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Auto Generate Music Melody Using Notes

**A dissertation submitted for the Degree of Master of
Computer Science**

**G.H.N.L.Rathnathilaka
University of Colombo School of Computing
2019**



Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this thesis is based on the work of

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under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

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Date:

Abstract

Lot of music lovers especially melody writers faced big problem when they write a new melody because they first write a music notation and then they need to play all notations one by one. If they think that is not good after playing then they need to write another notation and play again melody then again and again they need to play notation to get their expected melody. If they want to get the suitable instrument for that melody they need to play all instruments one by one and choose the suitable instrument. So this is time consuming.

This system is help to convert music notation sheet to melody without any knowledge of music. They only need to scan that notation sheet and upload to the system. Then automatically it converts that particular notation sheet into melody. We mainly focus for melody writers because they don't need to play their melody using instruments. Using this software they can play their melody without any instrument. So they don't need to get help from any other to play that instrument, and they can save their time. When they play the music notation they have option to record and save that melody. Also if they want to share that melody to their group members they can easily share it.

Using this system music lover can listen their created music notation very easily. It helps to melody writers to get their expected melody without using any instrument. Also it saves a lot of time and effort of the music writers who make the new music melody.

Acknowledgements

This project would not have been successful without the help, guidance and dedication of several persons who actually contributed their valuable time on my effort.

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Chapter 1

Introduction

1.1 Background

This System is a Desktop application which provide the facility to eastern music character convert to relevant music sound very easy manner with accurately. This application is an individual work, and there lot of functionality of the application. Those functionalities will be preprocess the image, separate the image characters, recognize the separated characters and refine the recognized content through several techniques. All together of these functionalities, this proposed system is capable with identify music characters of a particular image (scanned paper) in accurate manner with minimum conflicts and errors.

According to my Literature Review I didn't find similar system develop for this area (Eastern Music notation to melody converter). Found mobile application development system for music industry that system work as when person sing a song then its convert to music melody ,and also found another system called AMCTIES (An application capable of Automatic Music Composition using a Tree of Interacting Emergent Systems). That system can generate MP3 file according given specific instrument and then after that system convert that MP3 file to music notation only, There are no system develop for this research area(music notation to melody).Some system develop to identify western music character but no system develop to identify Eastern music characters and give the audio output according to the music character so it is big lost for our melody writers and music lover who want to write new melody they need to write it in the paper and play it to get the sound ,but western music some sort of system develop then they can create their own melody using the system, so we gave a solution to our melody writers to avoid this problem now they can also create new melody using this system.

1.2 Research Gap

In AMCTIES system only can give music instrument sound combination and create mp3 file and after its convert to music notation sheet only, there are some draw backs in this system such as its only give specific music instrument sound and create mp3 file, and its generated sound is not good quality because it's generate midi sound its computer generated sound so can't get the actual music instruments sounds. There are no options to identify handwritten or standard music notations and convert it into music melody. Also this system supports only western music so we gave a solution for fulfill above problems. Using that system melody writers don't need to play all notations one by one. When they write the notation and scan that document and upload to our system they can listen their melody at that moment.

Proposed system has multiple instruments options so they can play their music notation one by one music instrument and they can decide most suitable instrument for their melody. And also if they want to record that melody then they can easily do that and they can listen that record melody future if they want. System has an option to play back again that generated sound(wav) file.

The system provide additional facility to create music script by using system directly without uploading the image then melody writers can create their script using the system and they can play it, and also when they play the music notation then they have option to record and save it. If they want to share that melody to their group member they can easily share it by using email function.

1.3 Research Problem

Where are musical melody writers today? Whatever happened to the generation who so confidently condemned every preconceived notation regarding traditional musical structure? What are the problems and issues facing young melody writers?

Lot of music lovers especially melody writers faced big problem when they write a new melody. Because they first write a music notation and then they need to play all notations one by one. If they think that is not good after playing they need to write another notation and play again melody then again and again they need to play notation to get their expected melody. If they want to get suitable instrument for that melody then they need to play all instruments one by one and choose the suitable instrument. Also when they write a music notation some time that can lost. So they can lost their creative melody.

Then our concept it is very helpful for melody writers to write a melody and also listening whatever instrument music. So they can increase their creation and performance of new music. Lot of composers can survive their creativity. We can increase number of composers make their own ensembles and performing their own music more and more.

1.4 Project Objectives

The main intention of this study is to provide a solution for how to convert music notes into computer readable format and Standard music characters into audio output. The project will be focused on building a comprehensive application to gain many objectives.

- Learning environment for user, they can get more than one instrument can use, and get the varies music output of the application. For beginners can easily enter to the music field and they can get the knowledge about notation and get the stranded music notation. High quality of audio output can generate. Person can learn more instruments sound clip individually. Its help full for beginners and if they have less knowledge of music notation they can change whatever music note and get varies audio output and listen it. Then they can improve music knowledge in individually. I will try to get maximum correct output from music notation into audio output. They can store generate audio output and can use it again and again. Also they can create new things and develop their music skill and creativities.
- To implement Character Recognition System for music character recognition the proposed system should able to receive and interpret music note input from paper documents.
- Both musician and music composing are creating some music melody in their paper. Lot of musician writes the music note into paper then also they have not facility to listen that melody because they need especially location for it. But all musicians haven not all facility. They have to buy or rent the music instrument and play at a single time and listen that music and also only one person cannot doing it. Some time they have to hire music band and play it. After then can decide the melody good or bad. Then after they can grant it. It goes lot of time and money but this system will help musician convert their music notes into varies music instrument and they can listen one by one or together and listen one single audio output. And also they can easily modify their music notes at a time and listen again and again. It is good opportunity and good knowledge for them.

