Arduino Controlled Digital Percussion Instrument Design

MERT CAN BASCOBAN
Dept. of Electrical-Electronics Engineering
Suleyman Demirel University
Faculty of Engineering
TURKEY

OZLEM COSKUN
Dept. of Electrical-Electronics Engineering
Suleyman Demirel University
Faculty of Engineering
TURKEY

Abstract: - In daily life, musicians and people who want to play instruments cannot find enough time to practice and improve themselves. In addition, acoustic instruments, especially percussion instruments, are very difficult to use at home and indoors. For this reason, a percussion instrument design has been made to meet the needs of a person who aims to improve himself and learn new songs at the beginner level in percussion instruments. As a result of controlling the strip LEDs placed on each pad of the digital percussion instrument with the Arduino Uno, people can play the song they want with smoother touch and minimizing metronome errors.

Key-Words: Percussion Instrument, Arduino Uno R3, Drum Kit (Yamaha DD-65)
Received: June 21, 2022. Revised: March 6, 2023. Accepted: April 4, 2023. Published: May 3, 2023.

1 Introduction

Percussion and percussion instruments are used to establish a rhythm structure in music. Rhythm means "flow" in ancient Greek. It creates sound unity and serial rhythms that are revealed by varying lengths and beats. Rhythm structures in modern music are usually performed with percussion instruments. Any object on which sound is obtained by hitting, shaking or rubbing with hand or another object is a percussion instrument. In Western languages it is often referred to as the "percussion" family. They are also called "percussion instruments" in our language. The percussion family includes a significant part of the oldest instruments in history. Even the most primitive of these instruments are among the percussions of contemporary orchestras. These contribute not only to the rhythm, color and dynamic power of the music, but also to the melodic and harmonic elements of the music. In the first group, there are snare drums, drums, castanets, etc. has.

The second group includes vibraphone, xylophone, marimba, etc. Timpani, on the other hand, differs from the drum with its ability to be tuned. Tympanicians can obtain different sounds on the skin of this instrument, which can be stretched more or less [3,4]. Nothing will replace the teacher-student interaction in the traditional education environment given in higher education institutions providing music education in Turkey. However, it should not be ignored that the resources offered by technology will bring a different approach to music teaching. Because technology offers us incredible opportunities for a quality and effective education. Depending on the progress in today's technology, 'Rhythm devices' (Drum Machines) have started to be produced in this field, where we can receive all sounds digitally. Yamaha DD-65, the device used in the study, is an example of this [5,6,7].

The playstation game Guitar Hero, made by Harmonix Music Systems and released by RedOctane, can be shown as a model for this study. The game is played with controllers similar to various guitar models, drum models and microphones. In addition, the Alesis DM Lite Kit illuminated digital percussion device produced by

the Alesis brand can be given as an example. The main difference between the designed operation with this device is that the leds controlled by the arduino work in a pre-programmed way, whereas the Alesis DM Lite Kit works sensitively to the beat of the digital percussion [8,9]. Easy Guitar, which is actively used at http://mychordbook.com/, can be given as an example of the didactic aspect of the study. Easy Guitar is a smart guitar that aims to teach you how to play the guitar. Methods of learning classical guitar are expensive, difficult and time consuming. With Easy Guitar, users can learn to play the guitar with their favorite tracks online whenever they want [10].

Fig. 1. Easy guitar vision

Mychordbook is an online tuning book. It is a music education platform developed by Do Major company located in Bilkent University Cyberpark. The platform, which is aimed at musicians and beginners, teaches how to play the song with different instruments while listening to the song [11].

2 Material and Methods

Arduino Uno-controlled LED was used for the design of percussion with a teaching instrument and a training drum was designed accordingly. The control units used are given below, respectively.

2.1 Arduino Uno R3

It is an Arduino board containing ATMega328 microcontroller. After the first model of Arduino Uno, Arduino Uno R2, Arduino Uno SMD and finally Arduino Uno R3 came out. It has exactly the same features as the Genuino Uno board, which carries the Genuino brand, which is the sister brand of Arduino [12].

Fig. 2. Arduino Uno R3

2.2 Yamaha DD-65 Digital Drum Set

*8 percussion pads

*254 drum sounds

*2 foot pedals as kick and hi-hat *25 phrase

*32 note polyphony

*GM compatibility

*5 song recording possibility in internal memory

*Reverb effect

*Bagettes

*Headphone output

*The possibility of connecting any player (mp3 etc.) thanks to the AUX input and playing drums on this piece of music heard through the speakers of the DD-65

*Midi in/out input and output

*2 x 5W amplifier

Fig. 3. Yamaha DD-65 digital drum set [13]

2.3 Three-Chip Silicon Strip Led

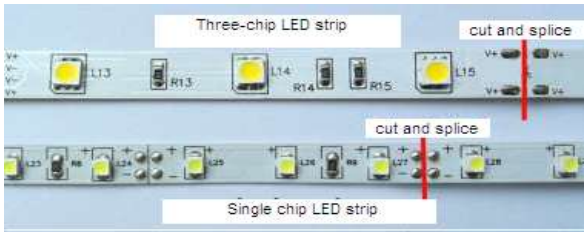

Fig. 4. Three-chip silicon strip led

2.4 Type31 Npn Transistor

The transistor is used to drive ten LEDs in the circuit. For this, type 31c transistors with an Ic value of 3 amperes are needed. The use of digital drums in the design, especially in the Yamaha DD-65 model; It has been chosen in terms of being a device that can be easily changed on it.

