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Design and Development of a PC Application to Address the Challenges Faced by Sri Lankan Academics in Typing North Indian Classical Music Notations

G. K. Subhash[1] and M. A. K. P. Kumarasiri[2]

[1]Department of Music and Creative Technology, University of Sri Jayewardenepura, Sri Lanka,
[2]Department of Information Technology, Sri Lanka Institute of Information Technology

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*Corresponding author
E-mail address:
subashkavidhu1@gmail.com

https://orcid.org/0009-0009-0304-6016

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ABSTRACT

The objectives of this study were to identify the challenges encountered by Sri Lankan academics in typing North Indian music notations and introduce a Portable Computer (PC) application as a solution for the identified challenges. So far, there has been no adequate study of the problems encountered by the Sri Lankan academic community in typing north Indian music notations. Accordingly, the absence of a systematic as well as a more effective computerized method for transcription of north Indian music notations is the research problem for this study. The mixed method was used to carry out the research work. As revealed by this research, it can be identified that Sri Lankan academics face various challenges while typing north Indian classical music notations. Difficulty in creating notations in a short time, lack of a unique method to typing notations, inability to obtain a high-quality output, and lack of a software application designed for only this purpose can be identified as those challenges. Accordingly, a software that can reduce all challenges, and can type north Indian music notations in both Sinhala and English languages was created by the researchers. Therefore, academics can type north Indian music notations without any errors and with a good finish, and thus it can be concluded that the challenges faced by the scholars in typing north Indian music notations can be overcome.

1. Introduction

Indian classical music is one of the oldest music traditions in the world. The music tradition of India can be divided into two large traditions, namely, North Indian and South Indian music (Nigam, 1998). The North Indian classical music, which is predominant in the northern part of the Indian subcontinent, originates from the ancient Vedic, Persian, and many folk traditions while the South Indian classical music is prevalent in the southern parts of the Indian subcontinent (Mammen et al, 2016).

In Sri Lanka, the music curriculum primarily focuses on North Indian classical music, integrating both local and foreign musical traditions under the broader category of 'Oriental Music' (National Institute of Education [NIE], 1992). Therefore, North Indian classical music has a unique position in Sri Lanka's oriental music (Peradiga Sangīta) education. North Indian classical music is taught in both theoretical and practical levels from grade 6 to university level in Sri Lanka (Weerakkodi, 2011).

Present-day north Indian classical music has its unique style of music notating. Sri Lankan scholars use the Bhātkhandē Music Notation system, which was introduced by Pandit Bhātkhandē to notate north Indian classical music manuscripts. Computer-aided typing of music notation is important in academic work. Nevertheless, a systematic and effective method for that has not been used so far.

Therefore, this study aimed to identify the problems encountered by the academic community who are engaged in computer-assisted north Indian classical music notating.

Accordingly, a portable computer (PC) Application was introduced as a solution to the identified problems. In addition, its effectiveness was determined through the research work.

1.1 North Indian Classical Music Tradition and Sri Lankan Music Education

In terms of music education in Sri Lanka, there are two divisions, Eastern music and Western music (Meddegoda, 2020). Among the Sri Lankan music practitioners, students, and scholars, the north Indian classical music tradition is considered as one of the major traditions of eastern music studies. As Mudunkotuwe (2007) states, 'north indian musical tradition is the basement of Sri Lankan music education' (P.27). In Sri Lanka, 70% of the content of oriental music is for the study of north Indian classical music and related musical aspects (Meddegoda, 2020).

1.2 Brief Introduction to North Indian Classical Music Notation System

At present, the Hindustāni or north Indian classical music system is a systematic musical tradition, which has a developed notation system to represent musical sounds and melodies in a visual form. Music notation is defined as a system for representing music in written glyphs or characters by encoding its pitch, duration, rhythm, lyric and ornaments. Notation systems have aided in the proper dissemination of musical compositions across cultural systems and traditions as well as their preservation over time (Misra et al, 2016). According to Nigam (1998), 'The art of describing musical ideas in written characters is called Notation' (p.76). The notation of a song is the charting of the notes according to the corresponding 'Tāla' (Hindi/Sanskrit: a measurement of musical time) (Perera, 1933).

The history of the Indian music notation system dates back to the era of Panini, a grammarian who is considered to have lived around 500 BC (Nigam, 1998). As mentioned by some authors the tradition of using notations for singing was practiced from ancient Vedic times (Mammen et al, 2016). As William Wilson Hunter in his 'Imperial Gazette of India' points out, it is speculated that the system of giving symbols for the

seven musical notes introduced in panini's era may have passed from the hands of the Brahmins to the Persians, from them to the Arabs, and from them to western music at the beginning of 11th Century (Nigam, 1998).

As some scholars point out, since the time of Panini, there was a system of notating Indian music (Abhayasundara, 1963). Different forms of notation systems were used in northern as well as southern musical systems at different times (Mammen et al, 2016). However, for the first time, a systematic method for notating north Indian classical musical songs was introduced by Pandit Viśnu Nārāyana Bāthkhandē (Meddegoda, 2018; Nayar, 1989; Mudunkotuwa, 2006). It is from his Kramik Pustak Mālikā book series. In addition to his method, other notation methods (e.g.: Pandit V.D. Paluśkār's method) are used in India (Nigam, 1998; Misra et al, 2016).

In Sri Lanka, Bhātkhandē's method is commonly used (Abhayasundara, 1963). As mentioned by Meddegoda (2018), it is said that the pioneering musicians of Sri Lanka obtained their music education using the Bhātkhandē notation system. In addition, they used to provide notation ensembles, which are considered to be of the western style. Accordingly, it can be recognized that the Bhātkhandē notation system is prominently used in Sri Lankan music today.

1.3 Bhātkhandē Music Notation System; main features

Abhayasundara (1963) describes the Bhātkhandē music notation system and its basic features under 14 points.

