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Application of Computer-Aided Music Composition in Music Therapy

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***Abstract*—Music Therapy is the use of a selected music to obtain the same expected changes and hormonal alterations in the body, played uninterrupted for a while, to obtain the desired positive effect. In this project we try to implement computerized composition of Carnatic Music for curing the ailments. There is a growing awareness that ragas could complement or even be a safe alternative for many medical interventions. For this purpose, it is necessary to design a system which can generate music given the user needs and specifications. Our project aims at implementing this idea by giving the swaras of raagas as input and generating pleasant music using genetic algorithm. This application can be used by the medical practitioners by selecting a raga for playing after giving the patient details and disease as input. Formulating the fitness criteria is a herculean task in order to satisfy coherency, variety, harmony, rhythm and to reduce redundancy. The history of the therapy should also be stored which can be used as a constraint for fitness evaluation. This application is developed using Java. A Java API, called JFugue is used to support music programming.**

***Index Terms*—Carnatic music, Genetic algorithm, Music composition, Music Therapy**

I. Introduction

Music can be defined as an art form that arranges sounds in a fashion that follows certain natural principles and provides that special inner feeling of happiness and contentment. Carnatic Music which is a classical Music of Southern India has its origin which dates back to 4th century A.D. Research works conducted on carnatic music have shown that carnatic music can be used for healing numerous medical ailments. But carnatic music has always been composer dependent and subjected to stringent rules thereby making it difficult for the therapist to apply in treatment. So there arises a need for a system which can generate music on its own in variety as long as and in the way the user wants it. On probing further it can be found that genetic algorithm can very well be used in automatic generation on user specific music.

A. Carnatic Music-Definition

Indian Carnatic Music [3] has two components namely raaga and thaala as its cornerstones.A raaga is basically the melody(scale) and the thaala is the rhythm(beat).The seven basic notes (or the Saptha swaras) that comprise a raaga are Sa, Ri, Ga, Ma, Pa, Da and Ni.Whereas the swaras Sa and Pa are always fixed,the swaras Ri, Ga, Da and Ni have three variants and the swara has two variants.The Carnatic Music raagas are structured into a mathematical table based on a scientific calculation of their swaras (Fig 1). The 72 raagas identified are known as the Melakarta ragas(Parant raagas) from which are obtained other ragas known as the Janya raagas. Neural research proves that the 72 raagas have the power to control 72 nerves in the human body.

B. Carnatic Music and Music Therapy

Music Therapy is a newly developed branch of Para medicine in which music or sound pulses that generate different kinds of music are being employed in curing ailments like mesothelioma, asthma, depression, and even Asbestos Cancer, peritoneal mesothelioma etc. According to an ancient Indian text, Swara Shastra, the seventy-two melakarta ragas (parent ragas) control seventy-two important nerves in the body. It is believed that a person who sings/performs a raga bound to the raga specifications (lakshanas) and with purity in pitch (swara shuddi) will have complete control on the corresponding nerve. To quote a few, for those who suffer from hypertension, ragas such as Ahirbhairav and Todi are prescribed. To control anger and bring down violence within oneself, Carnatic ragas like Punnagavarali, Sahana come handy.

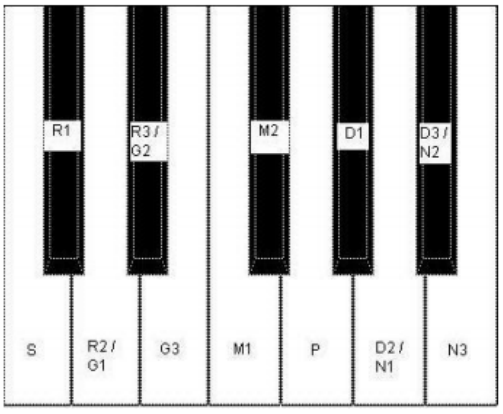

Fig. 1 Mathematical table of Swaras

TABLE. I Raagas used in Music Therapy

Raaga	Treatment
Todi	Provides relief from cold and headache
Shivaranjani	Memory problems
Bhairavi	Provides relief from Sinus, cold, phlegm, toothache.
Chandrakauns	Treatment of heart ailments and diabetes.

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DarbariKanara	Eases tension and provides relaxation.

A list of raagas used in music therapy is given above.

II. Implementation

A. System Overview

The application consists of a central database that contains the list of ailments and the corresponding raagas (one or many raagas for each ailment) that helps curing it. The therapist enters the patient's disease onto the user screen. The information about the required medical problem and the corresponding set of raagas is retrieved from the database and displayed on the screen. The doctor chooses an appropriate raaga based on the patient need. The doctor can change the tempo depending upon the patient's response during the course of the therapy. The entire treatment history is recorded in the database for aiding in the choice of raaga selection. The doctor can also update the database as and when a raaga is found to cure a health problem. Patient details, disease and the raga that was used to cure the disease are updated. The whole system architecture is as in fig II.

