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CONSTRUCTION OF A LOW-COST AUTOMATED SPECTRUM ANALYSER

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Spectral analysis of electromagnetic radiation is important in many branches of science with a wide range of applications. An optical spectrum analyser is able to detect the visible region of the electromagnetic spectrum. The objective of this research was to build a spectrum analyser with high spectral resolution and accuracy at a relatively low cost so as to integrate the instrument to the local scientific community. The main operating principle of the spectrum analyser is diffraction. Light enters the spectrum analyser through a single slit of 1.81 mm, and then collimated by a convex lens which is kept at its focal length from the single slit. A diffraction grating receives the collimated beam where Fraunhoffer diffraction occurs. The diffracted beam is then exposed to an image sensor. The image sensor is a charged coupled device. The data was processed with the open source software Theremino (v2.8). The software processes the image data into a bitmap image with a data point for each pixel. The individual colour data values of pixels are counted with an algorithm to provide the intensity data. The calibration was done with a standard low-pressure Hg source. The spectrometer possesses a spectral range of 380 - 710 nm. The software is capable of resolving a wavelength with an accuracy of 0.5 nm. The spectral resolution of the spectrometer which was calculated in accordance with the industry standard. For the given spectral range, the spectral resolution was 4.4 nm. The spectrometer can be utilized to observe emission spectra to analyse the ionic compositions in solutions. The spectrum analyser can also be modified as a tool in astronomical spectral analysis as a low-cost alternative. The spectrometer could be further improved with better image sensors to extend the spectral range.

Keywords: Analyser, Optical, Spectrum, Visible