Kathmandu University

Department of Computer Science and Engineering

Dhulikhel, Kavre

A Project Report

on

"Research on role of app localization in Universal Usability and its implementation in eSewa app with UI enhancement using Donald Norman's design principles"

[Course Code: COMP 341]

(For partial fulfillment of III Year/ II Semester in Computer Engineering)

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Submitted To

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Acknowledgment

In performing our research project, we had to take the help and guideline of some respected persons, who deserve our greatest gratitude. The completion of this project gives us much pleasure. We would like to show our gratitude to **Mr. Sushil Shrestha, Assistant Professor, Kathmandu University** for giving us a good guideline for this project throughout numerous consultations. We would also like to expand our deepest gratitude to all those who have directly and indirectly guided us in doing this project.

We would like to thank the Department of Computer Science and Engineering (DoCSE) and the whole university for providing us a chance to work on the project. Many people, especially our classmates and team members themself, have made valuable comments and suggestions on this project which inspired us to improve our project.

Sincerely,
Sailesh Dahal (10)
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Chapter 1: Introduction

We have seen our elders, mostly the older people of our family struggle to use mobile applications even mobile phones and such technological devices in general. In delving deeper into the reason behind this struggle, apart from lack of technical knowledge, we found that the language barrier is the main problem. Most of the elders are comfortable in talking and using the Nepali language than English but most of the applications and websites are mainly present only in the English language. In researching more about this topic, we found that this is a universal problem, and mobile applications, as well as websites and web apps all over the world, are localizing their products to include all demography to use their applications with ease. Now the unlocalized product is a major hindrance to the continued growth of your brand, and avoiding this entirely would eventually cause your application to stagnate. It would be wonderful if users across the world can access an application without the limitation of this barrier. And no doubt, localization of applications is key to solve this problem. But we were not satisfied with this conclusion. We wanted to explore how much impact localization makes on the universal usability of an application. Does localization is the ultimate answer to usability problems or does the user experience need to be enhanced using design principles? Following these queries, we conducted this research and took a popular existing application eSewa [1] to localize it in the Nepali language and enhance its UI based on design principles.

Chapter 2: Weekly Progress

This chapter talks about weekly progress that we have made while conducting this research project

2.1. Week 1

In first week, we found a problem to be solved around us: **Lack of localization in Mobile application creating hinderance to usability**, and considered it as our mini-research project. Then we formed a team consisting of four people i.e. Sailesh Dahal, Sarayu Gautam, Bhabin Khadka, and Ashish Subedi. Then we studied the case that we have selected and conducted the literature review and studied related works.
This was followed by a survey with more than 50 people (targeted users of our research) to justify our problem statement.

After our problem statement was defined, we conducted literature reviews and went through the related projects which used the concept of localization to enhance HCI. We went through more than 7 research papers and 5 notable ones are reviewed here.

2.1.1. Literature Review

The first literature review is of a concept paper presented at the 2010 international conference on Interaction Design & International Development by Andy Smith, Liam J. Bannon, and Jan Gulliksen. [2]

The model they proposed envisages three elements: the redefinition of HCI in the local culture, the embedding of HCI in local national organizations, and the consequential roll-out of localized HCI practices. They have provided a critical review of the literature on culture, specifically regarding its use within HCI. Concerning the localization of applications, they have explored research relating to different approaches in several cultures and contexts under differing countries and regions.

According to their findings, they concluded that cultural differences potentially affect usability evaluations in multi-dimensional ways. Differences can occur as a result of cultural differences inherent within different cultural user groups, with differing groups potentially reacting differently to unlocalized commands. Difficulty in using applications can also be evidenced as a result of language differences between users and applications.

The next paper is on the project conducted by Aiman M. Ayyal Awwad in 2017 that got published in the International Journal of Computer Science Issues. [3] The project was the localization of a visual programming environment to bi-directional languages. The environment they used is Catrobat. Catrobat has been developed for educational purposes to help students visualize and understand learning materials [4]. It allows students to build their own animations and games for their classes in academic subjects and wirelessly control external hardware.

Catrobat needs to talk to the young children in schools in their native language and enable them to get the best in the language of their choice. In this paper, they have presented localization of Catrobat into bi-directional languages such as Arabic, Persian, Urdu, and Hebrew, and introduced the challenging aspects of localization to such languages. The localization testing results confirmed that the product is cosmetically correct, linguistically accurate, and culturally appropriate. Therefore, it enhanced the usability and was effective to be employed in programming education for young school children which confirmed the tremendous role application localization plays in HCI.

The third literature review is more or less similar to what we want to accomplish through this mini-research project. [5] It is a paper on a usability testing experiment conducted for a localized weight loss mobile application. This paper introduces a context-appropriate mobile application for sustainable weight loss. Moreover, the cultural, traditional ecosystem will impact weight-loss strategies. They have adapted the application to the local context of a middle easterner’s society by conducting a usability testing experiment with potential users of the application.

They have also applied the principles of localization to derive an appropriate application. Beyond the applied usage of the application, the paper contributes to the currently scarce body of literature on Arabic based mobile development and stresses the role of application localization on universal usability.

The fourth paper is the analysis of the cultural usability of Mobile Keypad and displays for textual communication in internationalization and localization perspective. [6] The authors are Rikke Orngreen, Dinesh Katre, Mulagapati Sandeep. The analysis in their research is based primarily on heuristics tests, where: Hindi, Arabic, and Danish mobile phones are evaluated on assumptions of user needs, and in comparison, to English. They have also referred to the existing research on Chinese mobile phones to further complement their work. The study provides an insight into the much-needed locale-language centered approach in contrast with the current English centered approach of existing mobile keypad designs and display of text to increase user engagement and improve the usability.

The last paper that we reviewed dealt with evaluating the acceptance and usability of Kiswahili localized mobile phone application in Kenya. [7] The study used a mixed research design method. Specifically, a concurrent mixed method was utilized. The study found out that generally, the level of acceptance and usability of the Kiswahili language menu of the M-Pesa app was low. This was attributed to a lack of awareness about the existence of the Kiswahili language menu on the M-Pesa app, the use of hard and unfamiliar terms in the Kiswahili menu, and the negative attitude that the public has towards the Kiswahili language. In conclusion, the researcher suggests that the Kiswahili menu would be accepted and used if the message is clear, easily understood, uses common or familiar terms, if single terms are consistently translated, and is functionally suitable in the culture of the target text. Consequently, enough awareness should be created to dispel the public negativity towards the Kiswahili language.

We can conclude from this research that through localization increases usability, sometimes the selection of language may create a problem with the overall usage of the application.

2.1.2. Related Works

As the research for the project proceeded further, we went on to find some projects which have localization features and have a significant number of users from all age groups who enjoy the application.
Five such projects stuck out as noteworthy, each of which are listed here:

1. Facebook
2. Hamro Patro
3. Twitter
4. Khalti
5. Wikipedia

Facebook has gained its massive user base due to its availability in multiple languages and has shown the importance of language in HCI. [8] But its concept is based on internationalization i.e. focused on international languages rather than languages of local people, and hence is different from what we are trying to achieve. In contrast to Facebook, Wikipedia is provided in both local as well as international languages which have helped people across the globe to easily access the information. [9] But as the demonstration project, we have decided to translate a current application in Nepali, similar to what Hamro Patro [10] and Khalti [11] application have done. So, these applications are more closely related works than others.

Figure 1: Languages offered by Wikipedia

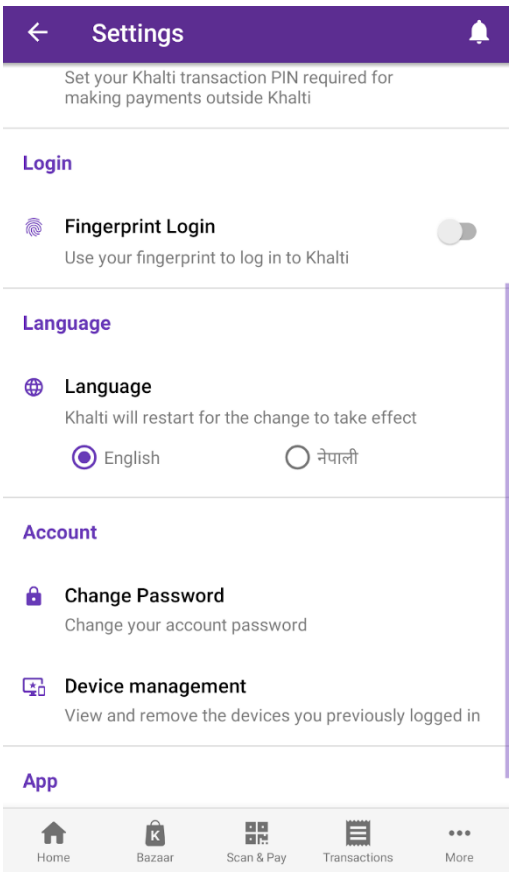


Figure 3: Languages offered by Khalti

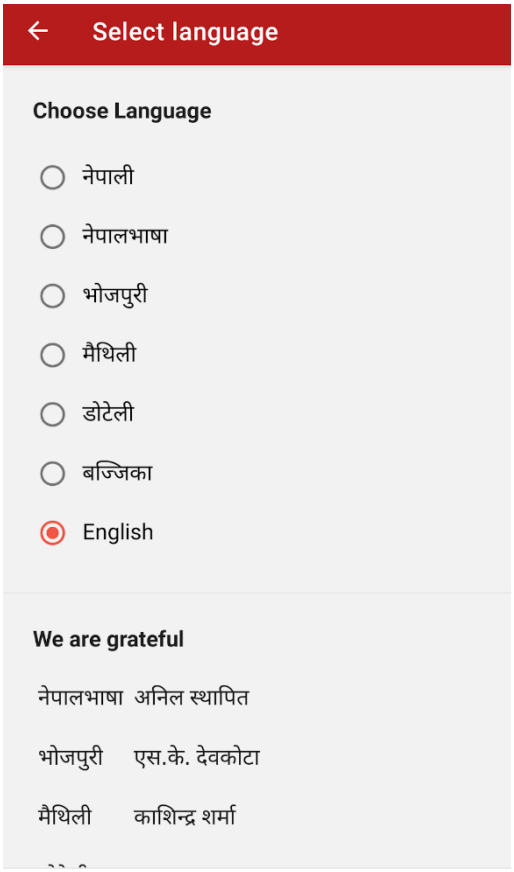


Figure 2: Languages offered by Hamro Patro

2.1.3. Survey and its conclusion

At first after two separate brainstorming sessions, we prepared the survey questions in English. It was necessary for the purpose of our research to include every age group of target audience since the target audience using ani sort of applications ranges from very young to even old age groups.

We were alerted by the result of the survey as most of the users attending the form belonged to the age group of 21-30.

