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AIR DRUMS: PLAYING DRUMS USING COMPUTER VISION

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Abstract

The cost of a drum set is an investment that most aspiring drummers would eventually need to shoulder in order to continue their craft. What this research aims to do is to hasten the introduction of drummers to the drumming experience without the costs, and also to allow for drummers to be able to practice, at least casually, without a full drum set. This thus allows the experience of drumming to a wider audience. The solution we explore is the development of a prototype virtual drum set that would only require users to have a laptop with a camera, along with easily accessible markers representing the tips of drum sticks and knee movement, such as colored papers. OpenCV based on Python was used to implement this, and used the concept of color-based blob detection for detecting the markers. The contributions of this work are the following: (1) the built prototype system is the first attempt as far as we know in building a purely camera-based air drum system that includes the feet movement for bass drum control; (2) the user interface of the system gives access to a more comprehensive set of drum components with the exclusion of the hi-hat due to its complicated dynamic properties; and (3) a more flexible system was built since it allows the usage of markers with different colors, shapes, and sizes. This prototype has also shown to have potential for further development as a released application, along with the possibility of use as a USB controller and MIDI controller.

INTRODUCTION

The drums are the most popular percussive instrument in the music industry today. Many beginners who aspire to be a percussive musician start out with learning how to play the drums. However, a typical drum set is usually expensive, takes a lot of space, and not easily transportable unlike other instruments such as the guitar or keyboard. Figure 1 shows the different components that consist of a standard drum set. The goal of this study is to build a system that will enable aspiring drummers to be able to play and practice the drums on thin air, with the use of computer vision. The idea is to translate a video being captured of a user playing the virtual drums, considering realistic movements with an actual drum set, to an audio synthesis of appropriate drum samples in real-time. Making use of a laptop's built-in web camera, the project aspires to create an implementation that would make it easier for people lacking the funds or equipment, to practice and learn the actual drums.

LITERATURE SURVEY

Implements the virtual drums using a computer vision approach. The advantage of these systems is that a camera is very accessible. However, the algorithms may be complex and difficult to implement in real-time. The work done by Bering and Famador locates and tracks the position of the hands in the video without the need for drum sticks. However, their work does not involve the movement of the feet which is important in recognizing the bass drum and the hi-hat control. Another work implemented by Brown et. al. uses orange markers attached to the end of the drum sticks to be able to locate and track the movement of the drum sticks. Again, their work does not involve the movement of the feet. The work by Rojo also used colored markers and implemented a dynamics computation for the volume setting of the synthesized drum samples. The most popular and marketable implementation making use of computer vision makes use of a high speed camera and reflective balls attached to the end of drum sticks.

EXISTING SYSTEM

Some implementations of portable drum systems employed the use of attachable sensors to drum sticks in order to detect the direction and the velocity associated the different components of a standard drum kit with the sticks. The gathered information is fed into a drum system to play the sound sample that corresponds to the relevant drum component. The advantage of these sensors is that they are more sensitive to velocity changes, and they also require less setup in comparison to using a camera. However, these sensors can still remain inaccessible to the general public due to cost considerations. An implementation of this in a commercial setting is Freedrum, which costs around $235 for a complete kit. Their implementation made use of having sensors on the drum sticks, as well as the feet.

PROPOSED SYSTEM

The goal of this study is to build a system that will enable aspiring drummers to be able to play and practice the drums on thin air, with the use of computer vision. The idea is to translate a video being captured of a user playing the virtual drums, considering realistic movements with an actual drum set, to an audio synthesis of

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IMPLEMENTATION

Object Detection and Tracking:

Keypoints: For what can be said to be a complete camera-based drum system, four keypoints are needed to be detected and tracked: the two tips of the drum sticks, and the two feet for bass drum and hi-hat control. These four points should be used to control the sound that the drum system will produce. For this prototype, we limit the scope to tracking the two ends of the drum sticks, and the right knee of a user. The movement of the knee instead of the foot was chosen for detection in order to allow a user of the system to be near the camera of his/her laptop. The removal of the detection of the left foot was done since its movement is usually used for the open and close state of the hi-hat. The implementation of this would be better suited after the perfection of accuracies of knee or foot movement detection, as this would lead to more accurate states of the hi-hat. It should be noted that the hi-hat is usually closed for most drum sequences thus making this design choice acceptable for a prototype.

