ABSTRACT

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The thesis aims to explain the phone payment system, the first-ever online payment system developed in Nepal and the changes this gateway has brought in people's daily lives with its features to pay the entire bill all over the nation.

This thesis describes the work of E-SEWA with different diagrams and illustrations, along with the evolution and reasons behind developing the application. It also focuses on the practical usage of Android and iOS devices with an example describing the process of testing and working with the features implemented in the test API.

With the development of this application, the payment scenario has changed with its simple and easy-to-use features. The path it has opened for the more advanced development of such applications in the future with more and efficient features included. This application works as a gateway in online payment systems, which is a massive step in digitalizing the economy of the nation and going cashless.

CONCEPT DEFINITIONS

IPN - Instant Payment Notification

ATM - Automated Teller Machine

POS - Point of Sales

API - Application Programming Interface

SDK - System Development Kit

OS - Operating System

IOS - iPhone Operating System

GUI - Graphical User Interface

UI - User Interface

ABSTRACT

CONCEPT DEFINITIONS

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1 INTRODUCTION

The invention of cash has led to a considerable transformation globally, which supports solid economic communication. After about 5000 years from that, the world is getting digitalized in terms of economy. From the economy of an individual to a nation's economy, everything is in digital form. Digital currency can build a more sustainable global economy. From the transactions of a bank to the marketing of even small shops, the overall ticketing system, from airplanes to taxis, the whole shopping markets, from buying and selling goods to almost all daily expenses that an individual needs or a company needs, takes place digitally. Digitalization has several ways to proceed, including ATM, credit and debit cards, Pay-Pal, and several online and mobile payment software.

Nepal is a developing country in terms of economy and digitalization. Nepal is a country where no social security number system applies to individual citizens. In terms of digitalization, only ATM's and card system has been implemented for the transaction of any economy and still the online payment through credit or debit card is not possible. Cash payment was the only source of transaction between the customers and the merchant or even within the individuals. The data of the nation's economy was not well recorded and managed and there was the fluctuation in the nation's economy. There was a lack of safety and security as there is the chance of increasing theft and robbery with the cash payment. The transparency of the economy was not visible as there were not any authentic records of the transaction between any parties which made the economy of the nation quite devastating. The geography of the country as there are more hills and mountain terrains, was also affecting to the nation's economy to keep the records.

To solve the above-mentioned problems e-sewa plays a major role providing all the safety and security needed for the country with the smoothness in the economy. The chance of theft and robbery is dropping back to the minimum, and it is easy to keep the record of the economy as the flow of the money is transparent. To decrease the issue of tax evasion and other fraudulent activities, e-sewa plays a great role. Through digital transactions anyone living either in the hills or in the mountains can send and receive payments without any difficulties which helps to retain the record of the nation's economy. The invention of the mobile payment system in 2009 has changed the face of transaction dramatically. Though in the beginning, it was not that practical among all the citizens but slowly as the world got into

smartphone and iOS devices in every individual's hand, it was able to function efficiently within every individual and established as a comprehensive payment solution among individuals and even companies.

The digital wallet named e-sewa is developed to pay, send, and receive funds among individuals using smartphones and the internet. Nepal Rastra Bank has provided a license to move on with its payment system as a Payment Service Provider and is officialised all over Nepal. Customers can use the application for various purposes, including electricity bill payments, drinking water bill payments, mobile top-up, TV payment, online ticketing, online shopping, movie tickets, and school fee. Also, dealers, specialist co-ops, and retail sources can quickly get instalments for merchandise and enterprises in their e-sewa wallet. Developed for both android and iOS devices, it also offers its primary web portal www.esewa.com.np, if a user wants to visit from any personal computer. (e-sewa 2019.)

People find using the mobile wallet easier than to carry the cash for any transactions and the vendors find this easier to receive the payment through this wallet more than a cash payment as it is easier, faster, and secure. Also, this sort of digital transaction prevents from the bacterial and viral infections as observed in the today's time. From a nation's economy to an individual's economy, digital economy is found to be secured and preferrable. Digital payments are found to be effective for payment sectors such as legal and regulatory framework, large-value fund transfer systems, retail payment systems, foreign exchange settlement systems, cross-border payments and international remittances, securities settlement systems, payment system oversight and cooperation, and planned and ongoing reforms to the national payment system. (Timilsina 2019.)

The aim of the project is to study and present the idea behind developing such payment gateways in near future with more advanced and practical features. Moreover, working with the API is the main theme of this project. This thesis help readers to learn about the online payment systems, ePay, payment gateway, phone payment, and mostly about the testing of API along with the history of online payments in Nepal. With the development of this application, the payment scenario has changed with its simple and easy-to-use features. The path it has opened for the more advanced development of such applications in the future with more and efficient features included. This application works as a gateway in online payment systems, which is a massive step in digitalizing the economy of the nation and going cashless.

2 ONLINE PAYEMENT

There internet is growing rapidly in the past few years. The advancement of e-commerce throughout the globe thoroughly promoted the digitization of the payment process with various online payment methods such as debit and credit cards, contactless payments, and mobile wallets. The popularity gained by such online payments, especially mobile payments, can be seen, as there is immense web participation in people's daily lives. Technology is the leading factor in today's era, every aspect of living bound within the technology. The entire universe has dropped in every individual's hand through smartphones and other mobile devices. In simple words, for any money-related transactions, a platform has been set up as a type of inter-organizational information system that connects various associations and individuals, is called online payment, which uses the internet for its operation. (Becker 2007.)

Economic communication started with trading products or services between two parties at first and then more parties onwards. Exchange of goods or services may have been the initiative for the personal trade. With time, such exchanges became more complex and challenging. Hence, people came out with values in an abstract manner, advancing from metal or alloy coins to certified notes of money, cheques to credit or debit cards, and online payment. 1994 was when online payment and internet development were initiated for the first time. For the first time, Stanford Federal Union, the U.S.A, offered online internet banking services to all its members. With time, many organizations were able to provide such facilities to their customers. Online payment consists of various payment methods, including electronic checks, e-cash, credit and debit cards, electronic fund transfer, mobile payments, e-wallets, intelligent and loyalty cards, virtual credit cards, and stored value cards payment. There is online banking in various fields such as e-banking, m-payment, e-cash, internet banking, online banking, e-broking, and e-finance. (ACSOPS 2017.)

To pay for something via online means, the customer enters the payment information from their debit card or PayPal into an online check out form and the payment processing company send that data to the card scheme. Finally, the card scheme checks the details from the customer's bank for enough fund to be able to perform the transaction or payment. This way the online payment system works. There are two basic components to the online payment system which are listed below. (Ten 2004.)

