

Digital Restoration of Analog Audio

The age of audio cassettes and cassette players are long gone. In today's digital world we are used to hear the audio in digital formats with no hiss or hum. But what about our old collection of music in audio cassettes? Are we going to lose it for ever? Not really. It is possible to digitally record the analog audio stored in audio cassettes and restore the sound quality to acceptable levels using modern computer techniques. All that we need is a cassette player, an RCA to stereo cable, a multimedia computer with necessary software and a little patience.



Source: Flickr.com/rockheim/.:eINico.

I recollect the days when the stereo cassette player in my home used to be my only source of hearing music. I used to enjoy hearing *Kathakali Padams* (the songs rendered while performing *Kathakali*, a dance form of Kerala) and my dad had a huge collection of padams rendered by various maestros in the field. Myself, just like the majority out there, shifted to digital music when the entire audio industry shifted to audio discs and other digital audio formats. Along with the medium, we also shifted from the music of yesteryear maestros to digitally available music by the new generation artists. Cassette decks are also becoming less popular these days. Most of us use computers or digital audio players for listening to music. But then, what happens to our old music collections in our old audio tapes? Often, they are recorded from some live concerts or stage shows and chances are very rare to get a digital version of the same. As time passes, the tapes will become unusable or the sound quality will get reduced. Moreover, it is not very easy to store these audio tapes, especially when you have a huge collection of recorded audio. Not to mention, there is no way to get a particular track as quickly as we do in case of digital files. So, are we doomed to lose all those music in our old tapes? Fortunately, not. It is possible to restore the files digitally and keep it safe from now on.

Before We Start...

We need to arrange a few things before we start restoring the old cassettes.

- We need a good cassette player. Clean the play head and make sure it gives the best sound it can produce. If you are using very old cassettes, then it is also advisable to clean the head in between recordings.
- If the cassettes are not touched for long, it will be good to fast forward and rewind at least once before we start recording that cassette.
- Make sure the cassette deck has a stereo out. It will be marked Line Out. In most cases they will be female RCA connectors.
- Sound cards (on board as well as separate) often have 3.5 mm TRS connectors. So, we need an RCA male to 3.5 mm TRS male cable to connect the audio system to PC.
- Sometimes old cassette players may not have RCA out option. In that case you may use the headphone out. It can be a 3.5 mm stereo out (use 3.5 mm stereo to 3.5 mm stereo cable) or else a 6.35 mm stereo out (use 6.35 mm stereo to 3.5 mm stereo cable). Pick an appropriate cable according to the connector available in your player.
- Make the connections properly. The Red color of RCA indicates Right and white indicates Left. Insert the TRS plug in the line-in port of your sound card.



Now we are all set to begin the digital restoration process. Pick a cassette, put it inside the deck. Wait! We are not yet ready to press the play button. We need to do a few settings in the computer as well.

Meet Audacity, Our Digital Restoration Partner



To download Audacity, visit:
<http://audacity.sourceforge.net/>

There are many commercial as well as free software available in the Internet to do digital recording. Here we are using **Audacity**, an open source software for recording and editing sound. Audacity can be installed in Microsoft Windows, Apple Mac, and GNU/Linux-based PCs.

Download Audacity from the official website and install it in your PC. Go to **Control Panel > Sound** (in Windows) and double click the Line In device. In the advanced Line In Properties window you can select the quality settings. (See Fig. 1)

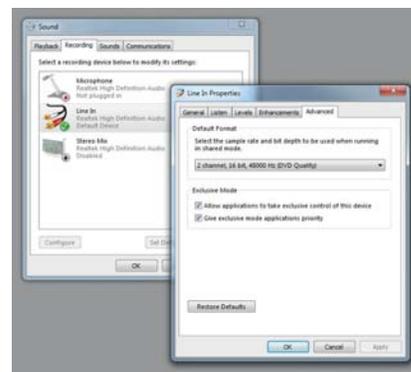


Fig. 1: Sound settings in Windows

Now start Audacity and go to **Edit > Preferences (Ctrl + P)**. Select devices from the items list on the left side and select the device as Line In. Also change the value of Channels: to 2 (Stereo). Alternatively you can do it from the options bar on top. (See Fig. 2)

Now you can hit the Record button (Fig. 3) available in the options bar and then start playing the tape in the cassette deck.

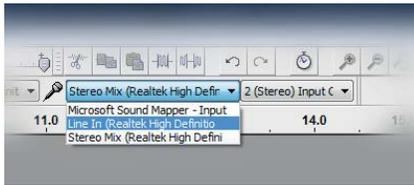


Fig. 2: Choose the input device and channels

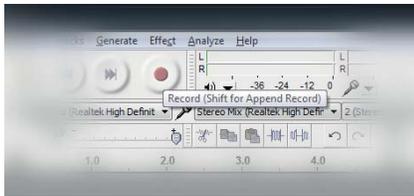


Fig. 3: Hit Record button to start recording. You can continue recording the same track by Shift clicking the button

The Audacity window during the sound recording in progress is shown in Fig. 4. We need to take care of a few things during the process.

