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Digi-Taal Instrument

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Abstract *—Musical instrument sounds relaxes our mind and body. An attempt is made here to develop a system which is less complex and cheap and in a much more superior technology. We are presenting an electronic tabla instrument which is capable of playing four different taals (teentaal, jhaptaal, roopak and dadra) by using voice recorder ISD 1760 IC with SPI protocol. This instrument has provision for speed and volume variation, which will add rhythmic effect. Our project generates output in high quality audio format and LCD displays ongoing tabla beat and number which is useful for learning purpose.*

Keywords*-tabla, taal, jhaptaal, teentaal, roopak, dadra, speed, SPI, ISD1760.*

I. INTRODUCTION

Playing technique of table involves extensive use of the fingers and palms in various configurations to create a wide variety of different sounds, reflected in the mnemonic syllables (*bol*). The heel of the hand is used to apply pressure or in a sliding motion on the larger drum so that the pitch is changed during the sound's decay.Some basic strokes with *dayan* on right and *bayan*on left are:
1) Ta: (on dayan) striking sharply with the index finger against the rim.
2) Ghe or ga: (on bayan) holding wrist down and arching the fingers over the syahi, the middle and ring-fingers then strike the maidan (resonant).
3) Tin: (on dayan) placing the last two fingers of the right hand lightly against the syahi and striking on the border between the syahi and the maidan (resonant).
4) Dha: Combination of Ta and Ghe.
5) Dhin: Combination of Tin and Ghe.
*Taal*s are formed by combining a predetermined number of beats in a particular sequence and playing them in that order. Of the following different *Hindustani taals*shown below, we are going to implement only four of these *taals*: *Teentaal*, *Jhaptaal*, *Dadra* and *Roopak*[1].

Table 1. Types of Taals and Number of Beats

Name	Beats	Divison
Teentaal	16	DhaDhinDhinDha|,DhaDhinDhinDha|,Dha Tin TinTa|Dha Tin Tin Ta
Jhaptaal	10	Dhin Na| DhinDhinNa|Tin Na| DhinDhin Na
Roopak	7	Tin TinNa|Dhi Na |Dhi Na
Dadra	6	DhaDhinNa|Dha Tin Na

II. LITERATURE SURVEY

In the market, there are two companies which manufacture tabla machines *RAAGINI SURTAAL* and *RADEL INDIA CORP*[5]. The idea of project is all our own creation and independent.Tabla machine consist of buttons for selecting taal and some more buttons are there to have desired effect e.g. volume, pitch, speed etc. These machines can be used in musical classes for learning & it can give accurate tabla effect in the absence of skilled person.

Figure1. Electronic tabla instrument-Radel India Corp

III. PROPOSED SYSTEM

In this project, we are going to implement a voice recording and playback module. We are going to record the beats which pertain to the *taals* that we are going to implement. These beats are recorded in random but at the time of playback, using SPI, we are going to supply the information of the address location of the next beat of a *taal*so that it will form particular taal. In a similar way, we are going to implement the rest of the *taals*.

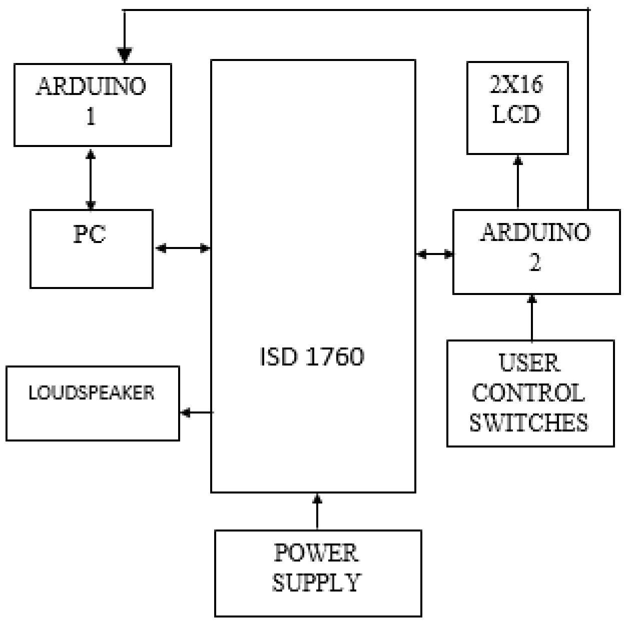

Figure 2.Block diagram of the system

3.1. ISD 1760

It is the main module in the system. It is a voicerecord-and-playback IC. We are operating this IC in SPI mode. The input is given in analog form. This input is obtained from PC or a mobile phone. This IC has a storage capacity of 40s to 120s depending upon the sampling frequency used. We are using 12kHz sampling frequency which corresponds to better quality audio output. Sampling frequency can be changed by varying the value of Rosc at pin 20 of ISD 1760[4].

