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

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Abstract— **This research paper is the outcome of our half-year research on the topic of the role of app localization in universal usability. The principal objective of our research was to determine the level of the impact made by application localization in universal usability and also check to see whether the usability of the current Nepali application (eSewa) can be enhanced by localizing it in the Nepali language or not. In addition to localizing eSewa, the UI of eSewa was also analyzed and improved, mainly using Donald Norman's design principles and other HCI principles including the survey, Prototype, User-Persona, Ethnography, Schneiderman's Eight Golden Rules, Heuristic evaluation, and Cognitive walkthrough. The result was a flutter application demonstrating UI of eSewa which was localized in Nepali language and adhered to most of the HCI principles. After the post-survey of the developed application, it was found that all demographic groups felt comfortable using the localized version of eSewa compared to the original one. The main conclusion derived from this research was that the localization of an application plays an important role in the universal usability of that application and using HCI principles while designing UIs immensely improves the experience of using applications by the users.**

Keywords— **Human-Computer Interaction, Localization, eSewa Universal Usability, Mobile Application, Design Principles**

I. 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 more 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.

As we progressed towards the research it was inevitable that we take reference and insights from existing established knowledge in the literature related to this topic. We did a literature review of 5 research papers having a concept similar to ours. The first paper concluded that differences can occur as a result of cultural differences related to different cultural user groups, with differing groups potentially reacting differently to unlocalized commands [2]. The next paper dealt with the project - localization of a visual programming environment in bidirectional languages [3]. Localization of that application increased the user base by 10 folds which were targeted to children having different native languages. This project demonstrated the huge role that localization plays in universal usability and HCI.

The other 3 papers were reviewed and documented for the final report.

We searched for related works that have implemented localization. Facebook has gained its massive user base due to its availability in multiple languages and has shown the

importance of language in HCI [4]. But its concept is based on internationalization (that is focused on international languages rather than languages of local people) and hence was different from what we were trying to achieve. In contrary 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 [5]. But as a demonstration project, we have decided to translate a current application in Nepali similar to what Hamro Patro [6] and Khalti [7] applications have done. So, these applications are more closely related works than others.

After the literature review and in-depth look at related works, we devised our hypothesis. We hypothesize that application localization increases the number of people using the app, which in turn increases the marketing and popularity of that app and induces more people to use the app increasing its universal usability. Also, from our research, we disclosed that good UI/UX that captures the attention and fulfills the requirement of users also greatly contributes to universal usability.

We approached this hypothesis with practical implementation and hence implemented both localization as well as design principles in the eSewa application UI that we developed. We used usability metrics to ensure our application adhered to the concept of universal usability. Also, we used Donald Norman's design principles [8] and Schneiderman's 8 golden rules [9] of UI design during our design process and later on evaluated it with multiple evaluation techniques like heuristic evaluation and cognitive walkthrough. The result obtained is a flutter application to depict the localized and redesigned eSewa UI. By creating the user persona and conducting ethnographic observation on our target audience, we tested the developed UI. Multiple surveys were conducted during the development phase as well as post-development. Through all these evaluations, analyses, and survey it was found that most users were comfortable with the localized version of the application, and also incorporating design principles in the UI design greatly improved their experience. The conclusion we deduced from this research is that localization plays a great role in universal usability (although we have only implemented the app in the Nepali language for now) and using design principles to design the UI of the application greatly improves its user experience.

II. Methods and Materials

The result that we wanted to obtain was a redesigned and localized eSewa UI which solved the barrier of language between the application and all the demographics who use it and provide the users with the best user experience while using the application.

A. Survey

For achieving this result, first of all, brainstorming was needed to prepare the pre-development survey questions. This survey was conducted to know about the satisfaction of eSewa applications with the users in the current scenario and to validate our problem statement. We prepared the survey questions in English. The purpose of our research needed to include every age group of the target audience since the target audience using any sort of application 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.

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 chose this topic in the first place. The 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 app (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 into the 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 group including the older ages.