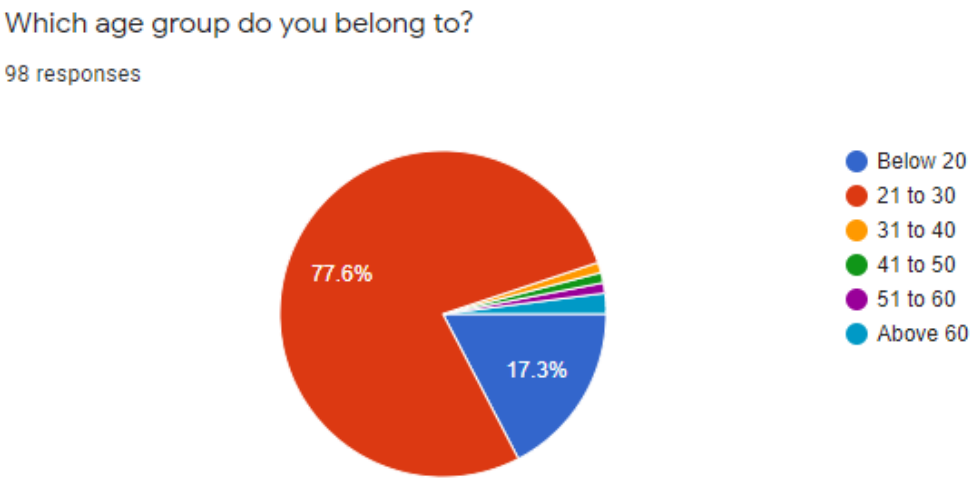


Figure 4: Age group chart for survey taken in English

We discussed this matter as to why the distribution of people filling this survey is unequal and reached an understanding that this might be due to the same reason why we choose this topic in the first place. This problem might be the language. While English is easily understandable by young age groups, older age groups might have a difficult time grasping every word written in English although they might know how to use any application (in this case filling the survey form). And although we wanted to include responses from different countries, we lacked resources to translate the form into different languages. Hence, we decided to translate the form to Nepali language to see whether there will be any changes in

the response. And we did see the change. There was participation from almost every age including the older ages.

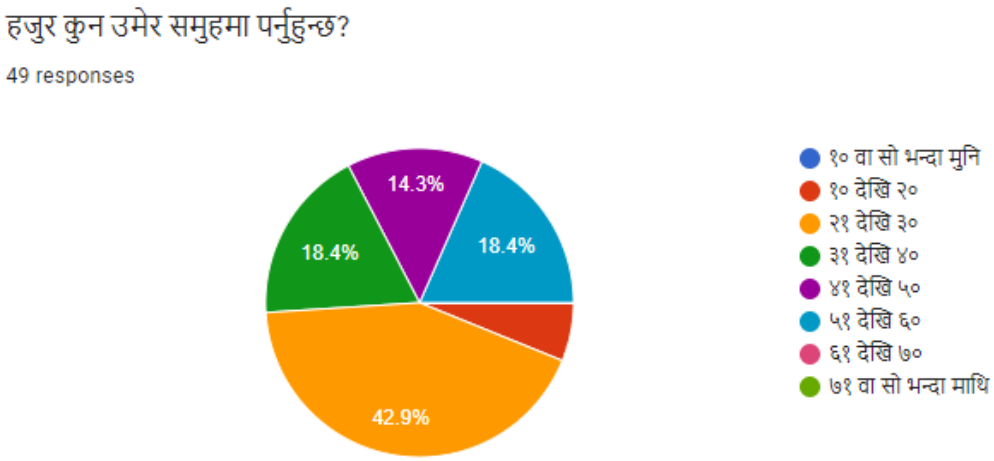


Figure 5: Age group chart for survey taken in Nepali

From the two surveys taken in order to justify our problem statement, we concluded the following:

1. Participants from the first survey, which was taken in English, are not concerned about the presence of localization in an application mostly because they are comfortable and are well versed in English language.

   Most of them wanted only some of the applications they use to be available in their native language and the other significant group say that it does not impact them.

   We can somehow conclude from the data that there is no noteworthy opposition on the use of localization in applications.

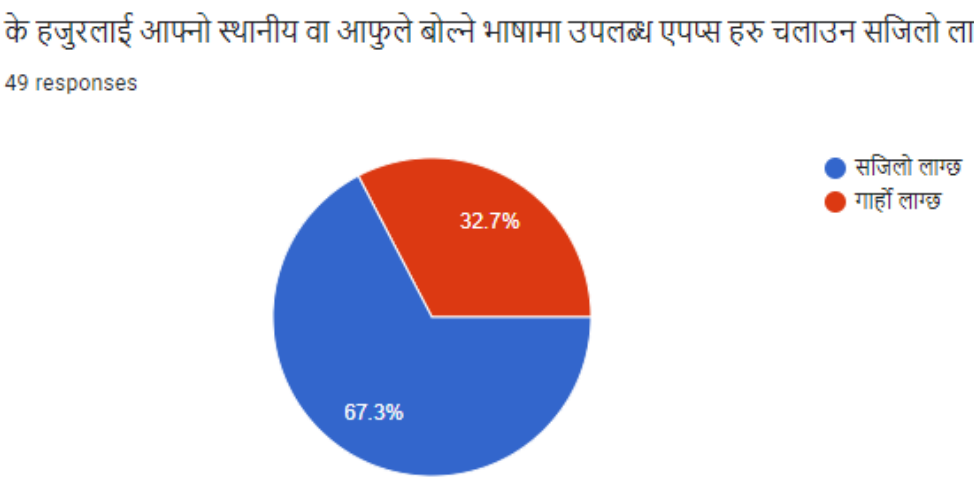


Figure 6: Chart showing response about ease in using applications available in native language

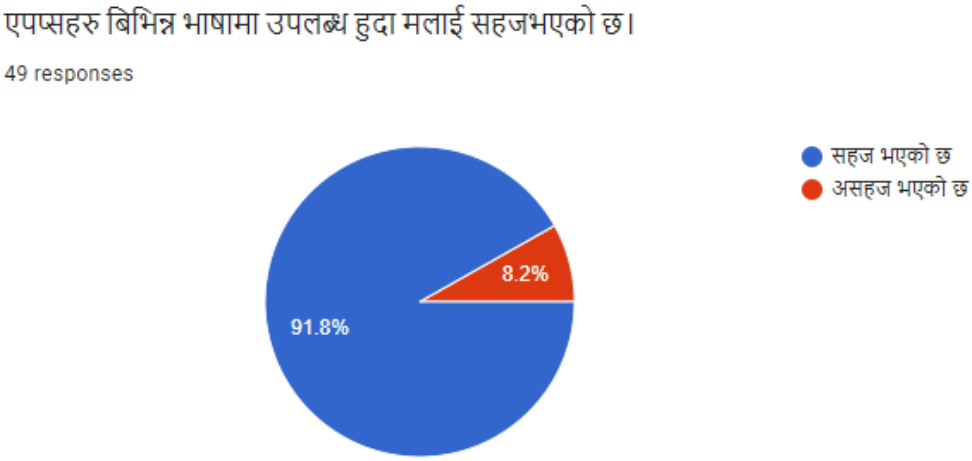


Figure 7: Chart showing response about ease in using applications available in multiple languages

Participants from the second survey, which was taken in Nepali language, would like to use the applications available in their native language. And both surveyors agree that applications available in different languages are easy to use.

2. The participants of both survey group are positive that governmental applications as well as utility applications should be available in different languages to facilitate every user who use it.

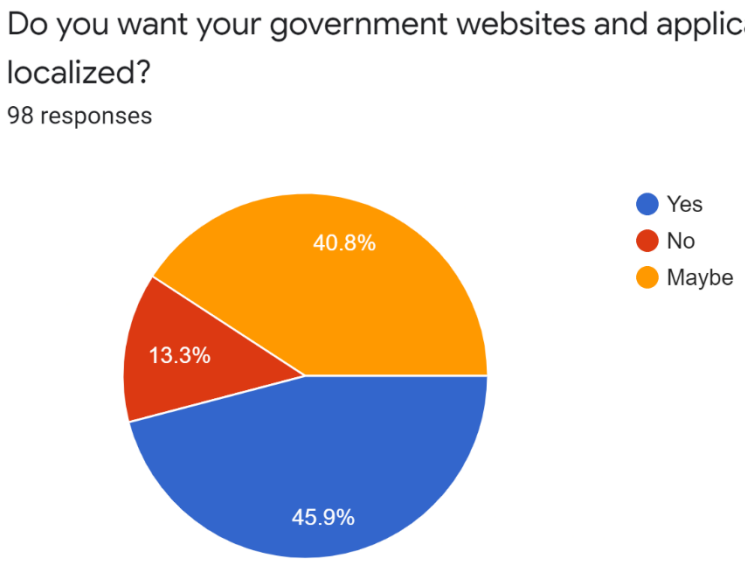


Figure 8: Chart showing response about localizing governmental application for English survey

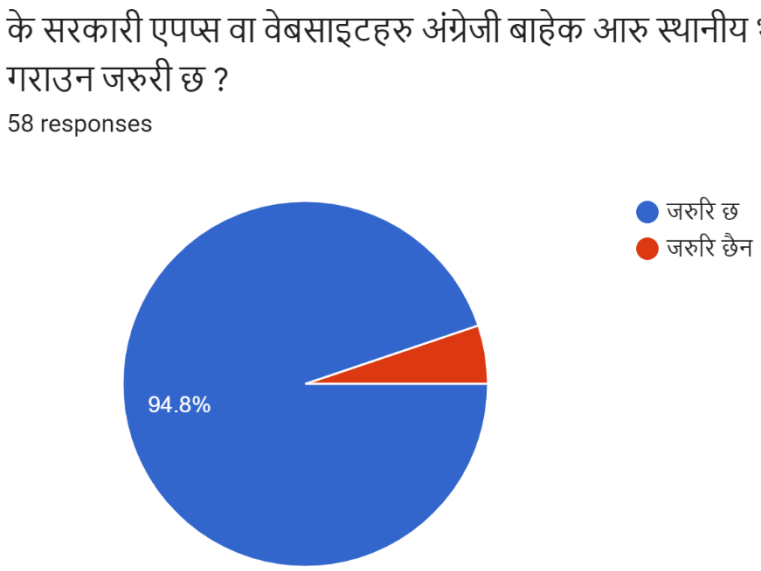


Figure 9: Chart showing response about localizing governmental application for Nepali survey

Though some contrast can be found on surveys pertaining to each user, everyone agrees with the fact that localization makes use of applications easier and localized applications can reach a wide audience.

From this survey it can be inferred that some people found it difficult to use applications available in native language. Even this problem can be addressed by means of including localization features in the app. We found from this survey that though it is called localization to make applications available in different languages there are two overall processes called Internationalization and Localization, which go hand in hand.

A detailed response for survey in English and Nepali can be found here.

2.2. Week 2

In second week, we prepared a document explaining the reason for choosing members in our group. We documented the case overview and why we have taken this case for our mini-research project. The overview also consisted of problem statement and common understanding between team members to work on this case. We also listed the probable solutions to the problem that we stated as hypothesis. We also discussed how innovative our research project is and if the outcome will be viable.