2.1 Card authorization

Customers are directly involved in the process of card authorization. The customer provides all the credit card details needed for the authorization which includes the name on the card, the card type, the card number, the CVV, the expiry date and the card holder's address. After the customer provides the details of the card, the information is then transferred through the payment gateway to the credit card issue for confirmation and verification which includes checking the cardholder's information whether there is enough fund or not to complete the payment. Finally, the message either with the success or failure of the process is returned through the payment gateway to the customer. The payment declines if the information that the customer provides at the time of entering the data is a mistake or there are insufficient funds on the customer's account. Also, the purchase can be suspicious, and the payment gateway sends an automatic confirmation email to the cardholder confirming the purchase details. (ACSOPS 2017.)

2.2 Transaction settlement

The payment processor which acts as a mediator between the bank and the merchant is responsible for managing the credit card transaction process. Here, the payment processor handles the transaction settlement. The payment processor is responsible for submitting the transaction details to the customer's bank depending on the system. The bank receives the information and then forwards it to the appropriate credit card company and waits for the final confirmation from the cardholder's bank. After there is final confirmation, the issuer sends back a credit which the bank uses to deposit a payment into the merchant's account. This results in the deduction of fund from the cardholder's bank with the details of the charge. (ACSOPS 2017.)

3 DEVELOPMENT OF PHONE PAYMENT

With the increment in smartphone users around the world, the mobile payment system has reached to its peak in today's era. There is an expectation that by 2024, up to 4 billion users around the globe will have mobile wallets, a great growth in digital transaction through mobile phones. Started from the year 1983, with an invention of digital cash called cryptocurrency till 1998, a famous and most used so far payment gateway PayPal was launched. It was a great revolution in the online payment world. PayPal is an American e-commerce company well known for internet money transfers. (Becker 2007.)

Technology has been boosting its speed with the time and situation and has continued to take the world by storm. After the world took over with android and iOS devices, mobile payments and mobile wallets began to function in a rapid manner that it began to work as a leather wallet which can store digital coupons, digital money, digital cards, and digital receipts, in a more secure manner. The payments that are made through mobile phones tend to be more secure, reliable, convenient and less time consuming and has reduce the transaction fees as compared to other payment options. The varieties of mobile payment seen today are in-app payments, Mobile Point of Sale (MPOS), online payment services, mobile P2P transfers, Bluetooth Low Energy (BLE), Near Field Communication (NFC), QR code reader and mobile credit card reader. (Becker 2007.)

4 PAYMENT GATEWAY

Every single transaction that takes place through online payment is made via payment gateway which acts as a link amongst financial organization and the vendors website. Payment gateway authorizes and validates details of payment between different parties. (Mahony, Pierce, Tewari 2001.)
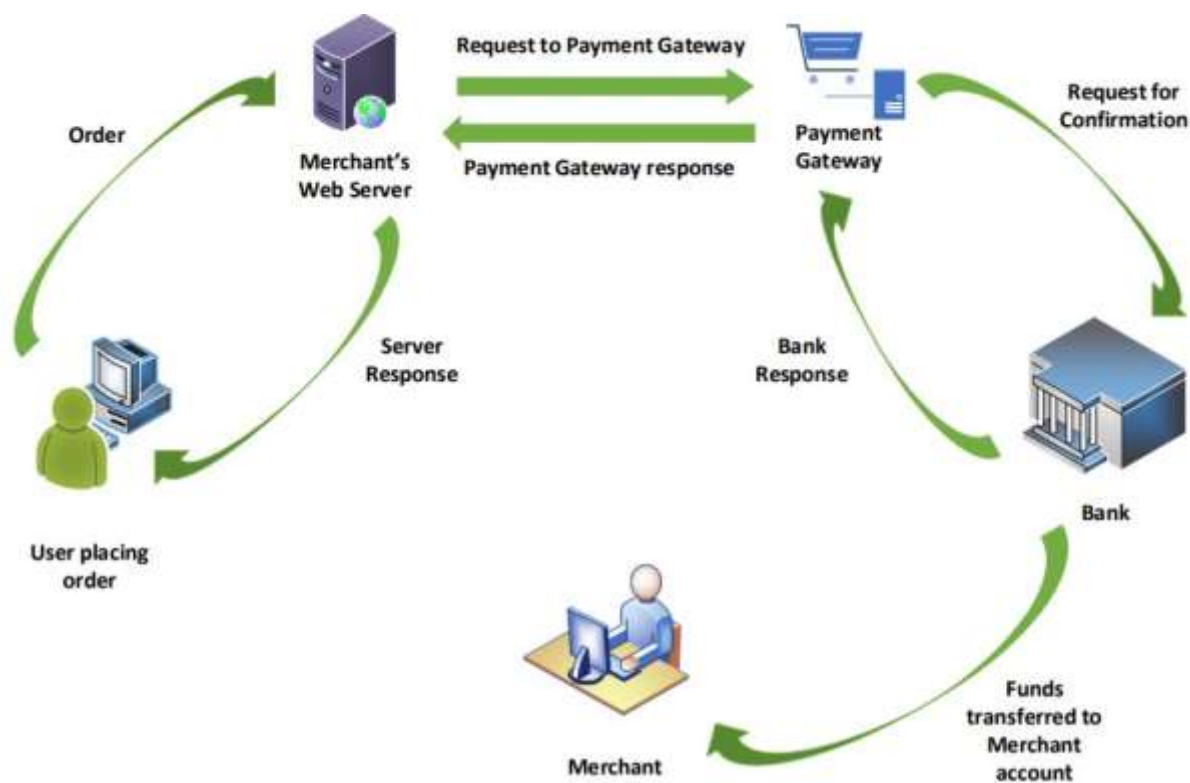
FIGURE 1. Online payment process showing the work of payment gateway (ACSOPS 2017.)

The online customer first places the order and is responsible for making the payment for the service that they require as shown in Figure 1. The order then reaches to the merchant's web server and that server responds to the user with the detailed information to proceed with the payment. Meanwhile, the server sends the request to the payment gateway which acts as a link between the parties. The gateway then requests for confirmation with the bank, where both the merchant and the customer have valid user

account with sufficient fund to proceed with the payment. The bank responds checking all the information that arrives through the gateway again back to the gateway as a confirmation to proceed further. Again, the gateway acts as a link between the payment gateway and the merchant's web server. The merchants web server then responses back to the user about the confirmation action that user needs to perform for the successful transaction. After user accepts the terms and conditions and places the payment the whole transaction process is completed successfully. On the other hand, the bank is responsible for the deduction or increment of funds from the customers or the merchants account, respectively. All the details of the transaction can be viewed and printed, if necessary, from the respective bank accounts. The payment gateway plays a major role for any successful transaction that happens online. The example of most common gateways is Amazon, PayPal, stripe, Apple pay, and e-sewa, the payment gateway this project is all about. (Socialnomics 2020.)

