

# Retrieval Of Music Notations And Enabling Trustworthy Service Evaluation In Smart Phones

Berlin Russel, Jeyam Thilagar, Murugesan

Department of Computer Science and Engineering, Dhanalakshmi College of Engineering, Chennai, Tamilnadu.  
Email: berlinrussel@gmail.com

**ABSTRACT:** Retrieval of music notations is one of the challenges which prevail even in recent days .The first step is to identify the scanned pages through optical music recognition by identifying the staff lines, musical object location, musical feature classification, and musical semantics. After identifications with various grammars they are categorised in order and trustworthy service evaluation system is enabled for the users to share their reviews of a particular music sheet they are buying through their smart phones or tabs in service oriented mobile social networks(S-MSN)without any third trusted party. Since there are no third trusted parties there are many chances for Sybil attacks and other modification review attacks which are to be avoided.

**Keywords :** optical music recognition; categorisation; trustworthy evaluation; Sybil attacks

## 1 INTRODUCTION

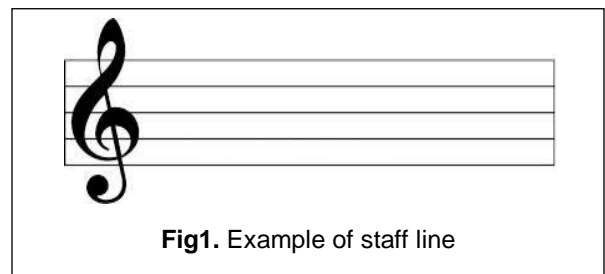
There are a lot of music compositions which are sold on the internet online but the sad fact is that none of it matches our needs .We cannot identify the right ones because they are not categorised in a proper way. The categorisation must be done on the server side but since categorisation of the music sheets require some additional knowledge on music, categorisation is a heavy process which is a burden when there are thousands of scanned files. For the ease of the categorisation optic musical recognition is used. Optic music recognition is used to identify and classify the scanned music sheets. As a part of the process the music staff lines are first identified with help of OMR. Then the found lines are replaced with white pixels and then the music notations are spotted and then they are recognised with the help of grammars. Then the found elements are converted into semantics which could be easily understood by anyone. By the help of this the music sheets can be easily categorised. The categorised music sheets are made available to smart phones using the service oriented mobile social networks. However, the S-MSNs are autonomous and distributed networks where no third trusted authority exists for bootstrapping the trust relations. Therefore, for the users in the S-MSNs, how to enable the trust evaluation of the service providers is a challenging problem. Trustworthy service evaluation is a one in which enables third party websites to write the compliments, compliments and reviews form which the service providers learn about the users experiences. Thus here we make the service providers to handle the TSE themselves[6] by moving it into S-MSN settings. vendors are required to manage reviews for themselves. This requirement brings unique security problems to the review submission process. Thus when a user buys a Music sheet he can write the review in the feedback which is maintained by the service provider itself. There are a few attacks which are possible if this is implemented such as likability attacks, modification attacks, Sybil attacks and so on which are avoided .The categorisation helps to get the right music sheet and the TSE is enabled to write reviews about the particular music sheet which would be a great help for the future users.

## 2 RECOGNITION OF MUSIC

Recognition of Music is major is the main work which has to be done effectively. For which the basic notations of music must be known. The scanned music which we take from the database is to be categorised based on the type of music notations which are printed on it. The music sheet will have staff lines, cleffs, notations, rests and other symbols which are to be identified effectively and efficiently.

### 2.1 Staff Lines




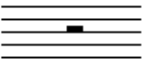

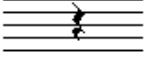

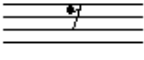

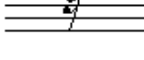
Staff lines are the basic lines which appear on the music sheet. Every scanned music sheet will have those staff lines. It has 5 lines and each line has a particular name for it depending on the cleff symbol. In this paper we concentrate only on the treble cleff and not on the bass cleff or the F clef since most of the songs that is 99% of the music sheets starts with the treble cleff .