1. 'Śuddha' (Hindi/Sanskrit: Natural) notes should only be referred to with a single note and no symbols above or below the symbol (1-D).
2. To indicate 'Kōmal' (Hindi/Sanskrit: Flat) notes, notes should be underlined (2-R).
3. A straight slash is used above the note to indicate the 'Tīvra'(Hindi/Sanskrit: sharp) note (3-M/)
4. A dot is placed below the note to indicate a 'Mandra' (Hindi/Sanskrit: Bass) note (4-Ḍ).
5. A dot is placed above the note to indicate 'Tāra /Ucca'(Hindi/Sanskrit: high) notes (5- Ṣ).
6. No marks are applied to natural notes in the middle octave either (6-N).
7. An S-shaped mark is applied to the right of the notes to indicate the number of 'Mātrās'. (Hindi/Sanskrit/Sinhala: Basic concept of time in oriental music)This is used for lyrics (7-S).
8. The number of Mātrās is indicated by short dashes (This is used for Notation) (8- -).
9. Notes belonging to a single Mātrā are in parentheses. 'Mūrki' (Hindi: an Ornament in North Indian Music). When a note is put within two brackets as '(Pā)' it means that '(Pā)' will be pronounced twice quickly touching its higher and lower neighboring note (9-(S)).
10. A technique called 'Mīnd' (Hindi: Blending Notes) is represented by the upper bracket applied over several notes (10).
11. The 'Khan' (Hindi: Grace) Note Technique is demonstrated by placing a smaller note on top of a particular note (11-RM).
12. A cross (x) sign is used to indicate the 'Samastāna' (Hindi: Most Strongest Point) of the Tāla (12-X).
13. A zero-shaped symbol (O) is used to indicate the 'Khāli' (Hindi: Weakest Point of a tāla) position of the tāla (13-O).
14. Numbers 2, 3, and 4 are used to indicate other time places (Anutālasthan) beside Samastāna (Abhayasundara, 1963, p.373-374). It means that apart from Samastāna (X) and Khāli (O), other Tāla positions

should be named as 2, 3, 4 etc (Nigam, 1998) (14-3).

15. Besides Abhayasundra's (1963) explanation, Nigam (1998) points out other few points concerning the Bhātkhandē Music Notation System.
16. ','- The sign of 'Coma' indicates very slight stoppage (15-G,).
17. '^'- This sign is a sign of 'Gamaka'(Hindi/Sanskrit: an Ornament in Indian Music) (Nigam, 1998, p.80).
18. Nevertheless, the Gamaka sign (^) was shown in early Sinhala manuscripts such as Perera's work Gīta Śikśaka (Perera, 1933). However, it is not used practically nowadays. In addition, there are other applications in modern notation systems.
19. Separation of bars by 'Vibhāgas' (Hindi:a vertical long line)s.
20. The song or the composition must be separated as 'Sthāi' and 'Antarā'(Hindi: Divisions of a song or composition) (Bhātkhandē, 2007, p.60).

The following diagram (Figure 1) shows how the above characteristics are represented in a North Indian Classical Music Notation according to Bhātkhandē 's method.

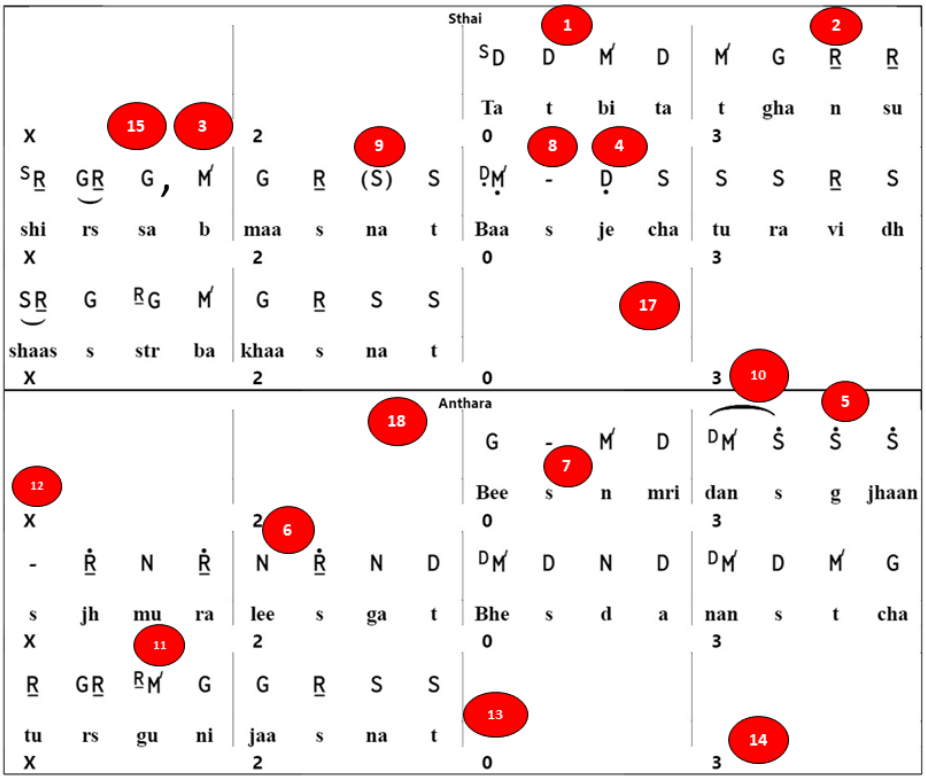

Figure 1. Main Features of Bhātkhandē 's Music Notation System

1.4 Literature Review

There has been sufficient research literature related to the fields of North Indian Music Notation System and North Indian music practice in Sri Lanka, but very few studies have been done on themes such as visual presentation of north Indian music using digital methods and typing north Indian music compositions. Considering the Sri Lankan context, musicians have, from time to time, used different symbols to represent the main symbols introduced by Pt. Bhātkandē. Some of the symbols in the early printed

notations of North Indian music, which can be considered to have followed the Bhātkandē music notation system, do not appear to be fundamentally consistent with it. This inconsistency may be due to the technical limitations of printing at the time. The notations in Perera (1933)'s Gīta Śikṣaka can be cited as an example. As mentioned therein, the ^ symbol is used for flat notes (Kōmal Swaras), and the double comma („) symbol is used to combine notes. However, these features are no longer in use in the modern notation system. Additionally, the symbol of vibhāga (a vertical line), which is used today to separate time units, was not used in earlier notations. Thus, an evolutionary process in the development of typing North Indian music notations can be identified.

Several studies can be identified with regard to the visual representation of north Indian notations through print and digital methods. Misra et al. (2016) introduce a new framework for transcribing and displaying Indic music notations on computers. This framework supports all major Indic notation systems and is explained using three main notation systems and scripts. They study the Bhātkandē, Paluskar, Akarmātrik, and Dandamātrik notation systems in detail, looking at the unique features of musical fonts based on Bengali and Devanagari scripts. Their aim is to create a common format for music notations in various Indian musical genres. However, their system mainly focuses on Bengali and Hindi languages, and it does not specifically address the Sri Lankan music context.

Mammen et al (2016) have developed a South Indian classical music representation or encoding system for the 'Sargam' (Hindi: Indian Musical Notes) notation scheme, which enables easy music notation storage, publishing, and retrieval using computers. This work follows a novel idea of developing a Unicode-based encoding logic and allows storage and easy retrieval of music notation files on a computer. Although this project is a massive work that covers the area of transcribing Indian musical notations, it does not focus on North Indian classical music transcribing and does not particularly address the Sri Lankan music context.

