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Enhancing Magnification In Foldscope for Improved Microscopy.

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Abstract:

Foldscope is the low-cost paper simple microscope. It is designed as a portable, tough, and to give alike optical value as compare to classic research microscopes. In the current paper, the work is directed on designing an addition that can deliver further improved magnification to current foldscope by means of lenses of flexible focal measurement gained by calculations and iterations. In order to recognize the cell structure in a specimen, the snap of sample will be associated with the catalogue of numerous specimen with image processing so that layman worker can find the specimen.

Keywords: *Foldscope, optical microscope, convex lens.*

Introduction:

Microscopes are commonly used in science as a tool that provide an important, pictorial linking between the accustomed macro-world and the extraordinary original micro-world. Though, some applications need non-conventional explanations owing to relative challenges and trade-offs among cost and performance (1). Foldscope is the low-priced paper microscope. Intended to be very portable, robust, and to give optical quality like conventional research microscopes. The Foldscope uses ball lens of diameter 2.4mm which has focal length of 1.716mm and aperture diameter of 0.7mm. It can provide magnification of 140X (2).

But there is some specimen which demand enhanced magnification than 140X, because the size of specimen is very small to view by using foldscope (3). In order to identify the specimen, an expert is required, to solve this problem certain application is required which can identify the specimen by comparing the image of specimen with the inbuilt database and displays the name and basic information about the specimen. This will help the layman to recognize the cell structure of specimen.

Generic Problem:

The main aim of this development was that foldscope has fixed magnification. So, currently different foldscopes are used to achieve different levels of magnification, because the universal foldscope is not available to see cell structure of various specimen (3, 4). Also layman is unable to identify the cell structure of specimen as no relevant data about different specimen is not available to him. The needs for such technological innovation is evident from the reports of Global Burden of Disease studies(5-9). Few of the related articles were reported(10-17).

Objectives:

An attachment was designed to proceed with this study. The factors that should be considered in the design process are summarized as follows.

1) Select the lens with required specification.
2) Create an attachment that can hold foldscope and lens.
3) Build a low-cost attachment.
4) Create the data base of various specimen.
5) develop image processing software.

Materials and Methods:

In order to increase the magnification of foldscope various experiments and calculations were performed. In the initial stages of project, iterative experiments were performed by using trial eye lens kit (used in ophthalmology department for eye check-up) followed by respective calculations. Various experiments were performed using single lens, multiple lens by keeping on one another, by varying distance between to lenses. But positive results were obtained by

use of single lens and amount of magnification achieved from trial lens kit was very less as lenses had long focal length and big radius of curvature. In order to achieve high magnification lenses with small focal length and radius of curvature were required. So, Further calculations were done to achieve required magnification. Based on calculations five lenses with different focal length and radius of curvature were ordered. The refractive index of lens material is 1.517. List of lenses with specifications is mentioned below.
Similar experiments were performed with these lenses to achieve required magnification of specimen.

Sr. No.	Types of lenses	Diameter	Focal Length
1	Bi-convex lens	6mm	5mm
2	Bi-convex lens	8mm	5mm
3	Plano-convex lens	4.7mm	5mm
4	Plano-convex lens	5.4mm	8mm
5	Plano-convex lens	6.5mm	10mm

Table: Various lenses with specification.

Result:

1. Using trial lenses clear image was obtained but amount of magnification achieved from these lenses is very less to differentiate result achieved from foldscope.
2. Plano-convex lens of diameter 6.5mm gave a clear image and achieved magnification 1.68.
3. Plano-convex lens of diameter 5.4mm and 4.7mm gave blurred image and required cancave lenses of power 20 and 60 dioptre respectively to give clear and magnified image.

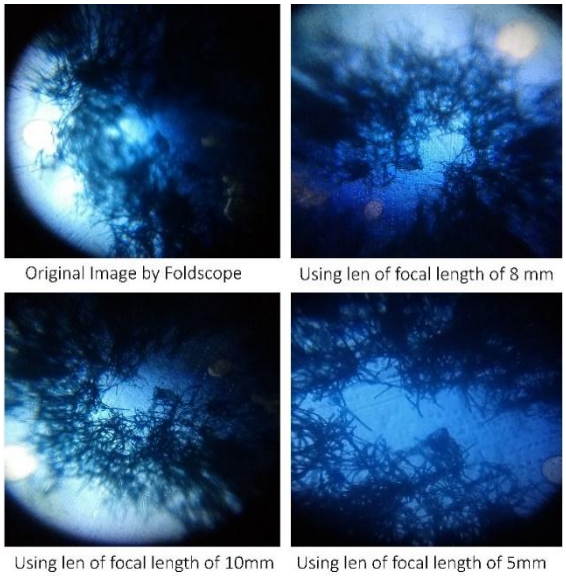

Fig: Obtained magnification using attachment

Conclusion:

1. Varying distance between two lenses will not give magnified and clear image.
2. Magnification can only be achieved by using single lens.
3. Variable magnification can only be achieved by using different lens.
4. Distance between slide and foldscope will affect required output as it affects the depth of field.

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