IoT based Smart Digital System for
TTE, Passengers, Pantry Services and Security Personnels

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ABSTRACT

The working of whole railway system in India is very complex and suffocated that there is an urgent need for reducing its complexity in order to increase efficiency. The intention of this paper is to present the idea on digitalization of chart system in railways, adding new services and also improving some of the existing facilities. This proposed system will use handheld device which extensively uses railway servers, Aadhaar database and Wi-Fi facilities at major stations. Main features are smarter allotment of vacant seats during the journey both by TTE (Train Ticket Examiner) and wait, RAC (Reservation Against Cancellation)-listed passengers. By proper back end support of server, pantry authorities, security personnel and smart phone application, the whole experience of journey will become satisfactory, secure and efficient for both passengers and administration. It also includes tailored feedback and grievance redressal system for seat allotment, pantry services and payment, security and overall journey experience. In the system, cutting edge IoT based technology, electronics, innovative smart phone application facility and intention to elevate the experience of train journey to a whole new level is focused. This proposed system includes a device which uses Raspberry Pi 3 Model B, fingerprint scanner, QR code scanner, and touch keypad.

Keywords: Aadhaar; Digital India; Fingerprint; QR code; Railways; Raspberry Pi 3;

I. INTRODUCTION

With increasing population of the country and increasing poor to rich ratio, the middle-class and lower middle class people are largely dependent on public services. Be it the food, transport and many daily needs are fulfilled by the public sector on a large scale for these people. But the whole system is very complex and suffocated, that there is an urgent need for reducing the complexity of system and execution of processes in order to increase efficiency.

In the era of urbanization and technology boom, people crave for comfortable, faster and secure systems which have minimal human intervention.

In the conventional system, plenty of paper is used for train chart system in Indian Railways, which is hazardous to the environment. The system can be shifted somehow to go cashless and paperless, which also ensures zero tolerance towards malpractices. One of the ways is, migrating the system towards digitalization to make it smarter and IoT concept based.

The concept of IoT (Internet of Things) has been around for a long time. Potentially, IoT can connect everything. That means everything can be assigned an IP address. IoT offers high value convenience and productivity in terms of increased functionality around us.

The idea is to provide TTE (Train Ticket Examiner) of the train with a complete, easy to operate IoT device which can check the tickets and reservation of passengers, update the information before and during

the journey, and also provide reservation during the journey to the passengers for vacant seats. The device will contain a fingerprint sensor, QR code scanner, a keypad for entering the required details.

At the time of reservation Aadhaar Card No. has to be provided. Railway server will fetches the details from Aadhaar Database. Railway database created for the particular passenger will have PNR number, other information fed by user and information from Aadhaar database. The smart device provided to the TTE will contain I/O devices like Fingerprint sensor, QR scanner, keypad and display unit. Device will sync data at regular intervals from major railway stations. It will also be able to show and allot the vacant seats to the RAC and waiting list passengers, to be controlled by TTE once the verification for all the confirmed passengers.

This system also includes smart phone application through which a registered passenger will be able to observe and book vacant seats during journey, order food from the menu updated by pantry manager and also ask for security, help or first aid.

Including all of these features it will make our current system more eco-friendly and more tidy. It will also save plenty of time of TTE.

II. SYSTEM

First, a fellow passenger during reservation has to provide his/her Aadhaar Card No., details like name, finger print, QR code, age, gender, full address, cell phone number will get linked with the current passenger database of the concerned train for which he/she has booked[1]. During the time of journey, TTE will carry the device and ask for a particular passenger's fingerprint or QR code to be matched with available database obtained earlier. If the device is not able to scan finger print and QR code, passenger will be asked for his/her Aadhaar Card No. and it will be matched with the one provided by the passenger at the time of reservation. Once all passengers are verified the "Confirm Occupancy" status will be communicated to server by the handheld device. Then this data will be made available on a smart phone app

for passengers who want to opt for those vacant seats who are in RAC(Reservation Against Cancellation) and waiting list. Fig. 1 describes the flow of Confirmed Seat Verification.

