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DIGITAL FINANCIAL INCLUSION: FACTOR INFLUENCING THE DEVELOPMENT OF DIGITAL PAYMENT SYSTEM IN METROPOLITAN TRANSPORT CORPORATION IN CHENNAI DISTRICT

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Abstract:
The government provides the public with a transport system to move from one place to another without any disruptions. Chennai boasts an excellent transport facility, but is it hassle-free? Are commuters satisfied with the transport service? The primary issue with Chennai's public MTC bus service is the difficulty in obtaining tickets with exact change. This study examines the factors that influence the implementation of a digital payment system in MTC. According to this research, the environment has the greatest impact on the implementation of digital payment in the Chennai transport service. Collaboration between the Chennai corporation and the Indian government has helped bring this service closer to being among the world's best. The study used a random sampling method and conducted interviews and questionnaires to collect data from January to March 2023. Confirmatory factor analysis was used to identify the key factors that influence the adoption of digital payment in MTC.
Keywords: Digital payment, MTC, Environmental factor, digital ticketing, and roadway transport.

1 Introduction:

Chennai is the most preferred city to live in. The reason behind the statement is that Chennai people would avail all the amenities such as food, dress, education, entertainment, and the best transport services. Chennai is the capital of Tamil Nadu; moreover, Chennai Mofussil bus terminus (CMBT), which is located in Koyambedu, is the most noticeable bus station in Asia, and it is also a center for traveling to other states and districts. On a daily bases, millions of commuters travel on public transport to various destinations. School students, college students, and office-going peoples depend on MTC buses in the Chennai district.

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Figure 1 Chennai Koyambedu MTC bus terminus

1.2 Worldwide public transportation:

According to Oliver Wyman and the University of California, Berkeley hong knog is the best transport connective at affordable cost and high density of stations. The second best is Swiss. Swiss is the best for connectivity. In Switzerland, buses connect small towns to remote areas. In Swisser Land hassle-free digital payment system is followed for trams,trains, and buses.

1.3 Public Transport in Chennai

In 2001, the major source of transport in Chennai city was buses, which were owned and managed by the metropolitan transport corporation. On 1st January 1972, Pallavan Transport Corporation (PTC) was formed in madras, now it is named "Chennai", in 1994 the PTC was divided into two based on the zone, namely "Pallavan transport corporation limited" for south madras and "Dr. Ambedkar transport corporation Ltd" for north madras. In 2001, the PTC and DATC reunited again and formed the "Metropolitan transport corporation" (MTC). Chennai MTC buses are the major mode of transport with various categories of fair slabs such as low cost, medium cost, and moderate cost. And several types of buses are available like "Deluxe buses", "Express buses", "Air-conditioned buses", and "non-deluxe ordinary service". Most of the bus routes cover the city, and few routes' buses are crowded during peak hours. According to MTC, as on 1st December 2022, a total of 3233 buses were running in the Chennai district.

In 2022 there were thirty-one depots, 608 routes, and 20,435 employees working in MTC and the average passenger using those services per day is 29.35 lakhs.

In MTC there are four categories of bus services available in the Chennai district and the fares for those services are also different from one category to another category. All four buses have thirty types of ticket fares, this ticket fare is charged based on the travel distance, and for every two kilometres, the fare will be changed. In ordinary service buses, the minimum fare is five rupees,

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and the maximum fare is twenty-four rupees, in this ordinary service bus ticket is free for women passengers. The second category is express services buses, where the minimum fare is seven rupees and the maximum fare is thirty-five rupees. The third category is deluxe services, in this bus, the minimum fare is eleven rupees and the maximum fare is forty-nine rupees. The fourth one is the "Air conditioner services" bus in this the minimum fare is fifteen rupees and the maximum fare is eighty rupees.

