

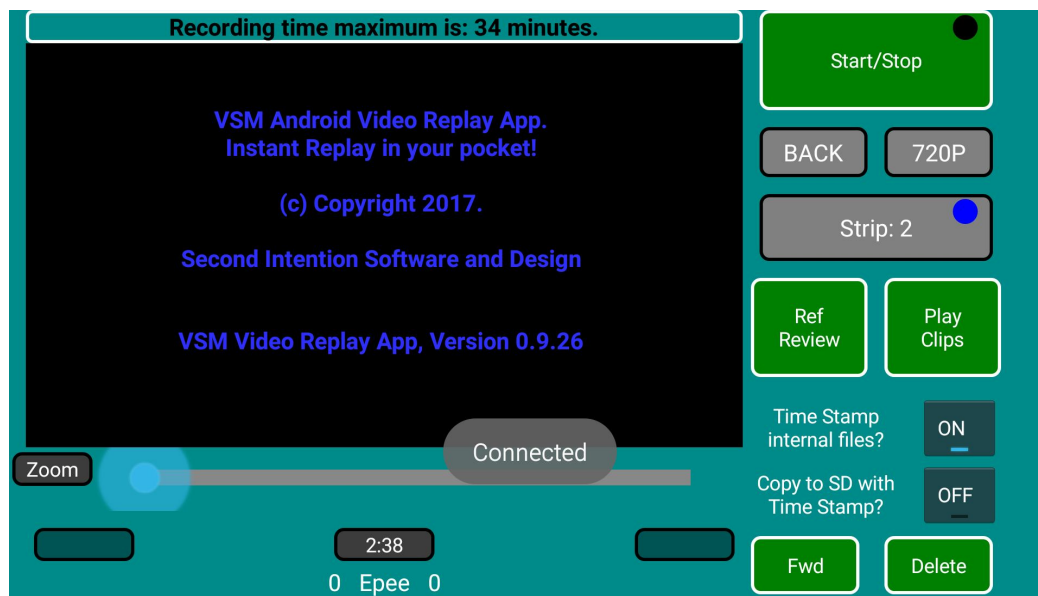
Introducing the Android VSM VideoReplay App: “Instant Replay in Your Pocket.”

The state of the art of the smart phone has advanced to the point where the processing power, camera resolution, storage options, and WiFi connectivity speeds will allow many smart phones to do full-HD and full-frame rate video replay. Now, if you use VSM, you can video record a fencing bout with your phone (or tablet) while simultaneously capturing the associated live-stream of data from a VSM scoring system and play it back later **with the scoring machine data overlaid, in normal speed or in slow motion**. This is an excellent tool for tactical analysis, coaching, or for referee “instant-replay” use.

Here’s what you need:

A recent vintage Android device with a decent camera, good WiFi, and enough free storage space for the video files. Specifically, the camera should be capable of HD video (720p or 1080p, although 480p is still useable. Typically this requires at least a 5 megapixel camera; but 8 or 12 megapixels are better.) Storage: more is always better, but at least a few gigabytes of storage on the main device are needed (more on storage later.) Video can consume a great deal of space quickly, and the higher the recording resolution, the more storage it takes. Android (as of this writing) is currently at version 7.0+ (Nougat); most current devices available run 6.0 (Marshmallow) or 5.1 (Lollipop). The VSM VideoReplay App will run on Android 4.4 or later (KitKat,) although some functions are only available on more recent systems..

More on Storage: The App is designed to use device-resident storage for the current video and data capture location. However, if there is a removable SD card, the App can be configured to immediately copy the captured video to the SD card -- then automatically delete the original files from device storage. This keeps the device storage requirements to a minimum, but you will still need to have enough device-storage available to record a reasonable-length bout.



Sample Android, record mode (Galaxy S5.) Note the approximate recording time is at the top of the view finder.

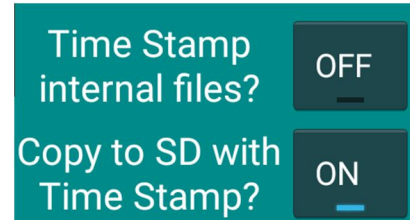
Record Mode:

There are two distinct modes of operation in the VSM VideoReplay App: Record and Playback. Record will be discussed first. There are several options that you can set prior to beginning to record a fencing bout: Front/Back Camera, Resolution, Strip#, Time Stamp Internal Files, Fwd/Rev perspective, and (only if available) Copy to SD.

