

Proposal to Encode Sinhala Archaic Numerals and Numbers

1. Introduction

This paper will present a proposal for encoding Sinhala numerals and numerations in Universal Character Set (UCS). Since British occupation of Kandy in 1815, Sinhala scribes had dropped the common use of numerals in Sinhala. Although a few scholars had recorded the existence of Sinhala numerals after 1815, a comprehensive research was required to establish the past existence and precise shapes of these numerals prior to encoding.

The proposal, L2/07-002R (ISO/IEC JTC1/SC2/WG2 N3195R), which was submitted by Mr. Michael Everson to the Unicode consortium for encoding a set of numerals which he claimed were Sinhala numerals, initiated research into Sinhala numerals and numerations. Through the research which was carried out by Mr. Harsha Wijayawardhana of University of Colombo School of Computing (UCSC) under the aegis of Information and Communication Technology Agency (ICTA) of Sri Lanka, it was discovered that other than the set of numerals submitted by Mr. Michael Everson for encoding, there were four other sets which were commonly used by Sinhala scribes, namely Sinhala Lith Illakkam mainly used for writing horoscopes; Swara, (Sinhala Consonant and vowel modifier based numerals); Katapayadia, a special Sinhala character based numeral set which was used for inscribing years in astrological writing and, in ancient Ola and rock inscriptions; and word based Bootha Anka or Samkaya used in Sinhala Poetry. The numeral set which was submitted by Mr. Michael Everson to UCS had been identified as Sinhala Illakkam.

Subsequently, Prof. K.D. Paranvithana of Raja Rata University and Mr. Harsha Wijayawardhana carried out further research and the findings were presented at the National Archeological Symposium held in July 2009, organized by the Department of Archeology. The Synopsis of the paper was published in the Volume II of the Symposium's proceedings. In October 2009, Mr. Harsha Wijayawardhana authored a book titled "Numerations in Sinhala Language".

2. Brief overview of the Sinhala Script

The Sinhala Script had evolved from Southern Brahmi Script from which other scripts such as Telugu and Oriya of South India had evolved. Sinhala belongs to Indo European family of languages and has a close kinship with northern Indian Languages such as Hindi, Bengali, and Gujarati etc. Sinhala script was subsequently influenced by Grantha writing of Southern India and shapes of Sinhala letters had remained somewhat static with a few changes since 1250 AD. Sinhala Script has several unique characteristics such as two additional vowels found after first two vowels, Ae and long Ae (Ae:) which allow words such as "apple" to be written in Sinhala easily. These two vowels are not found in other Indic languages. Sinhala script sans numerals was encoded in UCS in 1997.

3. Outcome of the Research

It was found in the research into Sinhala numerals that prior to the occupation of the Kandyan kingdom by the British in 1815, Sinhala scribes had used five sets of numerals:

- i. Sinhala Illakkam: This numeral set does not have a zero and had been commonly used to record numbers especially in the Royal court. It has separate symbols for 10,20,30,40,50,60,70,80,100, 1000.
- ii. Sinhala Lith Illakkam: This numeral set was widely used for calculations especially in Astrology and was continuously used well into the 20th century, mostly for writing positions of planets in horoscopes. There is some evidence that this set was used for writing page numbers and it may have been commonly used for giving numbers in inscriptions and identification of those require more research. Lith Illakkam has a zero and zero place holder concept. For zero, Sinhala Halant or Virama is used in this set.
- iii. Katapayadia: This is a special set of numerals which use Sinhala letters. Each number has several Sinhala letters and a word is made out of letters for a number and a number is depicted from right to left whereas the word can be read from left to right. Some of the Katapyadia based numbers are found in old Tamil rock inscriptions located in Pollonaruwa. These inscriptions had been created at the time of occupation of Cholla. Katapyadia based numbers become more prevalent in Sinhala inscriptions after Pollonaruwa, Dambedeniya and Kotte periods where Southern Indian influence on Sri Lank had reached its zenith.
- iv. Sinhala consonants with vowel modifiers (swara): This was used primarily for page numbering of Ola but there is evidence that it was used for general numbering of items but not in calculations.
- v. Bootha Anka or Samkaya: Numbers are depicted by certain Sinhala nouns and method of depicting numbers by words was used primarily by poets. This numbering system had come into Sinhala from Sanskrit and same objects which were used for numbers in Sanskrit were used in Sinhala as well by employing equivalent Sinhala nouns.

