Towards Development of a Multilingual Mobile Chat Application for Enhanced Global Communication

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Abstract

The advent of mobile chat applications has revolutionized everyday communication. These applications facilitate the exchange of user's textual and multimedia content across languages and cultures. Most chat applications are known to only support a limited set of predominantly spoken languages, thereby, leaving a substantial portion of the user population without adequate multilingual support. This paper aims to bridge the linguistic gap by presenting Kobapp, a multilingual chat application. The Kobapp, leverages some of the cutting-edge technologies, such as React-Native, Next.js, and the DeepL API, to offer real-time, accurate translations while at the same time offering user privacy. The development process of the Kobapp is outlined from the system architecture and design, emphasizing the integration of a client-side (Android) and server-side using Node.js, Express.js, and MongoDB. Notably, user feedback plays a crucial role in shaping an application's features and functionality. Therefore, the application's performance was evaluated through a conducted user study. Results of the study indicate a strong positive linear relationship between overall user satisfaction and translation accuracy for different language pairs. Moreover, the absence of outliers and the model's significance further reinforces the application's commitment to data quality and accuracy. Future research will explore new dimensions in multilingual communication and applications to promote a truly global community.

Keywords: *Chat Application, Multilingual, Real-time Translation, User Privacy, User-centered Design, Community Building, Accessibility.*

I. INTRODUCTION

Mobile chat applications have evolved from the common Mobile Instant Messaging and become an essential part of our everyday communication routines [1]. With mobile chat applications such as WeChat, WhatsApp, and Telegram, users can send and receive not only text as is in the case of Short Message Services (SMS) but also share multimedia content (images, voice recordings, documents, and videos [2]. Most of these applications employ the most predominant (native) language of interaction shared by the users. While such a rigid usability design might function effectively where two or more end-to-end communicators have the same language of communication, it is not the case when they don't grasp a common language. In most instances, beneficiaries from varied nations and cultures would prefer to intermingle. Such scenarios pose a substantial research topic that has already been identified [3]. Notably, Samanta et al. [3] empirically established that language diversity imposes a barrier to message communication and further demonstrated a mechanism where users send messages. in their preferred language before the system automatically translates this to the preferred language of the recipient. The prospect of expanding the process to multimedia communications, e.g., MMS and e-mail, is also noted. Hence, the need to build multilingual apps for successful communication crossing language barriers has never been clearer.

Although chat Apps have been around for several years, the development of multilingual mobile Apps is increasing and focusing on extending multilingual functionalities. These include exploring specialized dictionaries [4][5], 3D spaces [6][7] and improving end-to-end security [8]. These developments collectively underline the increasing sophistication in emerging usage requirements to improve mobile chat services.

Moreover, majority of these applications offer support for only a handful of widely spoken languages. This limitation inadvertently excludes a substantial portion of the global population whose primary languages are not among the supported few. Therefore, it has become increasingly clear that a platform facilitating multilingual interactions to overcome the barriers is not merely a convenience but a necessity. This necessity to bridge the linguistic barrier forms the aim of developing the Kobapp. The goal of Kobapp is to facilitate seamless communication between different cultures and languages using real-time accurate translations without compromising user privacy. Figure 1 reflects images of the Kobab translation between language pairs, English and Spanish via mobile devices. This article discusses the technologies used to create this program and outlines its potential as a catalyst for global understanding.

The key contribution of the article lies in the application's ability to deliver precise, real-time translations for messages in a multitude of languages, while at the same time ensuring user privacy and data security. To achieve this vision, the design of the application leverages cutting-edge technologies, including React-Native, Next.js, and TypeScript, combined with the powerful capabilities of a third-party API, DeepL, renowned for its language translation accuracy. By allowing users to set their language preferences during profile creation, the app empowers them to communicate effortlessly and authentically.

This paper comprehensively explores every facet of the chat application, from its underlying system design and architecture to its user-friendly interface. It is imperative to emphasize that the overall goal of this work is not to replace existing chat applications but to suggest a complement with the multilingual functionality that accounts for such important usage requirements. The suggested system promises to be a catalyst for bridging linguistic gaps and fostering a global community where diverse local languages can be used and understanding can flourish.

Figure 1. Kobapp Translation Between Language Pairs

The rest of the paper is organised as follows: section II presents existing works; Section III presents the methodology including the analysis and design; Section IV discusses the testing and evaluation; Section V discusses results. Section VI concludes the paper.

