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To Design and Development of a Cost Effective Electronic Drum Kit

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ABSTRACT
The goal of the project is to create a Cost Effective electronic drum kit using piezoelectric sensors for various percussion instruments. The inputs to the kit are small drum pads, which house a piezoelectric transducer. The output voltage from this device is detected and its output is interfaced with microcontroller . This information is processed through a Drum sound controller module which controls audio playback. The background work focuses on the concepts of tracking the timing of musical signals, deriving information from them, and creating a musical accompaniment. The system will then generate an expressive drum beat to accompany the audio signal in real time. The system is intended as a practice tool as well as a means to observe the musical interaction that may occur between humans and machine. It would involve implementing on an EEPROM for additional sound storage. It will contain a single module which will carry all sound database and allow the player to make their own patches and it will make it independent from interfacing with a computer.

Keywords - Arduino, Cost efficient drum kit, Electronic Drums, Home made percussion, Midi controllers, Piezo sensors.

I. INTRODUCTION

An electronic drum is basically a switch that triggers the playback of a digitally recorded drum. Here it is a drum controllers build out of PVC pipe and connected them to a studio drum machine to create a professional-sounding electronic drum kit.

Many musicians enjoy performing and practicing music with other musicians, however, it is not always possible to assemble a group of like minded musicians together for this purpose. A software based solution to provide automatic accompaniment for musicians is a good way to practice performing with others, as well as gauging how a piece of music might sound with additional instruments. For those looking to play their music with a drummer, drum programming software is readily available to anyone with an internet connection. However, most of these programs only allow for the programming of simple looping drumbeats and can take time to perfect. Those who are not familiar with drumming may also have a hard time programming a drumbeat that sounds good and fits with the music being played. These drum machines also do not typically respond to the musician's playing which forces the musician to follow whatever has been programmed. This is particularly bad for practicing as the player is not able play as expressively as they would with a human drummer. Various instrument playing robots have also been created, both programmable and improvisational. Unfortunately, most musicians cannot afford to purchase robots to use as band mates.

What's needed is a system which allows a musician to perform material on a live instrument and hear back a drumbeat which can go along with it. This could be useful as a practice tool and as a compositional aid for those who may not have immediate access to a human drummer.

The system described in this report is a step towards the ability to provide a practice tool for musicians who may not be able to rehearse with other musicians by allowing them to play their instrument live and have a supporting drum beat provided to them. Many beginning musicians will practice by playing along with their favorite songs. However, this method does not allow one to take a leading role in the performance. The finished program can be a useful tool for soloists to improve their group performance in an interactive way and without relying on a metronome.

The program may also be useful for those trying to write music as they could get an idea of how a given guitar or piano part would sound with drums supporting it. It will also be interesting to see how human musicians interact with a computer simulated drummer and how it may influence their performance. This system is designed to exhibit the basic musical intelligence of a drum player in such a way that it can react appropriately to different musical cues and properties**.**

Electronic drums are gaining popularity because they offer many benefits compared to traditional acoustic drums. For example, electronic drums produce less noise to the environment compared to acoustic drums. The volume levels of electronic drums can be adjusted and the samples used for each drum trigger pad can easily be changed. Tuning of acoustic drums is a time consuming task.

Electronic drums transform digital signals into sounds, simulating acoustic drums. An electronic drum set consists of trigger pads which are connected into an electronic drum module via cables. When a drum trigger pad is hit, the drum module plays back a sound associated to that specific pad.

1.1 Electronic drum module

The electronic drum module is an embedded device consisting of drum trigger inputs, a user interface and an audio output. It is the most important part of the electronic drum set containing all the intelligence , which is why it is often called the "Drum Brain". The audio samples used in an electronic drum module are usually built in, and they can be selected for each drum trigger pad separately. Often the drum modules have other features built in, such as metronome and play along songs. Different properties of the most advanced electronic drum modules currently on the market are listed in Table 1.1 . Most versatile drum module, when considering the ability to load your own samples, the 2BOX DrumIt Five with its 4GB onboard memory. The most expensive device, the Roland D-30, doesn't offer the possibility to upload your own samples, but the amount of samples and effects make it very versatile device. Even though the Alesis SamplePad is not an electronic drum module to be used with external trigger pads (it has four built in), it was taken into this comparison because of the possibility to load your own samples via SD memory card. However this module doesn't support stereo - audio or the possibility to load several audio samples for the same channel.