4. Conclusion and follow up by the Local Language Working Group (LLWG) of ICTA

ICTA's Local Language Working Group, after reviewing the research and after extensive discussions and consultations with other experts and stakeholders agreed that:

- i. Sinhala Lith Illakkam, (digits 0-9) to be included in the Basic Multilingual Plane (Sinhala block 0Dxx) of the Unicode standard from 0DE6- 0DFF.
- ii. Sinhala Illakkam (numbers 1-0, 10-90, 100 and 1000) be included in the supplementary area of the Unicode standard and it is suggested to be encoded from U+111E0 - U+111FF

These recommendations were made by LLWG taking into consideration that Sinhala Lith Illakkam was continuously used until the early part of 20th century and Sinhala Archaic Numerals ceased to be used after 1815.

5. Shapes of Sinhala Illakkam and Sinhala Lith Illakkam

i. Sinhala Illakkam

Shapes of Sinhala Illakkam were given by Mendis Gunsekera in his famous book 'A comprehensive Grammar of Sinhala Language'. And also the shapes of Sinhala Illakkam were depicted in W.A De Silva's 'Catalogue of Palm leaf manuscripts in the library of Colombo Museum'. Subsequently, the author discovered Sinhala Illakkam in the Kandyan Convention which was signed between the British and Kandyan Chieftains in 1815. The following Sinhala Illakkam were taken from the Kandyan convention:

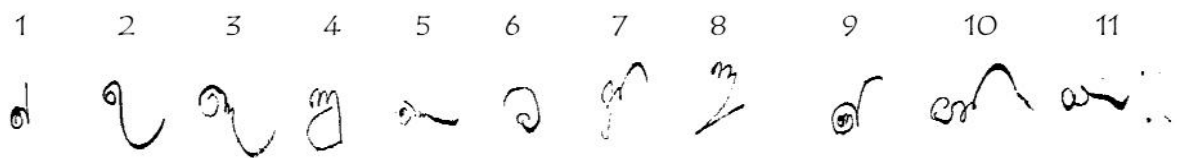


Figure 1 Sinhala Illakkam in the Kandyan Convention

Mr. Harsha Wijayawardhana had determined shapes of Sinhala Illakkam based upon all the above sources and shapes are given below:

 1	 2	 3	 4
 5	 6	 7	 8
 9	 10	 11	 12
 13	 14	 15	 16
 17	 18	 19	 20
 30	 40	 50	 60
 70	 80	 90	 100
 200	 300	 400	 500
 600	 700	 800	 900
 1000			

ii. Sinhala Lith Illakkam

Three versions of Sinhala Lith Illakkam had been discovered and some form of Halant had been used for the zero in all three versions. Mendis Gunsekera had stated in one of his papers that the symbol for zero in Arabic numerals can be used in place of the Sinhala Virama or halant in Sinhala Lith llakkam.

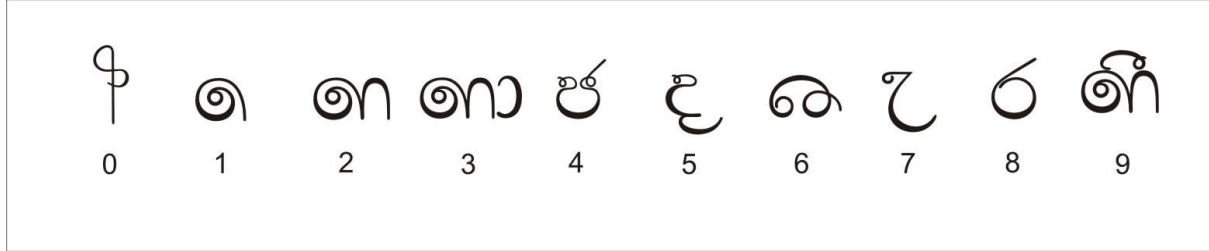


Figure 2 Sinhala Lith Illakkam

Note: In order to distinguish numbers from Sinhala letters in inscriptions, Sinhala scribes used to draw either a slanted or horizontal line across numerals.. This method had been prevalently used in writing Brahmi numerals though much research is required to establish it for Sinhala Lith Illakkam. Mr. Harsha Wijayawardhana had observed such letters which were struck in some inscriptions which he surmises as Lith Illakkam. In order to identify that these are Lith Illakkam digits requires further research. In order to distinguish zero from the letter “o” in English, some modern writers still draw either a horizontal or slanted line across.

