

Bangla Texting on Smartphones: Exploring the Challenges Faced by Users of the Bangla Keyboard

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Abstract: Bangla has a rich typographic tradition and an extensive vocabulary. With the advent of modern information technology, it has become essential for both the spoken and written forms of a language to be easily adaptable to modern media, particularly online platforms. The present study examines the core user challenges associated with Bangla keyboard layouts and identifies the underlying factors contributing to these challenges. Furthermore, the study proposes potential avenues for innovation and optimisation for future research. Employing a qualitative research design, data was collected through a survey of 235 university students enrolled in undergraduate-level Bangla courses, as well as interviews with 20 instructors teaching said courses. The findings indicate that, despite multiple efforts to optimise Bangla keyboards and their layouts for smartphones, a considerable gap remains between keyboard developers and users. Based on these findings, the study recommends further exploration of areas for improvement, particularly in layout optimisation and methods for using special characters.

Keywords: Bangla texting, Keyboard, Fonts, Layouts, Smartphones and users.

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1. Introduction

Bangla is a language with deep cultural roots and linguistic richness, reflected in its diverse scripts and extensive vocabulary. In the 1980s, users first started using Bijoy software, which was based on the ASCII system, for typing Bangla. However, even today, we do not have a decent Bangla font comparable to those in other languages. Haq & Sarkar (2003) claimed Bangla's modernity as one of four thousand languages globally, emphasising its non-Latin complex script, ranking it seventh in terms of the number of speakers worldwide. In the context of its broader usage, Sikder (2014) mentioned that over 300 million people speak Bangla globally.

However, with the advent of modern information technology, it is an absolute necessity for the spoken and written forms of a language to be easily adoptable in modern medias, specifically on online platforms. This implies a dependable input media for not only the professionals but also the mass population.

We can identify two variations of the primary input mode, keyboard adopted in both professional and mass populations, namely-

- i. Keyboards on a Personal Computer
- ii. Keyboards on a Handheld Device (i.e. – Smartphones)

Optimising the functionality of the two keyboards and their accompanying layouts have been a problematic challenge for developers.

While there have been multiple efforts in the front of optimising a Bangla keyboard and their layouts for both computers and smartphones for effectiveness, there remains a lot of problems between the developers of said existing keyboards and the users of said keyboards. In fact, brief research reveals that there have also been efforts in using advanced data mining and machine learning approaches for keyboard layout optimisation based on

keystrokes. Yet, there exists no qualitative or quantitative research into why such optimisation is necessary and what the challenges faced by mass users actually are in using a Bangla keyboard.

Without proper insight into what the challenges faced by said users are, it can definitively be stated that no progressive innovation can be achieved in the creation or optimisation of a universally standard Bangla keyboard.

2. Background

Aktar (2023) scrutinised selected fonts, taking into account aesthetic considerations and comparing font sizes. The analysis revealed anomalies in Bangla conjuncts and ligatures across different chosen fonts. Some of the anomalies of Unicode-based Kalpurush font are as following:

- ‘.’ of ‘o& o& py’ cannot be recognised because of opacity
- ‘ঐ ঋ ঋ’ is problematic in terms of aesthetic view.
- The typefaces of ‘ঐ ঐ’ are challenging to identify.

on the other hand, anomalies of ASCII based fonts have been discussed including font size comparison in different fonts.

Chandra, S. (2021) mentioned in his article regarding the display issues of the Indian typeface on display screen; the technical challenges including hinting, glyph positioning and substitution have been explained. Most importantly, he discussed that the anatomical nomenclature and grid system are the primary deficiency in the design process that hinders the quality font production. According to Chaudhuri, S., Ghosh, D. (2015), the Bengali alphabet and script, indicating the special problems they create for electronic fonts. Bengali vowels are usually not written in full, but indicated by vowel markers attached to the consonants. These vowel markers phonetically follow the consonant but are sometimes written before, above or under it. Most crucially, two or more letters can be combined in a single

conjunct glyph, which may look very different from its constituent letters, and also vary from font to font in traditional print. These factors make the Bengali keyboard more cumbersome than the Roman. A work by Xavier Molinero, et.al. (2024) has revealed that on defining three typeface legibility indices from the judgements of a group of 31 observers. Those indices are based on statistics, confusion matrices, and power indices from game theory. Most importantly, the complexities of the Bengali script make Optical Character Recognition a virtually impossible proposition when dealing with such a wide range of material in so many print fonts, not to mention manuscript. They apply them to three commonly used typefaces (Roboto, Helvetica and Georgia), and to a new one developed for the authors (Optotipica 5 v2022). Their findings are:

