

M-Ticketing System using QR Codes for Mumbai Local

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ABSTRACT

The Mumbai Suburban Railway serves up to 7.5 million commuters every day. It is a challenging task to provide a convenient and smooth ticketing experience to the commuters. The Mumbai Suburban railway uses the Proof-of-Payment fare collection system. Commuters have to stand in long queues to purchase a ticket. This causes inconvenience to the commuters. Many a times, to avoid such long queues and save time or if passengers are running late, they opt for going ticketless. The ticket checkers also have to manually check the commuters' ticket which requires them to manually analyze every ticket for validation. To serve so many people there was a need to have an alternate option other than manual purchasing. Therefore, an app called UTSONMobile was released for online ticket booking. However, the app proved to be inconvenient to the commuters and was criticized due to the tedious payment process, and other limitations like tedious registration process, inability to book tickets at the platform and outside the predetermined range, inability to download e-ticket offline etc.

Thus, to provide an agile and smooth ticketing experience to the commuters as well as to overcome the limitations of the existing app, a mobile application is proposed in this paper which will have an easy registration following which the users can book tickets from anywhere and can be linked to a free payment gateway like Paytm instead of using the concept of a RWallet. The ticket will be in the form of a QR code containing the details of the journey. This ticket can be downloaded offline. The ticket checker can easily check the validity of a ticket by scanning the QR code using just a mobile phone with a scanning application. This will thus provide an easier and better experience to both, the commuters as well as the railway authorities. The proposal in this paper will show how this system can be executed and will benefit everyone with the help of the research and survey.

General Terms

Android, QR Codes, M-ticketing

Keywords

Android, QR codes, M-ticketing, Mumbai Local, Ticketing app, QR codes for ticketing, Mumbai Local ticketing app.

1. INTRODUCTION

In order to serve more than 7.5 million commuters daily, the ticketing facilities available today for the Mumbai Suburban Railway are offline purchasing at the ticket counters, CVMs (Coupon Validating Machine), ATVMs (Automatic Ticket Vending Machine) and a mobile app called UTSONMobile. The problems with these existing options include standing in long queues which passengers running late find inconvenient,

CVM and ATVM machines also require passengers to stand in queues at times, there are limited number of ATVM and CVMs and these machines do not necessarily work all the time. The overall problem was long queues and wastage of commuters' time. To overcome these problems and to provide tickets on the go to the commuters, a mobile application called UTSONMobile was introduced for Android and Windows users. However, the app proved to be inconvenient to the commuters and is criticized due to the tedious payment process, and other limitations like tedious registration process, inability to book tickets at the platform and outside the predetermined range, inability to download e-ticket offline etc.

Therefore, a mobile application is proposed which will overcome the limitations of the existing app. The mobile app will provide the user with an account upon a simple registration which will be linked to the user's mobile number. After logging in and filling in the details of the required ticket to be booked, the total amount will be deducted from the user's account and a ticket in the form of a QR code will be generated. This ticket can be available offline for scanning as opposed to the existing paperless ticket. The ticket can be booked from anywhere at any time. The payment for tickets will be linked to a free payment gateway like Paytm as opposed to using the concept of a RWallet where the user first had to visit the website www.utsonmobile.indianrail.gov.in and add money to their RWallet first. The users couldn't just pay on the go and were required to have a minimum balance of Rs. 100 in their account to book tickets.[2] Also, the above website isn't user friendly and is not optimized for viewing on a mobile phone.[2] The tickets can be paper as well as paperless. The paper tickets remain valid even if they get damaged or torn because QR codes on the tickets can still be encoded.

The user can book the ticket at home or any other location without any location restrictions. Users who do not have access to internet can use the wifi facility available at the railway station to book tickets. The user can use the ticket's QR code offline from there on. Moreover, the TC can easily check the validity of a ticket by scanning the QR code even using just a mobile phone with a scanning application. This will thus provide an easier and better experience to both, the commuters as well as the railway authorities. Therefore, the entire ticketing process becomes easier and faster. Hence, this paper will prove how the proposed application can overcome the difficulties of the existing system and how it is necessary to be implemented with the help of a thorough research and survey.

