

Elmo TRV16 with RPI Camera Frame-by-Frame

This document describes the TRV modification that provides a high quality video capture with Elmo TRV16 projector. The resulting quality image is comparable to a frame-by-frame capture running at real time 24 FPS.

Since the real time capture by synching the projector and the camera at 24 FPS suffers from ghosting, an alternative approach is used by grabbing each frame individually and then stitching the video from these individual images. The ghosting effect is caused in real time capture by staggered frames. In another words the camera and the projector are synched but there is not guarantee at what point within the frame capture starts and if it starts in the middle of the frame the exposure can extend into the beginning of the next frame caucusing parts of both frames to be displayed. This is not an issue for stationary scenes since both frames are very similar, but for dynamic scenes this is an issue.

The frame-by-frame capture does not have this issue but unfortunately it is very slow. Another issue with it the sound capture that has to be done separately. During the post process the video and sound tracks get combined. So in a nutshell this is a pretty tedious process.

There are some intermediate solutions. One of them is Workprnter. With Workprinter the video is assembled during capture by using the frame sync pulses from the projector. It is faster that frame-by-frame but still not real time. Hence the sound still has to be captured separately.

This mod allows for real time frame-by-frame capture, both video and sound. It is accomplished by running the camera at twice the projector FPS. That results in two frames being captured for every projector frames. With the projector and the camera synched up one set of frames, either odd or even frames will be good. The post process then can extract the good set by using the DOS script.

The extracted frames are then imported into a video editor at the projector FPS i.e. 24FPS.

The original 48FPS video is then dragged into the video at 48 FPS. This results in 3 timelines in the video editor:

- Original video
- Original sound
- New clean video

For here, the original video gets deleted and the resulting video and sound is ready to be exported in any format desired. Thee sound and video will be perfectly synched.

Operating Instructions

Plug the unit into the 110V outlet.

Connect the HDMI connector to the HDMI monitor.

Turn the wireless keyboard on.

Load in the film and turn the unit on.

The display should show the RPI power up sequence and after a few minutes should display the camera output preview.

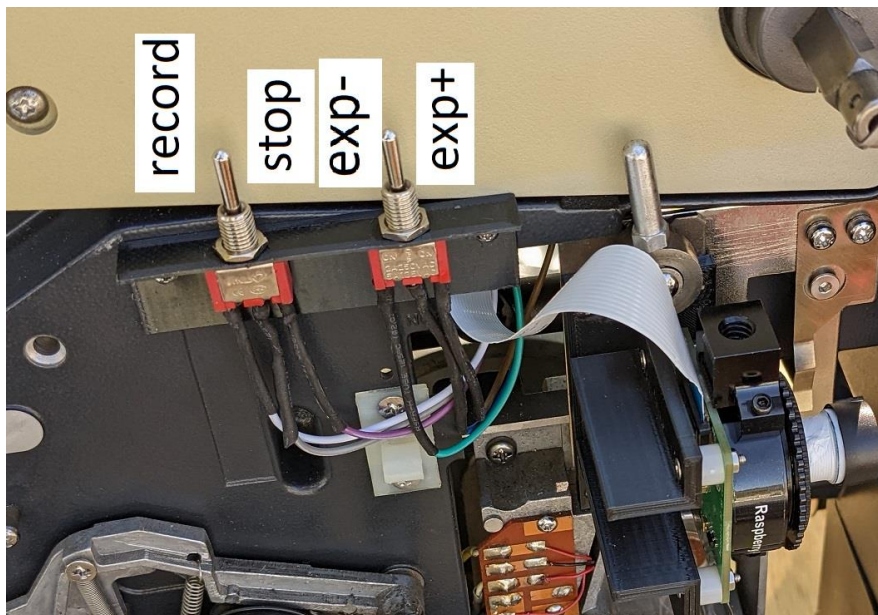
Move the cursor to one of the corners using the wireless keyboard.

Advance film beyond the leader.

Readjust lens focus by turning the lens in or out.

Preview

The camera operation is controlled by two control switches.



Normally, after power up the unit will automatically go into preview mode. Use the right exposure switches to adjust the correct exposure. The preview will be interrupted during exposure adjustment because the RPI has to stop the preview, adjust the exposure and then restart the preview. You can view the video and audio in preview mode or record the video and audio to an external HDMI recorder. Once done, stop the preview by sliding the left switch to the right and turn the unit off.

Recording Video and Audio

Once the right exposure has been achieved by using the right switch you can record the film (video+audio) externally using the external HDMI recorder or hit the left switch to the left momentarily to record to the internal Micro SD Card.

Note: For 48FPS recording hit both record and EXP+ switches together and hold them for 1 second. If the record switch is activated only the recording will be done at 24FPS and the video will have some ghosting.

Use the stop switch to stop the recording or preview.

It is to be noted that multiple recordings can be done one after the other in sequence and every time the record switch is activated a new video file will be created in the internal SD Card.

Also note that there is no preview audio during internal recording but the audio will be on the saved video.

Generally, set you exposure using the right switches prior to recording. Do not use the exposure settings after or during the recording session. It could cause the system to lock up. If it does then just turn it off and on.

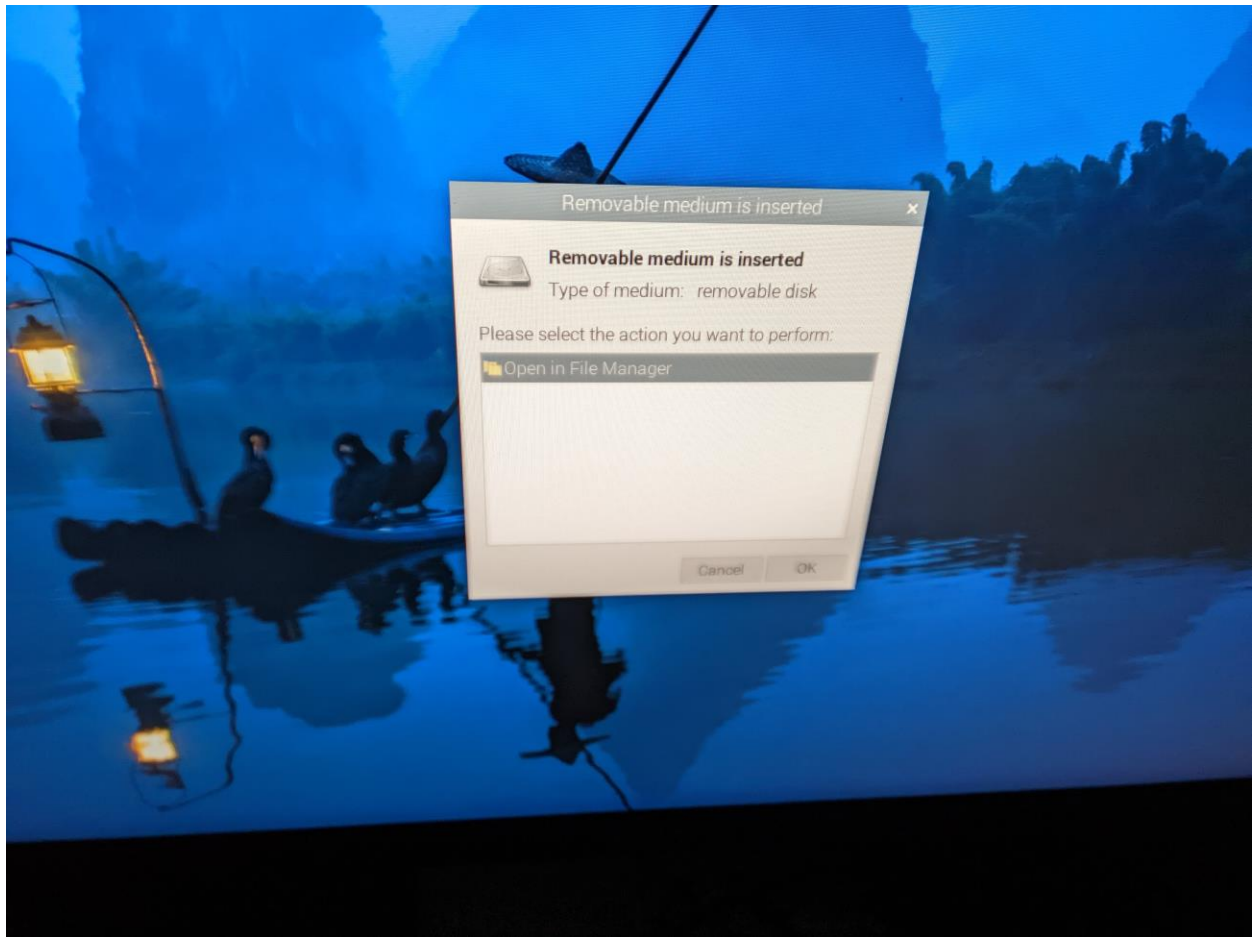
Retrieving the internally recorded videos

Reboot the unit and once the camera preview pops up stop it using the stop switch.

Then plug the USB Stick to the external USB connector still accessible even with the cover on.

