and standard, but people are yet not much aware of the system. With the NID card, people still are not getting the actual facilities in public service because of the poor infrastructure of the IT sector.

After analyzing the results from the survey and interview several findings came out which are influenced me to develop the e-Ticket system in such a way so that people of all ages and cultures can easily accept it. Still, the majority of citizens use public transport but have not satisfied with the service. We found that the public service specifically the transport sector needs a lot of development. Among them if we can focus on the payment system, it will dramatically change the

overall transport system, as with the implementation of this proposed system, the infrastructure will also be changed.

The proposed system is designed in such a way so that the whole public transport sector could be regulated. People will be more engaged as several travel packages are introduced. People can buy their desired packages so that they do not need to waste money. Especially the payment system will be more transparent and the transport authorities can be tracked easily which will make sure their accountability. The proposed system is about to provide the best possible service in a payment system that is very user-friendly and reliable.

8.2 Limitations and Future Work

There needs more feedback from the citizens as well as the massive survey all over the country, which is currently not maintained. Only a few data are collected to get the overall idea of the thought of the citizens. If more data can be collected then more options of electronic payment can be added.

This proposed system provides a vision, a proposed model which will serve the purpose of the research study but still there need several modifications. The developed system is functional but after further discussion with more specialists, it will be more user-friendly and functional though lots of reflections of the specialist are taken into account while developing the system. There need proper regulations, public awareness, and most importantly a secured internet.

In Bangladesh the IT infrastructure needs to be developed, otherwise deploying this e-Ticket will be difficult. For test purposes, the system should be developed in some specific routes of specific cities to get the results after a certain amount of time. If this system is deployed all over the country, then it will be a total mess.

The survey and interview were not conducted for owners and drivers which leads to a gap in the overall findings. In the future, during the practical implementation, this must be considered very carefully. This research did not found any details of multiple package options in the developed countries. So if there could be found more details of the payment model of the developed countries it will facilitate to modification of the proposed system model.

9. CONCLUSION

The present study has answered the formulated research questions, specifically:

- Q1. How to design and implement the e-Ticket system in Bangladesh?

An appropriate software development procedure was followed during the development of the system. Agile methodology was also adopted in the SDLC process. And the system is also developed with the renowned computer programming language which can be easily upgraded. For implementation, there is a need to modify the IT infrastructure to implement such a system, as the specialists recommended.

- Q2. How to Increase the Transparency of e-Ticket in the transport sector?

In the current system, the owners do not know how much money is being collected. The owner is bound to blindly trust the Drivers and helpers. But in this system no hand-to-hand cash transfer is possible. Everything is automated in the e-Ticket system which minimizes inefficiency, therefore increases transparency.

- Q3. What are the benefits of this proposed solution in the transport sector?

Throughout the system users of any level can use the system very easily as the User interface is so simple. The system allows more extended access to the public transport service.

Owners can save money and time using the system. The owner with the registered vehicle can run the travel business, just re-registering under a specific company. As the revenue will be distributed at the beginning of purchasing an e-Ticket, the government doesn't need to think about the manual collection of the tax. The e-Ticket service optimizes the available resources of the government. As there will be multiple options to choose from, citizens can choose their desired packages which will increase the interest of adopting themselves with the system easily. Providing choices

empowers citizens to not only try the system but to sustain the use of the e-Ticket system. While e-Ticket contributes to increasing transparency, the country will eventually realize better transport service for all.

- Q4. What is the suitable solution for architecture and design?

Proper solutions include a serve side software, an application for the client-web, and a mobile application as well. From both the Client web application and Mobile app any user can purchase an e-Ticket. everyone can use an RFID card, using the Mobile app anyone can use the QR Code instead of an RFID card.

The E-Ticket system will open the new era of a developed transport system in Bangladesh. Considering all the problems in the current manual fare collection/ payment system in the public transport system, it is just the demand of time to automate the system. We found that among 100 people of the capital Dhaka city, most of the people use public transport. The majority (60%) of the people want a digitized version of the payment system, like e-Ticket, so that their daily life becomes easier and will save time and money. We also found that the transport specialist, as well as people of different professionals, think there need several major developments in infrastructure as the current infrastructure is so vulnerable. The specialist also thought that the bus should run under a specific company on a specific route. Proper monitoring should also be counted and there should have several financial packages to attract the majority of the citizens to use the e-Ticket system. The interviewed specialists provided a thorough reflection on the proposed e-Ticket system which can serve the purpose of the present study.