2. EXISTING SYSTEM

The existing system is a mobile application available for Android and Windows phones and is employed by the Center for Railway Information Systems (CRIS). To use this app, the user has to sign up with his/her mobile number. After signing up, the user has to load the prepaid RWallet built in the app, using credit/debit cards, net banking, IMPS or private mobile based apps. After the RWallet is loaded, the app can be used to book tickets on the entire network.[1] The users are required to add a minimum of Rs 100 to your account. Also the website - www.utsonmobile.indianrail.gov.in - isn't mobile friendly. It has been built as a desktop site and the UI is all jumbled up when viewed on a mobile browser.[2] Once payment process is done it provides a one-time password (OTP) upon booking the ticket from their online app. The user has to feed in the OTP and the phone number into the ATVM machine located at the station. The ATVM machine generates the ticket. [3]

3. USERS OF THE SYSTEM

1. Local Commuters travelling daily with a ticket
2. Commuters travelling occasionally with a ticket
3. Ticket Checkers

4. PROBLEMS WITH THE EXISTING SYSTEM

The existing system has the following difficulties:[3]

1. Signing up requires an identification card number handy.
2. Tickets cannot be booked from the platform or home. The tickets can be booked only within a radius of 30m to 5 km of the origin station.
3. Minimum balance of Rs.100 is required in your account.
4. Paperless tickets cannot be cancelled.
5. E-ticket needs to be printed offline using an ATVM.
6. Physical print of the ticket should be taken at the originating station only.
7. UTS app account is attached to both your mobile number and your phone. This means that if you change your handset, you will have to submit a headset change request to be able to use the same account on a different phone.
8. Not available for iOS users.
9. Ticket cannot be downloaded or used offline.

5. ADVANTAGES OF THE PROPOSED SYSTEM

The following table illustrates what are the advantages of the proposed system and how they overcome the difficulties of the existing system.

Table 1. Problems of the existing system vs. Advantages of the proposed system

Sr. No	Problems of the existing system	Advantages of the proposed system
1.	Signing up requires an identification card number handy.	Easy registration process with only mobile.
2.	Tickets can be booked only within a specific range.	Tickets can be booked from anywhere at any time.
3.	Minimum balance of 100 Rs. Is required in your account.	No minimum balance required as payment is done through a gateway instead of using RWallet.
4.	Paperless tickets cannot be cancelled.	Paperless tickets can be cancelled.
5.	E-ticket needs to be printed offline using an ATVM.	E-ticket need not be printed.
6.	Physical print of the ticket should be taken at the originating station only	Paperless ticket is valid everywhere
7.	Account is linked to user's IMEI so cannot be accessed on a different phone.	Account can be accessed on any device.
8.	Ticket cannot be downloaded or used offline	Tickets can be downloaded and used offline.
9.	Requires manual checking of tickets by ticket checkers.	Requires only scanning of tickets by ticket checkers.
10.	Tedious payment process	Easy payment process

6. QR CODES

Since the proposed system generates m-ticket in the form of a QR code, let's first see what is a QR code, how it can be used for payments, how much data it can store etc.

6.1 What is a QR Code?

QR code (abbreviated from Quick Response Code) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan. A barcode is a machine-readable optical label that contains information about the item to which it is attached.[4]

A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed using Reed–Solomon error correction until the image can be appropriately interpreted. The required data are then extracted from patterns that are present in both horizontal and vertical components of the image.[4]

6.2 How QR codes work for payments?

QR codes can be used to store bank account information or credit card information, or they can be specifically designed to work with particular payment provider applications. There are several trial applications of QR code payments across the world.[4]

QR codes are commonly used in the field of cryptographic currencies, particularly those based on and including Bitcoin. Payment addresses, cryptographic keys and transaction information are often shared between digital wallets in this way.[4]

QR codes can be used for payments in many ways. A user can pay a retailer by scanning his unique code and then filling in the amount to be paid from his account. Or a retailer can scan the user's unique code and deduct money from user's wallet through a supporting mobile payment app.

