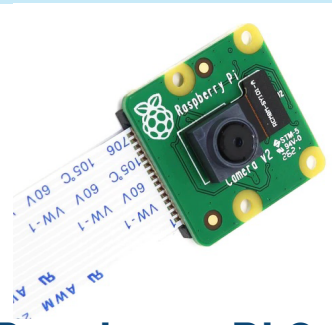
Detectors

Initially the amplitude was measured using a photo-diode with a transimpedance amplifier connected to a precision voltmeter. It was later replaced by a ThorLabs CMOS camera which has a lower sensitivity and dynamic range. After processing the images, the z-scans were almost indistinguishable. In the final automated setup a v2 CMOS Raspberry Pi camera module has been used which gave worse results due to a lower dynamic range and higher noise levels. Optimally, the setup should use a photodiode with an ADC or a CCD sensor which, compared to a CMOS sensor, have greater dynamic range and lower noise.

Photodiode CMOS CCD



v2 Raspberry Pi Camera

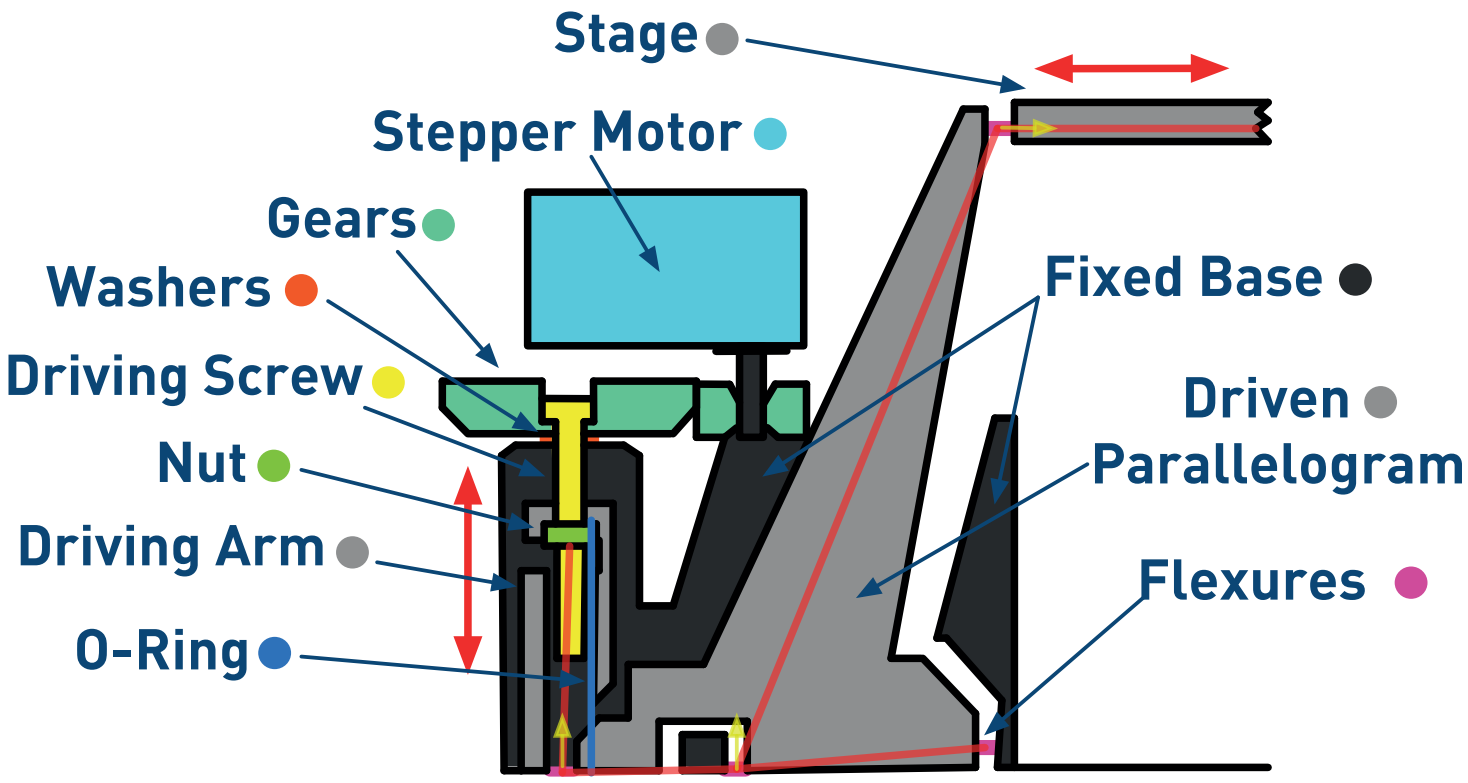
Stage

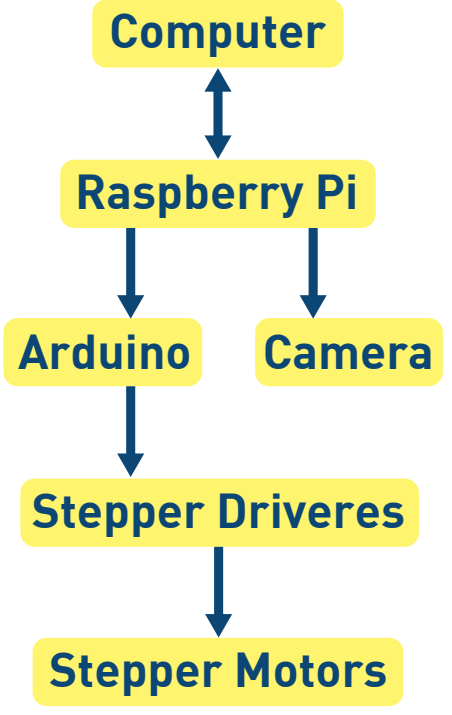
The 3D motorised stage utilizes the Open-Flexure project delta stage (DS) which is a high precision 3D printed microscope stage [2]. It took approximately 2 days to print out of PLA with PVC supports. The DS is based on a delta configuration with 3 parallelogram flexure mechanisms driven by 3 geared stepper motors. The sample is placed in a 3D printed mount on top of a continous rotation stage mounted on top of the DS stage. The whole assembly is then mounted on a linear translation stage with a micrometer which can be used to cali-brate the motion of the DS.

Control Electronics

The system is controlled by a Raspberry Pi (RP) 4 running an OpenFlexure distribu-tion of Raspbian. The RP is connected to the Raspberry Pi camera module as well as an Arduino Uno r3. The Arduino is then connected to 3 5V stepper motor drivers which are powered from a laboratory power supply. The stepper motor drivers then drive the stepper motors connected to the delta stage. The system can be man-aged directly on the RP or remotely through a computer connected to the RP through the local network.

OpenFlexture Mechanism





Scanning

The scanning is performed using the OpenFlexture softwares scanning feature which only supports the Raspberry Pi camera. Ideally the Scanning should be performed using an OpenFlexture Python library and a laboratory camera or a photodiode and an ADC.