Mobile Device Camera Connector for Low Cost Portable Endoscopy

Topic:

In third world nations there is a lack of affordable technology for visualization and picture-taking during endoscopy. A commercial solution is available for first world countries as the Endoscope-I; however, it is limited to using recent generations of iPhones. Also, the phone screen's limited size reduces the clinical usefulness of this visualization during endoscopy. Not only so, but the high cost of iPhones is a major barrier for wide-spread use, especially outside of first-world nations. Thus our goal is to create an android-based application and adapter to be compatible with endoscopes in order to address these existing problems.

Team members:

Daniel Ahn, Deepak Lingam, Kyle Wong

Mentor:

Kevin Olds, Dr. Amit Kochhar, Dr. Simon Best

Relevance:

The lack of a low cost solution for capturing digital images during endoscopy leads to painful, costly, and uncomfortable re-examinations. This is creates a barrier to sharing information about the endoscopy, requiring extra time for clinicians to see and examine the patients themselves. In rural situations, this is worsened since doctors are not always available so after a first examination, the patients must come back again when the doctor is available or going to the city. The lack of digital images also prevents clinicians from easily tracking patients' health progress over time.

Additional applications for this technology would be other surgical specialties that use endoscopes such as urology, obstetrics and gynaecology, gastroenterology, and orthopedic surgery. Having a universal adapter would permit this. Furthermore, having this tablet adapter would enable clinicians to take pictures during endoscopy on the hospital floor and in the ER even if they do not have iPhones or the standard endoscope imaging tower.

Technical summary:

In order to address this problem, we hope to create an application for Android devices for taking high quality pictures and saving, organizing, and transferring the pictures easily and securely. We also will need to create an adapter to attach a tablet to the endoscope that is ergonomic and easily usable. It may be necessary to create an optical component of the adapter in order to obtain images of usable quality from the tablet while attached to the endoscope. We may also need to have a portable light source for using the tablet's camera with the endoscope. Once we have a working adapter for a single android tablet, the goal would be to create a more universal adapter to fit any other tablet.

Deliverables / Updated

Minimum:

- a working adapter for a specific Android Tablet for a rigid endoscope
- Android application with GUI for adjusting tablet's camera settings and saving pictures to the device
- a working adapter for a specific ~~Tablet~~ **Camera** for Endoscope
- Android application with GUI for saving ~~Tablet's~~ **external** camera **images**

Expected:

- a working adapter for flexible endoscopes as well (to have universal adapter for all endoscopes)
- Android application with GUI for organizing images by patient identifier
- an updated **camera** adapter with modifications for flaws found during testing
- Android application with GUI for organizing images by patient identifier
- Real-time streaming **from external camera to tablet**

Maximum:

- universal adapter for connecting any tablet to any endoscope
- a portable light source that ensures high quality images
- Android application that uploads and offers secure viewing of patient endoscopy images
- universal adapter for connecting any tablet to any endoscope (unlikely)
- a portable light source that ensures high quality images (unlikely)
- Android application that uploads and offers secure viewing of patient endoscopy images
- Real-time image processing method to prevent specular reflection

Assigned Responsibilities:

Deepak - CAD design for adapter / light source, manufacture
Kyle - Android application GUI design
Daniel - Android application Camera focus

Dependencies:

1) Android tablet with a high-resolution camera
- plan A: borrow and use one from the Johns Hopkins Outpatient Center - Head and Neck Surgery Department - follow-up with Dr. Kochhar
- plan B: receive money to buy an Android tablet - follow-up on Dr. Kochhar and Dr. Best
- plan C: use personal Android phone for initial testing

2) A functional endoscope
- plan A: borrow or get an old endoscope from the Johns Hopkins Outpatient Center - Head and Neck

Surgery Department (both a rigid and a flexible endoscope) - follow-up with Dr. Kochhar
- plan B: borrow the old endoscope that Kevin Olds currently has

3) Access to a machine shop or 3D printer for manufacturing an adapter
- plan A: get access to any of the JHU Mechanical Engineering Machine Shop
- plan B: ask the machinist in the WSE Machine Shop to manufacture our design
- plan C: ask friends who have access to machine shops to manufacture our design
- plan D: have a highly detailed 3D CAD model of the adapter to be built

4) Access to mentors
- schedule weekly meetings with Kevin Olds
- schedule monthly meetings with Dr. Kochhar and Dr. Best
- send out email updates every two weeks
- get optics / lens advice from Dr. Kang (and other contacts through Kevin)

Management Plan and Milestones:
Weekly meeting with Kevin (Tuesday 2:45pm)
Email updates with project progress to clinicians every two weeks
Monthly meeting with clinicians, as needed

Key Dates:

Dates	Important Dates / Milestones / Deliverables
2/3 - 2/9	2/7 Meeting with Dr. Kochhar
2/10 - 2/16	
2/17 - 2/23	2/17 Pros & Cons Analysis on mobile platform and device 2/20 Project Proposal
2/24 - 3/2	2/27 Project Presentation 2/28 Obtain Android tablet
3/3 - 3/9	3/9 GUI Class Diagram
3/10 - 3/16	3/15 Adapter CAD Model
3/17 - 3/23	3/17-3/23 Spring Break
3/24 - 3/30	3/30 Minimum Deliverables - adapter and application **4/6** Minimum: **Camera** Adapter and App
3/31 - 4/6	4/6 Get feedback from Doctors on minimum deliverables
4/7 - 4/13	4/10? Project Checkpoint Presentation **3/27** Project Checkpoint Presentation

4/14 - 4/20	4/15 Expected Deliverables - more universal adapter and upgraded application **4/21** Expected: Upgraded App, **Camera** to Tablet streaming
4/21 - 4/27	4/22 Document software, Create User Manual
4/28 - 5/4	5/2 Maximum Deliverables - fully universal adapter and final application **5/2** Maximum: Universal Adapter (Unlikely), Final App, Image Processing
5/5 - 5/11	5/9 Writeup final report, Prepare poster 5/9 Poster Session

TBD

*Checkpoint presentation : late March, early April

*Seminar presentation

Reading list:

- Portable Light Source

Sznitman, Raphael, et al. "Active multispectral illumination and image fusion for retinal microsurgery." ***Information Processing in Computer-Assisted Interventions*****. Springer Berlin Heidelberg, 2010. 12-22.**

Related Patents

Matsumoto, Seiji, Etsuo Nakano, and Suwao Sato. "Battery-powered light source arrangement for endoscope." U.S. Patent No. 6,260,994. 17 Jul. 2001.

Irion, Klaus. "Endoscope with LED illumination."

Shipp, John I. "LED illumination system for endoscopic cameras." U.S. Patent No. 6,449,006. 10 Sep. 2002.