2.2.1. Problem Statement

Universal usability means that the product should be usable by everyone despite their condition, if they belong to the target group. For instance, if a person doesn't know English language and doesn't want to, he should not be excluded from using the application they want. It is the responsibility of that application to make it suitable to everyone using it. In the problem that we've chosen is that of implementing localization in the application.

2.2.2. Case overview

Application localization is the process of adapting an existing application to local language and culture in the target market. It is a process of adapting the application to a different linguistic and cultural context that involves much more than a simple translation of the text. This change process must reflect the specific language and cultural preferences of the content, images and the overall design and requirements of the app, all while maintaining the integrity of the application. Culturally adapted applications minimize the amount of cognitive effort needed by site visitors to process information, make it easier to access and make attitudes towards the website more favorable.

Upon researching our team found that there are only a few localized applications, thus limiting the market of applications which are not localized. Even popular applications such as eSewa lack this feature. If this app is localized, it will not only

increase the market but also improves the interaction of the user with the application. Thus, we have taken this case to further research about this topic, and make a sample localized UI of eSewa to see how it improves the user experience.

2.2.3. Team

Our team consists of four members: Sailesh Dahal, Sarayu Gautam, Bhabin Khadka and Ashish Subedi. All of our team members are diligent and hard-working and give a hundred per cent to solve a given task. While discussing, we all agreed upon the problem of app localization and decided to work together to analyze the problem and find a solution. All of us have come to face this problem where our elders couldn't find a particular feature of the application because it was written in English. Apart from universal commands used in applications like home, settings, notifications, etc., other complex commands were hard to recognize by people who are not fluent in English especially older population group. And as we all had faced this kind of problem in our home, we connected through this idea that localization is crucial in application and formed a team to do this research project together.

2.2.4. Portfolio

Sailesh Dahal
Sarayu Gautam
Bhabin Khadka
Ashish Subedi

2.2.5. Hypothesis

Nowadays, many top tiers companies are localizing their apps to reach a wider range of audience. As of 2020, Google has language support for 109 languages, [12] and Facebook has support for 101 languages. So, based on this we hypothesize that localization is great for universal usability and global reach.

2.2.6. Innovative and Viability

The concept of localization has been into existence since the 1980s but its concept has been booming in recent years. Since the market is getting stagnant, developers are targeting their application globally. However, in the context of our country only a few popular apps such as Hamro Patro, Hamro Keyboard [13] are localized. Most older generation people do have difficulties when it comes to using non-localized apps; localizing helps those users to use these apps easily and comfortably. So, the solution we present seems innovative and viable for developers developing apps for our country.

In second phase we discussed with two groups of our class regarding our case for this mini-research project. We received suggestion and feedback from these groups and documented the feedback.

Feedback from the group with research title "**Compatibility of speaking aid apps and their Localization**" is given below.

The problem statement is very appropriately written. The group has selected a contemporary problem. There are people who are not fluent in English, which is the fundamental language used in many applications even in applications developed by Nepal and are meant to be used by Nepali people. So, the idea of research on this pressing topic is very impressive.

The team has taken eSewa as their base example. Being in pandemic eSewa must be one of the most used applications. Since it deals with the transaction of money it is a very pressing issue to localize this application in the Nepali language. If there will be an option to use the application in Nepali, many errors can be minimized. Similarly, people who are not fluent in English will be able to easily use it. Thereby, increasing the usability of this application.

Advantages:

1. It serves the concept of universal usability
2. The application developed will be available for different regions.
3. It provides a platform for people from different cultures to come together through a single application.
4. Applications will be usable for people who are not fluent.
5. It provides for better communication amongst multilingual people.
6. It can even aid in cultural exchange.

Disadvantages:

1. The interpretation of local slangs and colloquialisms cannot be translated word to word.
2. Loss of information in the process of app localization.
3. Negative meaning or meaninglessness due to translation from one language to another.
4. Unavailability of words to represent the same thing in different languages

Feedback from the group with research title "**How dark mode affects HCI**" is given below.

Advantages:

1. The localization of apps is sure to increase the number of users using that app. Some users might not be comfortable using apps in a language other than their native tongue, localization is sure to help in this case.
2. Saves tradition, culture by saving the language. There are languages associated with a particular culture or tradition (In Nepal those can be Newari, Tamang, Maithili, Rai language, etc.) (like GitHub saved arctic code)
3. Sentiments of people are associated with languages, like one's perception or feeling while reading in English might be different than his perception while reading in Nepali or his native language. Things like national and cultural pride may come to play along with the sentiments.

4. It is comparatively easier to understand commands written in one's native language.

Disadvantages:

1. Concept of Local is not defined properly, how much localization is appropriate, and to what extent?
2. It is not clear which principle of HCI is applicable or related to this concept except the concept of universal usability.
3. Manpower is needed for translation purposes. It might not be feasible to translate all components of an application and It is cumbersome to translate the dynamic contents of the website.
4. The impact of Localization boils down to the persona of users who use the application. For instance, most of the users belonging to the 20 -30 age groups do not want the applications to be in their native language because they are so much used to the English language while the exact different scenario can be found in the case of a user of higher age groups.
5. In the next 50 years, (research says 10 languages will connect the world, so localization of applications might be costly and useless.
6. To save the manpower, if localization is done using AI, it is not as effective as manually done. We can take the example of the translation/Localization done on Facebook with the help of AI.

2.3. Week 3

Since our research dealt with color combinations and visual factors, we used a digital prototype in contrast to a paper prototype. The prototype tool was needed as a visual representation of what we are trying to achieve with eSewa. We have implemented Donald Norman's 6 design principles [14] and Schneiderman's 8 golden rules [15] while constructing our prototype and have reflected the same thing through UI.

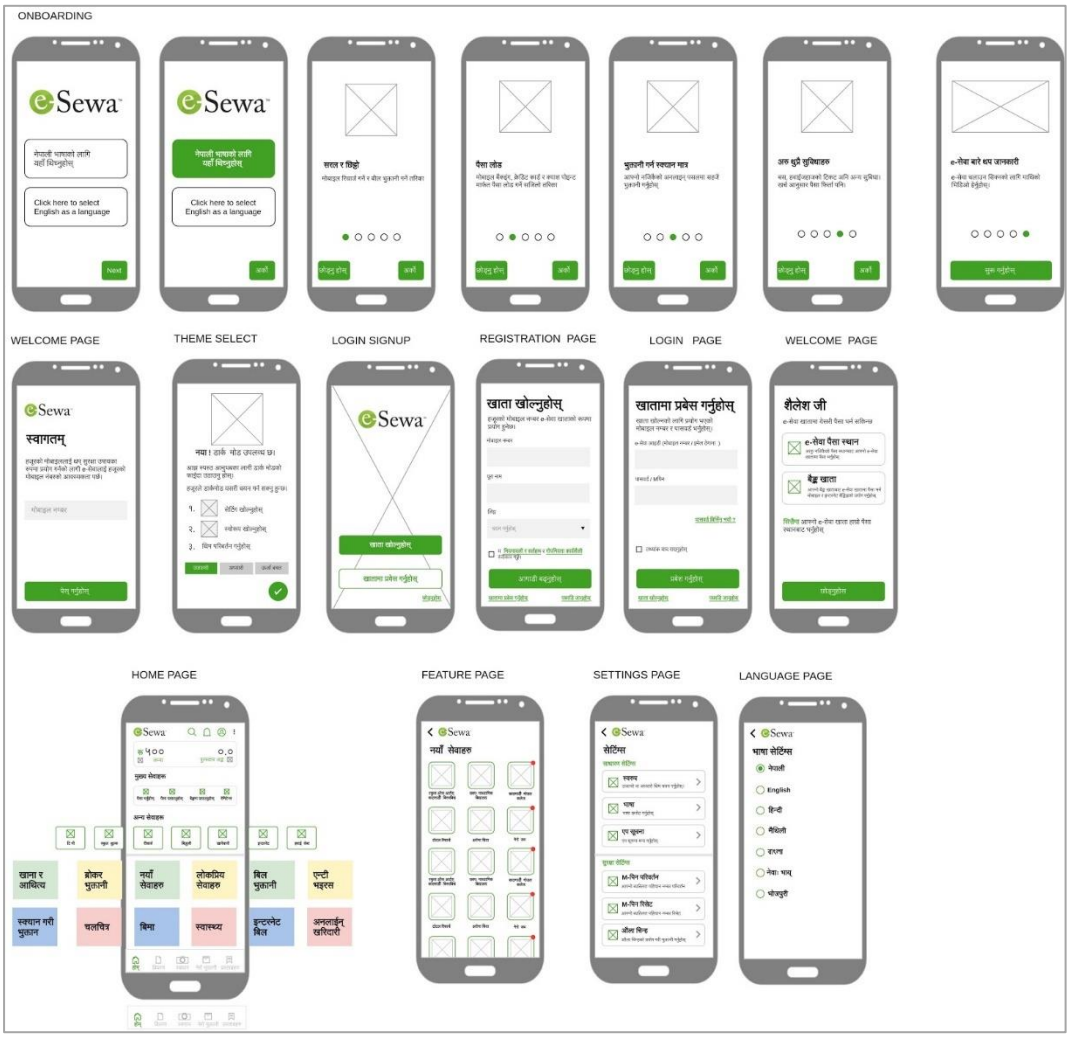


Figure 10: Digital prototype

We conducted the survey on our prototype. Then we conducted this survey on tech-savvy eSewa users having enough knowledge of design principles so that they could separate bad design changes from a good one and provide constructive feedback on

how we can improve. Nearly three-quarters of people filling the survey agreed to eSewa being available in Nepal as a good step towards the usability of this application. And though more than three-quarters of responders were satisfied with the current UX of eSewa, when we presented them with our improved prototype that incorporated design principles, almost all of them agreed that the prototype version of UI was better in terms of usability.

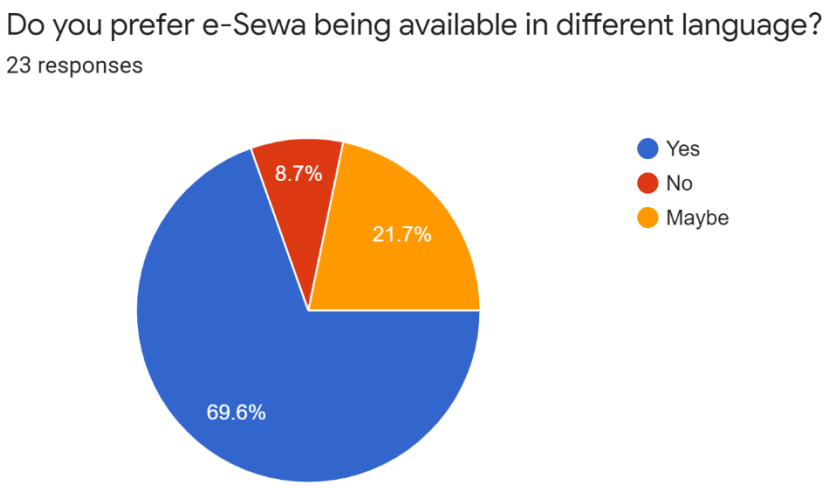


Figure 11: Preference of eSewa app being available in different language

In the prototype survey, we had included images of the prototype where we had maintained consistency in button size, images, and typography. More than half of the respondents agreed that the prototype version was better than the original eSewa UI where consistency wasn't given priority. All of the respondents agreed that compared to the original eSewa UI where the submit button was kept on the top right of the screen, the prototype version having the same button on the bottom right was more user friendly.