- To produce the facility of editing the converted music notation sheet after the conversion by providing an editor the importance of the system is that it provides facility to edit the music notation sheet after conversion. Therefore User is allowed to modify the music notation sheet further before publish it. All the processes runs behind the word processing environmental user interface and the final output will be displayed on the interface as editable set of music notation.
- The proposed system will provide solutions for plain text. Recognition of cursive text is an active area of research [5]. The system will be implemented with the facility of not only identify the music notation but also to process them, avoid the conflicts of music characters, increase the accuracy level by using digital dictionaries an repositories [3].

1.5 Product Functions

To clearly understand the functionalities of the system four manageable components were identified. These are the major functions perform in the project.

- Recognize eastern music characters using image
User needs to upload music notation sheet to the system and then system will recognize music characters from the image. Extraction of the eastern music characters and eastern music paper image preprocessing module is responsible for a suitable binary image, noise reduction for music character segmentation and generate a computer readable format. Whatever the image that is going converted to the binary format, it may not be in a required quality standard in order to process the line and character segmentation. There may be much noise, various angle effects and other facts which may affect to the process of segmentation and process of identification. What is does apply image enhancement techniques to remove noise or correct the contrast in the image.

- Conversion of eastern character into audio output
Detect eastern music characters in the image, and convert it into an audio output. This will be done by matching templates with the database [4]. Character of music notation is mapped corresponding to each code. And convert it into an audio output and add the recording facility for above played melody. And also add facility to share that melody to other people.

- Get printable document and share that to other people
User can generate standard printable music notation sheet using this system and also user can share that created document among their friends.

- Generate Music Notation using System
User can generate music notation without uploading any document to the system.

Chapter 2

Literature Review

According to my Literature Review I didn't find similar system develop for this area(Music notation to melody converter) but found mobile application development system for music industry that system work as when person sing a song then its convert to music melody, and also another system called AMCTIES(An application capable of Automatic Music Composition using a Tree of Interacting Emergent Systems).That system can generate MP3 file according given specific instrument and then after that system convert that MP3 file to music notation only there are no system develop for Eastern music notation to melody .

AMCTIES System Works

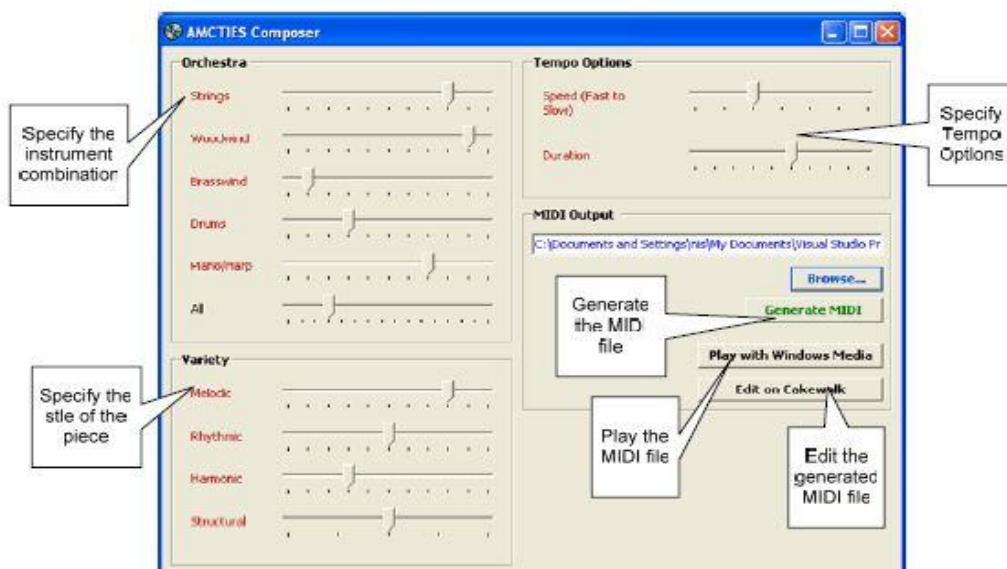


Figure 1: Create MP3 file Using AMCTIES System



Figure 2: Convert mp3 file into Notation in AMCTIES System

In AMCTIES system only can give music instrument sound combination and create mp3 file and after its convert to music notation sheet only there are some draw backs in this system such as its only give specific music instrument sound and create mp3 file, its generated sound is not good quality because it's generate midi sound its computer generated sound so can't get the actual music instruments sounds there are no option to identify handwritten or standard music notations and convert it into music melody. Also this system supports only western music. So proposed system give solution for fulfill above problems. Using proposed system melody writers don't need to play all notations one by one. When they write the notation and scan that document upload to system they can listen their melody at that moment.

This proposed system given multiple instruments options. So they can play their music notation one by one music instrument and they can decide most suitable instrument for their melody. And also if they want to record that melody then they can easily do that and they can listen that record melody future they want and another option to play back again that generated sound(wav) file.

This system will provide additional facility to create music script by using our system directly without uploading the image then melody writers can create their script using the system and they can play it, and also when they play the music notation then they have option to record and save it. If they want to share that melody to their group of member they can easily share it by using email function.

Some system develop to identify western music character but no system develop to identify Eastern music characters and give the audio output according to the music character so it is big lost for our melody writers and music lover who want to write new melody they need to write it in the paper and play it to get the sound but western music some sort of system develop then they can create their own melody using the system so this proposed system given a solution to our melody writers to avoid this problem, so they can also create new melody using system.

