Human Computer Interface to Play Virtual Musical Instruments Using Finger Sensor Data Glove

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Abstract — **In this paper, an attempting to make a new human computer interface to play musical instruments. Play various musical instruments with the help of a data glove virtually. The data glove that is used, will give us the values of location of hand in the virtual space. Using these values, play musical instruments virtually by calibrating the data glove with the prototyped musical instruments. The main input is the gestures made by human hand which will be further used to select the instrument to be played, play musical instruments and handle various sound related aspects such as volume, tone, pitch, rhythm etc. The output will be getting a system to play various musical instruments in virtual space by using just our gestures.**

Key Words — ***Data Glove ,Gesture, Musical Instruments,Virtual music.***

I. INTRODUCTION

Now a days, to play any musical instrument, we either need to own the same or have software to play it digitally. To play any instrument physically, you need to carry the high cost, bulky instrument everywhere you wish to play it. To play the instrument digitally, you need to have the software loaded, but they play one instrument at a time, either by using keyboard or mouse interface. By the help of our system, the user would be able to play music virtually by just the movement of his hand and fingers. Flexible sensors can find many useful applications detecting vibrations, contacts and impacts, air and liquid flows, pressures and compressions, displacements and motions. So they are utilized in the fields of robotic, medical, fitness, assistive technology, gaming, etc. But here point out the adoption of such sensors for realizing a data glove, capable to associate a sound to each single movement of every joint of the fingers of a human hand. [1] The problem revolves around virtually playing of musical instruments with the use of a Data Glove. Basic operations of selection of musical instrument and playing the selected musical instrument virtually with the use of data glove is to be done by the use of the proposed system. Rhythmic playing of various musical instruments to generate music is the expected output from the system. Earlier attempts to make a system to play musical instruments virtually include development of music glove by a musician Emogean Heap with a team of developers. This technology being new has been expensive and unknown for the basic users. Similar researches using various different techniques are in progress. Whereas the usage of data glove made of flex resister, used in this paper, has helped researchers to develop a system to play various musical instruments by a single person at a comparatively reasonable price than pre-existing system.[1][9]

II. LITERATURE SURVEY

The traditional method to generate music has been of using various musical instruments which can be categorized as aerophones (wind instruments), chordophones (string instruments), idiophones (self sounding instruments) and membranophones (Membrane instruments).[5][10]
The most famous type of conduction of musical instruments is by the musical instruments applications in the present smart phones. But while in this modification to music generation, the user has lost the feel and importance of playing the musical instruments. Hence a need to develop a system which could play the musical instruments the way they were played using the new age music technology was seen. A better system than the old physical instruments using the technology was to be made. The research for such a technology, lead us to the virtual musical instruments functioning using a data glove. [1]-[3]
Hand gesture recognition deals with the understanding of four musical time patterns and three tempos that are generated by a human conductor of robot orchestra or an operator of computer-based music play system using the hand gesture recognition. This hand gesture recognition system operates as follows: First, it extracts the human hand region by segmenting the depth information generated by stereo matching of image sequences. Next, it follows the motion of the center of the gravity(COG) of the extracted hand region and generates the gesture features such as CFP and the direction-code. Finally, obtain the current timing pattern of the music's beat and tempo by the hand gesture recognition using either CFP tracking or motion histogram matching.[2] The Fast Fourier Transform (FFT) is a powerful general-purpose algorithm widely used in signal analysis. FFTs are useful when the spectral information of a signal is needed, such as in pitch tracking or vocoding algorithms. The FFT can be combined with the Inverse Fast Fourier Transform (IFFT) in order to resynthesize signals based on its analyses.This application of the FFT/IFFT is of particular interest in electro-acoustic music because it allows for a high degree of control of a given signal's spectral information (an important aspect of timbre) allowing for flexible, and efficient implementation of signal processing algorithms.[4]
Woodwind instruments have a long tradition in many countries. A wide range of scientists, from physicists to musicologists, conducted research on their acoustics. However, most studies refer to classical western instruments. Research on traditional non-western instruments begun not many years ago and the results are considered valuable for musicological scopes, as well as for the sound synthesis industry.[6] The integration of mind, body, and sound is the focus of sonic virtual reality "jam". This is an interactive "gaming" system that uses body movements and

vital signs to generate soundscapes. Choosing from single player or multi-player mode, each player wears biosensors that capture data from actions of the body. This information is compositionally mapped to sounds for artistic, interactive, and therapeutic purposes. It includes the player interaction (or game play), software, hardware, possible future iterations, and current direction.[7]

The Computer Music Tutorial is a comprehensive text and reference that covers all aspects of computer music, including digital audio, synthesis techniques, signal processing, musical input devices, performance software, editing systems, algorithmic composition, MIDI, synthesizer architecture, system interconnection, and psychoacoustics. A special effort has been made to impart an appreciation for the rich history behind current activities in the field. Profusely illustrated and exhaustively referenced and cross-referenced. The Computer Music Tutorial provides a step-by-step introduction to the entire field of computer music techniques. Written for nontechnical as well as technical readers, it uses hundreds of charts, diagrams, screen images, and photographs as well as clear explanations to present basic concepts and terms. Mathematical notation and program code examples are used only when absolutely necessary. Explanations are not tied to any specific software or hardware.[8]

In this paper, "Data glove controlled virtual musical instruments", a system will be developed for creating an innovative way to play musical instruments. A new human computer interface that is the data glove to recognize human gestures and generate music using the gestures made has been used. The user using this system will be able to play various musical instruments with the help of a data glove virtually. The basic hardware component used as an input to the system is the data glove. The data glove is an interface device between the computer and the user. It is designed to give us the values of gestures of the users hand in the virtual space. These values can be used to perform various operations, like using the data glove as mouse. Using these values, the developed system is used to play musical instruments virtually by calibrating the data glove. The main input to the system is the gestures made by human hand. These gestures made by user using the data glove will be further used to select the instrument to be played, play musical instruments and handle various sound related aspects such as volume, tone, pitch, rhythm etc.

