

Secured Vehicle Toll Payment System using NFC

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Abstract—Nowadays, uses for NFC technology have been emerging day by day, the best application of NFC technology is in the contactless payment system. Similarly, due to various advantages of web application such as ease of maintenance and various user-friendly released version, the demand for new web applications supporting different types of devices and purposes are continuously increasing. Now different technologies such as Bluetooth, NFC, and BLE are being used for initiating the online payment. Considering the parameters such as cost, more reliability, and increased security, NFC technology is a best-fitted option for initiating the online vehicle toll payment system.

Thus, the application of Cloud-based web application along with different IoT devices like Smartphone (having NFC feature) and NFC tag (ISO/IEC 14443) is explained in this paper.

Paper the online vehicle toll payment system developed by using NFC technology is used for triggering the vehicle toll payment system supported by the web application.

Keywords—Near Field Communication, web application, Internet of Things, Contactless payment, Online toll payment, Secugen Hamster Pro, Finger Print Scanner.

I. INTRODUCTION

Transportation has one of the major shares in any country's economy. Improvement in transportation systems result into the good lifestyle through which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation. Increase number of vehicles on the road, results into number of problems such as congestion, accident rate, air pollution and many other. All economic activities for different tasks use different methods of transportation. For this reason, increasing transportation is an immediate impact on productivity of nation and the economy [4]. Reducing the cost of transporting resource at production sites and transport completed goods to markets is one of the important key factors in economic competition. Vehicle toll payment is a technology that allows the automated electronic collection of toll costs. It is capable of determining if the vehicle is registered or not, and then informing the management center about to process violations, debits, and participating accounts [4]. The most excellent advantage of this system is that it is capable of eliminating congestion in toll plaza, especially during those seasons when traffic seems to be higher than normal.

The above situation can be handled by using NFC Technology. Near-field communication (NFC) is a set of communication protocols that enable communication

between two electronic devices, often via NFC apps or NFC stickers (or tags) operating at 13.56 MHz [13]. There are several NFC technology companies that have come up with NFC phones, or smartphones and other devices that come with NFC chips, and these NFC technology companies predict that in three years, they will have nearly 2 billion of these mobile devices in circulation [13].

Similarly, in the business environment, their a huge usage of WEB applications and main reasons for this is ease of maintenance as well as the version released. Even security point of view the web application is secure as it's made only on the central server without the need for access to a user's computer [5]. Moreover, WEB oriented applications are available over the Internet for use so it can be accessed in any location and on any kind of small or resource-constrained device. Such web applications can be embedded with different other applications, control and management services, to realize management, monitoring reporting, etc [5]. Even hosting a specific web application can be done as WEB based applications is independent of system operation.

From the security point of view, the security of the web application and IoT depends on the security requirements of the web application and the IoT application domain. In case of a web application, as there is the only access to a single central server rather than using large amounts of workstations due to this security is on a high level, moving web applications and corresponding services to the web server gives more reliability and scalability to the whole system, while simultaneously allowing management and administration from one location.

II. EXISTING SYSTEM

In Current Scenario, now a day there are many toll collection centres in all highway roads. User has to wait in queue, he has to pay the tollgate amount and there are chances of misusing the money by tollgate people and its very time consuming. In the existing system, according to the manual toll collection methodology, a driver has to stop at a charging booth and pay the required fee directly to a collector [14]. The amount to be paid by each vehicle is determined by its characteristics or classification. In the manual toll payment system time consuming and many mischievous things may happen by manpower.

List of Disadvantages of the existing system,

- Managing toll details and collection data is a difficult job.
- Need to count the collected toll amount every time.
- Manual entry consumes more time.
- It is difficult to maintain bulk of record in manual.

- Lack of accuracy and error prone.
- Non-secure.
- No method to trace details.
- Human errors.

III. PROPOSED SYSTEM

Proposed concept, design and implementation of a web application and NFC application can be used for vehicle toll payment. The design and implementation model imply usage of an IoT device along with finger print scanner which initiates vehicle toll payments request by calling web application's web service functions. Further, the web application estimates the amount for toll payment by user (driver) through an electronic payment system. The web application itself is developed to be hosted on a server directly or on a virtual machine using virtualization technology on the physical server.