- Keep the volume of the cassette player near to maximum. This helps to keep the inherent tape noise to a minimum level in the signal sent to Audacity.
- Adjust the Input Volume using the slider (as shown in Fig. 4), so that the waveform will remain well inside the limits. Also you can monitor the Input

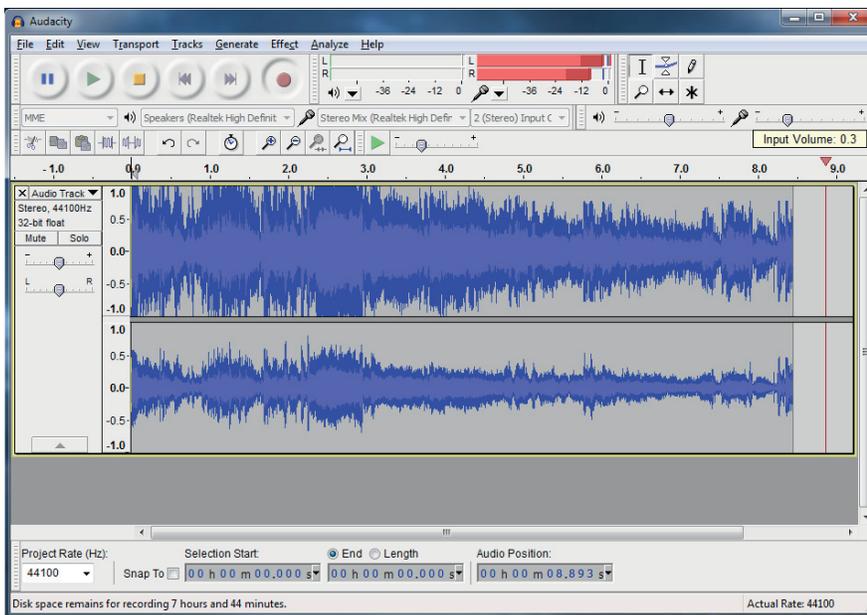


Fig. 4: Adjust the Input Volume in such a way that the waveform should not touch the top and bottom boundaries.

Level indication (shown in Red) and adjust the level so that the indicators will not touch the 0 limit.

- Do not use other processor intensive applications while recording. Also do not use any application which will use the sound card and driver.
- Note the Project Rate (Hz) combo-box on the bottom left corner. 44100 or higher is recommended here.
- Instead of recording the entire cassette at one stretch, it is advisable to pause in between and save the file. Audacity will save it as an Audacity project file (*.aup extension) and will create a directory in the same name to store the project files.

Cleaning Up

Once we complete recording an audio tape, the next thing to do is to clean the recorded tracks. Cleaning up primarily involves cutting away the bad portions of the audio spectrum and tweaking it in such a way that the final audio will sound good.

Normalizing

Notice the levels of left and right channels of a sample recording in Fig. 5. The levels are not the same. In some cases the waveform may not be centered on the horizontal line at 0.0 amplitude. (DC offset. This problem is not present in this recording.)

Also the amplitude level may be too high which will not be very pleasant to hear. These kinds of problems can be nullified using the **Effect > Normalize** option.

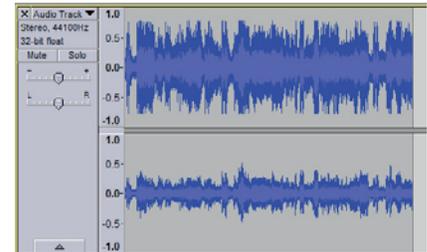


Fig. 5: A sample recording with separate channels for Left and Right audio streams

Select the option as shown in Fig. 6 and once we click the OK button, the wave form will get normalized to -1.0 dB amplitude. The track after normalization can be seen in the background of the Normalize dialogue box. It may be noticed that the level difference between Left and Right streams got reduced to a certain extent.