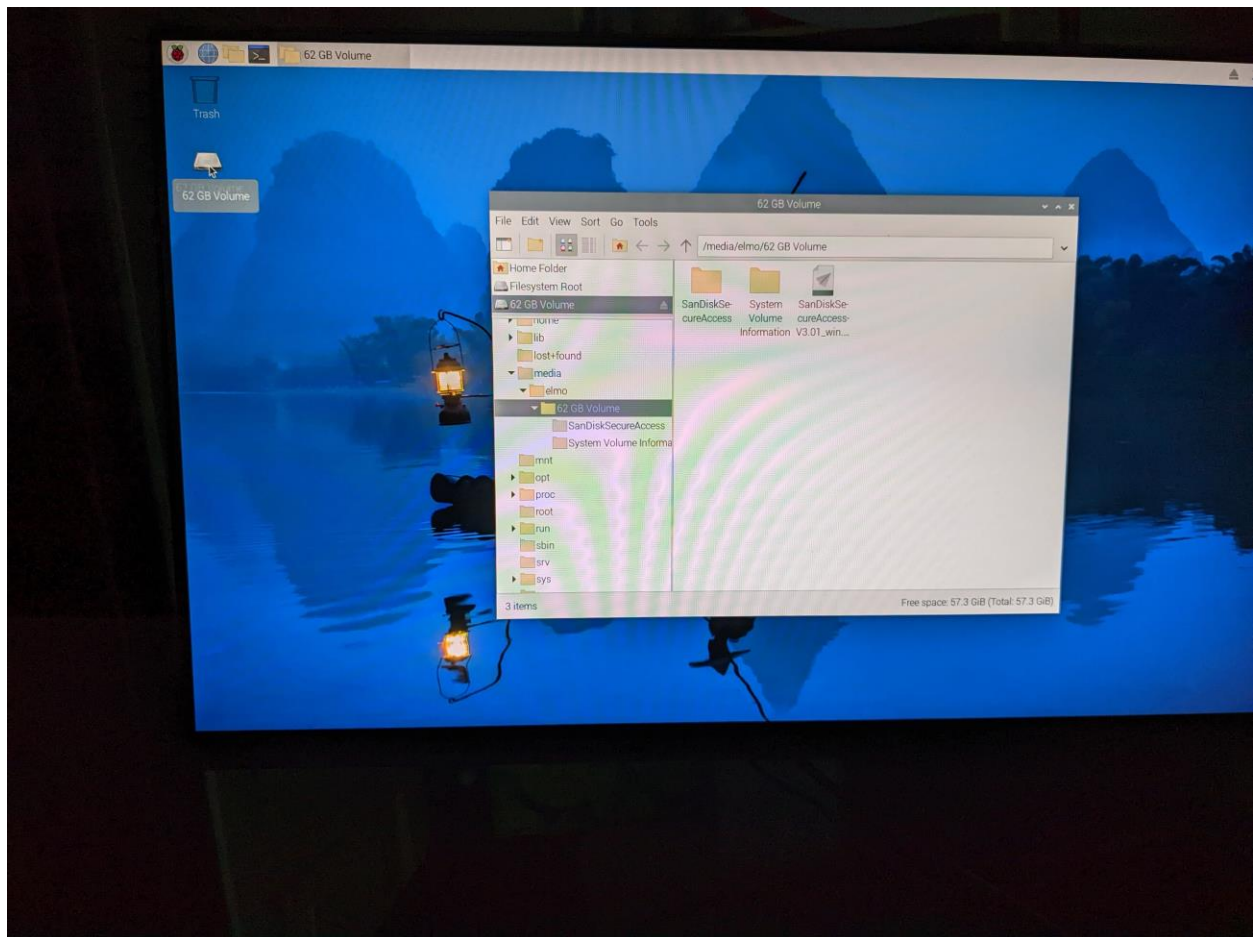
Actually it is better to use a USB hub and plug the USB stick into it along with regular keyboard and a mouse since the tiny keyboard provided is just to move the for the cursor out of the way during recording or preview.

The monitor will show the file manager prompt.



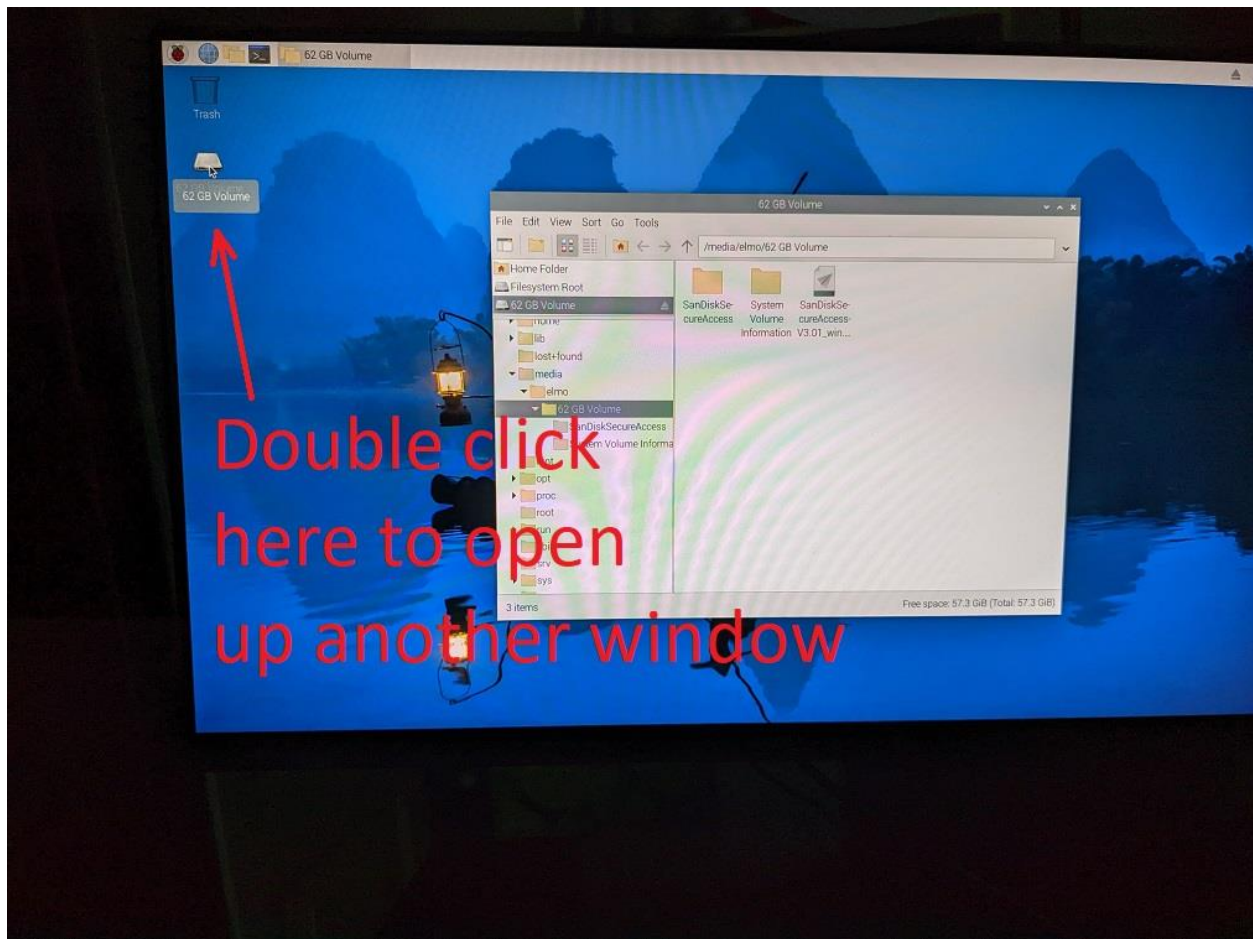
Click ok. The USB stick window will open up.

Note, the wireless keyboard left and right mouse buttons are located all the way on the left side of the keyboard.



This is there you will drag the video files into.

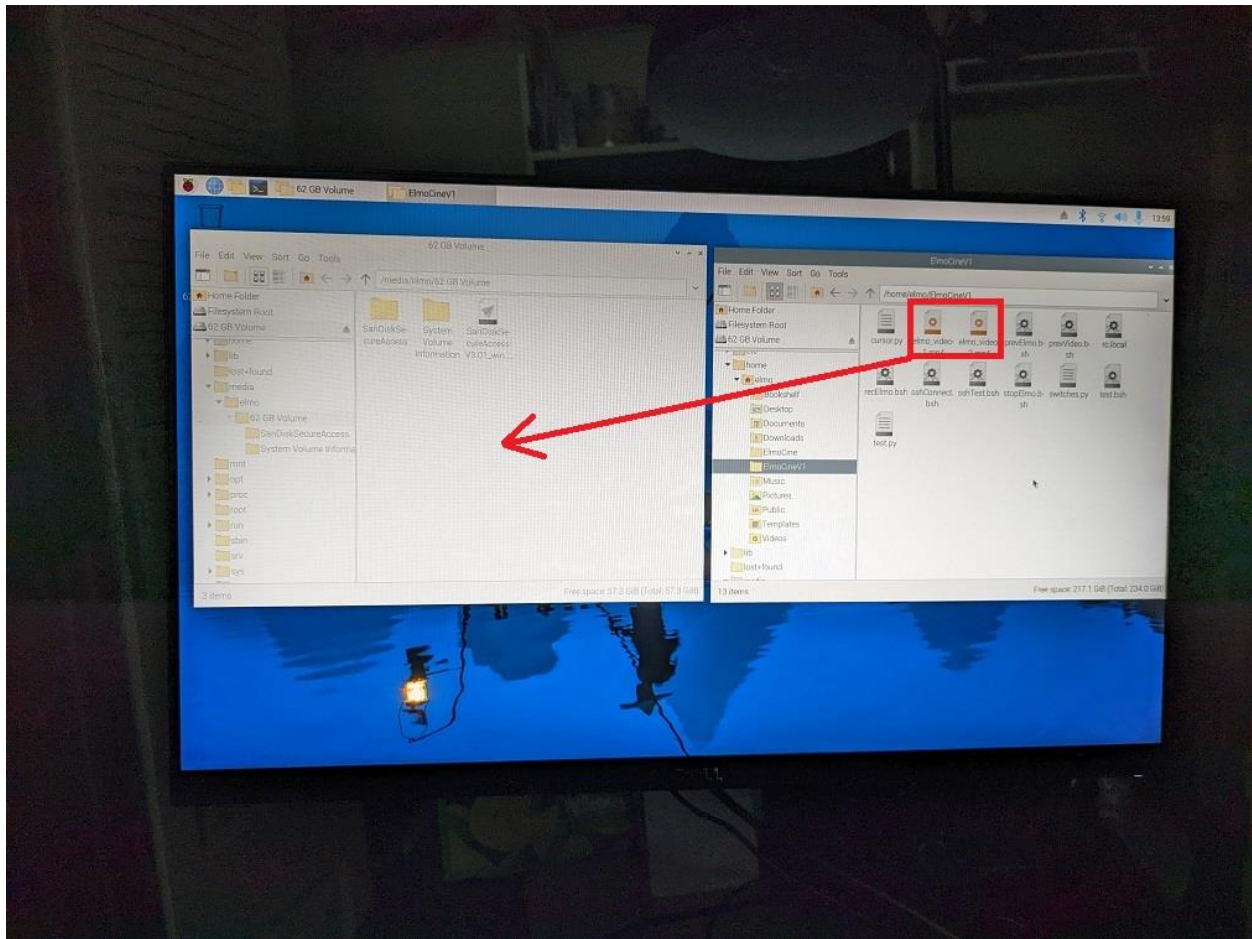
Then open up the source directory by clicking on the file manager.