B. Digital Prototype and its Survey

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 and Schneiderman's 8 golden rules while constructing our prototype and have reflected the same thing through UI.

Fig. 1 Prototype sample of eSewa homepage

Then we surveyed our prototype. 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.

C. User Persona

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.

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

The major needs and goals of 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

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

- No localization feature in current utility applications causing the majority 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

D. Ethnography

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

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.

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.

Was he in need of localization in the application?

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

E. UI design using Flutter and Localization in Nepali

After designing and finalizing our prototype, we moved on to the UI development part. We used flutter which is a front-end framework for building an android application to mimic the eSewa UI containing localization and design enhancements. We were able to demonstrate most of the major pages where design principles were applied. We translated the English strings into Nepali through google translate and used them as localized strings. The localization we performed in a static localization where dynamic contents are not changed.

F. Donald Norman's 6 design principles

From Norman's principle, considering the visibility, we decided to change the current vertical scrolling to a horizontal one.

Then for consistency, we focused on having consistent button size, spacing, color, and font throughout the app.

Including intuitive iconography and most importantly, integrating the localization feature, we tried to enhance the affordance of the eSewa application.

Fig. 2 Consistency in button size, contrast between background and button to enhance visibility

Though the feedback portion is hard to depict through prototype, circular progress indicator, shimmer, and ripple

effect in button act as the feedback in actual UI that we developed.

To ensure the constraint principle, we added * signs for the required field in the form and also included form validation techniques. There is also the feature of terms and conditions of the application without agreeing to which users cannot go inside and use the application.

G. Schneiderman's Eight Golden Rules

Using Schneiderman's golden rules,

For offering informative feedback, we used toasts for success and error messages.

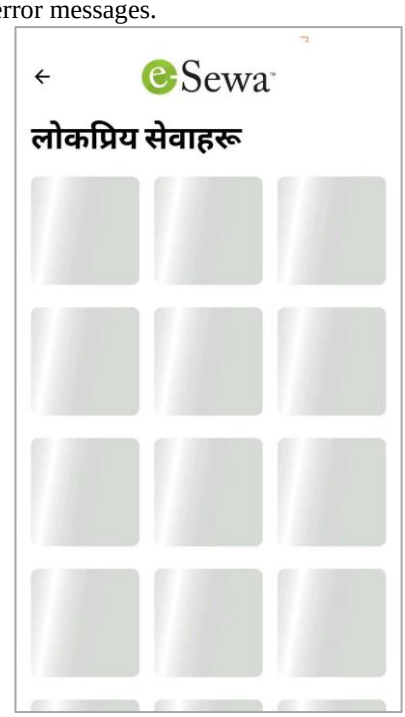

Fig. 3 Shimmer effect as feedback of content loading

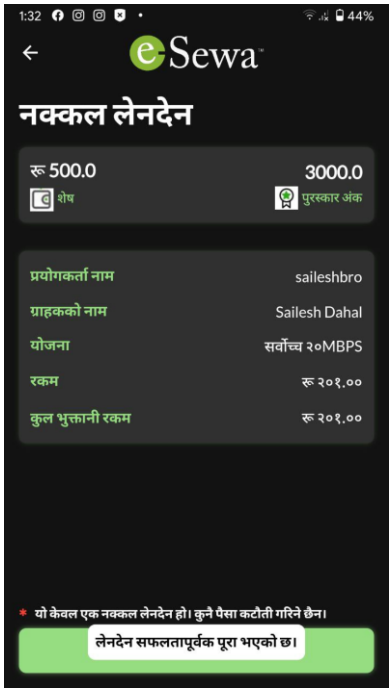

Fig. 4 Feedback on successful transaction

Also, we integrated form validation techniques to offer simple error handling.

In UI, we designed a timer-based transaction cancellation feature to permit an easy reversal of action.

To support the internal locus of control, we included theme changing and localization features which is the major part of our project.

Fig. 5 Settings page for theme changing, localization, and much more

Fig. 6 Transaction cancellation feature after clicking on start transaction

Fig. 7 Theme changing feature

To reduce the short-term memory load, a stepwise guidance feature is provided.