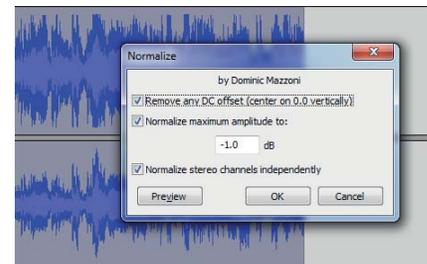


Fig. 6: Normalized track is given in the background

To further correct the level difference between right and left channels we can use the Pan option available on the left side of each track. By checking the output monitor you can adjust the percentage of panning. It will not get reflected in the waveform. But, once we export the track into a sound file, this change will be applied. (See Fig. 7)

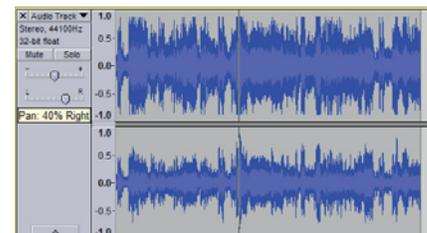


Fig. 7: Adjusting Pan slider

Splitting Stereo Tracks

In some cases we may need to edit left and right channels separately. In such situations we may split a track in to two, one representing the left channel and the other representing the right channel. Now we can edit them separately. Click the track name area (*Audio Track in the given example*) to show the menu and select Split Stereo track. (See Fig. 8)

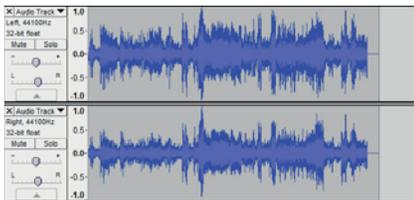


Fig. 8: A stereo track split into two separate tracks

Removing Hiss/Hum

Hum is low-frequency noise while Hiss is high-frequency noise. Almost all analog formats will have some sort of hiss and hum. The **High Pass Filter...** and the **Low Pass Filter...** available in the Effect menu of Audacity will help you to remove any hiss and/or hum present in the recorded file. **Noise Removal...** option can also be used for removing noise.

Increasing Volume

Often, after normalizing and applying other filters to remove Hiss/Hum the volume becomes too low. By selecting **Effect > Amplify...** you can increase the volume to desired levels. Keep in mind that the waveform after amplification should be with in the top and bottom limits. Otherwise the amplified sound may not feel good.

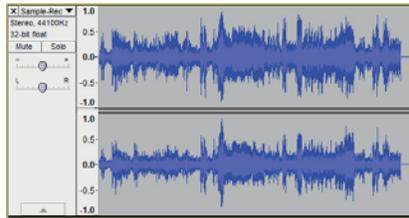


Fig. 9: Here is the final output of the sample recording after cleaning up

Cleaning recorded audio is mostly about playing with various available filters. It is not possible to correct all sound problems by using a single filter. You need to play around with different filters in different order to get a good result. The final output of the sample recording (*after exporting to a *.WAV file*) is given in Fig. 9. Notice the difference in the waveform as compared to the image given in Fig. 5. Keep in mind, over doing any of these filters will affect the entire track and we may feel a difference in sound.

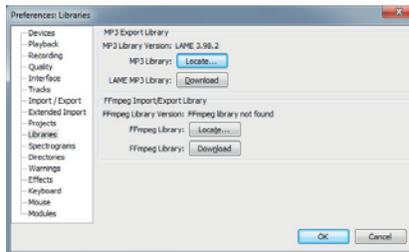


Fig. 10: Preferences: Libraries window

Exporting Audio to MP3

By default Audacity will not allow you to export the sound to MP3 format. You need to install additional plug-ins for

this functionality. To do that go to **Edit > Preferences...** menu. Select Libraries from the list of items on the left. (See Fig. 10)

Hit the **Download** button and it will take you to the download page of the LAME MP3 Library. Download and install the library. If you prefer to manually install the library, you can press the **Locate...** button and add the library file.

Once you add the library files, you can select the MP3 file type from the window opened **File > Export...** menu item. Click on the Options button and you will get a dialogue to set variables such as Bit Rate Mode, Quality, Channel Mode etc. (See Fig. 11)

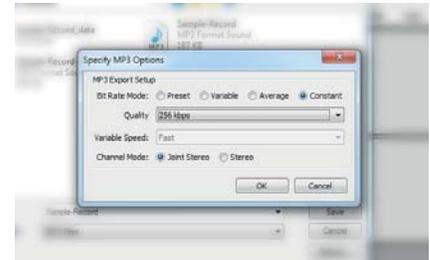


Fig. 11: MP3 Options dialogue box

Once you hit the Save button we will get another window in which we can add details of the sound file such as Artist Name, Track Title, Album Title, Track Number etc. Hit the OK button and the file will get saved in MP3 format. Always remember to keep a backup of these digitally restored audio files. Now we can transfer the songs to our digital music player and once again enjoy the music from old cassettes, of our favorite artists from the past.

Happy Digitizing! ■



Hareesh N Nampoothiri is a visual design consultant with an experience of more than a decade and worked with government organizations like C-DIT, C-DAC, University of Kerala and other private organizations. Currently he is doing research in University of Kerala, on communication design with special reference to the aesthetic principles of Indian art. He is an author of two books on graphic design and a regular columnist in leading technology magazines including CSI Communications. Kathakali, blogging and photography are his passions. He has directed a documentary feature on Kathakali and also directed an educational video production for IGNOU, New Delhi.