1.4 Features in Chennai MTC buses

1.4.1 Safety measures

To stop theft and Violence against women and children, the corporation has been installed CCTV cameras and panic buttons in Chennai MTC buses (Dt Next Bureau, 2022), there are four panic buttons and three CCTV cameras were installed in each bus. Therefore 2,500 buses in the city were done this installation. When passengers face discomfort during travel they could press the panic button, the warning sound will play in the control canter as soon as the button is pressed in the bus. Followed by the warning sound, the conductor and control canter officers will take the action as per the situation.

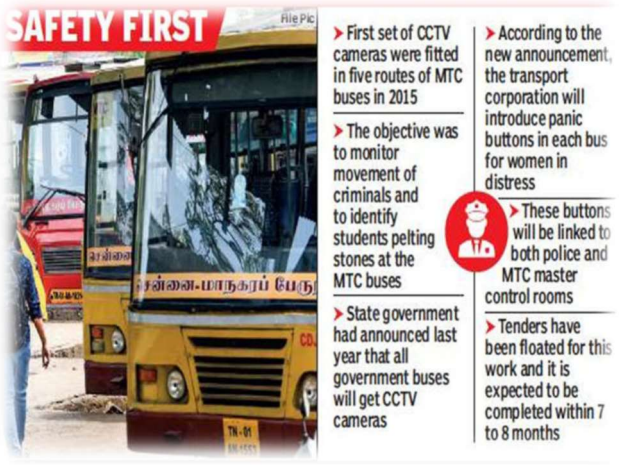


Figure 2 MTC features

1.4.2 Live track application

MTC has finally launched the Chennai bus mobile application for live location tracking of all MTC buses(Times of India, 2022). The passenger could get the details of the estimated arrival time, and the nearest bus stop of the mobile location. On the home screen, the passenger could get the route number, destination details, arrival time, etc.

1.4.3 Emergency

During an emergency situation, the passengers could open the door by using an emergency door open button without the help of the bus conductor. And emergency breakable windows on either side with safety hammers. The first aid medical kit is located on the back side of the driver's seat.

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Two fire extinguishers and safety buzzers were installed to alert the passenger during at the time of emergency.

1.4.4 other features

Special seats with crutches holder for differently-abled persons. A Bell switch is also available near the special seats to indicate the driver to stop the bus. Speakers and sanitizers holder are also additional features in the Chennai MTC bus.

2. Review of literature

2.1 Proposed digital payment in public transport

(Kazi et al., 2018)In Mumbai, the proposed application idea for a "smart E-ticketing system for public transport bus." The major problem in Mumbai's public transport is "non-refund of balance," "negligence to provide seats," and "long time waiting for a bus" to give a solution for that problem, the researcher proposed one smart application idea which provides allocating seating facility before boarding into the bus and digital ticketing system. Therefore, one could get the ticket by using this application, or they could get it from the installed vending machine, which is available at the bus stop.

(Kadam et al., 2018) pune University researchers proposed a GPS-based bus tracking application for smart city, the aim of this study is to save the time for waiting for the bus, estimated arrival time, and to know the passenger and occupaid seats available in the bus.

(Akter et al., 2019) in Malaysia, the study proposed installing a cloud-based bus-tracking mobile application. And they also included a real-time ticketing system in the proposed idea. In this study the, researcher clearly furnishes the benefits of installing mobile applications, such as the waiting time would be abolished, to find out the bus stop which is located nearby, the online ticketing system will be tension free, passengers could book seats before they boarding intoo the bus and this real-time application would be user friendly for physically challenged passengers.

(Jayalath et al., 2020) in Sri Lanka, buses are the major source of transport, where cash is the only mode of obtaining tickets. To change this system, a researcher carried out development-oriented research for a micro-transaction model proposed to be implemented with a blockchain system in public transport. The study listed the benefit of upgrading the ticketing system: Passengers will get benefits because there will be no disputes for change, revenue could be followed for bus conductors, and technical benefits such as getting a real-time ticket.