IV. SYSTEM OVERVIEW

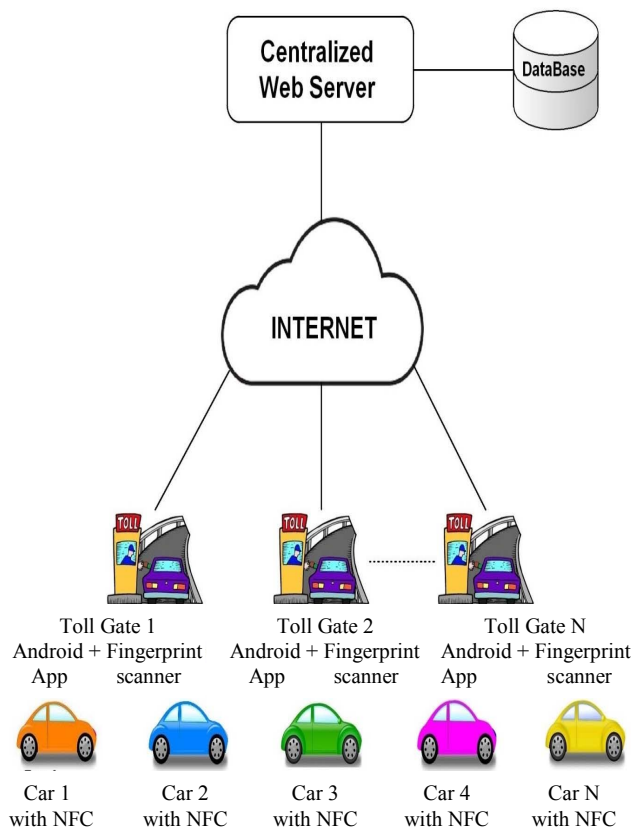


Fig. 1 . System Overview

The Fig. 1, shows the proposed system Overview for the NFC based vehicle toll payment system. Where the cars having the NFC device such as an NFC tags which can be tapped along with the corresponding finger print at the toll gate having Android App or toll gate having NFC Tag reader. As soon as the tag is read and the finger print is verified with the finger print data which is stored in the online database then particular toll amount will be deducted through the card/tag and the toll gate will get open and the

data will be saved in the database which is done by the enterprise web application. Here in this system architecture the whole data will be saved in the database or stored in the database. Where the data in the database can be accessed by the admin/Handler and the data in the database can be edited by the admin/Handler.

V. FRAMEWORK AND TECHNOLOGY

The design and implementation model use of an NFC device i.e. NFC enabled Mobile phone which initiates vehicle toll payments request by calling web application's web service function. The web application itself is developed to be hosted on a server directly or on a virtual machine using virtualization technology on the physical server.

ASP.NET Framework is used for the web application development and the android part is developed using Android Java programming Language of the vehicle toll payment system respectively. The tools used for the development are Visual Studio 2015 Community Edition and Android Studio for the web application development and the android part respectively. In this system, a central database is being implemented using MySQL 5.0 and SQLyog for storing the toll fares, toll id, addresses etc.

