doi:10.1017/S1431927615003918 Paper No. 0312 Microsc. Microanal. 21 (Suppl 3), 2015

3D Printable In-Situ Fluorescent Microscope

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In-vivo and in-situ fluorescent microscopy are commonly used techniques in research laboratories for direct micro-visualization of excised tissue or tissues within live animals [1]. The technology is slowly transitioning to clinical applications, however it remains at a prohibitively high cost [2]. The clinical utility includes in-vivo applications in the gastrointestinal tract and other organ systems, however the technology has greater potential for use in fields such as pathology, dermatology and others.

In the current paper we propose the application of 3D design and printing as a cheap method for providing the framework of a fiber optic fluorescent microscope. 3D printing allows the development of highly customizable and unique structural and mechanical parts at extremely low costs. It also allows for the reproduction and modification of the microscope for various experiments and applications using off-the-shelf components.

We used the XYZ, da Vinci 1.0 3D printer for printing and Blender 3D modelling software for designing the parts. We also used a Cannon T2i digital single lens reflection (DSLR) camera for the image acquisition, a 20x objective, dichroic mirror, excitation and emission filters and tube lens as shown in Figure 2. The filters and light emitting diode (LED) were selected for utility with acridine orange fluorescent dye, which was applied to the tissue to be viewed. An imaging fiber optic probe was attached to the objective using 3D printed parts for in-vivo or in-situ visualization. The other end was placed on the specimen as shown in Figure 2. Examples of the resulting images captured by the system are shown in Figure 1.

The 3D printed components include a filter cube, which holds the dichroic mirror, objective and fiber optic holder that attaches to the filter cube, a camera tube and the light source housing. The 3D printed light source collimator is designed to accommodate the LED and heat sink and also holds an excitation filter and a condenser lens. A condenser lens is placed at a distance according to its focal length for partial collimation of the light from the LED light source to the base of the objective lens. The camera tube is designed with a base adaptor that inserts into the DSLR camera and has slots that hold the emission filter and tube lens. The camera tube and filter cube are printed in black plastic to minimize external light noise.

References:

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[2] Shin D *et al*, PLoS One. 2010 Jun 23;5(6):e11218. doi: 10.1371/journal.pone.0011218.

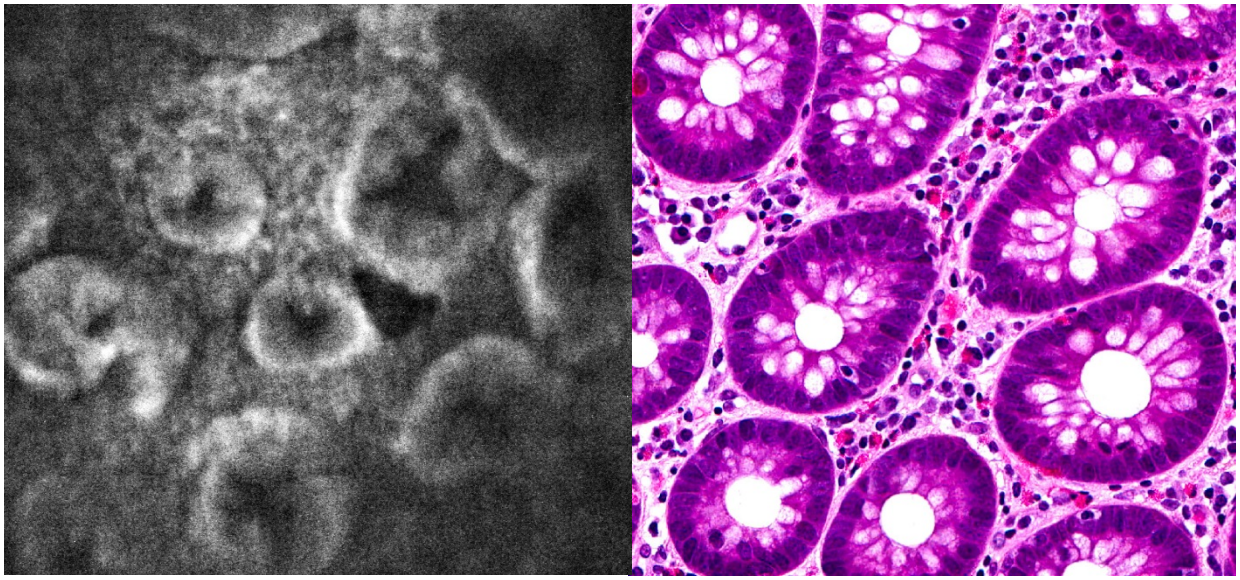

Figure 1. Colonic crypts seen using the 3D printed fluorescent microscope after application of acridine orange (left), corresponding hematoxylin and eosin processed slide (right)