Device	Memory Capacity	Custom samples	Expandable Memory	Notes	Prize Range
Roland TD-30	N/A	No	No	Wide variety of sounds	Rs.4,58,640
Yamaha DTX900	N/A	Yes	512MB DIMM	Samples can be loaded via USB(from PC)	Rs.2,14,060
2BOX DrumIt Five	4GB onboard Flash	Yes	No	Samples can be loaded via USB	Rs.1,49,842
Alesis DM10	128MB	Yes	No	Samples can be loaded via USB	Rs.54983
Alesis Sample Pad	14MB	Yes	SD,SDHC up to 32GB	Sample pad consist of trigger pads	Rs. 14758

Table 1.1 List of properties of different electronic drum modules(TD-30, DTX950, DrumIT Five, DM10 Sample Pad)

II. PROBLEM DEFINITION

There is always being many problems with the drummers while handling with their drum kit. They face numbers of challenges before practicing on their kit. First problem they has to face is the space. A normal professional acoustic drum kit occupies lots of space and the second major problem is uncontrolled high sound which it creates, that can't be bearable with the other nearby peoples. So a sound proof room is required likewise in studios. For a normal person it is very difficult to afford a drum kit as well as an sound proof room so that they can practice without disturbing others. As being a drummer they face many problems related to the same. So there comes a solution of making an Electronics Drum Kit which will be cost efficient as well as its volume can be controlled. This kit can also be interfaced with Personal Computer by which we can directly use it for studio based high quality recordings. This kit will be portable and it will not take more space and it can soo much portable that and may be shifted to any place for any live performance where it will be difficult for acoustic

drum kit. After developing this instrument it will definitely a Boon for all the drummers up there.

III. OBJECTIVES

The overall objective of this project is to design and implement a drum kit which uses machine listening and learning to analyze audio produced by a human musician in real time. By analyzing beat patterns and rhythms, the program should provide feedback in the form of an accompanying percussion part. The system will receive a musical audio signal as it is played, determine the tempo and beat pattern of the signal, then output a percussion accompaniment to the musical signal in real-time.

The main concept of this project is to made cost effective electronics drum kit which can compete very well to the kits which are available in the market. A well developed electronics drum kit which are available in the market costs minimum of Rs.40000 which are produced by well known companies like Yamaha and Rolland. in this project the kit is made by using readily available homemade articles which does not costs more than Rs.10000.

Briefly objectives of this project are as follows:

- An Electronics Drum Kit which will be cost efficient as well as its volume can be controlled.
- This kit can also be interfaced with Personal Computer by which we can directly use it for studio based high quality recordings.
- This kit will be portable and it will not take more space.
- It may be applicable for any live performance.

3.2 Comparison to acoustic drum set

3.2.1 Advantages

- Although not totally silent, electronic drums produce much less acoustic noise than a traditional drum kit. Also, the drummer can use a headphone for silent practice.
- Electronic drum sets are usually more compact than acoustic drums.
- One single electronic kit can simulate the sound of several acoustic kits, like a vintage jazz drum kit or a powerful rock band kit. It can also reproduce other sounds, like the Roland TR-808 sound widely used in electronic music.
- Electronic drums do not need complex microphone arrangements like acoustic drums. Instead, the sound can be obtained through line-out or MIDI connections. Because of this, an electronic drum is an adequate instrument for small and home studios.
- Electronic drums usually have useful features for the beginner drummer, like metronome and play-along songs.
- Electronic drums can be played at a lower volume level, avoiding the need for the rest of the band to increase its volume to match the drums. This is advantageous in smaller rooms where excessive volume is not desired.