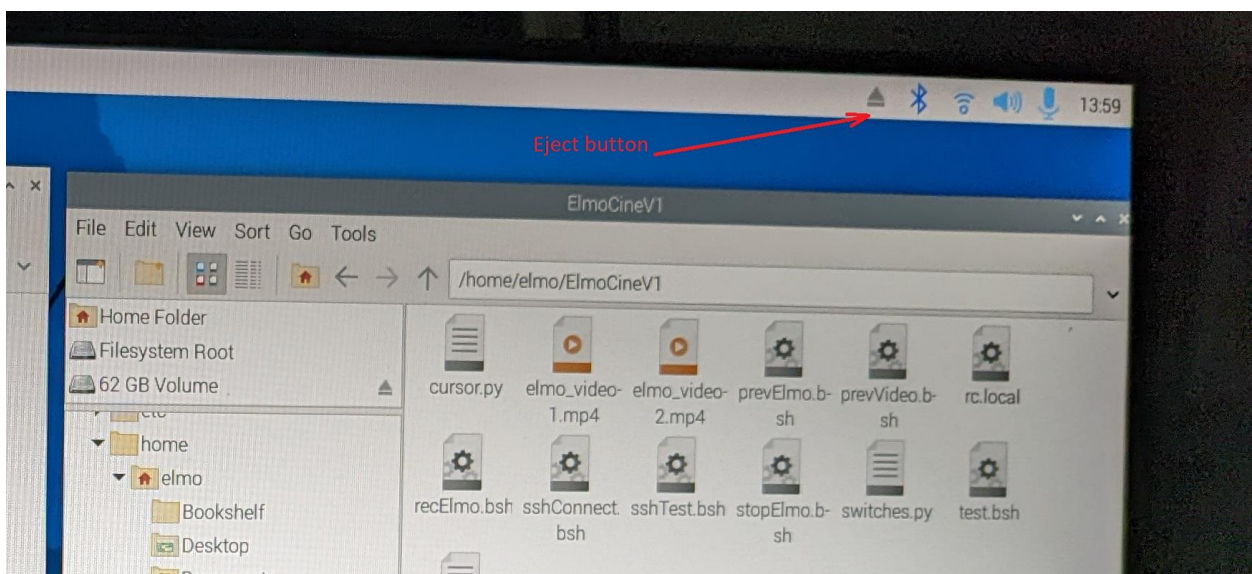
Double click
here to open
up another window

The in the source window navigate to the ElmoCineV1 directory by double clicking on it.

In there you will see the video mp4 files. Drag them over to the USB stick window,

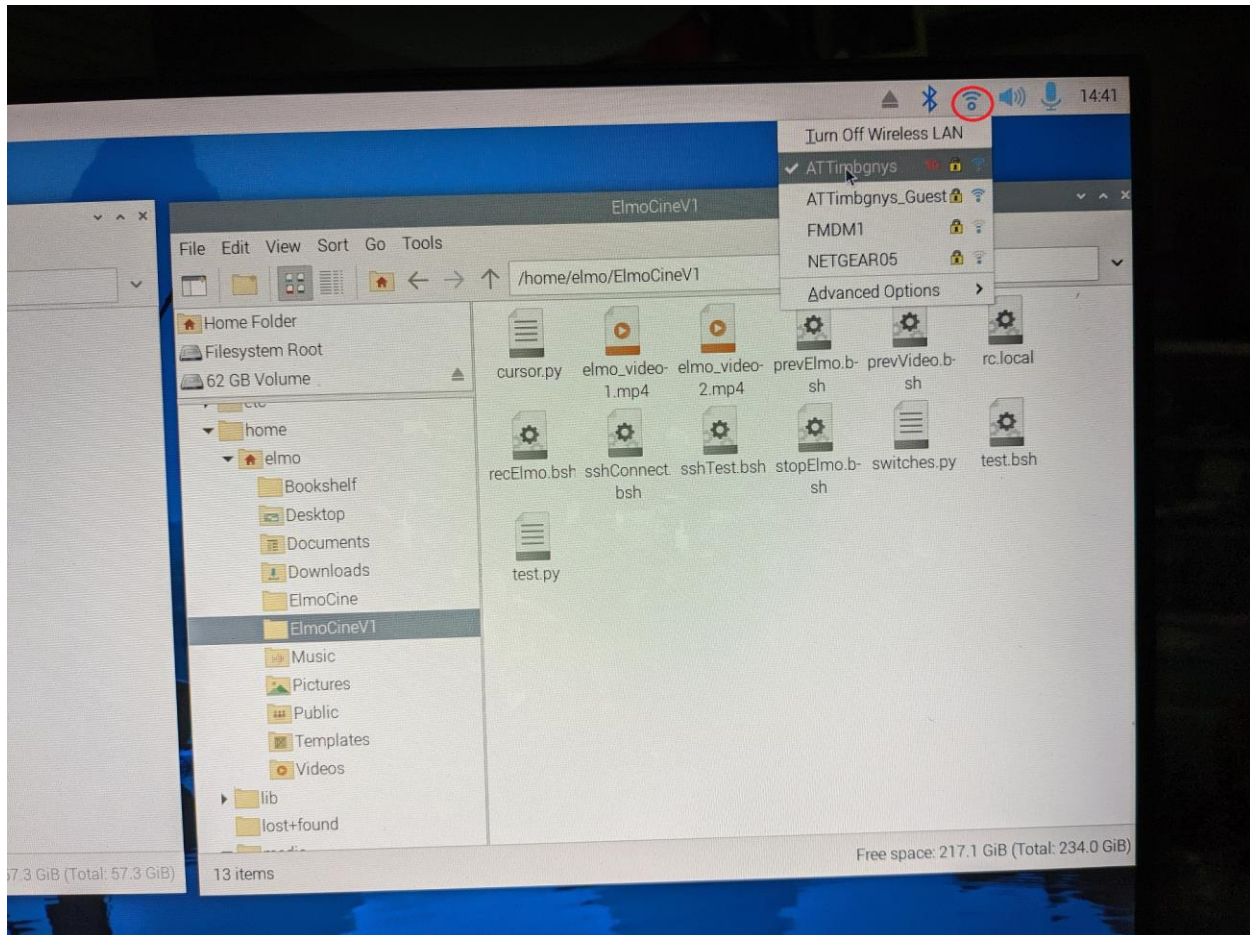


Eject the USB stick by clicking in the Eject button.



Copy files via Wifi

Connect the RPI tot the local router.



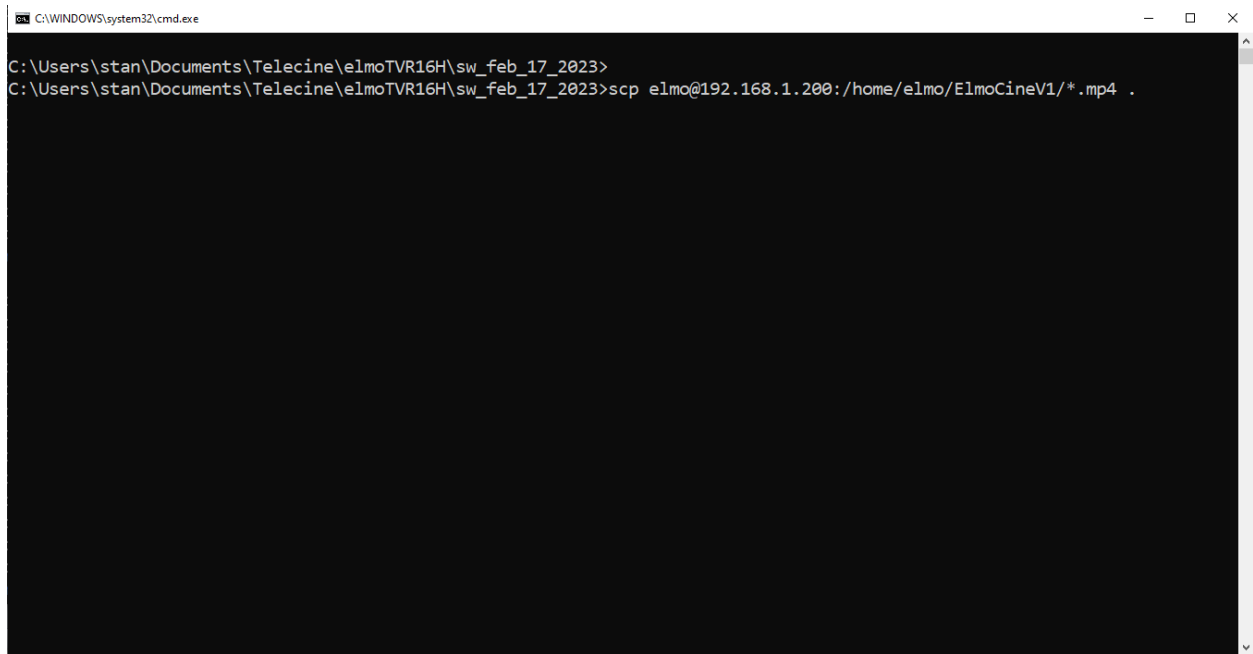
Click on the WiFi icon and select your router.