- For each typeface, three highly consistent legibility metrics were defined.
- Three legibility metrics were obtained from the judgements of a cohort of observers.
- Helvetica scores the highest uppercase legibility among the considered typefaces.
- Optotipica scores the highest lowercase legibility among the considered typefaces.
- Helvetica exhibits similar high legibility metrics across both lowercase and uppercase.

Ross, F. G. E. (1988) discussed that the text faces comprise the bulk of composing matter and thus have always formed the chief requirement of printers. However, it will be seen that a number of Bengali heading types influenced the design of text faces. Conversely, the advent of computerised typesetting in the 1970s and the dearth of non-Latin24 display fonts have also encouraged the use of text faces for heading or display purposes.

Often, consonant conjuncts are not actually pronounced as would be implied by the pronunciation of the individual components. For example, adding ল lô underneath শ shô in Bengali creates the conjunct শ্ল, which is not pronounced shlô but slô in Bengali. Many conjuncts represent Sanskrit sounds that were lost centuries before modern Bengali was ever spoken as in ভ্র. It is a combination of জ jô and ঞ ñô but it is not pronounced "jñô" or "jnô". Instead, it is pronounced ggô in modern Bengali. Thus, as conjuncts often represent (combinations of) sounds that cannot be easily understood from the components, the following descriptions are concerned only with the construction of the conjunct, and not the resulting pronunciation. The types are as follows:

- i) Fused forms; Examples: ক্ + য → ক্‌য (as in দীক্‌য); ক্ + ত → ক্‌ত (as in ভক্‌ত)
- ii) Approximated forms; Examples: র্ + য → র্য
- iii) Compressed forms; Examples: দ্ব, দ্বা, ঙ্গ
- iv) Abbreviated forms; Examples: Handwritten ঞ, ন, ত often lose a stroke or loop; In stylised fonts, অ may appear as a simple curve (without full structure); Abbreviated conjuncts like simplified জ্, দ্ব, or ত্র in logos or art fonts
- v) Variant forms; Examples: ড় vs ড, ঢ় vs ঢ (retroflex variants); য় vs য (yô vs yô-phôla)
- vi) Exceptions, Examples: র-ফলা behaves differently depending on position (reph above or trailing); ৎ (tô) used only in word-final positions (সৎ, যত্ন).

5. Diacritics and other symbols

সংশোধক বর্ণ <i>sôngshodhôk bôrnô</i>		
Symbol/Graphemes	Name	Romanisation
ৎ	খণ্ড ত <i>khôndô tô</i>	t
s	অনুস্বার <i>ônusshar</i>	ng
t	বিসর্গ <i>bishôrgô</i>	h
u	চন্দ্রবিন্দু	ñ
&	হসন্ত <i>hôshôntô</i>	—
ং	অবগ্রহ <i>ôbôgrôhô</i>	-
”	যফলা <i>jôphôla</i>	ê / yô
«	রফলা <i>rôphôla</i>	r
K©	রেফ <i>ref/reph</i>	r
&e	বফলা	-
ঐ	ঈশ্বর <i>ishshôr</i>	—
?	আঞ্জী/সিদ্ধিরস্তু <i>anji /siddhirôstu</i>	—

6. Bangla Keyboards

Keyboards are essential for communicating with others via different platforms. There are many keyboard layout options for Android, Windows, and iOS platforms. Some of the popular keyboards in use today is as follows:

6.1 Android Keyboards

Android released a various selection of keyboards. Some of keyboards are as follows:

- i. G-board: Google developed G-board; it supports multiple languages. Both phonetic transliteration and traditional Bangla keyboard layouts are available in this platform. It has features like voice typing, text prediction, and customisation options.
- ii. Avro Keyboard: This is one of the most popular keyboards for young generation. Both phonetic transliteration and traditional Bangla keyboard layouts are available in this platform. Avro's autocorrect options and customisation features make it a user-friendly option for users.
- iii. Bijoy Keyboard: It only uses traditional keyboard. Latest version added features like UniBijoy.
- iv. Ridmik Keyboard: It has features like phonetic transliteration. It also has options like emoji support, customisation, and easy language shifting.