Usually abbreviated to OCR is the mechanical or electronic conversion of scanned images of handwritten or printed Eastern Music characters into machine-encoded text. It is widely used as a form of data entry from some sort of original paper data source. It is a common method of digitizing printed texts so that they can be electronically searched stored more compactly displayed on-line and used in machine processes. OCR is a field of research in pattern recognition artificial intelligence and computer vision [9].

In this proposed system it implements OCR system for music lovers or melody creators who use eastern music characters. When considering about eastern music characters recognition it becomes more difficult because there are many numbers of factors that need to be considered [8]. If it is printed text format there are some advantages for the developers because each and every character is in same size, same pixel area and same space between each two characters. Using this OCR I try to identify eastern music characters. The basic idea of this system is melody writers (musicians) who write the melody. Normal scenario is melody writers write their melody using paper and then after they need to play one by one to get their expected outcome.

\

Chapter 3

Methodology

3.1 Enhanced The Binary Image

The process of improving the quality of a digitally stored image is called image enhancing. Here it is mainly focusing on providing a suitable enhanced image as the input, which is a main requirement of the music notation recognition process. This will be achieved by converting the captured photograph into an enhanced binary image through applying various techniques [10]. The output of this process will be act as the input for the character extraction and segmentation. Following steps will be included when enhancing the image.

3.2 Image Enhancing

After a capturing an image there may be undesirable effects, which is caused by the variation of brightness in a digital camera or scanner. It is called noise. There are many types of noise such as Gamma noise, Gaussian noise, Negative Exponential noise, Salt and Pepper noise and uniform noise etc. To remove noise on an image, image filters will be used [1].

3.2.1 Removing Noise By Using Linear Filtering

Averaging or Gaussian filters, are appropriate for remove noise [1].For example, an averaging filter is useful for removing grain noise from a photograph. Because each pixel gets set to the average of the pixels in its neighborhood, local variations caused by grain are reduced.

3.2.2 Removing Noise By Using Adaptive Filtering

This approach often produces better results than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high-frequency parts of an image [1]. This is best when the noise is constant-power ("white") additive noise,

such as Gaussian noise. The type of filter that is chosen to remove the noise can affect the important details. By studying above filters Median filtering will be used to remove noise.

3.2.3 Removing Noise By Using Median Filtering

Median filtering is similar to using an averaging filter, in that each output pixel is set to an average of the pixel values in the neighborhood of the corresponding input pixel. However, with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values ,outliers. Median filtering is therefore better able to remove these outliers without reducing the sharpness of the image [9].

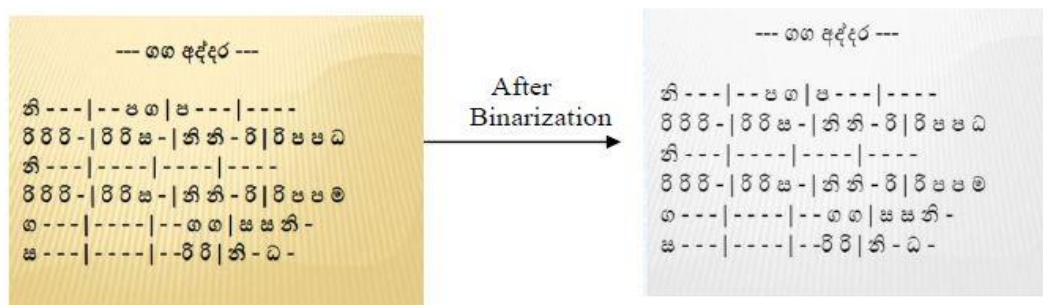


Figure 3: Binarized Eastern Music Character

3.3 Character Segmentation

The segmentation process is the most important phase of the overall Optical Character Recognition process [7].It is the most significant process because if the output of segmentation phase is incorrect then we cannot expect the correct results. But on the same time, segmentation is complex too. There are lots of techniques used to segment characters. But the most common technique is Horizontal and Vertical Projection Profile method. In this system, it is suggested to use the same technique [14].

3.4 Pixel Value Reading

In this project we have worked with bmp files, since they are one of the most commonly available image file formats. In order to be able to extract the pixel values from the image, the header of the image file had to be properly read and then according to the header information, the values of the individual pixels can be accessed. In order to be able to do so, it is mandatory to understand the structure of the bmp file format.

3.5 Conversion to Audio Output

One of the main components of the project is give the audio output. But before giving audio output need to identify text from image then after identify text from image final step is giving audio output according to exact music notation in here we allow user to get the sound more than one instrument. If user select to get the output sound piano then they can get that sound exactly their music script. So we need to store that related sound in our database and need to train the database to that when we identify character related sound will be given. The functions described in the related to the use to handle notes and hear music. They can get audio output by sending a series of audio commands to the sound card of your computer. First we add a music notation and get the audio output its same sound in real instrument and keep the sound exactly as it is. So we have to maintain the sound library.

Example

First we get the output like this after identify the characters

අයන්නකීයන්න

ගග-රි|සස-රි|ගගගරි|සස-රි

ධ-ධප|ම-මම|ප---|----

ධධ-ප|මම-ම|ප-පම|ගග-ග

රි-රිග|ම-රි-|ස ---|----

Figure 4: After Recognize Music Script

Then that notation script is get to the string buffer, after that line by line its break and finally its brake quadrants like this.

```

ගග-රි|සස-රි|ගගගරි|සස-රි ← 1st line
ගග-රි
සස-රි
ගගගරි
සස-රි

ධ-ධප|ම-මම|ප---|---- ← 2nd line
ධ-ධප
ම-මම
ප-----

```

Figure 5: Line by line separate script

Like that string brakes to separate parts. Finally its brake to one by one if character comes with dash its get as the combine character.