Samaratunga's (2022) research has revealed that printed music notations prepared in the Sinhalese Language using north Indian musical technical principles are highly flawed. Therefore, he opined that many academics rely on written manuscripts rather than printed notations. However, Samaratunga identifies the lack of a more accurate oriental music font as the main reason for the errors in these printed copies. Therefore, his introduction of a font called 'SARAROO Vivid Pro' can be recognized as an important moment in the notating of Sri Lankan oriental music. However, this does not offer a more successful solution than the difficulties that occur in rhythmic and complex graphing, when it comes to the proper tabulation of notations, etc. Arumawadu (2016) in his master's thesis introduces a Composition, Notation, and Playback System (CNPS) for the Sri Lankan Music Standard but it does not have a special program for transcribing North Indian music notations. Gunasekara's (2016) study on the recording of distorted musical signals is another study related to visual representation and playback music (N. Gunasekara, Personal Communication, October 2, 2022). However, it can be recognized that there has not been an adequate study of the challenges faced by Sri Lankan academics in typing north Indian music notations.

1.4 Research Objectives

- Identifying the various methods used by the academics for transcription of north Indian music notations.
- Identifying the problems faced by the Sri Lankan academics in notating Hindustāni music compositions through computer.

- Creating a computer application that can minimize those identified problems and create more attractive notations
- Verifying the quality of the application by testing its effectiveness.

1.5 Research Problem

Computer-aided transcription of North Indian classical music is an important requirement for oriental music studies at the academic level in Sri Lanka. However, there has been limited research on the challenges faced by the Sri Lankan academic community in transcribing North Indian music notations. Additionally, there is no established systematic methodology for the computer-aided transcription of these compositions among students and professionals involved in North Indian music in Sri Lanka. As a result, the lack of a systematic and effective computerized method for transcribing North Indian music notations that addresses the Sri Lankan context presents a significant gap in the field, which this study aims to address.

2. Materials and Methods

The study was conducted between the years of 2021 to 2023. An open online questionnaire was directed to identify the challenges faced by the scholarly community in typing North Indian classical music notations. For that, various professionals and student communities who use North Indian music notations have provided data. Due to the COVID-19 pandemic situation in the country during the two years of 2021-2022, and because it was the easiest and most practical method of obtaining data, the related questionnaire was directed to the online system. However, a considerable number of people have provided data for that. The software designed to mitigate the challenges identified in the questionnaire was tested in 2023, and the test was done physically.

2.1 Research Approach

In this study, the mixed method was used to carry out the research work. Quantitative Methods were used to identify the problems faced by the academic community regarding oriental music notation typing. A qualitative research approach was used to identify the nature of the North Indian music notation system and its practical usage in Sri Lanka. In addition, experimental research approaches were used to develop the software.

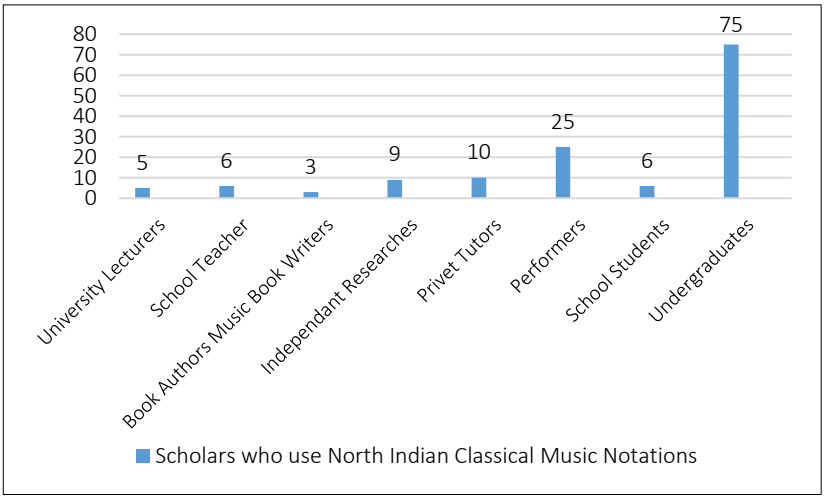

Figure 2. Sample of the data contributors to the questionnaire

During the COVID-19 Pandemic, physical contacts with the community was not possible. Thus, this data collection was carried out using online methods. Accordingly, the random sampling method was used to select the sample to identify the problems faced by scholars in notating North Indian classical music. Here, an open online questionnaire was sent to the scholars and students, who teach, learn, and practice North Indian classical music. According to the above chart, it is clear that the maximum data contributors to the questionnaire were university undergraduates. Accordingly, mainly university students and other data contributors, university teachers, schoolteachers, students, and practical users of music have responded to the questionnaire (Figure 2).

2.3 Verifying the Effectiveness of the Application

A self-planned trial was conducted to determine the effectiveness of the application. Accordingly, a sample of ten (10) respondents was selected under the purposive judgmental sampling method. The sample consisted of third-year students of the Bachelor of Arts Honors in Music Degree, Department of Music and Creative Technology at the University of Sri Jayewardenepura. The sample was selected based on the basic criteria of minimal ability to use computers and those who use North Indian classical music notations practically for their academic work.

A self-planned two-step methodology was used to measure the effectiveness of the Swara Mālā application. Due to the difficulties in the physical presence of data contributors, the first step was conducted online. Accordingly, copies of two notations of North Indian classical songs, which were written in both Sinhala and English (Notes) Languages were, given to the data contributors (Table 1, 2). They were instructed to reconstruct the given notations using any method in association with the computer. A time of 30 minutes was given for that and another 10 minutes were given to PDF the part completed in 30 minutes and send it to the researchers. The results are presented in the findings section.

The second step was done through physical methods. Accordingly, this second phase was held at the D1 Hall of the Department of Language, Cultural Studies and Performing Arts of the University of Sri Jayewardenepura. Accordingly, all data contributors were provided with Laptop Computers. After that, the data contributors were made to watch a video about the Swara Mālā application and the researchers explained to the data contributors about its use. As before, the data contributors were given hard copies of previously given notations and within 30 minutes, two copies were to be created using the respective software. After 30 minutes, an additional 10 minutes were given to send the soft copies of the created transcripts to the researcher. The results obtained in this case are also presented in the findings and discussion section.

3. Results and Discussion

3.1 Objectives of Using North Indian Music Notations

The main purposes of using North Indian music notations among the academic community were identified in the given questionnaire. Accordingly, the highest usage is found in music composing. That is 87 (Figure 3).

This means a graphical representation of newly created classical songs and compositions for singing as well as playing. 78 data distributors use North Indian classical music notations for music practice. In addition, some of them use Hindustani notations for academic purposes, especially for reference (29) and as an academic supportive tool (47) (Figure 3). Thus, it appears that North Indian classical music

notations are used for four primary purposes in Sri Lanka.