Figure 3 Sinhala Lith Illakkam with line drawn horizontally to separate Sinhala characters from Sinhala lith Illakkam digits

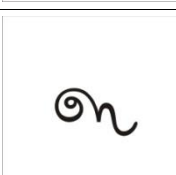
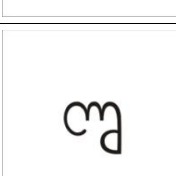
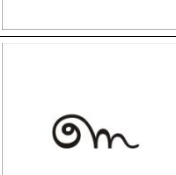
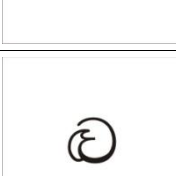
6. Proposed shapes and Code Points for encoding of the both Sinhala Lith Illakkam and Sinhala Illakkam

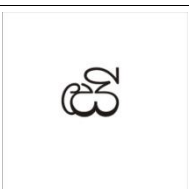
6.1 Sinhala Lith Illakkam

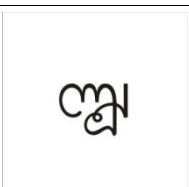
Code	Image	Name
0DE6		SINHALA LITH DIGIT ZERO
0DE7		SINHALA LITH DIGIT ONE
0DE8		SINHALA LITH DIGIT TWO
0DE9		SINHALA LITH DIGIT THREE
0DEA		SINHALA LITH DIGIT FOUR
0DEB		SINHALA LITH DIGIT FIVE
0DEC		SINHALA LITH DIGIT SIX
0DED		SINHALA LITH DIGIT SEVEN

0DEE		SINHALA LITH DIGIT EIGHT
0DEF		SINHALA LITH DIGIT NINE

6.2 Sinhala Illakkam,

111E1		SINHALA ARCHAIC NUMBER ONE
111E2		SINHALA ARCHAIC NUMBER TWO
111E3		SINHALA ARCHAIC NUMBER THREE
111E4		SINHALA ARCHAIC NUMBER FOUR
111E5		SINHALA ARCHAIC NUMBER FIVE
111E6		SINHALA ARCHAIC NUMBER SIX

111E7		SINHALA ARCHAIC NUMBER SEVEN
111E8		SINHALA ARCHAIC NUMBER EIGHT
111E9		SINHALA ARCHAIC NUMBER NINE
111EA		SINHALA ARCHAIC NUMBER TEN
111EB		SINHALA ARCHAIC NUMBER TWENTY
111EC		SINHALA ARCHAIC NUMBER THIRTY
111ED		SINHALA ARCHAIC NUMBER FORTY
111EE		SINHALA ARCHAIC NUMBER FIFTY
111EF		SINHALA ARCHAIC NUMBER SIXTY

111F0		SINHALA ARCHAIC NUMBER SEVENTY
111F1		SINHALA ARCHAIC NUMBER EIGHTY
111F2		SINHALA ARCHAIC NUMBER NINETY
111F3		SINHALA ARCHAIC NUMBER ONE HUNDRED
111F4		SINHALA ARCHAIC NUMBER ONE THOUSAND

	111E	111F
0		අශ්‍රම 111F0
1	ආ 111E1	භි 111F1
2	ල 111E2	භි 111F2
3	ආ 111E3	භි 111F3
4	ආ 111E4	භි 111F4
5	ආ 111E5	
6	ආ 111E6	
7	ආ 111E7	
8	ආ 111E8	
9	ආ 111E9	
A	ආ 111EA	
B	ආ 111EB	
C	ආ 111EC	
D	ආ 111ED	
E	ආ 111EE	
F	ආ 111EF	

Figure 4 Sinhala Illakkam In SMP and 111E0 is kept for zero if required. And other spaces for fractions and high numbers such hundred thousand etc