VI. SYSTEM ARCHITECTURE

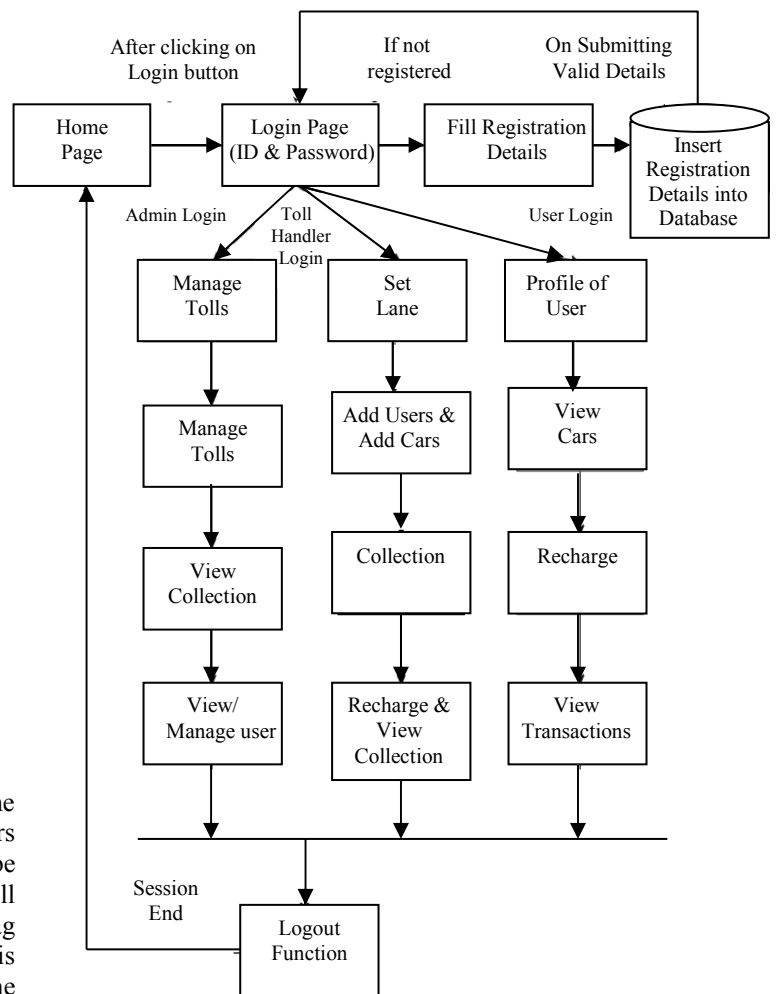


Fig. 2 . System Architecture

The Fig. 2, shows the proposed system Architecture for the NFC based Vehicle Toll Payment System. The system comprises of 3 major modules with their sub-modules as follows:

1. Admin: (Web Application)

- a. **Login:** Admin need to login using their valid login credentials in order to access the system.
- b. **Add Toll Details:** Admin can add new toll with its details.
- c. **Manage Tolls:** All the added tolls are manageable by the admin.
- d. **View Collection:** Admin can view amount collection at each toll.
- e. **View / Manage Users:** All the registered user's list will be displayed with their details.

2. Toll Handler: (Android)

- a. **Login:** Toll handler person need to login using their valid login credentials in order to access the system.
- b. **Set Lane:** Authorized person can set the toll lane
- c. **Add User:** Can add new user details, wallet details, 5 fingerprint thumb impression and assign card.
- d. **Add Cars:** Can add owner car details
- e. **Amount Collection:** Can collect amount from the car owner by scanning their NFC tag.
- f. **Recharge Account:** Can recharge add balance in user's account.
- g. **View Collection:** Can view amount collected at a particular toll lane.

3. User: (Android)

- a. **Login:** User can login using valid login credentials in order to access the android application.
- b. **Profile:** Can view their own profile with details.
- c. **View Cars:** View own car details.
- d. **Recharge:** Can recharge the wallet using a dummy payment method.
- e. **View Transactions:** Can view transaction details of toll payments as well as wallet recharge.

VII. SECURITY

For implementing the secured vehicle toll payment system AES-128 bits algorithm is used.

Here, the Admin and the user databases are encrypted using the AES-128 bits, and for the fingerprint scanning we have used FBI approved Secugen Fingerprint Scanner where the reader is based on a rugged sensor, which is also resistant to scratches, impacts and electrostatic shock. Also specified that the scanner rejects **latent** fingerprints and 2-D **spoof** fingerprint images (i.e. photocopies), as well as captures problematic fingerprints like dry, moist, aged or scarred [15]. Thus, enabling more security to this project.

