Smartphone Ophthalmic Surgery recording for e-records and education

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Abstract

Introduction: Surgical training in ophthalmology is challenging accounting for the difficulty in effectively showcasing the complexity and dexterity of movements required in a small operating field. Various types of in-line operating microscope attachments providing video recording capabilities have been in the market to enable surgical video recording, but their steep price-tag and maintenance requirements, can preclude their use especially in developing countries. Recent innovations, in mobile-based video recording and transmission capabilities, can provide a convenient and cost-effective solution for surgical training.

Materials & Methods: For the purpose of this study, we used an iPhone 4s,[1] installed with a camera-enhancing app called FiLMic Pro-v58, as our primary device for video recording.

Conclusion: Smartphones[2] can be a cheaper alternative to branded microscope video attachments, and the quality of video provided by them is comparable to their costlier counterparts. Ophthalmologists only need basic technical knowledge to setup such a system in their clinics or at academic institutions.

Keywords: Education, Ophthalmic, Surgery, Smartphones

Introduction

Smartphones have ushered in a new era of consumer-focused applications in several industries. From banking to shopping, smartphones have redefined the way we do business, by enabling convenient and instantaneous access to various processes. Healthcare has not been entirely immune to this technology fueled customer transformation. Innovators and clinicians across the world have introduced several apps to enable patients to schedule appointments, access insurance details, and even initiate live virtual visits with primary care physicians. The next generation of smartphones[3] with improved sensors, better optics, smaller form-factor, and user-friendly UI, have opened up the possibility of their use even in ophthalmology. Smartphones can be now used in retinal[4.5.6] and corneal imaging, ophthalmic education, ant. segment lesion imaging etc.

In the field of ophthalmology, there is a shortage of highly-skilled surgeons who can train the younger surgeons. Especially, in developing countries like India, the effect of shortage of expert surgeons on surgical education is further compounded by inadequate access to training materials and resources that can cater to a large number of ophthalmic surgeons in residency. At present, many teaching hospitals use a traditional beam-splitter attachment for their operating microscopes which can collect video feed and transmit it to a TV using audio-video interface or to a computer via TV-tuner card. Although such systems offer high quality of video feed as they are directly integrated with the microscope, at a cost of about Rs. 3-4 lakhs ($5000-$7000) or more, they are prohibitively expensive for many institutes. In addition to their fixed acquisition cost, they require high maintenance and may require specially trained personnel to operate them.

Salient features of this application:

1. Alternate system - Beam-splitter attached with microscope and then camera-TV-tuner card- to – computer is costly, requires trained manpower.[7]
2. Smartphone recordings are easy, cost-effective, any OT assistant can learn and operate-smartphone.
3. Video-recording helpful for personal development to review one's own surgeries.
4. Rare surgeries can be recorded and shown to UG, PG students for training.
5. Training to paramedical and medical persons by showing them recordings.
6. Integration with Hospital HMIS gives permanent record. This will become compulsory gradually.
7. Possible streaming of 'live' surgeries with 'COMCAST', outside the OT, will be explored in next project.
8. Use of this method is helpful in other specialties like ENT, General Surgery.

We used smartphones, as an affordable, convenient and easy-to-use alternative to beam-splitters, for video recording of various surgical procedures. The initial findings from that study are presented in this paper.

Materials and Method

We conducted initial trials with both iOS and android-based smartphones for this study. iPhone 4s was finalized as the test-device given the high-quality optics, relatively low-cost compared to newer iPhone models, and more consistent performance when compared against android-based smartphones.

The choice of hardware was also influenced by availability of image enhancing apps to improve quality of video capture. For the purpose of this study, we used a commercial version of a well-known image-

enhancing app known as FiLMic Pro-v58, which allows the user access to advanced camera features including exposure and focus control, and enhances the image capture quality significantly over the pre-installed camera app.

For this study, the camera was set at the highest digital zoom level, with video recording at 25 frames-per-second at 1920 x 1080 resolution and image stabilization switched off. The use of high digital zoom causes some deterioration of video quality, but provides a better and more detailed coverage of the surgical field. The iPhone was held steady with the head of the microscope through a ***Gorilla-Pod*** (http://joby.com/smartphones/griptight-gorillapod-stand) stand which has flexible arms that wrap around different parts of a microscope and hold the smartphone steady (see image).

Fixed clamp-based stand attached to the operating table can also be used as a lower-cost alternative. We relied on the operating microscope's native source of light for illumination of the surgical field. The smartphone's flashlight can also be used as additional lighting source in case of microscopes with low luminosity native lights.

The iPhone was placed in the cradle attachment of *Gorilla Pod*, (Fig. 1) which was then arranged on the head of the microscope with its flexible legs. Once the assembly was determined to be stable, the *FiLMic Pro* app was opened on the iPhone, and the surgical field of view was adjusted. Exposure, focus and zoom were adjusted depending on the position of the assembly and the lighting source. Ambience lighting in the operating room was adjusted to enable better video capture.