II. EXISTING WORK

This section reviews previous efforts relating to chat applications. Although various applications have been developed, they mostly support only a limited number of languages. A growing trend is towards multilingual chat apps that cross language boundaries. Some notable studies exist that sought the creation of chat software [3][9][10][11][12]. However, to the best of our knowledge, most of those studies only support either a single language or a small set of languages, thereby excluding a sizable percentage of the population who do not speak any of these. Consequently, a rising number of works have now focused on creating chat applications that cut across linguistic divides. Some of those applications are domain-specific [13]. For instance, with a focus on education [14], health care [14], and service marketing [15]. In this regard, the work of Ralston et al. proposes a multilingual student support chat application that offers voice interactivity [14]. Their work leverages IBM Watson Assistant, Tone Analyzer, and Language Translator. However, the system is contextualized to only student examination stress management scenarios and not general conversation. In Carisi and Luccio [15], a customer service chat application is described. But notably, most domain-specific approaches are not able to answer patterns that don't match predefined script methods for other domains. This is because they can only tailor conversations based on predefined rules and pre-trained dataset datasets. Besides the domain-specific chat applications are retrieval-based. The work of Kedam et al. is an instance of such retrieval-based approaches [16]. In Kedam et al. an information query and retrieval chat system in the user's language of choice is presented. However, it is noted that most retrieval-based chat applications return incorrect outputs since they are based on the retrieval of data [17]. In this regard, chat applications built using deep learning mechanisms appear to have more attractive prospects [18]. This is because of their ability to combine the efficacy of both the retrieval-based models and generative models. The former relies on heuristics and semantic net to process natural language communication, while the latter estimates the most accurate response and (or) language translations without the need for a predefined repository. Therefore, it is now more important than ever to utilize a Deep learning mechanism to create the multilingual app for effective communication across language barriers.

This paper therefore presents a multilingual chat application for Android devices that offers a great user experience and facilitates communication in several languages by leveraging on the Deep learning API (DeepL). The emphasis in context will be on the application's ability to deliver precise, real-time, and accurate translations for messages in multiple languages, while at the same time ensuring user privacy and data security.

III. METHODOLOGY

The methodology used in this article encompassed a holistic approach that combined recent technological stack and rigorous development practices as detailed in this section.

A. System Architecture and Design

The architecture of "Kobapp" is composed of two key components: the client side, which caters to the mobile (Android) platform, and the server side, responsible for handling data and communication. Moreover, user feedback was incorporated throughout the development cycle using both agile and iterative development processes. A high-level architecture diagram, as illustrated in Figure 2, encapsulates the integration of the client and the server components, emphasizing the seamless flow of data and communication between the two.

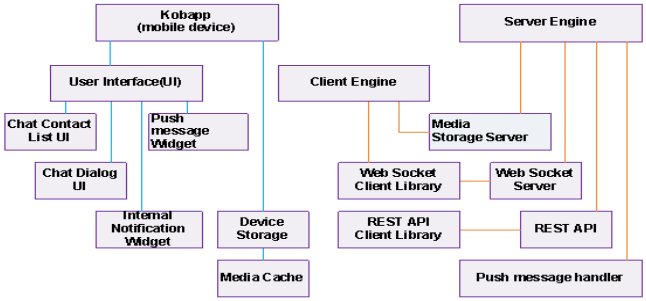

Figure 2. High-level Architecture Illustrates the Integration of the Client and the Server Components.

The client side caters to the mobile (Android) platform, and the server side is responsible for handling data and communication. The development of the former was primarily carried out using Android Studio, the official Integrated Development Environment (IDE) for Android app development. It leveraged Extensible Markup Language (XML) for user interface design, ensuring a user-friendly experience.

The server-side development of the Kobapp, on the other hand, was realized using technologies like Node.js, Express.js, socket.io, and MongoDB. Node.js facilitated server-side scripting, while Express.js allowed the creation of RESTful APIs for client-server communication. MongoDB was used as the database for efficient data storage.