H. UI design survey

The UI design was followed by a 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.

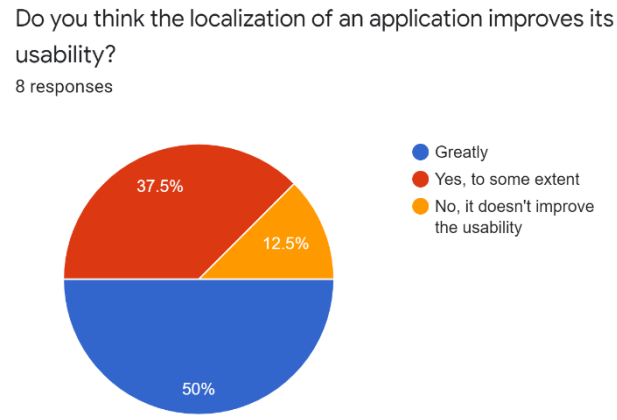

Fig. 8 Usability of the application after localizing

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.

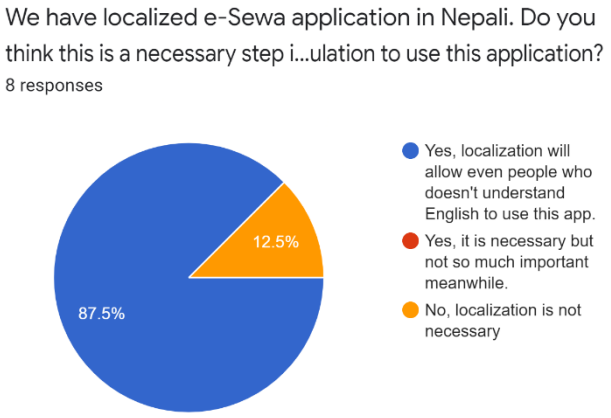

Fig. 9 Positive response on the localization of eSewa

I. Heuristic Evaluation

Finally, after analyzing the feedback from the prototype and developing UI following the design principles, we requested Mr. Mala Deep Upadhaya to conduct a Heuristic evaluation based on Jacob Neilson's heuristics [10], considering him as an expert, and conclusions were thoroughly documented.

J. Cognitive Walkthrough

After Heuristic Evaluation, 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.

III. RESULTS

A. Results from the survey

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

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

Most of them wanted only some of the apps they use to be available in their native language and other significant groups say that it doesn't impact them. We can somehow conclude from the data that there is no noteworthy opposition to the use of localization in apps.

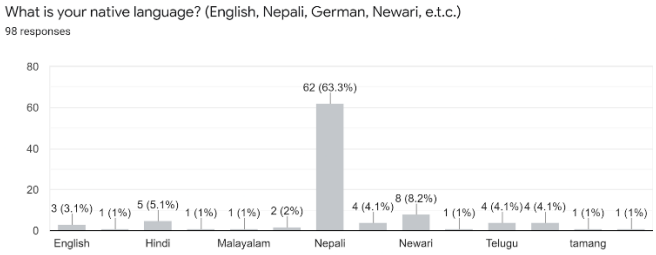

Fig. 10 Graph showing Nepali language as the most used language for communication in Nepal

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

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

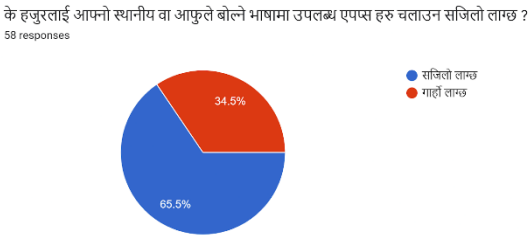

Fig. 11 Chart showing the preference of people to use apple in their native language

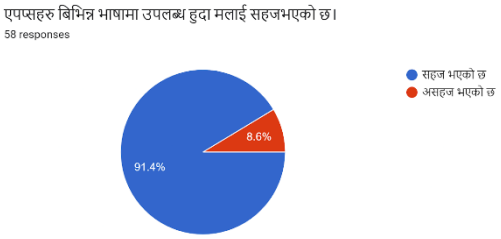

Fig. 12 Chart showing that localization makes use of app easier for most of the population