A surgical assistant managed the controls on smartphone, as needed, at the beginning and end of surgery. For this study, an operating surgeon also provided live commentary during surgery, which was recorded along with the video. Such instructional voice-over can also be included at the time of post-production editing of the surgical videos. The videos recorded through the phone were also processed and published using ***Windows Live***, which is the pre-installed video editing software, bundled with ***Windows*** operating system. Any other video-editing software can also be used for editing the surgical videos to include titles, special effects, text instructions, or remove sections of the video recording. The videos can also be converted to *.mpeg4* or *.mp4* formats using video converters to minimize file size for convenient storage or file-sharing.

Fig. 1: Shows iPhone mounted to the Microscope with help of 'Gorilla Pod'

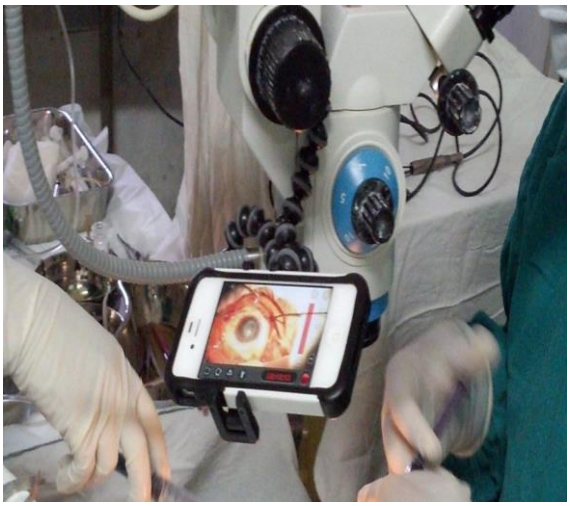

Fig. 2: Shows close up view of mounted iPhone with active recording in progress

Discussion

Smartphones have given us power to make 'Ophthalmic surgery video-recording' simple, economical and effective. Many small ophthalmic practices and clinics have limited resources. Video recording by specialized devices is expensive. Our smartphone solution offers highly effective and easy to use method. These recorded videos can be used as self-development purpose, or they can be used to demonstrate complex ophthalmic surgery procedures at 'Conferences'. This recorded videos are excellent tool for medical education purpose. Medical students can be shown surgical procedures for full understanding during their lecture session.

During my trials of surgery recording in our operation-theatre, I observed that supporting nursing staff was delighted and amazed to see these good quality videos of eye-surgeries which earlier very closely they were not able to see.

iPhone cost has decreased now. So more ophthalmologists are using this. Ophthalmic Microscopes are used by all 'Eye-specialists'. 'GorillaPod' stand and FiLMic Pro app costs just few dollars. Laptops are ubiquitous now. 'Windows Live' video-editing software is given free by Microsoft. So all this can be used towards producing good quality surgery videos.

One point to be noted here is that this video recordings are not 'coaxial' that means it do not reproduce the exact view of the procedure which surgeon sees in Microscope. In future we would like to explore how to make this 'coaxial'.

Open-source video-editing software like 'KINO' on any 'LINUX' platform can be used by anyone, which is available totally free on the Internet.
Link to view the final version of 'Ophthalmic Surgery' recording is given below.

Just 'ctrl+click' on the link and view the video file. You require active internet connection to view the video on your browser.

1. This link shows 'Conjunctival Cyst' removal ophthalmic surgery.

https://drive.google.com/file/d/0B4Nfjl4lQX10aTFXRUJqWlY1WHM/edit?usp=sharing

2. This link shows 'Small Incision Cataract' surgery for educational purpose.

https://drive.google.com/file/d/0B4Nfjl4lQX10Qm1DSFA3ZDVXOTQ/edit?usp=sharing

Ethical consideration: This is not needed as these do not involve any direct effect to the patients being treated. This procedure is adjunct to 'Health Informatics'. No identity of patient is revealed.

Results

Smartphone is definitely effective tool for various ophthalmic needs which includes recording of surgery-video. Good quality 'Ophthalmic Surgery' recording was possible by using this technique. However this does not give exact 'coaxial' view of surgeon's Microcope. But ease of use and availability of resources makes this procedure effective. The link given above, shows 'Conjunctival Cyst' removal surgery which was edited with help of 'Window Live' software. Second link shows suture less 'Small Incision Cataract' surgery.

Conclusions

Smartphone is very effective tool to record 'Ophthalmic Surgery Video' in any small Ophthalmic setup. This is cost effective and can be implemented easily by all health professionals.

This requires readily available app and other software. In future better quality resolution of smartphones will improve recording capabilities. According to me this is best solution for utilization in developing world.

Conflict of interest: No professional or commercial interest in any of the items described in this paper. In fact I firmly believe that 'Open-source', free software can be used for video editing and other purposes.

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