1. To practice music
2. To compose classical music songs and compositions
3. For educational purposes
4. For academic Purposes

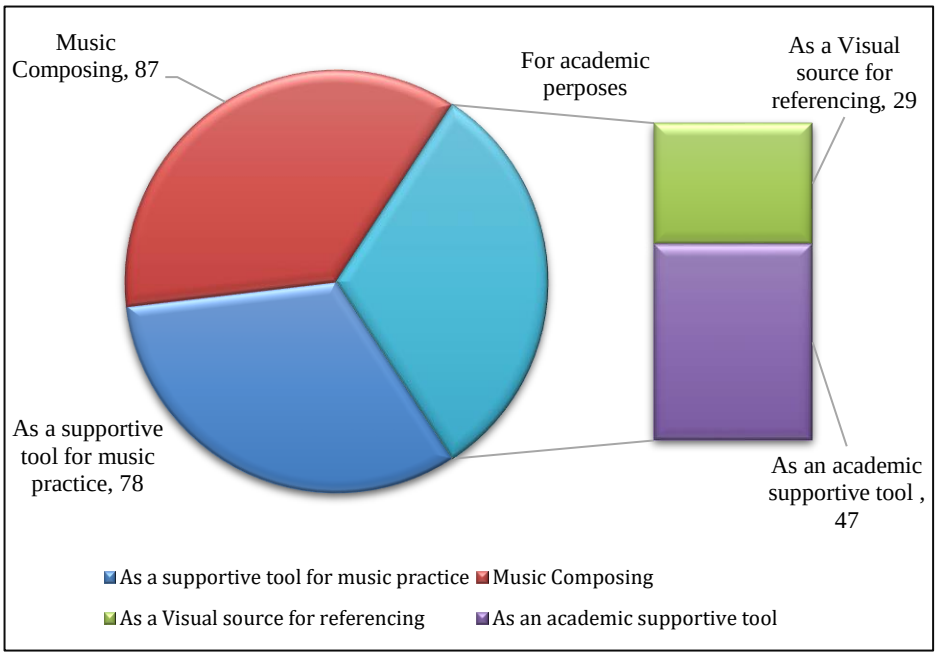

Figure 03. Objectives of Using North Indian Music Notations

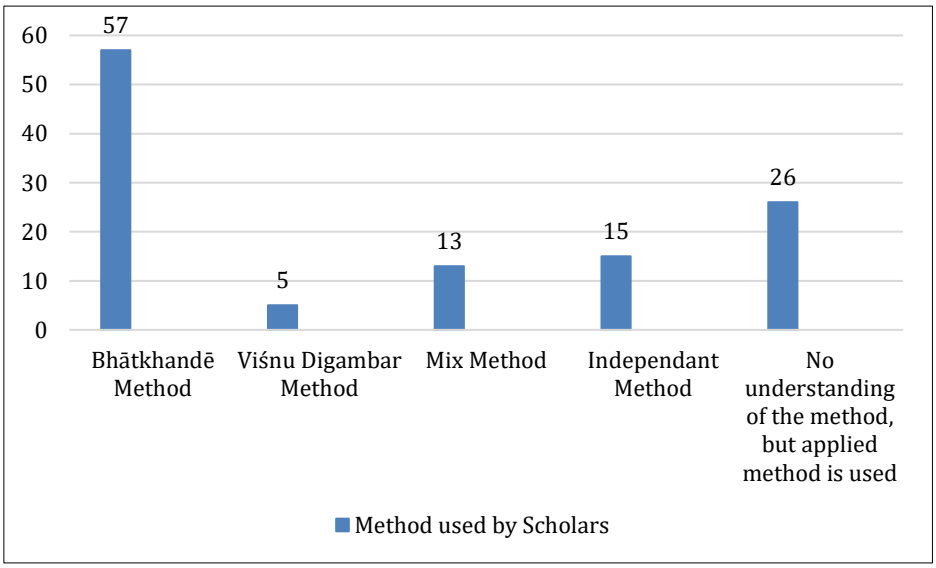

Figure 04. Oriental (North Indian) Musical Notations Users and Their Interests

3.2 Oriental Music Notation Users and Their Interests

It was discussed earlier that the Bhātkhandē's notation system and the Viśnu Digambar notation system are used as two accepted technical methods for notating North Indian music compositions in India (Nigam, 1998). Although the North Indian music notation method used in Sri Lanka was discussed in the literature review, an attempt was made to identify its use among the academic community through the questionnaire. The following chart shows the methods used by Sri Lankan academics to notate north Indian classical Music (Figure 4).

It appears that the majority of the sample (57) use the Bhātkhandē system and a considerable number of people (26) do not have a proper understanding of the system used. Very few people (5) seem to use the Viśnu Digambar, system another notation system in India, while others (13) use a mixture of both systems. About 15 academics are also found to be using an independent notation method (15) (Figure 4).

3.3 Different Techniques are used by academics to Transcript Music Notations

North Indian classical music notations can be used in a variety of ways to fulfill the various requirements mentioned above (Figure 5). Most of the sampled people use handwritten copies. They are used in the form of photographs or scanned copies. Others use the computer to create notations and use computer software like Microsoft Word for this purpose. Others enlist the help of someone else who knows how to type. Some data contributors use scans or photocopies of typed sources.

A handwritten notation is sufficient for general use and musical practice. However, considering the formal academic usage (Publishing papers, Class Tutes, etc.) of musical notations, a user-friendly, systematic, error-free, and more attractive method is required. Accordingly, it is important to focus on a creative notating technique that goes beyond simply writing by hand.

3.4 Computer-Aided Music Notating; Applications and Methods Used by Academics

Nowadays, people commonly use computer technology to fulfill their day-to-day requirements. Accordingly, computer applications are generally used to document data and information among the academic community. In music-related books, journal articles, teacher guidebooks, and providing North Indian classical music notations for research papers, it is necessary to create more accurate and visually- attractive notations. It appears that various methods are used by the academic community to notate North Indian classical music using computer technology (Figure 6). Accordingly, in addition to the use of handwritten music notations, it is important to recognize the methods used to create computer-based typed music notations. According to the graph above, fifty-six percent (56%) use Microsoft Word software to create north Indian notations. Seven percent (7%) use software such as Adobe Illustrator or Photoshop. Those who create north Indian notations using Microsoft Excel software are four percent (4%). Those who use software like Microsoft PowerPoint are two percent (2%). Twenty-four percent (24%) of people prepare north Indian notations with the help of all these applications. That is a percentage second only to those using Microsoft Word. In addition, some people were also found to be using a self-created musical font with the above applications. (They have mentioned it in the comment section of the given questionnaire)

3.5 User Satisfaction with Current Methods in Notating North Indian Classical Music

As discussed above there is a variety of methods used in North Indian classical music

transcription. Following are the results according to the responses given on whether the academic community is satisfied with the methodology used or not. Slightly more than half of the sample (52 percent) believe that they are not satisfied with the current method used for transcribing north Indian classical music notations. Forty-eight (48) percent are satisfied with the method they are using. The majority of people (52%) who are not satisfied with the existing methods related to transcription of North Indian Notations have given reasons for not being so satisfied. (Figure 7).