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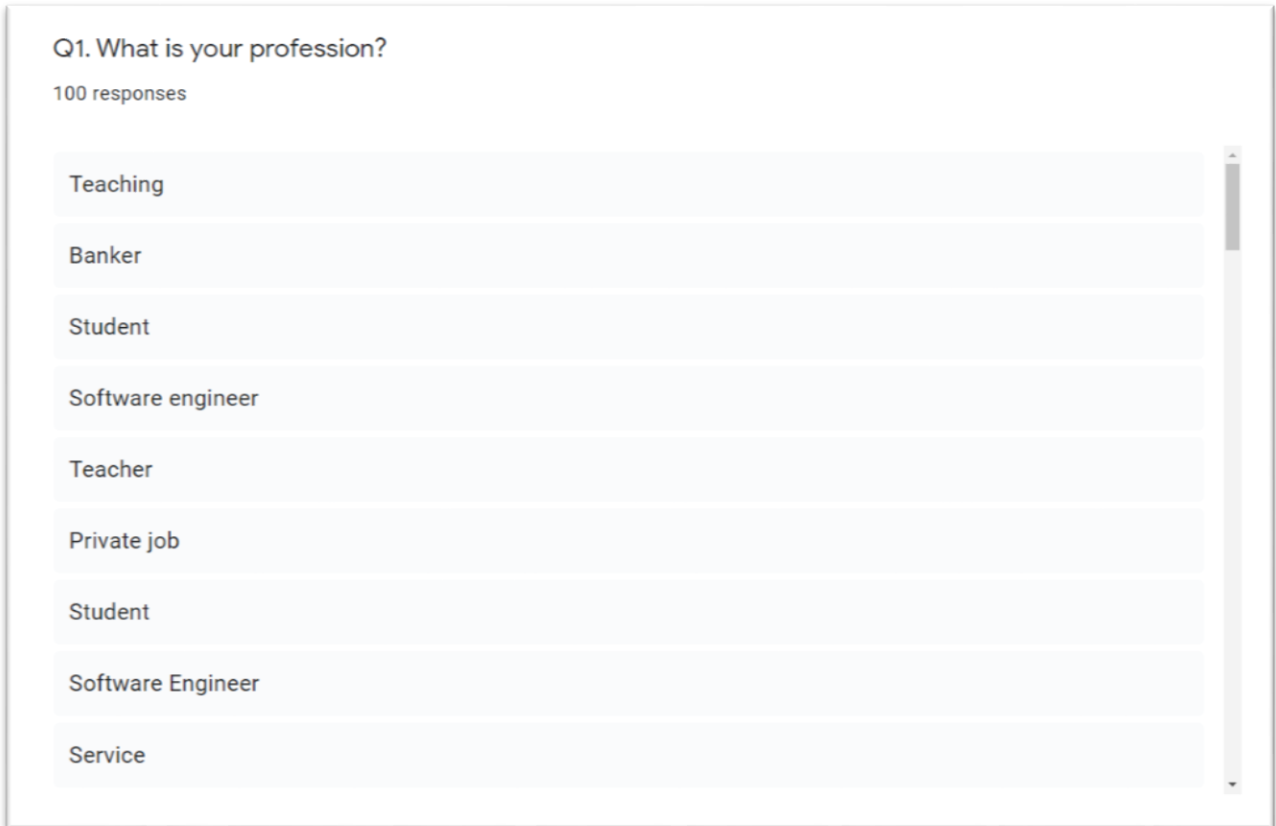
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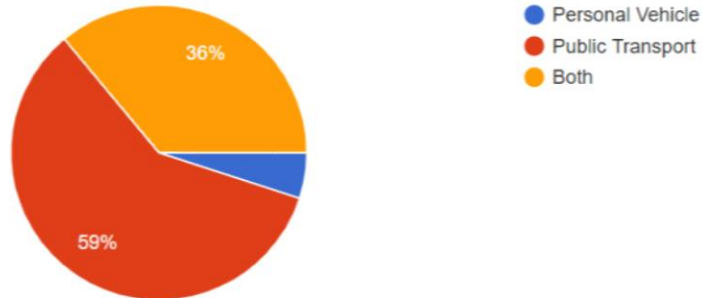
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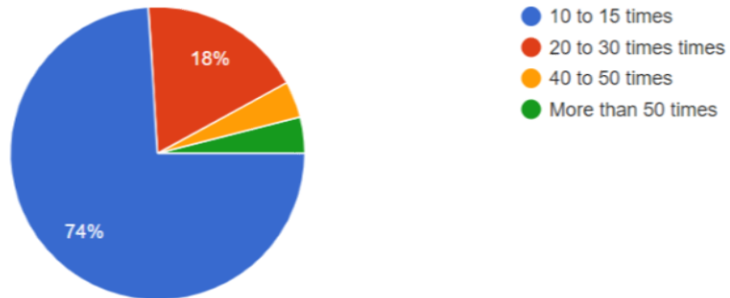# Appendix 2 –Questionnaires and Results

