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"Analysis of multi-level Telugu Script, feature of consonant, sub forms, vowels, vowels signs, Halant, position placement and spacing of various forms and the scope to eliminate complexity levels for easier learning, read write and print"

Sushilkumar Nidamarthy
Director, Lampex Electronics Ltd., Hyderabad, India
Email - cdtsmart@yandex.com

Abstract: *Most of Indian languages are with consonants secondary forms (Sub forms), some Symbolic sub forms and also vowels signs. With position placement of vowels and their signs and sub forms Telugu language script becomes multi-level. Consonants with vowels sign are at varied levels and sub forms with symbolic sub forms levels and consonants and vowels features/shapes with extensions change the level in the script. Height of consonants and vowels also differs. Some are with sideward extended consonants and vowels. Few consonants have extensions below the base line/level. Similar features also found in few vowels. All contribute to the complexity levels in the script.*

Key Words: *Written language, consonants and vowels, Perfect single consonant form, Perfect single vowel form, single consonant form, single vowel form, Sub forms, Vowel signs.*

1. INTRODUCTION:

Every written language has a set of letters in a series to represent the basic set of speech sounds. These alphabets of sound are referred as characters or the consonants. In most of the languages these consonants when arranged in one line, there will be minimum 2 levels, top level and below the base level of consonants. Most of Indic languages alphabets/characters of sound have defined consonants and the vowels groups. Each group can be classified under "Perfect single consonant form" and "Single consonant form" groups. There are sub groups under each. Similar forms can be grouped to Telugu consonants and vowels. Each such group can be divided into sub groups. English alphabets of sound are also grouped as characters and vowels. Hereinafter all English alphabets will be referred as characters. English characters examples are given below for understanding the current work.

English characters have two series – groups – Upper case and Lower case

Lower case characters – **a b c d e f g h i j t p q y** –

Figure 1

- "a" – Head/top level – 1
- Above head level – Level 2 "t" and Level 3 height differs
- Below the base level – Level 4 – "g, j, p, q, y"

Beauty of English is with 2 levels including vowels – (barring "t") and no sub forms (sub forms) and conjunct characters. All 26 upper case (Capital) characters A to Z fall under "Perfect single character form" – (uniform top and base levels) If words from other languages like French, Spanish, etc. used levels may change.

Lower case characters are grouped into two

- "Perfect single character form"
  - Same top and base level – a, c, e, m, n, o, r, s, u, v, w, x, z

- "Single character form" – same height sub groups
  - With upward extension – b, d, f, h, i, k and l
  - With below base level extension (below base level) – g, j, p, q and y
  - Character "t" does not fit in above groups

"Perfect matching pairs"

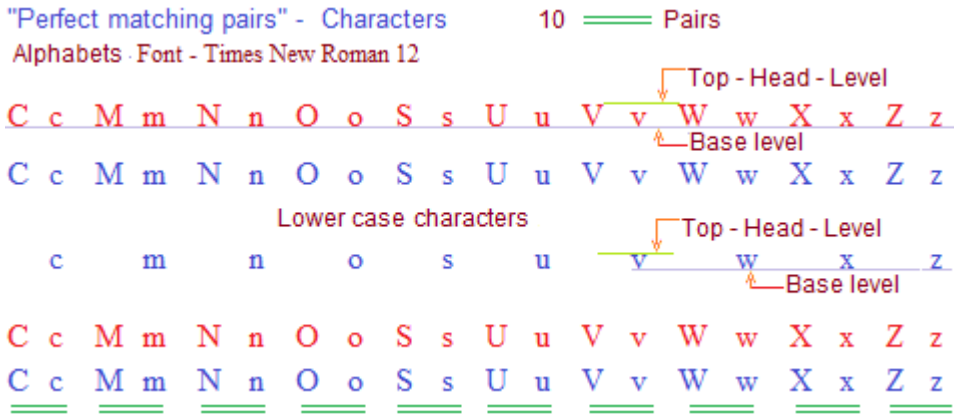

Figure 2

- 10 pairs (20 characters)
- Lower case 'u' has small projection at the base side

Other matching pairs = 2

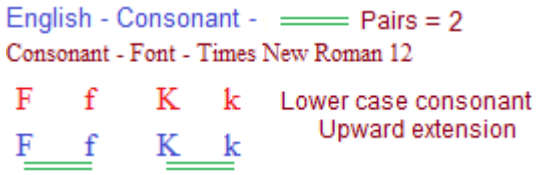

Figure 3

- Lower case c characters with upward extension – pairs
- Same height and base level, width differs

Note: Remaining characters do not fit in any above groups

2. DEVANAGARI SCRIPT:

Devanagari script is an ancient India script. In Devanagari all consonants "Single consonant form". Two consonants are pulled longer below, and that becomes level 1 below the base line of consonants. However, top level of consonants is uniform. As mentioned above Indic languages have defined groups of consonants and vowels. Each vowel has defined sign. Position placement of these vowels signs in Devanagari is uniform to all consonants. Indic scripts differ within the region. Marathi and Hindi have similarity to Devanagari script. Every letter has horizontal line across top/head called Shir rekha – Shir means Head and rekha is line. This horizontal line runs across the text. Devanagari script is with symmetrical rounded shapes within squared outlines.

Telugu and other south Indian characters are symmetrical rounded shapes.

Devanagari script

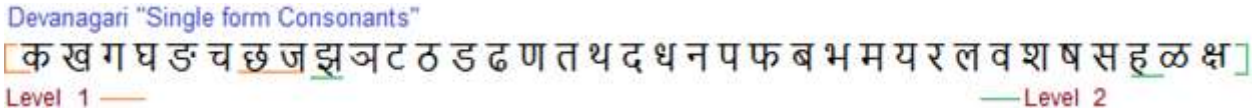

Figure 4

- All consonants with uniform top level
- Only 2 consonants with below base level extension

Most of Indian languages have common 8 series of consonants. Vowels, consonant sub forms and vowel signs are defined for each language. Telugu language is with 36 consonants and 16 vowels. Most of the consonants are with

their sub forms. Out of 16 vowels, 13 vowels have their signs. Out of 13 vowels signs – 6 are long tone and 5 are short tone signs. With position placement of vowels signs, consonants and their sub forms Telugu language script becomes multi-level. Consonants with vowels sign are also at varied levels. Consonants, consonants sub forms including symbolic sub forms with vowels signs change the levels in the script. Height of consonants and vowels also differ. Some are with sideward extended consonants and vowels. Few consonants have extensions below the base line/level and their height is more than other 27 consonants. Out of 36 consonants 27 are with Head–stroke (75%). Height of Head–stroke consonants is more than other consonants. Levels above the head–level of the consonant and also sub forms below the base contribute to the complexity levels in the Telugu script. *Devanagari, Kannada and many other Indic are one level script whereas Telugu script is multi-level.* Devanagari script is much simpler than other scripts. Such multi-level complexity levels in Telugu script have not been reported earlier. Telugu Researches and Pundits and even specially constituted Language Institutes have not been able to report nor analysed these aspects. In this regard, there has never been a serious effort to standardize Telugu fonts. Telugu OCR (Optical Character Recognition) might not have attained desired success level due to complex variable levels and less open space.

Systematic analysis is required to trace out the factors contributing to multi-level complexity in the script. Type and style of Font also plays an import role. Feasibility to eliminate consonants forms–features and their sub forms (secondary consonants) and to modify/substitute the consonants, their sub forms is carried out in this work. It is also feasible to create similar matching features with nearby tone harmony consonants pairs and also sub forms pairs. Besides, Head–stroke can be eliminated to bring all consonants with uniform height like Devanagari consonants. Modification may be required to few consonants, sub forms and vowels. It is also required to modify/substitute vowels and their signs and define position placement of each sign to every consonant. Secondary consonant form (sub form) both above and below base level of consonant (ABL) and below base level (BBL) and their position placement require to be re-worked out in details including spacing. Possibilities of inducting more symbolic sub forms with modify/substitute these forms below the base level of the consonants will be also worked out. All these may bring down multi-level complexity and nullify uneven levels. Current work is restricted to Telugu script.

3. ANALYSIS:

Multi-level complexity creates ups and downs in the Telugu script. Shape/features of consonants are also affected and the script loses its beauty due to uneven levels. It may be due to font also. Spacing between consonants and below level sub form is very serious issue. Similarly height of consonant also varies. Different type of extensions also increases the width of consonants. Position placement of vowels signs is also causing some issues. Height of sub forms below and above base level of consonants is also not uniform.

First step is to see current issues with conventional methods followed with current fonts. Before going into details of analysis, following illustrations are given to understand the multi-level complexity.

Note:

Nirmala UI Semilight font is used in all illustration, unless otherwise specified. Illustrations (Figures) are TIFF/PNG format.

Script examples – compare

1. Marathi

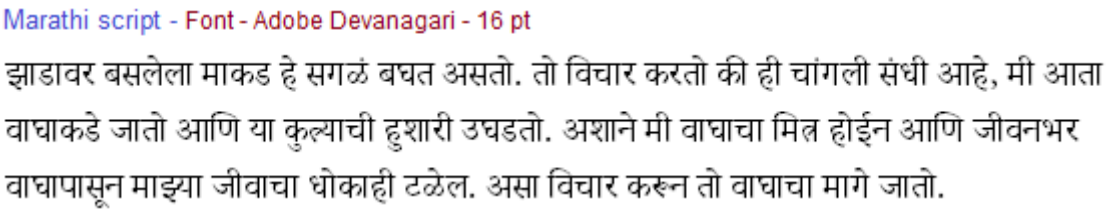

Figure 5

2. Kannada

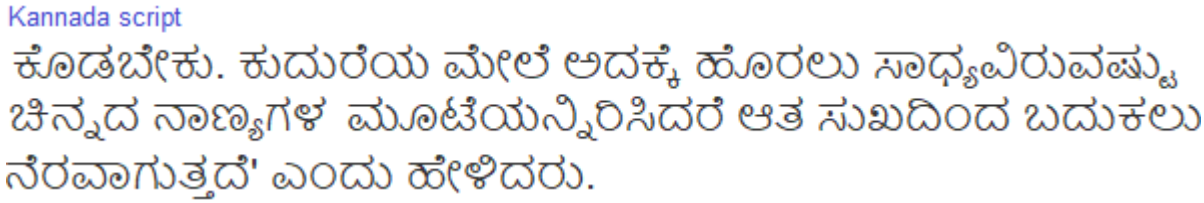

Figure 6

3. Gujarati

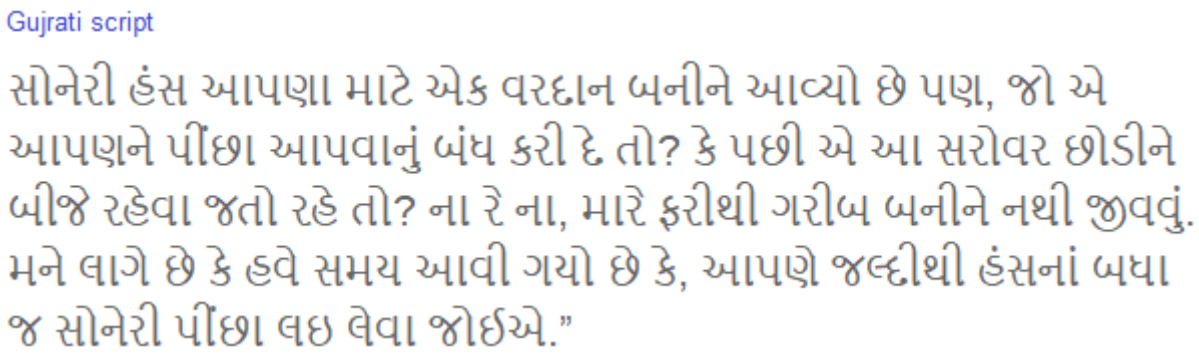

Figure 7

4. Tamil

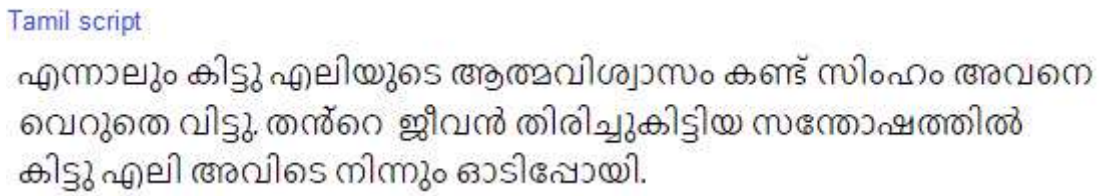

Figure 8

5. Telugu

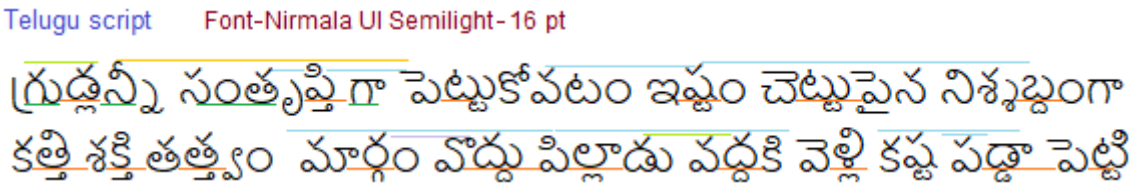

Figure 9

- Uniform top level – Only one top level in all above languages – Marathi, Kannada, Gujarati and Tamil scripts
- Top multi–levels complexity in Telugu scripts only

Script levels –Telugu script multi–levels – Compare

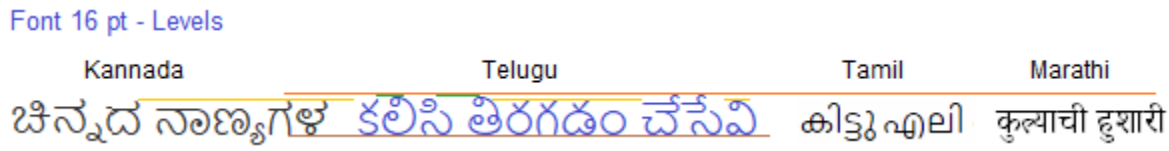

Figure 10

Example – Telugu script multi–levels

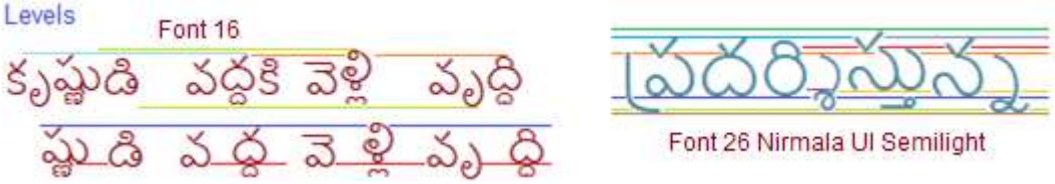

Figure 11

- Font above 10pt more glaring level difference
- Characters with sub form – level shift of consonant due to sub forms position placement
- No uniformity of base level of consonants
- Uneven levels due to vowels signs and other factors

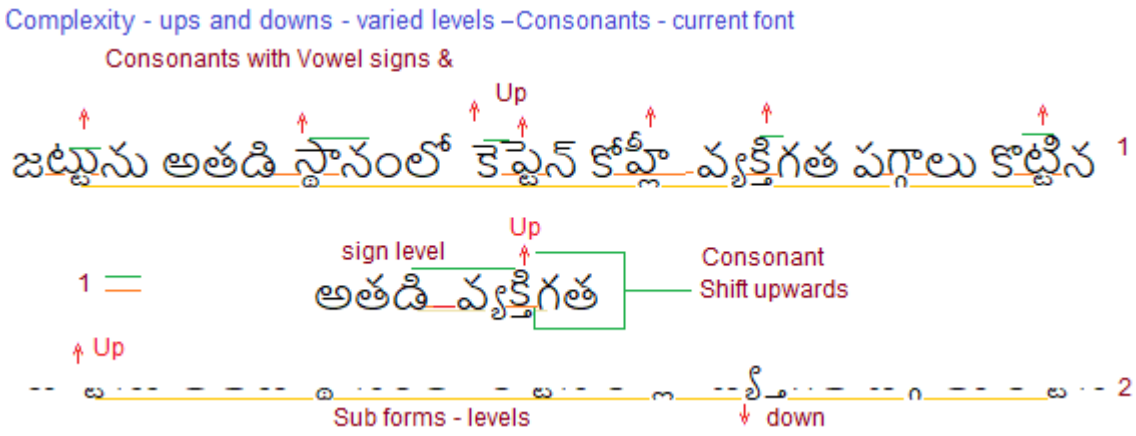

Fig. 12

- Difference in levels of vowel signs and Head–stroke
- Uneven levels of vowel signs
- Difference in levels in every line
- Sub forms level difference

Telugu script is more complex than Devanagari and other Indic scripts. Detail analysis is taken up step by step for each level and the levels are grouped for easy working and understanding the work.

In analysing Telugu language scrip, main focus is given on consonants, sub form, vowels, vowels signs, Halant, Head–stroke, other extensions and position placement of signs and sub forms. Analysis is also focussed on reducing multi-level complexity and make to one level like other Indic scripts.

Consonants have uniform top and base level and none with any sideward and downward extensions; can be referred as "Single consonant form". Consonants with equal top and base level, nearby width and without any extension – upward, side ward or below can be referred as "Perfect single consonant form". Same is applicable to vowels as "Perfect single vowel form" and "Single vowel form".

Telugu consonants can be grouped under two major groups:

A. *"Perfect single consonant form"*

B. *"Single consonant form"*

A. *"Perfect single consonant form"* – two categories

1. "Perfect single consonant form"
   Consonants with equal height, similar nearby width, with no additional extension over the head (top) of consonant and side ward and downward extension.

2. "Perfect single consonant sideward extension form"
   Equal height consonants with sideward extension but no with top (over the head) extension
   Equal height consonants with sideward extension and no top ward (over the head) extension

B. *"Single consonant form"* – six categories

1. "Single consonant upward extension form"
2. "Single consonant upward and downward extension form"
3. "Single consonant downward extension form"
4. "Single consonant upward and sideward extension form"

5. "Single consonant upward, downward and side ward extension form"
6. "Single consonant with downward extension form"

Halant is neither a vowel nor a vowel sign. Halant is a diacritic used in most writing systems and is just semi short (half) tone symbolic sign. Halant – ్ – is an important sign in Telugu script. Telugu script is with multi-level due to various factors which are analysed as below.