ISD 1760 has a very important APC (Analog Path
Configuration) register. The register provides for different configuration commands such volume control, SPI control, Source signal and music mixing, output format- analog- AUD/AUX. There is a format for SPI interface which consists of start/end address, data bytes and CMD byte.

LSB … MSB

	1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte	6th Byte	7th Byte
MOSI	CMD_Byte	Data Byte 1	Data Byte 2 or Start Address (Low Byte)	Data Byte 3 or Start Address (High Byte)	End Address (Low Byte)	End Address (Mid Byte)	End Address (High Byte)

LSB … MSB

	1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte	6th Byte	7th Byte
MISO	Status Register 0 (SR0) (Low Byte & High Byte)		Data Byte 1 or SR0 (Low Byte)	Data Byte 2 or SR0 (High Byte)	SR0 (Low Byte)	SR0 (High Byte)	SR0 (Low Byte)

Figure 3.SPI transaction format

3.2. Arduino UNO

Arduino is used with ATmega 328Pmicrocontroller. There are 2 Arduinos required- one at the time of recording and other at the time of playback and LCD interface. The Arduino 1 and PC work hand in hand during recording. The PC or mobile phone provides the analog sound wave to the ISD IC at the time of recording.Arduino 2 is used for user switches- so that user can select the desired *taal*, for LCD interfacing and SPI interface with ISD.

3.3. SPEAKER & LCD

The output of this instrument is in audio format which is given to LM386 amplifier and output is obtained at 8Ω/4Ω speaker and simultaneously beat name & number displayed on the 16*2 LCD.

3.4. POWER SUPPLY UNIT

We are going to use two power supply units. One is the 15v supply for ISD IC and the other 5v supply for Arduino board.

IV. SYSTEM OPERATION

4.1. Recording operation

The recording is performed with thehelp of Arduino 1 and PC. The beats to be recorded are present in the PC in ".wav" format. We use *Processing* software which helps to convert the .wav file into analog format for transporting it to the ISD IC.

Arduino 2 acts as a master to the ISD IC and commands the record and play operation. As soon as the .wav file is processed by the PC, Arduino 2 puts the ISD IC in record mode and at the same time signals the other Arduino 1 to give a signal to the PC to play the particular beat file so as to record it into memory of ISD. The software plays the analog .wav and transfers the signal in the IC's memory. As per the SPI command, the analog signal of a beat can be stored at a particular address location decided by the user. During the recording operation there is an LED which indicates the process by its blinking. By carefully defining the address location for storing the file, we have recorded all 4 beats –*dha, dhin, taa, tin* in the memory address as shown below--

BEAT NAME	ADDRESS LOCATION
DHA	029-02C
DHIN	018-01A
TA	041-045
TIN	032-035

4.2. SPI operation

Arduino 2 carries out the SPI communication as a master. In SPI mode, the entire memory location is fully accessible to the user. The address location is given so that at the time of playback, with SPI protocol, we can select any address location to play a particular beat and successively play the other beats to complete playing the entire *taal*. The APC register acts as a status register for the IC. This register provides for configuration commands and other controls like volume control, output format,etc.

Almost all the operations can be carried out using SPI interface. The format contains command byte CMD. There are several types of command.

1) *Circular memory commands:*PLAY, REC, FWD, ERASE, G_ERASE, RD_REC_PTR, RD_PLAY_PTR, SET_PLAY, SET_REC.
2) *Analog configuration commands:*RD_APC, WR_APC, WR_NVCFG, LD_NVCFG, CHK_MEM.

If we want to play a particular *taal*, then by SPI the hex number of the address location of a beat is given via SPI. This beat is played by giving SET_PLAY command. In Standalone mode the next beat is played by fast forwarding using FWD command and again giving PLAY command.

V. SOFTWARE SPECIFICATION

There are two software used for two Arduinos:

5.1. Processing

The main purpose of this software is to communicate the required *taal* to the ISD IC during recording phase. After the recording is finished, Arduino 1 and *Processing* are no longer required. The *taal*is in wave format and needs to be converted into analog format so that it can be stored in the IC. This software satisfies this requirement.