	0D8	0D9	0DA	0DB	0DC	0DD	0DE	0DF
0		ඩි 0D90	ච 0DA0	ධ 0DB0	ව 0DC0	් 0DD0		
1		ඵ 0D91	ජ 0DA1	නි 0DB1	ශ 0DC1	් 0DD1		
2	ං 0D82	ඵ 0D92	ජ 0DA2		මි 0DC2	ි 0DD2		ා 0DF2
3	ං 0D83	ඵ 0D93	කි 0DA3	ඳ 0DB3	සි 0DC3	ි 0DD3		ා 0DF3
4		ඵ 0D94	කි 0DA4	ඵ 0DB4	නි 0DC4	් 0DD4		ා 0DF4
5	ඵ 0D85	ඵ 0D95	කි 0DA5	ඵ 0DB5	ඵ 0DC5			
6	ඵ 0D86	ඵ 0D96	ජ 0DA6	බි 0DB6	ඵ 0DC6	් 0DD6	ඵ 0DE6	
7	ඵ 0D87		ඵ 0DA7	නි 0DB7			ඵ 0DE7	
8	ඵ 0D88		බි 0DA8	මි 0DB8		ා 0DD8	ඵ 0DE8	
9	ඵ 0D89		බි 0DA9	මි 0DB9		ා 0DD9	ඵ 0DE9	
A	ඵ 0D8A	කි 0D9A	බි 0DA A	සි 0DBA	් 0DCA	ා 0DDA	ජ 0DEA	
B	ඵ 0D8B	බි 0D9B	නි 0DAB	ඵ 0DBB		ා 0DDB	ඵ 0DEB	
C	ඵ 0D8C	ග 0D9C	බි 0DAC			ා 0DDC	ඵ 0DEC	
D	කි 0D8D	කි 0D9D	නි 0DAD	ඵ 0DBD		ා 0DDD	ඵ 0DED	
E	කි 0D8E	බි 0D9E	ඵ 0DAE			ා 0DDE	ඵ 0DEE	
F	ඩි 0D8F	ග 0D9F	ඵ 0DAF		ා 0DCF	ා 0DDF	ඵ 0DEF	

Figure 5 Encoding of Sinhala Lith Illakkam in BMP

7. Fonts

Fonts for the both Sinhala Illakkam and Sinhala Lith Illakkam have been created and will be released once encoding has been carried out.

8. Main Reference

Harsha Wijayawardhana, Numerations in the Sinhala Language, Information and Communication Technology Agency of Sri Lanka (ICTA), October 2009

9. Other References

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ගුණසේකර ඒබ්‍රහැම් මෙන්දිස් ග්‍රන්ථාන්වය, කතෘ - (පිටු අංක 3 සිට 10 දක්වා)

Appendix I

Sinhala Illakkam.