3.1 Multi-level Telugu Script – Analysis

Level – 1 – Telugu consonants – groups
Consonants –
SF – Consonant sub form
Level – 2 – Vowels
Level – 3 – Consonants – Vowels – Levels
Level – 4 – Vowel signs
Level – 5 – Halant – ్ –

Level –1 – Telugu Consonants

Consonant features description – consonant structure

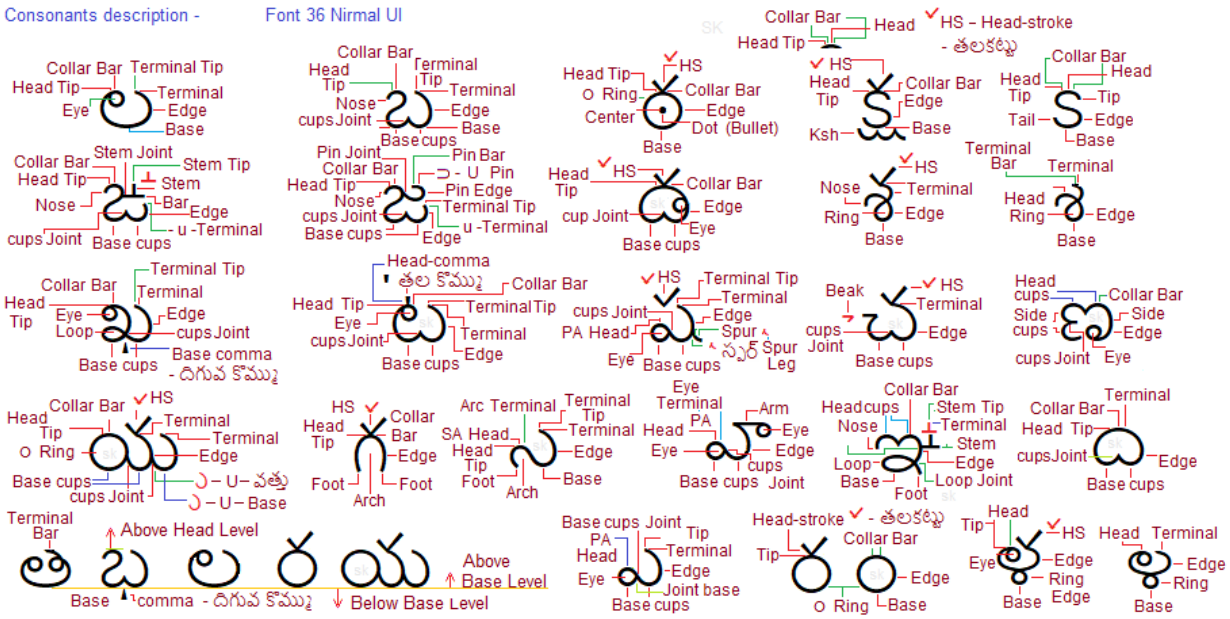

Figure 13

Note:

- Above description is for understanding the current work
- Consonants selected to representing similar features of other consonants also
- PA Head - lower side head and eye portion
- SA – NA Head – lower side head, collar bar portion and arch
- Indicative position placement of vowel signs/Halant, sub forms, etc.
- Details of Head– ✓stroke and other extension are details under each category/group
- Such description is not given nor published earlier elsewhere
- This description is not to be reproduced without prior permission

Telugu consonants – Current font – Conventional

Groups

- Consonants
- Consonants sub form groups – (SF – Secondary/Sub Forms)

Consonants – Sub form groups

- ABL – Above and below level group
- BBL – Consonant – Below base level group

- Conjunct consonant

Telugu consonants = 36

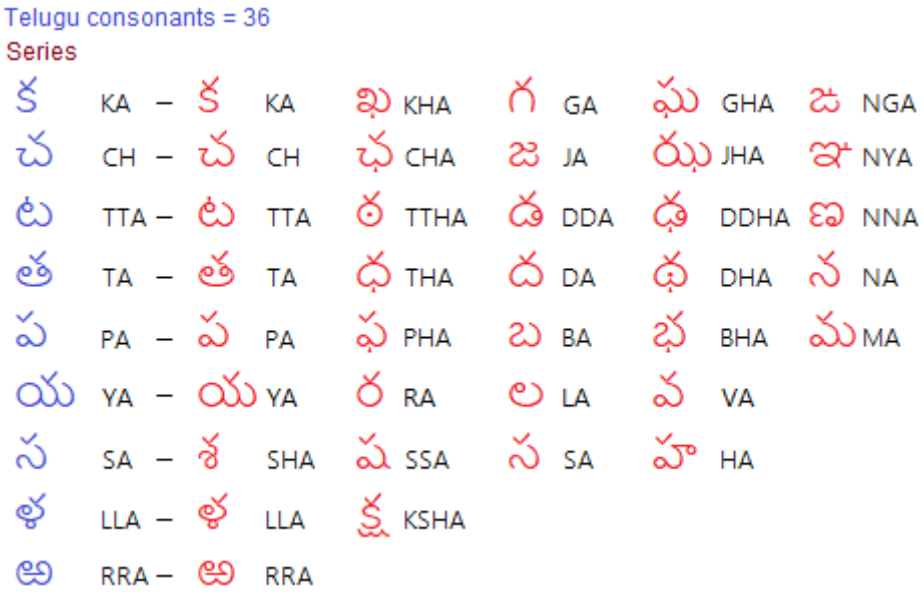

Figure 14

Consonants – *Pairs = 5*

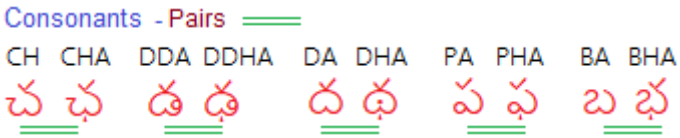

Figure 15

- 5 pairs with similar matching features with nearby tone harmony
- Height of consonants in each pair is not the same
- In Devanagari only 2 pairs of the same height

Consonants are grouped based on their features
Without Head– ✓stroke = 9 consonants

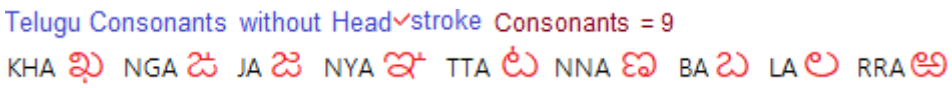

Figure 16

Base–◌్–comma consonants

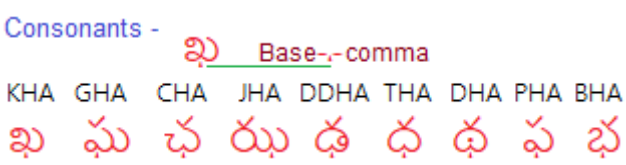

Figure 17

- Consonant with base–◌్–comma consonant is affecting base level

- Base–-.-–comma can be eliminated to make uniform base level

Head– ✓stroke consonants = 27

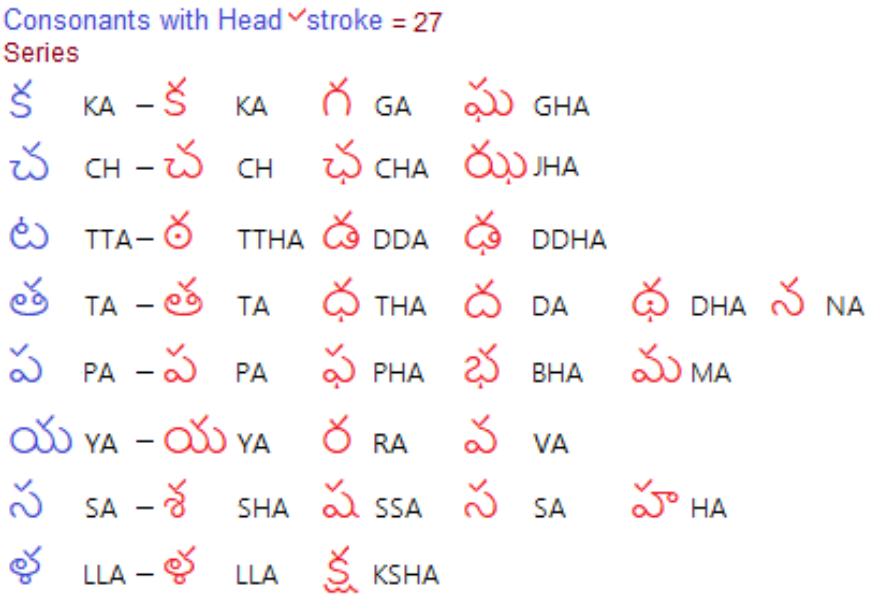

Figure 18

Consonants height – levels

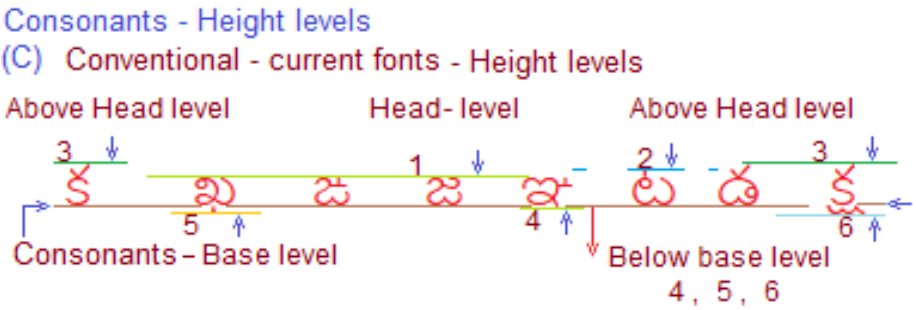

Figure 19

- Total 5 levels, 2 different levels over the Head of the consonants
- 3 different levels below the base line of the consonants
- Height of Head– ✓stroke consonants (3) is more than others

Consonants – *width* – *sideward extension* – *levels*

Figure 20

- Much wider consonants than “Perfect single consonant form”
- Feasible to modify and substitute wider consonants
- Uniform width of consonant is desirable

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Consonants – *below base level extension*

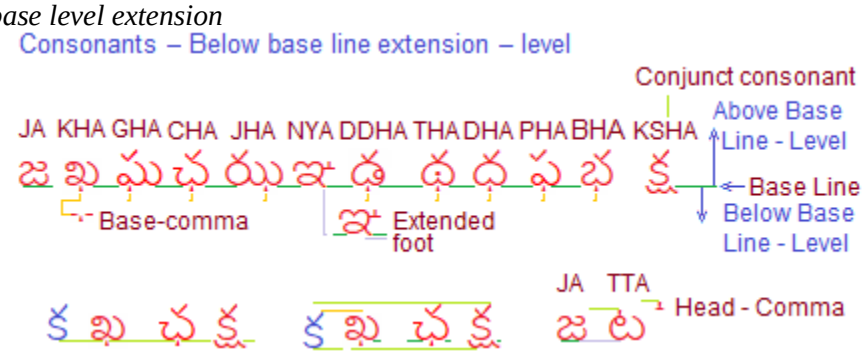

Figure 21

- Height of consonants with Base–◌-◌–comma – is more
- Only consonant – TTA – ట – with Head–◌¹–comma extension

Consonants - *"Perfect single consonant form"* = 6

Figure 22

- Under this group only 6 Consonants without Head ✓stroke

Consonants – *"Single consonant form"* – group – with Head ✓stroke

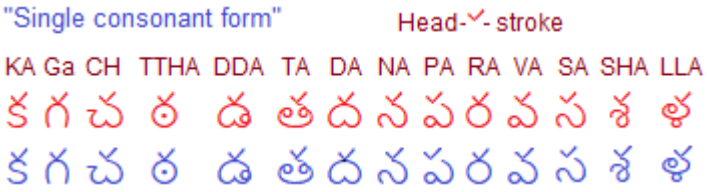

Figure 23

- Out of 36 Consonants only 14 consonants with Head– ✓stroke and equal height fall under this group

Conjunct consonant = 1

- Height of – క్ష – KSHA – is more than other consonants
- Feasible to merge SSA with main consonant to reduce height

Consonants – width groups = 11

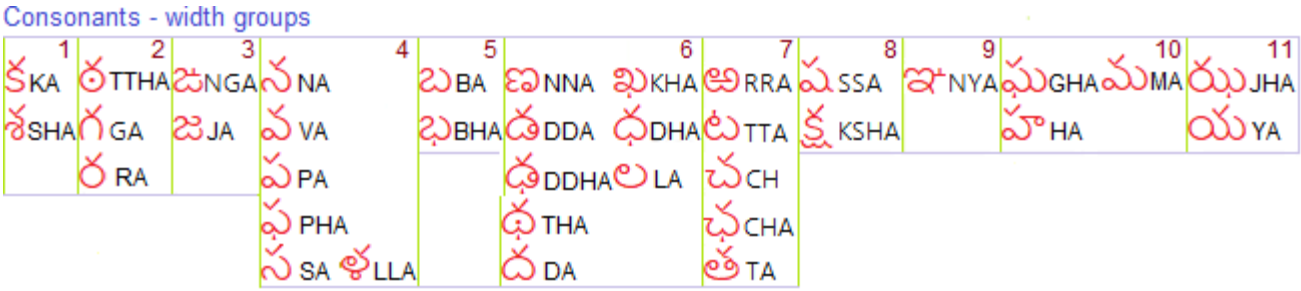

Figure 24

Consonants– *Sub form groups (SF – Secondary/Sub Forms)*

A. *Above and below the base line – level of consonants*
B. *Below the base line – level of consonants*

A. Above and below the base line – level of consonants

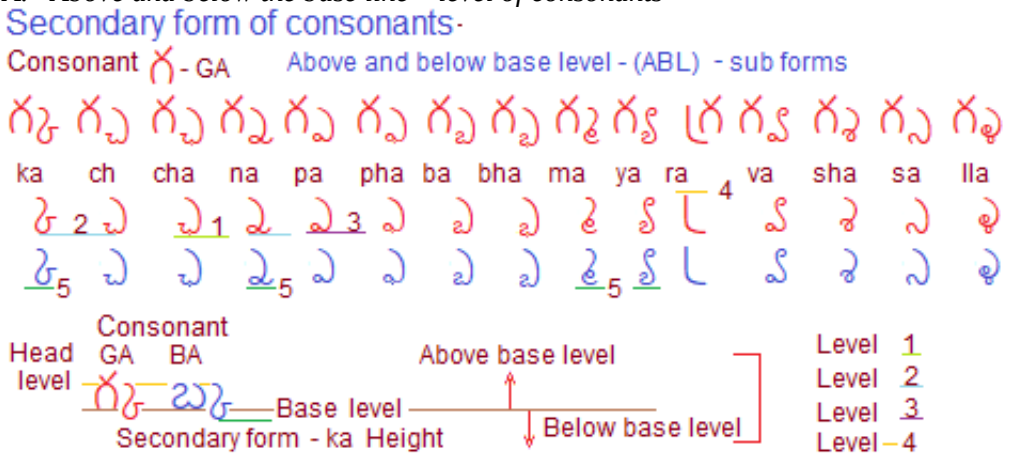

Figure 25

- Above and below the base line – level will be referred as "ABL"
- 15 ABL sub forms including 3 Symbolic forms
- 3 different levels (1,2,3) at base
- Top level 4 (Height more than others)
- Symbolic sub forms (5) features do not match with the respective consonant features

ABL – Sub Forms Pairs

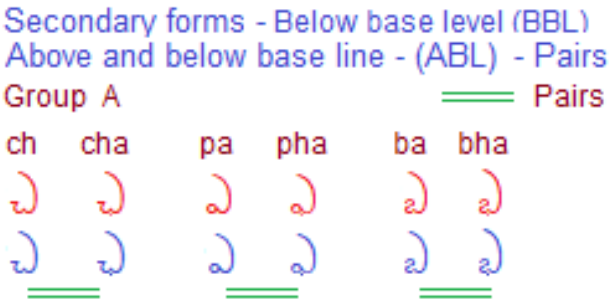

Figure 26

- Only 3 pairs (6 sub forms) with Base–-·-–comma

B. BBL – Sub forms below the base of consonants

Figure 27

- "Below the base line – level will be referred as "BBL"
- There is no uniform gap between the consonant and Sub forms

BBL – Sub forms = 21

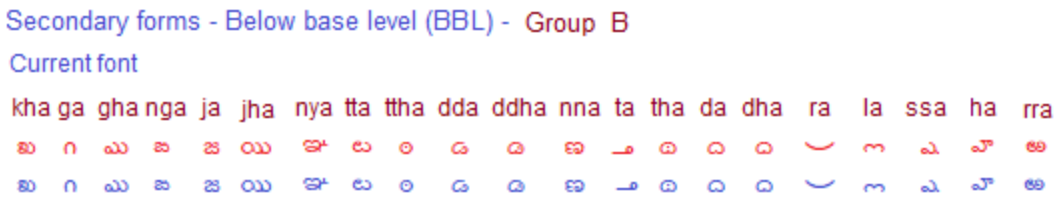

Figure 28

- 2 Symbolic Sub forms features do not match with the respective consonant features