5 HISTORY OF ONLINE PAYMENTS IN NEPAL

Online payments system plays a great role in enhancing effectiveness on circulation of money in an economy. Weak payments system does not just elongate the payments period and increases cost of transaction, but also poses serious threat to the confidence on the entire financial system. Thus, there are central banks all over the world. This is significant and vulnerable settlement systems, so it is important to make it efficient and trustworthy. There are bank systems to keep such significant in control, to safeguard peoples' trust for money as a medium of exchange. The bank maintains financial stability and crucial to make it efficient and effective functioning of the monetary framework. These facts led the central bank of Nepal to the payment system development. The aim is to be discussing the institutions giving the essential task roles for development of the Nepalese payment system from the historical perspective. Online business payments, most importantly these modern payments system also rely on Information and Technology. (Timilsina 2019.)

The beginning of the payment systems started with the establishment of Nepal Rastra Bank, as central bank, in 1956. The bank had direct control on all financial institutions within the country legally. However, until 1968, there was no specialized payments services and the banks used to work as transitional point with limited payment service to the payee and payer of the same branch of the financial institution. Furthermore, after early 1970's people in the country were encouraged to use cheques in the banking system. (Timilsina 2019.)

Generally, in 1990 another touching milestone to bring until to this current online payment system was introduction of digital payments. Commercial banks and some other financial institutions availed the clearing house facility. And until then branches of the financial institutions were not divided with the core banking system. So, Nabil bank, for the first time introduced card banking in the economy with the issuance of the credit card in 1990. This was followed in the other forms of digital banking such as internet banking in 2002 by Kumari bank and SMS banking by Laxmi bank in 2004. Himalayan bank introduces the first ATM in the country in 1995. Regardless of the consequences the smart choice technology (SCT) was established in 2001 with the development of the SCT network throughout the country. The huge epiphany in the payment system was full control of banks and financial intuitions alongside of the success of the e-sewa in 2006. (Timilsina, 2019)

After e-sewa payment system which is literally the evolved online payment system also the operation as a digital wallet in 2009 the customers could pay, send, and receive money via mobile phones and internet without having bank account. For the first time in the history of Nepalese payments system, the payments were executed without any involvement of financial institution. However, Nepal Clearing House Ltd. (NCHL) was established as a public limited company in late 2008. With the success of multiple payments cleaning and settlement strategies in Nepal, NCHL brought the big objectives, surprisingly in addition to electronic cheque cleaning services, and Interbank payments system form in 2016. (Becker 2007.)

Likewise, use of digital mode payments, non-bank regulated mobile wallet along with the increasing global financial integration was on rapid expansion. Central Bank was forced to develop safe and efficient payment systems, and work on the modernization of payment system. It started a dedicated department for the regulations to carry out payment related activities and helped to develop online payments infrastructure in the country. Viewing account balances, recent transactions, bank statements, funds transfers between the customer's linked accounts, payment to the third parties, including bill payments and third-party fund transfers are evolved similarly in Nepal as the development of international online banking and payment system. (Timilsina 2019.)

6 EPAY

EPay in this context means Electronic Payment Authorization, which serves in making payment for several reasons. Including automated teller machine (ATM), point of sales (POS), credit/debit card services, currency exchange, electronic financial services, and many more payments software, epay is the leading payment system used worldwide. Different nations can use this platform according to their market behaviour and people's need. Signing up for any ePay accounts needs credit/debit card credentials through which the fund is available. EPay plays a vital role in communication between shoppers and shopkeepers as a wallet where any bills-related payment or any transaction of funds can be made within a short period of time which is more accessible than ever. (Ten 2004.)

E-sewa ePay system serves as a bridge between the partner merchant and customers to perform transactions and receive money in a more secure environment. E-sewa, a mobile application, can be downloaded for both Android and IOS, and an e-Swea account is the first step to unlock activities in this platform. A bank account and a phone number are much needed, allowing the amount to be loaded to the e-sewa account, and the number of users registered is the e-sewa identity number. The amount can be stored in an e-sewa account and used according to the user's needs. (Ten 2004.)

6.1 API

A client system casts an action on a server system, and it performs with a client once. This communication between two systems is possible via API which stands for Application Programming Interfaces. It is like a language that two systems use to communicate. For example, to find out the weather, if a client requests through a weather application, it sends a request to a server over a specific address with a clean instruction asking the weather in that area that day and shows an access key, a password. If the message is structured in a specific way, the weather API understands it. And once the message is delivered the API returns its response over the same channel. API helps programmers to create such systems that dig on with the environment of another system, not necessarily knowing how the system works from inside. The two components that API consists of are technical specification, which describes data exchange between two solutions, and software interface to represent the specification. Any software that needs to

access information for any queries from a client from another software calls its API to specify the requirements of data to be processed. (Altersoft 2019.) The API documentation on how the system works is described in this project with the details and descriptions needed for the project. The e-sewa payment gateway developer hub is completely stated with the necessary figures and table needed for the project.

6.2 Transaction flow

After the user chooses the option e-sewa from the payment vault, it then redirects to e-sewa ePay login page as shown below in Figure 2. All the requirements once filled, the user gets to the confirmation page, where the user confirms the transaction and proceeds to payment. All the successful transactions display with all the details to both the merchant and user. Any unsuccessful payment where the transaction process is cancelled without completion or in case of network failure, the user then is notified with the failure message and then redirected back to the partner merchant's failure page. The notification process takes place through SMS or email of the user registered at the time of activation of the e-sewa account. For any successful transaction, the partner merchant gets credit accordingly, and the user gets notification through SMS or email. E-sewa application uses IPN to notify the merchant related to e-sewa transactions. IPN is a method for an online merchandiser to track purchases and server-server communication in real-time. To verify the fraudulent transaction, the partner merchant needs to summon exchange confirmation solicitation. In this way, e-sewa application notifies all the successful and unsuccessful transactions to the partner merchant with either success or failure response. (e-sewa, 2019)
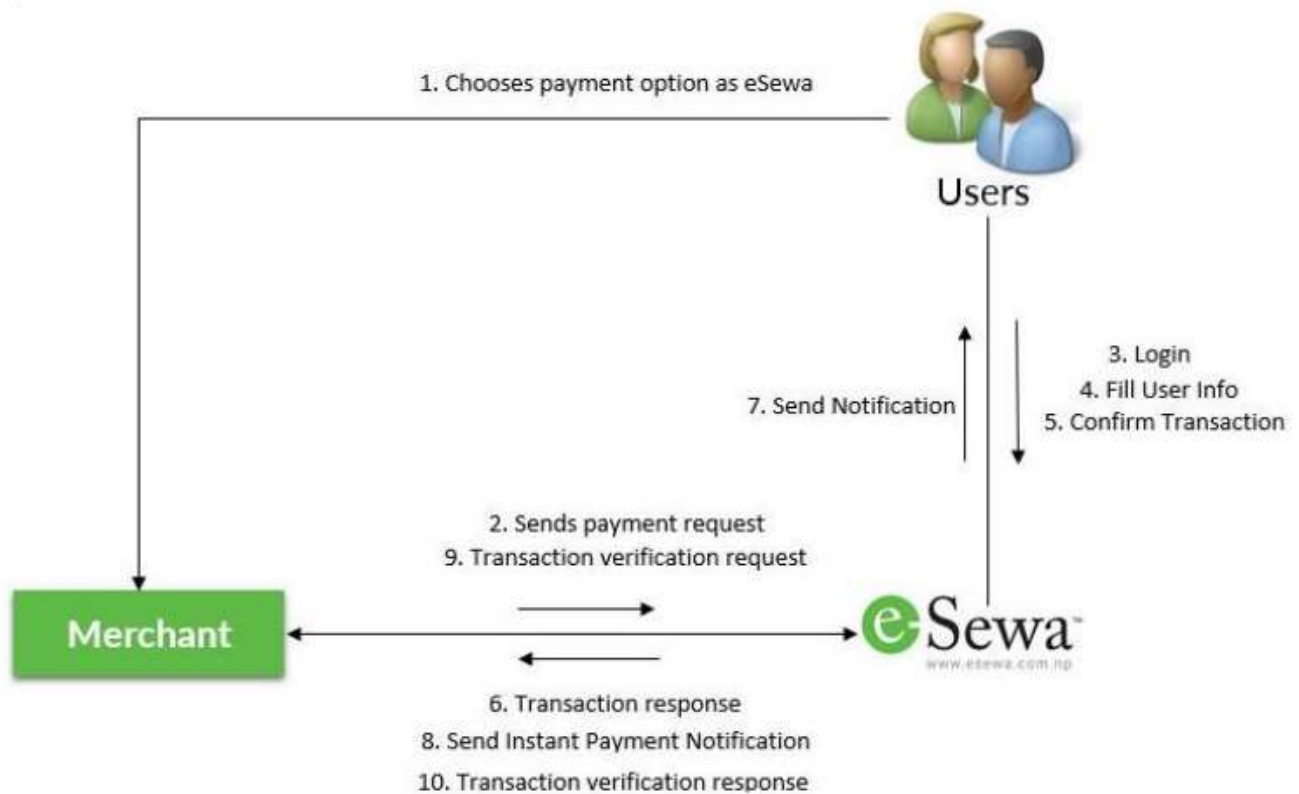
FIGURE 2. E-sewa system interaction for payment with transaction verification process (e-sewa 2019.)