Q1. What is your profession?

100 responses

Teaching

Banker

Student

Software engineer

Teacher

Private job

Student

Software Engineer

Service

Q2. How do you generally go from one place to anywhere?

100 responses

- ● Personal Vehicle
- ● Public Transport
- ● Both

36%

59%

Q3. How often do you use public transport in a week?

100 responses

- ● 10 to 15 times
- ● 20 to 30 times times
- ● 40 to 50 times
- ● More than 50 times

18%

74%

Q4. How often do you travel by a specific route in a week ?

100 responses

- ● 10 to 15 times
- ● 20 to 30 times times
- ● 40 to 50 times
- ● More than 50 times

16%

78%
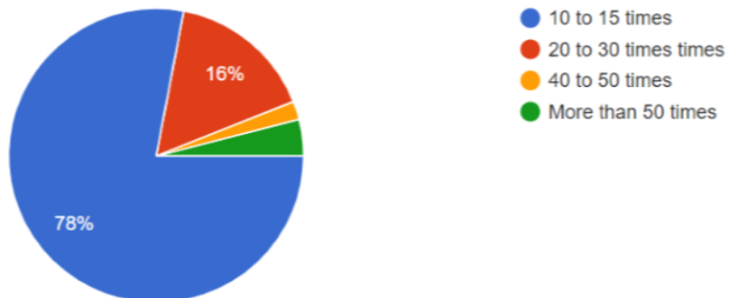
Q5. How often do you travel by a different route than regular in a week ?

100 responses

- 5 to 10 times
- 10 to 20 times times
- 20 to 30 times
- More than 30 times

89%

9%
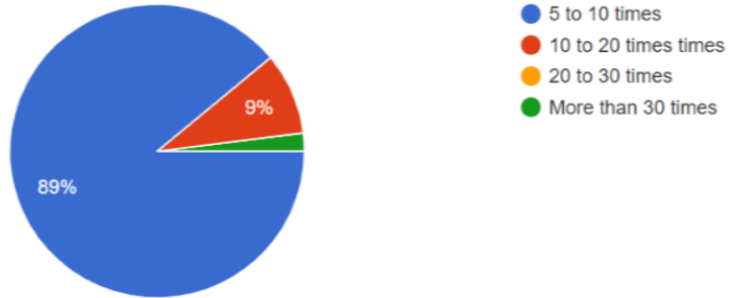
Q6. How much (BDT) do you cost for fare in week?
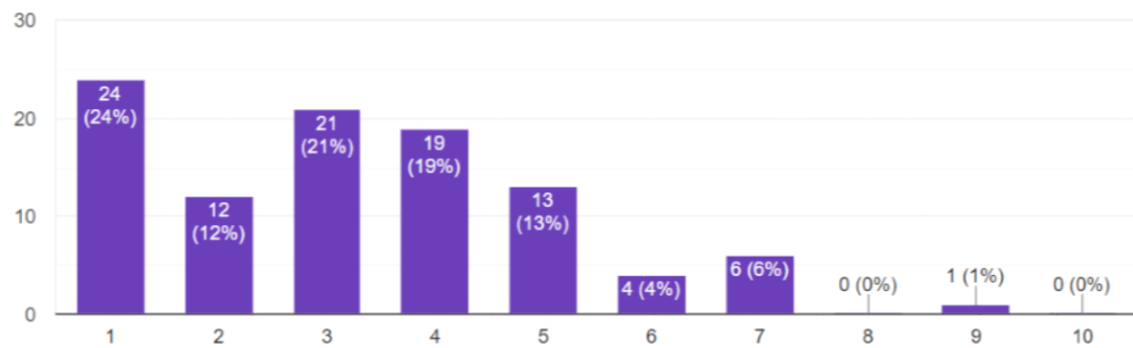
100 responses