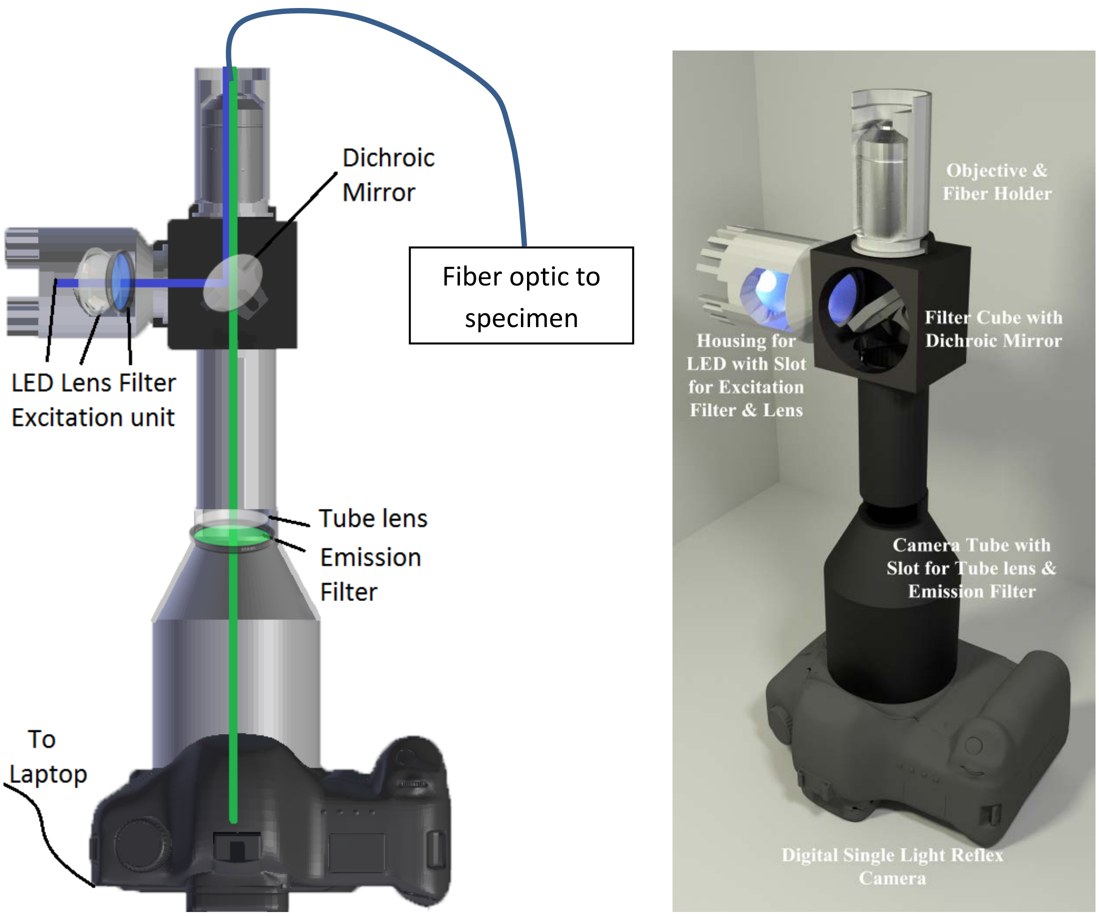

Figure 2. Schematic illustrating light path for fluorescent microscope (left), 3D rendered microscope showing printed parts (right)

https://doi.org/10.1017/S1431927615003918 Published online by Cambridge University Press