Copy to SD Option:

Many, if not most, Androids have expansion slots for an SD card. If you have one, this option will be available; if you don't it will not appear on the device. This method of "record, then copy" allows you to swap SD cards in or out as needed for more storage or to replay previously recorded videos. **Note: Not all SD**

cards are created equal; make sure to use one that is as fast as possible. Also, once you stop recording, the Android will require some time to copy the files over to the SD card (and the length of time is dependent on the SD card's speed rating.) This may delay an immediate review of the last hit. If you are using this App as a coaching tool, or for your own review, this is not generally a problem. However, if you are using the App as a referee-tool, it might be better to switch-off the "Copy to SD card" function, and only use the device's storage. Doing so will make any video available for review immediately; however it will also require more device storage space if you intend to keep many of the files. On that same note, using higher video recording resolutions creates bigger files, and this makes for longer "Copy to SD" times. If you use the "Copy to SD" option, all the copied files will use date/time stamped file names.

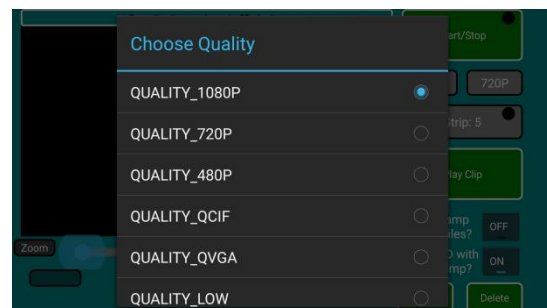


Time Stamp Internal Files Option:

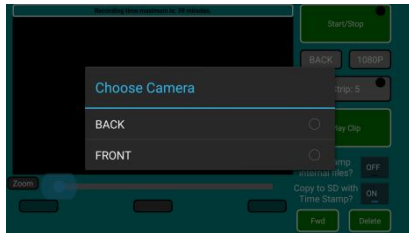
If you elect not use the "Copy to SD" function, then all your files will be stored on the device itself, potentially using most of the available internal storage. (The App will limit its use to leave at least ½ gig free. At that point you get an out of storage message, and can no longer record without manually freeing up more space.) However, you also have the option of turning off "Time Stamp Internal Files." This option will cause the video to always use the same file name, and delete any previous video before recording a new one. The down side here is that once you move on from reviewing a video and start recording again, the previous video is lost. But, running out of space is not such a problem.

Resolution:

You need to be aware of how much space is available, and manage it to make sure you have enough recording time remaining. Part of that battle is selecting an appropriate resolution. Try out a few resolutions, to make sure they meet your needs. Lower resolutions yield less storage requirements and longer recording times available.



Camera Selection:



Normally, you will use the “back” camera. However, if your device has both, you can switch between the front and the back cameras by clicking on the Back/Front button as desired. The front camera could be useful during coaching sessions where the Android Device is mounted on a stand, and would allow the view finder to be seen from the coaching strip while the lesson is in progress.

Strip#:

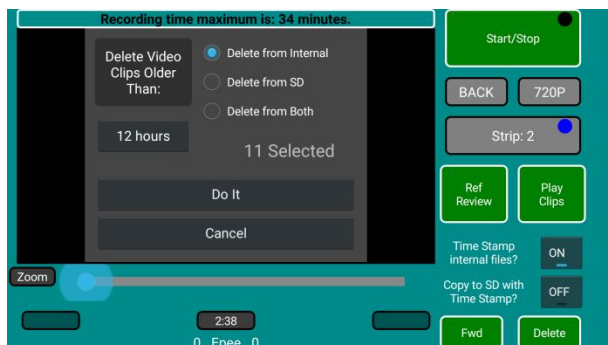
If you have multiple VSM strips running and connected to your network, you can select which strip’s data to record by choosing the strip number or name. Just click the “Strip” button and select the one you will be videoing. (This works just like the VSM Remote App.)

Note: if you have multiple VSM strips, make sure they have been programmed with unique strip numbers. Once the desired strip is selected, the App will connect, and the indicator in the Strip button will turn blue. Once the connection is made, the VSM system’s hit/time/etc. will be displayed in real-time on the VideoReplay App. **Obviously, videotaping one strip, while connected to a different strip is not desirable. And quite confusing to watch.**



Fwd/Rev Perspective:

Normally, the referee’s perspective is the obvious choice to use. But the ref will continuously be moving in and out of the video’s line of sight. Sometimes it may be better to shoot video from the opposite side of the strip. But that will reverse the left/right sense of the hit-lights... Simply click the Fwd/Rev button to make sure the video perspective is correct. Reviewing a recording made with the wrong perspective selected is also quite confusing...