BBL– Sub Forms Pairs = 4

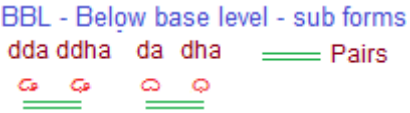

Figure 29

- Below base level – Base–-,- –comma extension creates height difference

Level – 2 – Telugu Vowels

Vowels description – features details

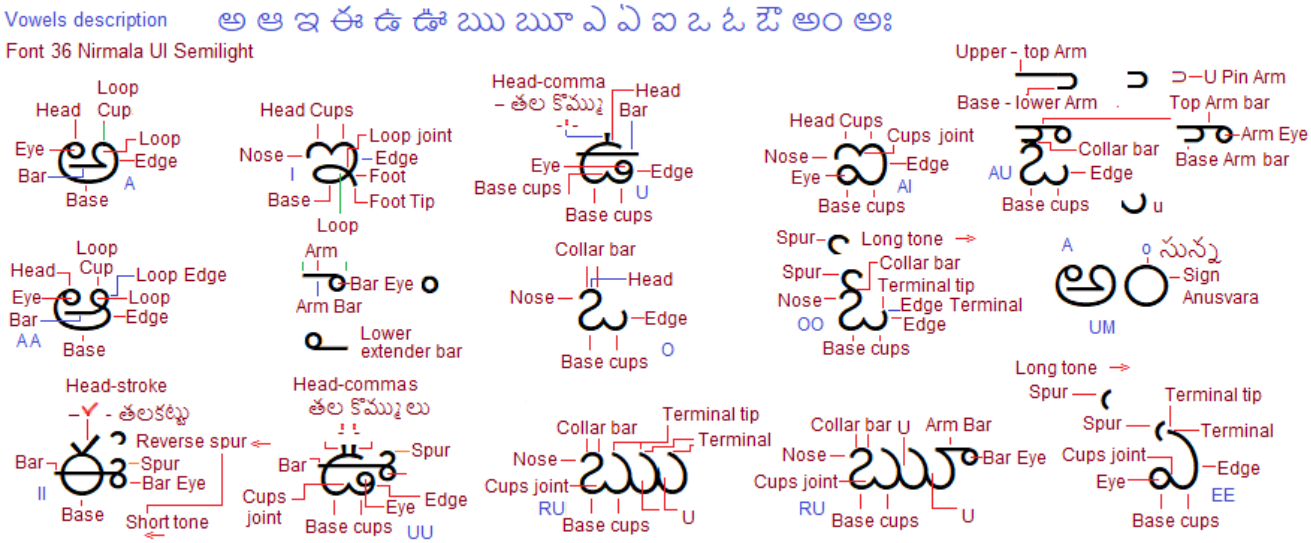

Figure 30

- Note:

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- Telugu Vowels – Current fonts – Conventional – 16 vowels

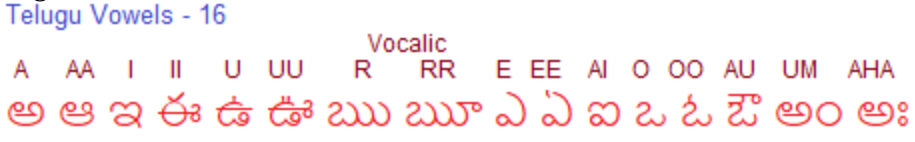

Figure 31

Vowels – *"Perfect single vowel form"*

Vowels – *"Perfect single form vowels"* – *Group* = 4

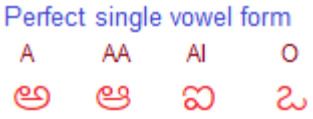

Figure 32

Vowels – *Height* – *Level*

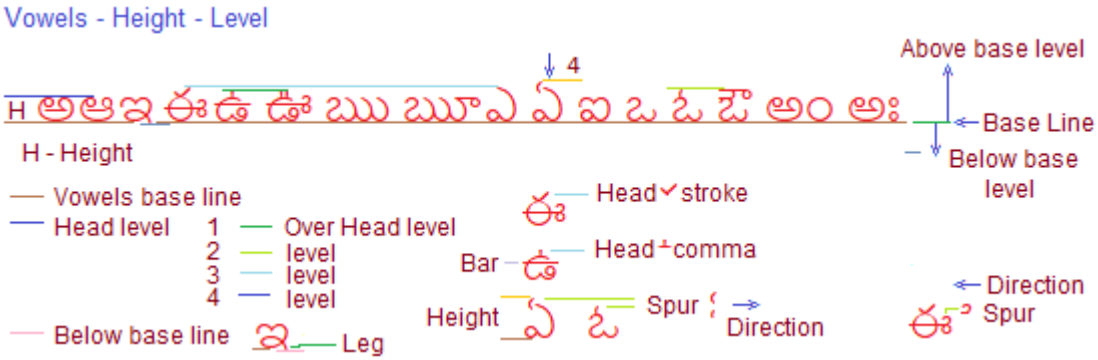

Figure 33

- Four levels over head of vowels and 1 below the base line
- Only vowel – ఈ – II – with Head– stroke like consonants
- Vowel – ఊ – II – with one Head– –comma, two – – to – ఊ – II –

Vowels – *sideward extension* – *width* – *Level* – 5 vowels much wider

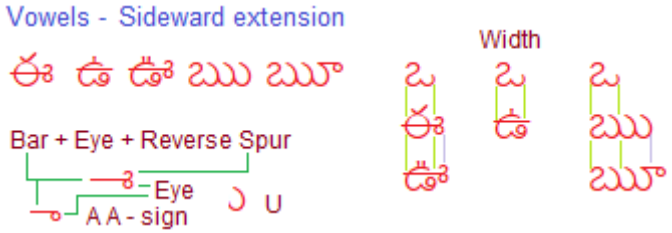

Fig. 34

Level –3 – Consonants with vowels – Vowels – Levels

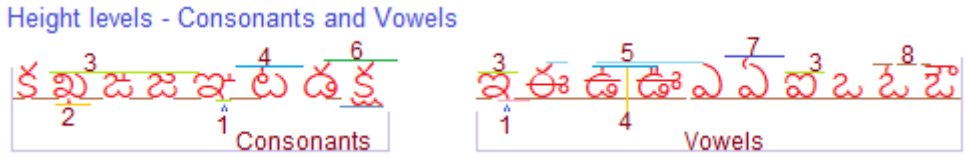

Fig. 35

- Level variation of consonants and vowels
- Head– stroke level also varies

"Perfect Single form consonants and vowels" – *Uniform height*

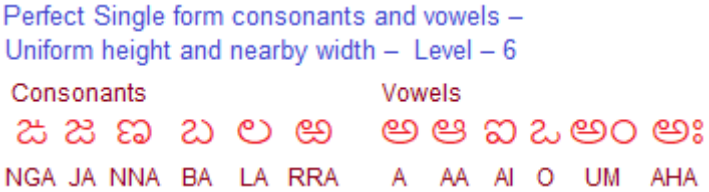

Fig. 36

- Both consonants and vowels have same base level and height

Level – 4 – Vowel signs = 13

Vowels and signs – current font – conventional

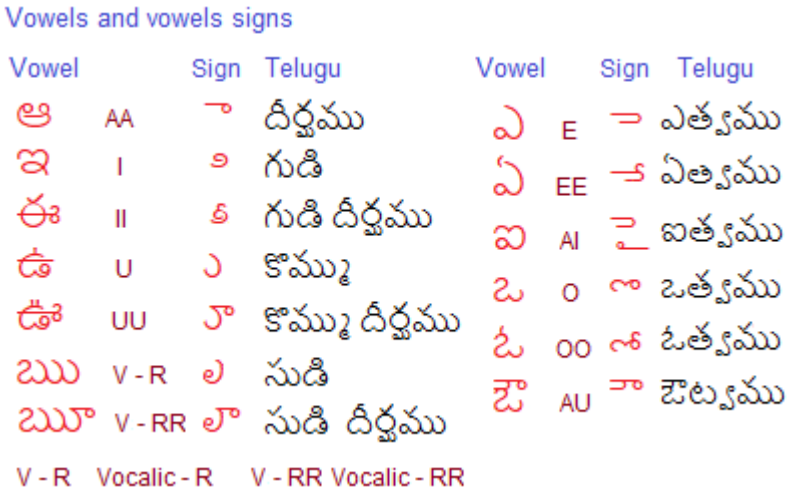

Fig. 37

Vowels and their signs

A. Vowel – ఇ – and – ఈ – signs

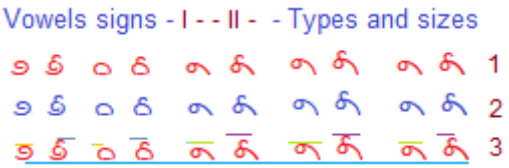

Fig. 38

- Three shapes – two under each – different height levels
- Line 3 – difference in levels

B. Other vowels signs

Length/size of Vowel – AA – sign

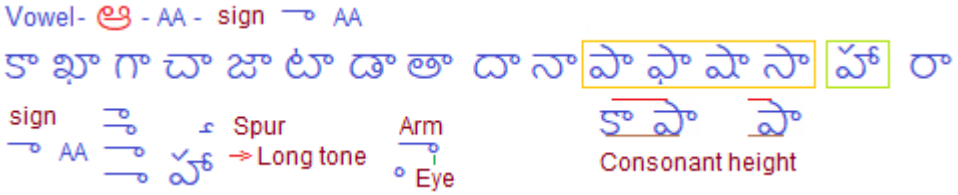

Fig. 39

- Sign length, shape and size of few consonants change
- Sign length varies

Vowel – ఉ – U – sign – ఊ – UU –

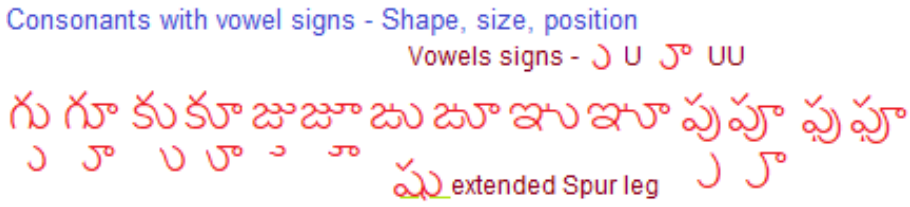

Fig. 40

- Vowels signs size, shape and position placement differs

Height/size of Vowel – ఎ – E – sign – ఏ – EE – sign

Fig. 41

- Length of upper (top) and base arm varies
- Portion of base arm merged-original consonant shape affected
- Similar position placement of – EE – ే – sign and – ీ – Spur denotes long tone

Height/size of Vowel – ఒ– OO– sign – ో –

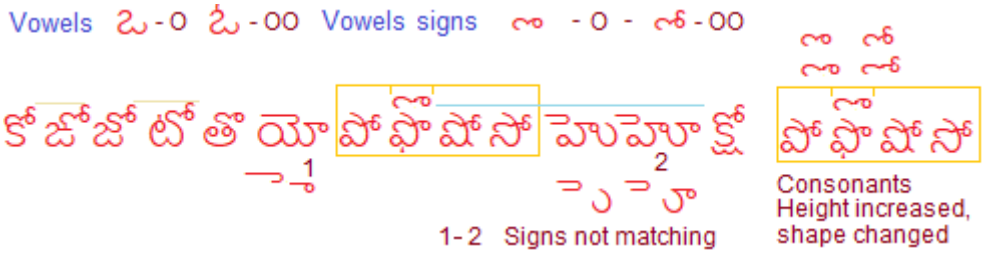

Fig. 42

- Signs length varies and position placement also differs
- Few consonant shape-size changes with the signs
- Signs 1- 2 marked do not match with O and OO – signs
- There is no definition for these –1–2 marked signs

Height/size of Vowel – ఔ – AU– sign – ౌ – AU –

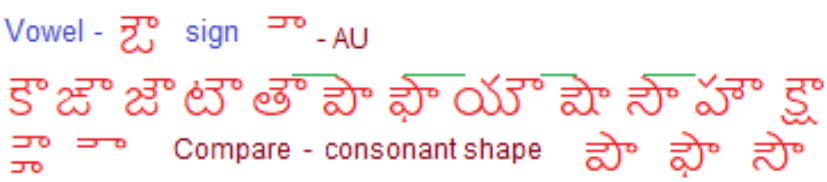

Fig. 43

- Length of upper (top) and base arm varies and consonant shape affected

Consonants with vowel signs – size – shape

Fig. 44

- Vowel signs typical to these consonants –2
- Height and the shape of consonants differ – 1
- Spur leg extended below the base level – 4
- Signs level difference – 5

PA – ప – type consonants with vowels signs

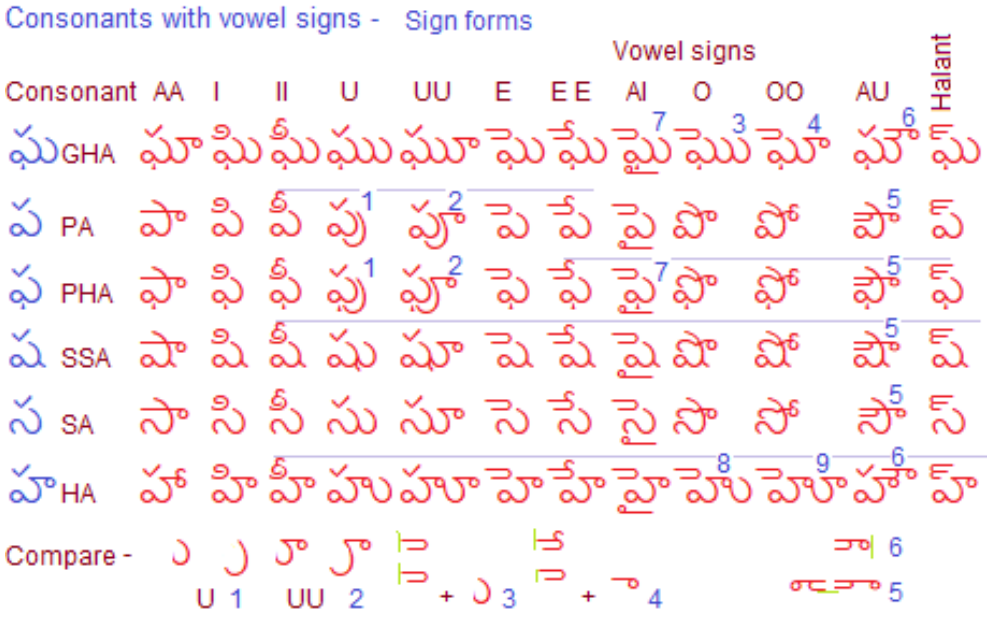

Fig. 45

- Height difference
- Vowel signs typical to these consonants – 1 and 2
- No gap between vowel sign lower extender bar
- 3 and 4, vowel signs extending below the base level and are not similar to 8 and 9
- 1, 2 vowel sign size is different than other similar vowel signs
- Difference of length 5 and 6 and also space between upper arm and lower arm
- Level difference, more ups and downs

Consonant with vowel signs - shapes – sideward extension

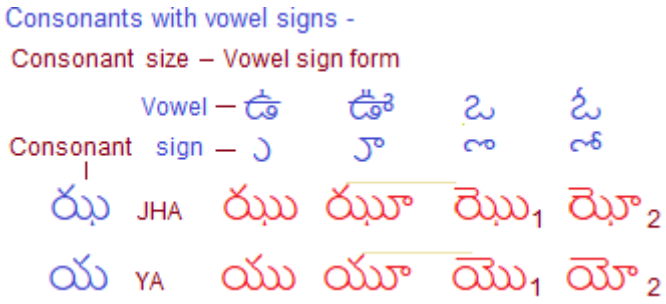

Fig. 46

- Height differs
- Vowel signs – 1 and – 2 are typical to these consonants and they do not matching with actual vowels signs

Level – 5 – Halant – ్ –

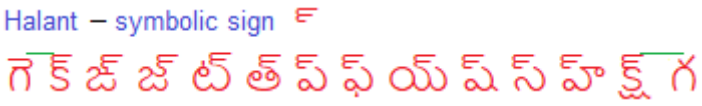

Fig. 47

- Halant level difference with other signs
- With Halant – semi short tone effect

Consonant with BBL sub Forms and vowels signs – uneven levels

Example

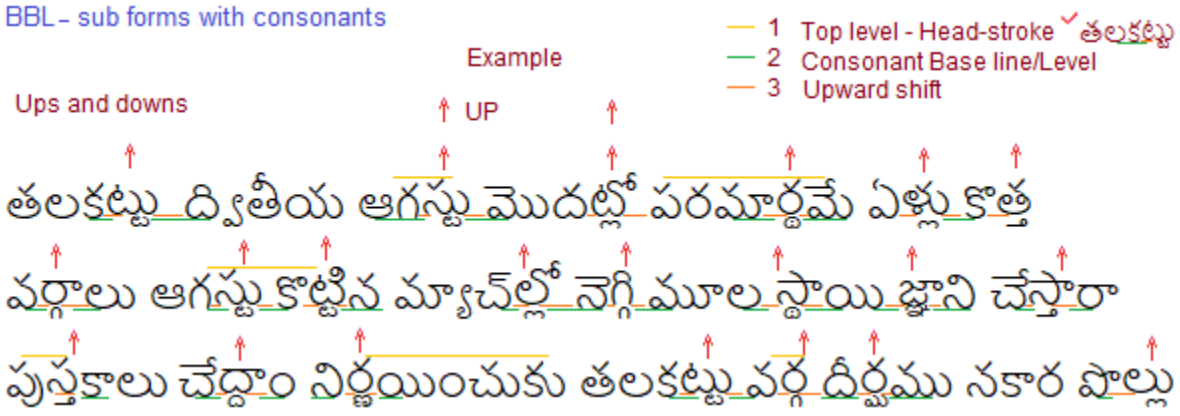

Fig. 48

- Upwards shift affects top level too
- Change in consonant base level with BBL sub form with or without vowels signs
- No uniform spacing between the consonants and BBL, looks awkward
- Variation in top level and base level
- Position placement of signs also vary
- Size of signs also vary and also shape/size of consonants
- Such variation noticed in printed, Telugu net sites like stories, etc.
- Google, Bing and other translators give similar outcome

4. FINDINGS:

Analysis – brief summary – current font/conventional

Level – 1 – Consonants

Out of 36 consonants

- 27 with Head–✓stroke
- 9 without Head–✓stroke
- 5 consonants pairs (10 consonants)
- 1 consonant with Head–ఁ–comma
- 9 consonants with Base–ా–comma and Head–✓stroke
- 1 consonant with Base–ా–comma and without Head–✓stroke
- 6 consonants with sideward extension
- 11width groups
- 1 Joint / Conjunct consonant with base Spur
- 1 consonant NYA with extended leg below base level of consonants
- 1 consonant with side bar (AA sign bar) and base ∧ Spur
- 14 “Single form consonants”
- 6 “Perfect single form consonants”