6.2 Windows Keyboards

In Windows platform, we have a selection of Bangla keyboards released for both professional and casual type:

- i. Avro Keyboard for Windows: It has same features as Android platforms
- ii. Bijoy Keyboard for Windows: It is based on ANSI or ASCII format. Professional typist prefers Bijoy keyboard.

6.3 iOS Keyboards

Various Bangla keyboards are available for this platform, released to work seamlessly with Apple products:

- i. G-board for iOS: Along with voice typing and customisation, it has same features like Android platform
- ii. Avro Keyboard for iOS: It has same features like Android platform.
- iii. Bijoy Keyboard for iOS: It is traditional software based on ASCII or ANSI

7. Methodology

This study conducted through mixed method. The aim of this study to scrutinise the challenges of the keyboard users on smartphones. Purposes of the study are:

- i. To identify core user challenges faced in the usage of a variety of keyboard layouts
- ii. To identify the core issues causing the challenges for the users
- iii. To extract possible innovation and optimisation avenues for future studies

7.1 Data Collection Methods

Employing a mixed method research design, a random sample of 235 students and 20 instructors from a reputed university was selected for the data collection. The students are aged between 21 -24 years old, have a handheld device (smartphone) and has considerable exposure to using online media. All teacher participated in this study teaches Bangla. A random sample of participants were assigned a task of typing Bangla words on their own device using existing “Bangla Keyboards”. The participants were free of choice to figure out their own preference of Keyboard and were urged to complete the task in both “English to Bangla” layout and “Bangla to Bangla” layout. They had freedom to seek guide or instruction online, i.e. – troubleshoot any usage issue they had themselves and to complete a survey questionnaire. In addition, interviews were conducted to explore the challenges they encountered. After finishing the task, the participants were asked to complete a qualitative survey of a generalised questionnaire. The questionnaire was drafted in order to simply root out the first-hand challenges faced by the random sample and ways they think the existing keyboards might be improved.

7.2 Data Analysis Methods

After the data has been categorically sorted by entry in the fields of Gender, Device Type, The Bangla Keyboard utilised, The Layout preferred, Challenges faces and Suggested Actions; we quantise the challenges and suggestions of the participants by assigning a count to all the categories of problems and suggestion faced.

The most commonly faced challenges are listed in the following nine categories:

- i. Hoshonto Usage
- ii. Conjunct Usage
- iii. Modified Vowel Sign Usage
- iv. Phonetic to Word Intuition
- v. Special Character Usage
- vi. Predictive Text Inaccuracy
- vii. Shifting Layouts
- viii. Finding Bangla Letters
- ix. Time Issue
- x. Layout Arrangement Issue

The most commonly suggested changes are listed in the nine following categories:

- i. Practice
- ii. Predictive Text
- iii. Voice Assistant
- iv. Special Char, Conjuncts & Vowels
- v. E2B Optimisation
- vi. B2B Optimisation
- vii. Layout Optimisation
- viii. Standardisation

8. Data presentation and Analysis

The total number of participating students was 235. Their reported challenges and corresponding recommendations are presented in Table 1. A comparative analysis between male and female students concerning the challenges they faced and their feedback is illustrated in Table 2.