Each line in the staff has a name from bottom to top E, G, B, D, F correspondingly and spaces between those lines have names F, A, C, E correspondingly from top to bottom.

### 2.2 Notations

Notations are the important or the major part of the music sheet. Without notations music sheet is just a piece of paper .Notations or the notes are of several types depending on the time through which they are played.They are Semi breve, Minim, crotchet, Quaver, Semi Quaver, Demi Semi Quaver, Dotted minim, Dotted crotchet. By finding and identifying the notation one can play the music. Therefore it plays a major role when music sheet is concerned.

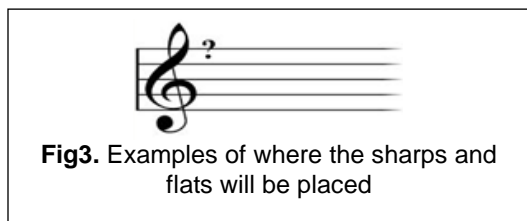
Name	Note	Rest
Whole Note		
Half Note		
Quarter Note		
Eighth Note		
Sixteenth Note		

**Fig2.** Example of Notation

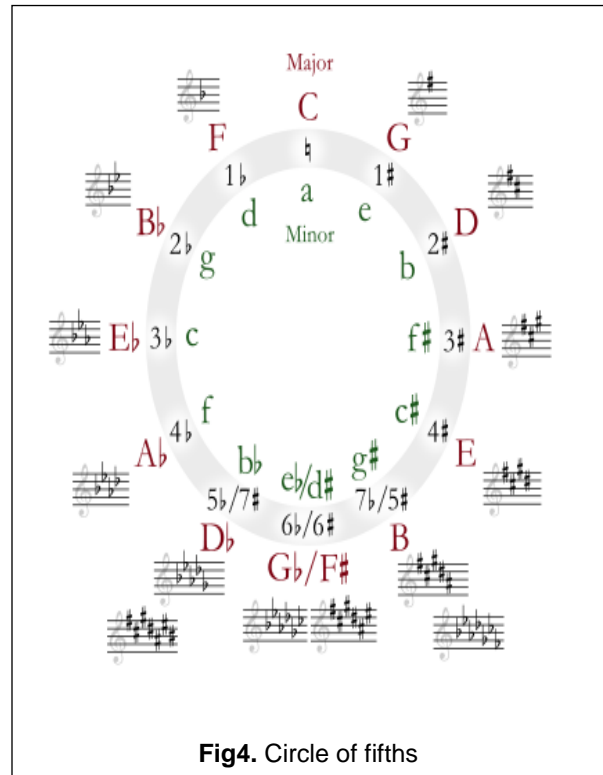
In this paper we do not emphasize on the rest notes cause its not going to do changes or going to add value for categorising the scanned music.

**2.3 Scales**

Scales are another important strategy in music sheets. With the help of scales we can differentiate and categorise songs sheets. There are 12 major scales and 12 natural minor scales which we are taking into account .There are also various other scales such as harmonic minor scales, melodic minor scales and so on. If we can identify the scales we can easily categorise the music sheets. The scales are mentioned in the music sheet in the form of flats (b) and sharps (#).Depending on the number of flats and sharps the scales can be easily identified.