6.3 Implementation and Integration

It is a process of implementing e-sewa as a payment option on the partner merchant's application. This chapter covers the two phases where the integration cycle itself is performed. To create merchant and end-user, a merchant should provide two separate emails in the test environment. The transaction is carried out through test user credentials via login and process the transactions. The adequate balance is updated to test the user account. (e-sewa 2019.)

6.3.1 Development and staging environment

This phase includes the quality of staging and design, where the development and testing process takes place on **URL:** 'https://uat.esewa.com.np'. Testing the process flow, transactions, and other integration results are the main intention of this phase. During the process, the partner merchant is provided with a test e-sewa id with the password for the successful transaction where the partner merchant can make sure whether the system is working the way it is. If the test server goes offline for maintenance and some other technical issues. In that case, something like "Service temporarily unavailable" will pop up on the

screen, or at least some error message will be displayed asking the user to try again and contact e-sewa staff regarding the major issue. This phase informs whether the merchant has successful transactions or has some issue, which helps to work out more for convenient transactions. (e-sewa 2019.)

6.3.2 Production environment

After the successful testing phase, the production phase occurs. This phase happens on **URL:** 'https://uat.esewa.com.np'. The production phase is the time for getting a successful transaction and applying e-sewa as a payment gateway. For this, the partner merchant will receive a merchant code on request for productional environment credentials. Partner merchants need to alter the requested URL and highlight creation workers and use creation production environment merchant credentials. At that point, the partner merchant will have the option to begin tolerating instalments utilizing the e-sewa in-stalment door. After the successful producers, partner merchant is ready to go with the e-sewa payment as a gateway for their transactions. (e-sewa 2019.)

6.4 Payment

This phase illustrates how the payment system works after the e-sewa receives the request from the partner merchant. This phase is carried out on **URI: '/epay/main'**. Once the partner merchant sends the transaction request to the URL provided by e-sewa through various parameters, some boundaries are required while others are discretionary. All boundaries should not be vacant or invalid. The parameters that are not in use must be of the default value set so that it does not make any change to the system, so the result does not vary. The task of e-sewa is to check whether the given parameters are correct and in format. If every task is systematic and valid, e-sewa responds accordingly. If the validation does not occur, it responds with a failure message or results at the end of the transaction process. The following are the request sample snippet in HTML, JAVASCRIPT, PHP, and PYTHON. The Figure 3, Figure 4, Figure 5, and Figure 6 shows the code used for the verification, required for the payment credentials by the partner merchant and the work of e-sewa to check the process to make a successful transaction. (e-sewa 2019.)

```html
<body>
    <form action="https://uat.esewa.com.np/epay/main" method="POST">
    <input value="100" name="tAmt" type="hidden">
    <input value="90" name="amt" type="hidden">
    <input value="5" name="txAmt" type="hidden">
    <input value="2" name="psc" type="hidden">
    <input value="3" name="pdc" type="hidden">
    <input value="epay_payment" name="scd" type="hidden">
    <input value="ee2c3ca1-696b-4cc5-a6be-2c40d929d453" name="pid" type="hidden">
    <input value="http://merchant.com.np/page/esewa_payment_success?q=su" type="hidden" name="su">
    <input value="http://merchant.com.np/page/esewa_payment_failed?q=fu" type="hidden" name="fu">
    <input value="Submit" type="submit">
    </form>
</body>
```

FIGURE 3. Request sample snippet in HTML. (e-sewa 2019.)

Figure 3 is a sample snippet of HTML file which is presented from the developers guide. It includes the form with post method in simple HTML code which redirects to https://uat.esewa.com.np/epay/main page. This includes the hidden values attributes. All these values are sent to the given form URL. The total amount of the product is Rupees 100 including the price of the product, tax amount of the product, its service charge, and the delivery charge which is seen in the chapter 7 when testing the API. This is the price value of the product in the test.

```php
$url = "https://uat.esewa.com.np/epay/main";
$data =[
    'amt'=> 100,
    'pdc'=> 0,
    'psc'=> 0,
    'txAmt'=> 0,
    'tAmt'=> 100,
    'pid'=>'ee2c3ca1-696b-4cc5-a6be-2c40d929d453',
    'scd'=> 'epay_payment',
    'su'=>'http://merchant.com.np/page/esewa_payment_success?q=su',
    'fu'=>'http://merchant.com.np/page/esewa_payment_failed?q=fu'
]

    $curl = curl_init($url);
    curl_setopt($curl, CURLOPT_POST, true);
    curl_setopt($curl, CURLOPT_POSTFIELDS, $data);
    curl_setopt($curl, CURLOPT_RETURNTRANSFER, true);
    $response = curl_exec($curl);
    curl_close($curl);
```

FIGURE 4. Request sample snippet in PHP. (e-sewa 2019.)