VIII. CONCEPT OF SECURED VEHICLE TOLL PAYMENT SYSTEM USING NFC

- This system is accessed by three entities namely, Admin, Toll Handler and User.
- Admin need to login with their valid login credentials first in order to access the web server application Ref. Fig. 3
- After successful login, admin can access all the modules and perform/manage each task accurately.
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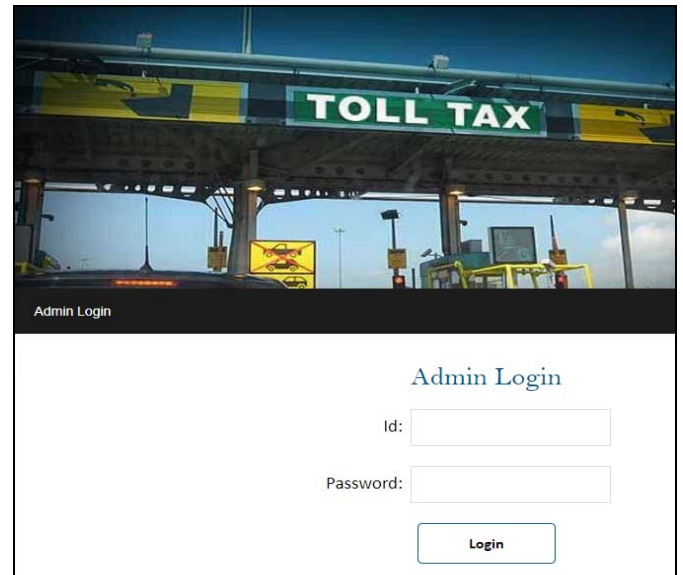


Fig. 3 . Admin Login Page (Web Application)

- Admin can perform task such as adding and managing toll and handler details, view amount collection of respective toll with date search and view or manage user details. Ref.Fig.4



Fig. 4 . Admin Task

- Toll handler person need to login using their valid credentials in order to access the system. Ref.Fig.5

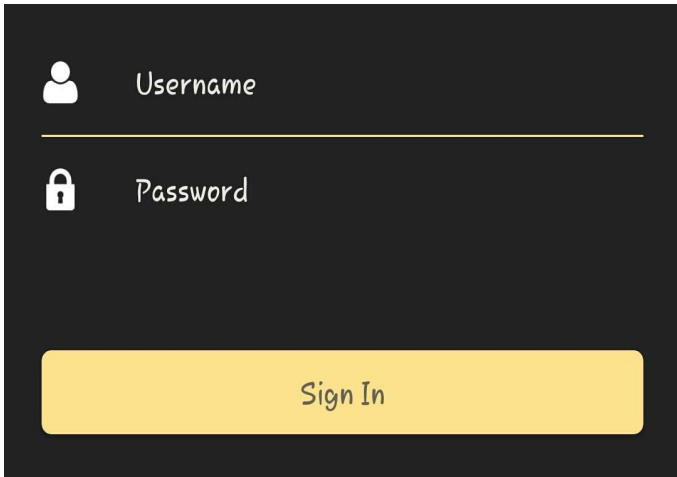


Fig. 5 . Admin Task

- Once toll handler person logs into the system, he need to set the toll collection lane in order to perform task Ref.Fig. 6

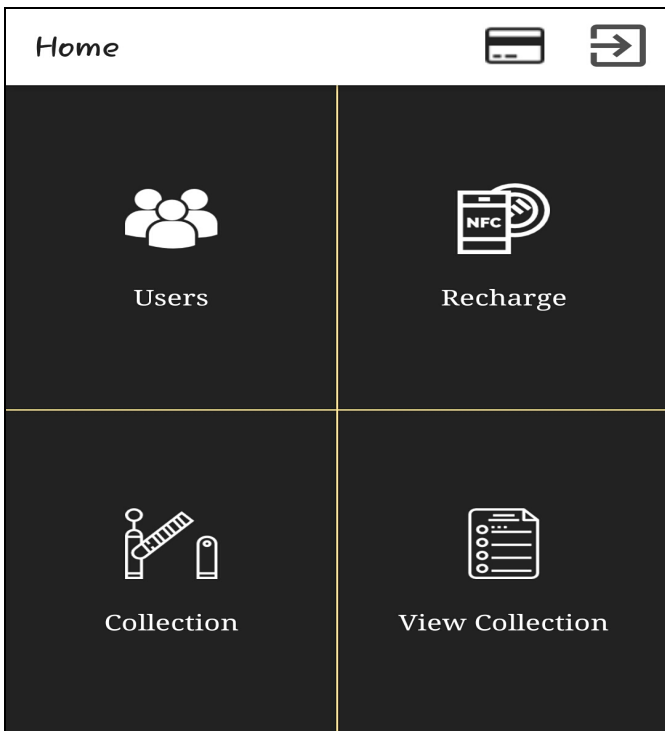


Fig. 6 . Handler Task Page (Android App)

- Toll handler can add new user with his/her details and setting up 5 fingerprint and assigning an NFC (Near Field Communicator) tag.
- Toll handler can add owner car details by scanning owners NFC tag and verifying thumb impression.
- Before collecting the toll amount from an incoming car, toll handler will scan the NFC tag of registered user.
- Once the NFC tag is scanned and the user is verified, handler can check for balance and deduct the respective amount else handler can recharge user's wallet with user specified amount.