Ex: ධ- this gets as the one character.

```

ග
ග-
රි
ස
ස-
රි
ධ-
ධ
ප
ම-
ම
ම
ප-----

```

Figure 6: Read character by character

Finally all characters stores to the byte array and then play it one by one , there is no delay of the playing sound files, because in here we are read all character and then after playing so there is no delay , if we read and play that sound file one by one then its delay.

3.6 Record Generated Sound

We have another option while playing this sound it automatically generate full music audio files after complete of play. Its help to user to play back the recorded sound again, and we have option call play back then user can play back that recorded sound, and also if user want to get the copy of recorded sound then user can get the copy after recording the sound clip and they can store that sound clip for future use .

3.7 Share Facility To Audio Output

After generating audio output user can share that audio file to others without logging to their email separately. We allow user to send the email using system. Then after they generate audio output they can share to others. So user can save their time and work efficiently.

3.8 Create Music Notation Manually

This system facilitate another valuable facility to create music scrip using our system, so user can create their music script and after they can play and check their music melody, this is save time by playing instruments, so any one can write notation and play until get their expected outcome, Multiple instruments are available to play that created music notation, and also they can save their notation using note pad , if they want to share that generated document to their friend option to send the mail by using system , so user no need to log to email separately .

Chapter 4

Testing and Implementation

4.1 Implementation

Image processing and test4j libraries using for neural network implementation with NetBeans IDE 7.0.1. First we build own application to identify the eastern music characters from the paper. We use Tesseract ocr method to create our software. Tesseract is the more power full ocr engine now so its accuracy is perfect, we add the test4j library to our application. Tesseract support many languages but we had to train, so we train our data set according to the our requirement.

First we need to get 'tif' format of image sample to train our data set to tesseract in here get the high level of accuracy we train 100 sample for one character so then it's give the perfect recognition results. Training is difficult but accuracy it's perfect.

After implement our ocr engine next steps to give the audio output according to identified character. We store sample music clips to corresponding character once character match with the sound its sound will generate automatically, normal scenario once character recognize and play the sound its get some sort of delay, to avoid this problem we stores all characters to the byte array and then play it one by one, there is no delay of the playing sound files, because in here we are read all character and then after playing so there is no delay, if we read and play that sound file one by one then its delay. Finally we build our system successfully.

➤ Hardware Interfaces :

The system specially requires high dpi desktop scanner. And also it requires at least Intel duel core 2.2 GHz computer system with a minimum memory of 2GB and 40GB hard Disk space.

➤ Software Interfaces:

Image processing and test4j libraries using for neural network implementation with NetBeans IDE 7.0.1, Microsoft SQL server 2012 is for database to store templates.

➤ Memory constraints:

Typically all image processing related processes consume much computer resources while they are running. With this proposed Offline Character Recognition System, it has been invented as the minimum resource requirements that following operational environment must be there for efficient performance.

- i. Memory 4GB.
- ii. Graphic Processor Memory 512MB.

➤ Operating System Requirements

This application will function only within windows environment.

Microsoft Windows 7 or above.

In addition to that this application will also function in windows vista, but minimum JRE 1.6 is need. While in the operations, only one user is allowed to handle the functioning of the application at a time.

4.2 Testing

4.2.1 Unit Testing

Unit Testing is the process of validating that the module performs the required task and completely implements the approved design. The purpose is to test all logical paths and loops. All safety critical units are identified by the Software Hazard and Safety Analysis will be tested and traced.

- Optical Scanning
- Color Testing - Gray scale image

4.2.2 Driver Testing

Optical scanning module is capable of detecting new USB scanners directly while for old scanners driver should be installed. It takes driver information directly from the operating system.

4.2.3 Integration Testing

Test is based on design and requirements specifications. All safety critical integration issues identified by the Software Risk Hazard and Safety Analysis will be tested and traced. Test outputs results matches with the expected results except a few minor areas which are removed effectively.

4.3 Software system attributes

4.3.1 Reliability

The reliability is considered moderately since this is a music characters converting System, we do not use any critical information. The probability of crashing or failing the system is considered as minimum except for any consequence of an Operating System error or the failure of external hardware. All the relevant details regarding the system shall be provided with the User Manual.

4.3.2 Availability

The availability of the system is that the system should be in operations at any time when it's called for. Also it should be able to deliver the required service at any time it is required. That is a system should be available with minimal system down time or without having any system failures. This system shall be available in any computer which has the hardware and software constraints mentioned previously. If a severe error occurs, it shall be solved imply by reinstalling the application.

4.3.3 Security

Security of the system is the ability of it to protect itself from external assaults. Since it doesn't contain any critical information, there is no significant security requirement for it. Anyone can use it since there is no harm in using it.

Chapter 5

Evaluation and Testing

5.1 Setting up the evaluation environment

This is the Main UI of the system user can upload image to the system using this UI.

There are two option can be seen here user can create music script using the system without uploading image to the system and user can upload image to system and get the audio output.