Figure 4 is the snippet from the Php file. All the parameters are same and includes the hidden value attributes. The same code in Figure 3 is written in Php where the function is same as in HTML. All the values are set and passed to the path variables. All these values are sent to the given form URL. The total amount of the product is Rupees 100 including the price of the product, tax amount of the product, its service charge, and the delivery charge which is seen in the chapter 7 when testing the API. This is the price value of the product in the test.

The parameters used like amt, pdc, and psd above in the programming language are described below in Table 1, and the parameters provided must not be empty or null. When not used, their respective values tend to be zero. For each effective transaction, e-Sewa will divert the client to the progress URI given by the accomplice shipper. The diverted URI will contain a response query string.

TABLE 1. Description of the parameters used.

Parameter name	Description
amt	The total amount of product or item or ticket
txamt	Tax amount of product or item or ticket
psc	Service charge by merchant on product or item or ticket
pdc	Delivery charge by merchant on product or item or ticket
tamt	Total payment amount including tax, service, and delivery charge (tamt = amt + txamt +psc +tamt)
pid	A unique ID of product or item or ticket
scd	Merchant code provided by e-sewa
su	Success URL: a redirect URL of merchant application where customer will be redirected after SUCCESSFUL transaction
fu	Failure URL: a redirect URL of merchant application where customer will be redirected after FAILURE or PENDING transaction

6.4.1 Payment Verification

Payment verification is one of the most important phases to overcome fraud and unauthentic transactions. It compares and then verifies all transactions within a specific product type over a given period. Hackers are emerging as there is technology emerging with greater speed. Every day new technology is born along with new hackers. Hackers take advantage of the limitation of the technology invented. Using the transaction verification process, e-sewa filters the fraud management process, which helps the partner merchant detect and respond to fraudulent transactions, so partner merchants must implement this before they take any effect. The transaction verification process provides a filter that identifies potentially fraudulent transactions and screens against data from payment characteristics to the total transaction amount.

It provides the tightest control possible over payments so that the payment verification can deny the fraudulent payments and accept the authentic with no issue. The payments that require further investigation and intervention, such as comparing prior orders or contacting the customer for detailed information, can be denied, or put on hold and pended for review. This process tallies the transaction amount and the price of the product, and if the price of the product varies from the transaction amount, the whole payment process dismisses showing the failure response from the vault. Hence, the process ought to be more sensitive, and every single step gets checked for the transaction's success from both merchants and customers. (e-sewa 2019.)

```html
<body>
    <form action="https://uat.esewa.com.np/epay/transrec" method="GET">
    <input value="100" name="amt" type="hidden">
    <input value="epay_payment" name="scd" type="hidden">
    <input value="ee2c3ca1-696b-4cc5-a6be-2c40d929d453" name="pid" type="hidden">
    <input value="000AE01" name="rid" type="hidden">
    <input value="Submit" type="submit">
    </form>
</body>
```

FIGURE 5. Request sample snippet in HTML. (e-sewa, 2019)

The Figure 5 shows the request snippet which mentions the code used to proceed with the payment verification process using HTML. It includes the form with GET method in simple HTML code which redirects to page https://uat.esewa.com.np/epay/transrec. The parameters include the hidden value attributes. The parameters used in the above frameworks are amt, scd, rid and pid, respectively. 'Amt' indicates the total amount of the product or the service, 'scd' represents the merchant code provided by the e-sewa, 'pid' means the unique ID of product or item or ticket generated by the merchant for the payment, and 'rid' indicates a unique payment reference code from e-sewa generated on successful transaction. The Figure 6 below consists of same code as Figure 5, but the codes are in Php.

```php
$url = "https://uat.esewa.com.np/epay/transrec";
$data =[
    'amt'=> 100,
    'rid'=> '000AE01'
    'pid'=>'ee2c3ca1-696b-4cc5-a6be-2c40d929d453',
    'scd'=> 'epay_payment'
]

    $curl = curl_init($url);
    curl_setopt($curl, CURLOPT_POST, true);
    curl_setopt($curl, CURLOPT_POSTFIELDS, $data);
    curl_setopt($curl, CURLOPT_RETURNTRANSFER, true);
    $response = curl_exec($curl);
    curl_close($curl);
```

FIGURE 6. Request sample snippet in PHP. (e-sewa 2019.)

```xml
<response>
    <response_code>Success</response_code>
</response>
```

FIGURE 7. Response sample snippet for successful transaction. (e-sewa 2019.)

After the completion of payment, API sends the message either with success or failure response. As per the requirement the developer can edit the response message. This the final step of the process where either there is successful transaction or unsuccessful transaction. The Figure 7 is a response sample snippet for successful transaction whereas the Figure 8 below shows the response sample snippet for unsuccessful transaction.

```xml
<response>
    <response_code>failure</response_code>
</response>
```

FIGURE 8. Response sample snippet for unsuccessful transaction. (e-sewa 2019.)

After the verification phase, the merchant receives the credentials and URLs for logging in to the mobile wallet, where the merchant can find the payment made for the product or service. The URL for the production mode and development mode is **https://merchant.esewa.com.np** and **https://uat-merchant.esewa.com.np**, respectively. Each merchant then receives a username, password, and merchant ID or service code to log in to the portal. After the successful login, one must be registered as an e-Sewa user to make the payment with e-sewa by which the user receives a unique e-sewa ID and password. (e-sewa 2019.)

7 TESTING THE API

API testing is a type of software testing that validates APIs. Its aim is to determine whether the APIs that are developed meet the expectations when it comes to functionality, performance, reliability, and security for an application. API- testing is different from that of Graphical User Interface (GUI) testing as it lacks GUI. GUI are difficult to maintain with the short release cycle and frequent changes commonly used with Agile software development and DevOps. API testing commonly includes testing REST APIs or SOAP web services with JSOM or XML message payloads being sent over HTTP, HTTPs, JMS, and MD. Instead of concentrating on the look and the feel of an application, API testing mainly concentrates on the business layer of the software architecture. (Guru99 2021.)

API automation testing requires an application that can interact via an API. The test is performed either by using testing tools to drive the API like RapidAPI testing, SoapUI, Postman, REST-assured, and Katalon Studio or by writing own code to test the API. This project implies the testing through codes using Visual Studio Code as a text editor and HTML, CSS, and Php as programming language.

7.1 Visual Studio Code

Visual Studio Code is a source code editor for building and debugging modern web and cloud applications. This code editor is made by Microsoft for Windows, Linux and MacOs. The features included in Visual Studio Code are syntax highlighting, support for debugging, intelligent code completion, snippets, code refactoring, and embedded Git. It comes with built in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extension for other languages such as (C++, C#, Java, Python, PHP, and Go) and runtimes such as (.NET and Unity). (Visual Studio Code 2021.)

7.2 HTML

HTML stands for Hyper Text Markup Language and is the most basic and standard building block of web. HTML is the basic element to create a web page in a web browser. Other technologies beside HTML such as CSS and JavaScript are used for the appearance, style of the page, and for the functionality and behaviour. (W3Schools 2021.)