Table 1. Challenges and corresponding recommendations are presented

Gender	Phone Brand-Model	Keyboard	Layout Preferred	Challenges Faced 1	Challenges Faced 2	Challenges Faced 3	Challenges Faced 4	Challenges Faced 5	Suggestions 1	Suggestions 2	Suggestions 3	Suggestions 4	Suggestions 5
Male	Samsung Galaxy S21	Ridmik	English to Bangla	Finding words are challenging	Bangla letters are similar in sound, so finding similar English letters are difficult	Typing Conjunctions was difficult	Specific Combination of english letters for respective bangla letter in Bangla is not intuitive	N/A	Make the Bangla to Bangla Layout more user Friendly	N/A	N/A	N/A	N/A
Female	Iphone 14 Pro Max	Ridmik + Gboard	Bangla to Bangla	রক্ষা, া রেফ - Usage was difficult	Problem writing া, ি, ি, ি from English	Had to use space after া, to prevent conjunctions from forming	া, ি cannot be written directly	Problems writing conjunction letters	া, ি, ি, ি and other conjunctions should be there separately in the keyboard	Can't write a word without using space	For English to bangla, া, ি becomes the same.	N/A	N/A
Male	Google Pixel 6	Ridmik	English to Bangla	The adjoint alphabets are difficult to write	The writing process feels inefficient	There are no default guides to spell certain alphabets	Typing requires use of 2 or 3 multiple keyboards	To write a custom word, you need to give space and then write. Then again press backspace	A guide can be can be incorporated to easily write complicated settings	Some practice games can be introduced to help new writers learn fast and effectively.	N/A	N/A	N/A
Female	Iphone 14 Pro	Built In	Both	Conjunctions are difficult to type	When I am typing the sound of a letter, I do not find the exact sound in letters when using English to Bangla.	Different keyboards use different rules to find a certain word	N/A	N/A	The keyboard should have all conjunctions ready like the letters on special keys	All types of keyboard should use same rules to find a certain word	N/A	N/A	N/A
Male	Iphone 13 Pro	Apple	English to Bangla	If we do not press after া then it becomes conjunction words	Because of not being familiar with bangali keyboards.	I faced difficulty in typing in case of Bangla to Bangla keyboard	N/A	N/A	We should practice more in Bangla Keyboard to get habituated with it.	N/A	N/A	N/A	N/A
Male	Iphone 11	Ridmik	English to Bangla	If space is not used after া, it becomes a Conjunction word.	When typing, sometimes the letter is correct and sometimes it comes out wrong	N/A	N/A	N/A	All bangla keyboards should be brought under the same format	N/A	N/A	N/A	N/A

Male	Samsung A22	Ridmik	English to Bangla	If takes time to type Bangla in my phone	N/A	N/A	N/A	N/A	Regular practice can solve the problem	N/A	N/A	N/A	N/A
Female	Vivo Y51	Ridmik	English to Bangla	I cannot type such bangali word and symbol in the Keyboard	I have facing of typing some extra spacing after pasting a copied article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Male	Samsung AS1kkl	Ridmik	Bangla to Bangla	কোথায় where I thought it was কোথায়	Everytime when every two words has to be together like কোথায়	Time Consuming	N/A	N/A	This sign ূ has to be the same	N/A	N/A	N/A	N/A