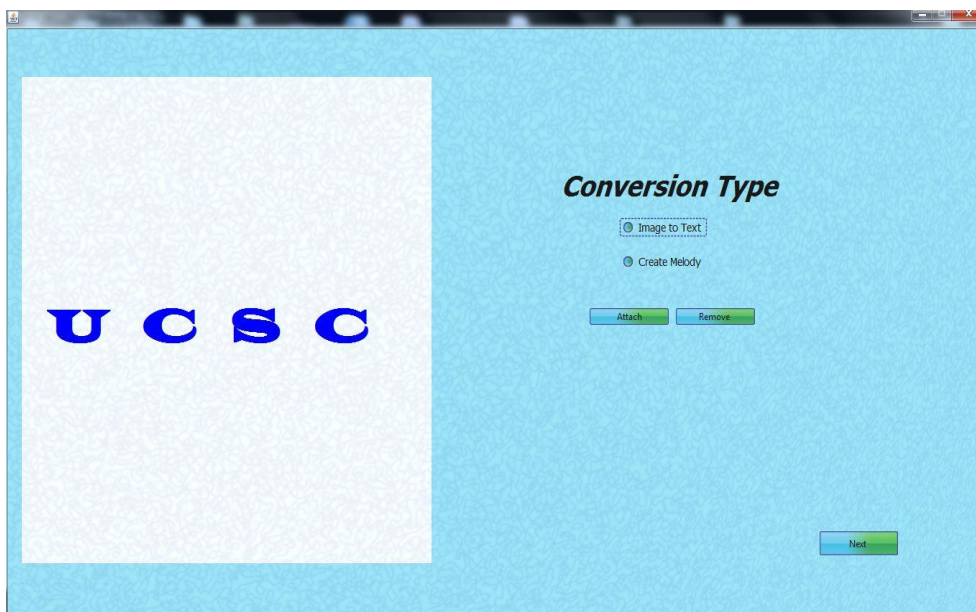


Figure 7: Home Page

5.2 Test with sample data

Sample file can be upload to the system by click the attach button. Once select the image it will be loaded to the image view section.

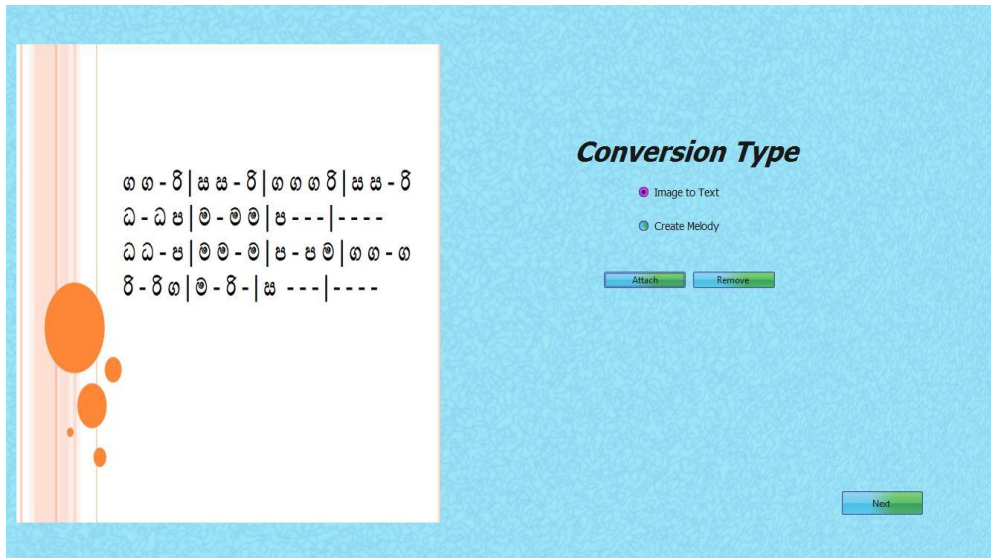


Figure 8: After Music Script Attach

Then user can select Image to Text option and click the next button it will load the next window.

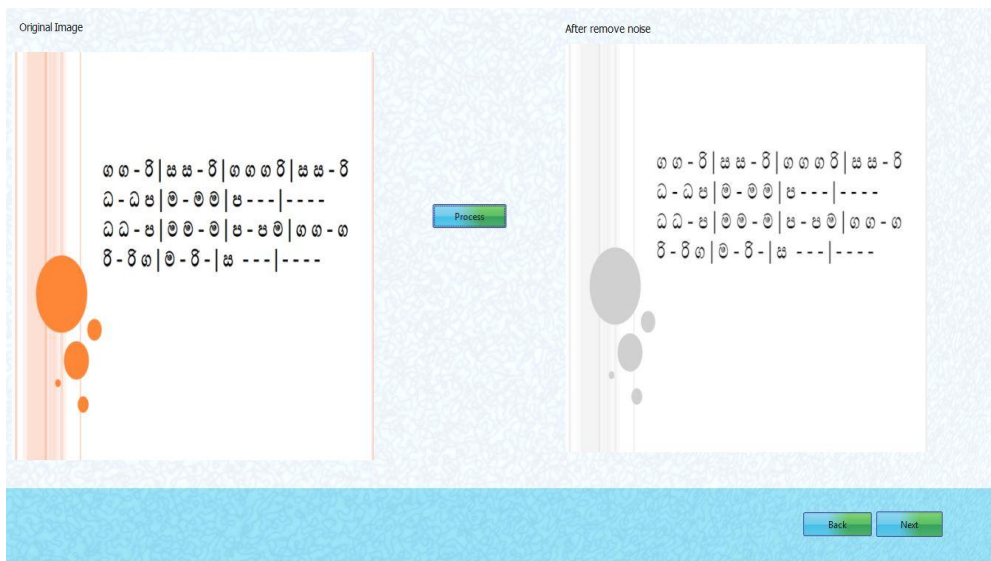


Figure 9: Convert to Gray Scale

Once user click the process button system generate the gray scale of the image. System convert image to gray scale because of it's easier to recognize character using gray scale image.