6.3 How much data can they store?

The amount of data that can be stored in the QR code symbol depends on the datatype (mode, or input character set), version (1, ..., 40, indicating the overall dimensions of the symbol), and error correction level. The maximum storage capacities occur for 40-L symbols (version 40, error correction level L)[4]

Table 2. Amount of data that can be stored in a QR code

Input mode	max. characters	bits/char
Numeric only	7,089	3½
Alphanumeric	4,296	5½

6.4 How to generate a QR code?

Step 1: Select a QR code generator. For eg, Kaywa, GOQR.me, Visualead, QR Stuff.

Step 2: Design and link it up.

Step 3: Test the QR code.

Step 4: Track and analyze performance. [5]

6.5 Benefits of QR codes for ticketing

1. QR code tickets cannot be forged easily.
2. Free for an unlimited number of tickets, no ticket fees.
3. No costs for special paper or special printing.
4. Quick and easy to use.
5. More convenience.
6. Increased safety.
7. Storing your payment details in your mobile phone and carrying it around is much safer than bringing your entire wallet full of cash and credit cards everywhere you go. [7][8]

7. PROPOSED SYSTEM

The diagram below (Fig 1) shows the system architecture and shows the entire process of how the system works for the booking tickets.

The user first has to sign up and register his/her account and then login to his account. The user then has to select the book ticket option which displays the ticket details page. The user then fills in the details of his ticket and then proceeds to pay. The user selects his preferred option as the payment gateway listed. The user's ticketing and payment details are then sent to the railway's server which requests the payment gateway for the payment. The payment gateway confirms the payment with the user's bank account. The user's bank then transfers the fund to the railway's account and sends a payment response back to the payment gateway. The payment gateway sends the response received to the railway's server which then confirms the booking of ticket and generates the ticket with a unique QR code and sends it to the app. The user then uses this ticket for his journey.

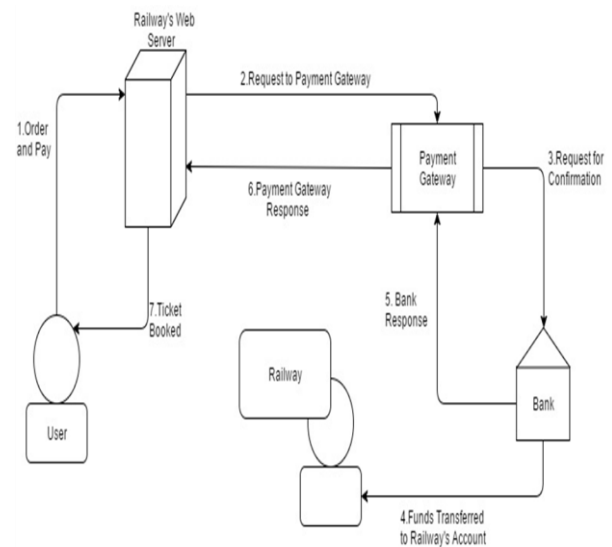


Fig 1: Working of the system

8. IMPLEMENTATION

Registration Page:

In Fig 2, user has to first register by providing basic details (Username, Password, Email-ID and Contact Number) and create a profile.