Gender	Phone Brand-Model	Keyboard	Layout Preferred	Challenges Faced 1	Challenges Faced 2	Challenges Faced 3	Challenges Faced 4	Challenges Faced 5	Suggestions 1	Suggestions 2	Suggestions 3	Suggestions 4	Suggestions 5
Male	Samsung Galaxy S21	Ridmik	English to Bangla	Finding words are challenging	Bangla letters are similar in sound, so finding similar English letters are difficult	Typing Conjunctions was difficult	Specific Combination of english letters for respective bangla letter in Bangla is not intuitive	N/A	Make the Bangla to Bangla Layout more user Friendly	N/A	N/A	N/A	N/A
Female	Iphone 14 Pro Max	Ridmik + Gboard	Bangla to Bangla	কিভাবে, ূ, ূূ - Usage was difficult	Problem writing ূ, ূ from English	Had to use space after ূ to prevent conjunctions from forming	ূ, ূ cannot be written directly	Problems writing conjunction letters	ূ, ূ, ূ and other conjunctions should be there separately in the keyboard	Cant write a word without using space ূ	For English to bangla, ূ, ূ becomes the same.	N/A	N/A
Male	Google Pixel 6	Ridmik	English to Bangla	The adjoint alphabets are difficult to write	The writing process feels inefficient	There are no default guides to spell certain alphabets	Typing requires use of 2 or 3 multiple keyboards	To write a custom wor, you need to give space and then write. Then again press backspace	A guide can be can be incorporated to easily write complicated settings	Some practice games can be introduced to help new writers learn fast and effectively.	N/A	N/A	N/A
Female	Iphone 14 Pro	Built in	Both	Conjunctions are difficult to type	When I am typing the sound of a letter, I do not find the exact sound in letters when using English to Bangla.	Different keyboards use different rules to find a certain word	N/A	N/A	The keyboard should have all conjunctions ready like the letters on special keys	All types of keyboard should use same rules to find a certain word	N/A	N/A	N/A
Male	Iphone 13 Pro	Apple	English to Bangla	If we do not press after ূ then it becomes conjunction words	Because of not being familiar with bangali keyboards.	I faced difficulty in typing in case of Bangla to Bangla keyboard	N/A	N/A	We should practice more in Bangla Keyboard to get habituated with it.	N/A	N/A	N/A	N/A
Male	Iphone 11	Ridmik	English to Bangla	If space is not used after ূ, it becomes a Conjunction word.	When typing, sometimes the letter is correct and sometimes it comes out wrong	N/A	N/A	N/A	All bangla keyboards should be brought under the same format	N/A	N/A	N/A	N/A

Male	Samsung A22	Ridmik	English to Bangla	If takes time to type Bangla in my phone	N/A	N/A	N/A	N/A	Regular practice can solve the problem	N/A	N/A	N/A	N/A
Female	Vivo Y51	Ridmik	English to Bangla	I cannot type such bengali word and symbol in the Keyboard	I have facing of typing some extra spacing after pasting a copied article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Male	Samsung A51kkk	Ridmik	Bangla to Bangla	কু+কু+কু where I thought it was কু+থ	Everytime when every two words has to be together like কু+থ	Time Consuming	N/A	N/A	This sign কু has to be the same	N/A	N/A	N/A	N/A

Table 2: A comparative analysis between male and female students concerning the challenges they faced and their feedback

Entry	Gender	Hoshonto Issue	Conjunct Issue	Modified Vowel Sign Issue	E2B: Phonetic to Word Issue	E2B: Special Character Issue	Predictive Text Issue	Shifting Layout Issue	Finding Letters	Time Issue	Layout Issue	Practice	Predictive Text	Voice Assistant	Special Char, Conjuncts & Vowels	E2B Optimisation	B2B Optimisation	Layout Optimisation	Standardisation	Hoshonto
1	Male			1		1							1		1					
2	Male					1			1											
3	Female					1						1								
4	Female					1						1								
5	Male											1			1					
6	Female		1	1					1	1										
7	Male					1												1		
8	Female		1						1	1					1			1		
9	Female	1	1	1						1	1	1			1			1		
10	Male	1	1				1		1	1	1		1		1			1		
11	Male		1		1				1								1			
12	Female	1	1	1		1			1						1					
13	Male	1	1		1			1	1	1		1	1							
14	Female	1			1			1			1				1			1	1	
15	Male	1	1						1			1								
16	Male	1	1		1	1			1										1	
17	Male									1		1								
18	Female		1	1		1														
19	Male	1	1							1										1
20	Male		1	1					1		1		1		1			1	1	
21	Female	1			1										1		1			1
22	Female							1	1		1	1	1							
23	Male			1	1													1	1	
24	Female																			
25	Female		1	1									1		1	1				
26	Female					1						1								

27	Male				1													1	1	1	1	
28	Female			1		1																
29	Male							1	1			1	1			1	1	1				
30	Male	1																				1
31	Female				1	1																
32	Male		1	1												1			1			
33	Male	1				1										1						
34	Female	1																				1
35	Male		1				1	1								1	1					
36	Male	1	1			1										1						
37	Male	1	1										1				1					
38	Female	1	1	1	1	1						1				1						
39	Female							1	1	1	1											1
40	Male	1				1	1				1	1	1						1	1		
41	Male	1	1			1					1			1	1		1			1		1
42	Male		1	1			1		1													
43	Female		1			1			1				1				1		1			
44	Female												1									
45	Female		1			1				1				1			1			1		
46	Male		1			1	1				1				1				1	1	1	