After generate gray scale image user can go to next stage by clicking next button.

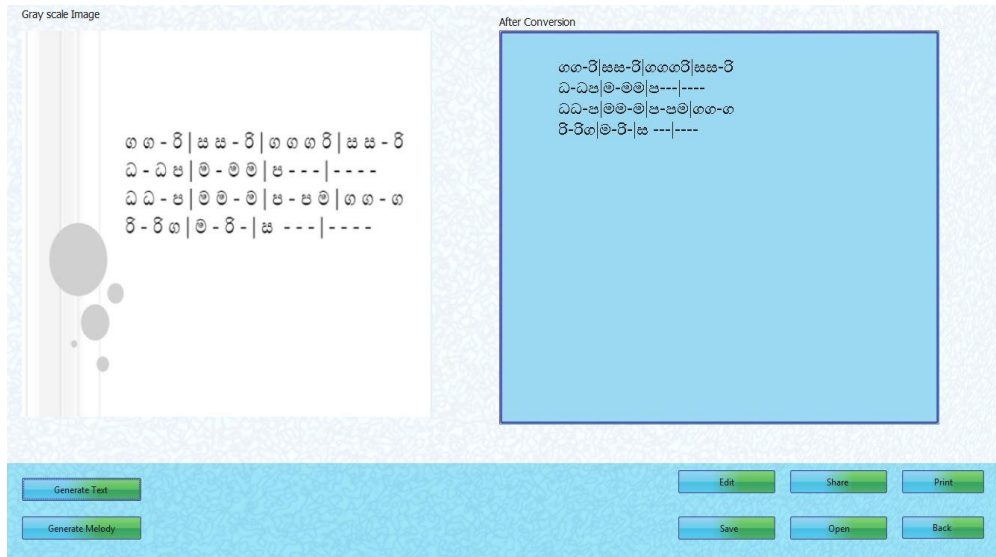


Figure 10: Character Recognition UI

This is the final step of the image recognition section. Gray scale image is loaded to the left side of the interface. Right side of the interface user can generate text by clicking Generate Text button. Once user click that button it's generate the text using image processing techniques.

After successfully recognition of text user can generate audio output by click the Generate Melody button.

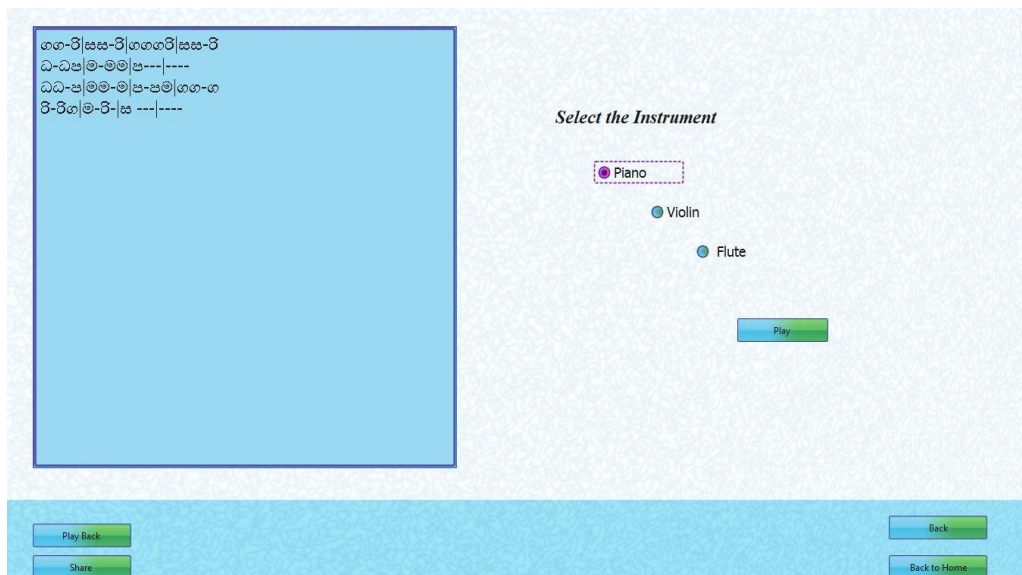


Figure 11: Audio Output Generating UI

In here user can select the instrument what they want to play they can listen the melody by click the Play button.

5.3 Evaluation of results through different kind of text

In here we test with different sample for example different size of text, text with bold letters, and color text, by using this test we get the good result of the text recognition. This system gives more than 90% of accurate results and also audio output generation gives the accurate results.

5.4 Research Findings

This system is focused on building a comprehensive desktop application that allows you to get many purposes. The main purpose of this study is to provide a perfect solution about how to convert Eastern music characters to exact audio output.

We target to achieve following goals:

We need to be analyzed scanned input document and identify music characters of that scanned paper, we mainly focused this system for melody writers who write melody day today life and music lovers .Because if melody writer want to play their music script they need instruments, and they need to spent time and effort to play that script, but using this system they can play their music script without having any instruments and they can change their script and play until get their expected output . For example if they want to play that script using 2 or more instrument some time they don't know how to play the specify instrument then they face problem again so they need to get help from other party and sometime need to pay them as well, so need to west money and the time .