Enter the password and click OK.

Now you will be connected to your local router and you can transfer the files using the scp session.

Google for scp transfer for your specific computer that you normally use.

Shown here is the SCP session for Windows 10.

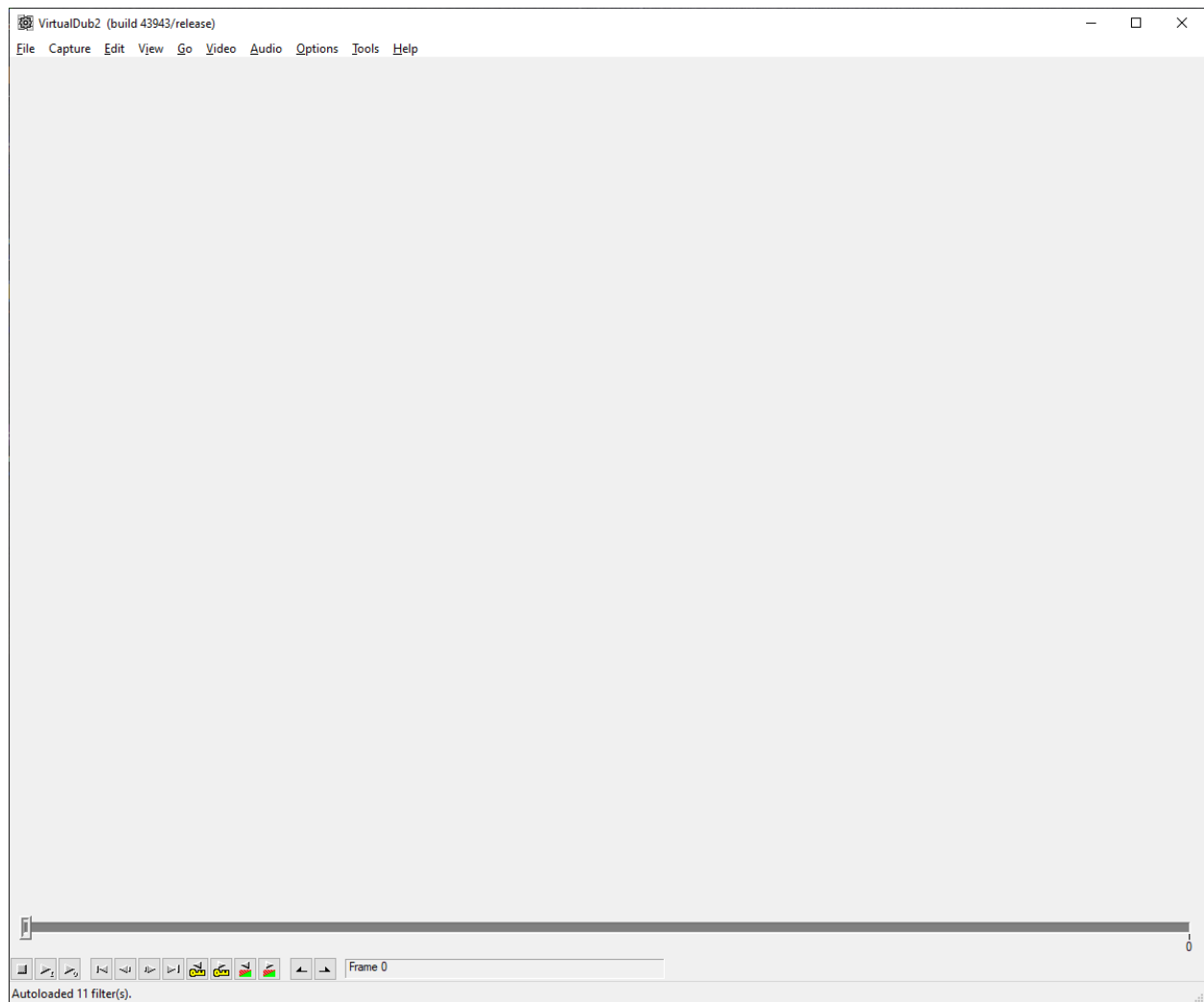
A screenshot of a Windows command prompt window. The title bar at the top reads "C:\WINDOWS\system32\cmd.exe". The command prompt shows the current directory as "C:\Users\stan\Documents\Telecine\elmoTVR16H\sw_feb_17_2023>". The user has entered the command "C:\Users\stan\Documents\Telecine\elmoTVR16H\sw_feb_17_2023>scp elmo@192.168.1.200:/home/elmo/ElmoCineV1/*.mp4 .". The rest of the window is black, indicating the command is still running or the output is not visible.

```
C:\WINDOWS\system32\cmd.exe
C:\Users\stan\Documents\Telecine\elmoTVR16H\sw_feb_17_2023>
C:\Users\stan\Documents\Telecine\elmoTVR16H\sw_feb_17_2023>scp elmo@192.168.1.200:/home/elmo/ElmoCineV1/*.mp4 .
```

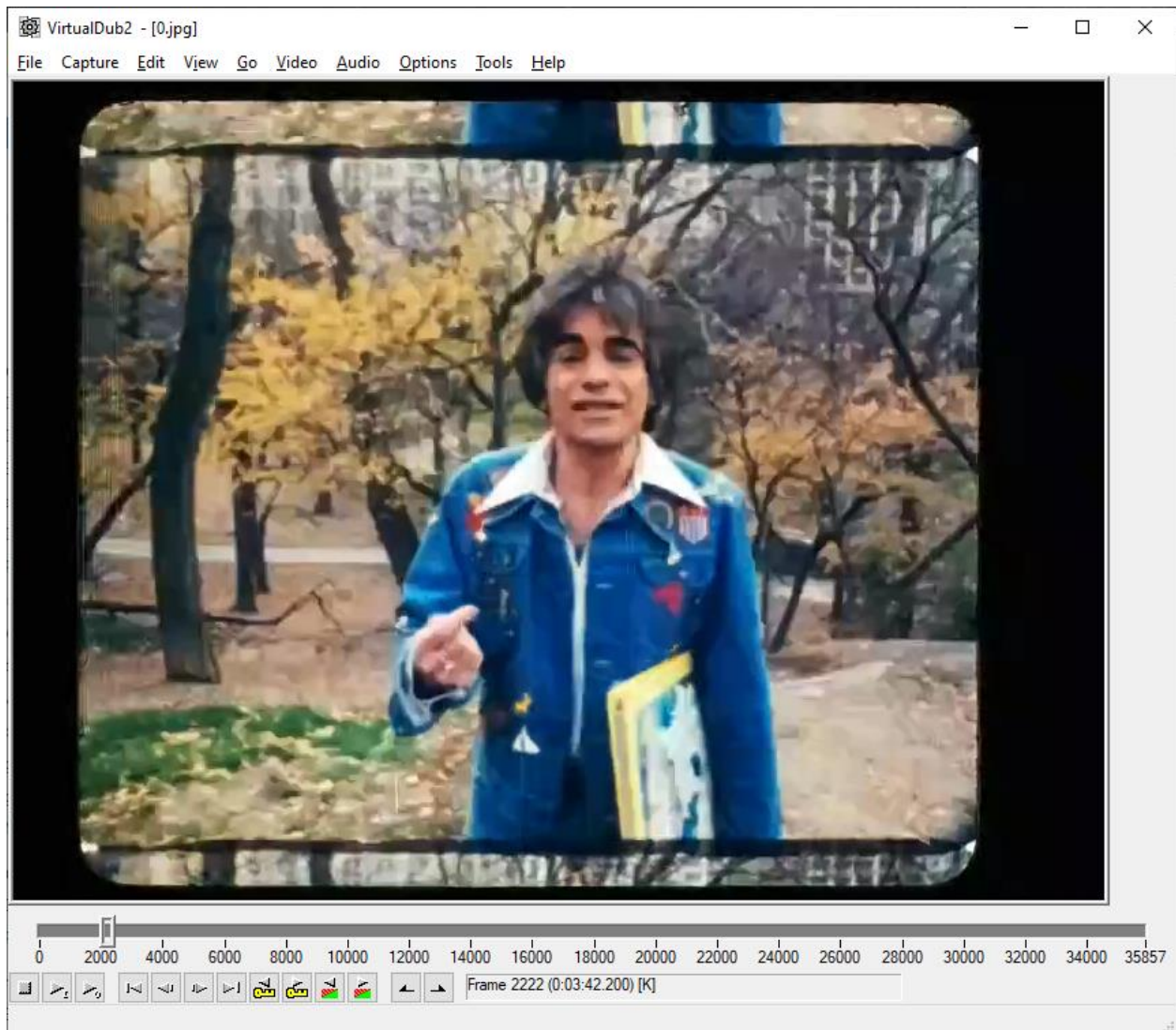
In command window navigate to the directory where you want to store the files and run the scp copy shown above and you are done.