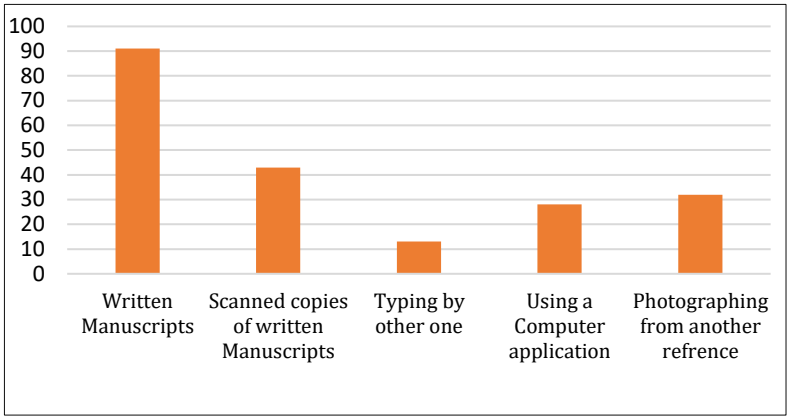

Figure 05. Different Techniques are used by academics to Transcript North Indian Music Notations

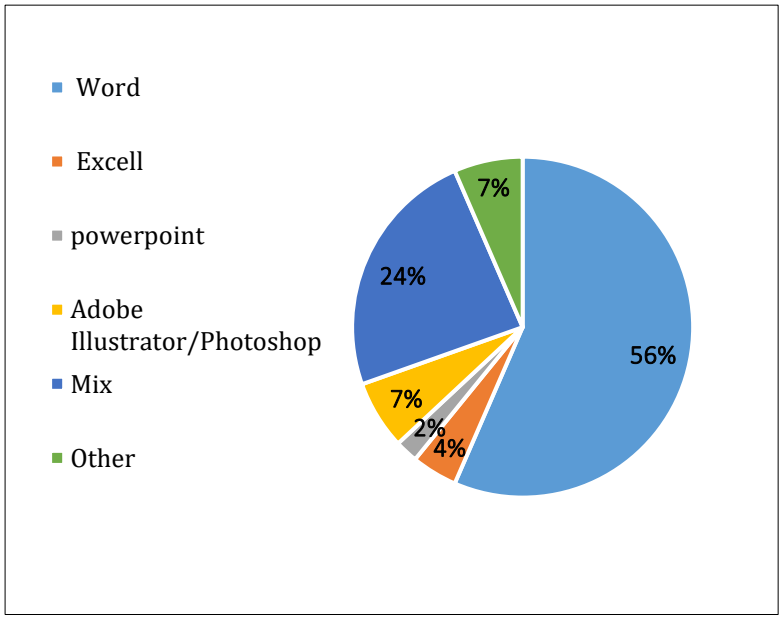

Figure 06. Computer- Aided Music Notating, Applications Used by Academics

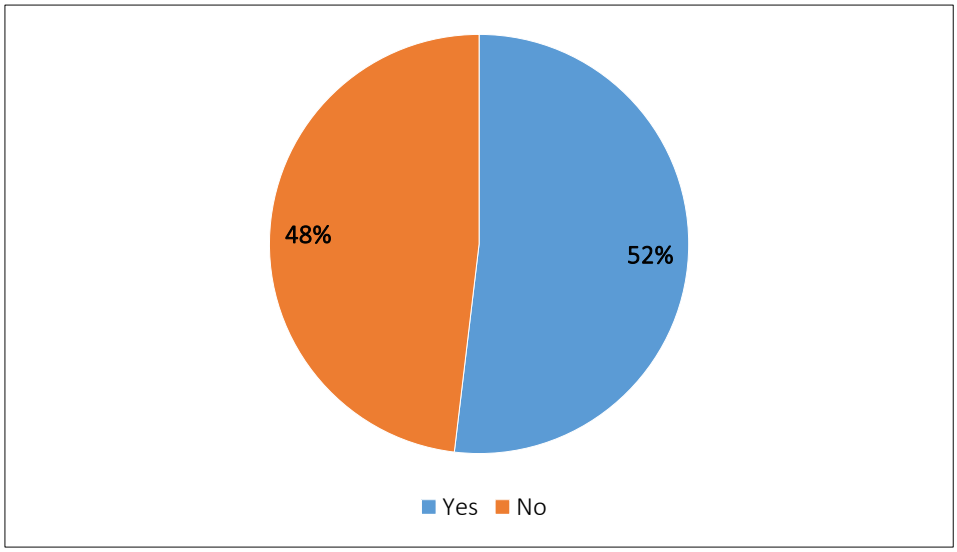

Figure 07. User Satisfaction with Current Methods in notating North Indian classical Music

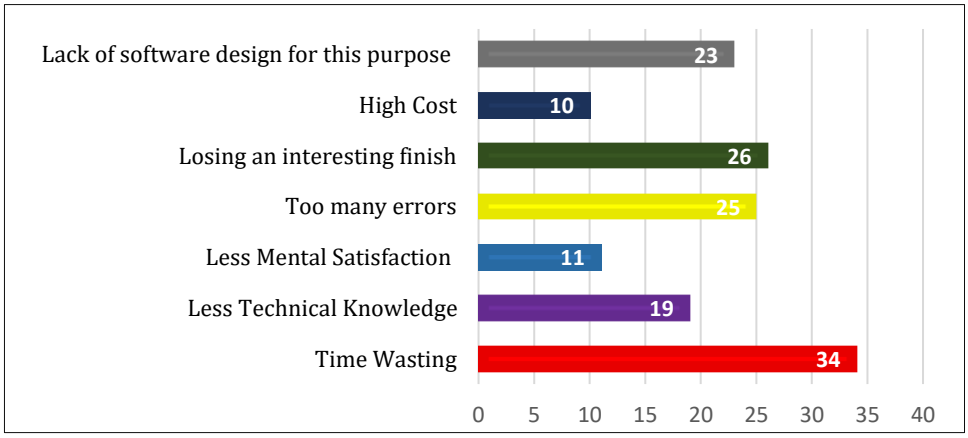

Figure 08. Reasons for Non- Non-Satisfaction

Figure 09. Swara Mālā: Logo of the Application

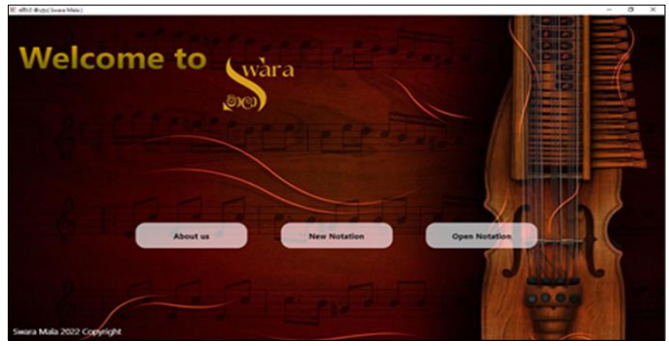

Figure 10: The main window of the Swara Mālā Application

As shown in the above graph (Figure 8), the user's satisfaction is not adequate with the existing methods for notating due to various reasons such as the appearance of the notations, and the need to create notations with efficiency, and accuracy. 34 people who provided data related to the sample think that the existing methods are a waste of time. 26 people believe that they cannot be satisfied with not being able to get a good finish. 25 people are not satisfied with the existing system due to the increase of errors in the notation and 23 people are not satisfied because of the lack of specially designed software for notating North Indian classical music. 19 people are not satisfied with the existing system because they have less technical knowledge and eleven people say that the existing system is not enough because they have little mental satisfaction in creating notations. The opinion of fewer people or 10 people is that the current methods are more expensive.