82
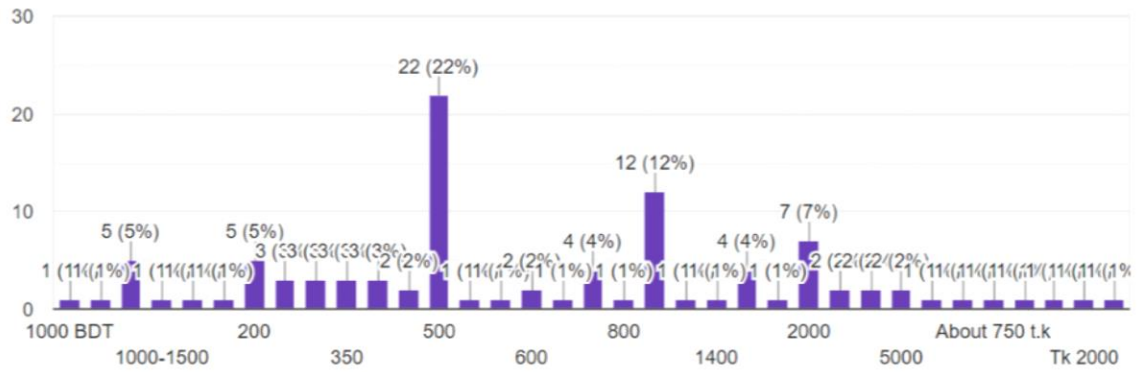
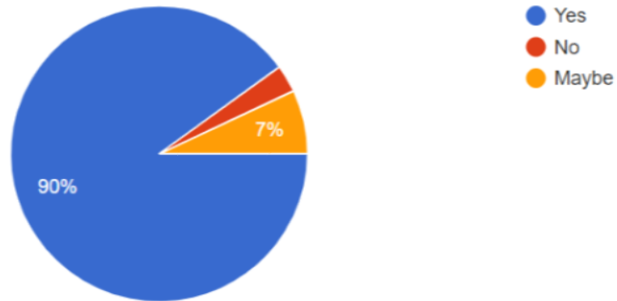**Q7. How much are you satisfied with the travel fare of the transport service?**

100 responses
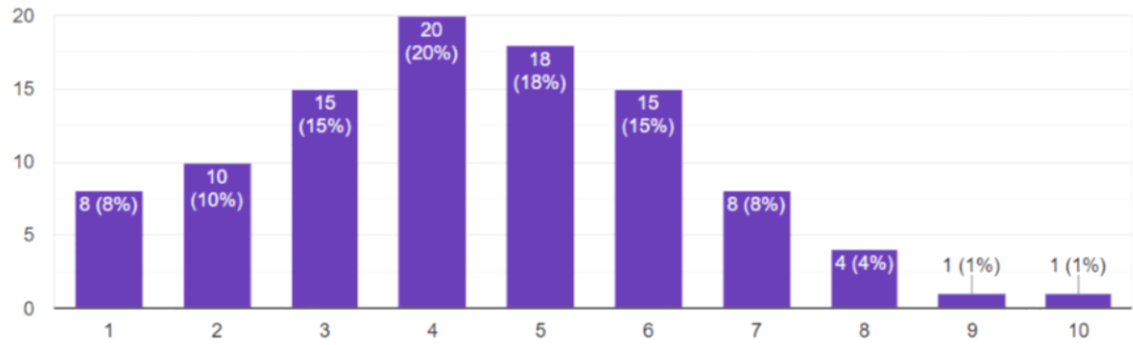
Q8. How much are you satisfied with the overall public transport service in Bangladesh?
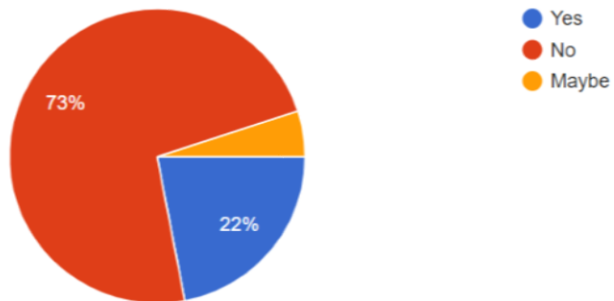
100 responses

Q9. Do you think there needs to be an update of the payment service of the public transport?