Telugu consonants - extensions and combinations – levels – examples

- Head–ఁ–comma consonant ట – TTA
- Base–ా–comma consonant – ఖ – KHA
- Head–✓stroke consonants and base–ా–comma consonant – CHA, DDHA, THA, DHA, BHA, PHA
- Head–✓stroke consonants – క – KA
- Head–✓stroke and Base–ా–comma consonant – చ – CHA
- Head–✓stroke and) U – consonant – మ – MA
- Head–✓stroke, Base–ా–comma and) U – consonant – ఘ – JHA
- Head–✓stroke and spur ∧ at the base consonant – ష – SSA
- Head–✓stroke and extra-long tone ¯ bar consonant – హ – HA
- Head–✓stroke conjunct consonant – క్ష – KSHA

Level – 2 – Consonants – Sub forms

Consonants – Sub form groups (SF – Secondary/Sub Forms)

A. *ABL – Above and below the base line – level of consonants*

- 15 ABL sub forms including 3 Symbolic forms
- ABL base levels 3 (1, 2 and 3)
- Top level 4 (Height more than others)
- 5 with green line – Symbolic Sub forms features do not match with the respective consonant features
- Sub forms pairs 3 out of 15
- 3 Sub forms are with Base–ా–comma extension
- Height and width level difference

B. *Below the base line – BBL sub forms level*

- 21 BBL sub forms including 3 Symbolic forms
- 2 Symbolic sub forms features do not match with the respective consonant features
- 7 sub forms are with extension
- 5 sub forms are with Base–ా–comma extension
- 1 sub form with Head–ఁ–comma
- 1 sub form with base ∧ spur
- Sub forms pairs 2 only
- 2 sub forms with extension, create width different
- Sub forms width varies
- More ups and downs

Level – 3 – Vowels

Out of 16 vowels

- Only 1 vowel with Head–stroke – ఈ – II
- 2 vowels with Head–comma – one vowel with 1 Head–comma and the other with 2 Head–commas
- 1 vowel with extended leg – ఇ – I
- 3 vowels with bar and Spur – ఈ – II, and – ఊ – UU – all are with reverse direction – ు – Spur (indicative of "short tone")
- 2 vowels with – ె – Spur – forward direction (indicative of "long tone") – but it is not correct shape with vowel – ఏ – OO –
- 1 vowel with its sign – ఔ – AU
- 2 conjunct vowels – అం – UM, – అః – AHA
- 2 vowels with sideward extension (Vocalic R and RR)
- 5 vowels pairs (10 vowels)
- Vowels ఇ – I and ఈ – II – features do not match
- Assigned vowels signs 15
- Vowels and vowels signs with forward direction – ె – Spur – denotes long tone
- 4 "Perfect single vowel Form"
- Vowels signs with forward direction – ె – Spur – denotes long tone

Level – 4 – Vowels signs

- 2 vowels – I – II – signs – 3 shapes each
- 2 independent vowels signs – AA ా sign & Au ౌ sign
- 1 cluster sign – ై – AI
- 2 vowels signs – pairs (Each with 1 short and 1 long tone signs)
- Each vowel sign length varies
- Original shape of consonants change with vowel signs
- With vowels signs few consonants height is increased
- Few vowels signs replaced with other signs for few sideward extended consonants
- Signs base portion merge with consonants Head-collar, terminal, Terminal tip, upper cups head collar, etc.
- Forward direction – ె – Spur used with consonant to make long tone vowel – ఆ – AA – sign
- Other signs ొ ో ౌ not matching to vowels signs
- U and UU signs to PA, PHA and VA do not match with U and UU signs to other consonants

Other details

- Position placement of vowels signs is not uniform
- Space between consonant and BBL sub form is also not uniform
- Height and width of both consonants and vowels vary
- Original shape/form of consonants are affected with vowel signs
- Length of vowel signs are with vide variation
- Head–stroke base tip is merged in consonant Head-collar-bar, terminal tip, etc.
- Head–stroke is not a vowel sign to pronounce short tone.
- Head–stroke may not be appropriate to vowel – ఈ – II –.

Note

- All above contribute multi-level height and length difference
- Scope to modify/substitute consonants to make base level equal
- Scope to eliminate consonants forms
- Scope to increasing pairing of consonants with similar features and nearby tone harmony
- Scope to modify/substitute consonants sub forms, pairing of consonants sub forms with similar features and nearby tone harmony
- Scope to modify space between consonants base line and sub form below the base line and position and placement of sub forms

- Scope to modify/substitute vowels, paring of vowels and modify/substitute vowels
- Scope to modify/substitute vowels signs, position placement of vowels signs, Halant and Head ✓stroke

Based on the above analysis, following has been worked out to eliminate multi-level complexity and overcome uneven levels in the Telugu Script.

In order to eliminate such uneven levels it may be necessary to follow certain procedure. This will include modify/substitute consonants, vowels and vowels signs; bring all with the same base level and other position placement of each vowel sign. Based on analysis modification of sub forms of both levels namely ABL – above and below level and BBL – below the base level is also necessary. Spacing between BBL sub forms and consonants is equally important.

5. PROCEEDURE AND METHODS FOLLOWED:

A. Consonants
1. Bring Telugu consonants under two groups - "Perfect single form consonants" and "Single form consonants"
2. Position placement of Head–✓stroke
3. Bring all Telugu consonants on the same base level
4. Modify/substitute consonants to achieve above 1 and 2
5. Create maximum number of "Pairs" of consonants – each pair with similar matching features and nearby tone harmony
6. Eliminate downward and horizontal extension to bring all consonants to nearby width

B. Consonants secondary forms/Sub forms/Conjunct consonants
1. Modify/substitute Sub forms falling under the following groups
   Group – 1 – Above and below level (ABL) Sub forms
   Group – 2 – Below base level (BBL) Sub forms
2. Bring maximum number of Sub forms under Group – 1
3. Pairing of Sub forms with similar features and nearby tone harmony
4. Substitute maximum – 1 – Sub forms with Symbolic forms
5. Position and placement of the ABL Sub forms
6. Position and placement of the BBL Sub forms
7. Spacing between Consonants and BBL Sub forms
8. Vowel signs to ABL Sub forms

C. Vowels
1. Vowel forms, base level, size, modification/substitute
2. Pairing of vowels with similar features and nearby tone harmony
3. Advantages with examples

D. Vowels signs
1. Modification/substitute
2. Adjust the level of vowel signs
3. Position placement of vowels signs without affecting the shape and size of consonants
4. Advantages with each sign examples

E. Halant sign
1. Modification/substitute
2. Position placement of vowels signs without affecting the shape and size of consonants
3. Advantages with example
4.

F. Telugu Script and new Varnamala

G.
1. Brief summary
2. Conclusion

A. Consonants

Telugu consonants are grouped based on types of extensions to the consonants and consonants without any extension

Group – 1

"Perfect single form consonants" – same height and base level without extension

ఙ – NGA, ఝ – JA, ఞ – NNA, ఴ – BA, ఌ – LA and ఠ – RRA

- Only 6 consonants in this group These come under “Perfect single consonant form”

Group – 2

Loop– leg extension and wider = 1 consonant

Consonant – ఞ – NYA

Group – 3

Head– ఁ –comma as extension = 1 consonant

Consonant – ట – TTA

Group – 4

With only Head–✓stroke, no other extension

క – KA, గ – GA, చ – CH, ఠ – TTHA, డ – DDA, త - TA, ద – DA,
న – NA, ప – PA, ర – RA, వ – VA, స – SA, శ – SHA and ళ – LLA

Total 14 consonants with Head ✓stroke

Group – 5

With Head–✓stroke and Base– ◌ –comma = 6 consonants

ఛ – CHA, ఢ – DDHA, థ – THA, ధ – DHA, ఫ – PHA and భ – BHA

Group – 6

With Head–✓stroke, Base– ◌ –comma and – ◌ు – U – sign = 2 consonants

ఘు – GHA and ఝు – JHA,

Group – 7

With Head–✓stroke and extra – ◌ు – U – sign = 2 consonants

ము – MA and యు – YA

Group – 8

Consonant with only Base– ◌ –comma = 1 consonant

ఖ – KHA

Group – 9

Consonant with Head–✓stroke – conjunct consonant = 1 consonant

క్ష – KSHA

Group – 10

Consonant with Head–✓stroke and spur ◌ at the base = 1 consonant

ష – SSA

Group – 11

Consonant with Head–✓stroke and extra-long tone – ◌ – bar = 1 consonant

హ – HA

Group – 12

Possible substitute to consonant – ఠ – TTHA – and – ఱ – RRA –

Groups – 2, 3, 5, 6, 7, 8, 9, 10 and 11 are dealt below

Groups – 2

Substitute consonant – ఙ – ఞ – NYA

- Substitute consonant – ఞ – NYA – comes under “Perfect single form Consonants” – Group – 1

Groups – 3

Head–ˈ–comma – ఌ – TTA

- Eliminated Head–ˈ–comma and extra inward edge-terminal curve modified
- Modified consonant – ఌ – ఌ – TTA - now comes under “Perfect single consonant form” Group – 1

Group – 5

With Head–ˇstroke and Base–˒–comma

ఛ – CHA, ఢ – DDHA, ఝ – THA, ధ – DHA, ఫ – PHA and భ – BHA

Base–˒–comma replaced with Dot ⁚ Bullet

ఛ – CHA, ఢ – DDHA, ఝ – THA, ధ – DHA ఫ – PHA and భ – BHA

- Consonant – ధ – DHA – with flat base to differentiate with – THA
- All with uniform base level and come under “Single consonant form” – Group – 4

Group – 6

With Head–ˇstroke, Base–˒–comma and – ు – U

ఘ – GHA and – ఝు – JHA

Substitute consonant – గ – GHA – to – ఘ – GHA

- Dot ⁚ Bullet added to – గ – GA – becomes – గ – GHA – and both become a good matching pair and comes under Group – 4 – (“Single consonant form”)
- Width of – గ – GA – and – గ – GHA – slightly increased and both come comes under Group – 4 – (“Single consonant form”)

Substitute consonant – జ – JHA – to – ఝు – JHA

- Consonant – జ – JA and substitute జ – JHA – now a good matching pair
- Length of ˒ type hair pin of both slightly ˒ increased
- Substitute జ – JHA – now comes under Group – 1 – “Perfect single consonant form”

Group – 7

Head–ˇstroke and extra – ు – U

మ – MA and – య – YA

- Modified – ఎ – MA – (vertical bar, flat base, spur) without no Head–ˇ–stroke and now it comes under Group – 1

Substitute – ఴ – YA – to – య – YA

- Substitute – ఴ – YA – comes under Group – 4

Group – 8

Substitute to Base–˒–comma consonant – ఖ – KHA –

Substitute – క – KHA – to – ఖ – KHA –

- Dot :Bullet added to modified consonants – క – KA becomes substitute – ఖ – KHA to – ఱ – KHA and comes under comes under Group – 4

Group – 9

Conjunct consonant with Head–stroke

క్ష – KSHA – Conjunct consonant

Modified consonant – క్ష – KSHA –

- Modified consonant – క్ష – KSHA – comes under Group – 4

Group – 10

Consonant with Head–stroke and base spur

ష – SSA

- Consonant – ష – SSA – shape slightly modified matching to – PA – consonant
- Consonant – ష – SSA – comes under Group – 4

Group – 11

Consonant with Head–stroke and long-tone – ా – bar

హా – HA

Modified consonant – హ – HA –

- Modified – హ – HA – with flat base, easier read write
- Modified – హ – HA – with flat base, comes under Group – 4

Group – 12

Substitute to consonant

- Substitute – ఙ – TTHA to consonant – ఞ – TTHA – comes under Group – 1
- Substitute – ఠ – RRA – to consonant – ఱ – RRA – comes under Group – 4

Head–stroke

Fig. 49

Position placement of Head–stroke

Fig. 50

Position placement of Head–stroke – Advantages

- Head–✓stroke base tip is visible
- Uniform size to all consonants
- Uniformity of height of Group – 4 consonants

"Single form consonants" with Head–✓stroke

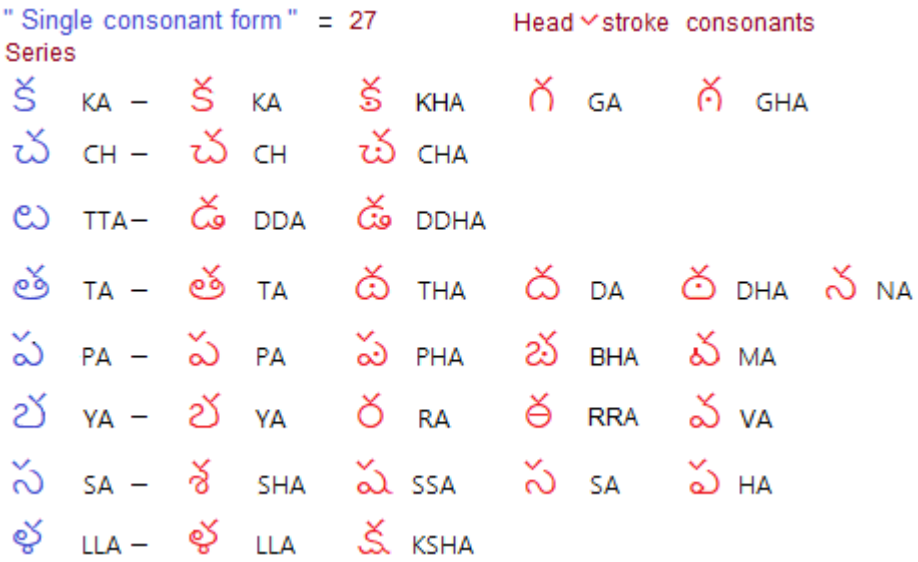

Fig. 51

- "Single consonant form" – RRA – is included under – YA – Series
- Under "Single consonant form" conjunct consonants – SSA – and– KSHA – are exception with base ^ Spur
- 27 - "Single consonant form", before only 14

"Perfect single consonant form" – Group – 1

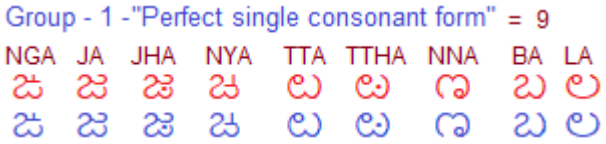

Fig. 52

- 9 "Perfect single consonant form", before only 6
- All will have same base line and height

Pairs – similar matching features and nearby tone harmony pair –

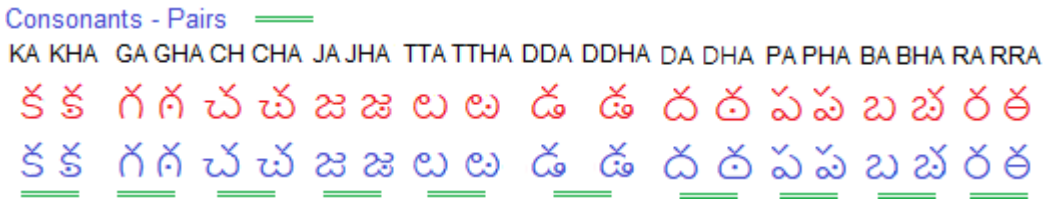

Fig. 53

- Total number of pairs with similar matching features and nearby tone harmony 11 pairs (22 Consonants - more than 50%) out of 36 consonants, an asset to Telugu Script, highest compared to any Indian language
- All consonants width is almost same, an advantage to Telugu Script

- All consonants with uniform base level will facilitate position and placement of secondary forms below the base level
- Consonant – DA– no change
- Clear look of Head–stroke and uniform level to all consonants

"Perfect single consonant form" – Pairs = 2 (Consonants = 4)

Fig. 54

Eliminated consonants forms = 11

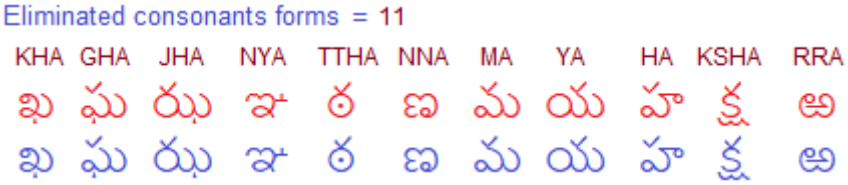

Fig. 55

Astavarga consonants = 36

Fig. 56

- Defined as "Astavarga consonants" – 36 consonants – include all
  - "Perfect single consonant form"
  - "Single consonant form"
  - All consonants come under one width group
- Astavarga is easier to learn

A. Consonants secondary forms including Symbolic forms –

- Secondary consonants can be referred as "sub forms"
- Features of sub forms normally match the features of consonants.