From table 1 we see that a total of nine participants—five males and four females—shared detailed feedback on their experiences with Bangla typing. The male participants used various Android devices such as Samsung Galaxy S21, Samsung A22, Samsung A51, and Google Pixel 6, as well as iPhone 11 and iPhone 13 Pro, while female participants used iPhone 14 Pro, iPhone 14 Pro Max, and Vivo Y51. Most participants used Ridmik Keyboard, while others also used Gboard, built-in keyboards, or Apple's default system. In terms of layout preference, the majority preferred English to Bangla phonetic typing, though a few expressed a preference for Bangla-to-Bangla layouts or switching between both depending on the situation. Among the most frequently reported challenges were difficulty typing conjunct letters, confusion with phonetic mapping (English letters to Bangla sounds), and issues with special characters like রেফ, র-ফলা, and হসন্ত. Some participants noted that if space is not used after the hoshonto (্), conjuncts are unintentionally formed, while others highlighted that certain Bangla vowels (e.g., ও, ঔ, ঊ) are

hard to produce accurately from English letters. Participants also claimed regarding the inconsistencies across different keyboard layouts; input method for a character or the same sound varies depending on the layout. A few mentioned that Bangla typing is time-consuming due to repetitive layout switching or using workaround methods, for instance, backspacing or inserting spaces. Participants recommended making Bangla keyboard more user-friendly; there must be proper guidelines or training tools including practice games and applying a standard in keyboard layout. Other participants commented that using conjuncts and other special characters should be input directly on the keyboard; word prediction options should be improved. One participant recognised that practicing Bangla typing regularly will increase the capability of typing. From Table 2, we can see that participants suggested some improvement in the Bangla typing system while using English-to-Bangla layout. Participants claimed significant challenges in English-to-Bangla or Bangla-to-English input methods. 14 participants highlighted challenges using ‘hasanta’. Another major concern was conjunct formation (e.g., ক্, ঞ্, ঞ্). Over 20 users reported another major concern that is conjunct formation (e.g., ক্, ঞ্, ঞ্). More than 10 participants faced challenges regarding modified vowel sign difficulties (for example – ি, ি, ি, ি, ি, ি). Users reported challenges with phonetic mapping in English-to-Bangla layouts, where the phonetic input did not intuitively lead to expected Bangla word formation. Several participants mentioned problems with predictive text suggestions while inputting complex conjuncts or less frequent words. Also, we found that challenges with layout switching, finding specific letters, and understanding the conjuncts or ligatures. A few participants noted that practicing and familiarity improved their skills in typing, while others reported to improve optimisation and the need for standardisation across

keyboard layouts. Some of them claimed to add voice assistants and improvements in layout optimisation for reducing valuable time.

The total participants as instructed was 20. The following table provides the problems and recommendations of instructors.

Issue/Feedback	Number of Participants	Details
Problem typing "খ-ফলা"	3	1 iPhone user, 2 Android users
Problem with conjuncts (যুক্তাক্ষর)	1	Suggested using images of conjuncts to improve typing speed
Typing results in irregular letters or unexpected space	1	Irregular outputs while typing
Aesthetic view is problematic	2	Found the visual appearance unsatisfactory
Need for a decent Bangla layout	1	Requested better layout design
No problems reported	12	Majority had no typing issues

9. Findings

The following figure illustrates the most frequently reported challenges faced by users-