- Handler can view collection toll amount of respective lane of toll Ref. Fig.7

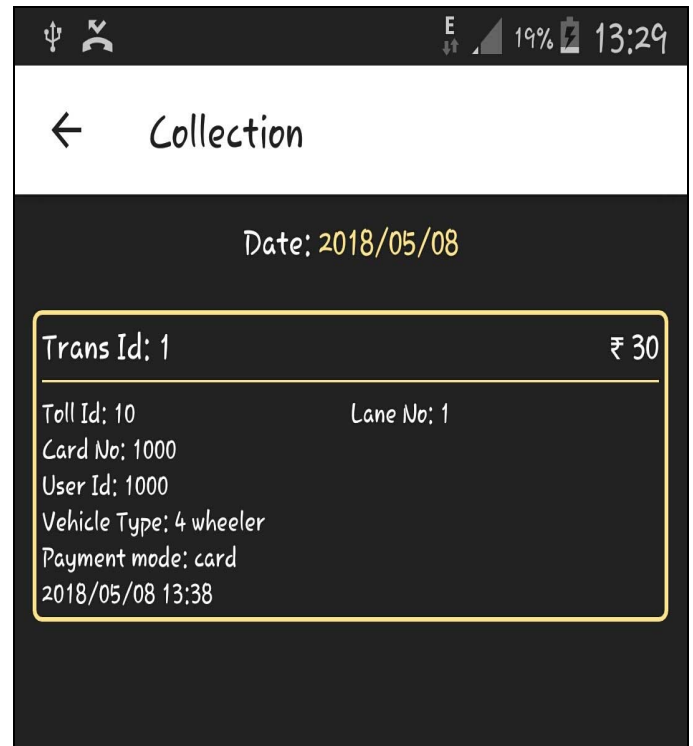


Fig. 7 . Collection

- User or the car owner can login into their installed android application in order to access the application. Ref. Fig. 8

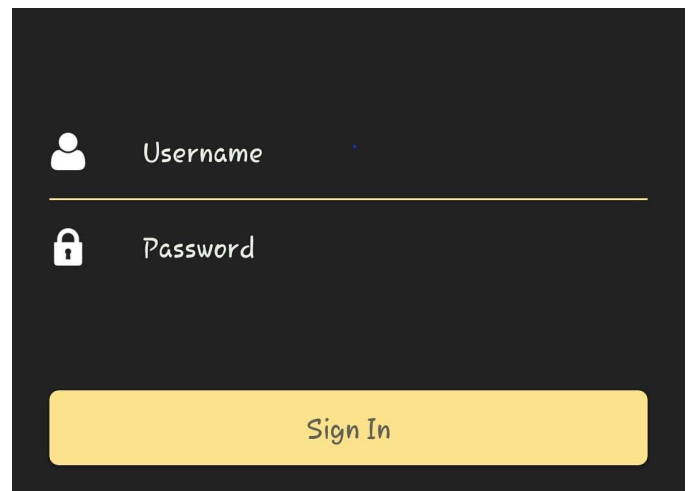


Fig. 8 . User Login (Android App)

- On successful login, he/she can view their own profile details with car details as well. Ref. Fig. 9

