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RESEARCH ON IMPROVING PERFORMANCE TO METALLOGRAPHIC MICROSCOPES

Teodor Socaciu, Mihai Simon
"Petru Maior"University of Târgu Mureş
teodorsocaciu@yahoo.com, mihai_simon@yahoo.com

ABSTRACT

Precision optical components from an old optical microscope can be improved and emphasized with a dedicated digital microscope camera. This is an affordable way to obtain a high performance metallographic or biological microscope, with minimum of spending. This paper study those ways and adapts a camera to existing microscopes for researchers use, optimizing visualization by projecting the image and improving the microscope use by different options of capture and image processing.

Keywords: Metallographic microscope, digital microscope camera, image and video capture and processing.

1. Introduction

With traditional eyepieces, the movement of a pupil can blur the image because the pupil moves beyond the narrow ray bundle produced by conventional microscope technologies [Fig.1]. [1] Most microscope users have to sit in a rigid posture and the slightest movement of the pupil will cause them to lose the image.

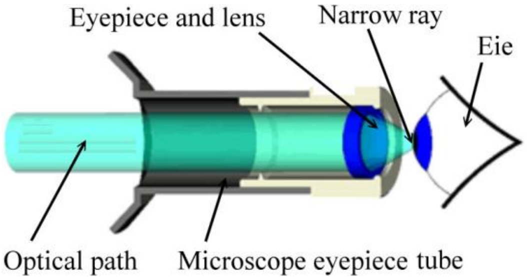

***Fig. 1** – The narrow ray bundle produced by conventional microscope technologies.*

The latest technology continually advances by combining entry level microscopes with digital cameras. There are basically two different varieties available: "all in one" where the digital camera is fixed into the microscope and cannot be removed or one with a separate digital camera connected to the microscope by a digital adapter which is removable [Fig 2].

There are obvious advantages and drawbacks to both. Digital Camera Mega Pixels generally range from below 1.3 MP to 7 MP. All digital microscope cameras are equipped with extensive software for capturing, photo editing, measuring and recording. The extensive software found in dedicated microscope digital cameras can offer endless learning opportunities. As opposed to commercial type digital SLR or point and shoot cameras offered by Nikon, Olympus or Canon, don't include dedicated microscope software.

a. b.

***Fig. 2** –Fixed (a) and removable (b) from microscope digital camera*

2. Method used

This affordable method uses old but valuable metallographic microscopes with good optical parts. We can say that this method is a recycling method due to increased concern in this field, but mostly is a retrofitting method because of economy problem.

After a thoroughly **check for defects** or mechanical parts ware, a good cleaning and greasing is necessary. Spare parts can be obtained from a sacrificed not so good microscope. [2]

Cleaning: The optical parts can be cleaned with a lint-free paper tissue made for use with fine machinery and optical parts. Distilled water is the first solvent to try. If that doesn't work, alcohol has bigger dissolving power. Isopropyl alcohol is one of the best solvents but it must be at least 90% pure. Acetone should never be put on plastic parts as it dissolves most paints and plastics.

On 40 to 100X or more objectives used with immersion oil, the excess must be wiped off the lens after use. Occasionally dust may build up on the lightly oiled surface so we must use an oil soluble solvent. The best way to avoid having to clean the lenses on your microscope is to use it carefully. **Lighting** is an important aspect. It is clear that these microscopes needed proper modern light source preferably adjustable in intensity. A with reflector for minimum waist replaced the unreliable old light bulb [Fig. 3].

a. b.

Fig. 3 – *(a) The old light bulb; (b) the new halogen 12V 35W fitted lamp*

Frame stability has been improved by utilizing an external power supply to reduce heat generation, vibration and thermal expansion. The frame is one of the valuable parts, constructed of cast iron for improved rigidity and stability.

Adapting the digital camera provides tremendous versatility and bright images with minimal reflections or frame modifications. Focus assembly results in greater stability over prolonged observations because the accidental contact with the microscope is less. [4]

3. Application

Retrofitted microscope is an old MMP-4 upside-down metallographic microscope. With quality lenses and cast iron structure, is a perfect candidate. The technology is a retrofit digital camera accessory that replaces traditional eyepieces on stereo and research microscopes [Fig. 4].

Fig. 4 – *Digital camera accessory*

The optics of the camera magnifies at 10X and the CCD sensor resolution is 2mp. The UVC Plug and Play driver helps any user for easy installation. The unit slides onto the host microscope tubes in the same way as the original eyepiece.

After following the above steps, the digital camera was fitted to ocular tube [Fig. 5]. An adaptor piece is used for precise mounting and centering.

