Offline Transaction System

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Abstract. The usage of online payment systems is increasing multifold these days due to their transaction reliability and ease of completion in real-time. The most preferred service is UPI service, which is majorly available in Metropolitan cities, in some semi-urban and rural areas which have a proper communication infrastructure. However, there is a major issue to expand these services in rural areas, which lack proper communication infrastructure. Even after the internet revolution, it is ensured that all Indians are connected to data at all times but there might be situations where the user could not able to connect to the Internet owing to many reasons like High Altitude, Low Network availability, in-flight, etc. As an individual, such situations cannot be avoided, and there it comes to the applicability of offline transaction systems. We plan to change that by introducing an offline transaction system. We plan to expand on the idea of an offline payment system that will ensure that a reliable & secured digital payment system is available to all individuals.

1 Introduction

Creating an o*ffl*ine payment system to democratize digital payment technology and ensure that the facility is made available to everyone. We have used react for the Front end, MySQL for maintaining databases, and JavaScript for the backend. We plan to eliminate various problems with digital systems too.

1.1 Objective

The major objective of our system is to make the current digital payment process o*ffl*ine and make it more flexible for both entities. We aim to make digital payment available to every segment of the population and not just metropolitan cities as is the case largely now. The current digital payment system proved to be a great revolution but now thereis a need to democratize it further and make it accessible to all. We believe that introduction of such a system can bring about a lot of positive changes. We want to address limitations in the current system which include:

1. Creation of DUAL NETWORK SERVER (DNS) which will process payment o*ffl*ine by using SMS Service.
2. Using encrypted sound waves using a specific high-frequency sound, which stores transaction data that will process payment later.
3. Using Batch-processing (mesh technology) in which case payments will be processed after a designated amount of time and will require an internet connection.
4. Bluetooth / NFC-based o*ffl*ine transaction systems which will be wallet-to-wallet transfers which will also not be reflected immediately.
5. Launching these features like an inbuilt function wherephones will be inbuilt to act as an independent server (DNS) to give call the API of the particular bank.

2 Literature Survey

Existing Online payment solutions are popular and we more or less know how this works. Let us take a lookat the available o*ffl*ine transaction services.

1. Ahamad, S.S at.el [1] has expressed the flaws in existing solutions like end-to-end communication, information privacy as well as client's anonymity. The authors have proposed a secure and Privacy-preserving mobile commerce for NFC proximity-based. The author claims about the low cost computations and communication.
2. The proposal based on the recent Covid -19 pandemic, where a huge increase in online transactions have taken place. However many times the internet connectivity is not available due to many reasons. Yash Kumar Gupta at. El [2] has proposed a cheaper offline solution without involving higher online transaction costs.
3. General overall observations of the survey are that existing OFFLINE solutions are either heavily reliant on Infrastructure or unable to process payments to OFFLINE[3,4,5].

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4. Major problems with these cards were that the majority number of times o*ffl*ine transactions did not process, absence of Infrastructure like availability of the card hence were unsuccessful [4,5].

5. Pay TM 2019 launched a Tap-to-Tap pay card, in which users loaded money and could pay with or without the internet, provided that the receiver had the Tap-to-Tap card as well[6]

6. Googlepay partnered with pine labs in July 2019 to allow merchants to initiate payment requests by punching in a customer's mobile number on their PoS service which was later unsuccessful [7].

Addressing a few issues which could potentially contribute to solving this problem are:

1. Creation of DUAL NETWORK SERVER (DNS) which will process payment o*ffl*ine by using SMS service (mobile network). Using SMS service will ensure convenience and secure transactions.

2. Using encrypted sound waves using a specific high-frequency sound, which stores transaction data that will process payment later.

3. Using Batch-processing (mesh technology) in which case payments will be processed after a designated amount of time and will require an internet connection.

4. Bluetooth / NFC-based o*ffl*ine transaction systems which will be wallet-to-wallet transfers which will also not be reflected immediately.