100 responses

- Yes
- No
- Maybe

90%
7%

Q10. Do you use the NID card to get any public service?

100 responses
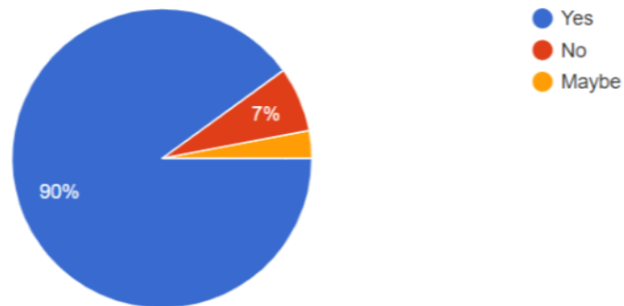

- Yes
- No
- Maybe

73%
22%

Q11. For which purpose you mostly use the NID card?

100 responses

Train

Banking

Bank transaction

Official

None

Bank Account

any necessary issue

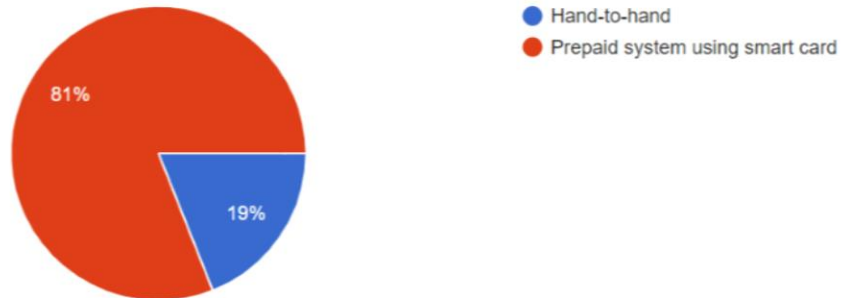For registration or verification

to verification of anything

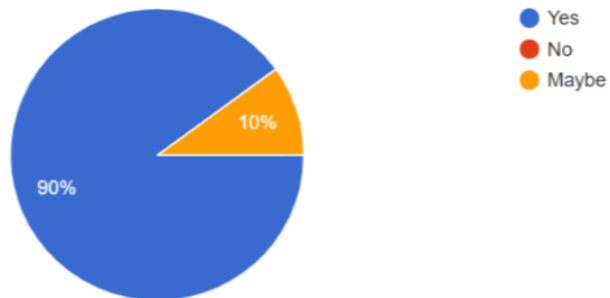## Q12. Have you heard about the e-ticket system earlier?

100 responses

- Yes
- No
- Maybe

90%

7%

Q13. How do you prefer to pay the fare?

100 responses

- Hand-to-hand
- Prepaid system using smart card

81%

19%

Q14. Do you think this e-ticket system can save your time?

100 responses

- Yes
- No
- Maybe

90%

10%

Q15. Do you think this e-ticket system can save your money?

100 responses

- Yes
- No
- Maybe

7%

34%

59%
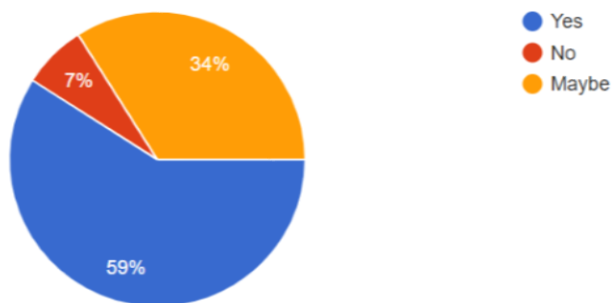
Appendix 3 –Interview Questions

- Please Tell about the payment /fare collection system of the current public transport sector in Bangladesh
- What are the major problems in the current payment/fare collection system?
- As a solution can we use an e-ticket system? Like, the system will be prepaid, people will pay the fare earlier to active the e-ticket and will use a smart RFID card or QR code in their smartphone.
- And how much do you think this e-ticket system will help to save time, money for citizens, drivers, owners, and the government, and ensure overall satisfaction? Any suggestions to develop my designed software/payment model?
- What could be the main barriers to implement this e-Ticket system?
- What infrastructure is required to be built?

Note: Transcribed interviews are attached in GDrive. Please check the link below;
https://drive.google.com/drive/folders/1yQAs6lFBzzxrjC6182-muTrTzPkALW6H?usp=sharing