2.2 User adaptiveness:

(Saleh et al., 2013)in Saud, consumer reaction testing research based on sample distribution among different categories of consumers had been done by the King Saud University researcher. In that, they found that the sample product given by the grocery shop has no impact on the purchasing

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behaiour of the consumer except for women consumers. They also found that young consumers are eager to use new products. This study supports adopting new technology or new product with trial bases.

(Fontes et al., 2017) The two different cities from China and Portugal were taken to derive the factor which included the passenger to adopt digital mobile payment in public transport. That, they found that Chinese youngsters are motivated to accept a new system in the ticketing system when compared to Portugal. Convenience and time saving is the major factor in accepting the technology.

2.3 Research Gap:

Few studies were done on proposed digital payment and acceptance of digital payment systems in public transport, but none were done based on Chennai city. This study focuses on implementing and accepting digital payments the passengers in Chennai city.

3. Research Problem

Problem-based on change management in Chennai MTC buses, (Ram Sundaram, 2017)early morning conductors usually say they do not have change for the tickets, different range of ticket is available such as Rs7, Rs13, Rs17, Rs19, and Rs23. It is difficult to get those odd number tickets because usually, passenger carries money such as ten rupees, Twenty rupees, fifty rupees, and hundred rupees. If a passenger gives a 20 rupees note for a thirteen rupees ticket, then it is a difficult task for that passenger to get a balance change from the conductor.



Figure 3 Odd number ticket below twenty rupees



Figure 4 odd number tickets above twenty rupees

Sometime dispute arises between passengers and conductors for giving damaged or toned notes. In Tamil Nadu, a passenger was slapped by the conductor for giving 100 rupees note for a ticket,

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fed-up conductor slapped the passenger for not giving exact change for the ticket(Mirror Now Digital, 2021). This problem is not only applicable to Tamilnadu, its applicable all over the world, where physical cash is used for buying tickets.

4. Factors affecting to implement of digital payment in MTC

4.1 Environment influence (EI)

The circumstance is the major reason behind the acceptance of implementing digital payment in MTC. Based on the real problem, the indicator for environmental influence had been constructed for this study, such as "crowded bus," "odd number fare," "Change management," and "fear of losing ticket." Obtaining change for a ticket will always end up with an argument with the conductor; most of the time, passengers will not get it correctly. The environmental factor is also the major one in consumers' influence to adopt the condition(Nazan Gunay & Baker, 2011). This is a common problem in all public transport, where cash is the only option for getting a ticket(Jayalath et al., 2020).

H1: Environment influence has a positive significant effect on the factors implementing digital payment in MTC.

4.2 Adoption of integrated E-ticketing (AET)

Integrated E-ticketing refers to payment for the ticket and receiving that ticket both must be in digital mode. Various studies reported that users are adopting mobile commerce, mobile banking, and M-payment services. It is also found that adopting behaviour is differed based on gender. Previous studies proved that males are more attracted to new technology because it is easy to use(Lwoga & Lwoga, 2017). This study employed four indicators that helped to measure the adoption of integrated E-ticketing systems in MTC buses.

H2: Adopting integrated ticketing has a positive effect on the E payment ticket behaviour, E payment behaviour, and passenger's attitudes toward implementing digital payment in MTC.

4.3 E-payment ticket behaviour (EPTB)

E-payment ticket buying behaviour refers to accepting digital payments in MTC buses among passengers. These are the pointers used to measure the EPTB "Trust," "easy to handle," "accept," and "comfortable."

H3: E-payment ticket behaviour has a positive effect on the E payment behaviour and passenger's attitudes toward implementing digital payment in MTC.

4.4 Passenger attitude (PAT)

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Convenience and time savings are the main reason behind the passenger attitude(Fontes et al., 2017). These are the indicators employed in this study to measure passenger attitudes towards MTC, such as "printing cost," "Revenue tracking," and "tension-free."

H4: Passenger attitude has a positive effect among the factors implementing digital payment in MTC.