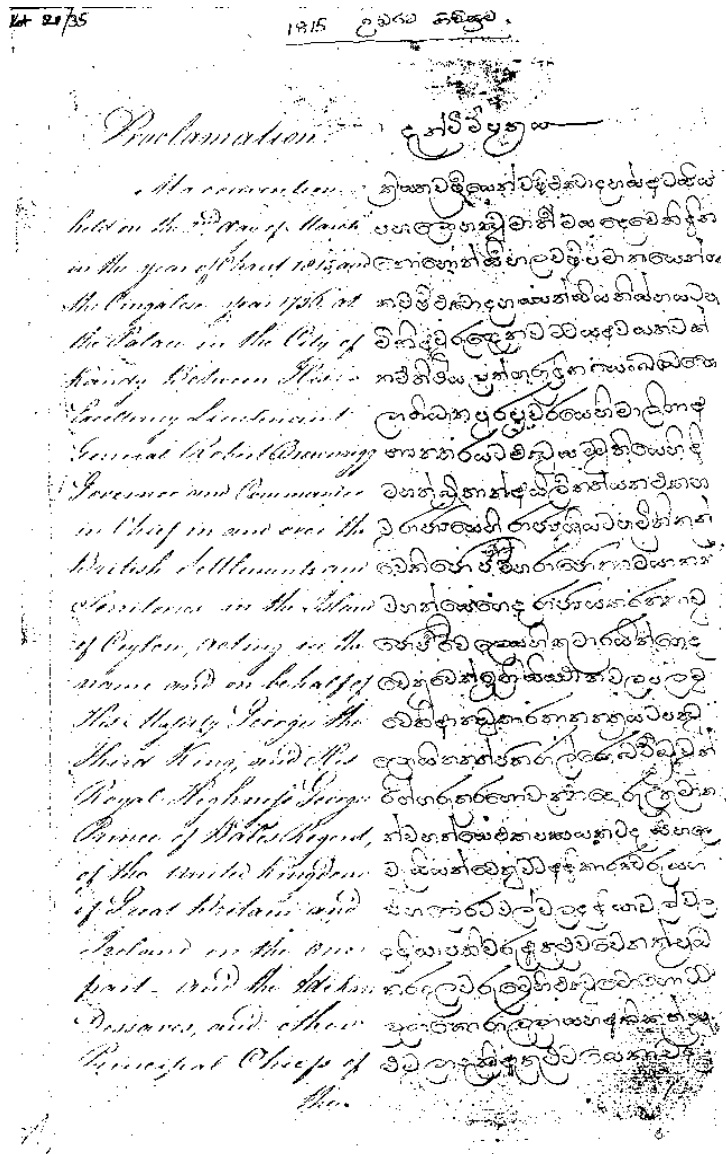


Figure 6 First Page of the Convention signed between Sinhala Nobles and the British

