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Digitalized Railway Ticketing and Predictive Analysis of Passenger Travel using Big Data Analytics

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Abstract: ***The need for Indian Railways to improve the service facilities and to avoid overcrowded compartments is thriving. The current scenario is that the railway ministry is unable to achieve an accurate data of commuters travelling everyday and the only means to retrieve the number of travellers is through ticketing, where a handful of them travel ticketless causing discrepancy of data. The smart card ticketing infrastructure accomplishes the use of electronic money and mobile services to purchase railway tickets. This is achieved with the help of an IOT device, a smart card which holds the passenger's finger print. Thereby, the railway ministry links the data received from the RFID sensors at the point of departure and arrival with that of aadhar database to obtain an accurate identification. This eradicates the trailing queues, ticketless passengers and thus saves time for the passengers and also achieves an accurate frequency of passenger travel.***

Keywords: Smartcard, RFID sensors, Aadhar database, Biometric recognition, Naïve Bayes classification and K-means clustering.

I. INTRODUCTION

Railways play a predominant role contributing to the economic development of our country in the fields of trade, industry and commerce. The carrying capacity is extremely high and also a safest means of transport. So, most of them prefer travelling by train to other means of transport.

The main objective is to propose a smart ticketing system for local trains in India. A smart card which holds the biometrics of a passenger is used as a digital ticket eliminating ticketless passengers and providing an accurate passenger pattern to the railway ministry of India. Better understanding of passengers is essential for higher transit authorities to satisfy customer needs and priority. Despite the high congestion of transit passengers, transit authorities have little knowledge about their customers due to reasons such as the anonymity of passenger's behaviour and the problem in analysis of the distributed information of massive population [1].An exact identification of the commuter is retrieved when the data obtained from the RFID sensors is linked to the aadhar database. The journey fare is automatically deducted from the corresponding bank account which is linked with the aadhar card of that particular person. According to a survey, the Indian railway department is incurring a loss of about 5crore rupees every year due to ticketless travellers. This proposed digital payment is efficient for revenue management.

II. PROPOSED METHODOLGY

This paper augments the transit passenger simulation by passenger segmentation using the Smart Card data. The segmentation aims to cluster passengers of similar travel pattern, i.e., with the same type of journeys at usual times and locations[1].

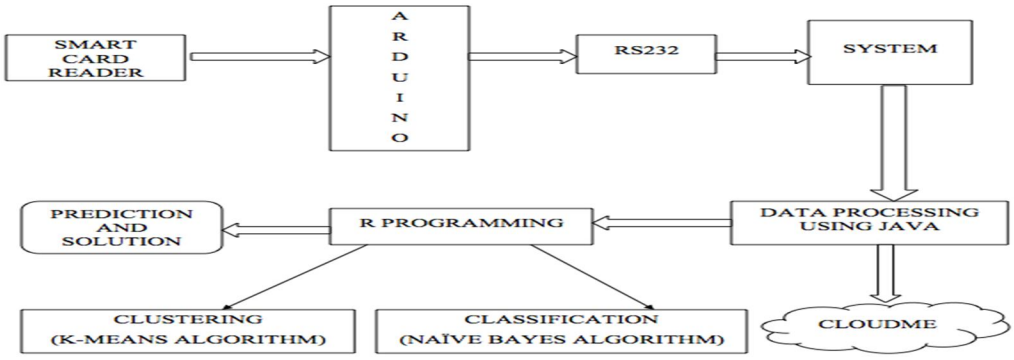

Fig1: Digitalized Railway Ticketing Architecture

A. The components involved in the smart ticketing system are described with the operations as follows:

1) *Smart Card an* Iot device which has an EMF coil embedded in it which gets energized when it gets coupled when sensed by the RFID. It contains the biometric of a passenger who is intended to travel.

2) *ARDUINO:* A microcontroller (atmega328 microcontroller) that one can programme, erase and reprogramme at any given time.[2]. It can receive and send information to most devices, and even through the internet to command the specific electronic device.it uses a hardware called arduino uno [3] circuit board and software programme (Simplified C++ [2]) to programme the board.