Using this system melody writer can save their money and time also and they have chance to write new melody because they need to write the script only and then upload to the system its convert to audio output, And this system has lot of features, when they upload the paper and they need to modify any character then system allow this facility also so they don't need to re write full music script again. And they can generate the new melody script to note pad and they can share the script and also generate melody as well.

Chapter 6

Conclusions and Future Work

Auto Generate Music Melody has succeeded in achieving its goal as a system that mimics the human music composition process. With this project has come up with an enhanced image processing techniques, better noise removal techniques, frame detection techniques, techniques for removing the image angle effects, proper character segmentation techniques and proper feature extraction techniques to overcome the weaknesses of the source image, and provide suitable image source for character recognition.

Inside the character recognition unit, techniques for pattern creation algorithms for fast access the pattern databases, pattern classification techniques, template matching algorithms is used to recognize and predict the accurate character from the input image source and increase the accuracy level of the whole process. It has several interesting features and implements many novel techniques.

And mobile application developed mainly for android users. In our next stage we hope to move for IOS and windows phones using cross platform development. Furthermore accuracy level can be increased using newly coming technologies and we will be adapting to those technologies and system will be modified according to needs.

It can also be considered as an excellent foundation for developing bigger and better music composition applications in the future. It will prove useful for professionals in both the music and the computer fields alike. Therefore this system has the potential to address the need of a larger target audience effectively and precisely.

REFERENCES

- [1] B. Gatos, I. P., & Perantonis, S. (n.d.). Adaptive degraded document image binarization. Athens.
- [2] Jelijkenismaten, P. (2000). Pattern Matching using Similarity Measures. Utrecht: University of Utrecht
- [3] Pranob K Charles, V., M. Swathi, & Deepthi, C. (n.d.). A Review on the Various Techniques used for Optical Character Recognition., (pp. 1-4).
- [4] Hanna Järveläinen (Seminar on content creation, Telecommunications software and multimedia laboratory, Helsinki University of Technology. April, 2000.) Algorithmic Musical Composition.
- [5] Nafiz Arica, F. T.-V. (n.d.). Optical Character Recognition for Cursive Handwriting. (p. 13).
- [6] Anand Joshiy, M. Z., Kadmawalay, R., Dantuy, K., Poduriy, S., & Sukhatme, G. S. (n.d.). OCRdroid: A Framework to Digitize Text Using Mobile Phones., (p. 21).
- [7] R.J. Rodrigues, A. T. (n.d.). Cursive character recognition – a character segmentation method using projection profile-based technique., (p. 6). Rio de Janeiro.
- [8] Jason J. S. Chang, Shun-Der Chen. The Post Processing of OCR based on Statistical Noisy model and language model. National TsingHua University
- [9] Tushar Patnaik, S. G., & Arya, D. (n.d.). Comparison of Binarization Algorithm in OCR. (p. 9).
- [10] H. Fujisawa, C.-I.L. (1999). Directional Pattern Matching for Optical Character Recognition. Tokyo: Hitachi Central Research Laboratory.
- [11] George Papadopoulos and Geraint Wiggins (2000) A Genetic Algorithm for the Generation of Jazz Melodies.
- [12] Shashank Mathur, V. A., Joshi, H., & Ahlawat, A. (n.d.). Offline Handwriting Recognition Using Genetic Algorithm., (pp. 1-7).
- [13] Percy Scholes (Oxford University Press, 1998). The Oxford Companion to Music.
- [14] Harley R. Myler, A. (n.d.). In Image processing Algorithms (pp. 16-149). Prentice Hall P.T.R.