REGISTRATION FORM

Enter the username

Enter your password

Confirm your password

Enter your email-id

Select your Gender

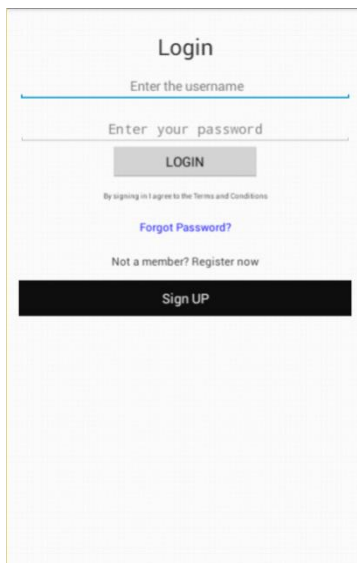
Male
 Female

Enter your contact no

LOGIN

Fig 2: Registration Page

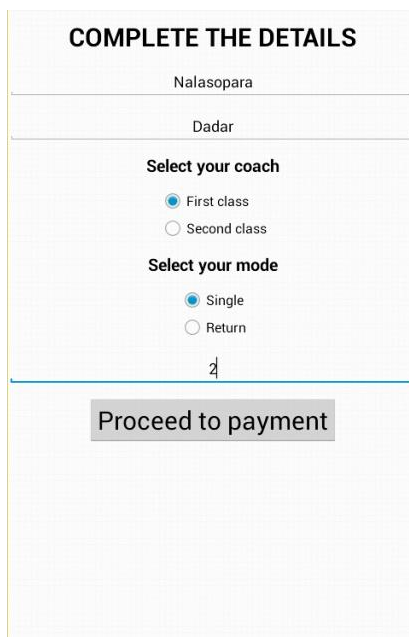
In Fig 3, User has to log in to his profile in order to book tickets.



The login page features a title 'Login' at the top. Below it are two input fields: 'Enter the username' and 'Enter your password'. A 'LOGIN' button is positioned below the password field. Underneath, there is a small text 'By signing in I agree to the Terms and Conditions', a link for 'Forgot Password?', and a text 'Not a member? Register now'. At the bottom, there is a 'Sign UP' button.

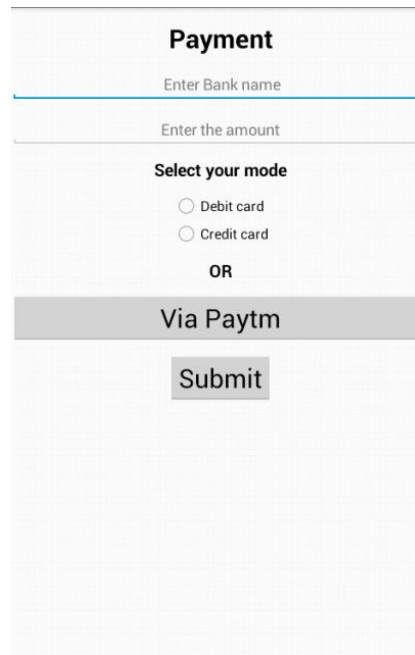
Fig 3: Login Page

In the Fig 4, Book Ticket: The user will enter details like source, destination, number of tickets, mode of journey, coach and then proceed to the payment page.



The 'Book Ticket' page is titled 'COMPLETE THE DETAILS'. It shows 'Nalasopara' as the source and 'Dadar' as the destination. Under 'Select your coach', 'First class' is selected. Under 'Select your mode', 'Single' is selected. A '2' is entered for the number of tickets. A 'Proceed to payment' button is at the bottom.

Fig 4: Book Ticket Page



The payment page is titled 'Payment'. It has input fields for 'Enter Bank name' and 'Enter the amount'. Below these are radio buttons for 'Debit card' and 'Credit card'. An 'OR' separator is present. A grey bar contains the text 'Via Paytm', and a 'Submit' button is below it.

Fig 5: Payment Page

In the above figure, Users can use a payment option according to their convenience. Options available are credit/debit cards and Paytm.

In Fig 6, Ticket Summary: On successful payment, the ticket summary will be generated with all details (name, source, destination, coach, number of tickets, price and time) along with a QR code.



The ticket summary page is titled 'SUMMARY'. It features a QR code on the left and a list of details on the right: Name : Ravi Babu, Source : Nalasopara, Destination : Dadar, Coach : First class, No of Tickets :2, Price : Rs 300, Time : 3:45pm.

