

# Mobile Recording Microscope

S. Saravana Prakash, S. Pravin Kumar

Department of Biomedical Engineering, SSN College of Engineering, Kalavakkam, Tamil Nadu, India

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## Abstract

Microscope is an important diagnostic tool used widely in Science & Technology. The widespread use of this tool can be seen in Medicine, Nuclear Sciences, and Education etc. Several attempts are being carried out to make microscopes easy to handle and user friendly. One such approach is the Mobile Recording Microscope which can be built using a simple smart phone. Unlike conventional microscopes, the mobile recording microscope uses the camera integrated in smart phones to record images. This reduces the efforts needed to store and transfer the recorded data. The replacement of wired medium and computer for recording images reduces the cost, space and difficulties incurred in use of microscopic devices. The hand-held smart phone for recording images assures anywhere and anytime use of the microscope. These advantages favour common man to use it independently without the assistance of a skilled person.

## 1. Introduction

Microscopes have been an intriguing device used since the 16th century. The microscope intends to enlarge extremely small and complicated structure with the help of magnifying lenses and focusing mechanism. The conventional microscope comprises of an illuminator, an eyepiece, a condenser lens, an objective lens, a stage and a focusing knob. Apart from these it also contains a cable to connect it with a computer for recording purpose. Fig.1 shows a basic microscopic device developed by Onfocus Laboratories. The quality of the captured image depends on the quality of the lenses and their resolutions. The applications of this conventional microscope can be seen in several fields like- Nanotechnology, Bio-medicine, Education, Nuclear Sciences etc.



Fig. 1. Conventional Microscope [1]

Several improvements and changes have been made in the structure of these devices to make it easy to use and cheap [2]. An innovative idea to reduce the costs and efforts

## Corresponding Author,

E-mail address: saravanaprakash54@gmail.com

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needed to use a microscope is the mobile recording microscope. This device eliminates the requirement of wired medium and computer to capture and store the images. A hand-held mobile device with an integrated camera is the minimum requirement needed for this device. The camera helps in capturing the images which can be later stored in the smart phone. These images can be easily modified and transferred to any other device as our need demands. The mobile recording microscope also comprises of an objective lens of suitable magnification and a mechanical focusing system. fig.2.

It has been developed from the base model suggested by Yoshino in his work on Smartphone to digital microscope conversion by Yoshino [5]. The plate adjustment has been replaced with the help of a rotatable lifting corresponding to the focusing mechanism in a conventional microscope. In addition, a comparative analysis of the images obtained using three different smart phones is also done.



Fig. 2 Mobile Recording Microscope

## 2. Methodology

The mobile microscope consists of a microscopic lens mounted on an acrylic sheet that acts as the mobile plate where any model of the smart phone can be placed over for recording purpose a plate placed below the mobile plate called as the slide plate where the microscopic slides can be kept and examined from the top via the lens. The focusing mechanism of the microscope looks similar to the mechanism of a car screw jack; where the rotatory motion is transformed into linear or translatory motion that lifting jack. A tripod like apparatus is present at the bottom base of the slide plate. A light source is kept perpendicular to the slide plate and lens such that light microscopy can also be

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achieved. The working of mobile recording microscope is such that slide is placed on the slide plate and the screws are adjusted to make sure there are no disturbances. Then a smart phone of suitable camera mega pixel is placed over the mobile plate. Ensure that the camera of the smart phone is exactly placed over the lens, thereby the image covered by the lens is completely recorded by the mobile camera. The focusing adjustment of the slide plate is done by rotating the holder beneath the slide plate. The fine and coarse adjustments in a typical microscope can be achieved here by means of the threading present in the lifting jack apparatus. The threading on the lifting jack rod when the spacing between the adjacent threads is decreased then the focusing will be fine and if the threading distance is more it corresponds to the coarse adjustments. After adjusting the lifting jack and focusing the slide, the mobile camera can be tapped to take shots. A camera with high mega pixel will result good resolution pictures and the recorded pictures look like shown in figure 3 and 4.

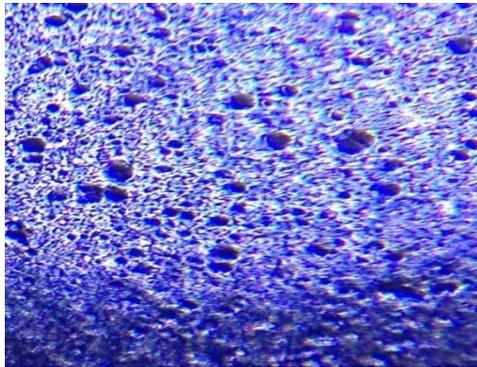


Fig: 3. CML (Chronic Myeloid Leukemia)- observed using I phone 5s

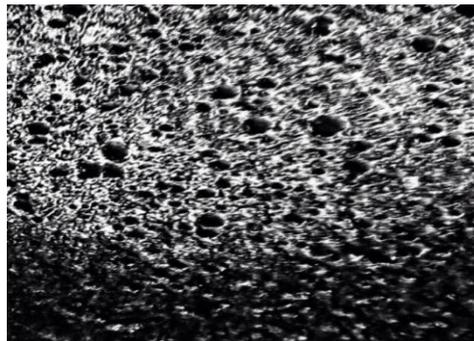


Fig: 4. CML – Black and White Image using I Phone 5s

The results observed were more satisfactory when using higher mega pixel cameras [3]. Zooming i.e. Magnifying can be achieved via mobile camera. The microscopic lens present normally has the power of 75X. If we add a combination of two or more lenses we would be able to achieve 150X magnification. The magnification provided by the lens naturally can be enhanced by zooming through the mobile camera. Thereby required resolution can be obtained and images can be taken easily by tapping the screen. This reduces the cost of a recording tool for microscopic recording and eliminates wired media recording from a digital microscope.