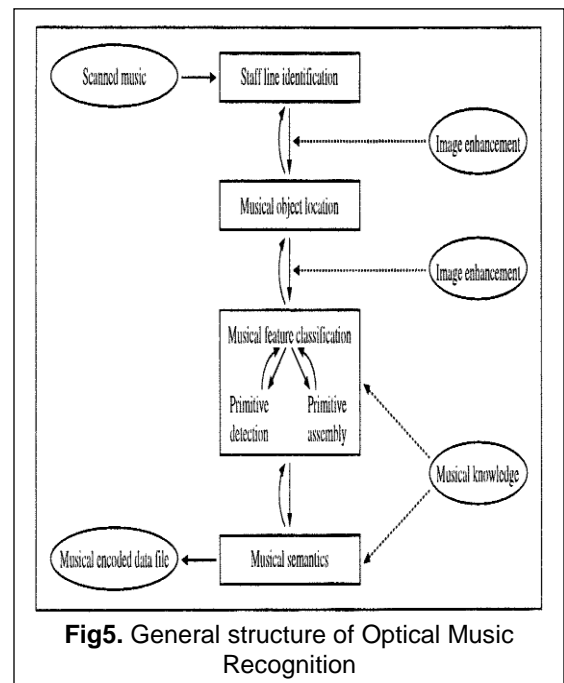


The flats or sharps would be present in the question marked area in the above diagram. The circle of fifths shows the sharps and flats for a particular minor and major scale. For example G Major and E minor scale has two sharps (#) whereas Bb major or the G minor scale has two flats(b).



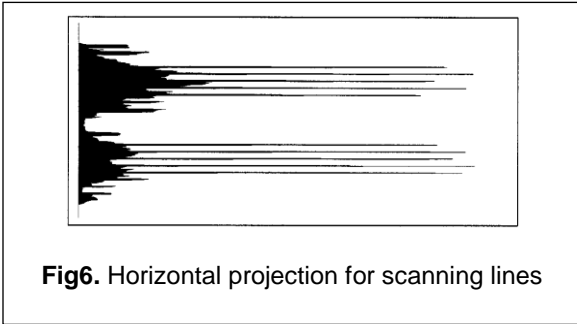
**2.4 Optical Music Recognition**

Optical music recognition greatly simplifies the task of musical data acquisition. This optical musical recognition recognises the music from the scanned music. It first gets the scanned music sheet identifies the staff lines, locates the music object, classifies the music object and the final step is the musical semantics[1].



**2.4.1 Staff Line Identification**

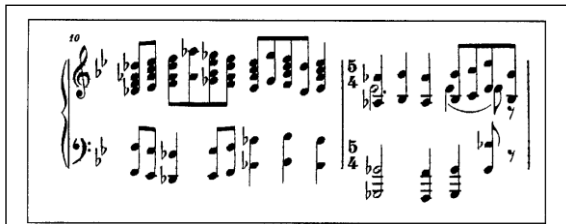
The staff line identification is the foremost thing which is very essential before identifying the symbols and notations. Most of the staff lines cannot be guaranteed to be in a straight line in a scanned music sheet[1],[2]. Therefore it is way harder than we think. The most widely used method for detecting the staff lines are horizontal projections .Alternatively we vertical scanning can also be done to find the staff lines.



**Fig6.** Horizontal projection for scanning lines

**2.4.2 Music Object Location**

Music object location is the next step after staff line identification is applying de facto algorithm[3] thereby the staff lines are ignored. The algorithm follows along the line, replacing it with white pixels unless there is evidence of activity on either side of the line. The check for the existence of a musical object generally searches a region no more than two pixels away from the top or bottom of that part of the staff line[1]. Therefore the music sheet without the staff lines would be as follows as in the figure without the lines on it.

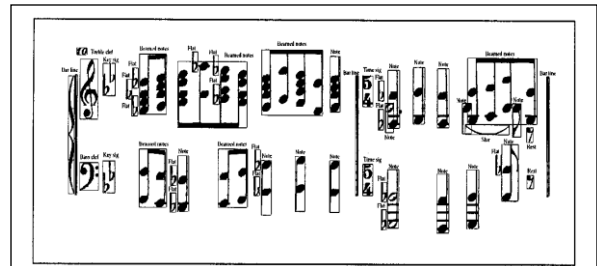


**Fig7.** Applying de facto algorithm

The image is processed from top to bottom, left to right through the invisible staff lines and if a object which is black is found is stored with the help of flood fill algorithm.[4,1].

