Autonomously Tracking Organisms at Microscopic Resolution in 3D

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Microorganisms are observed every day in the hopes of finding new developments that will help gain new insights into human health. Many organisms move quite fast under the microscope's field of view, and this makes it hard for scientists to follow them manually and precisely for long durations. An automated and precise way to observe and track organisms is needed to conduct research with ease. The tracking microscope enables scientists and researchers to observe and record microorganism movement with micrometers of precision autonomously. The microscope utilizes object detection to follow an object and keep the subject in frame using a three-axis actuator. The program is written in Python and utilizes OpenCV to track the subject. On the hardware side, an Arduino Uno combined with stepper motors controls the base that is used to move the subject to keep it in frame. Additionally, a custom build microscope is used to supply a 1080p video stream at 150 FPS. In total, four prototypes were built. After testing, it was concluded that the fourth prototype performed the best. It can track in three axes at forty times magnification and has a minimum speed of 2,000 µm/s. During the testing to track microorganisms, the fourth prototype was able to track a Stentor in three axes for two hours and map its trajectory autonomously. This research can be used in the future to observe organisms that were previously too fast to be tracked and can be used to examine their behaviors and methods of movement.

Awards Won:

Second Award of $2,000