3) *RFID Reader:* A hardware device that is mounted at the entrance of a station by which the fingerprint is detected.

4) *System:* It receives the data from the smart card reader which can be viewed only by the transit authorities.

5) *Cloud Me:* It is a typical open source file storing device offering Software as a Service(SaaS). Data analytics and passenger travel prediction is carried out by railway officials using this data.

6) *R Programming Analytics:* R is a flexible framework and it is capable for analysing various types of data which is available on the cloud [4].

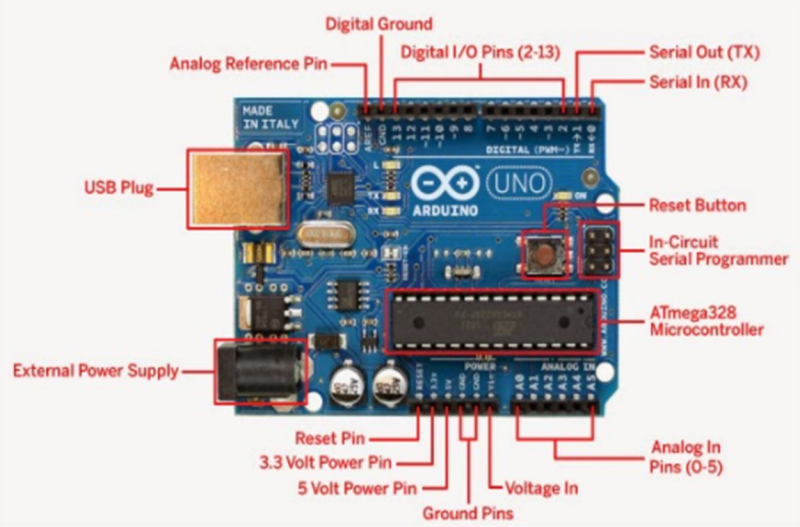

Fig2: Labelled structure of Arduino uno(atmega328 microcontroller).

III. OUTLINE FRAMEWORK

A. The user swipes the smartcard on RFID sensors placed at the entrance of the railway station and selects the desired destination.

B. The RFID reader reads the smart card and loads the data in the servers at the station.

Now, the biometric recognition of a passenger is verified with that of the aadhar database.

Fig3:Fingerprint retrieved from a smartcard

C. Once the destination is entered, the journey fare is validated with the bank account associated with the aadhar card of that particular individual and deducts the amount. If the account carries an insufficient balance then the passenger will not be able to take up the journey.

D. Platform tickets can also be purchased using the same card.

E. At the destination, the user has to swipe the card again and exit the station. This will enable the railways to achieve an accurate frequency travel and make necessary improvements and thus avoids the ticketless passengers.