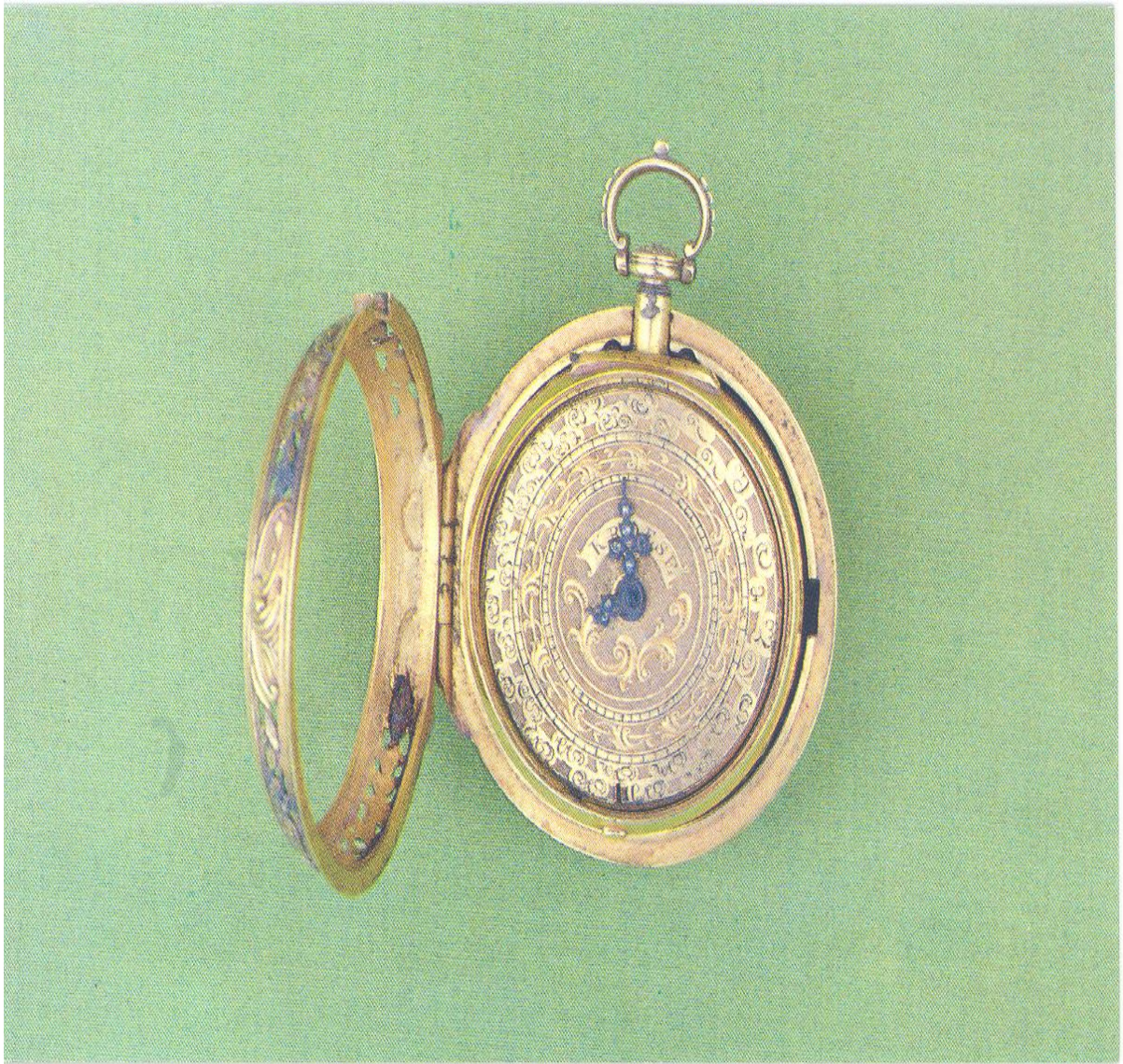


Figure 9 Pocket Watch used by last King of Kandyan Kingdom with Sinhala Illakkam

Appendix II Lith Illakkam

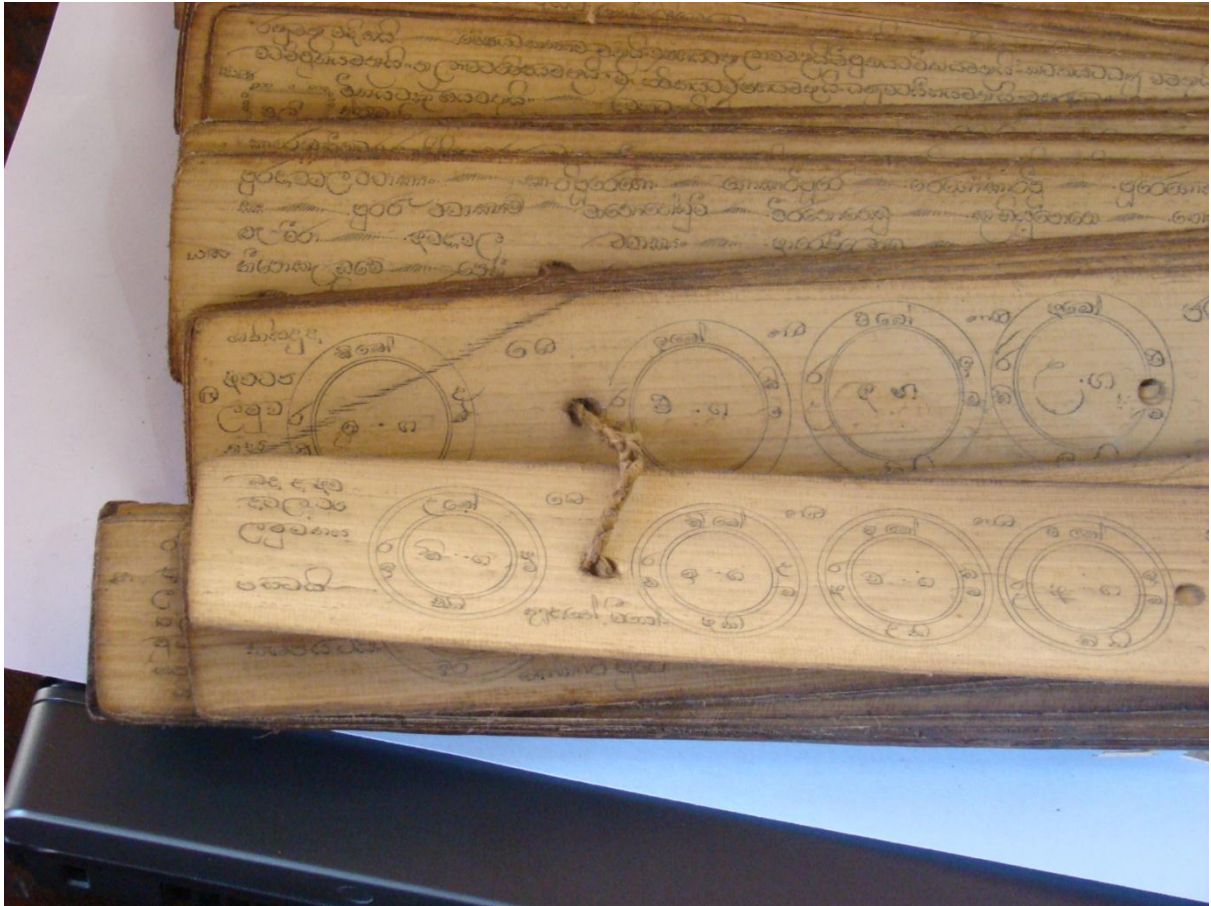


Figure 10 Ola book with astrological calculations in Kandy Museum