3 Circuit Design

In accordance with the design, the hardware-installed LED strips were mounted on the pads on the Yamaha DD-65 digital drum and cable connections were made. In order to control the Arduino Uno outputs, the test kit was tested with 14 input-output pins, 6 of which are to be used as PWM, and 7 LEDs installed on the 6 analog input breadboard. To test on this test kit, a metronome (100-120 Bpm) range was selected and the code was written accordingly, and after outputs were taken at different times for this test, the cable connections on the hi-hat, snare drum and bass drum on the Yamaha DD-65 model digital drum were soldered. LED strips were installed.

Fig. 5. LED mounting design

The hardware materials of the desired design have been made ready in general. A metronome program algorithm was created to be used for all songs and changes were made in its main lines to try on different songs. With Arduino, a circuit designed to drive the strip LEDs on the electronic drum was selected and applied to the transistor. The circuit design of the application is shown in Fig. 6.

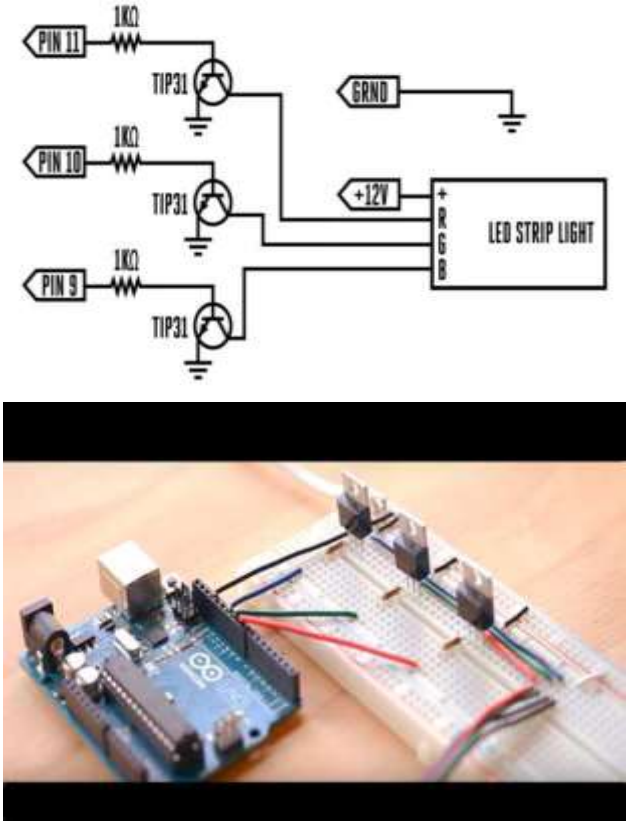

Fig. 6. Circuit design

Depending on the visual application goal with the video synchronization of the design, the Arduino and the processing program are communicated serially with the import processing serial library.

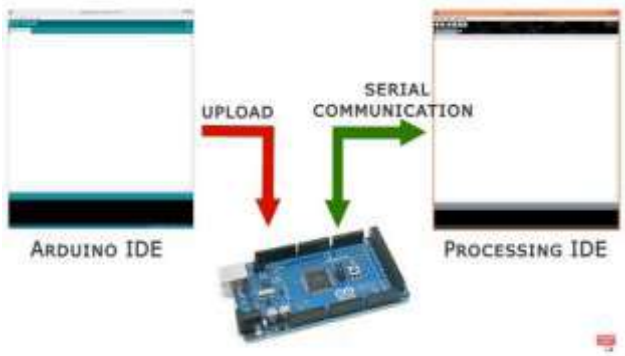

Fig. 7. Arduino and processing connection image

Fig. 8. Arduino and processing software connection image

Blink code was written by using Arduino examples to be used in Arduino. With this code, the data sent using ASCII, which is the American Coding System for Information Exchange, was observed through the LED from the PWM output. All educational videos have been added to the system with the Processing link and have been made to work in sync with the LED lights. In the design, the inside of the Yamaha DD-65 Drum Kit was opened and hardware information was obtained. Their order is given in Fig. 9, Fig. 10 and Fig. 11.