5. Launching these features like an inbuilt function wherephones will be inbuilt to act as an independent server (DNS) to give call the API of the particular bank.

6. To conclude, the Majority of the existing payment services make use of the internet as infrastructure, and o*ffl*ine transaction systems are have been tried by various organizations but have not succeeded in creating this system.

3 Proposed Methodologies

1. For the web app/ web portal mentioned in the system design section, where users will register on the website, will be made using the React.js library(JavaScript UI library).

2. For the server mentioned in the system design section, a Node.js server (Asynchronous JavaScript Runtime server framework) will be used.

3. The Database used to store the user's data will be implemented using the MySQL Database (the most popular relational database).

4. The O*ffl*ine Pay app will be made using the React Native framework (a React Framework for making cross-platform Mobile Applications) all technologies used in this project will be Open-source.

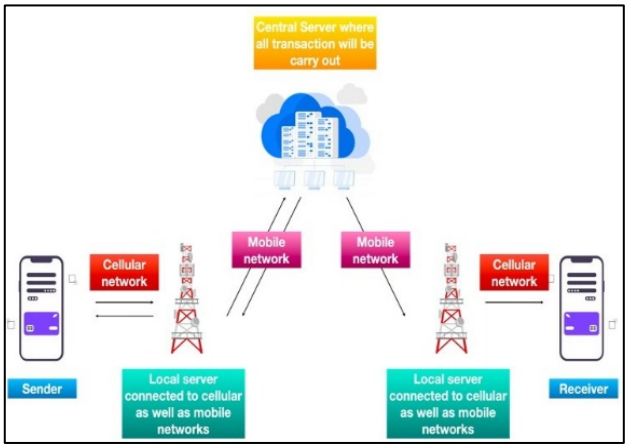

Fig. 1. Proposed System Architecture

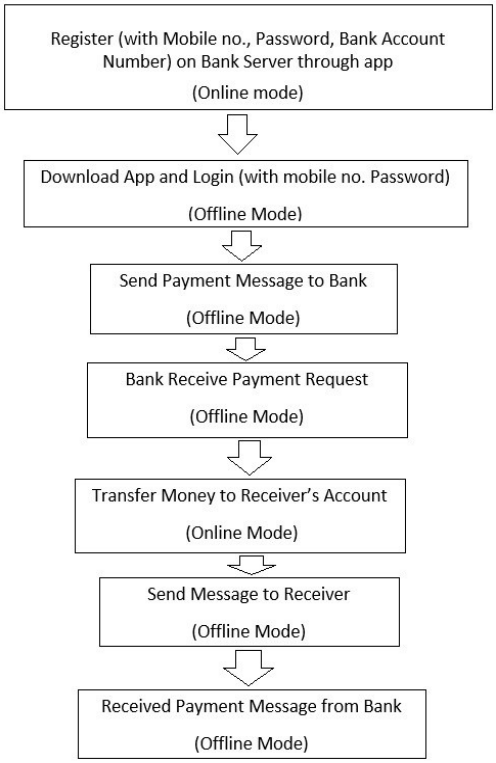

Fig. 2. System Workflow

1. Bank Database
   - Customer ID
   - Account Details
   - Transaction Details

2. Bank Website
   - Add User: This is a function used to register any new user. Using this user is added to the bank database. All the information of the user like name, communication details, bank details, etc.
   - User Database: Large database which is usedto store all the information provided by the customer.
   - Transaction list: This list is used to store transaction details and make them available on-demand.

- Transaction database: Used to store all the transaction details. Can be used by the user to retrieve details of all the transactions done by him as and when the need arises.

3. Working of System
   - Register on the app using mobile no., password, account no., etc. In online mode.
   - Download the app and login in o*ffl*ine mode.
   - Payment requests to the bank will be sent in o*ffl*ine mode by the user using SMS and OTP services which ensure safe and efficient transaction requests.
   - Bank will receive the payment request in o*ffl*ine mode through SMS gateway and it will start processing this request after authenticating the user and its request.
   - Money will be transferred to the receiver account by the bank after authenticating the request and credentials.
   - Message will be sent to the receiver and the senderwill get a payment message from the bank.
   - Detailed working of the external system:The process comprises two users for the transaction to take place – the sender and the receiver.