Fig 6: Ticket Summary

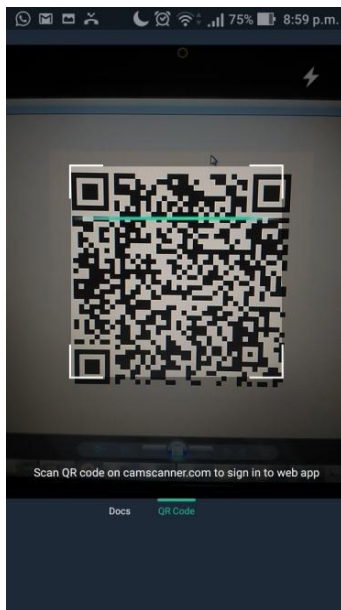


Fig 7: QR code scan

In the above figure, the QR code on the ticket can be scanned by any QR code scanner (for ticket-checking purposes).

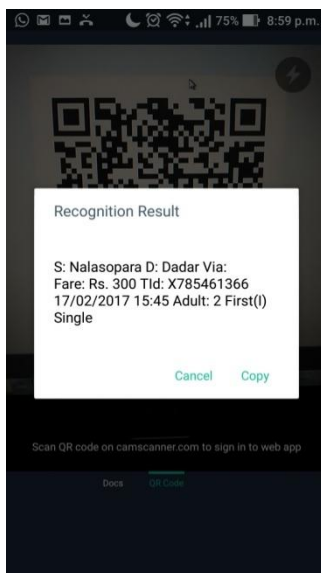


Fig 8: Result of QR code scan

As shown in the above figure, on successful scanning of QR code, the recognition result will be generated which will consist of all the details of the ticket.

9. REVIEW ANALYSIS AND SURVEY

9.1 Analysis of the user ratings and reviews

Although recent updates in the app like availability paper-less tickets in all of Mumbai Suburban Area, offline download of paperless tickets, integration of payment gateways like Mobikwik, Paytm are introduced, it still hasn't been able to make the ticketing process any better because the added features do not fulfill their purpose yet. This can be seen through the ratings and reviews of the users of the app in the month of February, 2017 after the release of the added features in January, 2017.

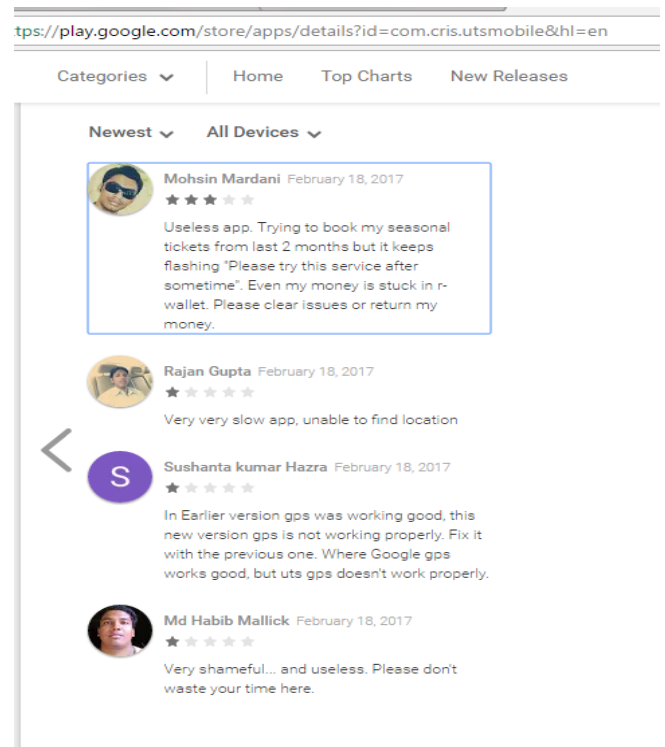


Fig 9: Reviews of the existing system after update

In the above figure, the recent reviews show that many people are **not yet satisfied** with the updates and still find the app inconvenient.