Blob Detection

The prototype system detects the three key points through blob detection based on color. As such, this method assumes that there are three different color ranges for the three key points, and that there are three differently colored markers attached to the ends of the two sticks and the right knee of a user. It should be emphasized that these colors should be different from each other, and that the camera view should not contain items of the same color bigger than the sizes of the markers as seen by the camera. For each frame captured by a camera, thresholding is done for each key point to be identified. Dilation is done to each set of extracted pixels in order to make the extracted pixels be more blob-like. The largest blob for each threshold is determined to contain desired key point, and then the center of this blob is computed in order to get the position of the key point. Figure 3 shows an example frame where blob detection was implemented. Event Detection Two methods were explored for detecting the event of striking a drum pad on the virtual drum set: (1) By Acceleration Computation, and (2) By Points Comparison.

Drum Sound Synthesis

There are eight drum components included in our virtual drum set: (1) Crash Cymbal, (2) Ride Cymbal, (3) Hi-hat, (4) Left Tom, (5) Right Tom, (6) Snare, (7), Bass, and (8) Floor Tom.

After the detection of a drum pad hit, the corresponding drum sound is generated based on the computed location of the hit given the pre-defined bounding boxes.

CONCLUSION

Based on our tests, we can say that we have achieved our goal of developing a prototype system for air drums, usable by beginner drummers and at a very low monetary cost. We have also built the first purely camera-based air drum system that includes the feet movement for bass drum control as far as we know. Moreover, the user interface of the system gives access to a more comprehensive set of drum components with the exclusion of the hi-hat due to its complicated dynamic properties. We have also built a more flexible system since it allows the usage of markers with different colors, shapes, and sizes. The tests for the detection-scheme also show the feasibility of using color-based markers for real-time detection in everyday environments given controllable situations. The use of color based detection for real-time detection is simplistic, but due to its speed it is thus viable for the goal of gaining the fastest hits per minute possible in real time. We are able to achieve an estimated 513 hits per minute for the triggering of the drum pads. The conversion of the current code base to C++ is something to be explored in making the code run faster, and thus increase our hits per minute. Further refinement of the algorithms used for whether a drum pad was hit or not, along with the knee movement detection is something that is also needed to be done. As our tests show, we need to further refine them to achieve 100% usability even if it is just for casual drumming, as reliability of musical instruments is the most important factor for playing musical instruments. The achievement of this would also allow for the inclusion of hi-hat control which would then make the standard drum kit experience complete. Improvements to the user interface and user experience of the application is also something to be done for future work as the virtual drum system gets out of the prototype stage. Further development on using it as a USB controller and MIDI controller, would depend on how accurate the system as it is further developed could be. However, those purposes are indeed use cases that have potential for this system.

REFERENCES

[1] ”Janne”, “Standard 5-Piece Drum Kit Parts,” 2018. [Online]. Available: https://drumfortress.com/standard-5-piece-drum-kit-parts/

[2] “Freedrum: The Drumkit That Fits in Your Pocket,” 2017. [Online]. Available: https://www.kickstarter.com/projects/freedrum/freedrumthe-drumkit-that-fits-in-your-pocket

[3] S. R. F. Bering and S. M. W. Famador, "Virtual Drum Simulator Using Computer Vision," pp. 370–375, 2017.

[4] B. Brown, D. Quenneville, and M. Shashoua, "CCS453 Computer Vision Spring 2016 Final Project: Air-drumming through Video Object-detection," 2016. [Online]. Available: http://www.cs.middlebury.edu/{∼}dquenneville/cs453/final-project/

[5] F. Rojo, "Air Drums Using OpenCV and Python," 2012. [Online]. Available: https://www.youtube.com/watch?v=MAnWwxTjL3k

[6] "Aerodrums," 2019. [Online]. Available: https://aerodrums.com/ home/