1. Both the users first register on the website.
2. Both the users have to download the app to be able to carry out transactions.
3. Users log in to the app using their credentials.
4. The sender might be faced with two scenarios, if an internet connection is available then the sender can directly click on send now and do the transaction and if the internet is not there then the sender makes use of the SMS to do the transaction.
5. Both the users get SMS of the transaction.

- Detailed working of the internal system:

1. In cases of the device does not have the internet, the app triggers it to send an SMS using an API called React-Native-get-SMS. This app sends SMS to the device whose number is registered on the website and is present in the database.
2. MySQL database stores the details of the registered users.
3. The SMS is received and a record of the transaction is completed.
4. The offline transaction is later logged in the history whenever the device has an active internet connection and is connected to the database.

4. Technologies Used
   - We have used Dual Network Server.
   - Database is synced using MongoDB ATLAS.
   - Interface for API is restful.

Response time of Node Server is recorded in an offline transaction.

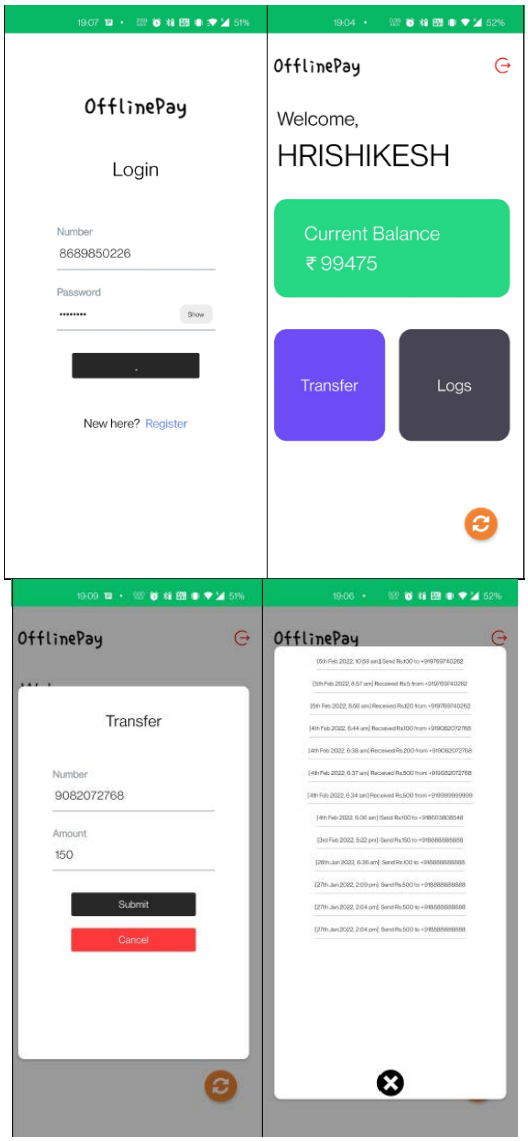

Figure 3: Login and subsequent pages

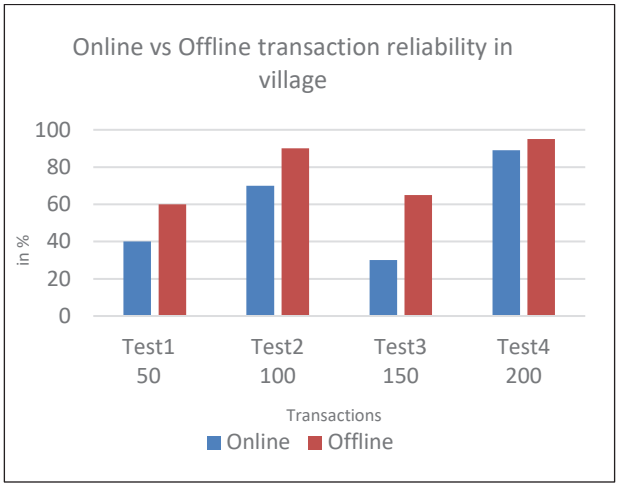

Fig. 4. Average Success Ratio

5. Results and Analysis

The system developed works fine for offline transactions and it can be conveniently used by people even in remote areas and even by a feature phone. SMS service provides a great way to implement offline transaction systems in terms of both ease of use and security.

We observed numerous advantages of offline transaction systems over online transaction systems while implementing our model. The most prominent advantages are no data expenditure, no network hassles, easily implemented at remote locations, and accessible by lower range mobile phones.

Offline transactions require more time as compared to online transactions in areas with good internet connectivity. There are various reasons responsible for this. Load balancing, network interference, throughput, etc.

On average, the speed of online transactions is faster than that of offline transactions provided the internet connectivity is sufficient. This is a result of higher throughput provided via the distributed nature of the internet and lower rate-limiting resulting in greater speeds of transaction.

Considering successful transactions, the chances of a transaction completing is more in the case of offline transactions. There are many reasons responsible for it. Majorly in rural and semi-urban areas, the absence or scarcity of internet results in a lower rate of success of online transactions. The reasons responsible for it are higher rate-limiting and lower throughput.

The offline success ratio is higher because the availability of the cellular network is more common in various rural and semi-urban areas. The offline transactions are dependent on sending and receiving of SMS. This process is dependent on the availability of the cellular network.