7.3 CSS

CSS stands for Cascading Style Sheets that is a language used to style the HTML document. It describes the presentation of a document written in a markup language such as HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript. CSS is developed by World Wide Web Consortium(W3C) and is contained by HTML documents. (W3Schools 2021.)

7.4 PHP

PHP is an acronym for "PHP: Hypertext Pre-processor". It is a sever scripting language and a powerful tool for making dynamic and interactive web pages. PHP is mostly deployed on web servers, many operating systems and platforms and is used with many Relational Database Management Systems (RDBMS). (W3Schools 2021.)

This phase carries the demo test for payment verification using API of e-sewa for the web, following all the necessary instructions and credentials provided in the developer's guide. Initially, the personal domain (prabinbelbase.com.np) is registered from Nepal's official .np domain registration site and later hosted on a shared hosting package. The test website works using Visual Studio Code as a text editor, HTML, CSS, and Php as a programming language in a development environment. The files include index.php, ok.php, notok.php, payment.php, and style.css. Below are the mentioned file codes and test procedures.

```php
<?php
include 'payment.php';
?>
<!DOCTYPE html>
<html>
<head>
    <meta charset='utf-8'>
    <meta http-equiv='X-UA-Compatible' content='IE=edge'>
    <title>E-sewa Test API</title>
    <meta name='viewport' content='width=device-width, initial-scale=1'>
    <link rel='stylesheet' type='text/css' media='screen' href='style.css'>
    <script src='main.js'></script>
    <title>E-SEWA API TESTING </title>
    <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@4.6.0/dist/css/bootstrap.min.css" integrity="sha384-
B0vP5xmATw1+K9KRQjQERJvTumQW0nPEzvF6L/Z6nronJ3oUOFUFpCjEUQouq2+l" crossorigin="anonymous">
```

```html
    <script src="https://cdn.jsdelivr.net/npm/bootstrap@4.6.0/dist/js/bootstrap.min.js" integrity="sha384-+YQ4JLhjy-
BLPDQt//I+STsc9iw4uQqACwlvpslubQzn4u2UU2UFM80nGisd026JF" crossorigin="anonymous"></script>
    <script src="https://cdn.jsdelivr.net/npm/bootstrap@4.6.0/dist/js/bootstrap.bundle.min.js" integrity="sha384-Piv4xVN-
RyMGpqkS2by6br4gNJ7DXjqk09RmUpJ8jgGtD7zP9yug3goQfGII0yAns" crossorigin="anonymous"></script>
</head>
<body>
    <center><h4>DEMO FOR E-SEWA TEST API </h4></center>
    <div class="container-fluid d-flex justify-content-center">

    <div class="row mt-10">

        <div class="col-sm-12">
            <div class="card"> <img src="https://imgur.com/edOjtEC.png" class="card-img-top" width="100%">
                <div class="card-body pt-0 px-0">
                    <div class="d-flex flex-row justify-content-between mb-0 px-3"> <small class="text-muted mt-1">START-
ING AT</small>
                        <h6>NPR 90&ast;</h6>
                    </div>
                    <hr class="mt-2 mx-3">
                    <div class="d-flex flex-row justify-content-between px-3 pb-4">
                        <div class="d-flex flex-column"><span class="text-muted">Fuel Efficiency</span><small class="text-
muted">L/100KM&ast;</small></div>
                        <div class="d-flex flex-column">
                            <h5 class="mb-0">8.5/7.1</h5><small class="text-muted text-right">(city/Hwy)</small>
                        </div>
                    </div>
                    <div class="d-flex flex-row justify-content-between p-3 mid">
                        <div class="d-flex flex-column"><small class="text-muted mb-1">ENGINE</small>
                            <div class="d-flex flex-row"><img src="https://imgur.com/iPtsG7I.png" width="35px" height="25px">
                                <div class="d-flex flex-column ml-1"><small class="ghj">1.4L Multi-
Air</small><small class="ghj">16V I-4 Turbo</small></div>
                            </div>
                        </div>
                        <div class="d-flex flex-column"><small class="text-muted mb-2">HORSEPOWER</small>
                            <div class="d-flex flex-row"><img src="https://imgur.com/J11mEBq.png">
                                <h6 class="ml-1">135 hp&ast;</h6>
                            </div>
                        </div>
                    </div>
                </div>
                 <form action="<?php echo $url; ?>" method="POST">
    <input value="100" name="tAmt" type="hidden">
    <input value="90" name="amt" type="hidden">
    <input value="5" name="txAmt" type="hidden">
    <input value="2" name="psc" type="hidden">
    <input value="3" name="pdc" type="hidden">
    <input value="<?php echo $merchant_code; ?>" name="scd" type="hidden">
    <input value="<?php echo $pid;  ?>" name="pid" type="hidden">
    <input value="<?php  echo $successurl ?>" type="hidden" name="su">
    <input value="<?php  echo $failurl ?>" type="hidden" name="fu">
```

```
      <input type="submit" value="Pay with eSewa" class = "btn btn-success btn-block" />
  </form>
              </div>
          </div>
      </div>
  </div>
</div>
</body>
</html>
```

FIGURE 9: A snippet from the index.php file.

As per the code mentioned in FIGURE 9, it includes the HTML code snippets and a form with hidden attributes. The code is used to design the basic layout for index.php page showing the details of the product. The parameters like tmt (total transaction amount), amt (amount of product), txamt (tax amount), psc (product service charge), and pdc (product discount) are passed statically to $url (the link which is mentioned in ok.php file along with variables $merchant_code, $pid). This file includes the form with POST method with all the variables sent to https://uat.esewa.com.np/epay/main .

```php
<?php
include 'payment.php';
$rfId = $_GET['refId'];
$data =[
'amt'=> $real_amount,
'rid'=> $rfId,
'pid'=> $pid,
'scd'=> $merchant_code
];
$curl = curl_init($fraud_url);
curl_setopt($curl, CURLOPT_POST, true);
curl_setopt($curl, CURLOPT_POSTFIELDS, $data);
curl_setopt($curl, CURLOPT_RETURNTRANSFER, true);
$response = curl_exec($curl);
echo $response;
curl_close($curl);

 ?>


 <a href="/">Back to Home Page </a>
```

FIGURE 10. Ok.php file for the successful transaction

After redirecting from 'index.php' with all the variables as mentioned in Figure 9, the API provided by esewa validates the request for payment only if the API finds it genuine. The array ($data) checks the fraud URL. The response is printed after the success of the payment redirecting to ok.php file as in Figure 10, if not it then redirects with failure response i.e., $response variable to Notok.php as shown below in Figure 11.

```php
<?php
echo "<h3>Oops !  Payment Failed.</h3>"

 ?>
<a href="/">Back to Home Page </a>
```

FIGURE 11. Notok.php file if the transaction is unsuccessful.

```php
<?php
$url = "https://uat.esewa.com.np/epay/main" ;


$pid = 'probben67123';
$successurl = "http://www.prabinbelbase.com.np/ok.php?q=su";
$failurl = "http://www.prabinbelbase.com.np/not-ok.php?q=fu";
$merchant_code = "epay_payment";
$fraud_url = "https://uat.esewa.com.np/epay/transrec";
$real_amount = 100;


?>
```

FIGURE 12. Payment.php file which links the URL for testing the API.