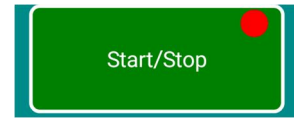


Delete Button:

The delete button lets you manage storage space available by letting you selectively delete existing groups of video and data files. Clicking the delete button will let you select files to delete according to age, and also gives you the option of deleting either files *older* than a certain age or *newer* than that age. Click on the text to toggle “older/newer” criterion.

How it works:

Once you have set which camera and resolution to use, there will be text above the viewfinder with a (very) rough estimate of how many minutes of recording time are available. This is based on how much internal storage is open. After you press the Start/Stop button to begin recording, the text above the view finder will continuously update how many minutes remain. If the time and/or storage runs out, the recording will automatically stop. After stopping recording, if the "copy to SD" option is set, the video and data files are automatically copied to the SD card, and then deleted from internal storage, allowing that space to be reused for the next recording.



Videos are recorded in .MP4 format and titled with-or-without a date/time stamp in the file name as selected. There is also a database file created if you have an active connection with a VSM system. This database contains all of the linked VSM systems "events": hits, time remaining, fencer names, warning cards, etc., as well as the time that each event occurred during recording. These time stamped "events" can then be recreated during playback at the appropriate moment in the video. Video files tend to be many hundreds of megabytes in size, while the database files are quite small, typically 10s of kilobytes. Both files are needed to view the video with the scoring information overlay. However, you can also record and watch videos without a VSM connection; you will simply be lacking the overlay during playback, and will only have manual speed control for playing in slow motion.

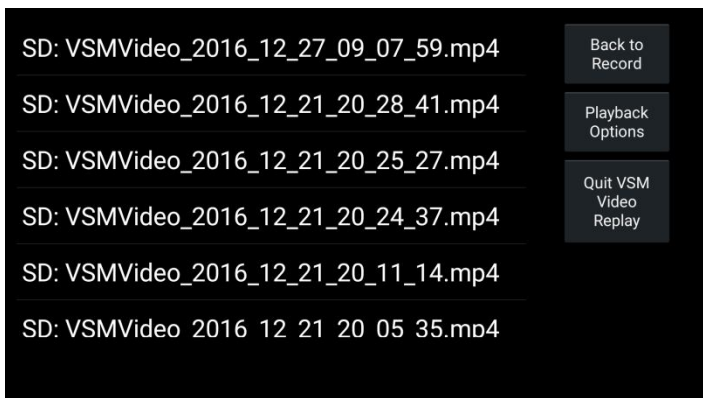
Zoom:

While recording, you can use the slider control below the viewfinder to digitally zoom in on



more distant action as the fencers move up and down the strip.

The main idea, though, is to be able to combine the time-stamped data events with the video playback in real time. By selecting the WiFi data stream of the same strip you are videotaping you can produce a very valuable tool to use either for self-critique, coaching, referee use, or for analyzing an opponent's tactics. Press the "Play Clips" button to switch to the Play-back mode. (Ref Review is covered later.)



Play-Back Mode:

The VSM VideoReplay App has two separate playback modes:

"PlayOn" mode and "Loop" Mode.



PlayOn mode will play back the entire video clip from beginning to end with the scoring machine data overlay, and can automatically switch from normal speed to slow motion

Long-pressing a title allows you to delete an individual clip.

moments before and after a hit arrives. The window of slow motion is selectable. And once the selected slow motion period is past, the video can speed up automatically to continue the play-back.

In Loop mode, only the selected time-window before and after a hit is replayed, automatically repeating first in normal speed and then in slow motion. The selected hit period will repeat until you choose a different hit to replay or quit (more on that later.)