Post Process for 48FPS Recordings

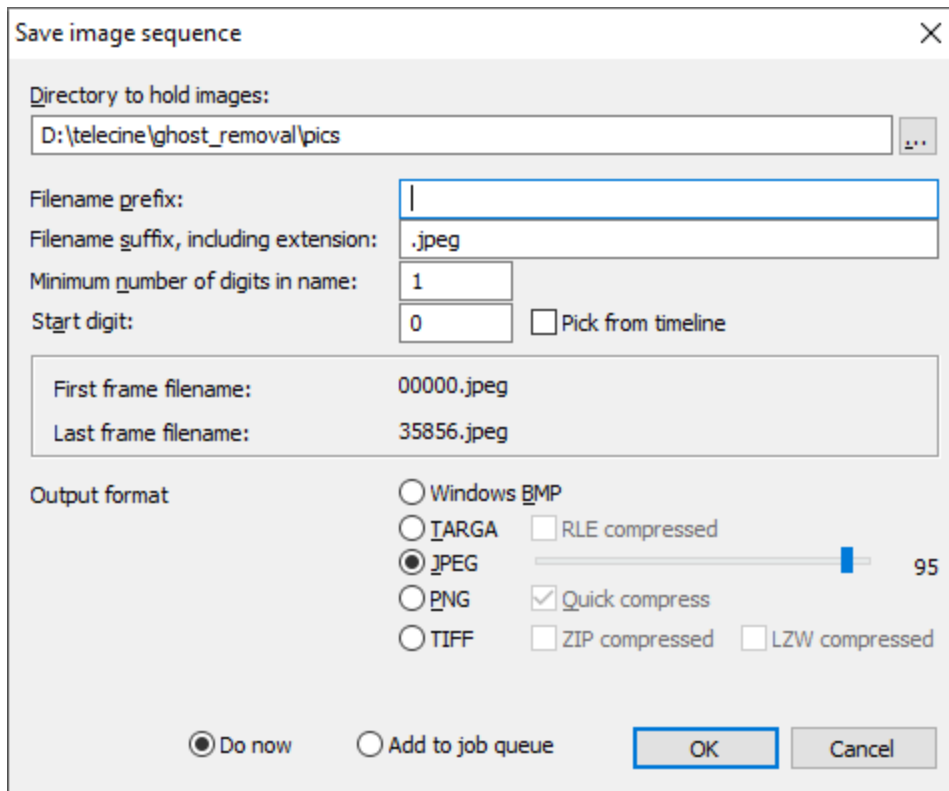
Run VirtualDub:



Drag the 48 FPS video into VirtualDub

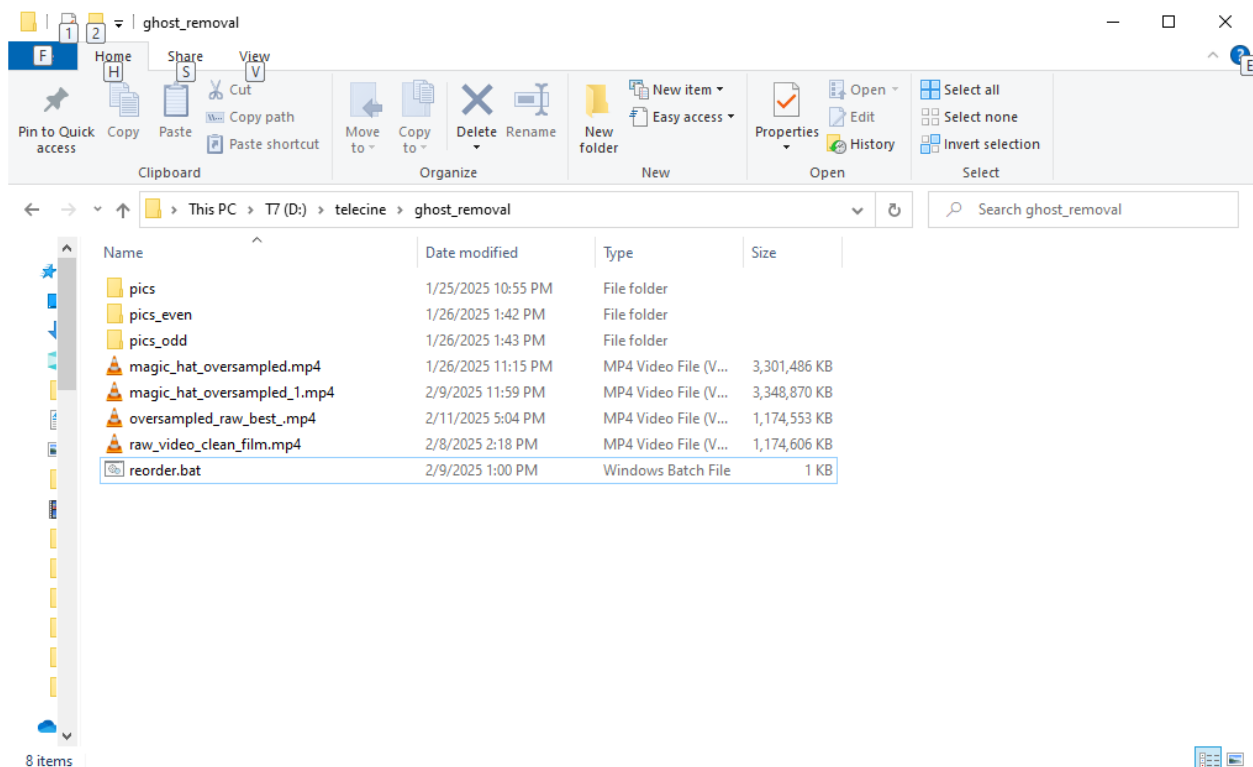


Then run File->Export->ImageSequence



Once the export is done the destination folder will have a large number of images.

Open up the ghost_removal folder (that is the folder where the pics folder is located).

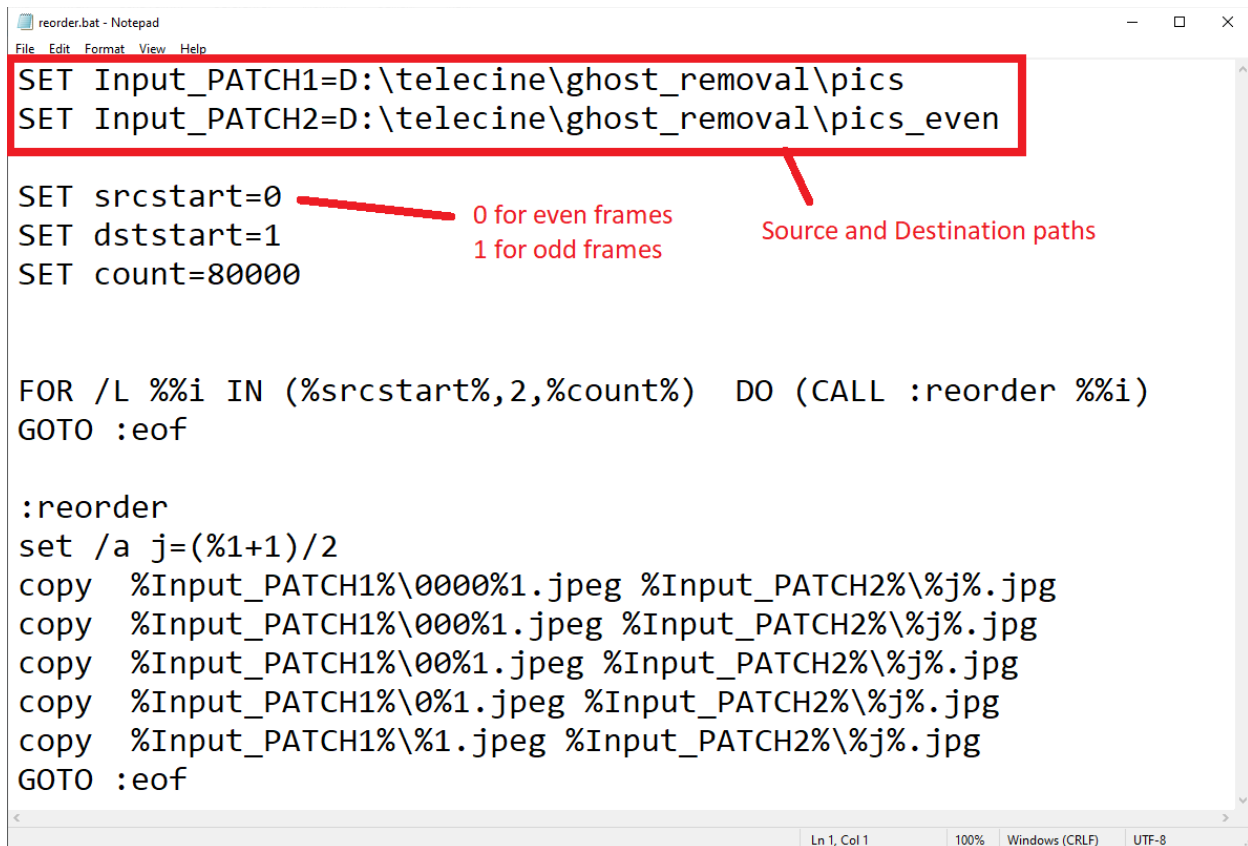


Download the reorder.bat file from github:

https://github.com/vintagefilmography/trv16_frame_by_frame

Save it in the ghost_removal folder or whichever name you picked.