- There is no standards for these sub forms
- Features of sub forms do not match the features of consonants are referred as "Symbolic forms"
- Portion of symbolic form may match partially to main consonant.
- Consonant special features can be taken to form symbolic sub form, especially the sub forms below the consonant base line or level.
- Symbolic sub forms are ideal

Based of sub forms position placement levels, two levels are defined below

Level – 1 – Above and below the base level of the consonants – ABL

Level – 2 – Below the base level of the consonants – BBL

Above and below base level (ABL) – Level – 1

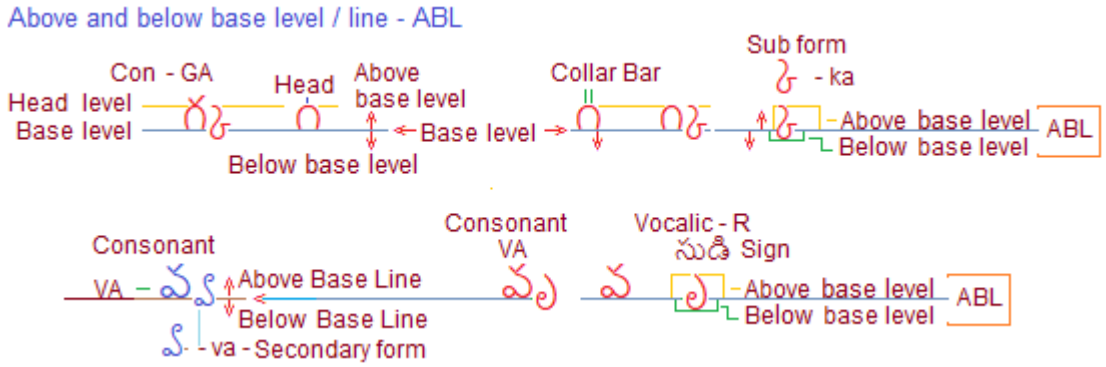

Fig. 57

- Vowels signs Vocalic R and RR also come under this ABL

Below base level (BBL) – Level – 2

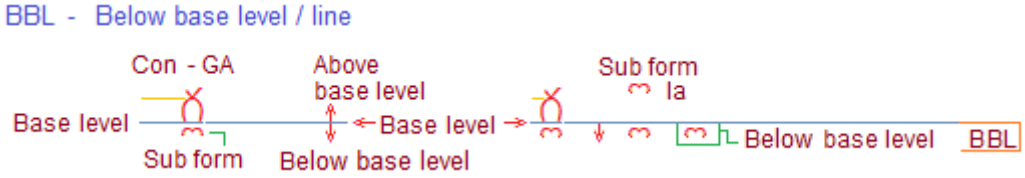

Fig. 58

- Sub forms including symbolic sub forms falling below the base level of the consonants come under this BBL

Level – 1 – Above and below consonant base level– ABL

Secondary consonant forms – ABL – Current font/conventional signs

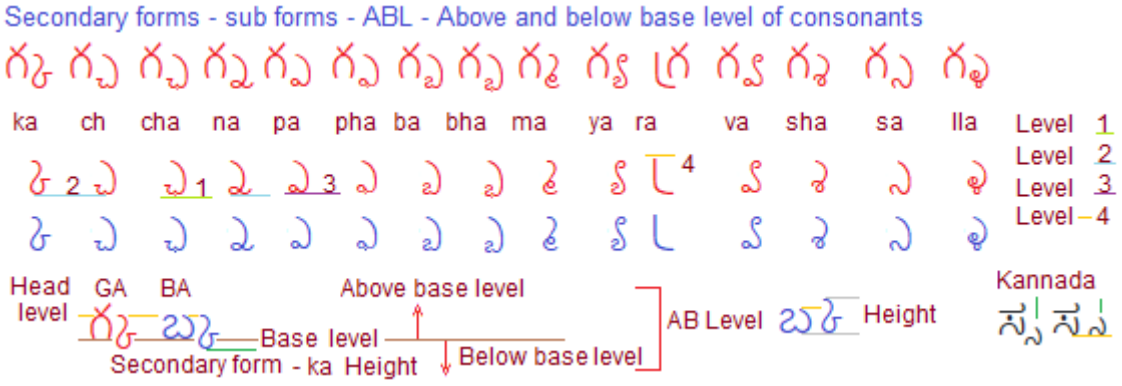

Fig. 59

- Height of ABL sub forms is more than the “Perfect single consonant form” consonant and also not uniform
- Scope to reduce height of all these secondary forms with uniform base level

ABL – Modified sub forms

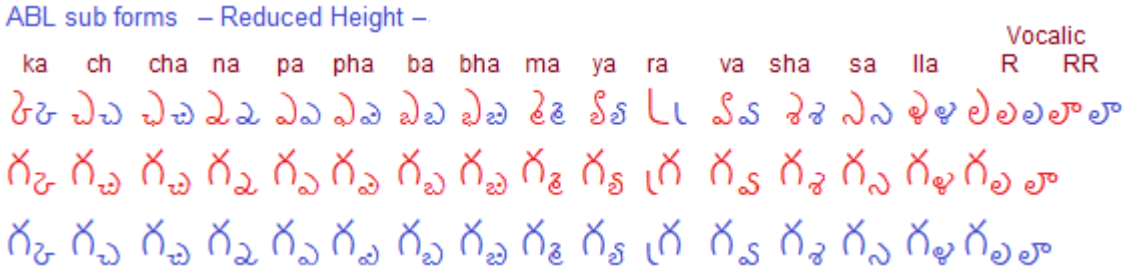

Fig. 60

1. Base-ˌ-comma replaced by Dot ˙ Bullet – for uniform base level
2. Vowels signs Vocalic – R – and Vocalic – RR – fall under this group and their height is also reduced on par with other sub forms
3. More open space

ABL – Modified Sub forms and Vocalic – R – RR – signs

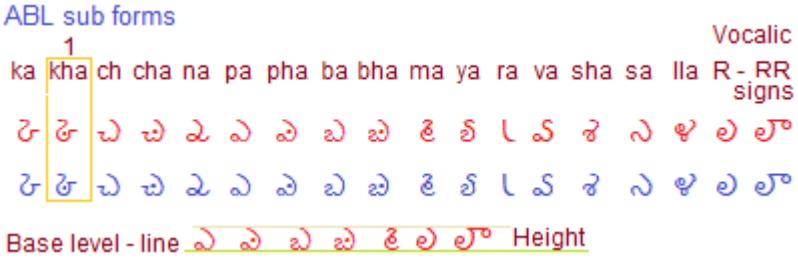

Fig. 61

- Sub forms – ొ – kha – (1) may be appropriate under ABL group
- Total ABL sub forms increased to 18
- Uniform base level and all are with equal height including Vocalic R & RR vowel signs

AB Level sub forms – Pairs = 4

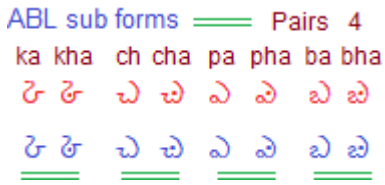

Fig. 62

- Total ABL – sub-form pairs increased to 4

Level – 2 – BBL – Below the base level of the consonants – sub forms = 19 –(Current font)

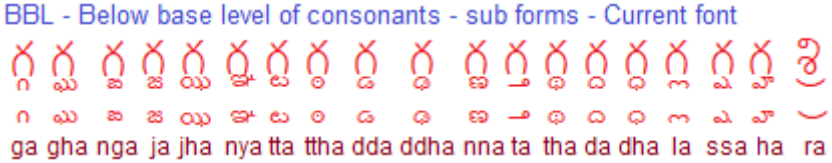

Fig. 63

- Space between consonant and BBL sub forms is not uniform, resulting uneven levels
- No gap between the consonant and few BBL sub forms
- BBL sub forms height and width varies
- Sub form – ಖ– kha – not included
- Sub form – ್ – ta –, – ್ – laa – and – ್ – ra – are symbolic form

Note: Secondary consonants forms will be referred as sub forms

Level – 2 – BBL – below the base level of the consonants – sub forms

BBL sub forms – Modified/substitute – BBL sub forms = 7 pairs

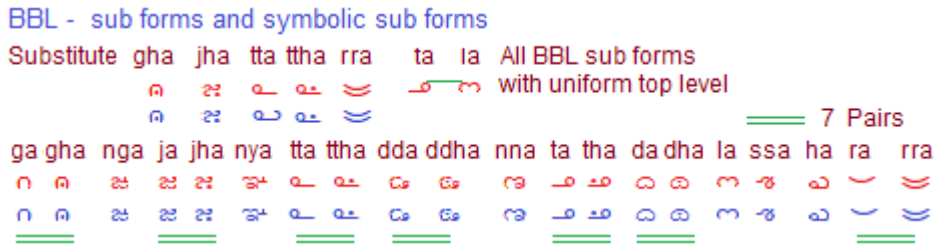

Fig. 64

- Height of symbolic forms – ್ – ta – and – ್ – la – slightly increased Base–ಁ- –comma is replaced with Dot : bullet of 2 sub forms for uniform base level
- Like symbolic sub forms – ್ – ta – similar symbolic forms added as substitute –
- Symbolic sub forms – ್ – tta –, – ್ – ttha –, – ್ – tha –,
- Other substitutes – ಗ – gha – and – ಜ – jha –
- Other sub forms match to respective consonant
  ಡ – dda , ಢ –ddha, ಣ – nna, ದ – da, ಧ – dha, ಷ – ssa and ಲ – ha

Symbolic substitutes to sub forms, based on consonants main features

Consonant	Main features	Symbolic sub form substitutes
ಬ್ಬ– TTA	– ಬ್ಬ – Eye and Terminal	ಬ್ಬ – tta
ಬ್ಬ– TTHA–	– ಬ್ಬ – Eye and Terminal – and Dot : Bullet –	ಬ್ಬ – ttha
ಜ್ಜ – JA –	್ಜ – ಾ hair Pin	್ಜ – ja
ಜ್ಜ – JHA	– ್ಜ – ಾ hair Pin of JA – and Dot : Bullet –	್ಜ – jha
ಙ್ಙ – NGA	– ್ಙ with stem	್ಙ – nga
ಞ್ಞ – NYA	– ್ಞ two head cups with ್ – stem	್ಞ – nya

Fig. 65

Symbolic sub forms = 8

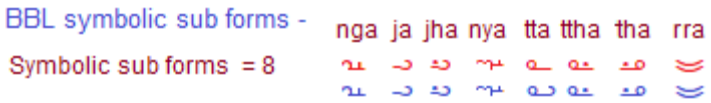

Fig. 66

Sub forms and symbolic sub forms = 20

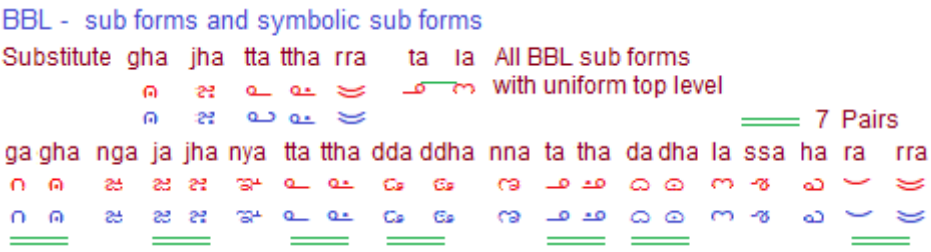

Fig. 67

- Sub forms – ಗ – gha,– ಟ – tta – and – ಠ – ttha – are good substitute to conventional sub forms
- Sub form –ಧ – dha – with flat base to match main consonant

Height level – Sub forms and symbolic sub forms

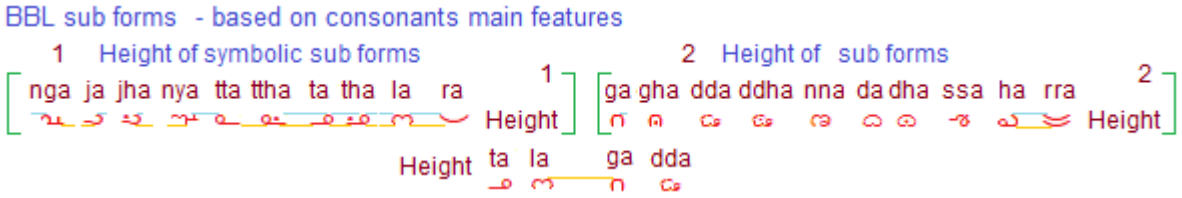

Fig. 68

- Height of sub forms is slightly more than symbolic sub forms
- All sub forms look clear with uniform top level

Sub forms – Pairs = 7

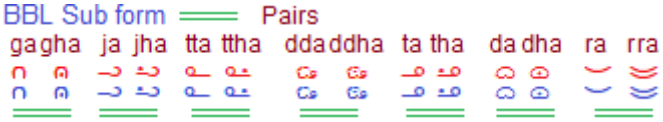

Fig. 69

Category – 2 – Position and placement of BBL sub forms – Total = 18

- Space betweent consonants and BBL sub forms
- Level – position placement of both groups sub forms

Position placement of sub forms including symbolic

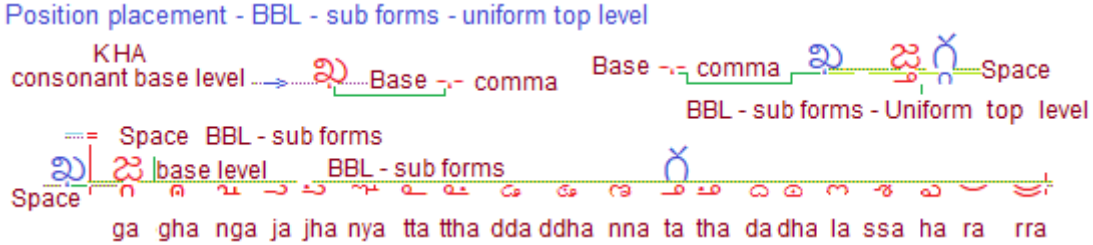

Fig. 70

- Uniform top level BBL sub forms
- Space/gap between consonants and Top level of BBL sub forms
- This gives clear space between consonant and BBL sub form
- Uniform top level and gap/space is very important

ABL and BBL sub forms uniform base level position placement and spacing

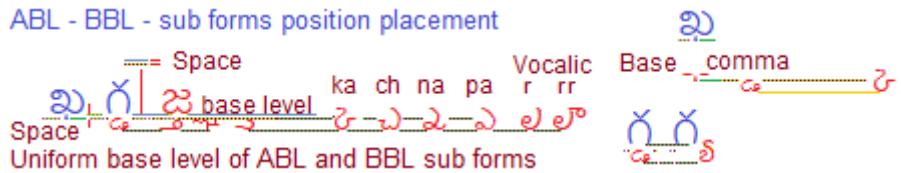

Fig. 71

- Position placement – spacing Vocalic R and RR signs is same as ABL sub forms
- Uniform base level ABL sub form and BBL sub form will be ideal for the script
- This will save space and avoid uneven levels

BBL sub forms below the consonants – position placement – "Pedda Bala Siksha"[1] screenshot

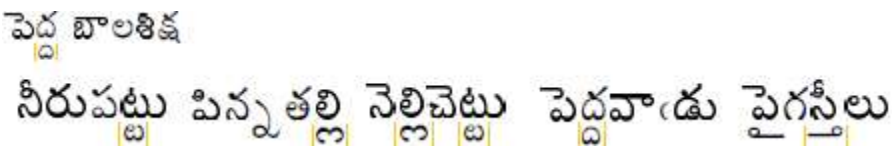

Fig. 72

- Sub forms below the consonants irrespective of vowel signs

ABL and BBL sub forms position placement levels below consonants – example

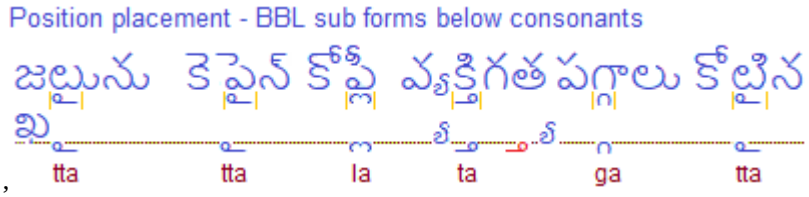

Fig. 73

- ABL and BBL sub forms uniform base level

ABL – BBL sub forms – position placement – Example

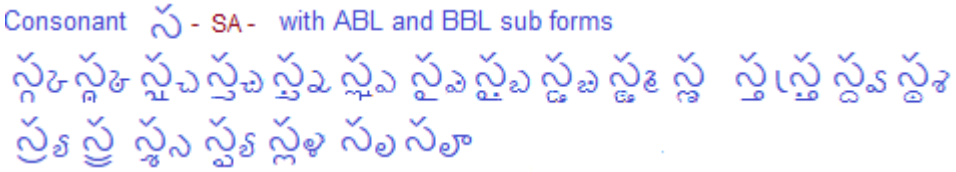

Fig. 74

- ABL base in line with top line of BBL sub forms
- Vocalic R and RR position placement like ABL sub forms

H. Telugu Vowels

Vowels structure/features description details

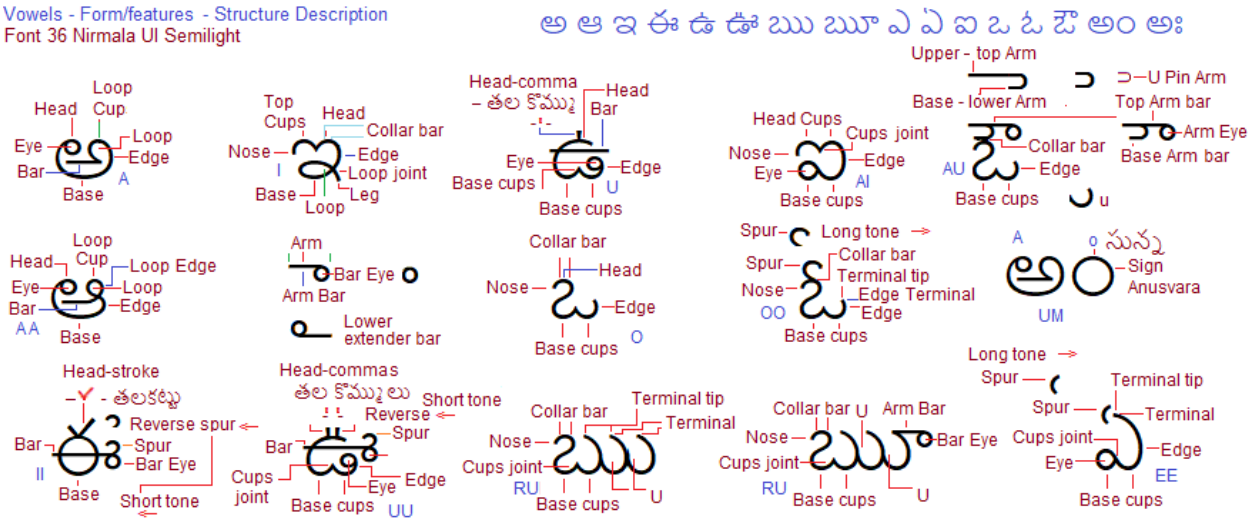

Fig. 75

Note

- Above description is for understanding the proposed work
- Above illustration (screen) will show Head, Collar Bar, etc. of vowels and vowel signs
- Consonants in the above illustration (screen) will represent other vowels which are not included.
- Such description is not found, given nor published earlier elsewhere
- This illustration not to be used without prior permission