3.6 Introducing a North Indian Classical Music Notation Application for Sri Lankan Academics; Swara Mālā

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3.6 Introducing a North Indian Classical Music Notation Application for Sri Lankan Academics; Swara Mālā

This application is primarily developed for Portable Computers. Accordingly, this application consists of a Selection window and another window containing the elements required creating the notation charts after the relevant selection. Due to its simple nature, the users can easily use it (Figure 10).

There are three selection windows (Figure 11). The first one is the Project Name. After giving the required name, one must select the Tālā or the rhythm pattern of the song that the user wants to notate from the next window (It shows a list and can select the appropriate Tālā). The structure of the notation chart will be adjusted according to the chosen tune. After that, the user has to choose either Khyāl or Sargam from the button. Choose Kyāl if the user wants to create a notation with lyrics and Sargam if only notes are to be used for the notation.

The next window that appears is the worksheet where the notation will be created. There is the ability to build the notation through both manual and automatic methods. Several buttons can be identified here (Figure 12).

3.6.2 Buttons and Features

Users can select the desired language for the notes and lyrics from the two buttons at the top of the interface, the Swara and Lyrics. This makes the task easier, especially for those who wish to use the bilingual method. Accordingly, Notes and lyrics can be included in all four ways: Sinhala - Sinhala, Sinhala - English, English - Sinhala, English - English. In addition, the user can choose whether to insert the rhythmic symbols shown in classical songs into the relevant graph from

the Symbols button. The three buttons on the right-hand corner allow you to determine the colors of note, lyric, and table. This is important to present the output more attractively.

Next in the row of buttons are settings related to changes to be made primarily to tones. Hindustāni or north indian classical music uses five other tones in addition to the seven main tones. These are commonly known as 'Vikriti Swarās'(Sanskrit/Hindi: a type of Musical Notes). They are divided into 'Kōmal' and 'Tīvra' (Jairazbhoy, 1971). The symbols to be applied to the respective swaras in the worksheet will be marked from the 'Kōmal' and 'Tīvra' buttons. For this, one must select the respective note and press the respective button. An underline is drawn for 'Kōmal' Notes and a short dash above the note for Tīvra Notes. The buttons of Ucca (Tāra) and Mandra are for visualizing higher and lower octave notes. To use it, one has to select the respective note and press the button. The Khan Note or Sparśa note (Grace Note) in north Indian classical music is visualized in a notation as an uppercase symbol, therefore to make a Khan Note it is required to select the note and press the button of Khan Note.

Mīnd is another symbol of the north Indian notation system; it is used for visualizing Mīnd (blending) notes (Mahajan, 1989). There is no need to select any note; just click the Mīnd button, drag, and drop where necessary. The bracket button is for bracketing notes. To use it, one must select all notes that have to be bracketed and press the button. The down bracket button is for bracketing lyrics for the requirement of the user. For use just drag and drop after pressing the button. The below buttons (Add Row, Delete Row) are used to add more rows and delete the last Row. The Break Chorus button is the button for separating the Sthāi (Chorus) and Antharā (Verse).

Using the download button, you can get a clear photograph of the created notation in JPEG (.jpg) format with a high-quality pixel rate. The Save button is used to save the project (Figure 13).

3.6.3 Technical Background of Making Swara Mala Application

This software was designed based on JAVA Script Computer Programming Language. This software is developed according to the Electron Framework. JASN [JAVA SCRIPT OBJECT NOTATION] program is used for storing Data. Two Fonts have been specially created for this software and it has been created using Font Forge software.

This software mainly consists of North Indian classical music notation structured templates related to using popular north Indian Tālas (Musical Times) in the present. The Notation Structures can be created automatically based on the user's choices. It can be manually edited according to the user's needs. After all editing, a clear photograph of the final notation can be downloaded as a JPEG [JOINT PHOTOGRAPHIC EXPERTS GROUP] file.

3.6.4 Verifying the effectiveness of the Swara Mala Application

A sample of ten, third-year Bachelor Honors Music Degree candidates of the Faculty of Humanities and Social Sciences of the University of Sri Jayewardenepura, Department of Music and Creativity, participated to verify the effectiveness of Swara Mālā Application. Accordingly, the inspection was carried out in two stages.

In the first stage of testing effectiveness, two North Indian music notations which were written in both Sinhala and English were provided by the researchers (as a soft copy) to the data contributors. It had to be re-created by the data contributors using any computerized method. The results were evaluated under the following criteria (This Test was done via Zoom Online Platform.) (Table 1).