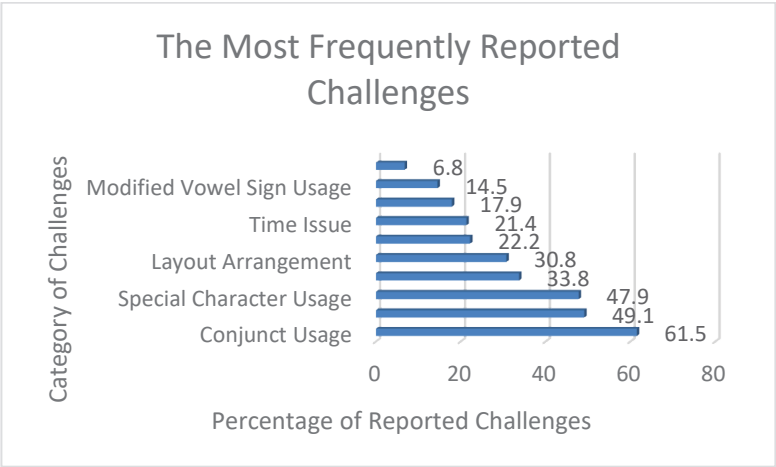


Figure 1: The most frequently reported challenges faced by users.

The aforementioned figure shows the major challenges users face while using Bangla keyboard layouts. 61.5% users faced challenges in the usage of conjuncts properly. On the other hand, 49.1% reported hasanta using challenges and (47.9%) claimed for special character usage. Additionally, struggling with searching Bangla letters (33.8%), while issues related to layout switches are reported by 30.8%. Many other challenges:

- phonetic to word formation (22.2%)
- time consumption (21.4%)
- shifting across layouts (17.9%)
- modified vowel sign challenges (14.5%)

Only 6.8% of users mentioned regarding predictive inaccurate text suggestions. These findings lead us to make the Bangla input system user-friendly. As a result, more participants show interest in typing Bangla on smartphones.

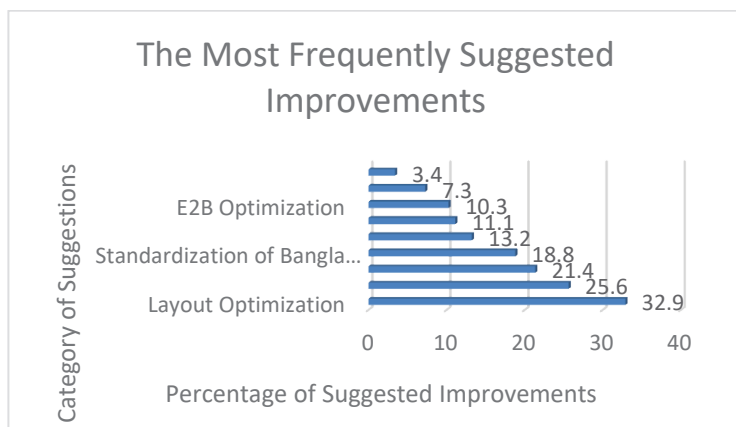


Figure 2: The most frequently suggested improvements by users.

The figure 2 illustrates the user's recommendation for the improvement of Bangla input method system Predictive text suggestion (11.1%). English to Bangla keyboard optimisation (10.3%). A few participants highlighted 'hasanta' usage improvement (7.3%) and added a feature like voice assistant (3.4%). These findings indicate that participants are not only concerned for technical issues but also, they recommend to reform Bangla keyboard layout according to user expectations that satisfy for typing Bangla with comfort.

Suggestions by users: 32.9% of users demand decent and accessible keyboard layouts development (32.9%). Usage practice (25.6%) is significant claimed 25.6%. Improvement is must for special character, conjunct, and vowel sign (21.4%). Other major suggestions: We need a standardisation of Bangla keyboard (18.8%). Bangla to Bangla indecent optimisation (13.2%).

The pie chart below clearly mentions that the number of Android users is 61.11%, while the number of Apple (iOS) users is 38.89%. The different percentages prioritise the compatibility issue and proper optimisation for Android platforms. Also, there must be significant support for Apple devices to address the users' demand.