This file stores the variables which can be accessed by other files. It includes $pid, $successurl, $fail url, $merchant_code, $fraud_url and $real_amount. The variables value is set as per the esewa API documentation. For fraud detection, the values are stored in the array in the payment.php file as in Figure 12, including amt, rid, pid and scd variables used to verify the transaction request. The link 'https://uat.esewa.com.np/epay/transrec' provided is responsible for checking and verifying that the request made is genuine. And after the successful verification, the response to that request is printed. Otherwise, the payment fails.

```css
@import url('https://fonts.googleapis.com/css2?family=Roboto:wght@500&display=swap');


body {
    background: #F5F1EE;
    font-family: 'Roboto', sans-serif;


}
h4{
    padding: 10px;
}
.card {
    width: 250px;
    border-radius: 10px

}


.card-img-top {
    border-top-right-radius: 10px;
    border-top-left-radius: 10px

}
```

```css
span.text-muted {
    font-size: 12px
}

small.text-muted {
    font-size: 8px
}

h5.mb-0 {
    font-size: 1rem
}

small.ghj {
    font-size: 9px
}

.mid {
    background: #ECEDF1
}

h6.ml-1 {
    font-size: 13px
}

small.key {
    text-decoration: underline;
    font-size: 9px;
    cursor: pointer
}

.btn-danger {
    color: #FFCBD2
}

.btn-danger:focus {
    box-shadow: none
}

small.justify-content-center {
    font-size: 9px;
    cursor: pointer;
    text-decoration: underline
}

@media screen and (max-width:600px) {
    .col-sm-4 {
        margin-bottom: 50px
    }
```

```
}
```

FIGURE 13. Style.css.

Figure 13 shows the CSS file which helps in creating the design and styles for the home page specially for product showcase as seen in Figure 14. Font family Roboto is used and other basic styling for product name, price, image, and properties of product and button are used. The above-mentioned files are the same as the files mentioned in developers guide but these files are typed and coded in real time. After the codes are completed, the demo for e-sewa test API is carried out.

FIGURE 14. Demo for e-sewa test API.

Figure 14 shows the home page that has a simple layout showing the product, product's price, product's description, and an option to proceed with the payment with e-sewa. The title of the page is 'DEMO FOR E-SEWA TEST API'. A vehicle worth NPR 90 with fuel efficiency is to be bought to test the transaction process. Just below the details of the vehicle, there is the option 'pay with eSewa' which then directs to the next page as shown in Figure 15.
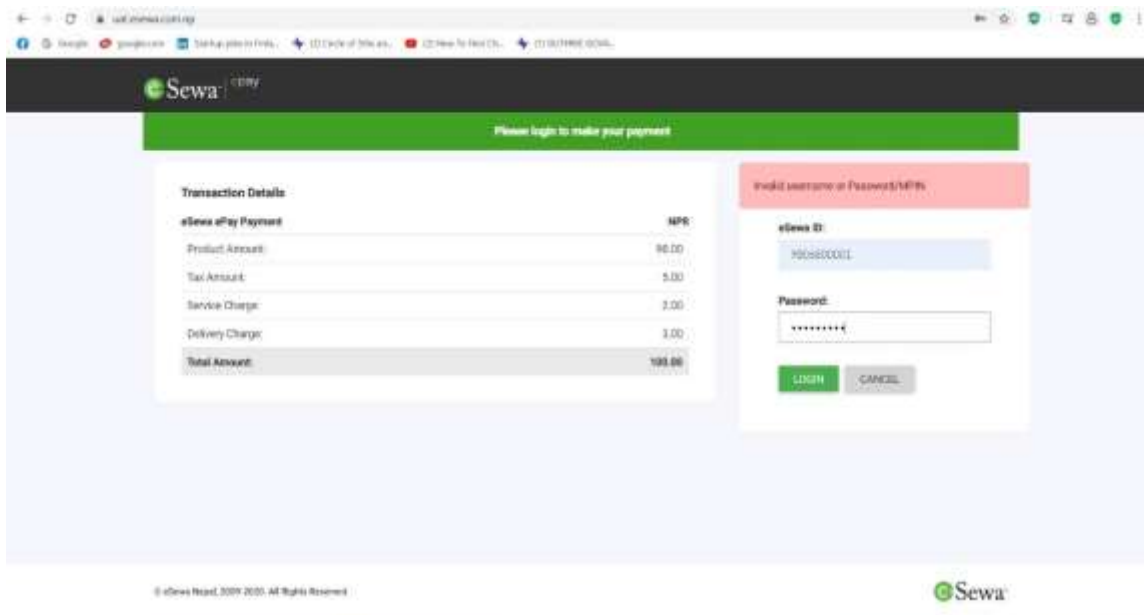
FIGURE 15. Login page to proceed with the payment.

After the user clicks the option pay with e-sewa, the page directs to uat.esewa.com.np, which e-sewa develops for testing purposes. The login details like username and password in the developer's guide, and thus, the same credentials should be used for the login. The details of the transaction and the total amount to be paid is seen in the above figure which asks the user to first login to complete the payment. If the incorrect username or password is used, it displays a message saying 'Invalid username or password/MPIN' which results in unsuccessful login.

FIGURE 16. User details to continue with the payment.

The user details required to continue with the payment is to be filled up by the user to complete the transaction. Esewa id, full name, contact number, address, and an email id are the requirements as shown in Figure 16. The balance at the top right of above Figure 16 and Figure 17 below is a dummy balance automatically generated with the API. After each payment test, there is a change in the balance. After the confirmation as seen in Figure 17, the result with the payment is published either with the success or failure response.
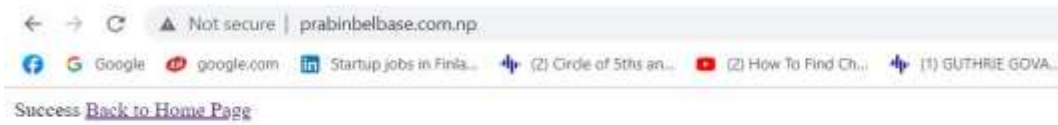

FIGURE 17. Final confirmation.

FIGURE 18. Successful payment.