F. The travel pattern is obtained by classification and clustering algorithms.

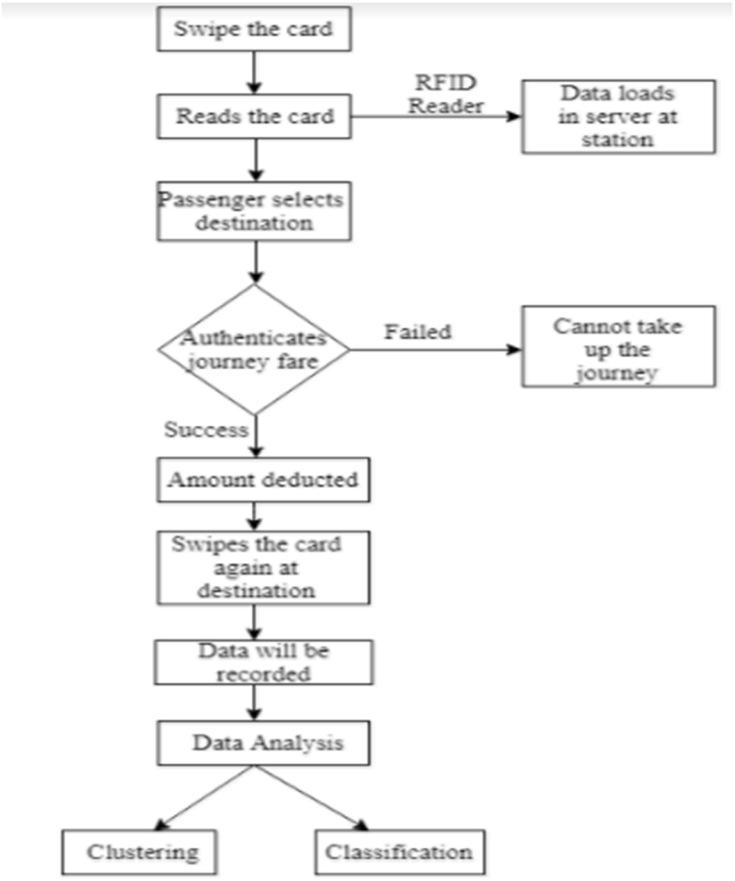

Fig4: Flowchart of the proposed system

1) *Classification algorithm:* For the effective mining of passengers, we use a Naïve Bayes approach. Bayesian decision theory uses Bayesian probability for deciding which attribute should become a node in the tree. It is a statistical system that in which various decisions are made based on various calculations to find out best tree suited, making use of probabilities and costs. A concept of Bayesian statistics is used to estimate the expected value. These agents are called estimators. This algorithm uses a non-parametric approach so can be used for making decision on large dataset [1]. The algorithm extracts singular points (cores and deltas) in a fingerprint image and performs classification based on the number and locations of the detected singular points. The classifier is invariant to rotation, translation and small amounts of scale changes. The classifier is rule-based, where the rules are generated independent of a given set [5].

2) *Clustering algorithm:* The main goal of clustering is to categorize data into clusters such that objects are grouped in the same cluster when they are “similar” according to similarities, traits and behavior. The most commonly used algorithm in clustering are partitioning, hierarchical, grid based, density based, and model based algorithms [6]. Clustering is a way that classifies the raw data reasonably and searches the hidden patterns that may exist in datasets [7]. K-means algorithm is an effective and powerful method in exploring the structure in data set. K-means clustering algorithm partitions the dataset into “k” number of subsets [7]. In K-Means each cluster is represented by its centroid. Centroids can be considered as the average point, also can be called as mean of points within the cluster. Kmeans provide effective result on dataset with numeric attributes, whereas noise and outliers affects the effectiveness and efficiency of the algorithm. K-mean classifies n instance in a dataset to k clusters, it finds an optimal solution which minimizes the objective function value. K-means clustering algorithm is based on assignment

step which finds the nearest cluster for each point using distance metrics between the point and the cluster centre. In updating step the computing of cluster centres will be performed based on the current cluster member points [6].

IV. RELATED WORK

A. *Mobile based RFID Readers*

The RFID tag is attached to the rear panel of the mobile, where the unique id is verified at the server station. Form is filled in the mobile application to receive the softcopy of the ticket which is stored in the RMS section of the mobile in order to avoid modification.

B. *Finger print and fare validation*

The passenger's finger print is received and journey fare is paid. At the destination, the existing finger print is validated along with the journey fare.

C. *Metro rail framework*

The commuter can either purchase a coin or a card based ticket. The coin is bought at the source of travel and dropped at the destination. Coins are purchased based on the distance of travel. Frequent travellers can obtain a card which is rechargeable. This has to be swiped at both the source and destination and money is deducted at the end of the journey.

V. FUTURE ENHANCEMENTS

Near field communication(NFC) can be enabled in the smart card to improvise the digital ticketing further , where the card can be sensed when passenger is within the radius of 100 meters. The passenger will be able to walk into the train directly, once the card is validated without any delay. This approach can be made as a real time application which would create a revolution during the next generation.

VI.CONCLUSION

This paper has brought in technology to the field of railways in order to improvise the infrastructure and provide better facilities to the commuters. This digitalized ticketing will allow the passengers to purchase tickets without having to wait and eradicating ticketless passengers, where the railway ministry achieves an accurate frequency travel pattern of the passengers.