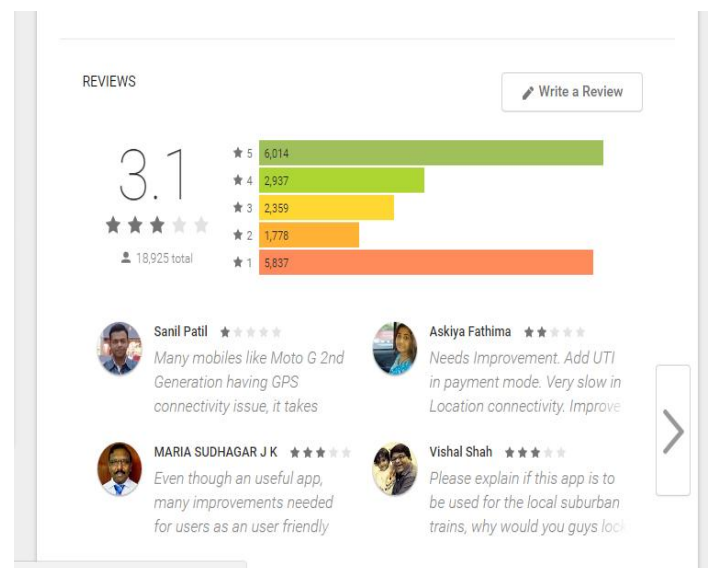


Fig 10: Overall rating of the existing system after latest update

In the above figure, it shows a 3.1 rating on a scale of 5. Though it had around 6000 people giving it a 5 star rating, there was almost an **equal amount** of people giving it a **1 star** rating indicating that there might be major flaws which have not been rectified in the latest update.

In the figure below, result of analysis done by collecting the newest 20 reviews on Google Play after the latest update was released on February 14th, 2017 is shown which shows that **more than half** of the people considered giving it a 1 star out of 5.

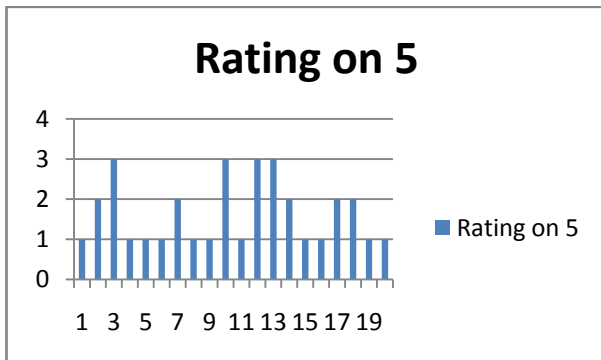


Fig 11: Rating on 5 graph

It clearly shows in Figure 12 that the **majority (55%)** people gave the app a **1 star** rating, **25%** gave **2 stars**, only **20%** gave **3 stars** and **0%** i.e. **0** people gave **4 and 5 stars** rating even after the latest updates released which claim to include major features like integration of other payment option, offline download of tickets, availability of paperless tickets for all stations.

Reviews after update released in Feb, 2017

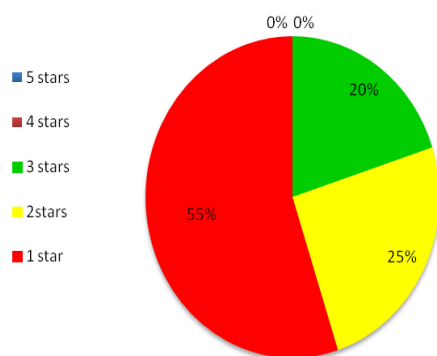


Fig 12: Pie chart for reviews

9.2 Survey

Even if these features are excluded from the problems in the existing system, major problems like tedious registration process, booking of tickets only within a radius of 30m to 5 km of the origin station, and not from the platform, manual checking of tickets, IMEI dependent account, cancellation of e-tickets, and tedious payment process still exist.