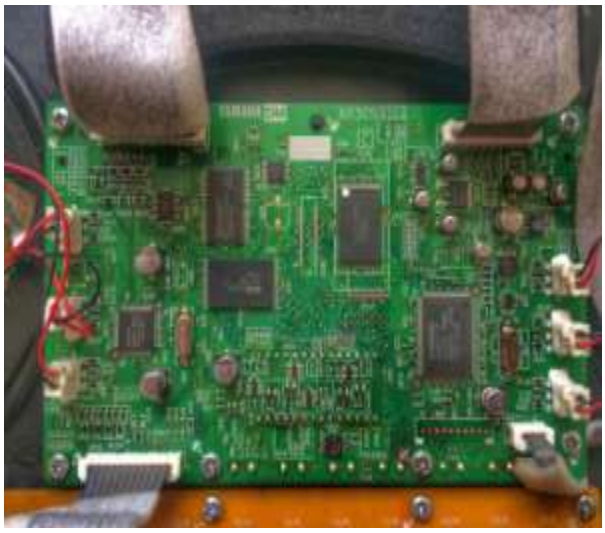

Fig. 9. Control unit

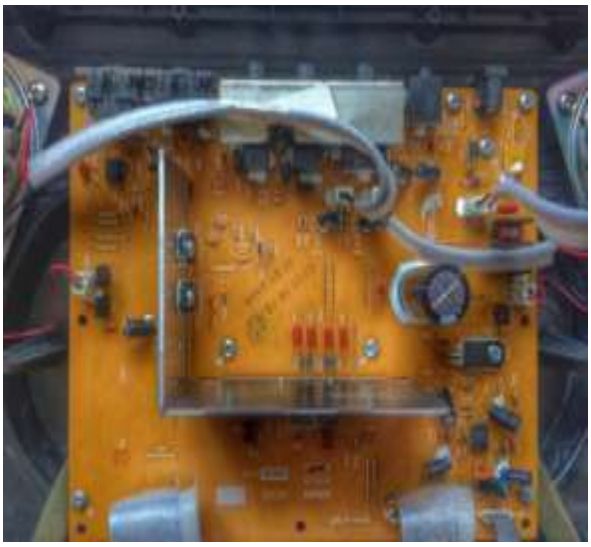

Fig. 10. Power supply

All software data in the Yamaha DD-65 drum kit is located in the control unit given in Fig. 9. Control unit 254 drum sounds, 25 phrases, 32 notes polyphony, GM compatibility, 5 songs recording possibility in its internal memory, Reverb effect is created with the support of this card software. All power to the Yamaha DD-65 Drum Kit is provided by the power supply given in Fig. 10. It provides the opportunity to play drums on the piece of music heard from the speakers of the DD-65 by connecting any player thanks to 8 beat sensitive pads, 2 foot pedals as Kick and Hi-hat, headphone output, AUX in input. Midi in/out input and output are fed with this card. All inputs and outputs are on the card.

Fig. 11. Yamaha DD-65 electronic components

The general appearance of the system is given in

Fig. 11. All the cable connections of the strip LEDs are passed through here and controlled by one input and one output. The input consists of outputs to the positive input of the adapter, and the output consists of outputs to provide control of all the pads located on the electronic drum. All information to the system is provided from the output output with arduino. The input only provides the energy that makes the system work.

4 Research Findings

The design works visually with video support and in the video, Hi-Hat, Snare, Bassdrum and Crash used by the tutorial are visually visualized with LED strip in sync. First, when the tutorial hits the Hi-hat, the user will be able to see it synchronized with the green LED on the Yamaha DD-65 digital drum in front of him.

Fig. 12. Hi-hat video sync

The snare signals will appear as shown in Fig. 13. Each time the trainer hits the snare drum, the user can visually see the note value data from the LED to which the snare signal is connected. Led data is received in the same way as the Hi-hat system.

Fig. 13. Snare video sync

The Crash sync shown in Fig. 14 is the part that is less active than the other parts. It is usually active at the end of each measure in the song. All data transfer, like other parts, is realized by visualizing the recorded note information in processing with the help of arduino.

Fig. 14. Crash video sync

Finally, different connection options are presented in the bassdrum section in Fig. 15. First, the LED connection is made for the pedal that provides bassdrum control. However, since no visual feedback can be received, it was decided to mount the electronic drum in the most visible part of the body.

Fig. 15. Bassdrum video sync

5 Conclusions

Many musicians play in different metronome ranges at every opportunity [Largo (40-69 Bpm), Larghetto (72-96 Bpm), Adagio (100-120 Bpm), Andante (126-152 Bpm), Allegro (160-176 Bpm), Presto) (184-208 Bpm)] need to improve themselves by practice. Every beginner musician tries to learn different transition combinations in the fastest way possible.

In this design, a percussion instrument is designed

for beginners to develop their sense of rhythm and to understand different rhythm combinations more easily. This tutorial percussion instrument is also designed using Arduino Uno controlled LEDs. People who are interested in percussion instruments of this design; it is aimed to develop themselves in different methods in an easy way without dealing with supportive and note analysis in this field. In line with the studies carried out in this field, the hardware structure of the system was created as a basis and the studies on the software were completed with up-to-date information. Today, visual materials such as LED are generally used for visual show purposes in the music industry. In this design, the idea of using these materials for education has been developed.

As a result, in this design, it is aimed for all percussion musicians to master the touch and metronome of the song, to follow the song traffic and to practice by making the work more visually enjoyable. For those who are new to percussion instruments, it is aimed to develop the sense of rhythm, to control the hit-hat, crash, ride, snare drum, tom1, tom2, floor tom, bass drum, to practice by making the work more visually enjoyable and to understand the different rhythm combinations between these equipments more easily.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflicts of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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