III. OBJECTIVES

The following are objectives of the paper:

A. Outcast bulky musical instruments

The basic motive of the project is to outcast the huge bulky musical instrument. To develop such a system, which could fulfill the needs of playing various musical instrument in the single system. The cost of having these expensive instruments can be reduced by developed system used to play various musical instruments virtually.

B. New human computer interface

Another basic objective is to use an interface which has not been widely used for such a system. Using a data glove, the system would play various musical instruments like piano, drums etc. virtually.

C. Retain the feel of playing musical instruments

While playing the musical instruments on the computer system, the use of data glove shall help user retain the feel and actions of playing the virtual musical instruments as like the conventional musical instruments.

D. Multiple musical instruments

The system developed should be able to play various musical instruments which would help user to generate music.

E. User friendly

The system should be as user friendly as possible using various graphical interfaces for playing using musical instruments. The basic objective is to promote music using a new interface to make music making process easier for learners.

F. Cost efficient

The developing system has to be cost efficient than the existing systems. It should also be cost efficient than the conventional musical instruments.

IV. METHODOLOGY

The block diagram for the whole data glove system is shown in Fig.1. The data glove system is controlled by a programmable microcontroller, 89S52. Its inputs are connected to microcontroller 89S52. The extra pins are used for the switching among the developed various virtual musical instruments. The data glove system is powered using a 5V battery.

The music generation system is a software which has an API that has been programmed to match the received inputs with the corresponding predefined musical stored notes. The transceiver unit is used for unidirectional communication from the data glove to the music generation system to send the triggering signals. When user bends the fingers, the micro controller receives the triggering signals. The triggered signals are then used for user interaction with the computer system.

These signals are used by the API for music instrument recognition and functioning. In the music generation API, the received signals from the data gloves transceiver system will invoke the API to display the user hand action and play the corresponding musical MIDI note of the decided musical instrument.

The left hand data glove actions are intended for the controls of the system. The right hand fingers actions are used to play the musical instrument. Similarly, the left hand is used for controlling the system, with functions such as selection of the octave in which the instrument is to be played and selection of the instrument to be played. Various musical instruments have various MIDI notes, these notes are stored in database with the pattern of hand. When the user plays a particular instrument, the pattern matching algorithm is used to search the pattern and play the decided instrument, by playing the stored MIDI note.

The complete procedure of the system can be depicted using the following algorithm:

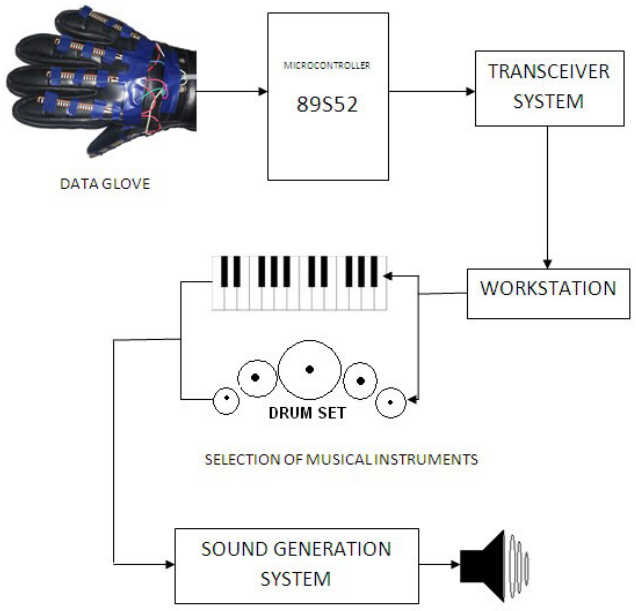

Fig.1. System Block Diagram

Step 1: Start.
Step 2: Start the system. User wears the data glove.
Step 3:User makes hand gestures in order to control and play musical instruments.
Step 4: The bend sensors notice the changes in the hand gestures and pass the signals to the
micro controller in the data glove.
Step 5:The signals are then transmitted to the music generation system using the transceiver
system.
Step 6: In the music generation system, predefined MIDI sounds are stored for the particular
instruments particular beat. This is checked using pattern checking of the gesture made and
the stored data.
Step 7: After the found stored beat, the music note is played to generate sound.
Step 8: Synchronized functioning of the system will help generate music.
Step 9: Stop.

CONCLUSION

In this paper, it is proven that by utilizing a data glove constructed using the bend sensors, with the use of MIDI notes, a system could be developed to play various musical instruments in an economical and faster way. This prototype will provide us with smooth and easy functioning system to play various musical instruments just by the gestures of users hands. Compared with traditional conventional musical instruments, the system retains the feel of playing these musical instruments. It also enables the user to play various musical instruments using this developed system which is cheaper than having the conventional huge bulky musical instruments.

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