As per e-sewa API developer's guide, the 'pid' value, which is the product id, should always be unique on each transaction otherwise the duplicate 'pid' leads to failure of the transaction as shown in Figure 19, which is the response message given by e-sewa for having duplicate 'pid'. After all this process in the development environment, the test user should submit the code to e-sewa API team for a review process. If it gets approved, the team of e-sewa provides a unique merchant code and charges a certain fee and per-transaction amount to use their API. Finally, the development link replaces with the production links as mentioned in the developer's guide. The Figure 18 and Figure 19 shows the success and failure of the payment transaction, respectively.
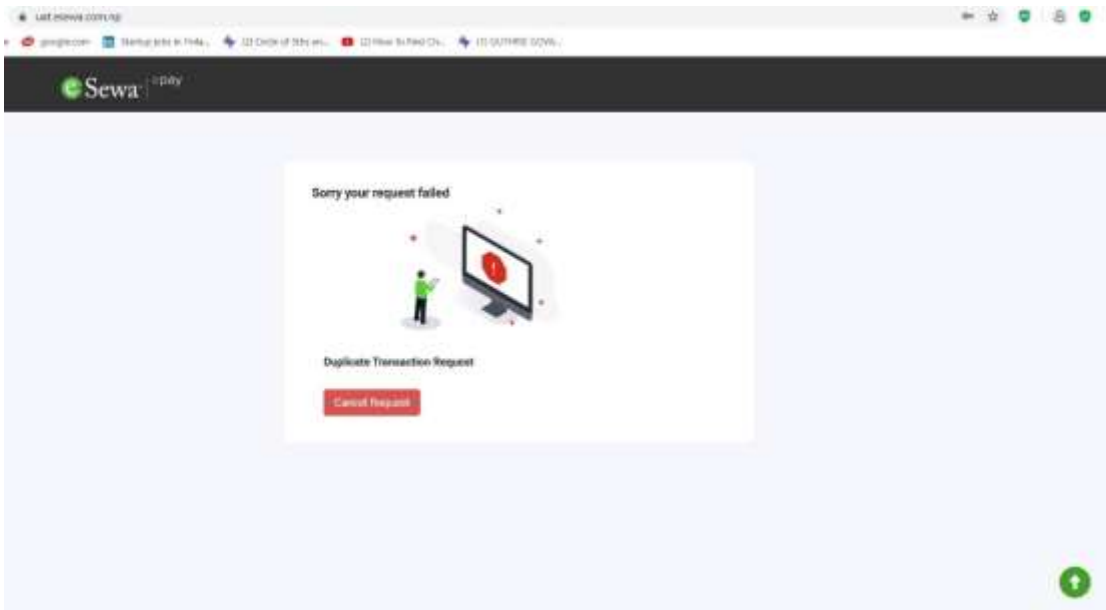
FIGURE 19. Unsuccessful payment.

8 ADVANTAGES, DISADVANTAGES AND CHALLENGES

Like every theory, hypothesis, system, machine, software, application, and many more, has its advantages and drawbacks, this application also has more benefits and some disadvantages. To bring this application to use was not an easy job for the developers, as the country lacked digitalization in every aspect of the economy. The application of this project faced many challenges. Like smartphones, the internet and computers started to take over and this application started to dream of longing in the market and reaching to every individual. Below are the advantages, disadvantages of the application and the challenges faced during and after implementing this application.

8.1 Advantages

The mobile wallet, e-Sewa has almost replaced the leather wallet in every individual's pocket. The necessity to carry cash and credit cards daily, monthly, and yearly has degraded. It is easier to access, reliable, user-friendly, less time-consuming, and more secure to transact with the mobile wallet. It helps to reduce cost and business risks at the same time. All the user and the transaction information are in the encrypted format before being transmitted through the internet. Mostly, the improvement in the economic data collection has been profound through this service. The data for each transaction is stored in a more authentic way, which helps calculate the country's economy more securely.

The most beneficial aspect of this mobile wallet or digital transaction is strict against corruption. All the individuals connect through a cashless payment infrastructure that shows transparency in the flow of money. Through such digital transactions, it is clear where the money goes and how the investment is, which quickly helps detect the funds outside the framework. Government and other departments can identify the resident's real-time purchases, which helps in the daily polling and the survey, and thus, the data becomes more accurate for keeping the record. Hence, the government can apply appropriate policies, rules, and regulations to control the nation's economy.

Timely payment is possible through e-sewa, which enables customers to save recurring payments and add periodical reminders and helps from being extra charged in case of late payment. Some discounts and cashback are the benefits a customer gets in case of timely payment, as per the scheme provided by

e-sewa. Thus, e-sewa plays a significant role in improving the nation's digital economy and supports the e-commerce business more securely and suitably. (Regmi 2021.)

8.2 Disadvantages

Every system, if misused, functions differently and is harmful in various ways. It depends on the user, how they use the system. There has not been any complaint about the mobile wallet as every individual is satisfied with the way it functions. E-sewa officials have mentioned that if any individuals or organization attached to it finds any bugs or technical errors in the system and reports to the company, it will be their privilege to know such bugs and correct them. The one who finds the bugs will be rewarded with some valuable prizes or even can get an opportunity to work with the company.

8.3 Challenges faced during implementation of the system.

Nepal being a developing country, has not been able to leave its remarks in any fields except in tourism. Due to the irregular political ups and downs, Nepal has always struggled to find a better position among the nations. Corruption and nepotism are the leading factors, due to which the country has not been able to perform at its best. Despite this, a new step from the developers of e-sewa mobile wallet has taken to support the country's economy more fairly. A fair and robust economy led to a better nation and took this step in digitalizing the nation's economy. Most of the elderly population is uneducated and is not able to operate even smartphones properly. Despite this, the launching of e-sewa ten years ago was a risky task. As there was rapid growth in smartphone use through the years, it reduced the risk that the developers had for the implementation of this system. Almost every individual now has got smartphones in their hands, and social media gained popularity as it provides more entertainment and is easy to operate. Even an uneducated person uses such social media with no difficulties, making e-sewa spread more quickly from one individual to another.

The main challenge for e-sewa is the competition in the market as many other platforms like e-sewa are in development. Connect IPS (Interbank Payment System) is the greatest challenge to e-sewa to this date as it is less costly than e-sewa. Connect IPS allows their customer to directly link their bank account to enable payment processors, fund transfer, and biller payments. There is still more to penetrate in the market by e-sewa to rise at the top. Already, six million users use the e-sewa Mobile Wallet. Nepal is on

the way to a cashless economy, and the use of e-sewa will rise if more features and the concern based on youth-based opportunities gets included with the time and situation.

9 CONCLUSION

The development of the e-sewa Mobile Wallet is explained in this project with the necessary figures and tables needed. The history and the present context of Nepal before and after implementation of the wallet are explained in this project. This project has successfully brought up the development of mobile applications by testing the API for payment verification.

Throughout the project, the author has learned more about the payment gateway, its use, Android, and iOS platforms to develop such application, API, and its testing environment, working with domain, advantages and disadvantages, challenges, and mostly the idea behind the development of such applications. As the world is advancing in technology and digitalization, the research on this project has helped to gain the vast knowledge to develop and implement such applications soon.

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