

Analysis of Gujarati script consonants and their features and bring all consonants under “Perfect single consonant form” and create maximum similar features matching and nearby tone harmony pairs.

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Abstract: Indian languages have common 8 class/series of consonants. Each class has defined number of consonants mostly based on phonetic nearby resemblance and the arrangement is also in defined manner. Each language has defined number of vowels. Each vowel has its own sign/s. Only Vowel –A – has no sign. Each consonant and sub form is with built in –A – vowel. Gujarati consonants, vowels, vowels sign have typical acoustic sound in pronunciation. In other words, each consonant has typical sound of pronunciation. Same is the case with each vowel. When consonant clubbed with vowel sign it is pronounced in different way. Similarly, consonants with sub form and vowel sign they are pronounced differently than its main consonant pronunciation. Each vowel sign has different sound level of pronunciation. Few vowels are short tone and few are with long tone. Each language has different sound pattern level pronunciation. Each language has consonants with defined structure/features and same for vowels and vowels signs. Uniform height of consonants and vowels is good for the script.

Key Words: Consonant features, sub forms, vowels features, signs, Head– stroke.

1. INTRODUCTION:

Gujarati is one of the most widely spoken Indian languages. It is a regional language of India. It is the official language in the state of Gujarat. Gurjars were the ancestor of modern Gujarati and Rajasthani. Script was further refined to bring consonants of nearby height and width. Gujarati script looks like Marathi, Hindi and other few languages scripts. It has close similarities with Sanskrit also. Current Gujarati script is one of the best Indic scripts. It appears similar to Devanagari script. However, it is clearer than Devanagari script. In Devanagari each character/consonant is joined with Head– stroke. Gujarati character/consonant and vowels are without Head– stroke and each consonant exhibits its full features. Same is the case with Gujarati vowels.

Gujarati script has 8 class/series of consonants. Each class has defined number of consonants mostly based on phonetic nearby resemblance and the arrangement is also in defined manner. Well-defined 36 consonants, 16 vowels and vowels signs are in Gujarati script. Most of the consonants are with their sub forms. Sub forms can be grouped as BBL –below the base level, ABL– above base level and ABH– above the head of the consonant. Out of 16 vowels, 13 vowels have their signs. Out of 13 vowels signs – 6 are long tone and 5 are short tone signs. Vowel –A – has no sign. Each consonant and sub form is with built in –A – vowel.

Devanagari/Marathi and Gujarati Consonants and script given below are for comparison

Compare

Devanagari/Marathi consonants with Head– stroke

Devanagari/Marathi consonants

KA KHA GA GHA NGA CH CHA JA JHA NYA TTA TTHA DDA DDHA NNA TA THA DA DHA NA
क ख ग घ ङ च छ ज झ ञ ट ठ ड ढ ण त थ द ध न
PA PHA BA BHA MA YA RA LA VA SHA SSA SA HA LLA KSHA GNVA
प फ ब भ म य र ल व श ष स ह ळ क्ष ञ

Fig. 1

- Each consonant with Head– stroke and Head– stroke length is not uniform

Gujarati consonants

Gujarati consonants

| | | | | | | | | | | | | | | | | | | | |
|----|-----|----|-----|-----|----|-----|----|-----|-----|-----|------|-----|------|------|------|-----|----|-----|----|
| KA | KHA | GA | GHA | NGA | CH | CHA | JA | JHA | NYA | TTA | TTHA | DDA | DDHA | NNA | TA | THA | DA | DHA | NA |
| ક | ખ | ગ | ઘ | ઙ | ચ | છ | જ | ઝ | ઞ | ટ | ઠ | ડ | ઢ | ણ | ત | થ | દ | ધ | ન |
| PA | PHA | BA | BHA | MA | YA | RA | LA | VA | SHA | SSA | SA | HA | LLA | KSHA | GNYA | | | | |
| પ | ફ | બ | ભ | મ | ય | ર | લ | વ | શ | ષ | સ | હ | ળ | ક્ષ | ઙ્ઞ | | | | |

Fig. 2

- Gujarati consonant depict full features.
- Many consonants with sideward extended base.
- No Head— stroke.

Compare

Devanagari/Marathi script examples

Marathi script example

झाडावर बसलेला माकड हे सगळं बघत असतो. तो विचार करतो की ही चांगली संधी आहे, मी आता वाघाकडे जातो आणि या कुल्याची हुशारी उघडतो. अशाने मी वाघाचा मित्त होईन आणि जीवनभर वाघापासून माझ्या जीवाचा धोकाही टळेल. असा विचार करून तो वाघाचा मागे जातो.