4.5 E payment behaviour (EPB)

In broad terms, EPB is related to the passenger behavior intention to adopt an electronic payment system in MTC since it enhances the performance of the work(Bagozzi, 1981; Lwoga & Lwoga, 2017). Four indicators are used to measure e-payment behaviour among passengers on implementing digital payment in MTC, such as "user-friendly," "one-tap system," "Track travel expenses", and "paper cash."

H5: E-payment behaviour has a positive significant on the passenger attitude towards implementing digital payment in MTC.

5 Methodology

A quantitative survey approach was used for this study, and a random sampling method was used for data collection, and 104 responses were collected. A well-structured questionnaire has been used for data collection and interview method also used for data collection. The questionnaire was divided into sections one, which includes demography factors and frequency of MTC bus usage, and the second consists of factors influencing the implementation of digital payment in Chennai MTC buses. A Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was employed in this study to measure the respondents regarding the implementation of the digital payment ticketing system in MTC Chennai(Owusu et al., 2021).

6. Analysis

The confirmatory factor analysis was employed to examine the factor of implementing digital payment in MTC Chennai.

Table 1 variable counts

No of Variables in the model	39
No of Observed variables	17
No of Unobersed variables	22
No of Exogenous variables	22
No of Endogenous variable	17

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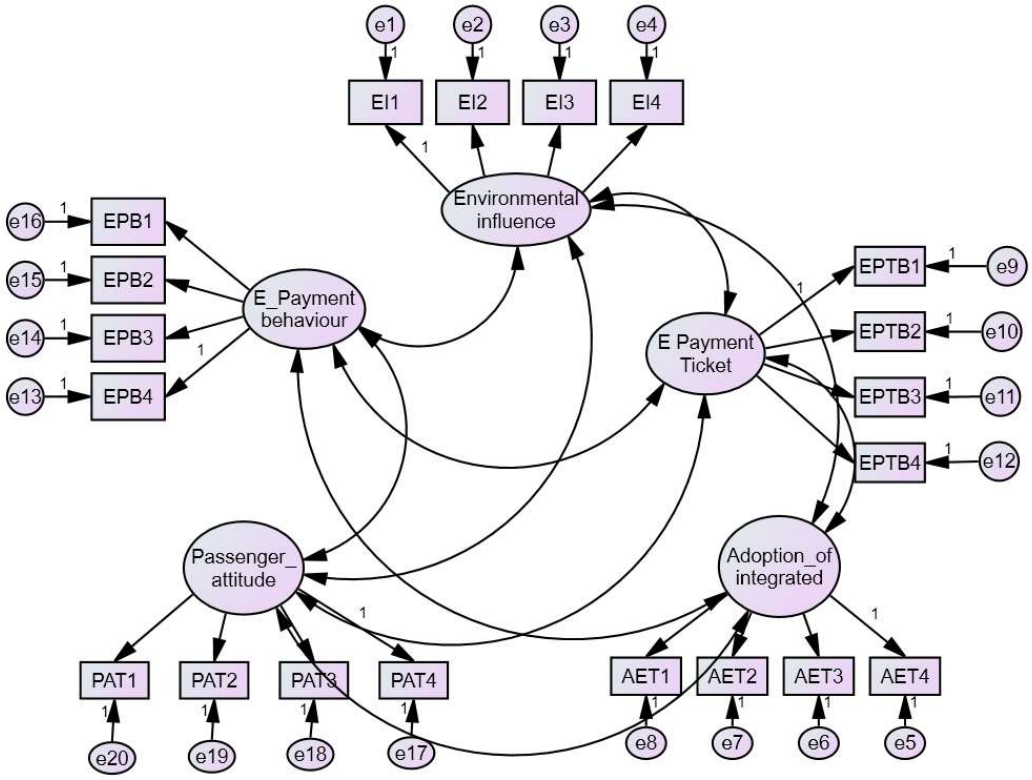


Figure 5 proposed model

Based on the review, the researcher derived those factors from various studies such as "Environmental influence", "E payment ticket", "Adoption of integrated," "Passenger attitude", and "E-Payment behaviour".