Telugu vowels = 16 (Conventional forms)

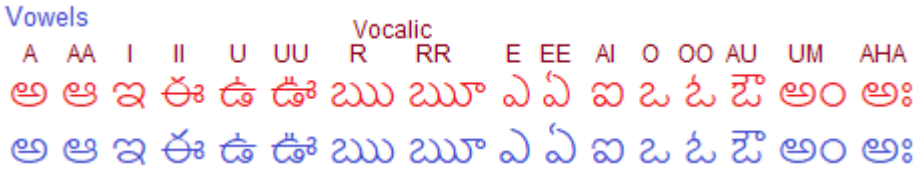

Fig. 76

- Only vowel – ఈ – II – is with Head–ˇstroke like few consonants.
- Vowels – ఇ – I – and – ఈ – II – features do not match

"Perfect single vowel form"

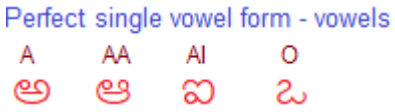

Fig. 77

- Only 4 Vowels come under this category

Modified vowels

Vowels – అ – A, – ఆ – AA

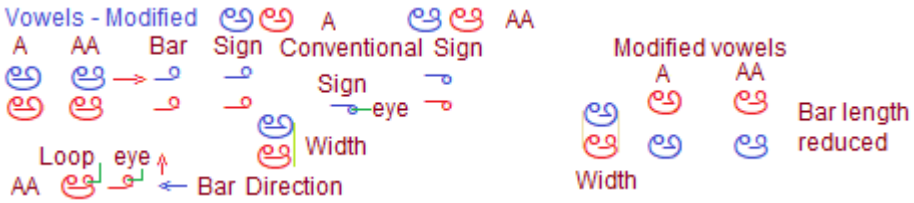

Fig. 78

- Modified vowels – అ – A, – ఆ – AA – bar length reduced
- Both vowels are with equal width
- Modified vowels – అ – A replace A in Um and Aha vowels

Modified vowels – ఇ – I – and substitute – ఀ – II – to – ఈ – II –

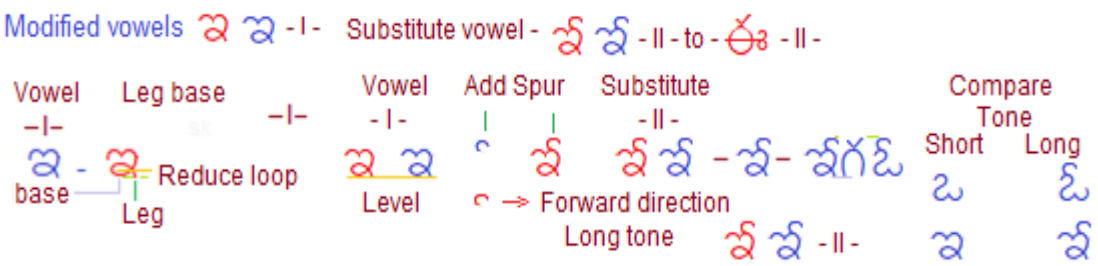

Fig. 79

- Modified vowel Modified vowel – ఇ – I – added with ◌ Spur on top cup-head becomes – ఈ – II – to conventional vowel – ఈ – II –
- Both modified vowel – ఇ – I – and substitute vowel – ఈ – II – become a good pair with similar features and nearby tone harmony like Devanagari – इ – I – and – ई – II – pair

Eliminated bar – modified vowels – ఁ – U – and – ఁఁ – UU –

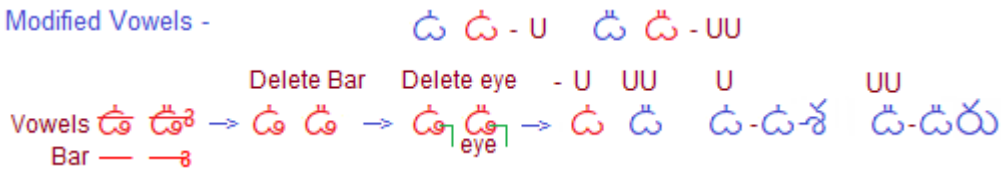

Fig. 80

- Vowel – ఁ – U – with one Head ◌ఁ comma and Vowel – ఁఁ – UU – with two Head ◌ఁ◌ఁ commas is sufficient to distinguish both these vowels
- Modified vowels features match to their signs
- Both vowels are very simple, sharp and easier to write read

Substitute vowels

Vocalic – R – ఌ – to vocalic – R – ఋ – and
Vocalic – RR – ౡ – to vocalic – RR – ౠ – and

Vocalic – R – ఌ – Vocalic – RR – ౡ – Advantages

- Height and width of substitute Vocalic – R – ఌ – and Vocalic – RR – ౡ – is equal to other vowel – ఒ – O –
- Substitutes match with their sub forms
- Both substitutes Vocalic – R – ఌ – and Vocalic – RR – ౡ – come under “Perfect single vowel forms”
- Easier to read write and space saving

Vowels height reduced – ఎ – E– and – ఏ – EE – advantages

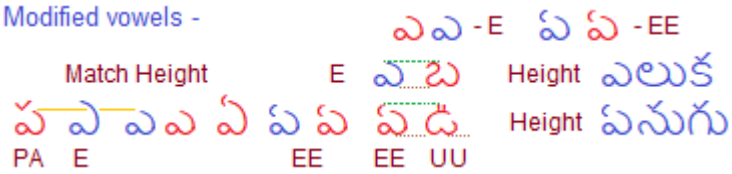

Fig. 81

- Height of modified vowel – ఏ – EE – is equal to modified vowels – ఁ – U – and – ఁఁ – UU –
- Modified vowel – ఎ – E – height is equal to consonant – ఒ – BA –
- Modified vowel – ఎ – E – no clash with any other vowel or consonant
- Modified vowel – ఎ – E – now comes under “Perfect single vowel form”

Vowel – ఓ – OO –
Modified vowel – ఓ – OO –

- Many fonts vowel – ఓ – OO –, Spur is not sharp and good shape
- Forward direction spur – ◌ – over the head-collar bar denotes long tone

Modified vowel – ఔ – AU –

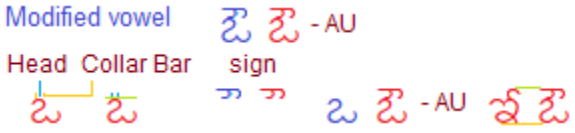

Fig. 82

- Modified vowel – AU – is just touching the head–collar bar (not merging with heard collar bar)
- Uniform height of modified vowel – AU – and substitute – II – vowel

Modified conjunct vowel – అం – UM –

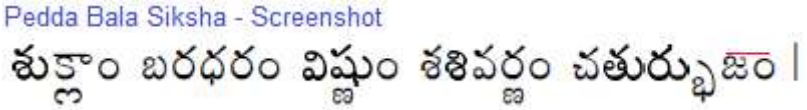

Fig. 83

Pedda Bala Siksha[1] screenshot

- Modified conjunct vowel – అం – UM – ం – is similar to old Telugu script
- UM – ం – is smaller than vowel – అ – A –, will not clash with Zero (0)
- Modified conjunct vowel – అం – UM – looks much better and more open space
- No modification to conjunct vowel – అః – AHA

Vowels including modified/substitute vowels – Total = 16

"Perfect single vowel form" - earlier 4, now 8

Fig. 84

"Single vowel form" = 6

Fig. 85

Vowels – Height levels – Before and after

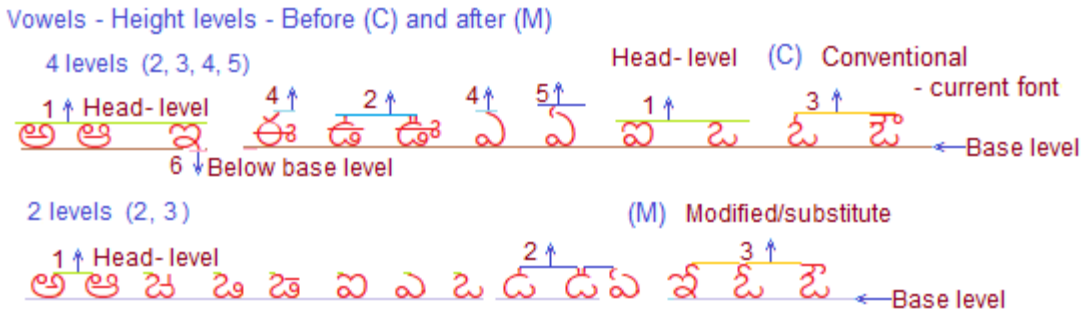

Fig. 86

- M - Now only two levels after modification/substitute
- C – Before modification/substitute –
  - Four levels above Head level of "Perfect single vowel form"
  - 1 level below the base line of consonants
- Complexity level reduced – only two levels
  - "Perfect single vowel form"
  - "Single vowel form"

Vowels – Height groups

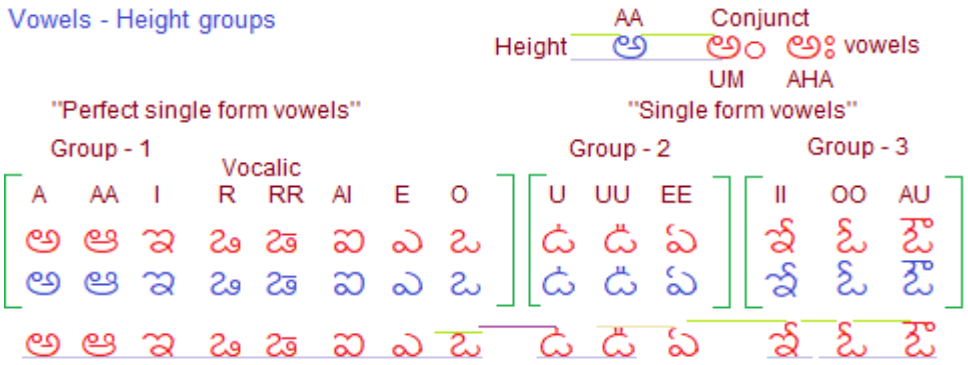

Fig. 87

- 3 different height levels – Height level groups = 3
- Conjunct vowels fall under Group 1
- Group 2 and 3 fall under "Single vowel form"
- Conjunct vowels height is equal to "Perfect single vowel form"

Vowels including modified/substitute

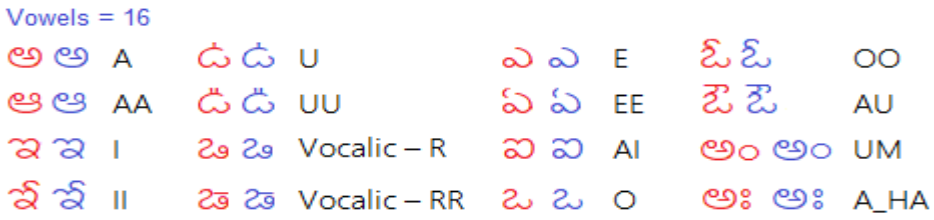

Fig. 88

Similar features matching and nearby tone harmony vowels pairs
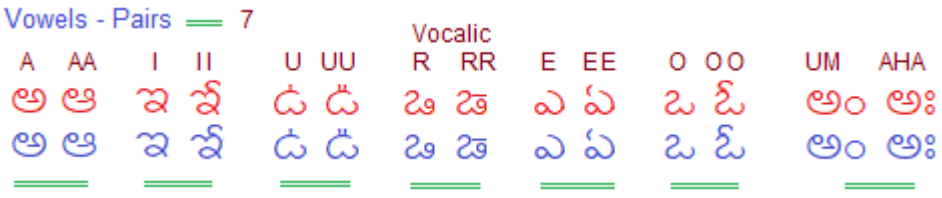
Fig. 89

- Pairs – underlines marked in Green – 7 pairs (14 vowels) – some with height difference
- No matching pair to other vowels

Eliminated vowels shape, size – form = 8

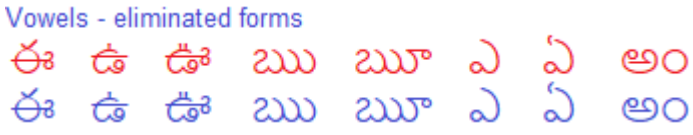

Fig. 90

I. Vowels signs

1. Modification/substitute
2. Adjust the level of vowel signs
3. Position placement of vowels signs without affecting the shape and size of consonants
4. Advantages with each sign examples
   Vowels signs and symbolic signs

- Modify/substitute some vowels signs
- Position and placement of vowels and symbolic signs

Modified/substitute some vowels signs - Advantages

Vowel – ఆ – AA – Modified – ా – AA – sign – Eye eliminated – Advantages

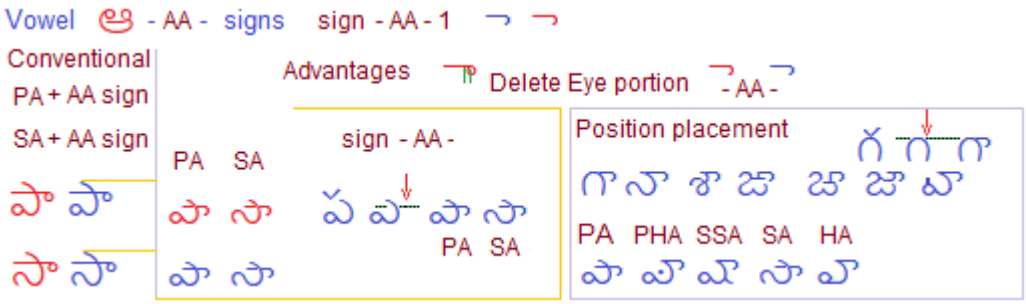

Fig. 91

- Position placement of – AA – sign to PA and SA consonants is slightly different

Sign – ా – AA – Advantages

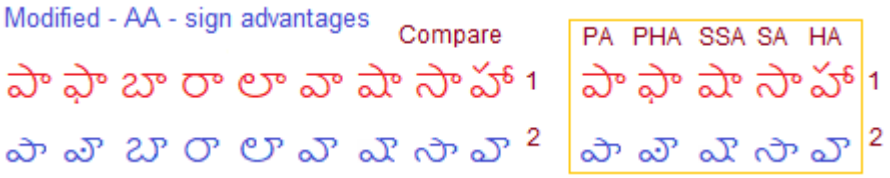

Fig. 92

- Modified – AA – sign reduces space between to consonants
- Eye portion eliminated, consonants look clear
- PHA with Dot ∴ Bullet, SSA with base ∧ Spur and HA with flat base
- Modified – ా – AA – sign suits to all other consonants, position placement given separately for all the consonants
- Easier to read write

Modified vowels – ఇ – I – and – ఈ – II –

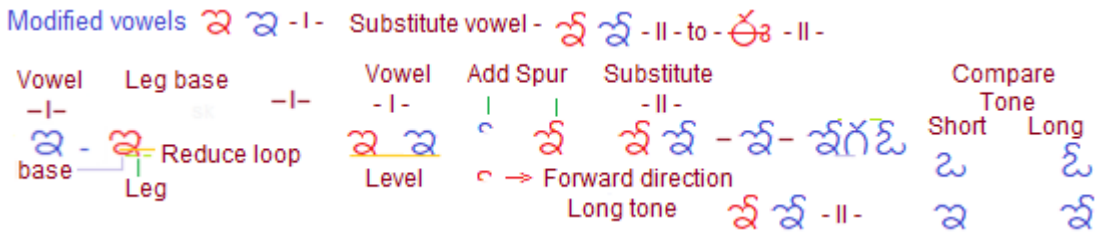

Fig. 93

- Features of both vowels match and become a good pair
- Both are very simple vowels, space saving and more open area
- Equal height of Vowel II top and Vowel – OO –

Signs – ి – I – and – ీ – II –

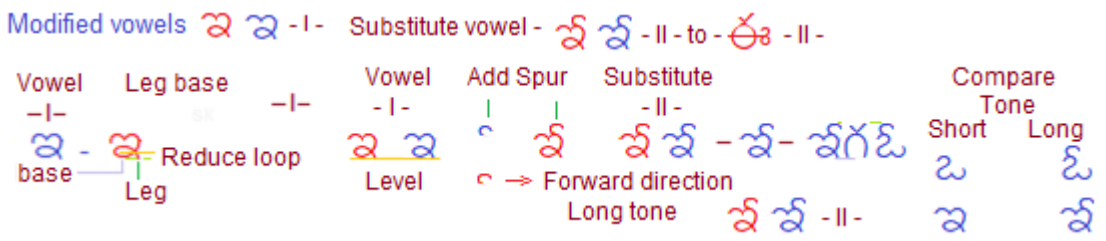

Fig. 94

Signs – ి – I – and – ీ – II – Advantages

Fig. 95

- Signs – ి – I – and – ీ – II – suitable to all consonants
- Sign – ీ – II – matches vowel – II – spur
- Script looks clear with more open space and easier to read write
- Uniform top level of – ి – I – and – ీ – II – and other signs

Vowels – ు – U – modified sign – ు – and vowel – ూ – UU – modified sign – ూ – Advantages

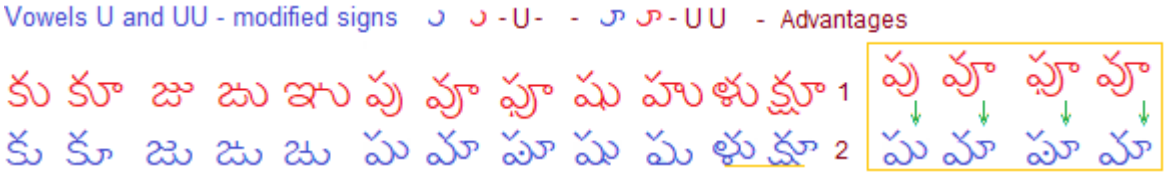

Fig. 96

- Line – 2 – Position placement of the signs is much better than conventional (1)
- Line – 2 – Position placement of the signs gives better look to the consonants
- Line – 2 – Consonant – SSA – and –KSHA– base spur is clearly visible
- Consonants shape/form not affected, more open space, clear view of consonants features
- Uniform consonants base level
- Much easier to write, read and learn