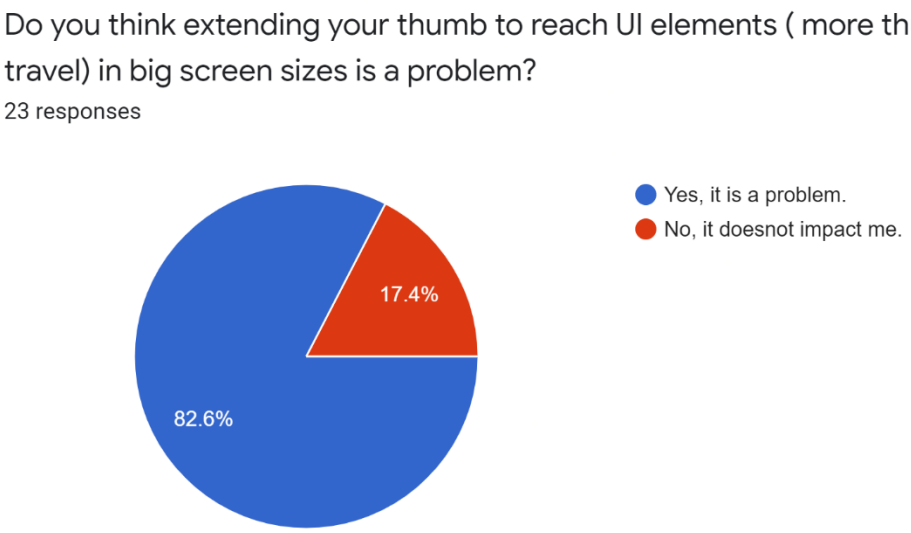


Figure 12: Response on extending thumb to reach parts of screen

More than three-fourth of respondents conceded that the prototype version of Login and Sign- Up pages is more consistent than that of the original version.

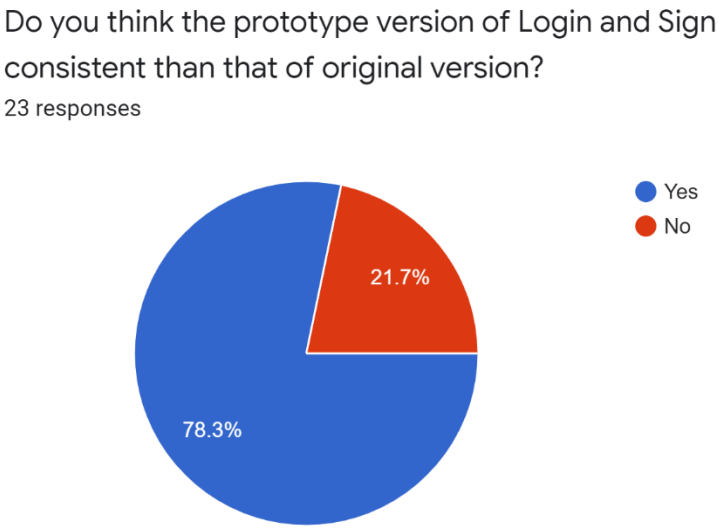


Figure 13: Response regarding consistent user interface

The same number of respondents admitted that layouts in the prototype have a clear distinction between clickable and non-clickable components compared to the original one. Also, more than half of the respondents preferred the prototype version of the Home Page of the eSewa application and also agreed to the prototype version

as being a better way of showing that there is a provision of cashback feature (considering the spacing). The responses were extremely helpful as they shaped our final thoughts on building UI and also guided us on real user needs.

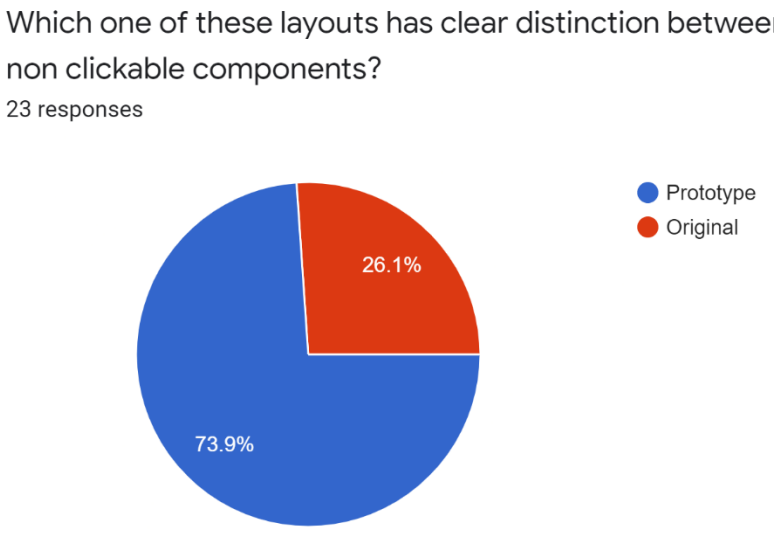


Figure 14: Response about the distinction between clickable and non-clickable elements

2.4. Week 4

In the fourth week, we designed the UI of the eSewa application by implementing localization and design principles for UI enhancement based on the digital prototype and the responses that were collected from the post prototype survey.

The heuristic evaluation done by Mr. Maladeep Upadhaya based on Jacob Neilson's 10 general principles [16] is stated below. He was able to evaluate the application based on 8 of those principles.

1. Visibility of system status

The UI of eSewa was redesigned in a way to always keep users informed about what is going on by using toast messages, pop-ups, important feedback, and by keeping important content at an accessible place. Every feature that this app provides is present on its front page and bottom navigation bar so that users don't have a hard time knowing about the current status of the system.

2. Match between system and the real world

As eSewa is a dynamic app that involves monetary transactions, by using a cashback system and reward points, the match between the system and the real world is made. This makes it possible for users to believe like they are seeing what they have already experienced and are involved with the system. Besides, the inclusion of intuitive iconography for referencing various characteristics further emphasizes this heuristic in the UI created.

3. User control and freedom

On eSewa UI, this metric is assured by providing quick navigation at the bottom of the page so that users can go back to the user control state from where they come from. Users can also access any feature of this app after signing up. They can communicate with the content by loading, receiving, transferring, and paying cash whenever they want to.

4. Consistency and standards

For all pages, eSewa has a consistent style. Users do not have to ask if the same thing is implied by different words, circumstances, or activities. By separating content according to its intent, it has maintained a standard that makes browsing this site smoothly. Also, this role is enhanced in the redesigned UI by maintaining consistency across the app in button size, spacing, color, and font.

5. Error prevention

Through the use of validation techniques in the form, this analysis criterion is met. E.g., a 10-digit number must be entered in the form field of the phone number. In the form, * signs are present for the required field. For content that is limited to being selected from the given choice, there are also dropdown menus kept in place.

6. Recognition rather than recall

After visiting eSewa more than once, it is a little bit harder to recognize where a particular feature is, for instance buying a movie ticket. Users need to scroll for quite an amount of time before reaching some features and this is a tedious job for memory. So, all major features are incorporated in the front page of the application which can be accessed without scrolling to reduce the cognitive load. It's designed to make it easier to recognize where a particular functionality is rather than to recall or memorize. Also, the navigation contains almost every possible exploration user can make and there is stepwise guidance in the onboarding pages. This makes the features in the application easier to recognize than to recall.

7. Flexibility and efficiency of use

eSewa has a flexible UI because it enables its users to follow any track they want when visiting the app without limiting them to one specific path. It is also successful in providing the impression it wants. Each consumer can now easily benefit from the features offered by eSewa, whether they are comfortable in the Nepali or English language, as the localization feature has been introduced.

8. Aesthetic and minimalist design

The design of eSewa, for the most part, is minimalistic. The arrangement of text and font sizes is also aesthetic. Heavy animations are not used and the contents are systematically arranged. The design is plain and elegant, matching this application's function as a digital wallet.

2.5. Week 5

In week 5 we conducted user persona and ethnography to find out the impact of our work. We developed the final UI addressing Donald Norman's 7 design principles, Schneiderman's 8 Golden Rules, and Cognitive walkthrough.

2.5.1. Creation of user persona

1. **Who is my ideal user or customer?**

The ideal user of an eSewa application is anyone who wants to have a utility application carry out most of the monetary transaction without having to be physically present to pay the bills. This mostly includes teenagers, young adults, adults, and early old age people.

2. **What behavioral patterns do my users currently exhibit?**

The general behavior pattern exhibited by current users are:

- Financially responsible
- Understanding of time value of money
- Good time management skills
- Performs frequent monetary transactions

3. **What are the needs and goals of my users?**

The major needs and goals of my users are:

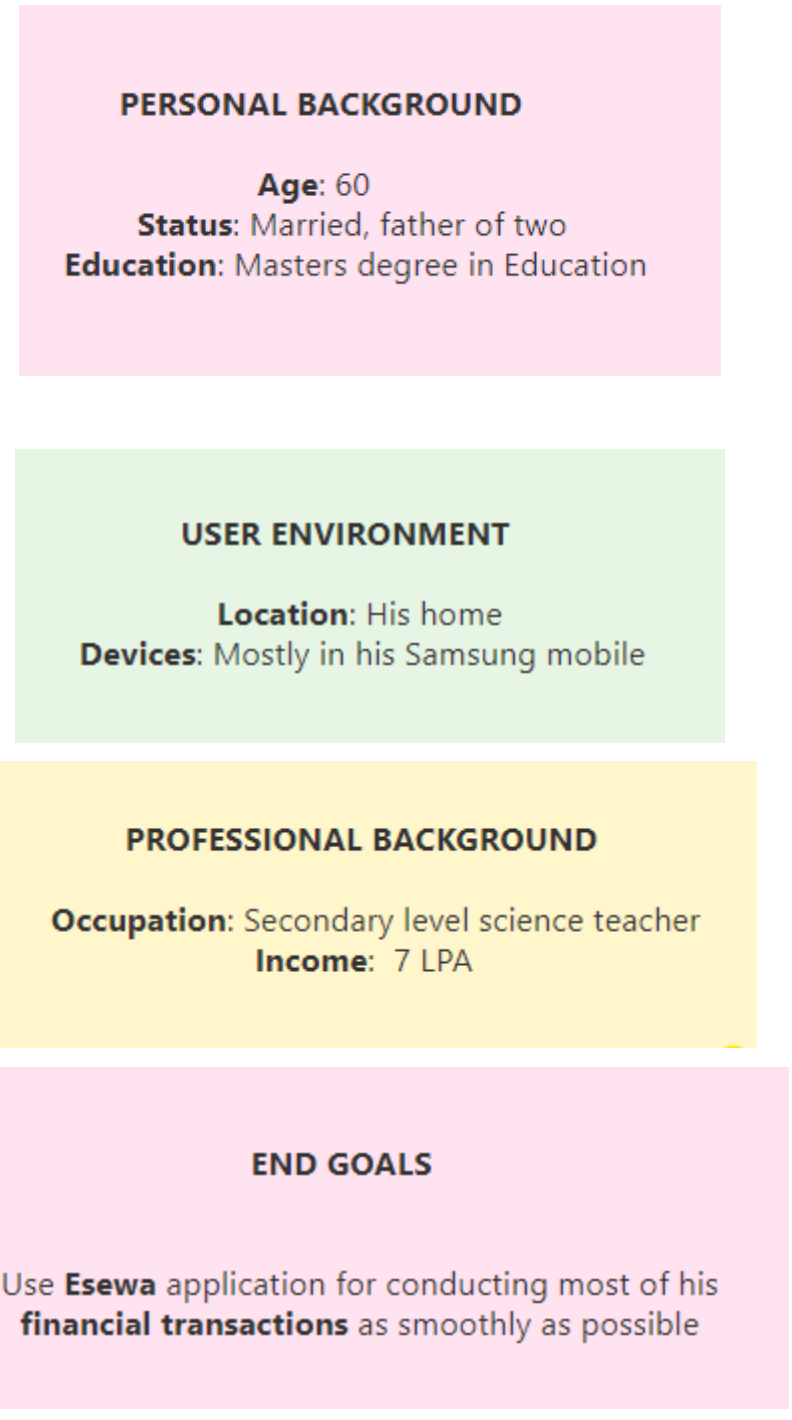
- To conduct all if not most of the monetary transactions online
- To not worry about utility bills deadlines
- To have the same place to receive and spend money
- To digitize the payment system so they can spend their time wisely