Fig. 3

Gujarati script examples

Gujarati script example

સોનેરી હંસ આપણા માટે એક વરદાન બનીને આવ્યો છે પણ, જો એ આપણને પીંછા આપવાનું બંધ કરી દે તો? કે પછી એ આ સરોવર છોડીને બીજે રહેવા જતો રહે તો? ના રે ના, મારે ફરીથી ગરીબ બનીને નથી જીવવું. મને લાગે છે કે હવે સમય આવી ગયો છે કે, આપણે જલ્દીથી હંસનાં બધા જ સોનેરી પીંછા લઇ લેવા જોઈએ.

Fig. 4

Gujarati – Astavarga consonants

Astavarga - consonants

| Varga | Consonants | Varga | Consonants |
|-------|-----------------------|-------|------------------|
| | KA KHA GA GHA NGA | | PA PHA BA BHA MA |
| KA | ક ખ ગ ઘ ઙ | PA | પ ફ બ ભ મ |
| | CH CHA JA JHA NYA | | YA RA LA VA |
| CH | ચ છ જ ઝ ઞ | YA | ય ર લ વ |
| | TTA TTHA DDA DDHA NNA | | SHA SSA SA HA |
| TTA | ટ ઠ ડ ઢ ણ | SA | શ ષ સ હ |
| | TA THA DA DHA NA | | LLA KSHA GNYA |
| TA | ત થ દ ધ ન | LLA | ળ ક્ષ ઙ્ઞ |

Fig. 5

2. ANALYSIS: Analysis is based on the following

Consonants and their features

- “Perfect single consonant form” – consonants
- Consonant pairs
- Sub forms
 - ABL– above and below base level of consonant
 - BBL– below base level of consonant
- Placement position of sub forms
 - ABL– above and below base level of consonant
 - BBL– below base level of consonant
- Vowels, Vowels signs, Placement of vowels signs and Halant

Consonants and their features

- “Perfect single consonant form” – consonants

"Perfect single consonant form" - consonants - class wise wise

| Class/ Varga | Consonants | | | | | Class/ Varga | Consonants | | | |
|-----------------|------------|------|-----|------|-----|-----------------|------------|-----|-----|----|
| | KA | KHA | GA | GHA | NGA | | PA | BA | BHA | MA |
| KA | क | ख | ग | घ | ङ | PA | प | ब | भ | म |
| | CH | CHA | JA | JHA | NYA | | YA | RA | LA | VA |
| CH | च | छ | ज | झ | ञ | YA | य | र | ल | व |
| | TTA | TTHA | DDA | DDHA | NNA | | SHA | SSA | SA | HA |
| TTA | ट | ठ | ड | ढ | ण | SA | श | ष | स | ह |
| | TA | THA | DA | DHA | NA | | LLA | | | |
| TA | त | थ | द | ध | न | LLA | ल | | | |

Fig. 6

- 33 consonants fall under “Perfect single consonant form” , uniform height
- “Single consonant form” – consonants

"Single consonant form" - consonants

| | | |
|-----|------|------|
| PHA | KSHA | GNYA |
| फ | क्ष | ण्य |

Fig. 7

- 3 consonants fall under “Single consonant form”, height more than “Perfect single consonant form”
- Consonant pairs – nearby tone harmony pairs – no similar matching features

Neaby tone harmony consonants - pairs

| | | | | | | | | | | | | | | | | | |
|----|-----|----|-----|-----|------|-----|------|----|-----|----|-----|----|-----|----|-----|-----|-----|
| KA | KHA | GA | GHA | TTA | TTHA | DDA | DDHA | CH | CHA | JA | JHA | PA | PHA | BA | BHA | SHA | SSA |
| क | ख | ग | घ | ट | ठ | ड | ढ | च | छ | ज | झ | प | फ | ब | भ | श | ष |

Fig. 8

- In each pair consonants features do not match.
- Scope to create similar features matching and nearby tone harmony pairs for easier learning.

Other consonants

Tra Shra
 त्र श्र

Fig. 9

Similar features consonants – 90% matching

Similar features 90%

| | | | | | | | | | |
|----|-----|-----|----|----|----|----|----|-----|-----|
| KA | PHA | KHA | BA | CH | YA | LA | VA | GHA | DHA |
| क | फ | ख | ब | च | य | ल | व | घ | ध |

Fig. 10

Height difference

Height difference PA PHA KSHA
 प फ क्ष Height

Fig. 11

Width difference

Width difference NNA न्न
 NA न

Fig. 12

- Sub forms
 - ABL – above base level of consonant

Sub form above consonant base level

प फ ख ब च छ ज झ ञ ट ठ ड ढ ढ़ म
 थ द ध ढ़ ङ ङ़ ञ़ ण ण़ य़ प्र ष ष़ व़ श़ ष़ ष़ ष़

Fig. 13

- All sub forms are clubbed with the consonant above the consonant base level
- AHL – above consonant head level

Sub form above consonant head level

र क् ष् ग् घ् ङ् य् छ् ज् ञ् ट् ठ् ड् ढ् ष् त् थ्
 द् ध् न् प् फ् ब् ल् म् य् र् ल् व् श् ष् स् ष्

Fig. 14

- Typical pronunciation only ra sub forms above the consonant head level.