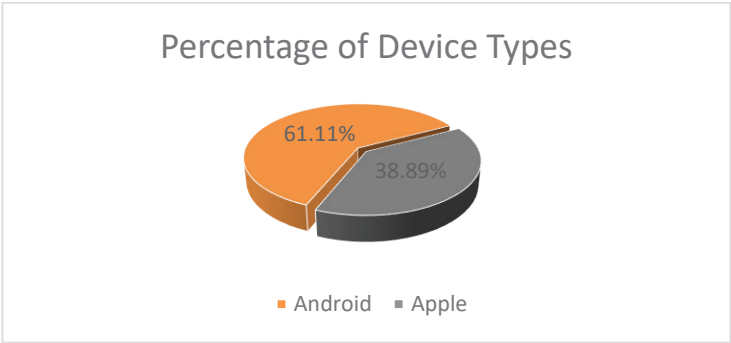


Figure 3: Android users vs Apple users based on challenges face while typing

10. Discussion

The findings indicate a holistic view of the challenges and user demands regarding Bangla input system. A highest number of participants (61.8%) claimed ‘Conjunct, Hasanta uses’ is a major challenging area due to lack of poor optimisation and it effect on efficient Bangla typing. The lack of Bangla Orthographic representation is another barrier. For Hasanta usages reported by 49.1% participants. Rendering challenges should be addressed to increase the Bangla typing skill with comfort. Also, locating Bangla letters across layouts lays more time consuming (33.8%) and 30.8% raised points on issues with keyboard layout. It suggests the encoding problems in the interface development of Bangla input system. These causes to take more time for typing Bangla, increased cognitive stress and to less attention of the user. Linguistic complexities and encoding solution are inadequately assured by the developers as participants claimed. Challenges include phonetic-word conversion (22.2%), slower speed of typing (24.6%), layout switching (17.9%) and modified vowel sign issues (14.5%). There should be an optimisation for predictive text suggestions (6.8%). Reformation is significant according to users’ expectations. The highest percentage (32.9%) demands layout optimisation. 25.6% is

for usage practice and handling special symbols, conjuncts, vowel signs modified vowel signs (21.4%). Participants suggested to improve both users' education and system-level bug fixation.

Recommendations include standardisation (18.8%), Bangla to Bangla layout and English to Bangla layout optimisation at (13.2%) and 10.3% respectively and participants showed interest in multifaceted features of the issues include predictive text improvement, technical design and linguistic accuracy (11.1%). Furthermore, insights from qualitative approach based on instructors' feedback lead to make rationale context. Several participants found challenges using Ja-falla (যফলা) and one user suggested to incorporate visual image (e.g., images of conjuncts) to value in typing efficiency.

Other feedbacks include aesthetic concerns of Bangla fonts and irregular text output, underlining the strong significance of interface compatibility and consistency in function. A significant number of participants claimed no challenges, rather they focused on individual skills in typing, device type and software version. The data also shows 61.11% users type using Android platform while 38.89% users use iOS platform. These findings lead to developing or updating the software across different platforms, with a prioritised importance on Android platform optimisation based on its larger users. However, settlement should also be addressed for iOS users while using devices for Bangla texting. Overall, there is an urgent need to update software versions on a regular basis, more funding is necessary for the betterment of the typing software, experts should implement standardisation for keyboard layouts, encode fonts accurately, consider aesthetic issues, and compatibility issues across platforms. These areas need to be solved on an urgent basis for the improvement of typing experience and contribution to larger platforms.

11. Conclusion

The demand for Bangla typing is increasing significantly. However, because of the lack of decent keyboard layouts, it is challenging to type Bangla with comfort. Developers must check the compatibility issues while developing keyboard layouts across all digital platforms. A decent font is a must to speed up the typing. Re-examination is needed to define user-friendly typing—should it be based on frequency or optimal across-based approach to develop layout designs. We need font technologies and standardisation of keyboard layouts for Bangla typing. Additionally, it is important to regularly update the software versions for maintaining long-term compatibility issues. There are examples of launching user-centric layouts such as Chinese, Japanese, and Arabic. It is a high time that we develop a user-friendly keyboard for Bangla typing.

12. Endnote

A sample of the questionnaire follows:

- Personal Information:
- Device Brand Name:
- Keyboard Used:
- Which layout did you select using – Bangla to Bangla, or English to Bangla?
- What challenges have you faced while typing Bangla on your device? (List 5 at most)
- Do you have any suggestions to overcome the challenges you have faced? (List 5 at most)

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