Smart phone application will be adding convenience to the system. It will be showing train status, vacant seat status, passenger and seat details, security alert page and pantry menu. When user feeds PNR number he/she will be given above details and able to order food through payment gateway BHIM or service or security related help. A facility will also be included
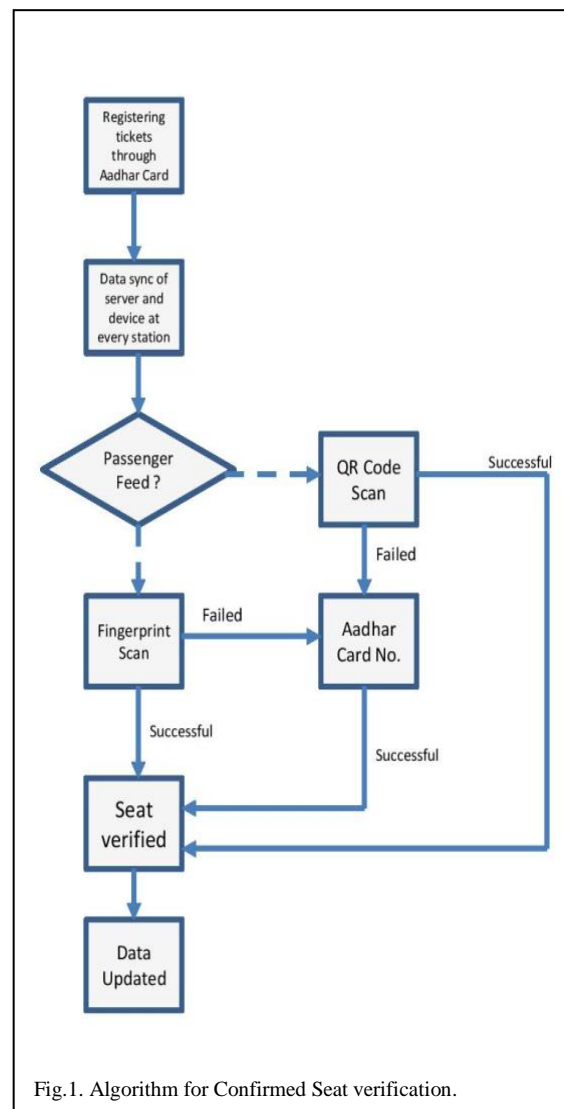

Fig.1. Algorithm for Confirmed Seat verification.

for feedback and grievances related to journey or service. "Wake me up" service can also be activated

from this app. The required services are to be generated at pantry in form of computing device (computer) for food order services with database to get above updating of food menu and to handling orders facility backed up.

At every major station during the journey or at regular interval the device will get Wi-Fi connectivity from the station in order to update passenger verification stats. Unlike, the chart system, in which the final chart is prepared exactly hours before the journey, in this system, the passenger database will keep on updating until just before the commencement of the journey, let's say just 15 minutes before[2].

Here, the passenger database includes both the reserved passengers as well as people who are in waiting and RAC list, unlike chart system which has only reserved passengers in the list. This is done to provide reservation to the people in RAC and waiting list, if any seats are vacant and ifs they are willing to take it.

III. SYSTEM IMPLEMENTATION

The Raspberry Pi 3 is the third generation Raspberry Pi. Here it is used to manage data online and sync it in our desired way. Database which was stored during the reservation and linked with the details of Aadhaar card will be fetched by Raspberry Pi just before the departure of train using Pi's onboard Wi-Fi and will be stored in the memory[6].

So, IoT device powered with Raspberry Pi 3 is created to implement this idea. Pi has major advantage over all other various boards. It uses python programming language and therefore itself has a rich set of libraries that can be used to connect to the Internet via the Ethernet port on board. Fig.2 explains whole system in the form of block diagram.

Passenger details provided during the time of reservation is linked with the Aadhaar card of that particular passenger and stored in the database of the

particular category which will be headed by this data i.e. finger print, QR code and Aadhaar Card No. Files will be created according to the selection of source and destination and will get stored in database storage server[4]. Fig.3 explains the process for Vacant Seat verification by a fellow passenger in the proposed system.