Due to various reasons like the sim card revolution and the increase in the number of cellular network consumers, offline transactions are more plausible. The security of offline transactions depends on the security of the bank server. The bank server is the one processing the transactions and logging these changes in the history/logs.

Offline vs online transaction speeds concerning successful transactions completed. Urban, semi-urban and rural areas all have different connection speeds and network availability.

Hence, they result in lower throughput, higher network interference, and lesser load balancing. This affects online transactions adversely and reduces the speed of transactions severely.

In areas with perfect connectivity and decent internet access, online transactions have the upper hand as they tend to be faster as compared to offline transactions.

Also, in areas with good connectivity, the step of sending and receiving an SMS is reduced; the load balancing works in the favor of online transactions and we can assume less to no network interference. So in areas with good Internet connections, online transactions were faster.

In semi-urban areas with decent cellular network range but lesser internet/ data speeds, offline transactions are faster. This is because the speed and success rate of transactions depend on the availability and speed of the internet.

Semi-urban areas perfectly describe the need for offline transaction systems. This is where the majority of existing online transaction systems fail due to the scarcity of the internet.

Areas where people can afford mobile devices and can pay for goods and services, but are stopped by the incapability of online transactions/ requiring internet. This is where offline transactions can make a difference.

6. Conclusion and Future Scope

We performed various tests and recorded success ratios of online and offline transaction systems under various circumstances. In conditions where there was really good network availability, the performance of both the systems was somewhat similar (Test4).

In cases with low network availability like Test3, offline transactions were far ahead of online transactions in terms of success ratio.

In cases with average network availability, like in Test1 and 2, the performance of offline transaction systems was still better owning to uncertainties in online transaction systems on account of network fluctuations, data availability, etc.

UPI services are currently limited to Metropolitan cities; whereas these services could be used in semi-urban and even rural areas which have proper infrastructure. We plan to expand on the idea of having an o*ffl*ine payment systemthat will ensure the availability of digital payment systems to everyone.

We conclude that such a system will enhance living standards and will open door to a lot of opportunities for people and will ensure ease of living for every individual.

There is scope for future developmental work too on this system in the field of increasing the easiness and making it more convenient to be used anywhere. Various features such as speed dial themed speed and instant payment system can be added to this and hence can be made much more hassle-free and contribute actively towards increasing ease of living.

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