Edit the reorder.bat file



```
reorder.bat - Notepad
File Edit Format View Help
SET Input_PATCH1=D:\telecine\ghost_removal\pics
SET Input_PATCH2=D:\telecine\ghost_removal\pics_even

SET srcstart=0
SET dststart=1
SET count=80000

FOR /L %%i IN (%srcstart%,2,%count%) DO (CALL :reorder %%i)
GOTO :eof

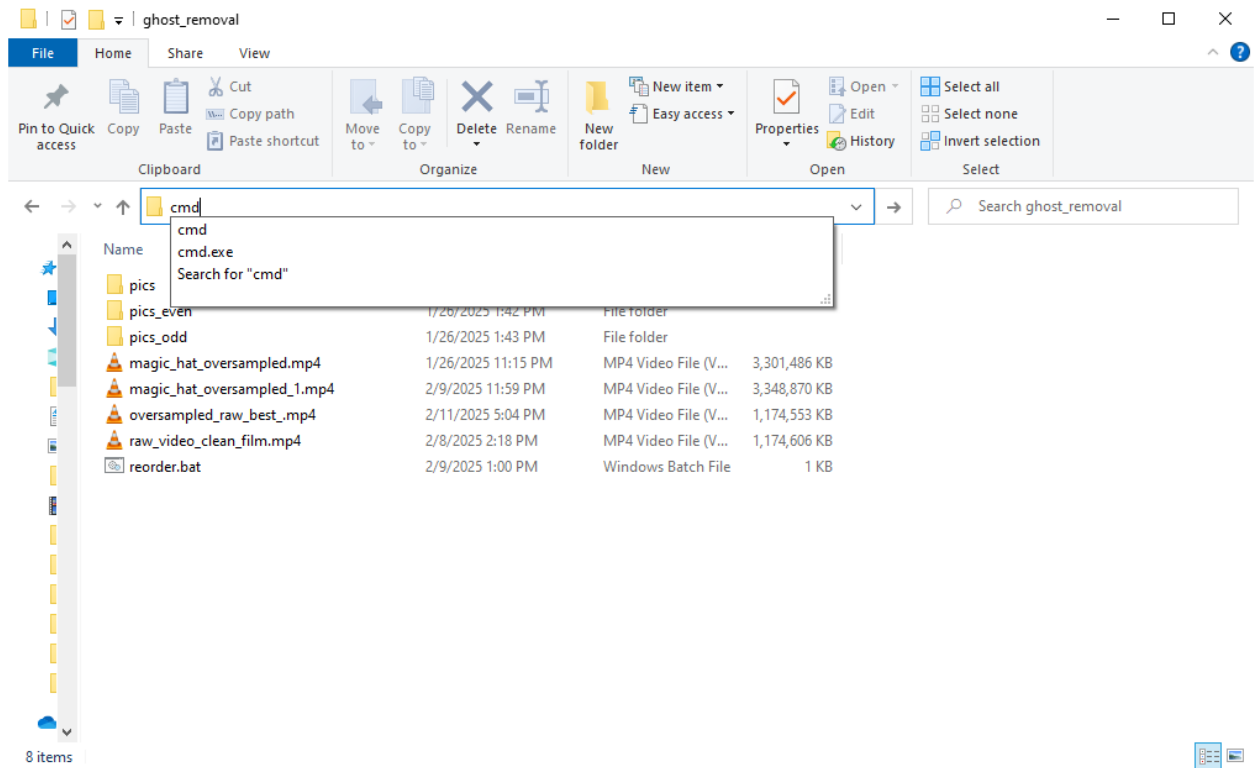
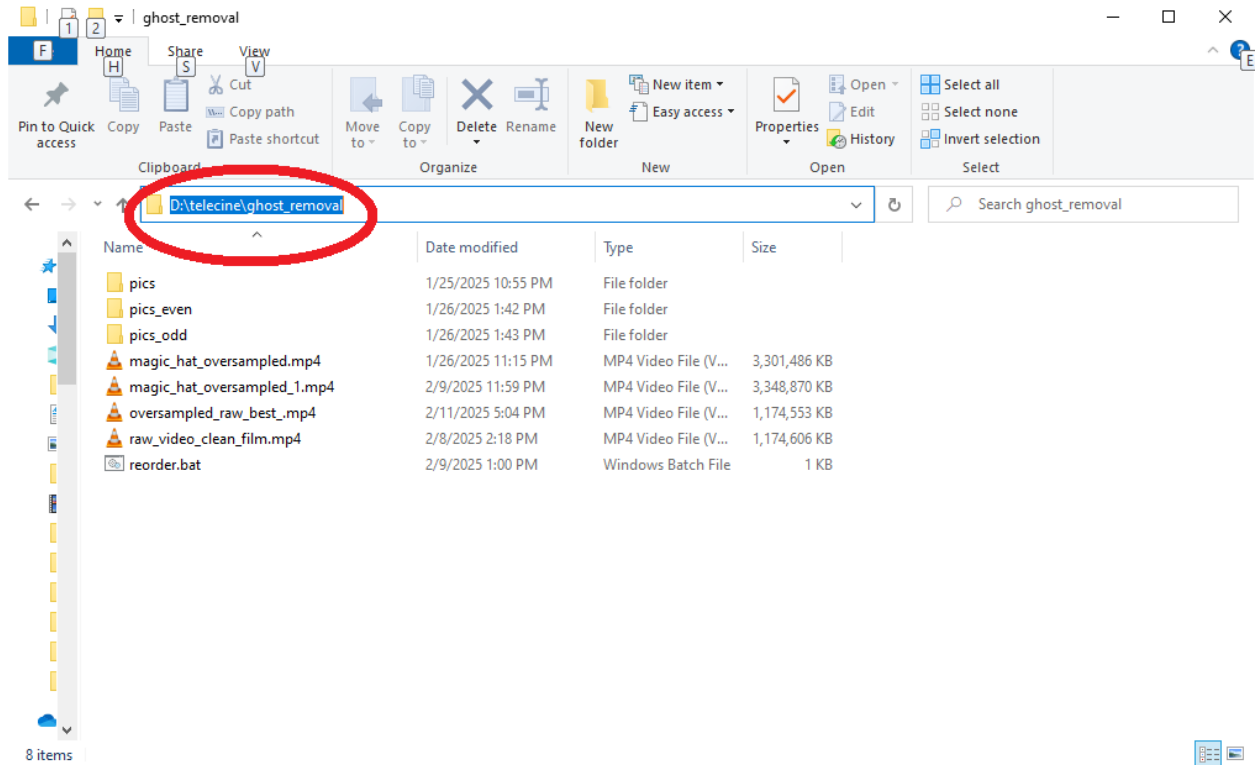
:reorder
set /a j=(%1+1)/2
copy %Input_PATCH1%\0000%1.jpeg %Input_PATCH2%\%j%.jpg
copy %Input_PATCH1%\000%1.jpeg %Input_PATCH2%\%j%.jpg
copy %Input_PATCH1%\00%1.jpeg %Input_PATCH2%\%j%.jpg
copy %Input_PATCH1%\0%1.jpeg %Input_PATCH2%\%j%.jpg
copy %Input_PATCH1%\%1.jpeg %Input_PATCH2%\%j%.jpg
GOTO :eof
```

0 for even frames
1 for odd frames

Source and Destination paths

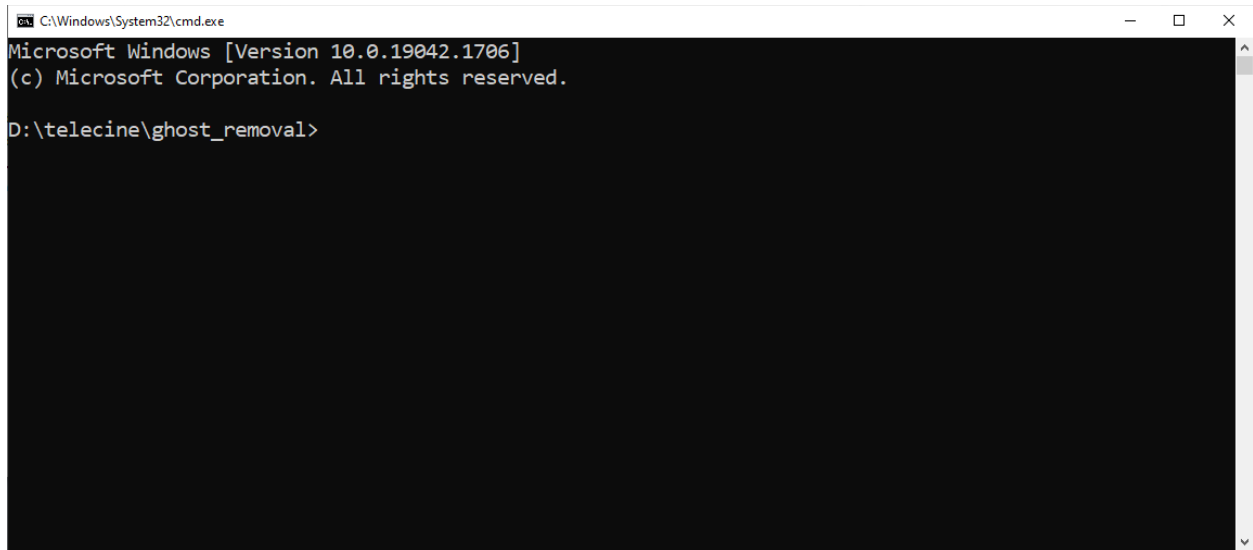
Ln 1, Col 1 100% Windows (CRLF) UTF-8

Click in the folder address line, highlight it and type the word cmd.



Hit Enter.

The DOS shell will open up.

A screenshot of a Windows command prompt window. The title bar at the top reads "C:\Windows\System32\cmd.exe". The window content shows the following text: "Microsoft Windows [Version 10.0.19042.1706]" followed by "(c) Microsoft Corporation. All rights reserved." on the next line. The current directory is "D:\telecine\ghost_removal" and the prompt is ">".

```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19042.1706]
(c) Microsoft Corporation. All rights reserved.

D:\telecine\ghost_removal>
```

Run the reorder bat file by typing in reorder.bat on the command line.

This will take some time.