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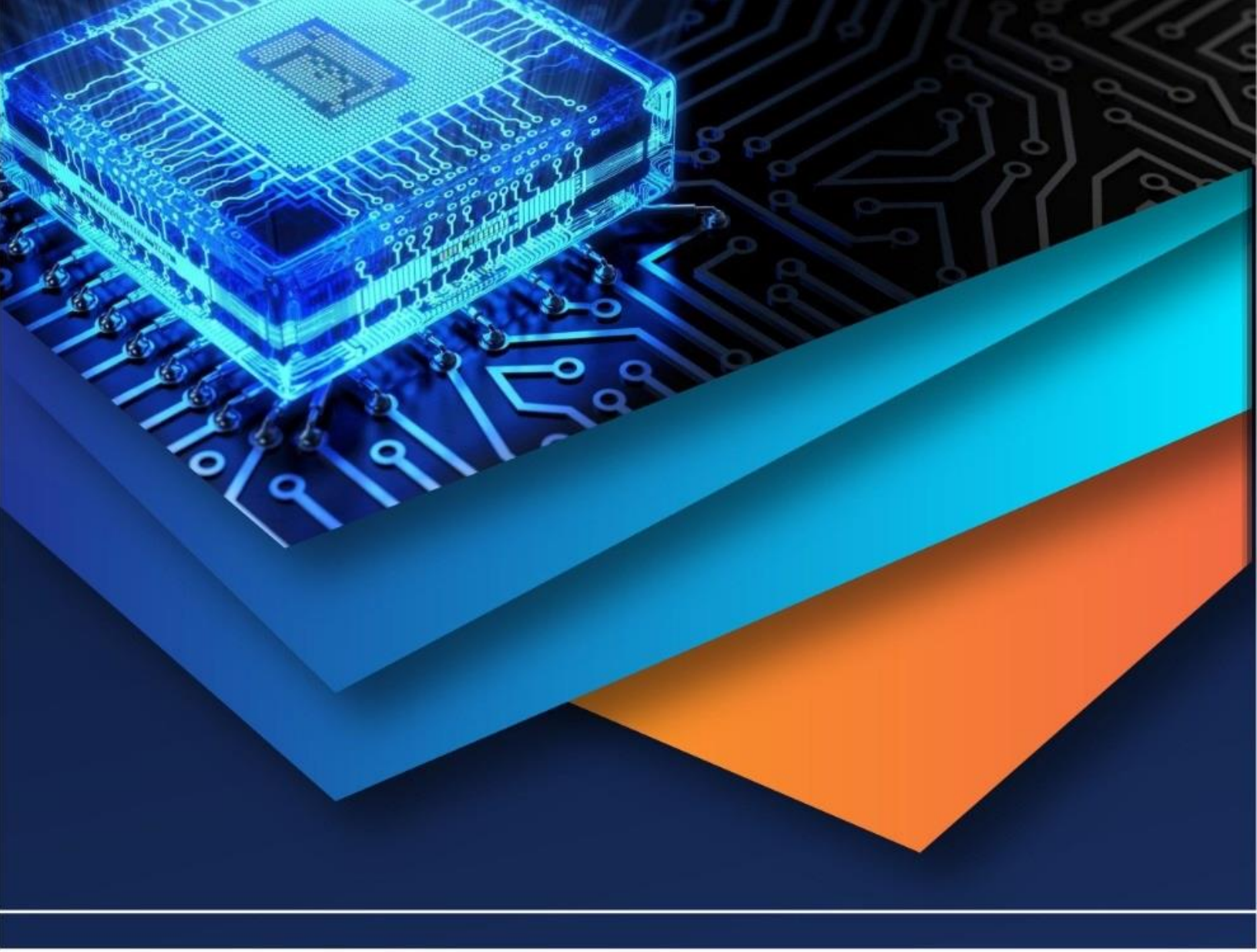

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