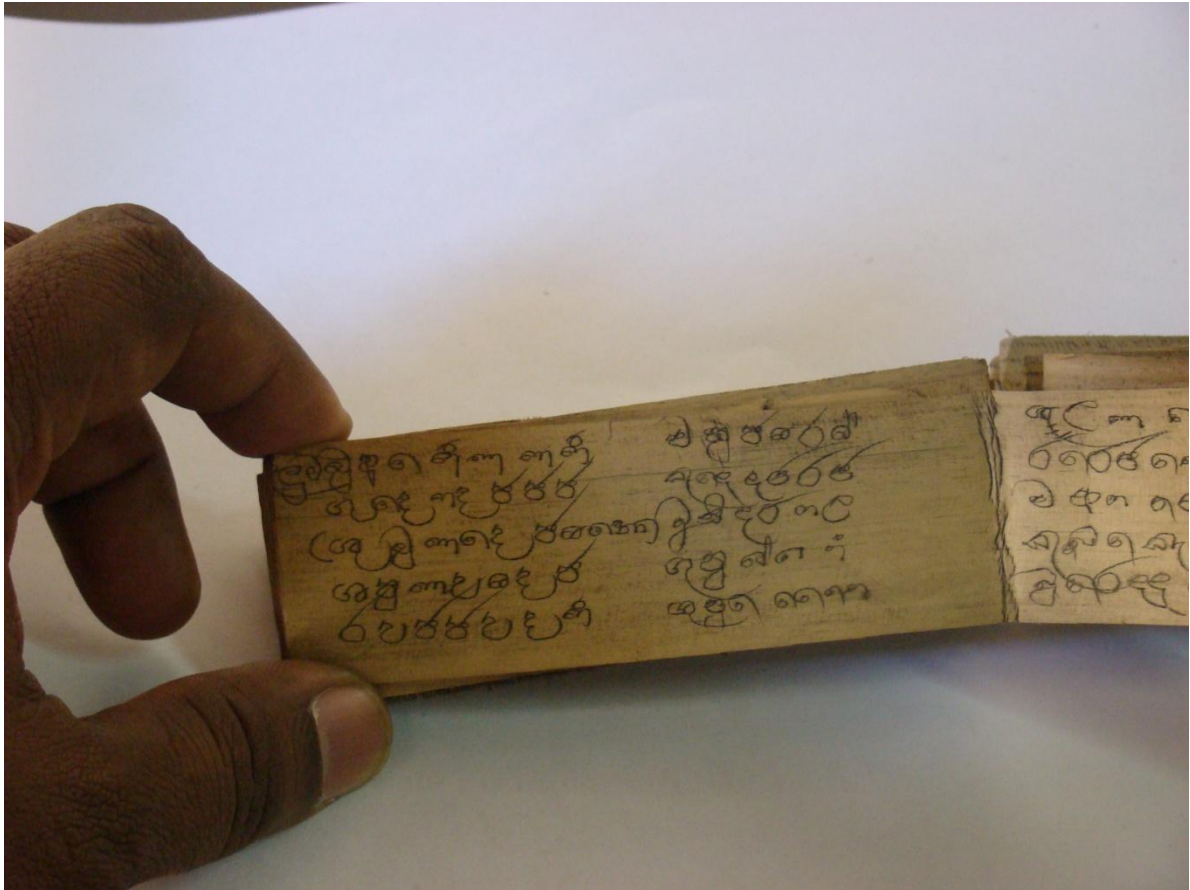


Figure 11 Planetary Position depicted with Sinhala Lith Illakkam- Kandy Museum



Figure 12 A 20th century horoscope with Sinhala Lith Illakkam



Figure 13 Ola book with page numbers in Sinhala Lith Illakkam