To prove this, a survey of 50 commuters was conducted asking them to highlight the major problems that they think exist and should be eliminated and whether they support our idea of the proposed system using QR codes for M-ticketing.

n/forms/d/e/1FAIpQLScIvoSgdzTCQrCoMChySxokgSKpgTCewZ4WBDOL_sUe37a76A/viewform

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*Required

Email address *

Your email address

n/forms/d/e/1FAIpQLScIvoSgdzTCQrCoMChySxokgSKpgTCewZ4WBDOL_sUe37a76A/viewform

Name *

Your answer

Problems currently faced *

- Ticket cannot be downloaded or used offline and is to be printed
- Signing up requires an identification card number handy
- Paperless tickets available for select railway stations only
- Paper tickets available for select railway stations only
- Tickets cannot be booked from the platform or home. The tickets can be booked only within a radius of 30m to 5 km of the origin station
- Not available for iOS users
- Application account is attached to the phone(IMEI) and number

Phone number

Your answer

n/forms/d/e/1FAIpQLScIvoSgdzTCQrCoMChySxokgSKpgTCewZ4WBDOL_sUe37a76A/viewform

Do you agree with the idea? *

- Yes
- No
- Maybe

Other Feedback and Opinions for the Application

Your answer

Send me a copy of my responses.

SUBMIT

Never submit passwords through Google Forms.

Fig 13: Survey form

The above form consists of all the details and input parameters for the survey conducted for the proposed idea of the M-ticketing system using QR codes.

9.3 Survey Results

SURVEY RESULT

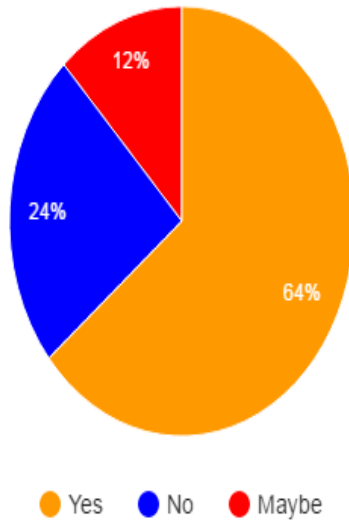


Fig 14: Survey Results 1

The above pie diagram shows that **64%** people were **in favor** of the proposed system which uses QR codes.

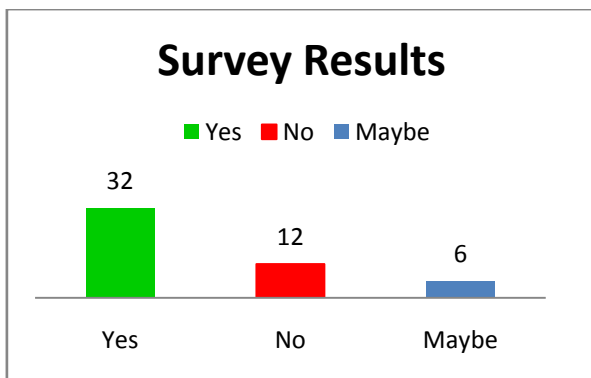


Fig 15: Survey Results 2

The survey was conducted for 50 people out of whom 32 people (64%) **agreed** completely with idea of the use of QR codes for ticketing system.

This proves that the existing system has some major flaws and the proposed system would be suitable to overcome the limitations of the existing system.

10. FUTURE SCOPE

Option for payment of fine, seasonal pass, platform tickets can be included. Option to send booked tickets to friends ,family etc can be included. GPS tracker to track the location of the user and automatically suggest nearest location. SMS and email notifications with booking code for confirmation of booking.

11. CONCLUSION

This project aims to give an agile and smooth ticketing experience to both, the commuters as well as the railway staff. If implemented, it will give a new ticketing experience to people and will also contribute to a cashless economy and it would be safer for users to carry the tickets and payment details in their phones rather than carrying cash, credit/debit cards etc. With the growing popularity of smart phones and mobile wallets, this is the right time to introduce this technology so that people also become familiar with it and adapt to it. This will improve the overall service provided to passenger. The system can be further developed for various features such as seasonal pass, send booked tickets to family, friends etc. Users could be notified through SMS or E-mail about the ticket bookings for confirmation.

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