**2.4.3 Musical Feature Classification**

Musical feature classification is the next step after removing the staff lines. Once the staff lines are removed, the musical objects must be classified. The musical features such as the symbols are converted into primitive shapes by decomposing with the help of Document Image analysis[5,1].



**Fig8.** Musical features within labelled bounding boxes[11]

**2.4.4 Musical Semantics**

Musical semantics is the final stage of optical music recognition in which the symbols are converted into semantics. Essentially it involves interpretation[1]. The semantics for the musical symbols are in the figure. Nowadays standard interpretation has come like MusicXML. MusicXML is intended to be easy for automated tools to parse and manipulate.

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Staff System 1:
Staff 1:
{4Db 4F 4Ab 5Db}(0.5), {4Eb 4Ab 5C 5Eb}(0.5),
{4F 4Ab 5Db 5F}(0.5), {4Ab 5Ab}(0.5),
{4Gb 4Bb 5Eb 5Gb}(0.5), {4F 4Ab 5Db 5F}(0.5),
{4Eb 4Ab 5C 5Eb}(0.5), ....

Staff 2:
{2F 3F}(0.5), {2Eb 3Eb}(0.5), {3Db 2Db}(1.0),
{2Eb 3Eb}(0.5), {2F 3F}(0.5),
{2Ab 3Ab}(1.0), {2Bb 3Bb}(1.0), {2Ab 3Ab}(1.0) | ....
    
```

**Fig9.** Music semantics

**2.5 Categorisation**

After finding the musical semantics it is evident that the key or the scale of a particular song could be found out without the musical knowledge. The number of sharps and flats could be found and matched with the circle of fifths to find the scale and each song is categorised in their particular scales in the database and an application must be developed in the Smartphone such that the user can retrieve the song in a particular scale. The user can see a sample page of the music sheet and can buy the particular music sheet if it satisfies him.

### 3 REVIEW

After buying the user gets the file and he write the review of the products worthiness and usage which will be useful for other buyers. Now till now the user reviews for this domain was subjected to third party . Each service provider independently maintains a TSE (Trustworthy Service Evaluation )for itself, which collects and stores users' reviews about its services without requiring any third trusted authority[6].But when there is no third trusted authority there are some attacks which are possible which are avoided.

#### 3.1 Review Attack

When we place the system under the vendor from the third party there are many possibilities that a Review attack may happen. For example if a user writes a bad review about the music sheet which he purchased it may distract other buyers so there is a lot of possibilities that the vendor may reject the review or modify the review misleading the users. In other cases the vendor might modify comments which are given by the users which will be misleading to the buys who view the comments before buying the product.

#### 3.2 Sybill Attack

TSE assigns multiple pseudonyms to a registered user, so there are many ways that a user may use those possibilities to make multiple reviews at that particular point of time. For example a user a user can give multiple reviews which are false or in other cases if the user is the friend of the vendor he may write multiple good reviews with help of pseudonyms which will be misleading since his real identity will not be shown.

#### 3.3 Prevention of Attacks

These Sybil attacks can be restricted by Sybil-resisted TSE in which the user will not be able to make more reviews at a particular slot of time. If the user does multiple reviews on a particular slot of time his original identity will be shown to the public[6] and he will not allowed to use the application for the next five minutes and he will be logged out. In the non cooperative system when the vendor launches the review rejection attack the non cooperative system has a performance drop (>25 percent) in submission rates. The basic TSE achieves significantly higher submission rates than the non cooperative system. Thus basic TSE can effectively resist the review rejection and modification attack[6].

### 4 Conclusion

Thus the scanned music sheet is analysed by finding the staff lines, locating the musical symbols, classifying and converting them into musical semantics .From the semantics the sharps and flats are found and the scale of the song is found effectively with the help of circle of fifths and categorised according to the corresponding scales. This system is moved into service-oriented mobile social networks enabling trustworthy service evaluation where the users after buying the music sheet can share their reviews without any Sybil or review attacks successfully.

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