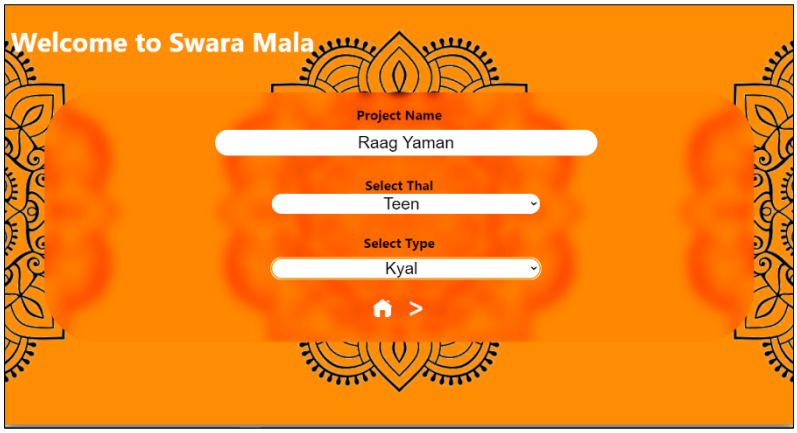

Figure 11: Project Window

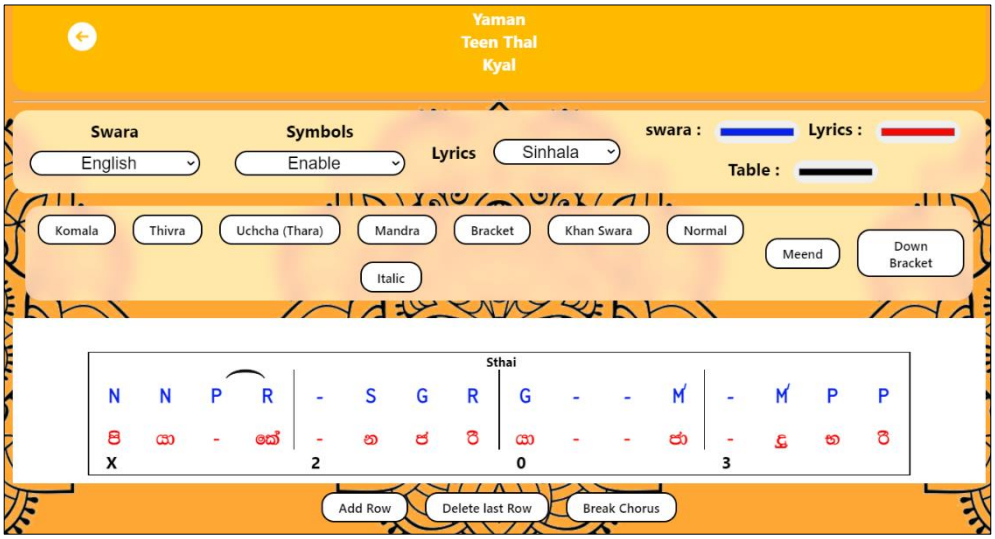

Figure 12: Buttons and Features

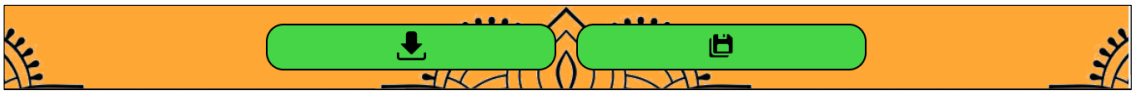

Figure 13: Download and Save

Criteria for the First stage of the test

Q1. Consistency of given copy and created copy - 25 marks

Q.1.1 Correctness of Notes, Symbols and Lyrics

Q.1.2 Color and other elements

Q1.3 Distance between rows and columns

Q1.4 Table partitioning

Q1.5 Sthai and Antara Division

Overall, in the first stage, none of the data contributors was able to complete the given notation in time. That is why all the data contributors in the above graph (Table 1) are shown as failed. However, some people have tried to transcribe the Notation to some extent and have failed to create them completely. Each data contributor's

reconstructed notations were evaluated subject to the aforementioned criteria. Accordingly, according to the relevant criteria, 25 points of five points were awarded to those who had created to the level of about eighty percent (80%), and lower points were awarded to the lower levels. Accordingly, it appears that the ability of data contributors to transcribe North Indian vowel letters through any other method is low and it takes more time. Accordingly, the failure of the currently used methods is evident.

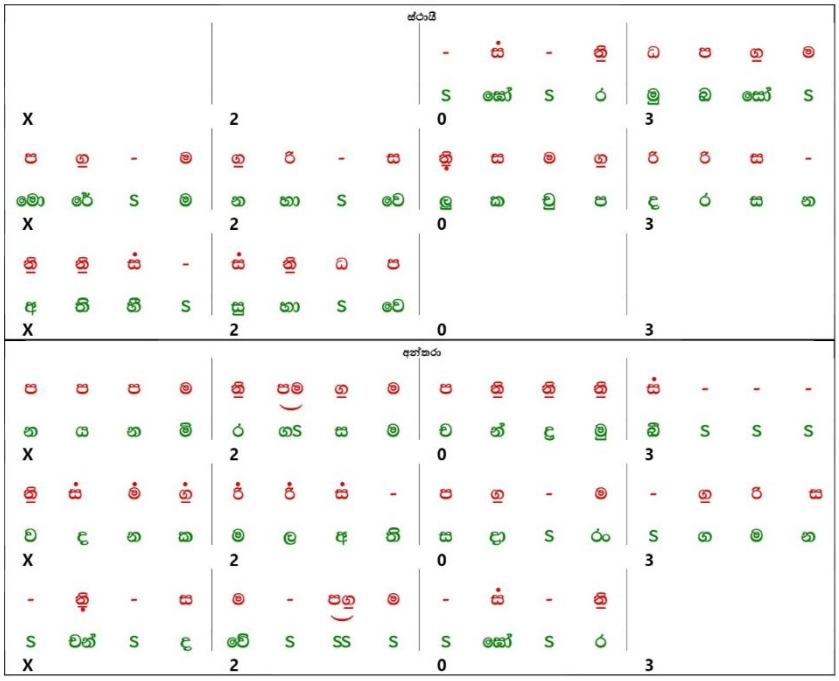

Figure 14. Provided North Indian Notation 1

Table 01. Results of the First Stage of the experiment

Contributor	Q1 (Out of 25)					Total Marks (Out of 25 Marks)	Q2: Time Pass=< 30Minutes<Fail
	Q1.1	Q1.2	Q1.3	Q1.4	Q1.5		
1	03	05	02	01	03	14	None of the data contributors was able to complete the task within the given time limit. Therefore all of them are considered as Fail
2	02	05	05	01	00	13	
3	05	05	02	02	04	18	
4	04	05	01	02	05	17	
5	02	04	01	04	02	13	
6	03	01	04	05	01	14	
7	02	05	04	01	00	12	
8	05	02	04	01	02	14	
9	04	05	05	01	02	17	
10	04	05	04	01	05	19	