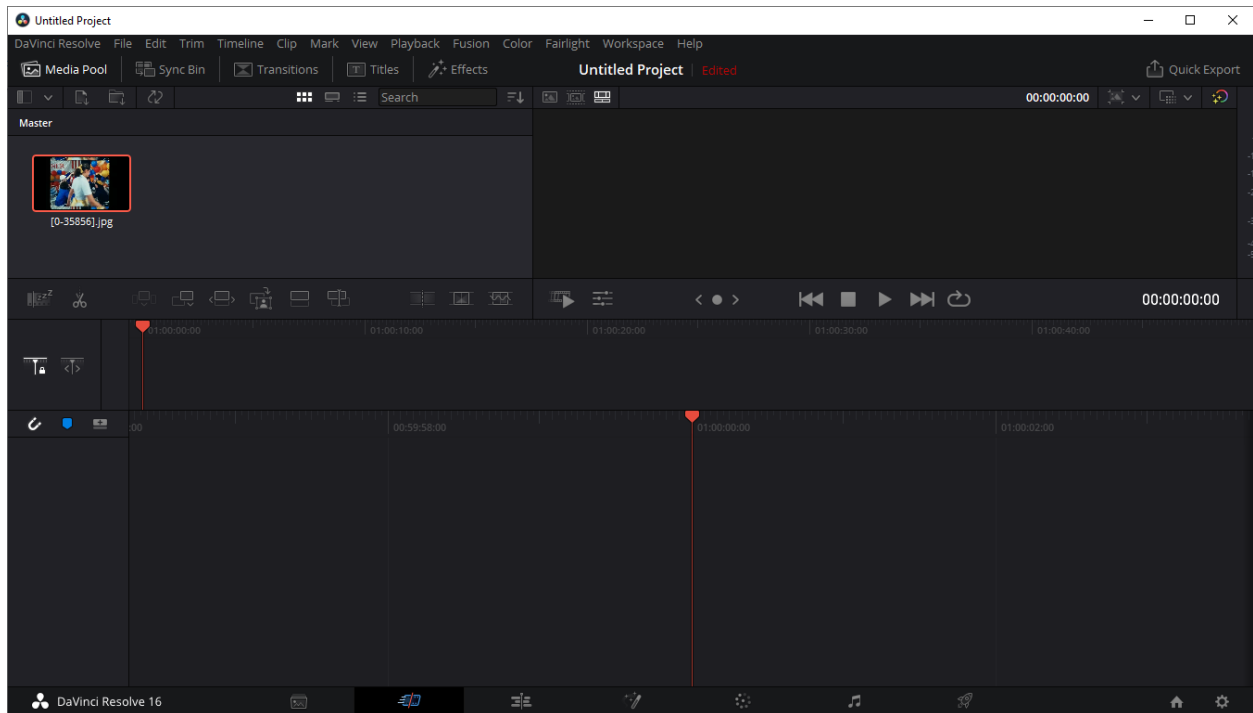
Once done, you can drag the first image from either the odd or even images folder into Virtualub. Virtual Dub will create the video from the sequence.

Set the frame rate to 24 and check the video. There is no way of guessing which video will be better, so you have to evaluate both of them. Once the video selection is done proceed to the next step.

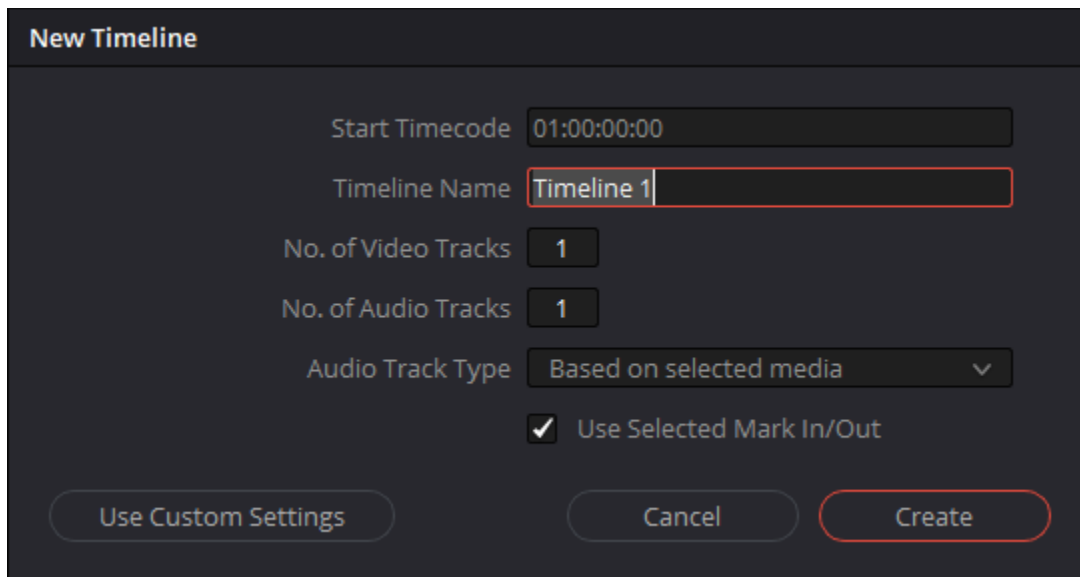
Run daVinci Resolve or equivalent editor.

Select all images in the even or odd folder and drag them into Resolve Media.

After a while the images will be shown as a clip.

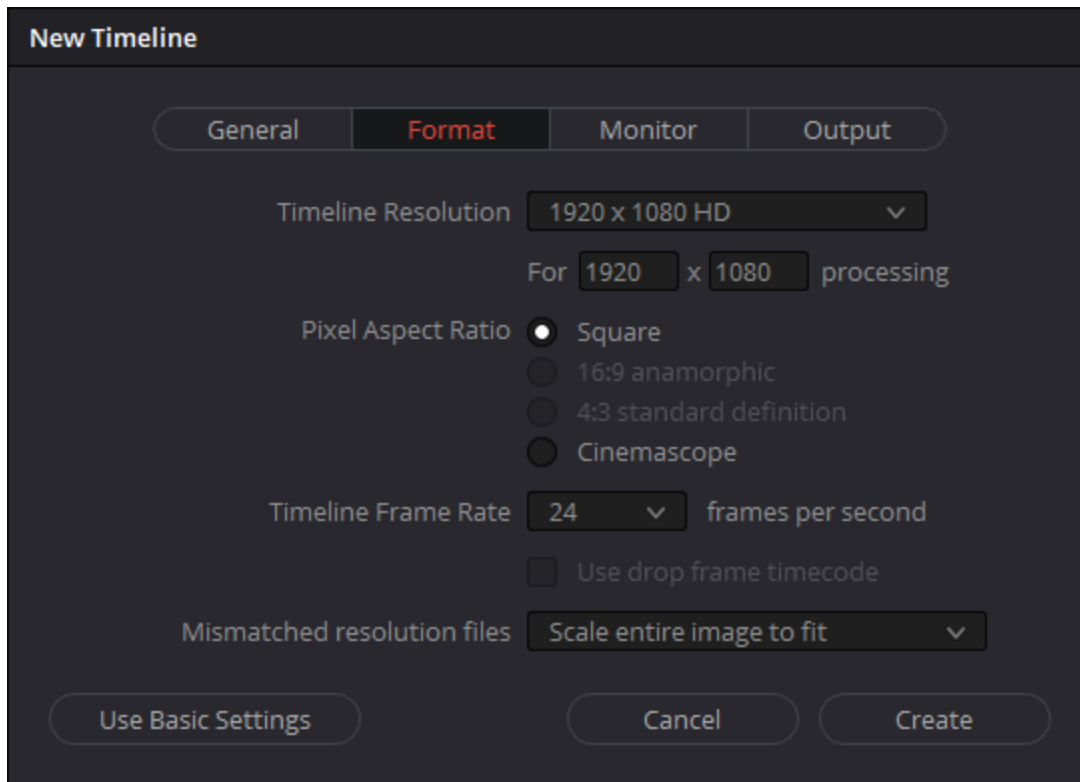


Right click on the clip and select CreateNewTimeline.



Click on Use Custom Settings.

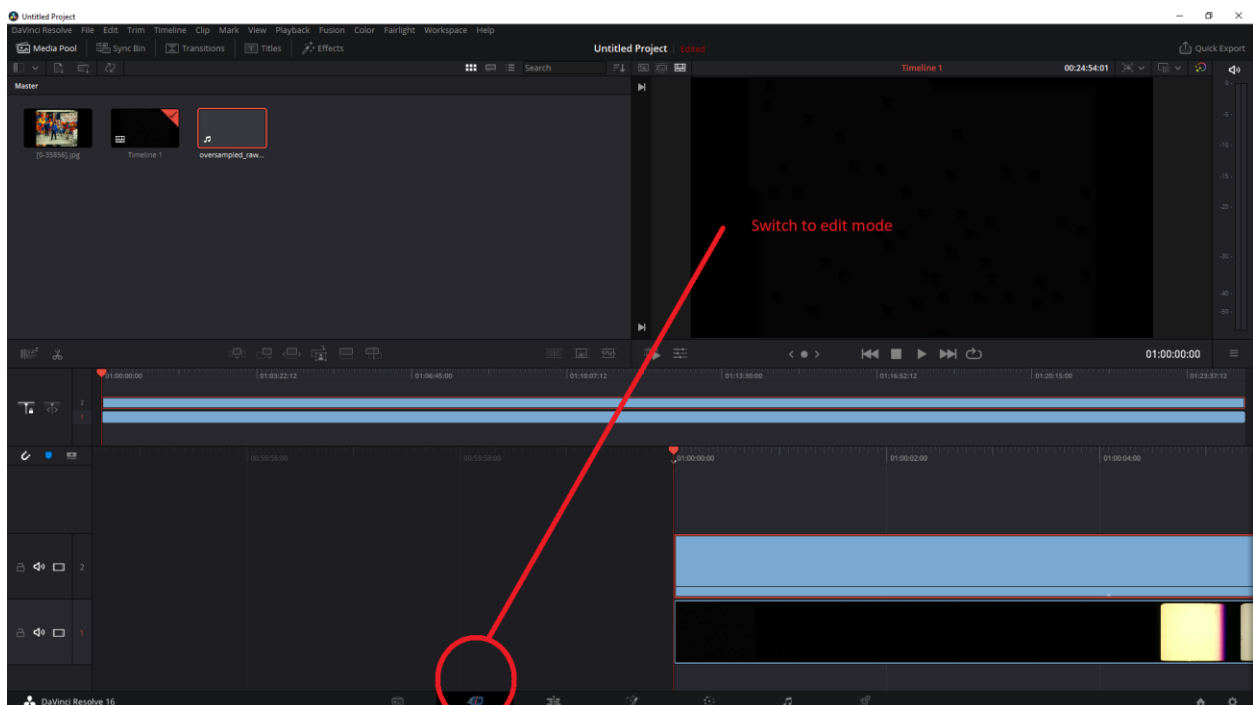
Click on Format



Make sure 24FPS is selected and set the timeline resolution to 1280x720.