During the time of departure of train, file related to the respective train will be uploaded on the device using the onboard Wi-Fi. It will be there until the train reaches the destination. Huge amount of data is handled and managed with the help of MySQL which is discussed later.
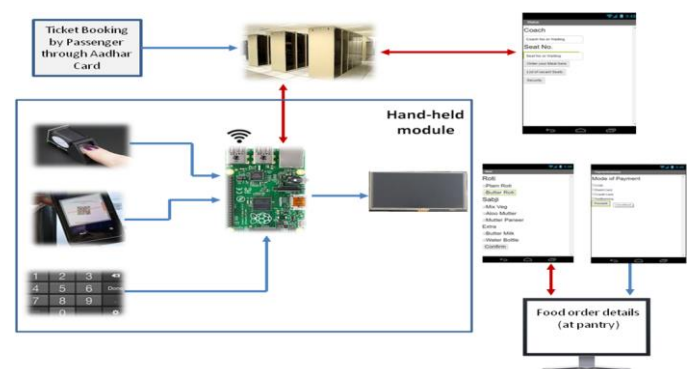

Fig.2. Proposed System

Now, TTE will ask for any one of two inputs during the time of journey i.e. finger print and QR code. Finger Print and QR code will be primary inputs and Aadhaar card number will be secondary. Any one of the input will be fetched and compared throughout the file with the help of MySQL to make the database management more efficient and less time consuming. If the input is successfully matched with the respective list, a token of confirmation will be displayed on the screen. Camera connected with Pi will scan QR code on the Aadhaar Card; MySQL will help here to execute the loop and examine the list, and if matched, a token of confirmation will be displayed. Smart phone application has been created to ease the task of passengers and increase the transparency between passengers and railways. It will accept the PNR number from the passenger and check its

directory. According to the status of the passenger he/she can order its meal on train or check out the waiting list or get the security on train during any mishaps. List of vacant seats option will only be available to waiting list passengers. Meal and Security will be available to confirmed seat passengers only. Passengers can order their meal from list provided to them by pantry. Payment can be done through a payment gateway. It will help to promote cashless transactions. At last feedback might be given by the passenger to increase the productivity of the current services[5].The following figures shows the details of seat verification, details stored in the server of Indian Railways and list of all the vacant seats between various stations.

Date of Journey	Aadhar Card No	PNR No.	Coach No.	Seat No.	Passenger Name	Age	M /F	Source Station	Boarding Station	Destination Station	Photo
XX-XX-XXXX	XXXXXXXX	XXXXX	S7	24	Passenger 1	24	M	XXXX	XXXX	XXXXX	
XX-XX-XXXX	XXXXXXXX	XXXXX	S7	14	Passenger 2	38	M	XXXX	XXXX	XXXXX	
XX-XX-XXXX	XXXXXXXX	XXXXX	S7	09	Passenger 3	19	F	XXXX	XXXX	XXXXX	

IV. FEASIBILITY/VIABILITY OF IMPLEMENTATION

The proposed system will be largely dependent on syncing the data of server with device. This is quite easy as at present era of technology and faster connectivity, the servers of railways are used extensively for syncing the data.

The device contains Raspberry Pi which is easily available and has many advantages over other hardware boards. This new IoT based system being faster, smarter and convenient has all the recent breakthrough advantages.

With Raspberry Pi and IoT, the design of device can be designed efficiently and can be optimized at regular intervals. Due to the same reason, its implementation will also be quite easy and smooth. The device reliability is good, and overall cost is also affordable as the hardware used in the device and the principle used is common, easily available and moderately cheap.