4. **What issues and pinpoints do they currently face within the given context?**

The issues and pinpoints they currently face within the given context are:

- No localization feature in current utility applications causing most of the target audience to stop using the application
- No proper idea of using utility application

- The features in current applications not properly accessible
- The UI/UX of current utility applications do not address the need of people



PSYCHOGRAPHICS

Enjoys having full control over his finance

Hates tech-savvy applications

Prefers applications in the Nepali language

Fancies beautiful UI

Wants a safer place to save and invest money

Tends to expect proper feedback and guidance for his actions

SCENARIO

" I use Esewa application for performing most of my financial transactions (mostly for paying utility bills).

I really enjoy using it but there is a huge room for improvement. For instance, I enjoy using applications in the Nepali language. It is easier for me but Esewa hasn't considered this possibility.

Also, I have to scroll a lot to use the feature I want to use. It is not much problem as I am a frequent user. For novice users, this might be a problem. The UI/UX can also be enhanced a lot.

2.5.2. Ethnographic Observation

Ethnographic Observation was conducted twice:

- Once for frequent (expert user)
- Once for the novice user

For expert users, he had an easy way around eSewa and he was able to conduct all transactions and operations easily. That is the reason why even in the survey, the expert users were satisfied with the current features and UI/UX of eSewa.

In contrast, the novice users, though they knew the features provided by ESewa due to its extreme popularity, they had a difficult time figuring out the place for a particular operation. By novice user, we chose someone who has used ESewa but uses it less frequently to remove our sampling bias.

Also, for excluding the theoretical bias, we used cameras to conduct our observation without being present there ourselves. For removing personal bias, we asked someone else who knows less about eSewa to narrate the experience of the users.

We were just the complete observer and the whole process was done without interrupting the natural flow of things. The process was to see, record, analyze, and cite the observation which is done for the less frequent user as the expert user knew his way properly around eSewa.

We focused on the following factors while doing the observation and we used the same person that we have described in user persona:

1. Was the user able to utilize all the features provided by the current eSewa application?

No. As per the narration and camera observation, he was able to use the basic features like load /transfer and send money with ease along with other minor

functions. But he could not find the option to buy the movie ticket through the application which we had suggested he do before observation.

2. Was he able to achieve the action he wanted to accomplish by ease?

Actually yes. He wanted to pay his utility bills which, as he mostly used eSewa for that purpose, were conducted with ease. Although he admitted at a short interview after the observation that it had taken quite a while for him to figure the feature when he had just started using the application.

3. Was he in need of localization in the application?

Yes, he wanted the application to be in the Nepali language.

2.5.3. Analysis from the observation

1. Apart from expert users, people mostly use eSewa for loading/transferring, and sending money.
2. More vertical scrolling needs to be done to reach different features and also there is a view-more link to access more hidden features. This can be cumbersome to many people.
3. eSewa is missing out on potential customers due to the lack of localization.

The various application evaluation methods are applied to evaluate the application only after the application development. But the designer should also be able to ensure that his creation aligns with design principles. For the evaluation of eSewa, both the prototype as well as the original application, we have used Donald Norman's six design principles and the Eight Golden Rules of Interface Design by Schneiderman. First, we evaluated the original application, and on the aspects where the original was inadequate in its design, we implemented those things in our revised UI and then documented the improvements made.

As per Schneiderman's 8 golden rules,

1. Strive for consistency

When we open the eSewa application, there is consistency in typography, coloring, the overall layout of the application, the navigation menu, terminologies, and other elements. So, we can consider the app to follow this first rule. For small inconsistency, we made sure that was removed in the UI we made.

2. Offer informative feedback.

There is no doubt that the eSewa has followed this rule as there is a feedback feature for informing the user that certain action is completed, or if any information is missing out, or if there is an error. The feedback feature is crucial because it allows users to know that the action he intended to perform or has performed has some consequence. Also, if something is missing out while filling the form, a warning message is displayed to let the user know he should complete that task. To enhance this feature, we have used toasts for success and error messages in our UI.

3. Design dialog to yield closure.

This rule is prevalent in the eSewa in multiple instances. For example, a certain task that needs to be conducted is provided with the required sign and appropriate label. When the form is being filled the tips are provided through error and warning messages and the completion of any task is marked by appropriate toast.

4. Offer simple error handling.

Simple error detection techniques are responsible for making a huge difference in preventing the user from doing anything wrong or unexpected. We integrated form validation techniques to offer simple error handling in the UI we developed.

5. Permit easy reversal of actions.

Throughout the eSewa application, wherever there is the presence of a writing form, if the written statement needs to be corrected, it can be done through a simple

command of CTRL+Z. We designed a transaction cancellation feature to permit an easy reversal of payment action in the UI we made. This easy reversal of action helps prevent potential errors from occurring as well as discharges the user from stress.

6. Support internal locus of control.

It is highly desired by advanced users to have control of the device. They know that their efforts were right and in order as the system responds to their behavior.
To support the internal locus of control, we included theme changing and localization features which is the major part of our project.

7. Reduce short-term memory load.

To reduce the short-term memory load, consistency is maintained throughout the application. The placement of every component is very accurate and also the session lasts longer. Also, a stepwise guidance feature (onboarding) is provided to help users navigate the site easily without much memory load.

As per Norman's design principles,

1. Visibility

It's important to keep key pieces of information visible to decrease users' cognitive load and help them remember that it's there. Considering the visibility, we decided to change the current vertical scrolling to a horizontal one and incorporate major features in the visible portion of the app rather than having to scroll indefinitely.

2. Affordance

Affordance is an attribute that indicates how it's used like the clues so that no instructions or labels are needed to portray the usage. A lack of affordances makes for an unpleasant user experience. Including intuitive iconography and most importantly, integrating the localization feature, we tried to enhance the affordance of the eSewa application through our project.

3. Constraint

Constraint refers to the determination of ways to limit the form of interaction between users that may take place at a given time. There are different ways of accomplishing this. To ensure the constraint principle, we added * signs for the required field in the form and also included form validation techniques. Also, we have incorporated the feature of terms and conditions of the application without agreeing to which users cannot go inside and use the application.

4. Consistency

This principle states that the functionality and gestures should be the same or similar to something the user has seen or used before. So, for consistency, we focused on having consistent button size, spacing, color, and font throughout the app.

5. Feedback

Feedback refers to the visible response that one gets from performing any interaction or a confirmation that an action was performed. Circular progress indicators, shimmer, and ripple effect in the button act as the feedback in the actual UI that we developed.

For the eSewa application, we performed Cognitive Walkthrough in the UI application that we developed considering the task of paying for a movie ticket of QFX cinemas. We chose this task because we had found it was hard for novice users to find and perform this transaction.

Will the user try and achieve the right outcome?

To get to the movie payment option in our enhanced eSewa UI, firstly users will have to log in to get inside the application. Before getting to the login there are onboarding pages that provide summarized guidelines on what the app is about. After login, the first instinctive way is to explore the home page and hence we have integrated all important features in this page. The user will firstly search in the top services section and then on other services sections. They will horizontally scroll

through other services sections and search for the movies option. When they don't find it there, they will move to all categories section and with one horizontal swipe, they will see the movies section. When clicked it will lead to all the cinemas that offer online ticket services. Like this, the user will try and achieve the right outcome through minimal steps compared to the original UI of eSewa where the user had to vertically scroll and check for every category before moving on to the next once before finally reaching the movies section.

So, the cognitive walkthrough questions are:

Will the user notice that the correct action is available to them?

Since eSewa offers multiple functionalities, reaching to and managing every section is hectic. But compared to the original eSewa UI, users will be quick to notice the correct action for achieving the right result. The localization feature will be of tremendous help to users who prefer the Nepali language to use the application to notice the availability of correct action.

Will the user associate the correct action with the outcome they expect to achieve?

Since the movies section is kept with all other similar categories containing required destinations like banks, hospitals, movie theaters and the like, users will surely associate the correct action with the outcome they expect to achieve.

If the correct action is performed; will the user see that progress is being made towards their intended outcome?

Yes, although finding the correct action is not easy amidst the many functionalities that eSewa presents, once the movies section is reached, it gives the feeling to the user that progress is being made towards the intended outcome, that is to buy the movie ticket of their desired movie theatre.

2.6. Week 6

In week 6, we performed usability testing with the target user through survey on the developed APK. We sent this APK to the same people who had filled our prototype survey.

We requested the respondents to install it on their device, check it out, and fill the form with their honest review. Almost all of the respondents were frequent users of eSewa which made it more effective to work on their review. More than three-fourths of the respondents agreed that localization made it easy to understand the instructions provided in the application. They also confirmed that localization in Nepali was a necessary step in including a wider population to use the eSewa application.