Table: 1. Comparison between Conventional Microscope and Mobile Recording Microscope

Conventional microscope	Mobile recording microscope
Illuminator	Light source
Eye piece Recording tool	Smart phone
Imaging tool	
Lens (4x, 10x.etc)	Microscopic Lens
Coarse and fine focus	Lifting jacking jack
Power supply is necessary	Does not require power supply
Bulky and expensive	Less in weight and cost.

3. Results

Chronic myelogenous (myeloid or myelocytic) leukaemia is a cancer of the white blood cells. It is a form of leukaemia characterised by the increased and unregulated growth of predominantly myeloid cells in the bone marrow and the accumulation of these cells in the blood [4].CML is now largely treated with drugs like tyrosine kinase inhibitors. Since the results can be sent over long distances pathologists can be benefited as it saves a lot of time and cloud data transferring makes the work even simpler than the conventional mailing technique. Therefore the obtained results can be sent anywhere in the world by internet and can be used for further analysis. A comparative image study has been observed using CML slides under different smart phone cameras Sony Xperia L, Sony Xperia T2 ULTRA DUAL and I phone 5s is shown in figure 5. It can be observed that the image obtained using I phone seems to be better in resolution than other two mobile cameras.

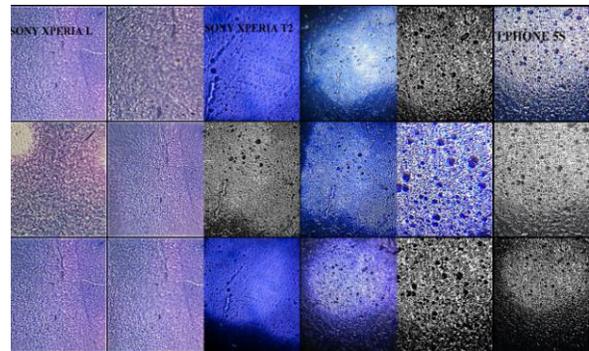


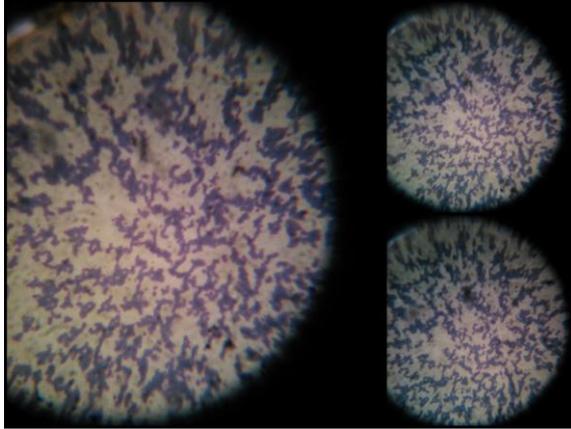
Fig: 5. Comparative Image Study using CML slides under Sony Xperia L, Sony Xperia T2 ULTRA DUAL and I phone 5s

Table: 2. Comparison of the Images Obtained using Three Mobile Models

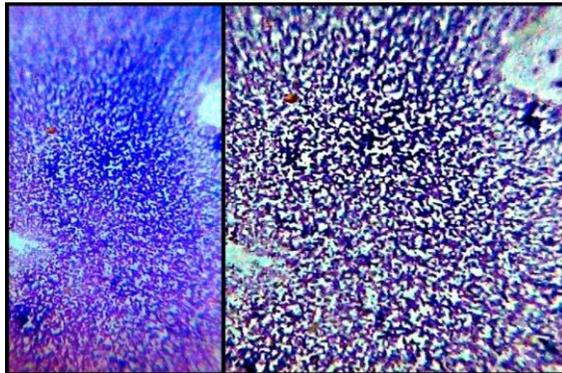
Model / specifications	Sony Xperia L	Sony Xperia T2 ULTRA DUAL	I phone 5s
Camera (mp)	8	13	8
Disturbance in capturing	Less	Very less	No disturbance
Post processing	Necessary	Not necessary	Not necessary
Resolution	Good	Better than Xperia L	Better than Xperia T2

Comparison of images obtained using mobile recording microscope and conventional microscope.

Malaria is a mosquito borne infectious disease of humans and it also affects other animals, which is caused by parasitic protozoan of the plasmodium type. Traditionally Malaria is confirmed by the microscopic examination of blood films or by antigen based rapid diagnostic tests. Microscopy is the most often used method to detect malaria. Stained malarial slide is prepared and subjected to examination under these scopes. Image observed under conventional microscope is as shown in figure 6 and by a mobile recording microscope image as shown in figure 7.



**Fig: 6.** Image Observed under Conventional Microscope



**Fig: 7.** Images of the Same Malarial Slide Observed under Mobile Recording Microscope using Sony Xperia T2 Ultra Dual

#### 4. Conclusion

Mobile recording microscope uses the camera in a smart phone to record images. The device acts as a stand-alone apparatus that can match up with any smart phone camera for microscopic examination. The holder-rotation mechanism makes the microscope easy to build, use and does not require any assistance of a skilled person. The cost incurred is reduced and hence makes the device an apt tool for students to aid them in their educational projects and research. The smart phones aid for recording and storage can also be used to transfer the images via wireless technologies to any device and to any distant location. On a comparative note, the results observed using the mobile recording microscope was found to be better than a simple conventional microscope.

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