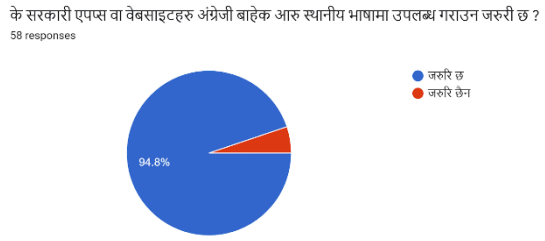

Fig. 13 Chart showing that most people prefer using governmental and utility applications in their native language

Though some contrast can be found on surveys about 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 the native language. Even this problem can be addressed by including localization features in the app.

From 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.

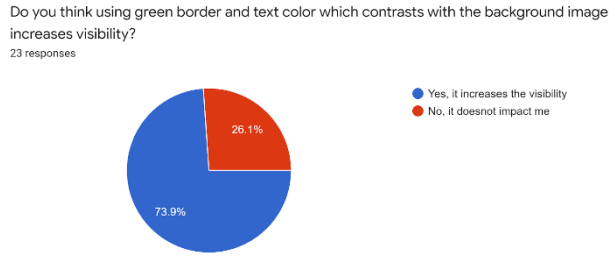

Fig. 14 Chart showing that visibility has been improved in the prototype by contrasting background image and button

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.

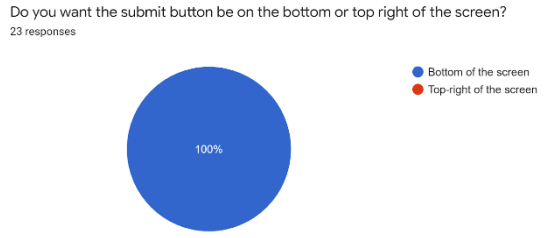

Fig. 15 Chart displaying full agreement on the placement of submit button on the bottom right of the screen to reduce thumb movement

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

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).

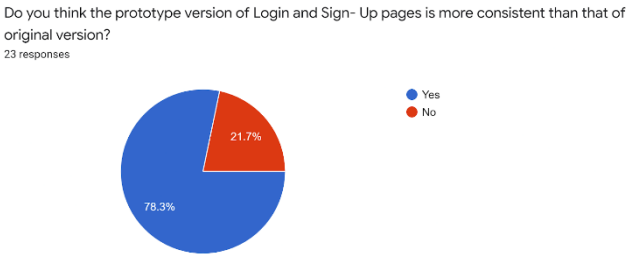

Fig. 16 Chart showing the preference of people to prototype version compared to original eSewa UI considering the consistency

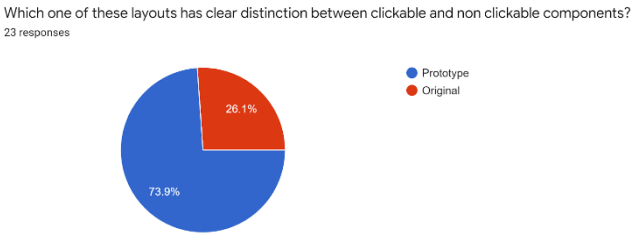

Fig. 17 Chart showing the preference of people to prototype version compared to original eSewa UI considering the clear distinction between CTAs

The responses were extremely helpful as they shaped our final thoughts on building UI and also guided us on real user needs.

B. The result from Heuristic Evaluation

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.

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. Also, there is the inclusion of intuitive iconography for referencing various characteristics.