- Sub form – Halant stroke – \ – below consonant base level

Sub form - stroke \ below consonant base level

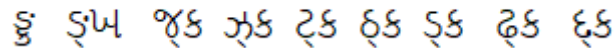


Fig. 15

- Typical short pronunciation Halant stroke – \ – below consonant base level.

Vowels

Gujarati vowels

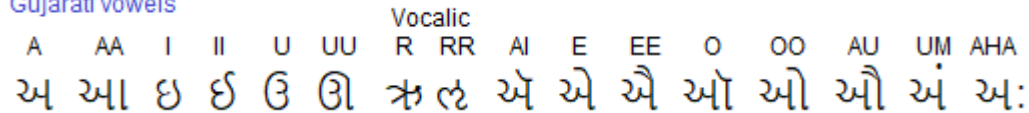


Fig. 16

- Gujarati vowel depict full features
- Many vowels with sideward extended base
- No Head— stroke

Vowels height groups

Vowels - Height groups

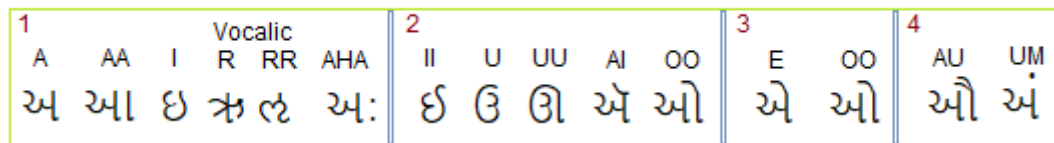


Fig. 17

- Scope to reduce number of groups.
- “Perfect single vowel form” – vowels.

“Perfect single vowel form” - vowels

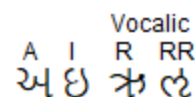


Fig. 18

- 4 “perfect single vowel form” vowels.
- Uniform height and nearby width.

Vowels signs

Vowels - signs

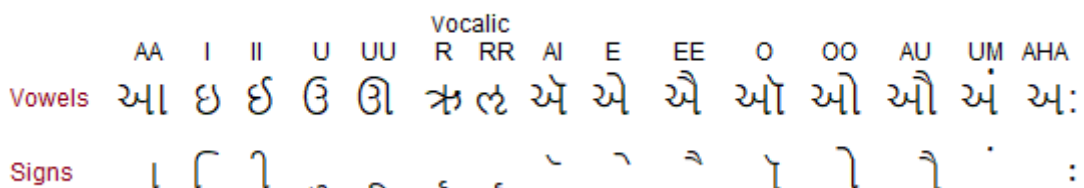


Fig. 19

- Scope to bring I, II, AI, E, EE, O, OO and AU at uniform height.

- Placement of vowels signs

Position placement - vowels - signs

AA I II U UU VR AI E EE O OO AU UM AHA
ना नि नी नु नू नृ ने ने नै नो नो नौ नं नः

Fig. 20

Height levels – vowels signs

Height levels - vowels - signs

AA I II U UU VR AI E EE O OO AU UM AHA
ना नि नी नु नू नृ ने ने नै नो नो नौ नं नः

Fig. 21

- Halant

Typical semi half tone pronunciation (the implicit vowel) of the consonant - Halant stroke – ँ –

ॐ

Fig. 22

A brief summary

Consonant

- 3 consonants fall under “Single consonant form”.
- 33 consonants come under “Perfect single consonant form”.
- 10 similar 90% matching features consonants .
- 3 consonants height is more than other consonants.
- NNA consonant width is more than others.

Sub forms

- Position placement of most of the sub forms are above the base level of the consonants.
- Few below the base level of the consonants.

Vowels

- 3 vowels height groups.

Vowels – signs

- Height level varies of vowels signs place over the consonants.
- Uniform base level of vowels signs placed below consonant base level.

Position placement of vowels signs

- Height level varies of vowels signs place over the consonants.
- Uniform base level of vowels signs placed below consonant base level.