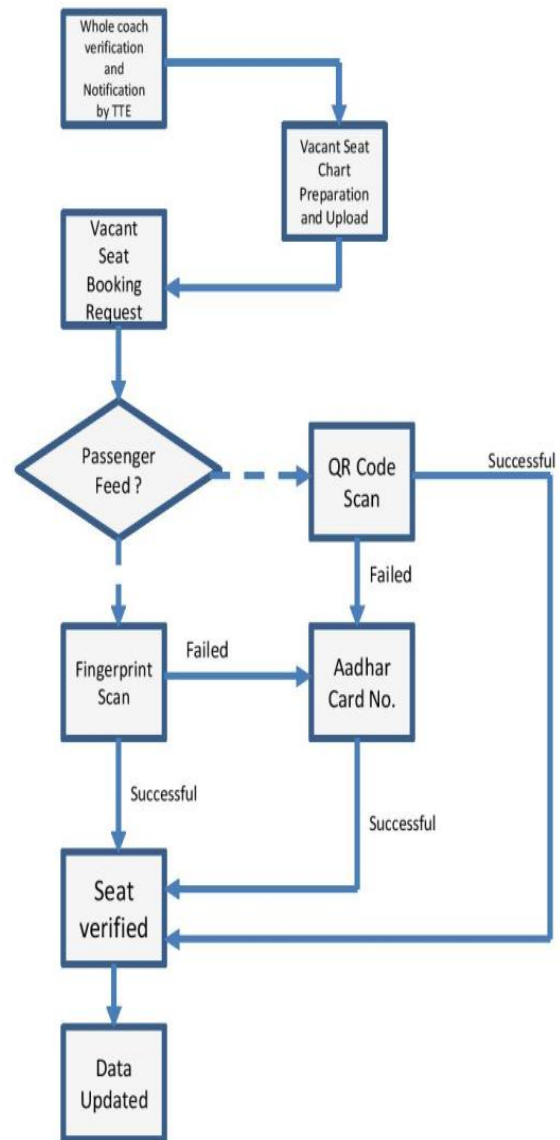| Date of Journey	Aadhar Card No.	PNR No.	Coach No.	Seat No.	Passenger Name	Age	M / F	Source Station	Boarding Station	Destination Station	Photo	Mobile No.	Fingerprint	QR Code	Full Address
XX-XX-XXXX	XXX XXX	XX XX	S7	24	Passenger 1	24	M	XX XX	XXX	XXXX		XXX			XXXX XXXX
XX-XX-XXXX	XXX XXX	XX XX	S7	14	Passenger 2	14	M	XX XX	XXX	XXXX		XXX			XXXX XXXX
XX-XX-XXXX	XXX XXX	XX XX	S7	09	Passenger 3	19	F	XX XX	XXX	XXXX		XXX			XXXX XXXX

Fig.3. Algorithm for Vacant Seat verification after its booking

The server of railways will also temporarily contain Aadhaar Card details of passengers travelling, apart from the regular details it contains at present, but it will be quite easy to link the server with the Aadhaar database.

V. MIGRATION FROM CURRENT PRACTICES

The official filling up of vacant seats during the journey will be introduced for the first time in Indian Railways through this system, implementation of which is quite easy and beneficial for passengers.

For the first time, the food menu with genuine price rates will be available digitally to the passengers with an additional facility to order and pay through the application itself. Easy access to security will be provided to passengers. This will decrease crime rate and also improve handling of medical emergencies. These also, can be easily be implemented with the help of smart phone application quite easily.

The heart of whole system is the IoT based device. At present, there are no such devices being used in Indian railways. So, initial manufacturing cost of device will increase overall expenditure of railways.

But, the running cost is very less. It is due to the use of device which includes highly recognized hardware having minimal chances of failure.

A TTE of the Indian Railway, at present, does not know how to operate this kind of device. So, he/she has to be given a 2-days training workshop before he/she can actually use the device in the train. This kind of training, which is not there at present in Indian Railways, will have to be introduced.

Due to the extensive use of technology-based device in this system, technical support regarding the device and the whole system is to be provided at major stations. This also, is not there at present in Indian Railways and it is one of the challenges.

The server support will be till the end of the journey and storage of the concerned data will be up to 1 week after a particular journey is over for a better feedback mechanism. The server support will be easy, but storage up to 1 week would be quite a tough task as compared to current practices being followed by Indian Railway Servers in order to address grievances suitably related to services provided during the journey.

VI. SUSTAINIBILITY IN THE LONG RUN

As the whole system is technology based, it will only, but improve in the future. Through the feedback mechanism, the system will get a chance to improve for railways' and passengers' betterment.

Due to ever-evolving nature of technology also, the system will be able to reflect at current features and practices, and change accordingly to improve.