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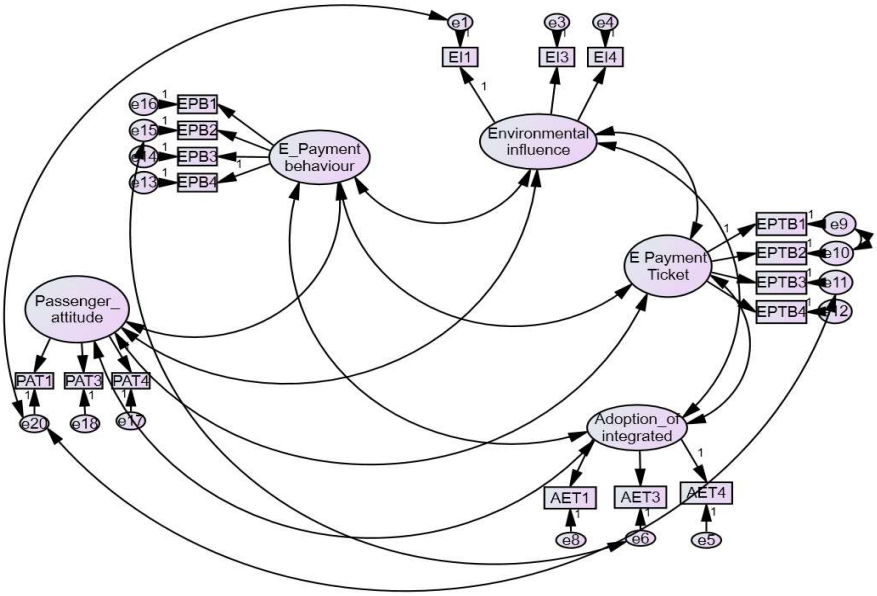


Figure 6 Proved model

The Fig2 proved model is fixed after the testing of confirmatory factor analysis. This CFA is used to find the suitable indicator of the factors and influencing factors of the study. This proven model helps find similar factors and reduce the indicators. AET2 is similar to other factors, such as AET1 and AET4, EI2 is similar to EI1, AET3, and EPB3, and PAT2 is similar to the other two factors. Therefore, the most similar influencing factors, such as AET2, EI2, and PAT2, are removed from the proposed model.

Table 2 Calculation of AVE and CR

	Path		FL	IR	Delta	Ave	Sum of FL	sum of delta	CR
EI1	<---	EI	0.53	0.28	0.72				
EI2	<---	EI	0.61	0.37	0.63				
EI3	<---	EI	0.95	0.89	0.11				
EI4	<---	EI	0.81	0.65	0.35	0.549	2.891	1.804	0.82
AET4	<---	AET	0.77	0.60	0.40				
AET3	<---	AET	0.86	0.74	0.26				
AET2	<---	AET	0.52	0.27	0.73				
AET1	<---	AET	0.59	0.34	0.66	0.5	2.736	2.052	0.78

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EPTB 1	<---	EPTB	0.77	0.59	0.41				
EPTB 2	<---	EPTB	0.79	0.62	0.38				
EPTB 3	<---	EPTB	0.73	0.54	0.46				
EPTB 4	<---	EPTB	0.80	0.64	0.36	0.596	3.087	1.615	0.85
EPB4	<---	EPB	0.66	0.44	0.56				
EPB3	<---	EPB	0.75	0.57	0.43				
EPB2	<---	EPB	0.56	0.32	0.68				
EPB1	<---	EPB	0.57	0.33	0.67	**0.412**	2.549	2.352	0.73
PAT4	<---	PAT	0.89	0.78	0.22				
PAT3	<---	PAT	0.91	0.82	0.18				
PAT2	<---	PAT	0.71	0.51	0.49				
PAT1	<---	PAT	0.59	0.34	0.66	0.614	3.089	1.546	0.86
Fit indices: Chi2=131.34, P value=0.45, RMSEA=0.045, GFI=0.985, CFI= 0.973, IFI=0.974, TLI =0.964									

*AVE average variance extracted, CR construct reliability, FL Factor loading, IR item reliability.