Appendices

Appendix A – Activity Diagram

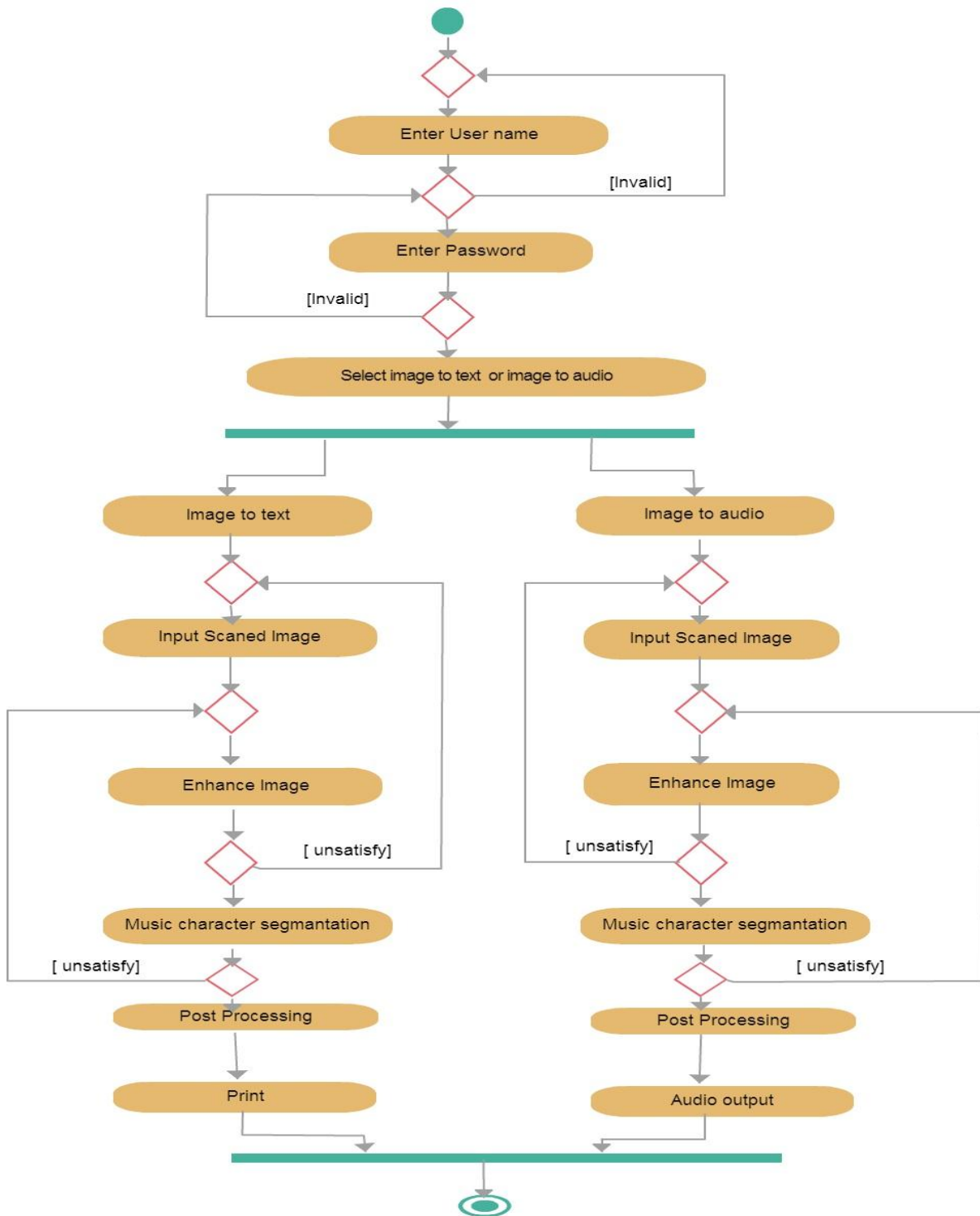


Figure 12 : Activity Diagram

Appendix B – Overall System Architecture

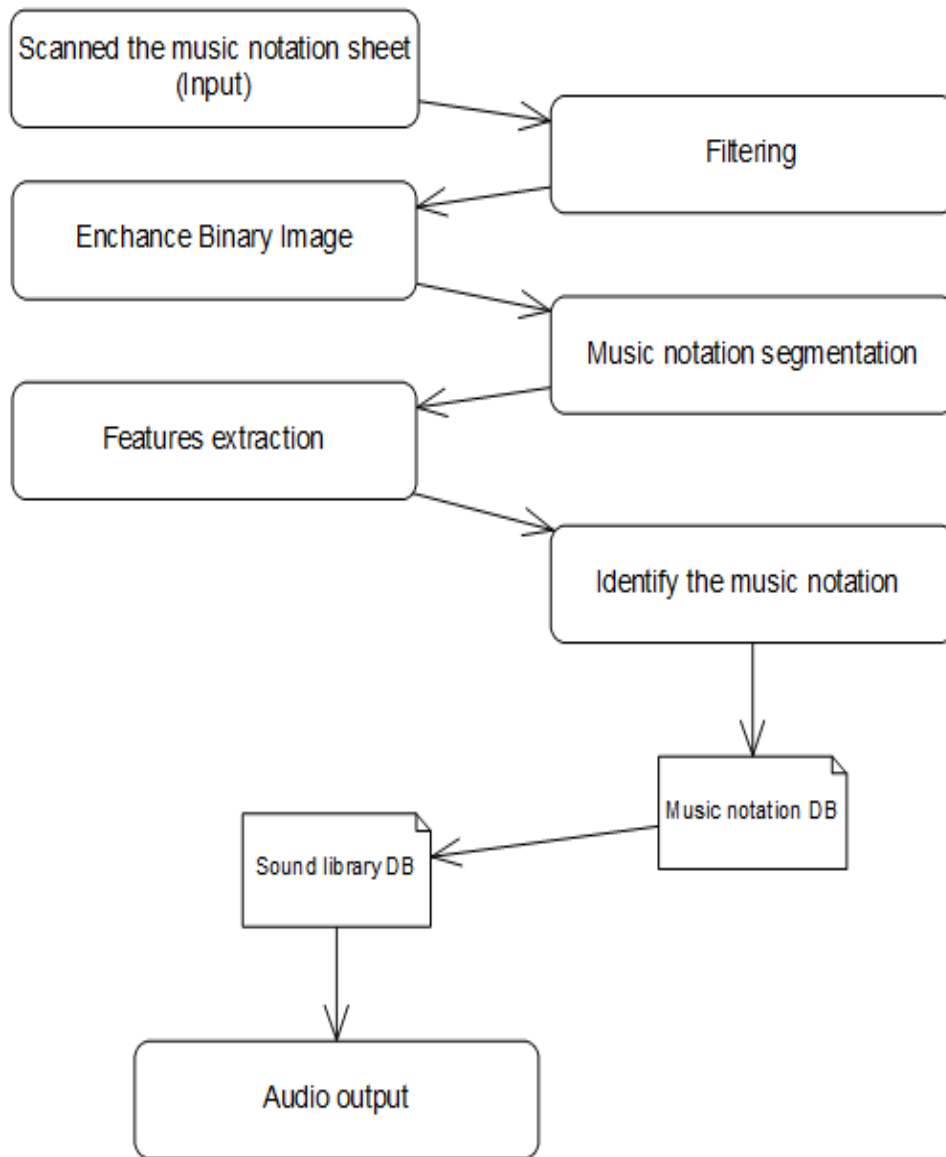


Figure 13: Overall system architecture