B. Genetic Algorithm

Genetic algorithm is a search heuristic that mimics the natural evolution. A typical genetic algorithm requires:

1) A genetic representation of the solution domain,
2) A fitness function to evaluate the solution domain.

Once we have the genetic representation and the fitness function defined [2], GA proceeds to initialize a population of solutions randomly and later improve it through repetitive application of mutation, crossover, inversion and selection operators [1]. In music generation, genetic algorithm is applied as below.

1) Initialization and Selection

Initially, a set of substrings of the raaga's swaras is generated randomly that constitutes the initial population. Only those strings that satisfy the thaala (rhythm) are retained and all others are discarded.

2) Reproduction

The next step is to generate next generation population of solutions from those selected through genetic operators: crossover (also called recombination), and/or mutation. For each new solution to be produced, a pair of "parent" solutions is selected for breeding from the pool selected previously. By producing a "child" solution using the above methods of crossover and mutation, a new solution is created which typically shares many of the characteristics of its *"parents"*. New parents are selected for each new child, and the process continues until a new population of solutions of appropriate size is generated. These processes ultimately result in the next generation population of chromosomes that is different from the initial generation. This process of reproduction is repeated until each child reaches the cut off fitness value,

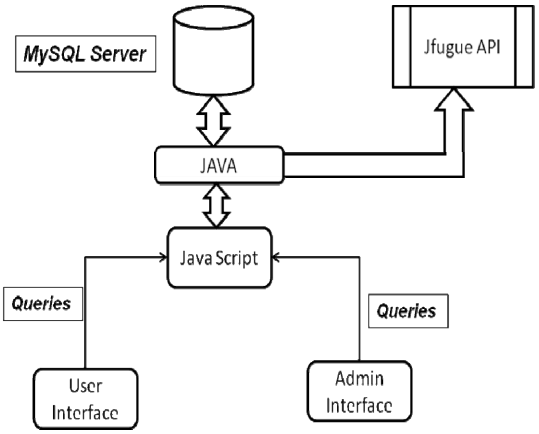

Fig 2 System Architecture Diagram

set previously depending on the type of output required. This process leads to fitter children for quality musical output.

3) Production of Musical Length Of Desired Length

The resultant offspring strings are randomly combined to produce larger musical fragments which are later evaluated for fitness based on criteria like tempo, rhythm, harmony, melody, pitch, duration. Cross over and mutation [4] are performed on these larger fragments for the production of fitter fragments. Once the cut off fitness value is reached, this process is stopped and the music is played. The flow of actions is as shown in the figure III.

Let us consider a raaga called punnaagavarali. The swara set for this raaga are :

C C# D# F G G# A#

Considering Aadi Thala (8 equal duration beats) the random population selected may be

Cq C#h D#q Fh G#h A#h

Cq D#q Fh A#h C6h

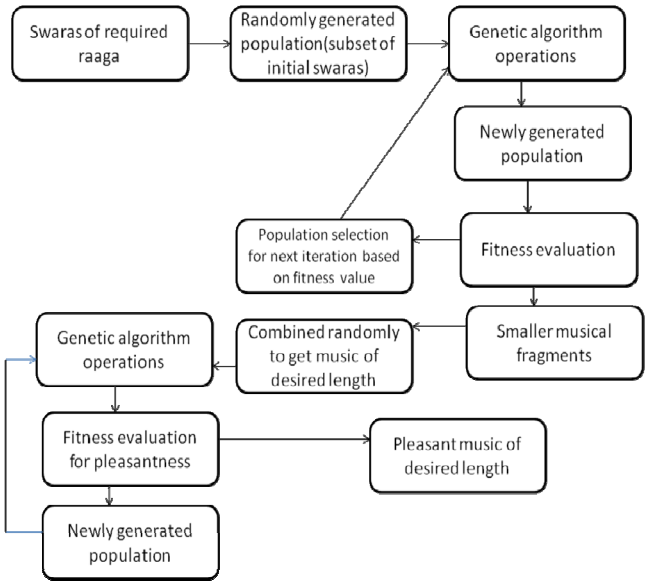

Fig. 3 System Flow Diagram

Gh G#h A#h C6h

Fh Gh G#h A#h

where h indicates a half note and q indicates a quarter note. The subsequent operations are done on this population.

Advantages of using Genetic Algorithm:

1) Large search space- Experiments all possible subsets of

the swaras thereby becoming a variety musical generation technique.

2) The resultant population of an iteration is further put into operations of the genetic algorithm based on their fitness value and the hence the newly evolved population is better than the previously evolved population thereby producing very pleasant music.

III. Further Work

This work can further be extended by validating the music generated by testing with a patient and studying the EEG response. The algorithm with little modification equipped with mood detection sensor can be used in generating mood based music.

IV. Conclusion

Thus on refining the music generated by the genetic algorithm, music of good quality and variety and which has the maximum potential in the treatment of specific medical ailments can be produced using this application.This application once coded will be of extensive help and usage in medical field.

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