B. Third-Party Integration and User Feedback

To ensure the utmost precision in language translation, we integrated the DeepL API into the backend infrastructure of "Kobapp." DeepL is renowned for its accuracy in language translation. This integration involved connecting with the DeepL translation API endpoints and handling API requests and responses, as well as implementing robust error-handling mechanisms. It is important to further emphasize the rationale for choosing DeepL over other renowned APIs that serve similar purposes. One reason is its exceptional language translation accuracy. Utilizing this third-party service ensures that Kobapp provides precise, real-time translations for messages in a multitude of languages. This accuracy is paramount to facilitating meaningful cross-cultural conversations, one of the core objectives of Kobapp. Another reason stems from DeepL's proven efficiency and speed. Real-time translations are crucial in a chat application, where users expect quick responses. By integrating DeepL, Kobapp can deliver translations without significant delays, enhancing the fluidity of conversations.

Notably, several studies (for example He et al. [19] and others [20] have validated the efficacy of integrating third-party language translation services like Google Translate to enhance functionality and user experience of chat applications Thus, the use of DeepL in Kobapp stems from those premises.

IV. TESTING AND EVALUATION

The purpose of conducting testing was to assess the app's performance functionality and overall usability in real-world scenarios. Moreover, this phase enabled us to identify potential issues, validate the system's capabilities, and ensure a high-quality user experience. To achieve this, we conducted a user study of the Kobapp app following a similar approach described in the work of Nakano & Komatani [13].

Accordingly, we remotely trained 25 raters of the app using cloud-based survey forms. Our rationale for selecting few raters is justifiable in the fact that the evaluation required a specified target audience (e.g. native speakers of the language in question). Thus recruiting 25 users within that demographic can be sufficient to get valuable insights on their experiences.

The participants were 400 Level students of Computing Department of Admiralty University of Nigeria. The participants were given access to the application on their own Android smartphones via a web browser. They were grouped into five pairs of two persons and tasked to engage in just two chat conversation sessions per day in a span of 5 days. We created test cases to check interpretation accuracies across 3 international languages namely, English, French, and Spanish. Every session commenced with a system's opening statement and consisted of 15 exchanges initiated by the system, followed by 15 exchanges initiated by the user. The final user-initiated exchange was deliberately made unclear, at which point the system declared the session to be terminated.

A pool of 10 different session topics was prepared. The first session for each user was centred around the topic of "Software Development." In the subsequent sessions, the session topics were chosen at random, ensuring that participants did not discuss the same topic in consecutive sessions.

Upon the conclusion of each session, participants hereafter referred to as 'raters' were asked to provide evaluations of the application by rating twelve aspects on a 5-point Likert scale, with options ranging from "1: strongly disagree" to "5: strongly agree" via the cloud-based survey form.

Table 1. Other Model Coefficient Including Variable Indicators

Variables Entered	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	8.767	.695		12.609	.000
1. Translation from English to French is accurate	0.056	0.033	0.185	1.666	0.112
2. The translation from French to English is accurate	-.013	0.038	-0.039	-0.344	0.735
3. The translation from English to Spanish is accurate	-0.067	0.059	-0.133	-1.138	0.269
4. The translation from French to Spanish is accurate	0.091	0.113	0.109	0.804	0.431
5. The translation from Spanish to French is accurate	-1.022	0.139	-0.937	-7.332	0.000

a. Dependent Variable: Overall, I am satisfied with the translation accuracy of this multilingual chat application

We performed multiple linear regression analysis based on the survey outcome to study three things viz. (i) Understand how the impact of multiple sets of predictors such as the accuracy of translation in different language pairs, collectively affect the dependent variable, which is overall satisfaction with the translation accuracy of the multilingual chat application. (ii) quantify the Strength of the relationship between the predictor variables and the dependent variable and understand how much of the variation in satisfaction can be attributed to the translation accuracy of different language pairs. (iii) Identify what are the significant predictors. In other words, determine which specific language pairs (predictors) have a statistically significant impact on the overall satisfaction of users. These especially the latter help us make informed decisions or improvements. Table 1 reflects the predictor variables alongside other coefficients of the model. The t-statistic of 1.666 for the first (i.e. Translation from English to French is accurate) predictor indicates that its coefficient is not significantly different from zero. Whereas the value of -7.332 for the second (i.e. The translation from Spanish to French is accurate) predictor suggests a significant difference from zero which in turn has more impact on the dependent variable.

V. RESULTS AND DISCUSSION

It is understood that the presence of outliers could have a negative effect on correlation coefficients. A single outlier can inflate or deflate the correlation, so it's important to check for outliers when interpreting correlation results.