5.2. Arduino

The software is used for burning the code in ArduinoATmega 328 IC. All the code related to SPI communication is written in software's interface and burned in Arduino 2. The commands which are being given to Arduino can be seen on serial monitor.

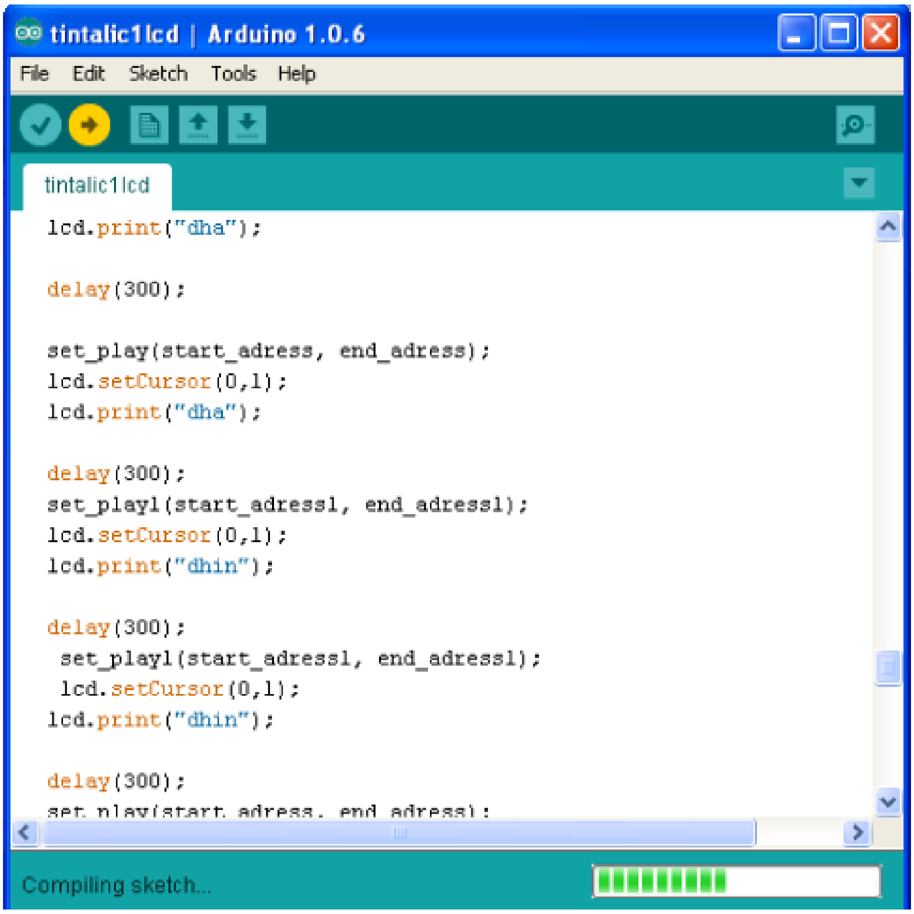

Figure 5. Arduino user interface

The address spaces on which a particular beat to be recorded is determined such that the beats of the *taal* do not merge together during playback.