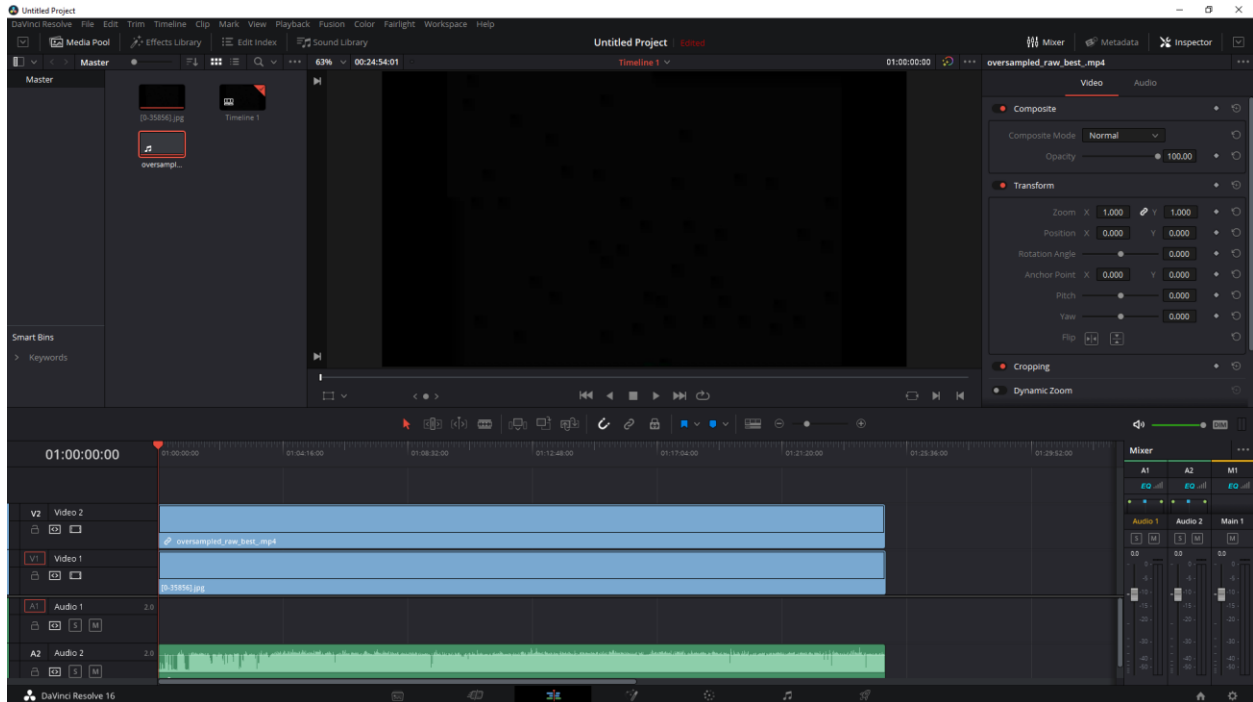
Hit create.

Switch to Edit mode:



Three timelines will be visible.

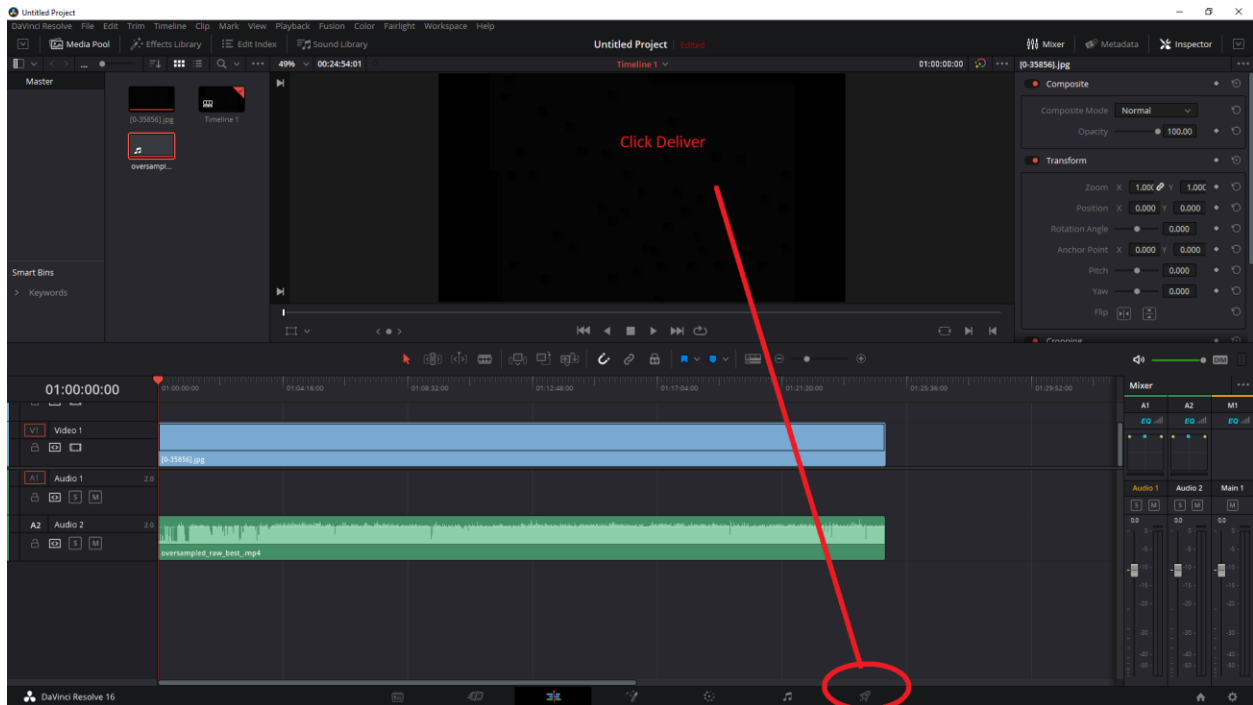
The original video, original sound and the timeline created from images.



Delete the original timeline.

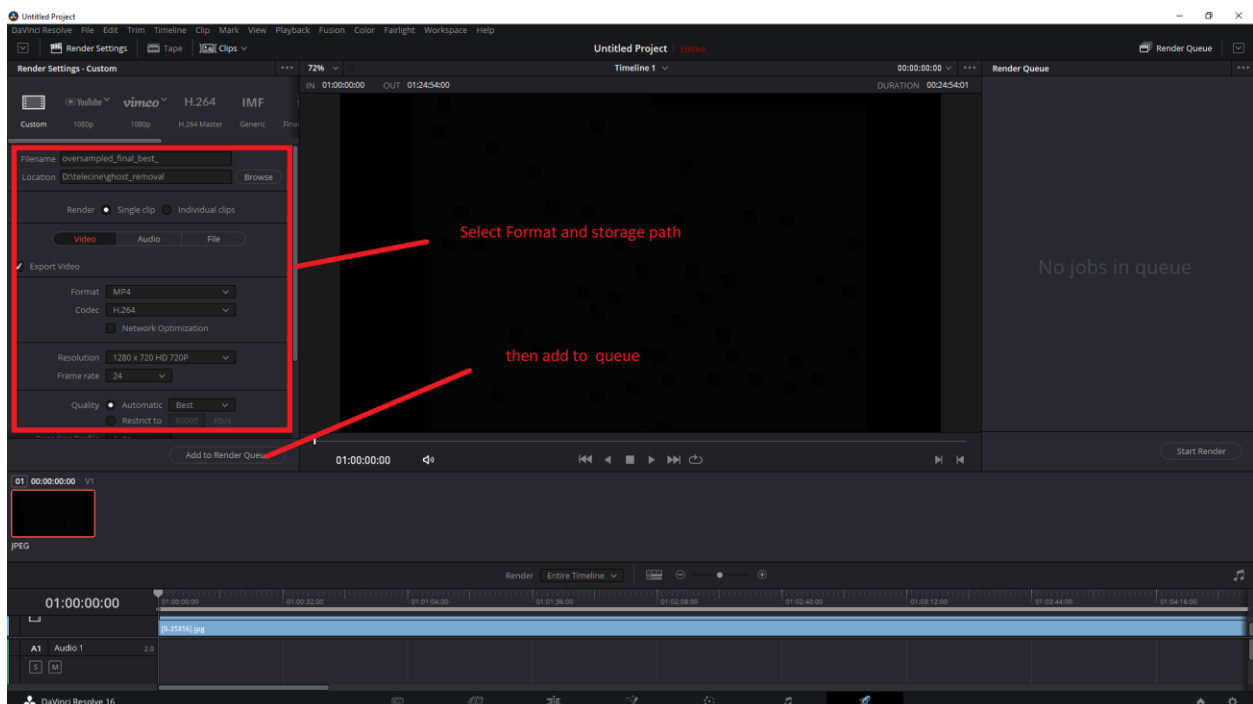
You end up with the timeline created from images and the original sound. And basically that is it.

Click Deliver



Select export format. MP4 is OK. Select best quality.

Add it to the queue



Hit Start Render. The exported file will be saved in the destination folder.