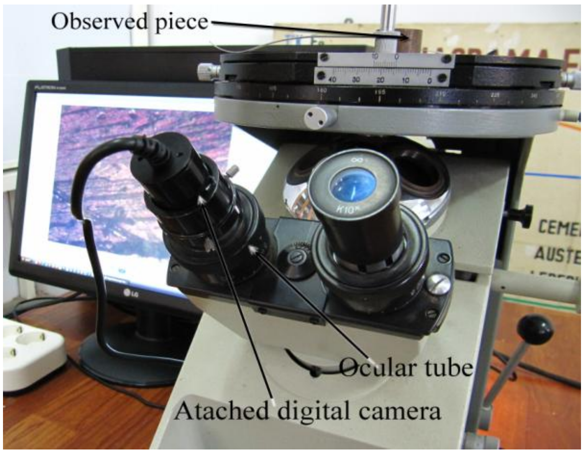

Fig. 5 – *Fitted camera to the ocular tube*

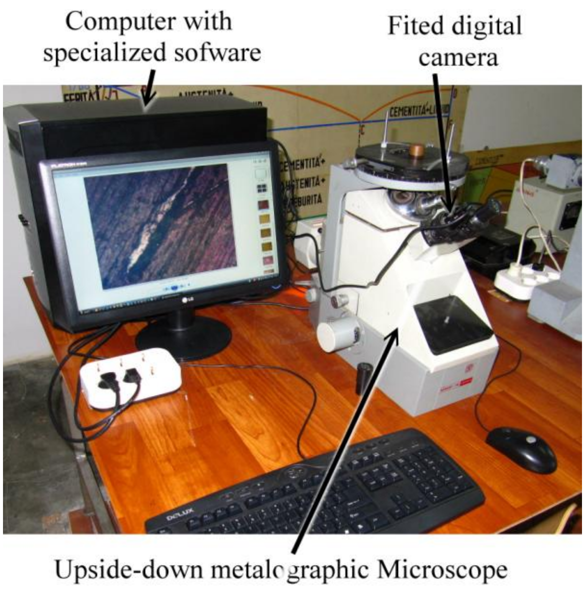

Fig. 6 – *The obtained retrofitted microscope assembly*

4. Results and conclusions

This method makes available at an affordable price the capture of images and showing live video on a computer screen or projector [Fig. 7].

For researchers who are studying, this digital instrument can offer multiple advantages.

It simply replaces the eyepiece of the microscope so we can view comfortably on our computer screen. Adapts to virtually any type of microscope; making from this study a general method of retrofitting old microscopes.

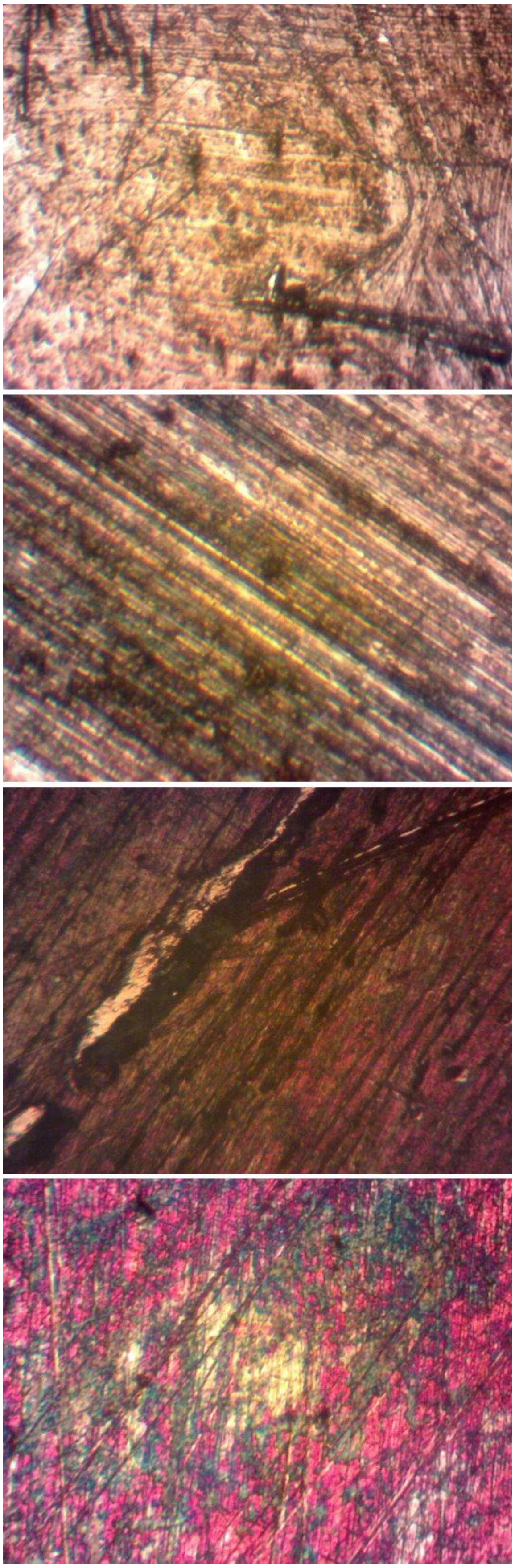

***Fig. 7 –** Examples of metal structure observed at 160 X*

The appropriate objective must be selected for best results (Tab. 1).

***Table 1:** The appropriate objective selection*

Objective / NA	d_0 (μm)	D_0 (μm)	n
5x / 0.15	2.2	11.2	1786
10x / 0.30	1.1	11.2	1786
20x / 0.50	0.7	13.4	1493
40x / 0.75	0.45	17.9	1117
40x / 1.30 Oil	0.26	10.3	1942
63x / 1.40 Oil	0.24	15.1	1325
100x / 1.30 Oil	0.26	25.8	775

The distance d0 is referred to the specimen and, when multiplied by the magnification, results in the point distance D0 in the intermediate image (for green light λ = 550 nm). Finally, the number n represents the number of resolved pixels if they are “lined up” along the field diameter of 20 mm (20mm / D0) [5].

For microscope users who wear eyeglasses or those who suffer from eye or neck strain the results are excellent.

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