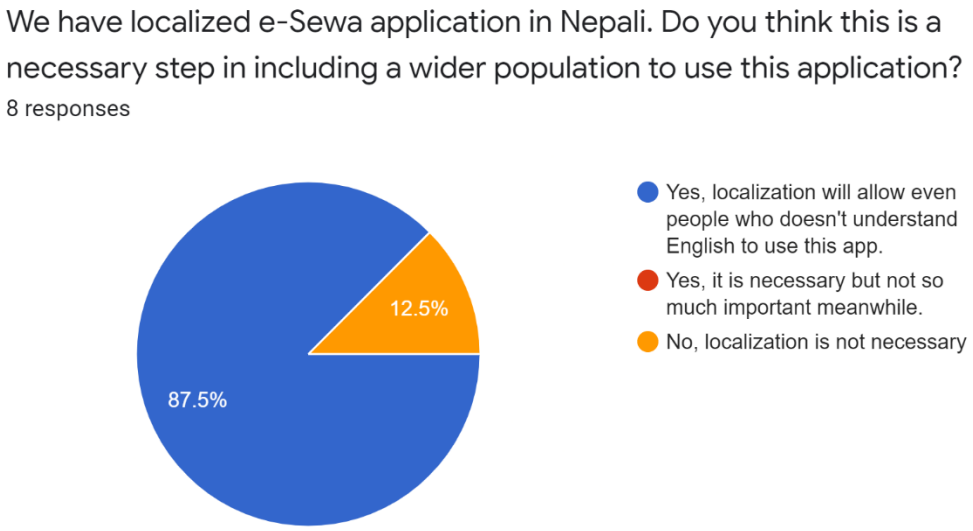


Figure 15: Response on the final design APK

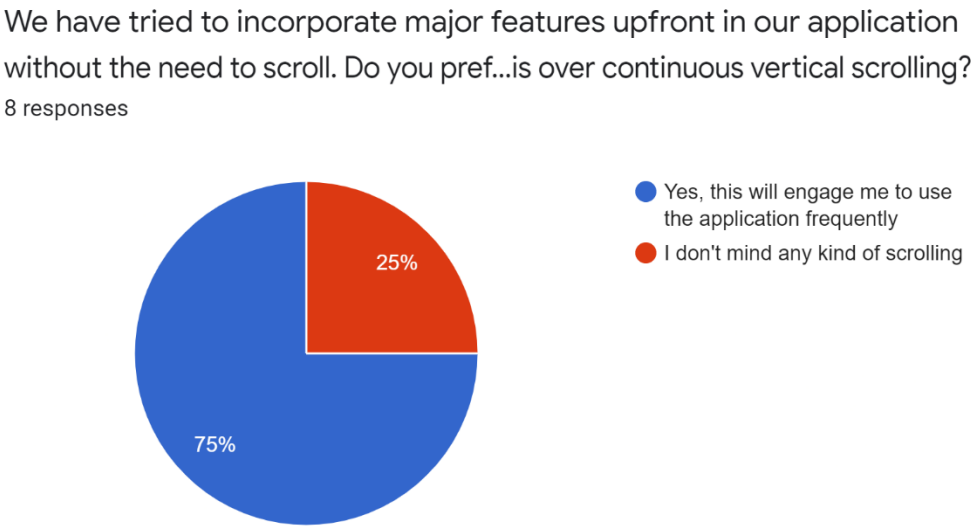


Figure 16: Users prefer horizontal scrolling in APK

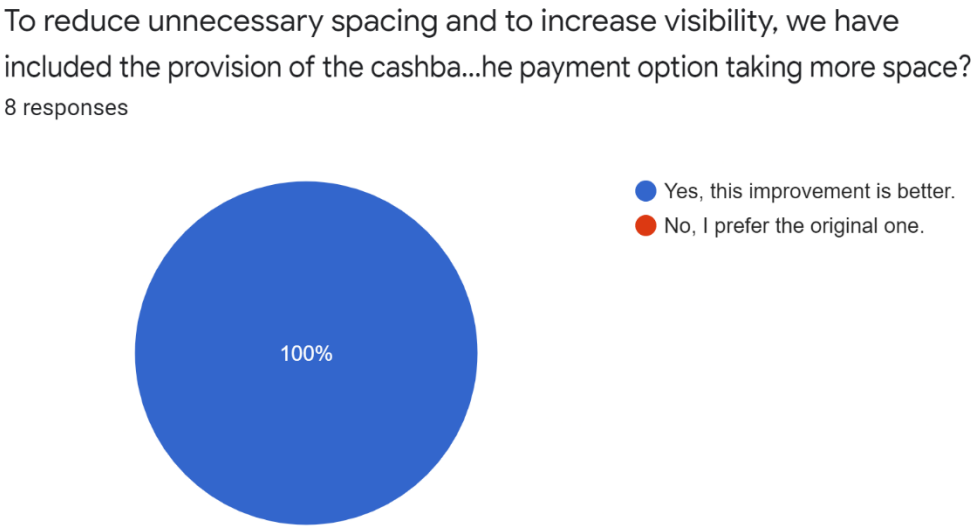


Figure 17: Users agreeing on UI enhancement

The screen shots of the UI are in the appendix. Here is the link to the minimal viable product.

References

[1] eSewa, "eSewa | Digital wallet in Nepal for Online payment services," 29 11 2020. [Online]. Available: https://esewa.com.np/. [Accessed 30 11 2020].

[2] A. Smith, L. Bannon and J. Gulliksen, "Localising HCI Practice for Local Needs," *Proceedings of the 2010 International Conference on Interaction Design & International Development*, pp. 114-123, 2010.

[3] A. M. A. Awwad, "Localization to Bidirectional Languages for a Visual Programming Environment on Smartphones," *International Journal of Computer Science Issues*, vol. 14, no. 3, May 2017.

[4] Carobat, "Home - Catrobat," Carobat, 30 11 2020. [Online]. Available: https://catrobat.org/. [Accessed 30 11 2020].

[5] S. L. Mansar, S. Jariwala, M. Shahzad, A. Anggraini, N. Behih and A. AlZeyara, "A Usability Testing Experiment For A Localized Weight Loss Mobile Application," *Procedia Technology*, vol. 5, pp. 839-848, 2012.

[6] R. Orngreen, D. Katre and M. Sandeep, "Analyzing Cultural Usability of Mobile Keypad and Displays for Textual Communication in Internationalization and Localization Perspectives," *IFIP Advances in Information and Communication Technology*, vol. 316, 2010.

[7] A. S. Wandera, "Evaluating the acceptance and usability of Kiswahili localised," *The Journal of Specialised Translation*, no. 24, July 2015.

[8] Quora, "How The Growth Team Helped Facebook Reach 500 Million Users," 15 9 2014. [Online]. Available: https://www.forbes.com/sites/quora/2014/09/15/how-the-growth-team-helped-facebook-reach-500-million-users/?sh=13bf96d17058. [Accessed 30 11 2020].

[9] Wikipedia, "List of Wikipedias - Meta," 30 11 2020. [Online]. Available: https://meta.wikimedia.org/wiki/List_of_Wikipedias. [Accessed 30 11 2020].

[10] Google, "Hamro Patro : The Best Nepali Patro NP - Apps on Google Play," 30 11 2020. [Online]. Available: https://play.google.com/store/apps/details?id=com.hamropatro&hl=en&gl=US. [Accessed 30 11 2020].

[11] Google, "Khalti Digital Wallet (Nepal) - Apps on Google Play," 30 11 2020. [Online]. Available: https://play.google.com/store/apps/details?id=com.khalti&hl=en_US&gl=US. [Accessed 30 11 2020].

[12] Google, "Search Settings," 30 11 2020. [Online]. Available: https://www.google.com/preferences?hl=en-NP&fg=1#languages. [Accessed 30 11 2020].

[13] Google, "Hamro Nepali Keyboard - Apps on Google Play," 30 11 2020. [Online]. Available: https://play.google.com/store/apps/details?id=com.hamrokeyboard&hl=en_US&gl=US. [Accessed 30 11 2020].

[14] Enginess Insights, "The 6 Principles Of Design, a la Donald Norman | Enginess Insights," 30 11 2020. [Online]. Available: https://www.enginess.io/insights/6-principles-design-la-donald-norman. [Accessed 30 11 2020].

[15] University of Texas, "Shneiderman's Eight Golden Rules of Interface Design," 15 5 2004. [Online]. Available: https://faculty.washington.edu/jtenenbg/courses/360/f04/sessions/schneidermanGoldenRules.html. [Accessed 30 11 2020].

[16] J. Nielsen, "10 Usability Heuristics for User Interface Design," 24 5 1994. [Online]. Available: https://www.nngroup.com/articles/ten-usability-heuristics/. [Accessed 30 11 2020].