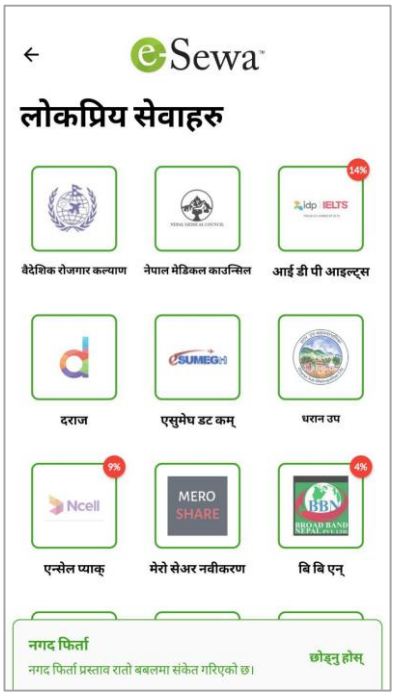

Fig. 18 Cashback displayed as a bubble to reduce extra spaces

Fig. 19 eSewa signup page using form validation and * for required field

On eSewa UI, the User control and freedom metric are 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.

For all pages, eSewa has a consistent style. Also, this role is enhanced in UI by maintaining consistency across the app in button size, spacing, color, and font.

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

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 have been incorporated in the front page of the application which can be accessed without scrolling to reduce the cognitive load.

Fig. 20 Horizontal scroll for minimizing scroll and enhancing visibility

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. 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.

Fig. 21 Implementation of localization feature

The design of eSewa UI, for the most part, is minimalistic. The arrangement of text and font sizes is also aesthetic. The design is plain and elegant, matching this application's function as a digital wallet.

C. The result from Cognitive Walkthrough

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 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.

After conducting this walkthrough, it was concluded that the user noticed correct action is available to them and associate the correct action with the outcome they expected to achieve. Also, they realized that if the correct action is performed, they can see that progress is being made towards their intended outcome.

IV. DISCUSSION

A. Main Discussion to check if our solution is innovative

The concept of localization has been in existence since the 1980s but its concept has been booming in recent years. Since the market is getting stagnant, developers are targeting their applications globally. However, in the context of our country, only a few popular apps such as Hamro Patro, Hamro Keyboard [10] 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.

B. Discussion with groups "Compatibility of speaking aid apps and their Localization" and "How dark mode affects HCI" on the first draft of our case and their summarized review

On the topic of choice and problem statement:

The problem statement is very appropriately written. The group has selected a contemporary problem. Some people 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.

From both groups, the common and noteworthy pros of our case were pointed out to be:

Provides a platform for people from different cultures to come together through a single application.

Applications will be usable for people who are not fluent in English.

Provides for better communication amongst multilingual people and serves the concept of universal usability

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.

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) and can even aid in cultural exchange.

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.

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

And then we analyzed the cons of this case suggested by those groups and came up with ways to address them

For instance, local slang and colloquialisms cannot be translated word to word which can be mitigated by avoiding vague words in an application.

If there is a loss of information and meaninglessness during translation, a dedicated team of professional translators can be put to work while developing applications.

If people are uncertain about how much localization is appropriate, and to what extent we can localize only the static content for time being as we know that it is not possible to localize all of the dynamic contents.

The impact of Localization boils down to the persona of users who use the application hence we need to provide them the option of choosing between different languages and not localize to a specific local language.

If Localization/translation using AI is not effective, AI can be trained rigorously.

C. Discussion on analysis of Ethnographic observation

Apart from expert users, people mostly use eSewa for loading/transferring, and sending money.

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.

eSewa is missing out on potential customers due to the lack of localization.

V. Conclusions

To recapitulate, the review clearly shows that localization is crucial if all demography is to be included to use the application. 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 the 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 for everyone using it. The problem that we've chosen is that of implementing localization. Also implementing design principles in UI greatly affects the user experience and is directly related to users enjoying the application more. The key points that arose from the final survey and usability testing with the participants were that they all very much preferred the new design as it was: easy to use thanks to localization, nicely presented and had good visual aspects that were clear and recognizable and the result indicated that the new design is more friendly to all kinds of user groups underlining the concept of universal usability. Their response showed that they are interested in using the redesigned app as it achieves specified goals with effectiveness, efficiency, and satisfaction in a relevant context, mainly related to the language barrier.

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