VI. RESULT

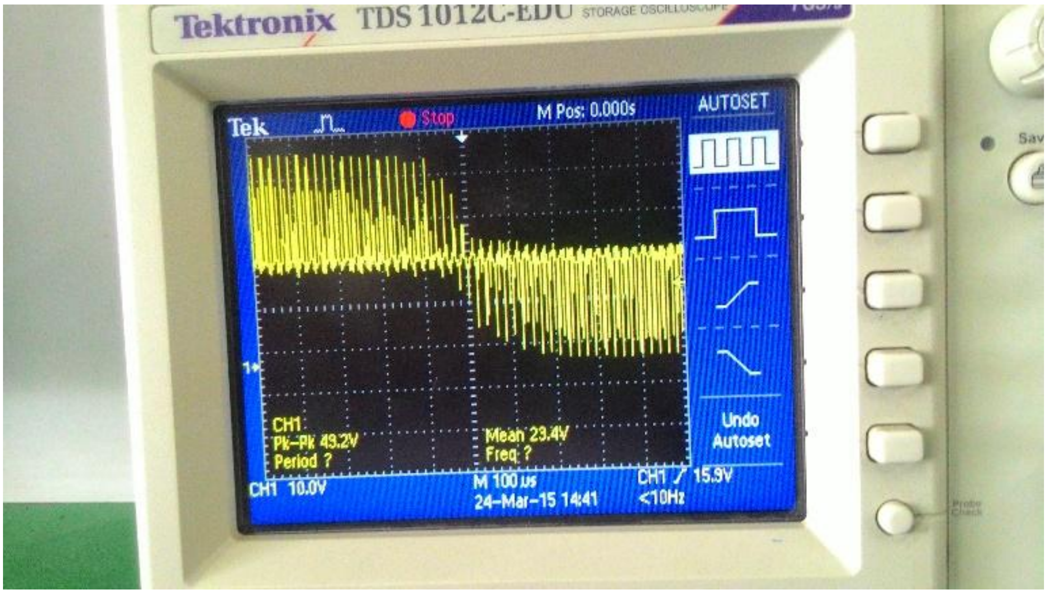

Figure 6. Output waveform on the DSO

The output waveform is analog in nature and it is available at the speaker. This output waveform of different beats and different speeds was observed in the DSO. Different beats have waveforms of different frequencies. We observed the waveform of every beat as well as heard it on the speaker. The sound quality is clear.

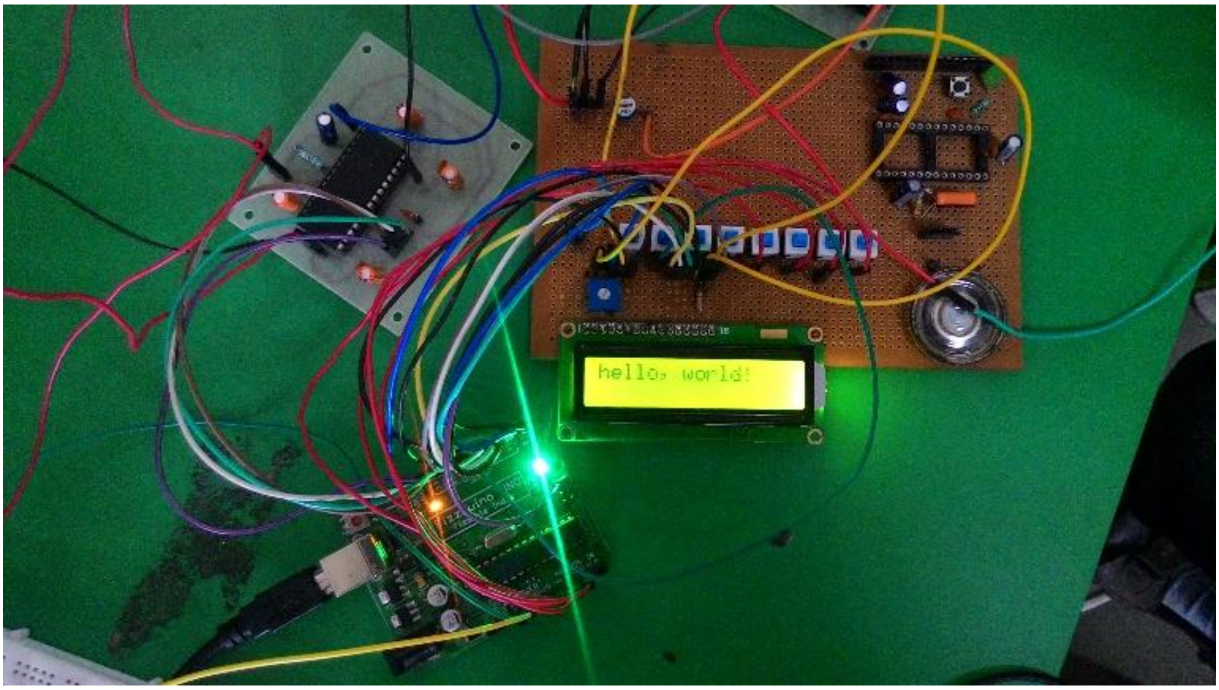

Figure 7. Working diagram

The LCD displays the number of the beat playing, name of the beat and also the name of the *taal*playing.

VII. CONCLUSION

This paper presents technology implemented for making Digi-taal instrument. It was observed that the output obtained is a clear quality sound which is heard from the loudspeaker. We used an 4Ω, 3W loudspeaker for better output. This instrument is efficient, cost effective as well as reliable for users. It can be developed to fully equipped *tabla* machine or other musical instrument for ex. Guitar, harmonium, etc.

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