Position placement of modified sign – ు – U – and – ూ – UU – Advantages

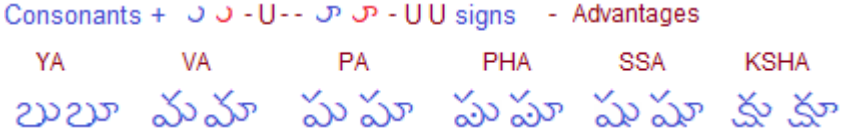

Fig. 97

- Position placement of signs above the edge point of VA, PA, PHA and SSA consonants
- Such position placement of signs is appropriate to – KSHA – and –YA also

Modified sign – ు – U – and – ూ – UU – Words – example

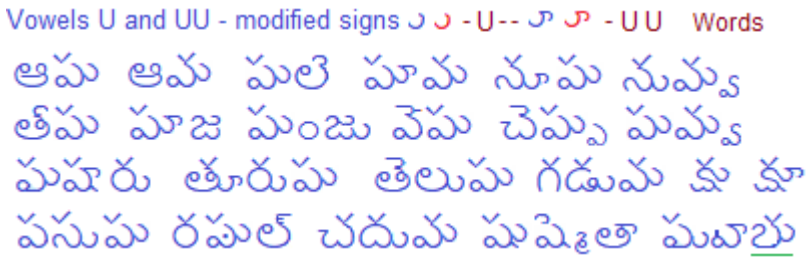

Fig. 98

- Position and placement of these signs will avoid extension below the base
- Similar position placement is good for – KSHA – and – YA – consonants
- Base spur of – KSHA – clearly visible
- Easy to distinguish consonants with these signs, easier to read write
- Such position placement never attempted earlier
- Much better than conventional sign position and placement

Vocalic – R – ఌ –and Vocalic – RR – ౡ – signs – Advantages

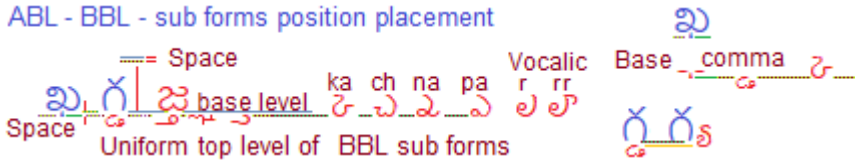

Fig. 99

- Uniform top level BBL sub forms and base level of ABL – V– R and V– RR match

Vowels – modified signs – ఎ – E – ె –and – ఏ – EE – sign – ే – EE –Advantages

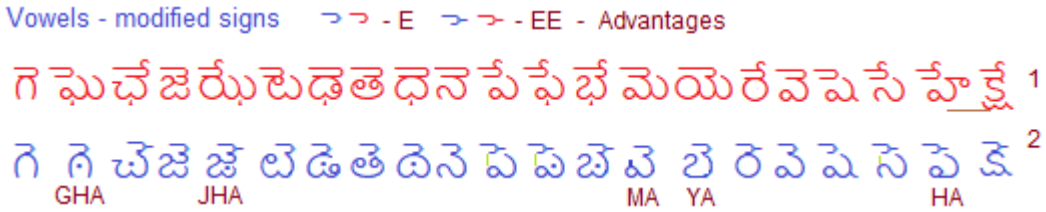

Fig. 100

- Line – 1 – Conventional (current signs) upper and lower arm's length varies and lower arm is merged in Collar bar/terminal tip/Pin bar/stem bar
- Line – 2– Modified signs are very simple and suitable to all consonants, lower arm not merged
- Line – 2– Sign –EE –bar denotes long tone
- More open space, clear view of consonants and easier to read write

Vowel – modified sign – – ఐ – AI – sign – ై – ై – Advantages

Fig. 101

- Line – 1 – conventional way – current font with extender bar – ౕ –
- Line – 2 – PIN shape vowel sign with two bars

- Simple sign suitable to all types of consonants
- Top level of the sign is equal to the top level of – E – sign – (2)

Vowels –modified signs – ◌ొ – O – and – ◌ో – OO – – Advantages

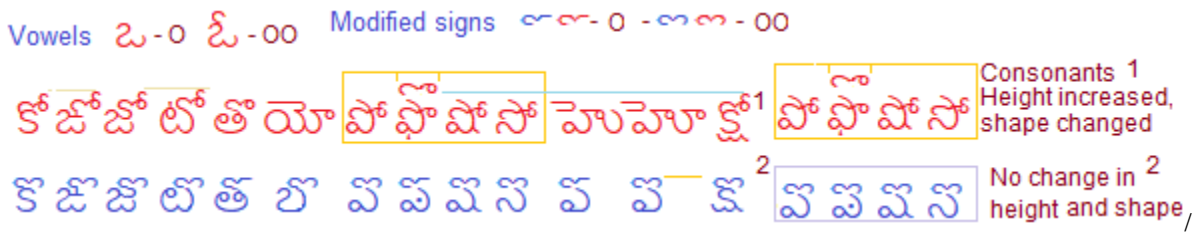

Fig. 102

- Line – 2 – Modified signs – O – and – OO – are uniform to all consonants and are much better than conventional signs – Line – 1 –
- No need to increase height of consonants and no change of shape of consonants
- Sign – OO – two cups denote long tone
- Uniform top level – Line – 2 – and more open space
- Shorter length perfectly suited to all consonants

Modified vowel sign – ◌ౌ – AU – – Advantages

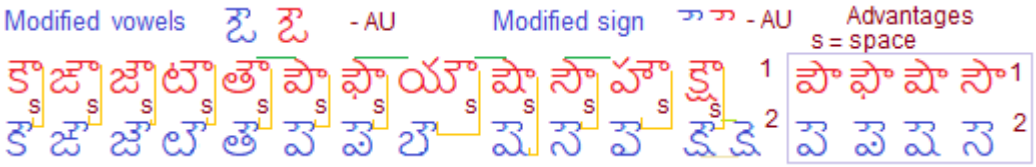

Fig. 103

- Line – 2 – Modified sign – AU – is simple and suitable to all consonants, consonant shape not affected
- Line – 2 – s – less space than conventional sign
- Same top level to – E – sign – Line – 2
- Space saving, clear look, much better than conventional sign

Modified Halant – ◌్ – symbolic sign – Advantages

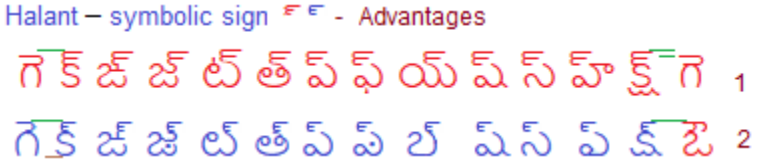

Fig. 104

- Line – 1 – conventional and current font, level varies
- Line – 2 – modified Halant sign suits to all consonants
- Modified Halant position placement is similar to vowel sign – E –

Position placement of vowels signs

It is very much necessary to define position placement of each vowel sign to every consonant. Position placement of each vowel sign is very import. Same is the case with Halant. Level of position placement of each sign will avoid uneven levels in the script.

Every consonant is unique by its features and form. However, consonants can be grouped on the basis of their common features like Head-Collar-bar, Terminal Tip, Terminal bar, PA type consonants and Stem-Tip-Pin –Cups. Signs EE and OO are with bar to indicate long tone. All these will assist in easy read write and easier learning.

Each vowel sign has also its unique features. Length of few signs may slightly vary according to position placement based on consonant features. Every vowel sign has its base point. Base point will touch with the defined position placement for each consonant. No sign base will merge with any portion of the consonant.

Eye portion and spur are totally eliminated for each sign to make single level like Devanagari, Kannada and other scripts. This means uniform top level of the signs above the consonant head. Consonants shapes/forms and features are not affected with these signs. Consonants look very clear even with these signs. This also creates more space between two consonants and also between two words without losing beauty of the script.

Vowels – signs

Fig. 105

Modified signs – Example

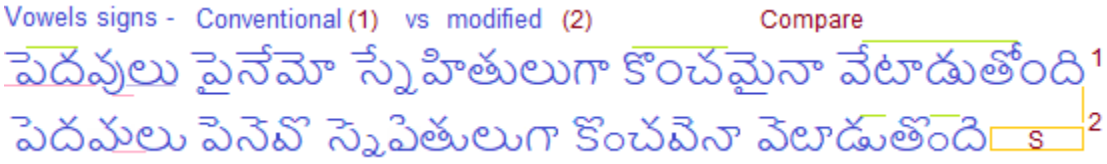

Fig. 106

- Conventional vowels signs – level difference – Line – 1
- Line – 2 – s = space saving and uniform top level – only one level – multi-level eliminated,

Vowels – Words

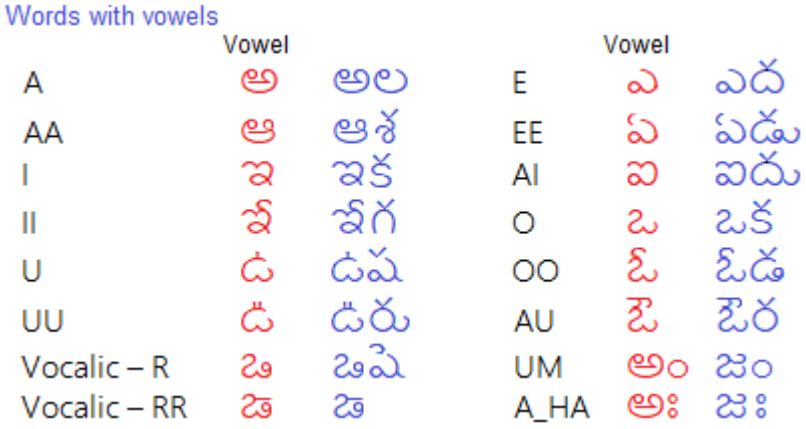

Fig. 107

Eliminated vowels signs forms

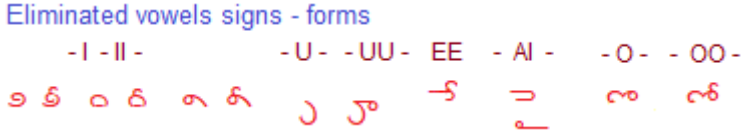

Fig. 108

- Eliminated above conventional vowels signs - forms

Hereinafter

- All consonants, modified consonants and substitute all will be referred as “consonants”
- All secondary forms, modified, substitute will be referred as “Sub forms”
- All vowels, modified vowels, substitute vowels will be referred as “Vowels”
- All vowels signs, modified signs,, substitute signs will be referred as “Vowels signs”

Compare levels - vowels signs and Halant symbolic sign – all signs same level

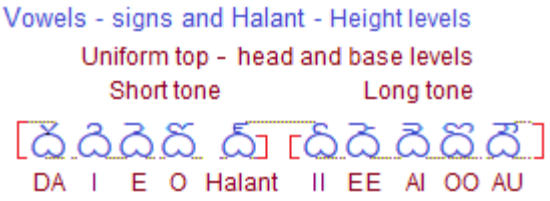

Fig. 109

- Uniform top level of Head–stroke, short tone signs, long tone signs and Halant

Consonants – vowels – signs – position placement – Groups

Consonants are grouped according to their features. This is necessary to position and placement of vowels signs for each consonant under the respective group. Position placement of each category of signs to these consonants will avoid uneven positions and adjust the spacing between two consonants and also words. Such position and placement will clearly show consonant features and good look to the script. This will facilitate easier learning, read write. Print will also look much better than the conventional signs.

Consonants are grouped as Collar – Head, Stem – Pin – cups, Terminal bar, Terminal tip and PA – PHA – SA – HA. Vocalic – R and Vocalic – RR come under ABL group.

Consonants – vowels – signs – positon placement groups

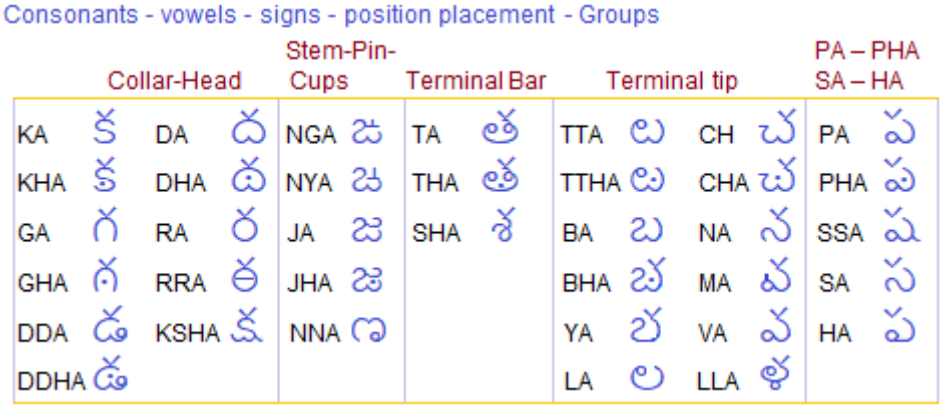

Fig. 110

PA – PHA – SSA – SA – HA – Group

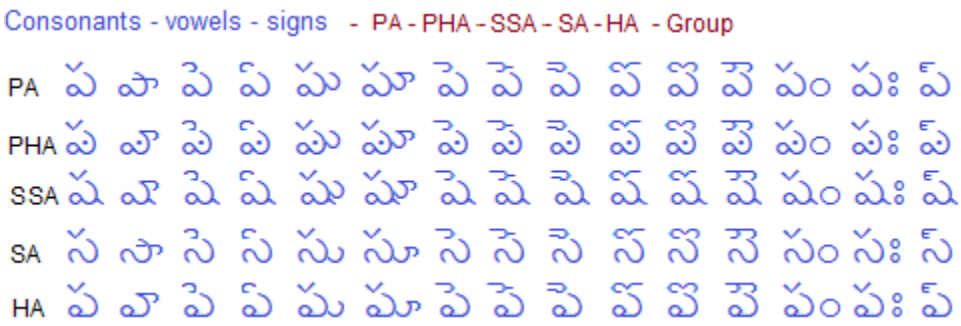

Fig. 111

Collar–Head – Group

Fig. 112

Stem – Pin – cups – Group

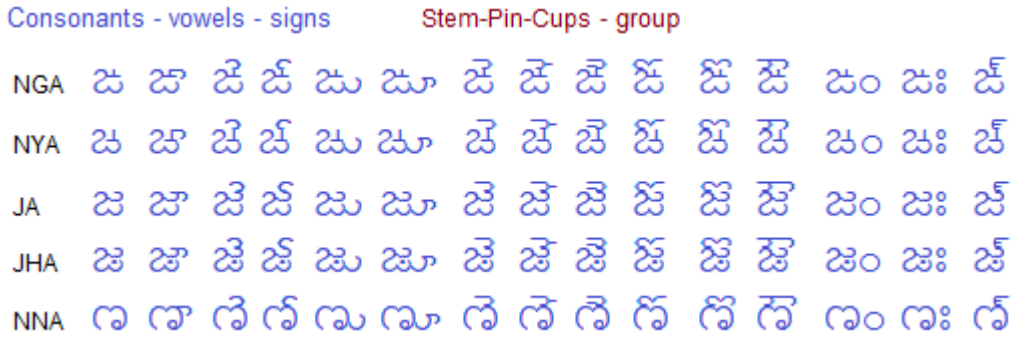

Fig. 113

Terminal bar – Group

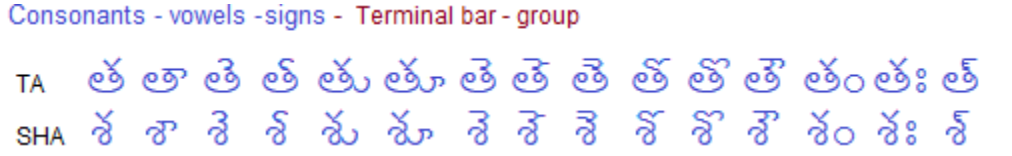

Fig. 114

Terminal tip – Group

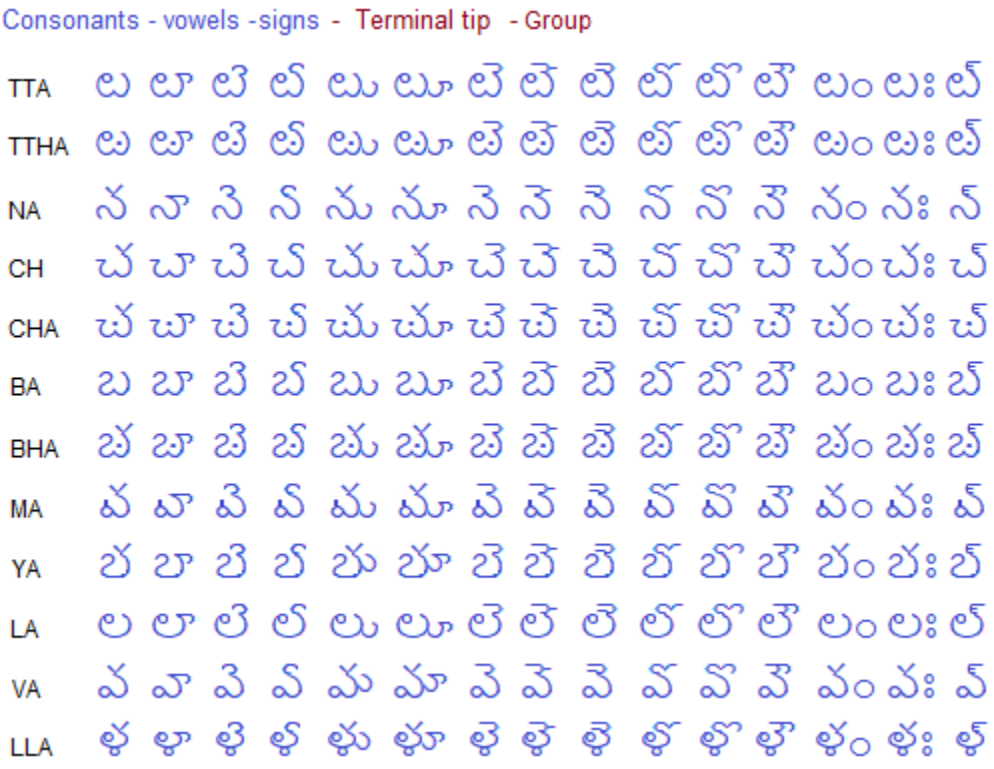

Fig. 115

- Position placement of vowels signs is ideal to keep up uniform consonants base level
- Position placement of sign – AA – to PA and SA is slightly different – for easier identification
- Position placement of U and UU signs for YA, PA, PHA, SSA, SA, HA and KSHA look very good
- Sign – AA – suits to all consonants giving more open space and saving space
- Stem – Pin – cups – Group – signs position placement differs to give clear view of consonants features
- Consonant form/features look sharp and clear including base spur of consonant – SSA and – KSHA
- Consonants form/features not affected
- Position placement of vowels signs keep equal top level