Appendix

A.1. Screenshots

Figure 19: Application starting

Figure 18: Asking user to select language

Figure 21: After Nepali language is selected

Figure 20: Onboarding page start

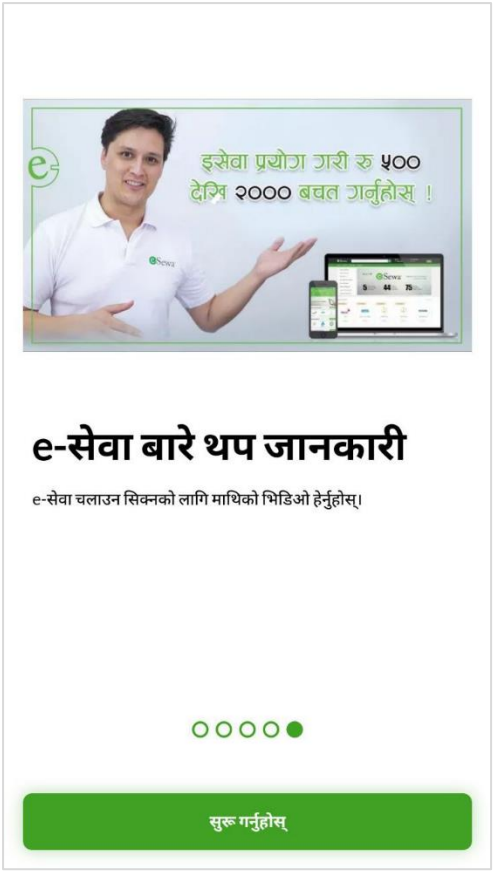


Figure 23: Onboarding page end

Figure 22: Theme selection page

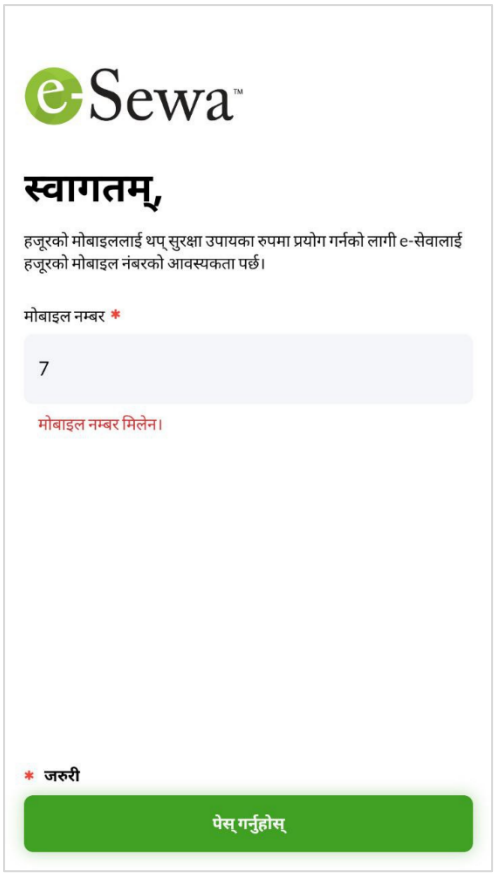


Figure 25: Error handling in forms

Figure 24: Feedback about form processing

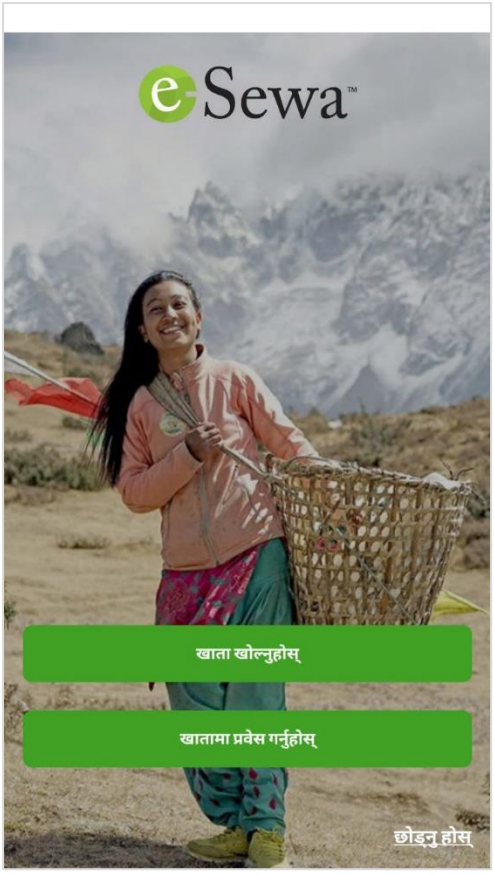


Figure 27: Contrast between background and button

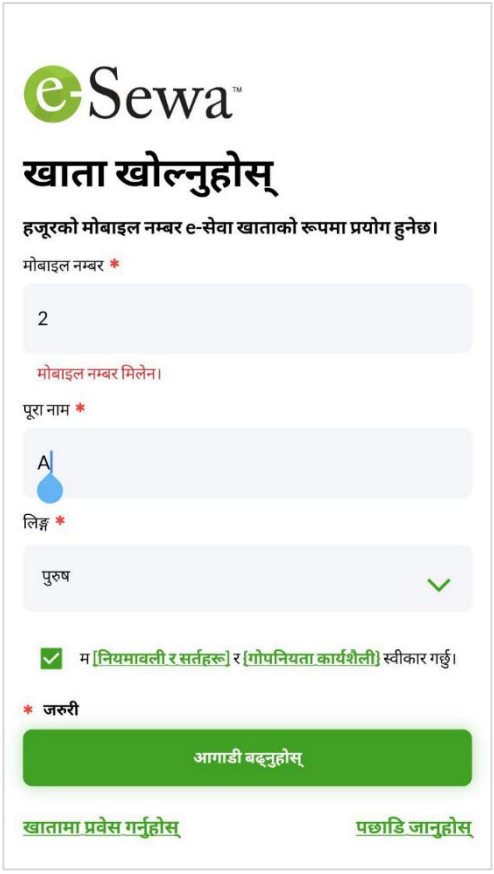


Figure 26: Error handling in signup page

Figure 29: After successful authentication

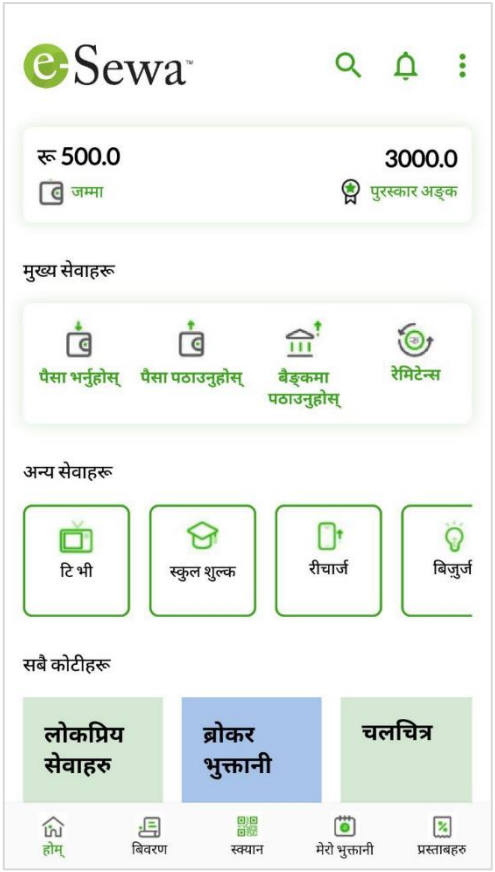


Figure 28: Redesigned home page

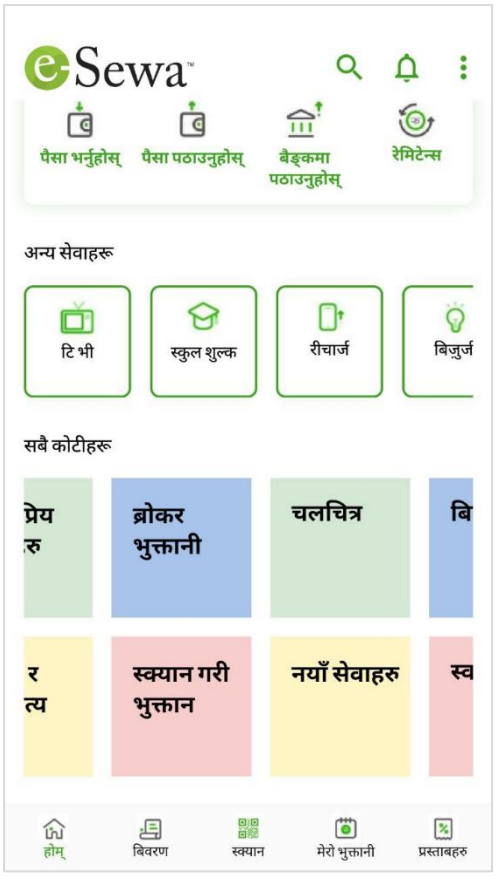


Figure 31: Horizontal scrollable section

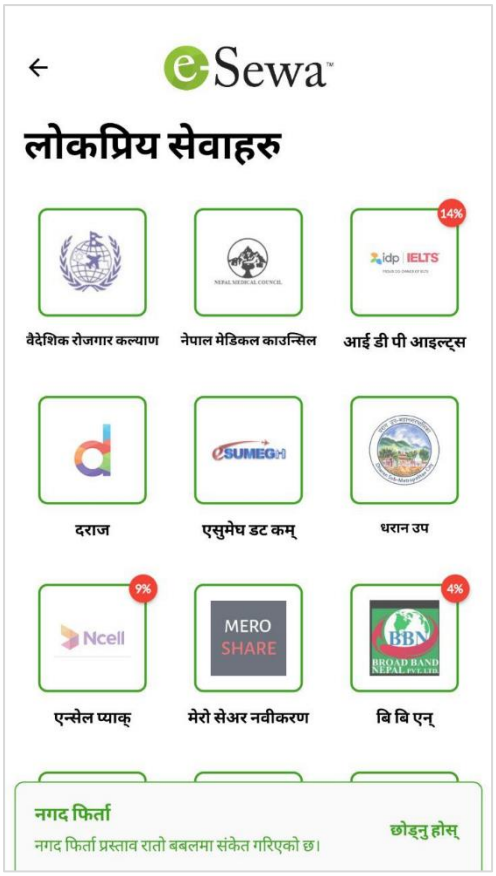


Figure 30: Top services page with cashback information as bubble