3.2.2 Disadvantages

- Despite recent innovations, electronic drums still cannot reproduce the exact feel and richness of the sound of acoustic drums.
- The most advanced features, like realistic pads and advanced sound modeling, are only featured in high-priced electronic sets, inaccessible for most non-professional drummers. Meanwhile, entry-level kits still use single triggered rubber pads and poor sampled sounds, limiting sound and playing experience.
- The sound of an acoustic drum set is powerful enough for a small gig. An electronic drum kit needs a power outlet and, at least, an amplifier, even for small presentations.
- Quality of sound is highly dependent on quality of amplifier and audio systems.

Building our own electronic drum pads may seem like a difficult task. The concepts behind electronic triggering are actually quite simple. A piezo acts much like a microphone. It picks up shock waves and passes them to drum module to interpret. The trick is getting the most accurate representation of your sticking action to the module without sacrificing the feel of a real drum. This design accomplishes both goals.

Mounting the piezo directly under the head resulted in a broken piezo, while mounting it in the foam resulted in a poor response from the rest of the pad. Therefore the Piezo needed to be bigger, or made to seem so. It is attached to a plywood piece, making the whole surface active. The piezo plate is placed below the plywood piece and on the above surface it is covered by rubber sheet ,which will help to give a bounce effect and will reduce somewhat noise which is produced by the stokes which given by the sticks . The drum head would then transfer the shock through the foam to the metal plate. This drum pad very efficiently transferred the shock to the piezo. No expensive power tools are necessary. This project is designed to be constructed with only basic hand tools that most people either have or can acquire at a low cost.

IV. CONCLUSION

This report presents a design and development of a virtual drum accompanist for musical composition and practice purposes. The ultimate goal is to have the virtual drummer seamlessly provide accurate and appropriate accompaniments to pieces of music as they are played. The system is to model a human drummer who has no prior knowledge of a song but can still create a suitable and dynamic drum beat to complement whatever is being played. The system did, however, help to provide an interesting perspective on the interaction between human and virtual musicians.

It is concluded that the piezoelectric sensors as a vibration sensor can be very well used for drum pads which senses the stroke pattern given by the drummer through sticks. The transducer circuit works fine while responding to it although it have some latency and accuracy problems but it can be removed by changing the values of the capacitors or other components. This can be done in future scope. Regarding the software part we have used is a freeware software available in internet which have its own limitations. Our own software can be developed which will work according to what we want so that in final implementation it can be a completely independent product.

Finally it is concluded that a joy for a drummer of playing drums can be made easy by this electronics drum kit which can be played without disturbing nearby peoples and it is soo much cost effective that it can be affordable regardless the drum kit which is available in market. Only a development and changes can be made to retain its accuracy ,after that it can be made commercially available to all.

V. FUTURE WORK

Some key improvements needed in the system are in the beat detection portion and the audio output section. Additional drum beat options, such as syncopation, swing beats, and drum fills could also greatly benefit the system by increasing its flexibility.

Other future developments may include upgrades to the artificial expression simulator and the drum beat template. Additional parameters may include hit locations for particular instruments which can greatly expand the range of sound and create a more natural feel. Musical recognition techniques could also be very beneficial to the system. If a musician performs a piece with a recurring theme, the system should recognize it and reprise the drum beat that was previously associated with that theme. This feature would give the system the ability to participate in very structured songs in a more cohesive manner. This would also allow musicians to teach the system to play a song if it is able to pick up on these musical cues.

The system could also be greatly expanded to include additional accompanists, such as piano, bass, guitar, horns, and stringed instruments. However, an extension like that would require a much higher level of audio analysis to extract the tones of individual notes. Another possibility is the implementation of a vision system which allows the user to give visual cues to the system to indicate movement changes, pauses, and other cues which are normally visually communicated between band members.

The most important part will be to develop a single module which will contain a microcontroller and memory with its own display ,which is exclude the need of 3rd party software and other pc interface. It will directly store the patches and sounds which we will need and also basic information .It will simply remove the need of PC and whole controlling part will be fed in this module.

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