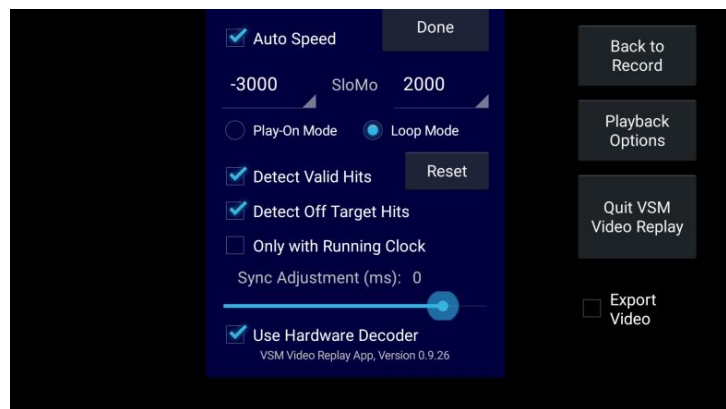
After first selecting "Play Clips" you will be able to select which of the recorded clips to play.

The titles will be in order of the date/timestamps and if they are on the optional SD card, be preceded by "SD: ". Just click the desired clip to play.

Before playing a video, take a look through the play back options.

Playback Options:

Clicking the Playback Options button will display this sub-menu that allows you to define the parameters of your video review session. The three centrally located check boxes allow you to control what hits are relevant to you. Hopefully they are self-explanatory.



The two drop-down selectors that define the "SloMo" window can be used to set the number of milliseconds both before and after a detected hit as defined by the check boxes. The "radio buttons" allow you to start your playback in either PlayOn mode or Loop mode as the default, but during the playback session you can switch back and forth as desired. The "Auto Speed" check box is checked to allow the App to automatically control the playback speed. If selected while in PlayOn mode, when playback reaches the defined "SloMo" time window, slow motion replay speed will automatically be triggered, and play at half-speed till then end of the "SloMo" window where replay will resume at normal speed.

If Loop mode is initially selected, replay will be started with the final hit in the clip (as defined by the check boxes). While in Loop mode, replay alternates between normal speed and ½ speed and repeats until a new hit is selected (more on that later) or you quit the playback session.

The bottom check box is normally checked by default; however there are some Android devices that do not have hardware based mp4 decoders built in. Unfortunately, the only way to tell is to try it out; if your device is unequipped with a hardware decoder, the App will hang, and crash (most likely.) If that happens, on restart, the App should deselect this option automatically, and use the software based decoder subsequently.

Sync Adjustment:

Of particular importance is the slider control for adjusting the data to video synchronization. This slider control ranges from -1000 to +200 milliseconds. The setting allows you to insure that the recorded data

stream is synced with the video play back. It is necessary to manually adjust it for each Android model's variation in recording lag. Many models use various algorithms to encode the video with or without stabilization or image enhancement. The only way to find the correct setting is by trial and error; however this is pretty easy to do in slow motion playback. Once you find the right setting for your phone or tablet, it should not change much. The easiest way is to record a video of just the VSM display while the clock ticks down, and adjust the sync so that the image of the scoring machine's clock ticks over at the same time as the Video Replay clock's on the bottom-center of the video.

Network latency is another factor that could potentially affect playback synchrony; however, during recording the network's latency is measured and included in the database so that it can be offset automatically during playback.

All setting choices are saved for future use. There is a reset button to return to the original settings. Click "Done" and then choose a video to begin playback.

Video Replay:



"Live" Play Back Controls:

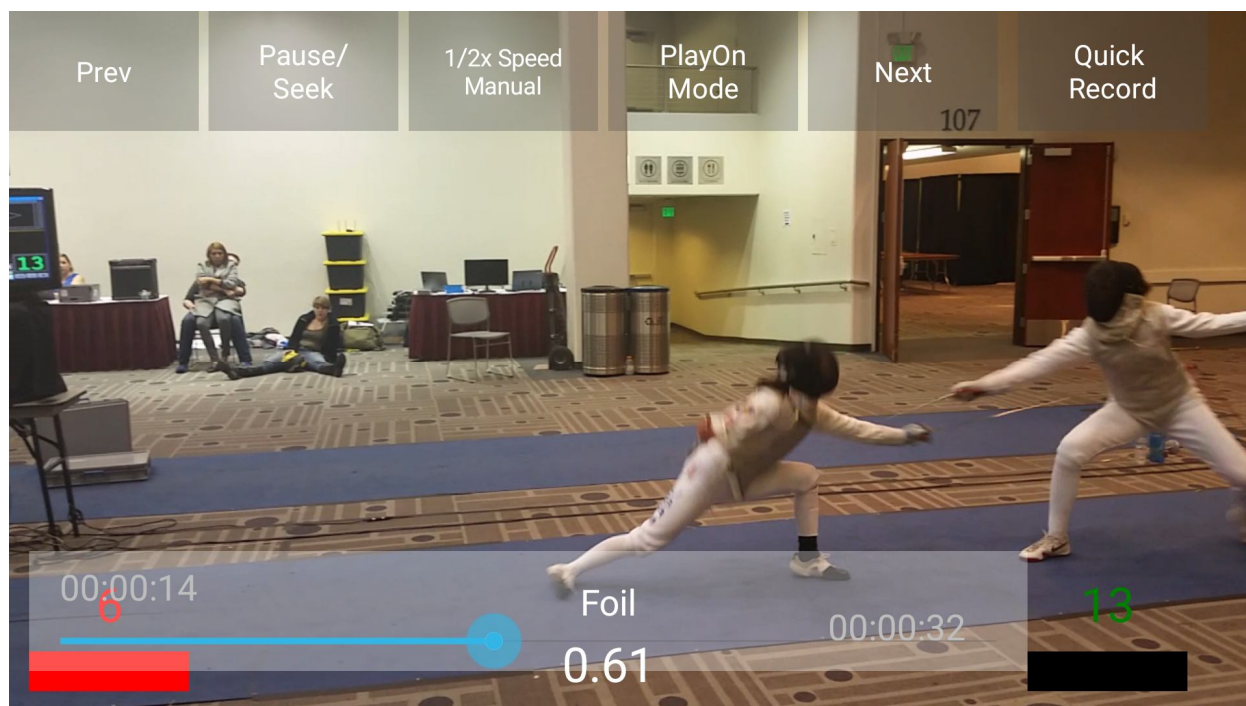
Across the top of the playback are up to 5 transparent buttons that let you control the play back during review. The left and right-most buttons are "Prev" and "Next," and allow you jump backwards and forwards though the clip, jumping directly from hit to hit. Either of these two buttons are absent if there is not a next or previous hit..

The center button, here labeled "1/2 Speed Auto," has three separate functions: the first is to show the currently selected playback speed, and if it is currently under automatic or manual control. The second

function is actuated by a “click,” and will toggle the speed between ½ speed and full speed. The final function is achieved by a “long-press” and will toggle automatic vs manual speed control.

Right of center is the control currently labeled “Loop Mode.” As you might expect, this button lets you toggle between Loop Mode (repeating) playback and PlayOn Mode (continuous) playback.

Any “Live” changes will be captured and saved as the default play-back options and reflected in the “Playback Options” selection window.



The second “live” playback control is the video control selector (labeled “Pause/Seek”) and is used to pause and resume the playback. While paused, the bottom of the screen will show a “seek” bar that lets you manually position the video as desired. Once you position it, in PlayOn Mode, the playback will continue from that point; in Loop mode, the playback will reposition itself to the closest hit (as defined in Playback options.)

Tips for Usage:

If you are using the Loop mode for reviewing referee calls and have no particular reason to archive the video, you should consider deselecting the copy to SD card option. That way the videos are immediately available for playback, with no delay for the copy operation. If space on your device is at a premium and you are not using the “time/stamp file names” option, then make sure the referee is satisfied with the video review, as once you resume videotaping, the previous video will be overwritten and deleted.

When using the PlayOn mode for student instruction or for your own improvement, you will likely accumulate a lot of video and eventually need to free some space up. You may want to copy the files to a USB flash drive or to a PC via a USB cable for future review. The Android file system is not unlike any

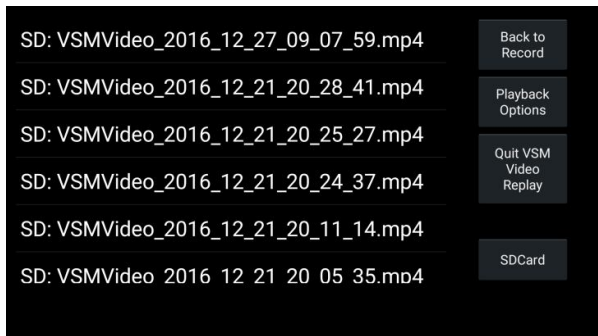
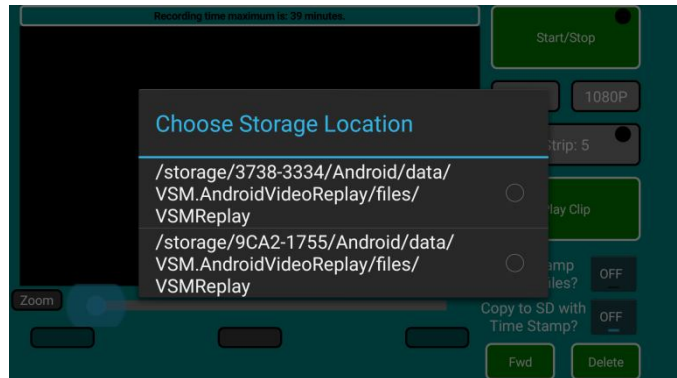
PC's file system, however there are some quirks that restrict which file directories are useable. The file structure that the App uses involves two different folders:

Internally, there will be a folder called "VSMReplay" that will contain the video files (.mp4 files) and the database files (.db files). Both files video and database files should be copied and kept together in your archive. The "VSMReplay" folder can be found under your device's "\storage\emulated\0" folder.

On the SD Card, though, the files are kept in a folder called something like: "\SDCard1\Android\data\VSM.AndroidVideoReplay\files\VSM\Replay". On some devices the "SDCard1" may just be "SDCard" or may even be an odd numerical or hexadecimal name such as "3738-3334". If needed you can use an Android third party file manager to move them or delete them. Generally, it is easiest to manage via a USB cable from a PC, though.

USB Drives:

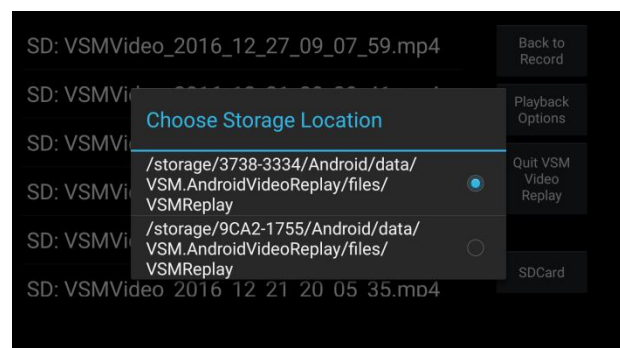
On some Androids it may be possible to also copy your video files to a USB flash drive, now that micro-USB flash drives have become more common. Not all Androids support this, and there may be some fiddling with settings necessary to enable this. It is even possible to use the USB flash drive as if it were a removable SDcard for the automatic "copy to SD" option. This is fairly "hit and miss," however.



If you have both an SD card and a useable USB drive you will be able to choose which one to use during recording for the "copy to SD" destination. To choose the drive, turn the "copy to SD" option off and then back on:

During playback, if there is a USB drive, you will know it because there will be a control for selecting the desired play-back source location at the bottom right of the video playback selection:

Click it to choose which source you wish to play:

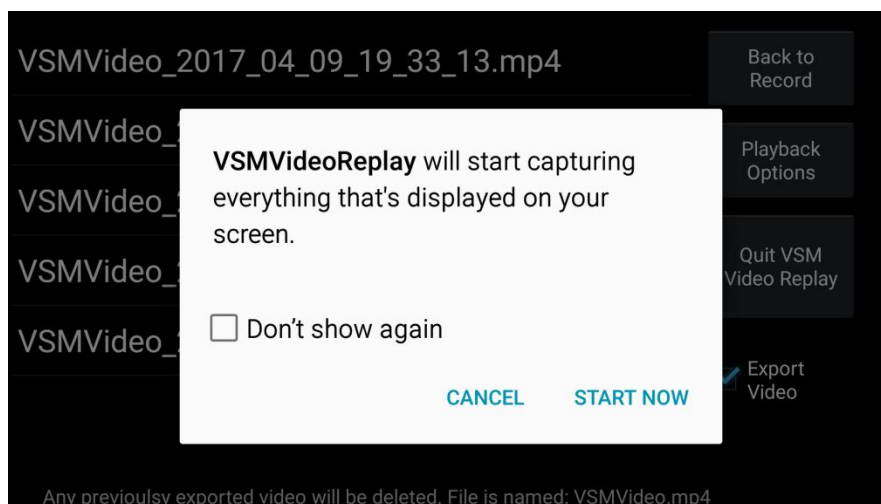


Export Feature:

Note the check box available (on later model Android Devices,) "Export Video." This feature allows you to enter a special replay mode that re-records the video with the data overlay into a single .mp4 video file. This allows you to share a composite, combined video with others who need-not-have the Video Replay app (or, for example, on "YouTube".) Here's how you use it.