Halant – Halant stroke – ँ – below the base level of the consonant

Based on analysis – Modifications/substitutes:

Consonants

Eliminating extra base extension

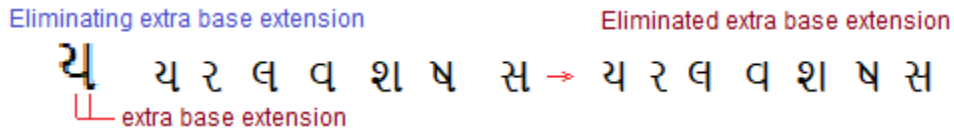


Fig. 23

- Eliminating extra base extension is good even for print

Uniform height



Fig. 24

Eliminating projections



Fig. 25

Modified and substitute consonants

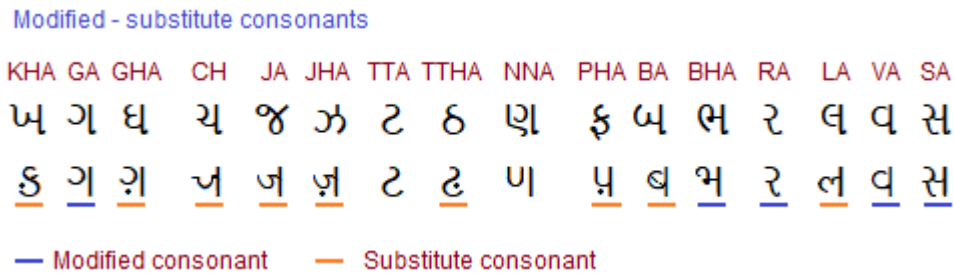


Fig. 26

- Consonants slightly.
- Substitute consonants are good for the script, easy to read write.

Consonant pairs

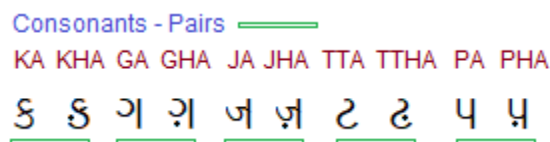


Fig. 27

- Pairs – similar features matching and nearby tone harmony Pairs good for easier learning and read write.
- Each consonant is independent and will not clash with any other consonant or vowel.

Modified vowels

Modified vowels –

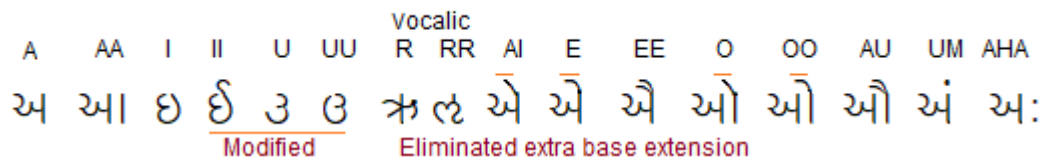


Fig. 28

- Uniform height of –II, AI, E, EE, O, OO, AU and Um – vowels
- Uniform height of – A, AA, I, U, UU, VR, VRR and AHA – vowels
- Slightly modified – II, U and II – vowels

Vowels - height levels

Vowels - height levels

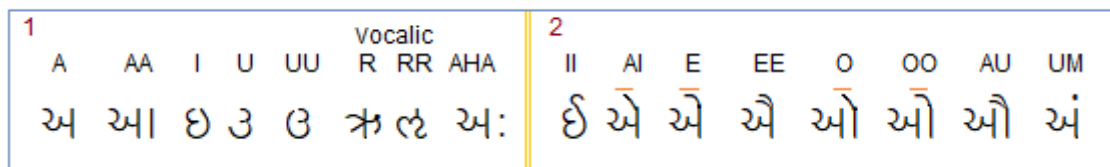


Fig. 29

- 2 height levels of vowels

“Perfect single vowel form” – vowels = 5

“Perfect single vowel form” - vowels

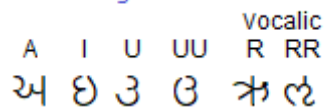


Fig. 30

Modified vowels – signs

Modified vowels - signs

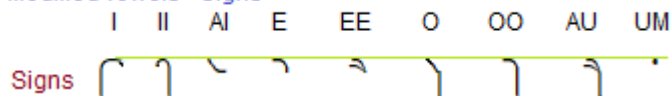


Fig. 31

- Uniform top level

Note:

- Sub forms need no modifications/substitute’.
- Position placement of sub forms remains unchanged.
- Position placement of vowels signs remains unchanged – Fig. 20.
- Position placement of Halant stroke – ँ – remains unchanged.
- Halant stroke – ँ – not modified.
- Vowels signs below the base of the consonant remain unchanged.
- Other signs remain unchanged.
- Special consonants – Tra – and – Shra – remain the same.