The technology and digitalization are now swiping over every department gradually. It is expected that sooner or later the major of processes in day to day life will be technology based only. So, this will help the proposed system to improve from time to time by changing and sustaining itself.

A proper and well planned execution of the proposed system will see a considerable rise in passenger satisfaction for the whole journey and services provided during the same and increase in trust for Indian Railways. This will certainly encourage the system to enhance from time to time.

VII. FEEDBACK MECHANISM FOR CONTINUAL IMPROVEMENT

Feedback contributes to increased productivity, retention and team management. We have provided various methods for feedback by the passengers. Generally, feedback will be provided for three categories-

1) Photos of meal ordered by the passenger will be uploaded on the app, which will be directly delivered to the Ministry which will help us to improve the quality of the food and make it more hygienic.

2) Condition of the damaged railway property can be directly sent to the respective Station Manager. It will help Indian Railways to increase their functionality.

3) The Swachh Bharat Abhiyan is the most significant cleanliness campaign by the Government of India. It will be more suitable in Indian Railways by uploading the images of uncleanliness in the premises of Indian

Railways. Action will be taken by the Department immediately.

Date of Journey	Aadhaar Card No.	PNR No.	Passenger Name	Age	M/F	Boarding Station	Destination Station	Mobile No.	Available Vacant Seats (Sorted according to time)
XX-XX-XXXX	XXXXX	XXXXXX	Passenger 1	24	M	Mumbai	Delhi	XXXXX	1) Surat-Baroda S7/07 (2 hours) 2) Mumbai-Surat S7/34 (3 hours) 3) Mumbai-Jaipur S7/15 (11 hours) 4) Baroda-Delhi S7/29 (13 hours)
XX-XX-XXXX	XXXXX	XXXXXX	Passenger 2	14	M	Mumbai	Baroda	XXXXX	1) Surat-Baroda S7/07 (2 hours) 2) Mumbai-Surat S7/34 (3 hours)
XX-XX-XXXX	XXXXX	XXXXXX	Passenger 3	19	F	Mumbai	Surat	XXXXX	1) Mumbai-Surat S7/34 (3 hours)

Fig.6. An example of a list of available vacant seats for RAC and wait-listed passengers displayed on the hand held device and in the smart phone

VIII. CHALLENGES

The proposed system highly relies on availability of data connection at regular intervals of time. But it might not be available sufficiently at certain remote areas of the country. Poor cellular network and accessibility of data network are certain obstacles to utilizing the full capabilities of the system.

Also, passengers, though few, who are not familiar with smart phones will have a problem to properly use the smart phone application.

The foremost step in the system is the providing of Aadhaar Card No. But obviously, all passengers of Indian Railways, at present, will not have an Aadhaar Card. So, before the proposed system is implemented properly, it will need the availability of Aadhaar Card with each and every passenger.

Even if Aadhaar Card is there with a fellow passenger, his/her mobile no. and address might not be updated and this might pose a big obstacle for properly utilizing the smart phone application as it needs OTP sent to the registered mobile no. for security purpose.

IX. CONCLUSION

Thus, it is well understood that the proposed system, if properly implemented and well maintained, will bring a whole new experience to travelling in Indian Railways for the fellow passengers. It will increase the passengers' faith and trust in Indian Railways. It will also foster the idea of Digital India. The security and safety of passengers will increase, which will trigger a decrease in crime rate. The system, through the help of technology will improve in the future by the challenges posed by the technology itself. It will simplify the whole working of Indian Railways considerably. It will highly improve the handling of passengers' grievances during and after the journey, which at present, is very lethargic. There are certain challenges in and after the implementation of system. But, these challenges itself will enforce the system to improve continuously to decrease flaws in it. The idea also promotes the saving of environment, by suspending the use of paper for the chart system in Indian Railways. A whole new array of services will be introduced with improvisation of current services. At last, the tailored feedback will ensure that the passenger gets his/her due compensation for the disservice(s) provided. It will also increase railways' awareness of the passengers' view for the whole system, which will again encourage the railways to improve and correct itself for the right of passengers.

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