CFA was conducted with the indicators to measure the digital payment implementation in MTC; the measurement model fit the data with 131.34 chi. sq value, the P value is greater than 0.05, which denotes the model is a perfect fit. Here, the comparative fit index value is 0.973, representing the model as a good fit. The root means a square error of the approximation value is 0.045, which is less than 0.08, indicating that the model perfectly fits. A good thumb rule is that an AVE is 0.5 or higher, indicating adequate convergent validity. Digital payment implementation in MTC provides AVE value greater than 0.5 value for all factors except “EPB”, But the CR value is satisfied with 0.73. The estimated CR value, which is greater than 0.7, indicates the internal consistency that exists in the questions. Here, in this model for all five factors CR value is greater than 0.7, Therefore, There is no error in the factor structure, which is imposed on the measure implementation of digital payment in MTC.

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Table 3 Discriminant validity of digital payment in MTC

Factor	AVE	Squared Interconstruct correlation (SIC)				
		EI	**AET**	**EPTB**	**EPB**	**PAT**
EI	0.549	-	0.141	0.196	0.372	0.241
AET	0.512	0.141	-	0.376	0.48	0.656
EPTB	0.596	0.196	0.676	-	0.503	0.504
EPB	0.41	0.372	0.48	0.503	-	0.424
PAT	0.614	0.241	0.60	0.504	0.424	-

All average variance extracted estimated in the table3 are larger than the corresponding squared inter-construct, except for "EPB". This indicates that the construct is associated with more than they do with other constructs. Therefore CFA model demonstrates discriminant validity.

Table 4 Covariance estimate of digital payment in MTC

	Path		**Estimate**	**S.E.**	**C.R.**	**P**
EI	<-->	AET	0.099	0.034	2.919	0.004
EI	<-->	EPTB	0.098	0.032	3.036	0.002
EI	<-->	EPB	0.123	0.035	3.453	***
EI	<-->	PAT	0.14	0.04	3.482	***
AET	<-->	EPTB	0.229	0.047	4.849	***
AET	<-->	EPB	0.16	0.04	3.946	***
AET	**<-->**	**PAT**	**0.277**	**0.052**	**5.284**	***
EPTB	<-->	EPB	0.158	0.039	4.025	***
EPTB	<-->	PAT	0.219	0.047	4.69	***
EPB	<-->	PAT	0.182	0.044	4.166	***
PAT1	<-->	EPTB3	-0.112	0.034	-3.335	***
EI1	<-->	PAT1	0.173	0.047	3.686	***
AET3	<-->	EPB2	0.091	0.031	2.881	0.004
EPTB1	<-->	EPTB2	0.068	0.029	2.379	0.017

6.1 Implementation of Digital payment in MTC

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In this study, the hypotheses have been tested by using the CFA model with a maximum likelihood standardised estimate method, which accounted for measurement errors, as well as the interrelationships between constructs. That result verified the model fit of the data ($\chi^2 = 131.34$, P value=0.45, RMSEA=0.045, GFI=0.985, CFI= 0.973, IFI=0.974, TLI =0.964).
The finding determines that the most influencing factor among the constrain is adopting integrated E-ticketing. In table 4, the estimated value is 0.227, which is higher when compared to other constrain. AET was positively influencing the EPTB, EPB, and PAT. Hence H2 was supported.

The study found a significant positive relationship among the constraints EI was positively influencing the other constraints such as AET, EPTB, EPB, and PAT; thus, H1 was supported. And EPTB and EPB positively influenced the other constraints, such as EPB, PAT, and PAT, respectively. HenceH3 and H5 was supported. Meanwhile, PAT1 negatively influences the EPTB3; the estimated value is -0.112; hence, H4 is unsupported.