Eliminated consonants forms

Eliminated consonants - forms

KHA CH JA JHA TTHA NNA PHA BA LA
ખ ચ જ ઝ ઠ ડા ફ બ લ

Fig. 32

New Astavarga – consonants

New Astavarga - consonants

| Varga | Consonants | Varga | Consonants |
|-------|-----------------------|-------|------------------|
| | KA KHA GA GHA NGA | | PA PHA BA BHA MA |
| KA | ક ક્ ગ ગ્ ઙ | PA | પ પ્ બ ભ મ |
| | CH CHA JA JHA NYA | | YA RA LA VA |
| CH | ચ છ જ જ્ ઝ | YA | ય ર લ વ |
| | TTA TTHA DDA DDHA NNA | | SHA SSA SA HA |
| TTA | ટ ઠ ડ ઢ ણ | SA | શ ષ સ હ |
| | TA THA DA DHA NA | | LLA KSHA GNYA |
| TA | ત થ દ ધ ન | LLA | ળ ક્ષ ઙ્ઘ |

Fig. 33

3. SUMMARY:

Consonants

- Modified/substitute consonants – Fig. 26
- Similar matching features and nearby tone harmony consonants pairs – Fig. 27 – before none
- All consonants come under “Perfect single consonant form”
- Eliminated 9 consonants forms – Fig. 32
- New Astavarga – consonants – Fig. 33

Vowels and signs

- Modified vowels – Fig. 28
- Vowels height groups – Fig. 29
- “Perfect single vowel form” – vowels – Fig. 30
- Modified vowels – signs – Fig. 31

Script – based on new Astavarga

Script-

સોનેરી હંસ આપણા માટે એક વરદાન બનીને આવ્યો છે પણ, જો એ આપણને પીંછા આપવાનું બંધ કરી દે તો? કે પછી એ આ સરોવર છોડીને બીજે રહેવા જતો રહે તો? ના રે ના, મારે કરીથી ગરીબ બનીને નથી જીવવું. મને લાગે છે કે હવે સમય આવી ગયો છે કે, આપણે જલ્દીથી હંસના બધા જ સોનેરી પીંછા લઇ લેવા જોઈએ.”

Fig. 34

Substitute consonants – Read

Substitute consonants – વાંચો

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| KHA | GHA | CH | JA | JHA | TTHA | NNA | PHA | BA | LA |
| ક (ખ) | ગ (ઘ) | ચ (ઞ) | જ (ઝ) | ઞ (ઝ) | ટ (ઠ) | ન (ણ) | પ (ફ) | બ (ભ) | લ (લ) |

Fig. 35

4. CONCLUSION:

Gujarati script is one the best form among Indic script. It looks clear exhibiting full features of each consonant. However, many consonants have similarity (Fig.10) with other consonants but they cannot form pairs. More number of similar features matching and nearby tone harmony pairs are essential of easier learning, read and write. Procedure yielded eliminating 9 consonants forms (Fig. 32). Few consonants have been slightly modified and some are with substitute. Substitute consonants to current consonants forms are shown in Fig. 35. It also yielded 5 similar features matching and nearby tone harmony pairs which is very good for the script. All consonants now come under “Perfect single consonant form” which uniform height and nearby width. Sub for LA will be in accordance with the substitute LA.

Vowels height groups is reduced from 3 to 2. All vowels sign placed above consonants, both short tone and long tone sign have uniform top level including UM sign (Anusvara). This is an advantage to the script and will add beauty to the script.

New Astavarga – consonants look nice and can be adapted. Modified vowels and signs are good to adapt. Script with modified, substitute consonants and modified vowels signs is very clear to look. This is an asset for the script. It will assist to develop further efficient Optical character recognition (OCR) software. New Unicode to be defined for modified and substitute consonants. Unicode may be necessary for all sub forms. Standardization of Gujarati fonts is also equally important.

5. RECOMMENDATIONS:

- New Astavarga – consonants look nice and can be adapted for the Gujarati script.
- Modified vowels signs are good for the script and can be adapted.
- Eliminated base extension of each consonant and vowel add beauty to the print script and can be adapted.
- More number of similar features matching and nearby tone harmony can be adapted for easier learning, read and write.
- Standardization of Gujarati Regular, Bold and Italic fonts must be taken up for uniformity and adaptability even for text book printing and Web application.
- Gujarati typing keyboard and software can be taken up.
- More efficient OCR (Optical character recognition) software can be developed.

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