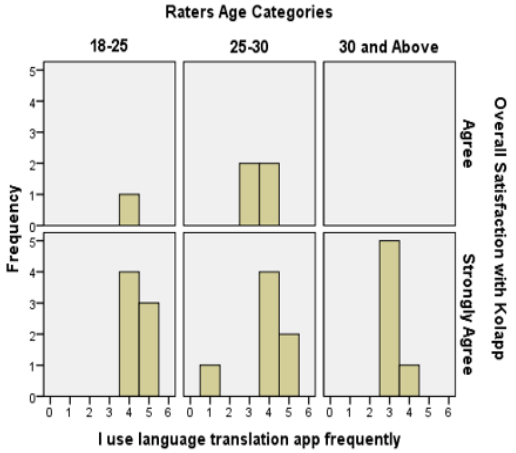

Figure 3. A Check for Possible Outliers

Figure 3 reflects a histogram representing the frequency of observation across age groups for two important variables: frequency of usage of language translation apps and overall satisfaction. A review of the histogram shows no data points appearing far from the bulk of the data, suggesting no possibility of extreme outliers.

Table 2. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.899[a]	0.808	0.758	0.201

a=Predictors-(Constant), The translation between two language pair is accurate.

In Table 2, the R = 0.899 indicates a strong positive linear relationship between the dependent variable (i.e., user's overall satisfaction with the translation accuracy of the Kolap application) and all the predictor variables together (i.e. which is the question, 'translation between any two language pair is accurate).

Table 3. ANOVA: Model Overall Significance and Fitting on Data

Model		Sum of Squares	Degree of freedom	Mean Square	F	Sig.
1	Regression	3.232	5	0.646	15.996	0.000[b]
	Residual	0.768	19	0.040	-	-
	Total	4.000	24	-	-	-

The list of predictor variables includes, the translation from Spanish to French is accurate," "Translation from English to French is accurate," "The translation from English to Spanish is accurate," "The translation from French to English is accurate," and "The translation from French to Spanish is accurate". With notably high R Square = 0.808, further implies approximately 80.8% of the variance in the overall satisfaction with the app's translation accuracy can be explained by the defined predictor variables. In other words, the predictors

collectively explain a significant portion of the variance in satisfaction. The Anova Table 3 provides information about the overall significance of our model and how well it fits the data. The low p-value (Sig = 0.000) which is associated with the F-statistic suggests that our model is indeed significant. This also suggests that at least one of the predictor variables is strongly related to overall satisfaction with the translation accuracy. This finding further affirms our previous assertion in Table 1, where the high R-squared value (0.808) implies the model explains a substantial portion of the variance in the dependent variable Which in turn provides us with valuable insights into the relationship between the accuracy of translation in different language pairs and overall satisfaction with the multilingual chat application's translation accuracy.

VI. CONCLUSION

With the recent growing demand for human interaction more than ever, the importance of effective global communication in any context cannot be emphasized. The multilingual chat applications are built out of the vision to transcend linguistic barriers and perhaps foster understanding among diverse cultures. In this regard, our team embarked on the Kobapp project which marks a a significant step toward bridging the linguistic gaps and further enhancing global communication. As the results have reflected, Kobapp is poised to play a pivotal role in this endeavor. The technical efforts involved and underpinned by cutting-edge technologies and robust design offer a distinctive user experience. This is evident in the applications' prioritization of precision, real-time translations, and data security.

The user study was conducted with meticulous attention to these prioritized usage requirements. This is to underscore the importance of user feedback and thorough testing in creating such a vital application. The positive feedback received as reflected in the robust user satisfaction ratings validates our approach. In particular, the application's strong positive linear relationship with user satisfaction and the significant portion of variance explained by the predictor variables underscores the practicality and effectiveness of "Kobapp." The absence of outliers and the model's overall significance affirm our commitment to data quality and application accuracy.

Nevertheless, it is imperative to emphasize that our goal is not to replace existing chat applications or offer a substitute application but to complement them. Notably, the Kobapp introduces multilingual functionality which arguably is an essential usage requirement to enhance any global communication.

Certainly, the journey does not end here as we envision a world where diverse local languages can flourish, and understanding can thrive, as facilitated by our application. In the realm of future research direction, we look further to enhance the application, explore new dimensions or usage requirement requirements in multilingual communication, and revamp new applications that promote a truly global community.

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