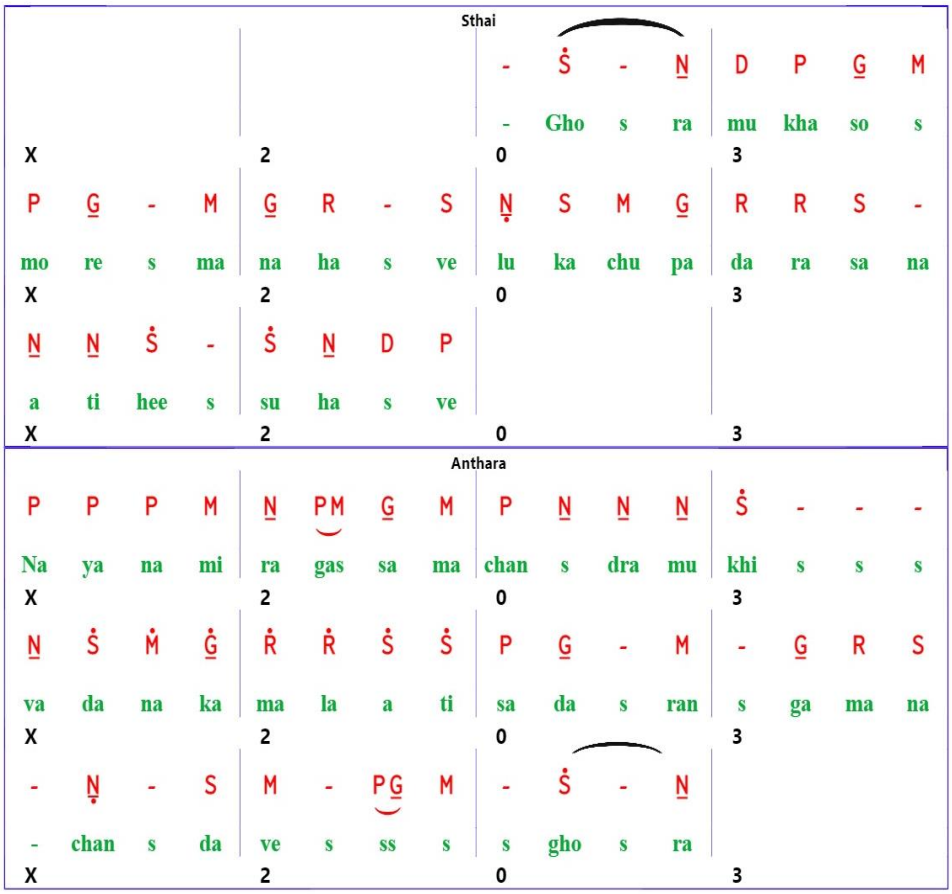

Figure 15. Provided North Indian Notation 2

Table 02. Results of the Second stage of the experiment

Contributor	Q2 (Out of 25)					Total Marks	Q2: Time Pass=< 30 Minutes<Fail	
	Q2.1	Q2.2	Q2.3	Q2.4	Q2.5		Time/Minutes	Pass/Fail
1	5	5	5	5	5	25	21	Pass
2	5	4	5	5	4	23	17	Pass
3	4	5	5	5	5	24	23	Pass
4	5	4	5	5	5	24	18	Pass
5	5	5	5	5	5	25	19	Pass
6	4	5	5	5	5	24	18	Pass
7	5	5	5	5	5	25	16	Pass
8	3	5	5	5	5	23	10	Pass
9	5	5	5	5	5	25	16	Pass
10	5	5	5	5	5	25	25	Pass

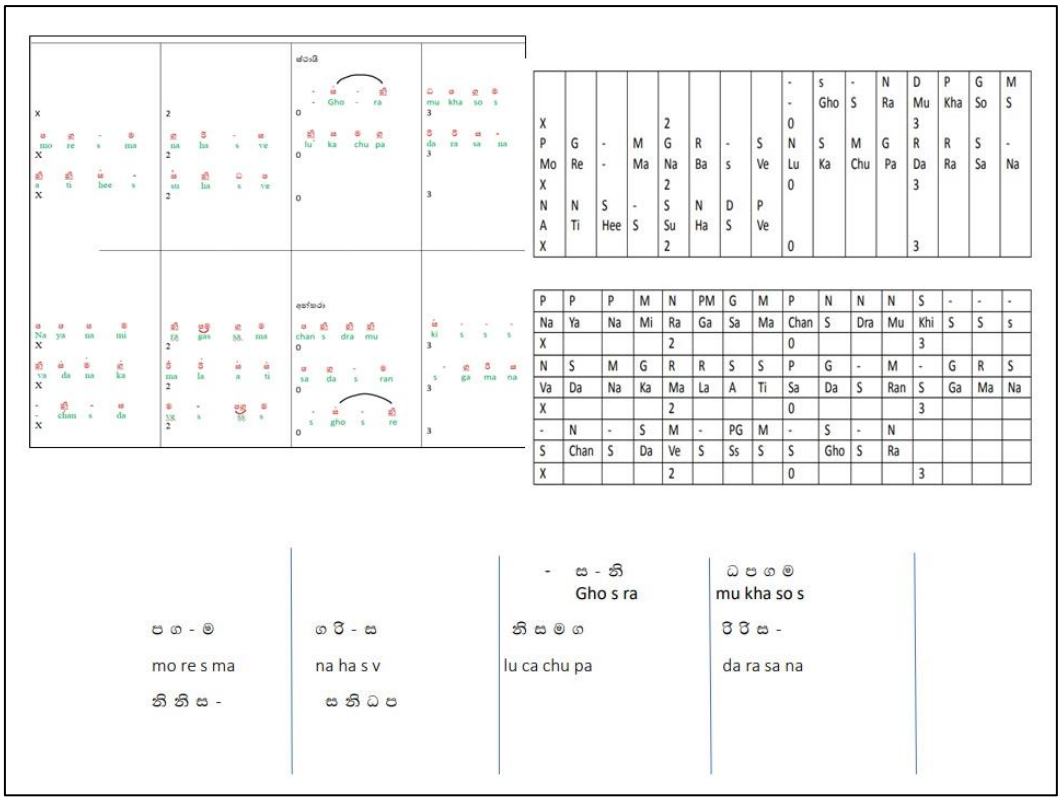

Figure 16. Incomplete Notations by the data contributors in the first stage

Stage 2

In the second stage, the data contributors were allowed to watch an introductory video clip of the Swara Mala Application, after the software was provided to all data contributors. After installing it properly, it was advised to use the given two notations (Figure 14, 15) and recreate it within 30 minutes using the application. The results were measured based on the criteria used earlier. Accordingly, the results are as follows. (Table 2)

Accordingly, it appears that data contributors 1, 5, 7, 9, and 10 have been able to create a perfect copy of the Notation using the new software provided by the researchers (As 25 points are scored). In addition, other data contributors seem to have been able to recreate a Notation that is very similar to the original copy. In addition, all the data contributors completed the notation within twenty-five (25) minutes. They completed the task within 30 minutes. Thus, it can be recognized that the factors that affect the dissatisfaction of users in the transcription of computer-aided North Indian Notations can be reduced to a minimal level using this Application.

4. Conclusion and Recommendation

Northern Indian Classical music has occupied an important place in Sri Lanka's Oriental Music Education. Notations are important for visualizing north Indian classical Songs. Sri Lankan scholars mostly use the Bhātkhandē system in notating north Indian classical music. Notating north Indian classical music plays an important role in the academic work in but the methods used so far for typing north Indian classical music notations have been less effective. As revealed by this

research, it can be identified that the Sri Lankan academics face various challenges while typing north Indian classical music notations. Difficulty in creating notations in a short time, users' low technical knowledge, lack of a unique method to typing notations, inability to obtain a high-quality output, and lack of a software application designed for this purpose can be identified as those challenges. Accordingly, to overcome the above-mentioned challenges, software that can type north Indian classical music notations in both Sinhala and English Languages was introduced by the researchers. Therefore, it is possible to type north Indian music notations without any errors and with a good finish. Thus, it can be recognized that the challenges faced by scholars in typing north Indian classical music notations can be overcome.

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