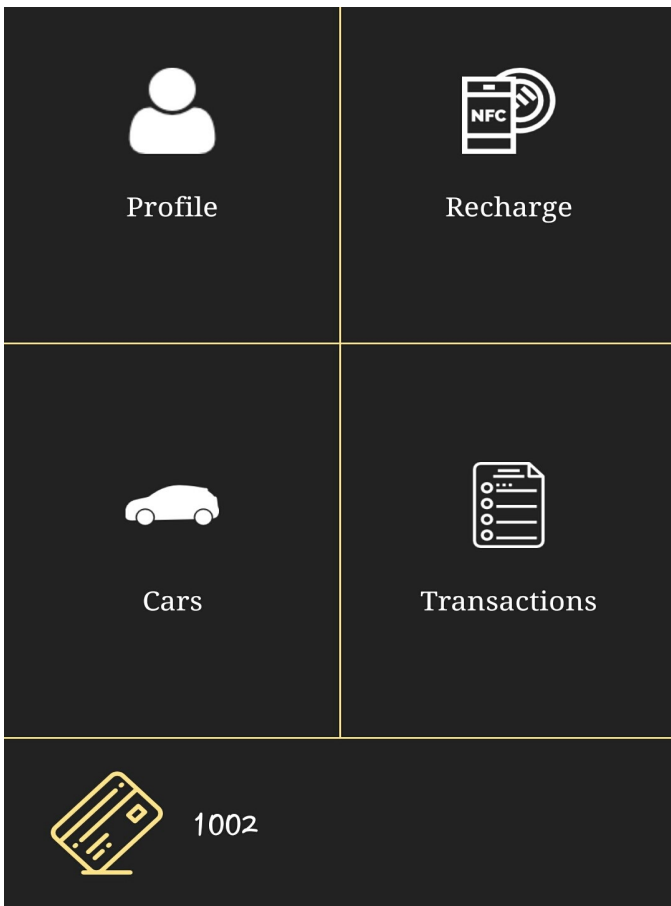


Fig. 9 . User Task

- User can recharge the wallet with a dummy card payment Ref. Fig. 10 or just paying the money by cash at the Toll booth to the Toll handler and view their transaction of wallet recharge as well as toll payments.

←
Recharge

Balance : 600

Fig. 10 . Recharge

- The Data of user/Profile is stored in the encrypted form in centralized database which is not readable to any of the entities. Ref. Fig. 11

Uid	Name	Address	Contact
1000	YclzTpRTZbXv+...	JpXJMmzYc85q...	erkiLKugFIHqXf...
1001	txWHESHMGf...	s4pCi58J2X8jD8...	JPDdFyWzdI53a...
1002	ll8r9FgnQFkoAi...	FHohgzH3kps6...	RDnRc2ly2/Oso...
NULL	NULL	NULL	NULL

Fig. 11 . Encrypted User's Data

- The Database of Finger Print of various Users is as shown Ref. Fig. 12

F1	F2	F3
AqZP9H8Gz5fA==	+SRTqB8YhhQ...	Ai2++Ob2ccu4...
4fc6itfXaqDKE+...	swWRPjZGGWx...	swWRPjZGGWx...
MZCtoUL/oi02...	8kX/uTeLH9oX...	o4L/5sb0DYLwt...
NULL	NULL	NULL

Fig. 12 . Finger Print Database

IX. CONCLUSION

One of the most important impacts of technology is to develop sustainable technologies that can reduce the traffic conjunction and save energy and time. This System mainly aims to fulfil needs in these aspects, by saving both the time on the toll and save fuel. It also regulates the pollution along with the usage of vehicle at toll gates as shown, it makes the toll collection payment easy by using NFC toll cash collection process.

This System about “**Vehicle Toll Payment System using NFC**” developed in web as well as android application based on Asp .Net and JAVA language respectively. The NFC (Near Field Communication) along with the web application is developed to support integration into the cloud or an enterprise system. As in the vehicle toll payment application the number of devices can be enormous, the scalability of the application is supported and represents a vital role. Besides the fact that this system is easy to use for travelers as well as for companies engaged in the highway management, advantages of such system could be multiple in other segments of service as well. The information contained in the database can be used to easily create reports about the number of vehicles and the category of vehicles that pass through the system of payment per day. In addition, it can be easy at any time to retrieve the data on the amount of money that is on daily or any other period paid at the cash register. This approach opens multiple possibilities because additional benefits in systems with toll can be introduced. New possibilities can exist in the form of

loyalty program for travelers who frequently use certain segments of the road, in order to attract as many passengers to use precisely this route. These programs may provide discounts on tolls, free refreshments at rest stops along the road, integrate with other products (e.g. vacations, traveling agencies) in order to use specific routes with such kind of payment, etc. Apart from paying tolls system, such system could be applicable to many other systems, such as systems for parking payment, parking garage payment.

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