First, check the box:



You will see this warning, as well as the disclaimer at the bottom of the screen. Click start now to begin recording. [If you select "don't show again," subsequent use of this feature will begin immediately.] Once capturing begins, select the clip you want to export. It will begin playing (as previously described.) All

the playback controls will still function allowing you to move around in the clip, select or deselect normal speed or SloMo, etc. **All while re-capturing the video to a new output file, combining video, sound; called "VSMVideo.mp4."** The re-capturing ends when you stop the playback. The resulting video file is located in the location usually used for recorded video files, the devices "DCIM/Camera" folder. **Note that sounds are also re-recorded.** This is done using the microphone on your device, allowing you to add any voice-over commentary. Which is pretty cool. Only the one fixed file name, though so you'll need to rename it before you make any additional exports or it will be over-written.

Use as a Referee tool:

At a SoCal ROC recently the VSM Replay App was beta-tested in a real, full scale event. Using real, rated Refs who typically got about 30 seconds of instruction before their first time use of this app. What I learned was that a simple way to quickly go from recording to review and then back to recording was needed. To address this need, I added two controls: one on the recording side and a corresponding one on the playback side of the app.



During recording, if an immediate "let's review that action" call happens, click the "Ref Review" button.

The App will automatically stop recording, switch to playback, and start playing, cued to the most recent hit in "Loop Mode" where it will loop continuously alternating between full-speed and SloMo. *[Note that this is dependent on having the "Playback Options" set appropriately (i.e., number of ms before and after the hit, valid-hits and/or off-target hits, with or without a running clock.)]*

When the review has concluded, click on "Quick Record." The App will switch back to record mode, and if the recording mode was on previous to selecting "Ref Review," it will immediately start recording again. (But only if recording was previously "on".)

The idea was to provide a one-click to review, and one-click to resume recording functionality. This works provided the playback options are correctly set. Specifically, make sure the "running clock only" option is not selected for Sabre (since the clock is generally not used) and for any bouts in which time is not being kept (as in lessons, sparring, etc.)

"Loop Here" Button

Occasionally, I've been asked "but, does it only work with VSM?" My answer to that is: pretty much, yeah. That was the whole idea... You know... use modern, cheap, omni-present technology for the advancement of fencing... Like TVs, computers, networks, and smartphones. But, if you're at a club that's still in the last century (check for horse-and-buggy parking behind the club while you're there,) you can still use this app to record fencing video. There just won't be any data stream to overlay the clock, the hits, etc. But you will get a "Loop Here" button during playback. This button lets you set a manual loop point, and causes the video to go into Loop mode, replaying in normal speed and SloMo at that position. This button only is shown if there is no associated data stream with the video file.

Screen Casting

Since Android 5.0 (I think) there's been a (kind of experimental) feature called "Screen Casting" or "Screen Mirroring" that lets you send your phone's display to another (generally larger) display like a PC or a HDTV. To make it work, you need to enable it on your Android, and have a suitable receiver for it, for example the "Roku" entertainment device supports screen mirroring, as does Google's "Chrome Cast" device. Results are generally good, although I've seen some devices that produce poor quality video as well. But when it's working well, it's quite easy to round up a spare tv, and with a cheap device like the Roku or Chrome Cast have a large HDTV available for your replay use.

Future Development:

Hopefully, there will be an iOS version of this App in the future, as well as a playback-only Windows based program that can be run on any PC.

Summary

- Make sure that your VSM scoring machine PCs are connected to your network. Having them “hard-wired” (rather than connected via WiFi) will yield fewer network problems with lower latency and better sync consistency.
- If you have later a more recent Android device with a 5ghz WiFi band available, using a router with 5ghz band will also improve your connection speed and reliability.
- Use as fast an SD card as possible to expand available recording times and storage space, and minimize the delay during the “Copy to SD” operation following recording a bout.
- If you need an immediate replay, consider turning off the “Copy to SD” function. But either make sure you have plenty of recording time and space available, or turn off the time-stamped file name feature.
- Try using a lower resolution for recording if space is at a premium.

The VSM Video Replay app can be used by numerous Android devices *simultaneously* for full strip/360 degree coverage. Newer devices may be able to “screen cast” the replay to larger monitors using a “Chrome Cast” or “Roku” receiver plugged into any TV’s available hdmi port, though this also requires your network to have decent bandwidth available. If you don’t have a screen cast receiver device, you can also generally connect the Android via a hdmi adapter cable (which will be device dependent.)