Figure 32: Localized settings page in Nepali

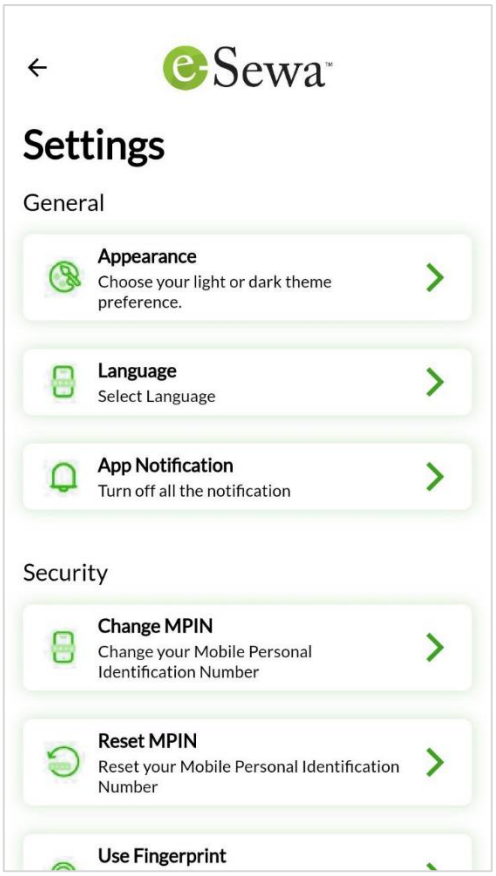


Figure 33: Localized settings page in English

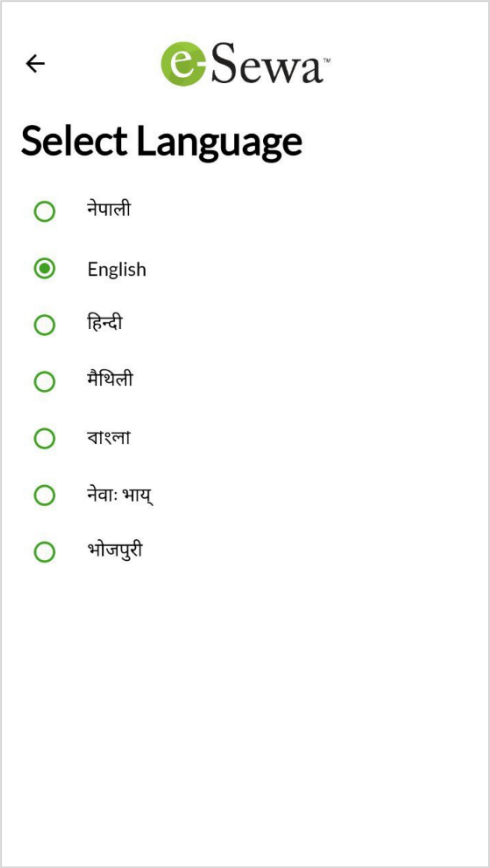


Figure 34: Currently English language selected

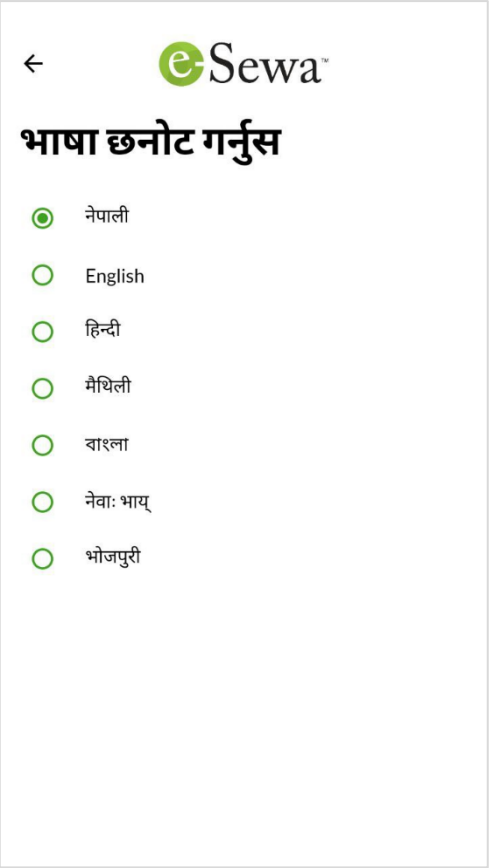


Figure 35: Currently Nepali language Selected

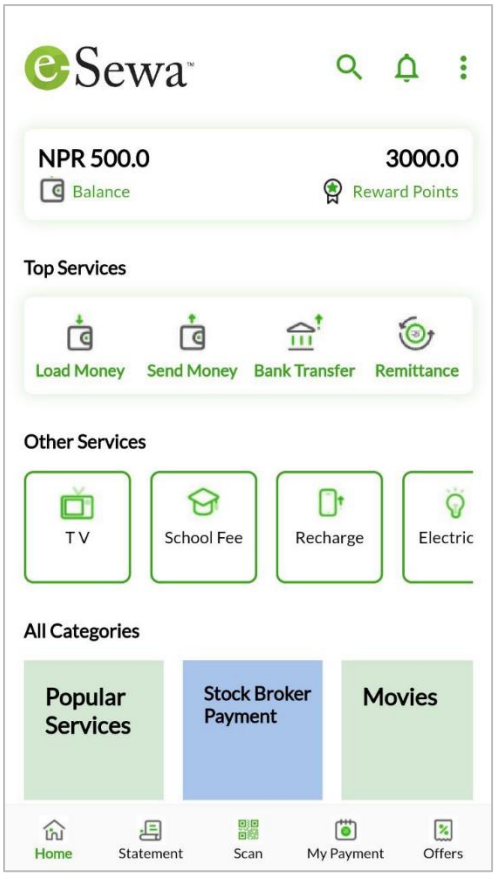


Figure 36: Redesigned home page in English

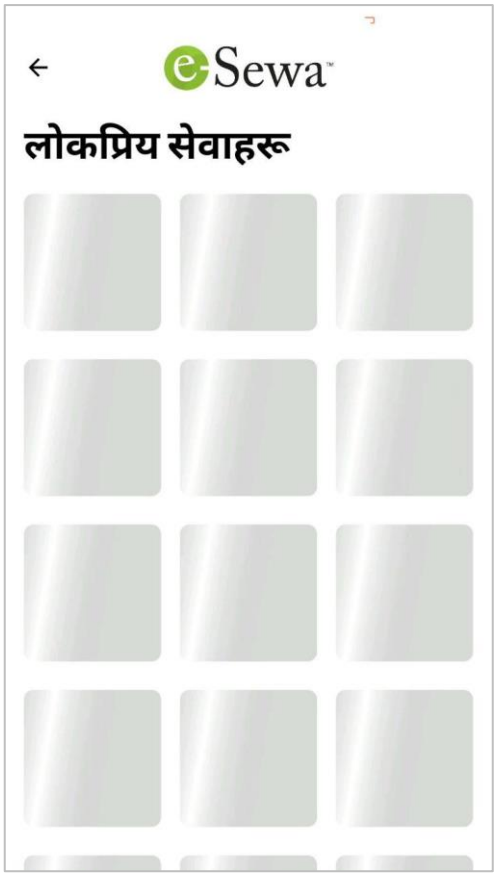


Figure 37: Shimmer effect for content loading feedback

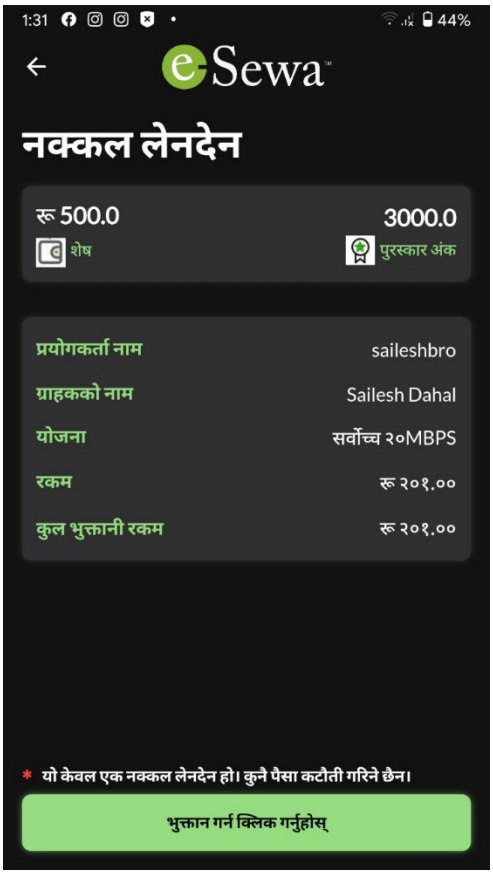


Figure 39: Transaction demo page

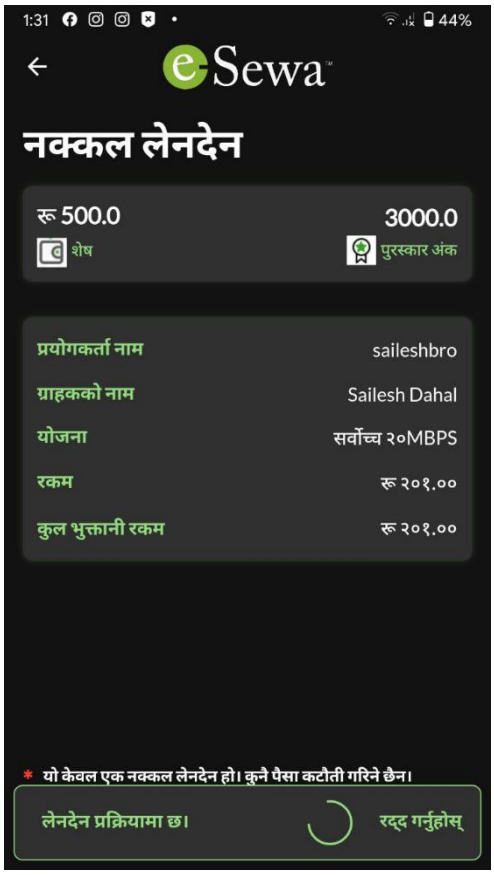


Figure 38: Transaction cancelation and loading

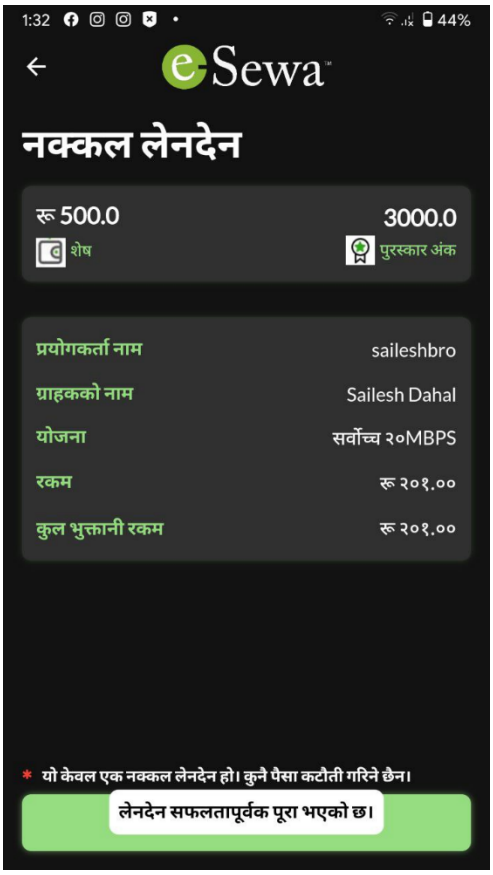


Figure 41: Transaction completed message

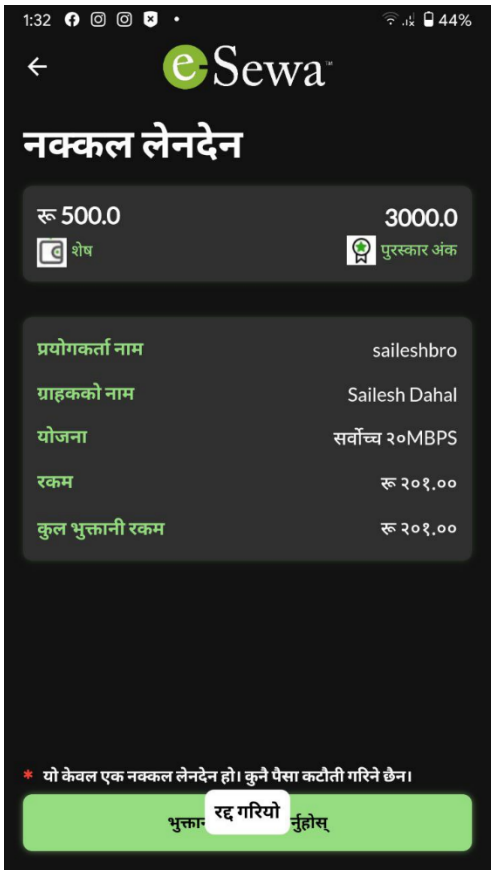


Figure 40: Transaction cancelled message

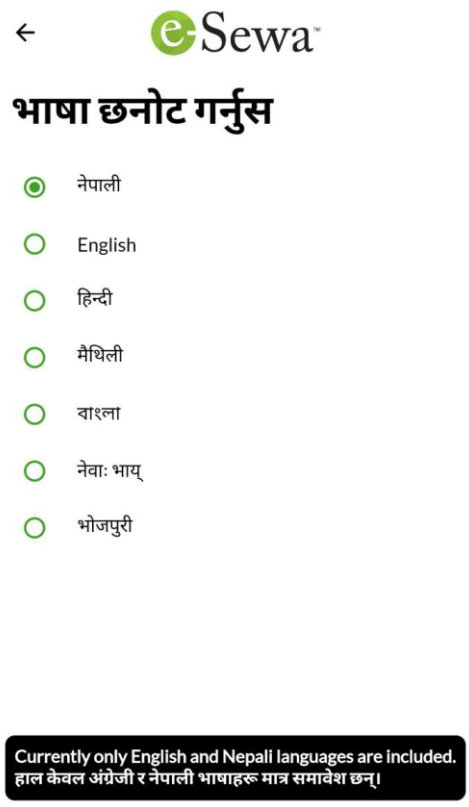


Figure 42: Only two languages are implemented popup