6.2 Most influencing factor in implementing digital payment in MTC

Table 5 Friedman test

Ranks			
	Mean Rank	Chi. sq	P value
E-Payment behavior	3.12	25.752	0.000
Environmental influence	**3.36**		
E Payment & Ticket Buying behavior	2.64		
Adoption of integrated E-ticketing	2.70		
Passenger attitude toward MTC digital payment	3.18		

From Table 5, it is clear the most influencing factor is an environmental influence because of the rude behavior of the conductor and the struggle to get back the change from the conductor. The second influencing factor is passenger attitude towards MTC digital payment. It is a positive one since passenger accepts the implementation of digital payment in MTC. The last three influencing factors are E-payment behavior, adoption of integrated E-ticketing, and E-payment & ticket-buying behavior. Since the digital ticketing system exists in metro rail and after the pandemic, people adopted contactless payment systems. Therefore, digital payment is now easy for the public to use in public transport.

7. Discussion and Implication

Based on the study, the researcher proposed a seamless ticketing system in chennai MTC, such as a smartcard system, QR Code scanning system, and application-based payment system. If the government plans to implement a Smartcard system, then the conductor could scan the smartcard with the card reader mechanic, which will reduce the cash for the travel fare, and the ticket will be

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sent to the registered mobile number of the passenger. And recharging for that card must be available in all metro stations and bus terminus, and a net payment facility should be enabled.

QR code scan pay system refers to a quick response code. It would be pasted in the corner and near the doorway, a passenger could scan the QR code through the UPI application for ticket payment; once the amount is successfully paid then, the ticket must be sent to the registered mobile number, or the passenger could get the access from the conductor after showing the successful payment message.

Mobile applications for ticket generation, this facility is already available on Chennai suburban train. In Chennai, the public eventually uses the MTC bus application for tracing bus locations; this study insists on implicating an additional payment system on that MTC bus application.

8. Finding and suggestion

The government in Chennai is planning to implement a unified E-payment system for all modes of public transportation, similar to those currently in use in Delhi and Bangalore. By December 2023, a mobile application will be launched, enabling users to pay for MTC buses, metro trains, and suburban trains. The application is currently under development for public transportation. This study helps to analysis the passenger behaviour and implementation of digital payment in MTC. This study is evidence that passengers are ready to accept the new technology in the ticketing system and are willing to use the application, which reduces the burden of carrying physical cash. In this smartphone era, day-to-day useful applications are always welcome among users.

According to this study, it is recommended to introduce an E-payment system for MTC. The main issue faced by conductors and passengers is the dispute over change for tickets. It is important to implement this system throughout the entire state, not just limited to the Chennai district. The goal is to ensure that all passengers across the state are reached by this system. While implementing new technology is beneficial, it should not result in a higher ticket price. Public transportation must remain affordable for all types of passengers, including those in the middle class.

9. Conclusion

The Indian government introduced the National Common Mobility Card (NCMC) in Delhi in 2019, which serves as a single card for all types of public transportation. Switzerland offers the second-best public transportation connectivity in the world, with trams, buses, and trains, as well as seamless ticketing systems. Three types of tickets are available in Switzerland, including shortest distance tickets, standard passes, and day passes, which passengers can obtain through the application or ticket machines at all bus and train stations. However, passengers must obtain their tickets before boarding the transportation. Similar to Zurich in Switzerland, Chennai has a variety of transportation options available, including both roadways and railways. However, the main issues faced by the public in Chennai are the ticketing system and the infrequency of buses. If these two problems are addressed and resolved, Chennai has the potential to become one of the

top cities in the world for transportation. The Chennai corporation and the government of India are actively working towards improving the transportation system to achieve this goal.

10. scope for further study

After implementing an integrated ticketing system through an application in Chennai City, there is potential for further study. One such study could focus on the satisfaction and awareness of new technology in the ticketing system of MTC.

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