Consonants – Word

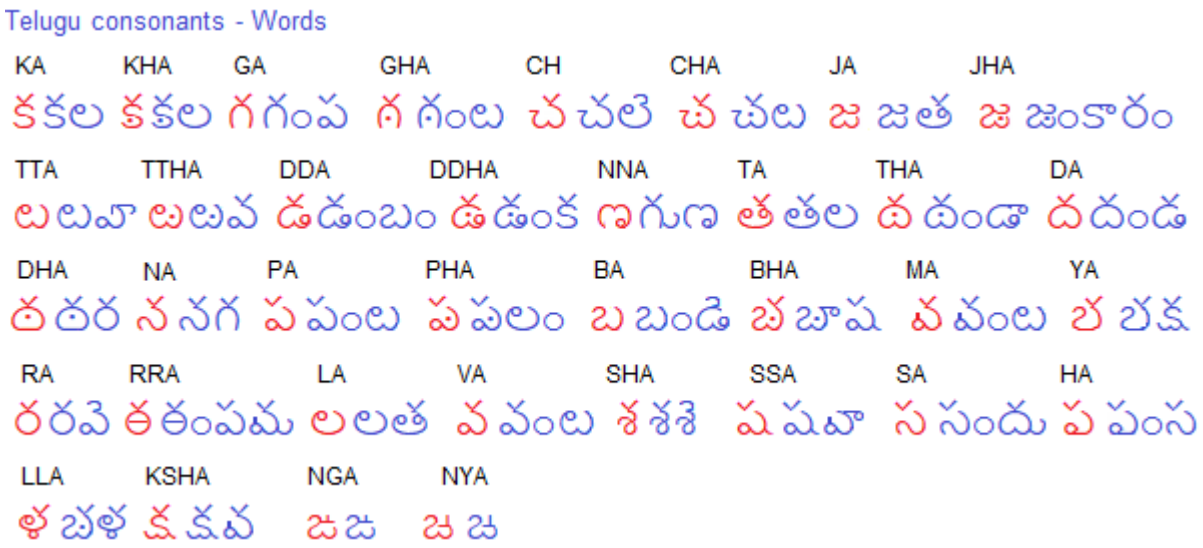

Fig. 116

Script examples :

1

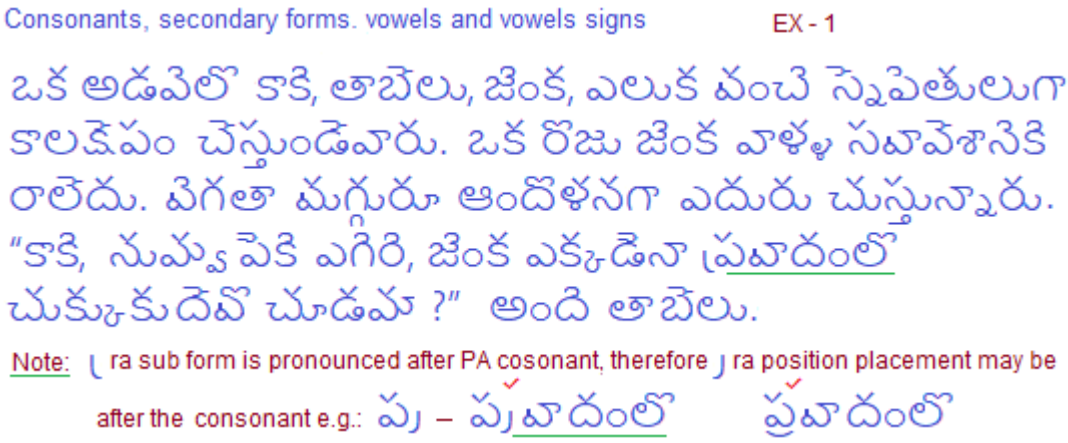

Fig. 117

- Positon placement of ra sub form may be after the consonant like Devanagari and Kannada to give correct pronunciation. While reading consonant is pronounced with semi half tone with more stress on ABL sub forms. Similarly with BBL sub form

2

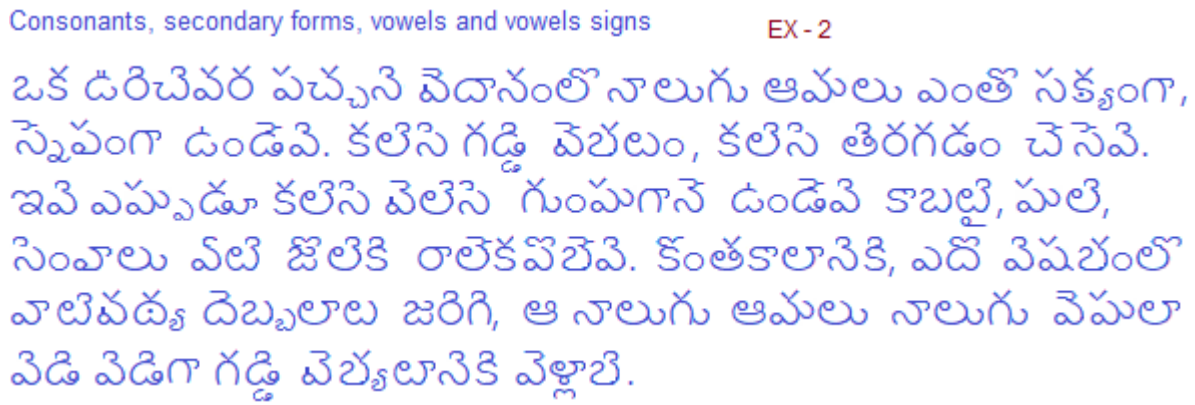

Fig. 118

3

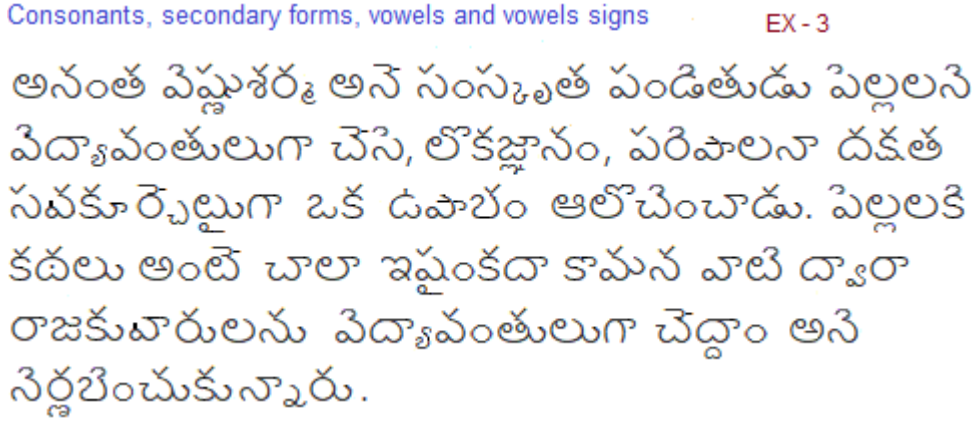

Fig. 119

- All 3 scripts` look very clear and much better with more open space
- Uniform top level of short tone signs + Halant
- Uniform top level of long tone signs
- Uniform top level of all BBL sub forms

- Easy to read even symbolic sub form
- Uniform consonants base level, no ups and downs
- Consonant shape not affected
- Position placement of vowels signs is appropriate
- Position placement of all vowel signs is much better than the conventional way

Head–ˇstroke - Vowels signs – Halant – uniform top and base level –

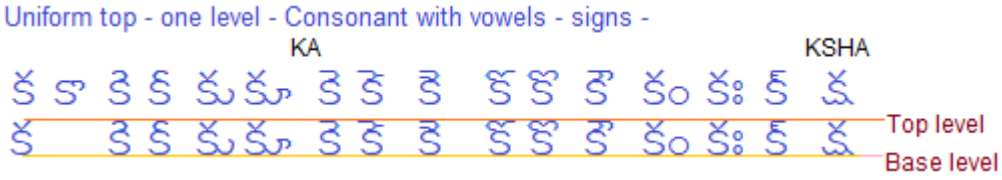

Fig. 120

Scripts – uniform top level – compare

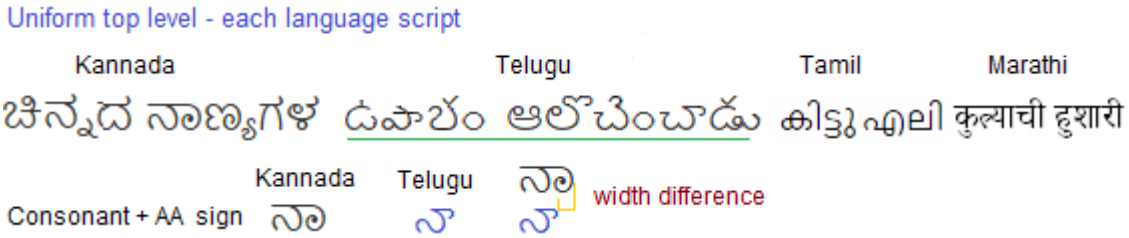

Fig. 121

- After above procedure Telugu script fits in the same category of uniform top – one level

A brief summary of method followed – all levels

Level – 1 – Consonants = 36

- All Head–ˇstroke consonants 27 come under single consonant form
- 11 consonants pairs (22 consonants) – before 9 (18 consonants)
- All consonants are of almost same width – before 14 width groups
- Uniform base level – before uneven
- Defined Astavarga consonants
- 11 consonant forms eliminated

Telugu consonants - extensions and combinations – levels

- Head –ˈ– comma eliminated
- Base –ˌ– comma eliminated of all consonants and replaced by Dot˙ Bullet
- No sideward extension to any consonant
- No –AA – sign bar to any consonant, before 1

Level – 2– Sub forms

Consonants – Sub form groups (SF – Secondary/Sub Forms)

C. ABL – Above and below the base line – level of consonants

- 16 ABL sub forms height reduced
- Uniform height of all ABL sub forms
- Uniform base level
- Sub forms pairs 3 (6 sub forms)
- None with Base–ˌ–comma extension – before 3
- Uniform spacing below base level of consonant – before uneven
- Substitute to symbolic – kha – sub form added

D. Below the base line – BBL sub forms level

- 11 Symbolic sub forms – before 3
- 7 pairs – before 4
- None with extension – before 7
- None with Base– –comma extension – before 5
- None with Head– –comma – before 1
- None with base spur – before 1
- Sub forms pairs 2 only – before 1
- None with extension – before 1
- Sub forms width almost same – varied before
- Uniform spacing below base level of consonant – before uneven

Level – 3– Vowels

Out of 16 vowels

- None with Head– stroke – before 1
- Non with extended leg – before 1
- 1 conjunct vowel modified
- None with sideward extension – before 4
- 7 vowels pairs (14 vowels) – before 5
- 14 "Perfect single vowel Form" – before 4
- 6 "Single vowel Form" – before 4
- 5 vowels forms eliminated
- 3 vowels height groups

Level – 4– Vowels signs

- 2 vowels – I – II – signs one shape – before 3 shapes each
- Slightly different position placement of AA sign to PA and SA than other consonants
- U and UU signs simplified
- Modified shape of – O – and – OO – signs
- Substitute AI sign, eliminated lower extender bar
- AU sign slightly modified, eliminating Eye portion
- Reduced length of signs
- Defined position placement of vowels signs to group wise consonants
- Modified position placement of U and UU signs to YA, VA, PA, PHA, SSA and KSHA
- Eliminating Eye portion of all signs

Other details

- Substitute to NYA and YA
- Original shape of consonants not affected with vowel signs
- Defined position placement of vowels signs
- Uniform top – one level of both short tone and long tone signs and also Halant
- Length of all signs reduced
- 3 vowels substituted – II, Vocalic R and Vocalic RR

6. SUMMARY HIGHLIGHTS:

- Single consonant form – Fig. 51
- Perfect single consonant form – Fig. 52
- Consonants pairs – Fig. 53
- Eliminated consonants forms – Fig. 55
- Astavarga consonants – Fig. 56
- ABL sub forms – Fig. 61
- ABL sub form pairs – Fig. 62
- BBL sub forms – Fig. 61
- BBL sub forms pairs – Fig. 69

- ABL and BBL sub forms position placement spacing – Fig. 59
- BBL sub forms position placement example – Fig. 70
- ABL – BBL sub forms – position placement – Example – Fig. 74
- Vowels – Fig. 81
- Vowels – pairs – Fig. 82
- Eliminated vowels – forms – Fig. 83
- U and UU signs position placement – consonants – Fig. 97
- U and UU signs position placement – word – Fig. 98
- Vowels and signs – Fig. 105
- Vowels signs example – Fig. 106
- Vowels– Words – Fig. 107
- Eliminated vowels – signs – forms – Fig. 108
- Levels - vowels signs and Halant symbolic sign – Fig. 109
- Vowels signs position placement – Consonants – Groups –Fig. 100
- Consonants group wise defined position placement of vowels signs – Fig. 110, Fig. 111, Fig. 112, Fig. 113, Fig.114 and Fig. 115
- Consonants – words – Fig. 116
- Script examples – Fig. 118, Fig. 119, Fig. 120 and Fig. 121

7. RECOMMENDATIONS:

- Script examples given above show much uniformity levels with more open space
- Each consonant has unique features and can be adapted
- Each vowel has unique features and suggested vowels forms can be adapted
- Vowels signs can be adapted
- If head bar length of vowels U and UU and EE spur slightly increased, then there will be only two height levels
- ABL and BBL sub forms are also good to adapt
- Uniform top level of BBL sub forms and matching base level of ABL sub form is good to adapt
- Spacing between consonants and sub form is good to adapt
- More BBL symbolic sub forms are good for the script
- Head–ˇstroke can be eliminated of CH, CHA, DDA, DDHA, TA, THA, DA, DHA, BHA, YA, SHA and LLA
- All consonants fall under “Perfect consonant form” and “Single consonant form” are good to adapt
- Maximum number of consonants and vowels pairs is also unique for Telugu script
- From edge to Terminal tip, curve may be reduced
  - All above can be adapted to easier learning
- Position placement of vowels signs for each consonant is good to adapt
- Position placement of signs U and UU to YA, VA, PA, PHA, SSA and KSHA can be adapted
- Eliminated Eye portion of all signs is good to adapt
- Font developer need to focus on uniformity on shape of consonants, vowels, sub forms, vowels signs and Halant
- Standardization of fonts
- New Unicode may be defined for each sign, Head–ˇstroke, consonants and vowels

- Unicode[2] for

  - Head ˇstroke
  - Sub forms – ABL and BBL
  - Conjunct consonant KSHA

8. CONCLUSION:

In this work, several factors have been analysed including consonants - their features and structures, pairing of consonants, consonant sub forms and spacing etc. Vowels and vowel sign features, Halant - symbolic – sign and Head ˇstroke have also been analysed. Details given under analysis show the magnitude of complexity in the Telugu script. Uneven levels are glaring as the font size increases more than 10pt. Script shows such uneven levels with most of the fonts. Similar ups and downs are also noticed in several Telugu scripts on websites, printed text, etc. The complexity of Telugu script is much higher than Devanagari, Kannada and other Indic scripts.

Procedure adopted eliminated multi-level complexity and create more open space. Method yielded good results which are highlighted under brief summary above. Height of vowels has been brought down to three levels. Vowels signs have been simplified. Above consonants with vowels signs are now at one height level. Uniform top level of short tone and long tone vowels signs, Halant and Head–ˇstroke is good for the script. Position placement of vowels signs for each consonants group is well defined. Defined

position placement of vowels sign for each consonant is very important to view clearly consonants features, maintain uniformity and avoid uneven levels.

Maximum number pairs of consonants and vowels are an asset to Telugu script. Simple modification show good results. Few substitutes both for consonants and vowels are good to adapt. All 27 consonants with Head–stroke are brought under "Single consonant form" and the rest under "Perfect consonant form" is an asset to Telugu script. Width of all consonants is almost same. Few consonants forms have been eliminated. All consonants and vowels have same base level. Vowels have been brought under one width group with 2 height level. Cluster sign substituted by a simple sign is also good to adapt. Vowels signs look good and give more open space. Each vowel sign position placement is well defined for each consonant. BBL symbolic sub forms are also good with unique identity. All will add beauty to the script. Examples of script illustrations give clear view of words, consonants with sub forms and vowel signs show simplified script.

All these give about 30% space saving and nullify multi-level complexity. One level with vowels signs like other Indic script will enhance beauty of Telugu script and save lot of space between two text lines. More number of matching pairs would assist for easier learning, read write and print. Vowels also look very clear, saving space and reduce uneven levels considerably. It may also reduce number of strokes with new fonts. It may also assist in developing efficient OCR software. Standardization of Telugu fonts is also equally important.

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1. Chennabhatla Venkata Ramanamooti "Pedda Bala Siksha[1]"
2. Telugu "U0C00 Unicode[2]"
3. Telugu script – Wikipedia "https://en.wikipedia.org/wiki/Telugu _script"